FOR CONTRACT NO.: 12-0F0314

INFORMATION HANDOUT

AGREEMENTS

Railroad Overpass Agreement for Placentia OH

Railroad Overpass Agreement for South Placentia OH

ENCROACHMENT PERMITS

City of Placentia Encroachment Permit

City of Fullerton Encroachment Permit

Orange County Flood Control District Encroachment Permit

MATERIALS INFORMATION

Materials Report – SR-57 Northbound Improvement Project (South Segment), From Orangethorpe Avenue to Yorba Linda Blvd.

Geotechnical Design Report – SR-57 Northbound Improvement Project (South Segment), From Orangethorpe Avenue to Yorba Linda Blvd.

Foundation Report for Soundwalls, Retaining Walls, and MSE Walls – SR-57 Improvement Project (South Segment), from Orangethorpe Avenue to Yorba Linda Blvd.

Bridge Foundation reports for Orangethorpe Ave UC, South Placentia OH, Crowther Ave UC, Placentia OH, Placentia Ave UC, Chapman Ave UC, Nutwood Ave UC, Yorba Linda Blvd OC.

Sign Structures Foundation Report – SR-57 Northbound Improvement Project (South Segment), from Orangethorpe Avenue to Yorba Linda Blvd.

Aerially Deposited Lead Report – SR-57 Northbound Improvement Project (South Segment), from Orangethorpe Avenue to Yorba Linda Blvd.

WATER QUALITY

Regional Water Quality Control Board, Section 401 Water Quality Certification.

PERMITS

US Army Corps of Engineers, Nationwide Permit

State of California Business, Transportation and Housing Agency

Memorandum

REVISED

Flex your power!
Be energy efficient!

To: NAHID BAGHBANIAN,
Office of Office Engineer

Date: December 23, 2009

File: 12-ORA-57-PM 16.0/18.4
E.A. 0F0311
SR-57 NORTHBOUND WIDENING
BNSF RAILROAD: PLACENTIA OH, BR #55-449, PM 16.84/16.87
(MP43.46, US DOT #026577K and PUC #002B-43.40A)

From: KATHY J. ANDERSON, Branch Chief
R/W Acquisition, Condemnation and Railroads
District 12 - Irvine

Subject: **RAILROAD CLEARANCE**

The above-referenced project is now ready to list as far as the BNSF Railroad is concerned. This clearance is subject to final execution of the Construction and Maintenance Agreements, and fund allocation by the California Transportation Commission.

The work by the BNSF Railroad is estimated to be **$260,000** and is covered under the pending State Agreement No. **12R067**. The scope of work is for engineering review, inspection and flagging required for protection of Railroad property, tracks and appurtenances thereto, trains and equipment during that period of time the State is near railroad tracks. The SR-57 Northbound Widening project proposes to widen the Placentia OH at PM 16.84/16.87.

The railroad long clauses for insertion into the contract special provisions are attached.

Attachments

cc: Pija Ansari, Project Manager
Mili Lim, Branch Chief
Joel Robinson, Project Engineer
Evy Washington, Railroad Agent
Dora Manuel, HQ R/W R/R
Elaine Lewis, HQ R/W R/R

DRAFT

EXHIBIT "C"
CONTRACTOR REQUIREMENTS

1.01 General

- 1.01.01 The Contractor must cooperate with **BNSF RAILWAY COMPANY**, hereinafter referred to as "Railway" where work is over or under on or adjacent to Railway property and/or right-of-way, hereafter referred to as "Railway Property", during the construction of the widening of the Placentia Overhead Bridge on BNSF Railway's San Bernardino Subdivision, MP 43.46, US DOT# 026577K and PUC #002B-43.40A.

- 1.01.02 The Contractor must execute and deliver to the Railway duplicate copies of the Exhibit "C-1" Agreement, in the form attached hereto, obligating the Contractor to provide and maintain in full force and effect the insurance called for under Section 3 of said Exhibit "C-1". Questions regarding procurement of the Railroad Protective Liability Insurance should be directed to Rosa Martinez at Marsh, USA, 214-303-8519.

- 1.01.03 The Contractor must plan, schedule and conduct all work activities so as not to interfere with the movement of any trains on Railway Property.

- 1.01.04 The Contractor's right to enter Railway's Property is subject to the absolute right of Railway to cause the Contractor's work on Railway's Property to cease if, in the opinion of Railway, Contractor's activities create a hazard to Railway's Property, employees, and/or operations. Railway will have the right to stop construction work on the Project if any of the following events take place: (i) Contractor (or any of its subcontractors) performs the Project work in a manner contrary to the plans and specifications approved by Railway; (ii) Contractor (or any of its subcontractors), in Railway's opinion, prosecutes the Project work in a manner which is hazardous to Railway property, facilities or the safe and expeditious movement of railroad traffic; (iii) the insurance described in the attached Exhibit C-1 is canceled during the course of the Project; or (iv) Contractor fails to pay Railway for the Temporary Construction License or the Easement. The work stoppage will continue until all necessary actions are taken by Contractor or its subcontractor to rectify the situation to the satisfaction of Railway's Division Engineer or until additional insurance has been delivered to and accepted by Railway. In the event of a breach of (i) this Agreement, (ii) the Temporary Construction License, or (iii) the Easement, Railway may immediately terminate the Temporary Construction License or the Easement. Any such work stoppage under this provision will not give rise to any liability on the part of Railway. Railway's right to stop the work is in addition to any other rights Railway may have including, but not limited to, actions or suits for damages or lost profits. In the event that Railway desires to stop construction work on the Project, Railway agrees to immediately notify the following individual in writing:

  Kathy J. Anderson, Branch Chief
  Right of Way Department
  3337 Michelson Drive, Suite 380
  Irvine, California 92612-8894

- 1.01.05 The Contractor is responsible for determining and complying with all Federal, State and Local Governmental laws and regulations, including, but not limited to environmental laws and regulations (including but not limited to the Resource Conservation and Recovery Act, as amended; the Clean Water Act, the Oil Pollution Act, the Hazardous Materials Transportation Act, CERCLA), and health and safety laws and regulations. The Contractor hereby indemnifies, defends and holds harmless Railway for, from and against all fines or penalties imposed or assessed by Federal, State and Local Governmental Agencies against the Railway which arise out of Contractor's work under this Agreement.

- 1.01.06 The Contractor must notify the Railroad – Melvin V. Thomas, Railway's Manager Public Projects, telephone number 909-386-4472 at least thirty (30) calendar days before commencing any work on Railway Property. Contractors notification to Railway, must refer to Railroad's file 026577K.

- 1.01.07 For any bridge demolition and/or falsework above any tracks or any excavations located with any part of the excavations located within, whichever is greater, twenty-five (25) feet of the nearest track or intersecting a slope from the plane of the top of rail on a 2 horizontal to 1 vertical slope beginning at eleven (11) feet from centerline of the nearest track, both measured perpendicular to center line of track, the Contractor must furnish the Railway five sets of working drawings showing details of construction affecting Railway Property and tracks. The working drawing must include the proposed method of installation and removal of falsework, shoring or cribbing, not included in the contract plans and two sets of structural calculations of any falsework, shoring or cribbing. For all excavation and shoring submittal plans, the current "BNSF-UPRR Guidelines for Temporary Shoring" must be used for determining the design loading conditions to be used in shoring design, and all calculations and submittals must be in accordance with the current "BNSF-UPRR Guidelines for Temporary Shoring". All submittal drawings and calculations must be stamped by a registered professional engineer licensed to practice in the state the project is located. All calculations must take into consideration railway surcharge loading and must be designed to meet American Railway Engineering and Maintenance-of-Way Association (previously known as American Railway Engineering Association) Coopers E-80 live loading standard. All drawings and calculations must be stamped by a registered professional engineer licensed to practice in the state the project is located. The Contractor must not begin work until notified by the Railway that plans have been approved. The Contractor will be required to use lifting devices such as, cranes and/or winches to place or to remove any falsework over Railway's tracks. In no case will the Contractor be relieved of responsibility for results obtained by the implementation of said approved plans.

- 1.01.08 Subject to the movement of Railway's trains, Railway will cooperate with the Contractor such that the work may be handled and performed in an efficient manner. The Contractor will have no claim whatsoever for any type of damages or for extra or additional compensation in the event his work is delayed by the Railway.

1.02 Contractor Safety Orientation

- **1.02.01 No employee of the Contractor, its subcontractors, agents or invitees may enter Railway Property without first having completed Railway's Engineering Contractor Safety Orientation, found on the web site www.contractororientation.com. The Contractor must ensure that each of its employees, subcontractors, agents or invitees completes Railway's Engineering Contractor Safety Orientation through internet sessions before any work is performed on the Project. Additionally, the Contractor must ensure that each and every one of its employees, subcontractors, agents or invitees possesses a card certifying completion of the Railway Contractor Safety Orientation before entering Railway Property. The Contractor is responsible for the cost of the Railway Contractor Safety Orientation. The Contractor must renew the Railway Contractor Safety Orientation annually. Further clarification can be found on the web site or from the Railway's Representative.**

1.03 Railway Requirements

- 1.03.01 The Contractor must take protective measures as are necessary to keep railway facilities, including track ballast, free of sand, debris, and other foreign objects and materials resulting from his operations. Any damage to railway facilities resulting from Contractor's operations will be repaired or replaced by Railway and the cost of such repairs or replacement must be paid for by the Agency.

- 1.03.02 The Contractor must notify the Railway's Division Superintendent Mark Kirschinger at 909-386-4150 and provide blasting plans to the Railway for review seven (7) calendar days prior to conducting any blasting operations adjacent to or on Railway's Property.

- 1.03.03 The Contractor must abide by the following temporary clearances during construction:

15'	Horizontally from centerline of nearest track
21'-6"	Vertically above top of rail
27'-0"	Vertically above top of rail for electric wires carrying less than 750 volts
28'-0"	Vertically above top of rail for electric wires carrying 750 volts to 15,000 volts
30'-0"	Vertically above top of rail for electric wires carrying 15,000 volts to 20,000 volts
34'-0"	Vertically above top of rail for electric wires carrying more than 20,000 volts

- **1.03.04** Upon completion of construction, the following clearances shall be maintained:
  - 25' – 3" Horizontally from centerline of nearest track
  - 23' 10" Vertically above top of rail

- **1.03.05** Any infringement within State statutory clearances due to the Contractor's operations must be submitted to the Railway and to the State of California and must not be undertaken until approved in writing by the Railway, and until the State of California has obtained any necessary authorization from the State Regulatory Authority for the infringement. No extra compensation will be allowed in the event the Contractor's work is delayed pending Railway approval, and/or the State Regulatory Authority's approval.

- **1.03.06** In the case of impaired vertical clearance above top of rail, Railway will have the option of installing tell-tales or other protective devices Railway deems necessary for protection of Railway operations. The cost of tell-tales or protective devices will be borne by the Agency.

- **1.03.07** The details of construction affecting the Railway's Property and tracks not included in the contract plans must be submitted to the Railway by State of California for approval before work is undertaken and this work must not be undertaken until approved by the Railway.

- **1.03.08** At other than public road crossings, the Contractor must not move any equipment or materials across Railway's tracks until permission has been obtained from the Railway. The Contractor must obtain a "Temporary Construction Crossing Agreement" from the Railway prior to moving his equipment or materials across the Railways tracks. The temporary crossing must be gated and locked at all times when not required for use by the Contractor. The temporary crossing for use of the Contractor will be constructed and, at the completion of the project, removed at the expense of the Contractor.

- **1.03.09** Discharge, release or spill on the Railway Property of any hazardous substances, oil, petroleum, constituents, pollutants, contaminants, or any hazardous waste is prohibited and Contractor must immediately notify the Railway's Resource Operations Center at 1(800) 832-5452, of any discharge, release or spills in excess of a reportable quantity. Contractor must not allow Railway Property to become a treatment, storage or transfer facility as those terms are defined in the Resource Conservation and Recovery Act or any state analogue.

- **1.03.10** The Contractor upon completion of the work covered by this contract, must promptly remove from the Railway's Property all of Contractor's tools, equipment, implements and other materials, whether brought upon said property by said Contractor or any Subcontractor, employee or agent of Contractor or of any Subcontractor, and must cause Railway's Property to be left in a condition acceptable to the Railway's representative.

1.04 Contractor Roadway Worker on Track Safety Program and Safety Action Plan

- 1.04.01 Each Contractor that will perform work within 25 feet of the centerline of a track must develop and implement a Roadway Worker Protection/On Track Safety Program and work with Railway Project Representative to develop an on track safety strategy as described in the guidelines listed in the on track safety portion of the Safety Orientation. This Program must provide Roadway Worker protection/on track training for all employees of the Contractor, its subcontractors, agents or invitees. This training is reinforced at the job site through job safety briefings. Additionally, each Contractor must develop and implement the Safety Action Plan, as provided for on the web site **www.contractororientation.com**, which will be made available to Railway prior to commencement of any work on Railway Property. During the performance of work, the Contractor must audit its work activities. The Contractor must designate an on-site Project Supervisor who will serve as the contact person for the Railway and who will maintain a copy of the Safety Action Plan, safety audits, and Material Safety Datasheets (MSDS), at the job site.

Contractor shall have a background investigation performed on all of its employees, subcontractors and agents who will be performing any services on railroad property under this Agreement.

The background screening shall at a minimum meet the criteria defined by the e-RAILSAFE program outlined at http://www.e-railsafe.com in addition to any other applicable regulatory requirements. The e-RAILSAFE program uses rail industry background screening standards.

Contractor shall obtain consent from all employees screened in compliance with the e-RAILSAFE program criteria to release completed background information to BNSF. Contractor shall be subject to periodic audit to ensure compliance.

Contractor shall not permit any of its employees, subcontractors or agents to perform services on property hereunder who are not approved under e-RAILSAFE program standards. Railroad shall have the right to deny entry onto its premises to any of Contractor's employees, subcontractors or agents who do not display the authorized identification badge issued by a background screening service meeting the standards set forth for the e-RAILSAFE program or who pose a threat, in Railroad's reasonable opinion, to the safety or security of Railroad's operations.

Contractors shall ensure its employees, subcontractors and agents are United States citizens or legally working in this country under a work VISA.

1.05 Railway Flagger Services:

- **1.05.01** The Contractor must give Railway's Roadmaster (760) 255-7639 and Melvin V. Thomas, Railway's Manager Public Projects, telephone number (909) 386-4472 a minimum of thirty (30) calendar days advance notice when flagging services will be required so that the Roadmaster can make appropriate arrangements (i.e., bulletin the flagger's position). If flagging services are scheduled in advance by the Contractor and it is subsequently determined by the parties hereto that such services are no longer necessary, the Contractor must give the Roadmaster five (5) working days advance notice so that appropriate arrangements can be made to abolish the position pursuant to union requirements.

- **1.05.02** Unless determined otherwise by Railway's Project Representative, Railway flagger will be required and furnished when Contractor's work activities are located over, under and/or within twenty-five (25) feet measured horizontally from centerline of the nearest track and when cranes or similar equipment positioned beyond 25-feet from the track centerline could foul the track in the event of tip over or other catastrophic occurrence, but not limited thereto for the following conditions:

- **1.05.02a** When, upon inspection by Railway's Representative, other conditions warrant.

- **1.05.02b** When any excavation is performed below the bottom of tie elevation, if, in the opinion of Railway's representative, track or other Railway facilities may be subject to movement or settlement.

- **1.05.02c** When work in any way interferes with the safe operation of trains at timetable speeds.

- **1.05.02d** When any hazard is presented to Railway track, communications, signal, electrical, or other facilities either due to persons, material, equipment or blasting in the vicinity.

- **1.05.02e** Special permission must be obtained from the Railway before moving heavy or cumbersome objects or equipment which might result in making the track impassable.

- **1.05.03** Flagging services will be performed by qualified Railway flaggers.

- **1.05.03a** Flagging crew generally consists of one employee. However, additional personnel may be required to protect Railway Property and operations, if deemed necessary by the Railways Representative.

- **1.05.03b** Each time a flagger is called, the minimum period for billing will be the eight (8) hour basic day.

- 1.05.03c The cost of flagger services provided by the Railway will be borne by the State. The estimated cost for one (1) flagger is approximately between $1,000.00 for an eight (8) hour basic day with time and one-half or double time for overtime, rest days and holidays. The estimated cost for each flagger includes vacation allowance, paid holidays, Railway and unemployment insurance, public liability and property damage insurance, health and welfare benefits, vehicle, transportation, meals, lodging, radio, equipment, supervision and other costs incidental to performing flagging services. Negotiations for Railway labor or collective bargaining agreements and rate changes authorized by appropriate Federal authorities may increase actual or estimated flagging rates. **THE FLAGGING RATE IN EFFECT AT THE TIME OF PERFORMANCE BY THE CONTRACTOR HEREUNDER WILL BE USED TO CALCULATE THE ACTUAL COSTS OF FLAGGING PURSUANT TO THIS PARAGRAPH.**

- 1.05.03d The average train traffic on this route is _____ freight trains per 24-hour period at a timetable speed
- ___MPH and _____ passenger trains at a timetable speed of ____ MPH.

1.06 Contractor General Safety Requirements

- 1.06.01 Work in the proximity of railway track(s) is potentially hazardous where movement of trains and equipment can occur at any time and in any direction. All work performed by contractors within 25 feet of any track must be in compliance with FRA Roadway Worker Protection Regulations..

- 1.06.02 Before beginning any task on Railway Property, a thorough job safety briefing must be conducted with all personnel involved with the task and repeated when the personnel or task changes. If the task is within 25 feet of any track, the job briefing must include the Railway's flagger, as applicable, and include the procedures the Contractor will use to protect its employees, subcontractors, agents or invitees from moving any equipment adjacent to or across any Railway track(s).

- 1.06.03 Workers must not work within 25 feet of the centerline of any track without an on track safety strategy approved by the Railway's Project Representative. When authority is provided, every contractor employee must know: (1) who the Railway flagger is, and how to contact the flagger, (2) limits of the authority, (3) the method of communication to stop and resume work, and (4) location of the designated places of safety. Persons or equipment entering flag/work limits that were not previously job briefed, must notify the flagger immediately, and be given a job briefing when working within 25 feet of the center line of track.

- 1.06.04 When Contractor employees are required to work on the Railway Property after normal working hours or on weekends, the Railroad's representative in charge of the project must be notified. A minimum of two employees must be present at all times.

- 1.06.05 Any employees, agents or invitees of Contractor or its subcontractors under suspicion of being under the influence of drugs or alcohol, or in the possession of same, will be removed from the Railway's Property and subsequently released to the custody of a representative of Contractor management. Future access to the Railway's Property by that employee will be denied.

- 1.06.06 Any damage to Railway Property, or any hazard noticed on passing trains must be reported immediately to the Railway's representative in charge of the project. Any vehicle or machine which may come in contact with track, signal equipment, or structure (bridge) and could result in a train derailment must be reported immediately to the Railway representative in charge of the project and to the Railway's Resource Operations Center at 1(800) 832-5452. Local emergency numbers are to be obtained from the Railway representative in charge of the project prior to the start of any work and must be posted at the job site.

- 1.06.07 For safety reasons, all persons are prohibited from having pocket knives, firearms or other deadly weapons in their possession while working on Railway's Property.

- 1.06.08 All personnel protective equipment (PPE) used on Railway Property must meet applicable OSHA and ANSI specifications. Current Railway personnel protective equipment requirements are listed on the web site,

www.contractororientation.com, however, a partial list of the requirements include: a) safety glasses with permanently affixed side shields (no yellow lenses); b) hard hats c) safety shoe with: hardened toes, above-the-ankle lace-up and a defined heel; and d) high visibility retro-reflective work wear. The Railroad's representative in charge of the project is to be contacted regarding local specifications for meeting requirements relating to hi-visability work wear. Hearing protection, fall protection, gloves, and respirators must be worn as required by State and Federal regulations. **(NOTE – Should there be a discrepancy between the information contained on the web site and the information in this paragraph, the web site will govern.)**

- **1.06.09 THE CONTRACTOR MUST NOT PILE OR STORE ANY MATERIALS, MACHINERY OR EQUIPMENT CLOSER THAN 25'-0" TO THE CENTER LINE OF THE NEAREST RAILWAY TRACK. MATERIALS, MACHINERY OR EQUIPMENT MUST NOT BE STORED OR LEFT WITHIN 250 FEET OF ANY HIGHWAY/RAIL AT-GRADE CROSSINGS OR TEMPORARY CONSTRUCTION CROSSING, WHERE STORAGE OF THE SAME WILL OBSTRUCT THE VIEW OF A TRAIN APPROACHING THE CROSSING. PRIOR TO BEGINNING WORK, THE CONTRACTOR MUST ESTABLISH A STORAGE AREA WITH CONCURRENCE OF THE RAILROAD'S REPRESENTATIVE.**

- **1.06.10** Machines or vehicles must not be left unattended with the engine running. Parked machines or equipment must be in gear with brakes set and if equipped with blade, pan or bucket, they must be lowered to the ground. All machinery and equipment left unattended on Railway's Property must be left inoperable and secured against movement. (See internet Engineering Contractor Safety Orientation program for more detailed specifications)

- **1.06.11** Workers must not create and leave any conditions at the work site that would interfere with water drainage. Any work performed over water must meet all Federal, State and Local regulations.

- **1.06.12** All power line wires must be considered dangerous and of high voltage unless informed to the contrary by proper authority. For all power lines the minimum clearance between the lines and any part of the equipment or load must be; 200 KV or below - 15 feet; 200 to 350 KV - 20 feet; 350 to 500 KV - 25 feet; 500 to 750 KV - 35 feet; and 750 to 1000 KV - 45 feet. If capacity of the line is not known, a minimum clearance of 45 feet must be maintained. A person must be designated to observe clearance of the equipment and give a timely warning for all operations where it is difficult for an operator to maintain the desired clearance by visual means.

1.07 Excavation

- **1.07.01** Before excavating, the Contractor must determine whether any underground pipe lines, electric wires, or cables, including fiber optic cable systems are present and located within the Project work area. The Contractor must determine whether excavation on Railway's Property could cause damage to buried cables resulting in delay to Railway traffic and disruption of service to users. Delays and disruptions to service may cause business interruptions involving loss of revenue and profits. Before commencing excavation, the Contractor must contact **BNSF's Field Engineering Representative (909)-386-44079 and** Melvin V. Thomas, Railway's Manager Public Projects, telephone number (909) 386-4472. All underground and overhead wires will be considered HIGH VOLTAGE and dangerous until verified with the company having ownership of the line. **It is the Contractor's responsibility to notify any other companies that have underground utilities in the area and arrange for the location of all underground utilities before excavating.**

- **1.07.02** The Contractor must cease all work and notify the Railway immediately before continuing excavation in the area if obstructions are encountered which do not appear on drawings. If the obstruction is a utility and the owner of the utility can be identified, then the Contractor must also notify the owner immediately. If there is any doubt about the location of underground cables or lines of any kind, no work must be performed until the exact location has been determined. There will be no exceptions to these instructions.

- **1.07.03** All excavations must be conducted in compliance with applicable OSHA regulations and, regardless of depth, must be shored where there is any danger to tracks, structures or personnel.

- **1.07.04** Any excavations, holes or trenches on the Railway's Property must be covered, guarded and/or protected when not being worked on. When leaving work site areas at night and over weekends, the areas must be secured and left in a condition that will ensure that Railway employees and other personnel who may be working or passing through the area are protected from all hazards. All excavations must be back filled as soon as possible.

1.08 Hazardous Waste, Substances and Material Reporting

- **1.08.01** If Contractor discovers any hazardous waste, hazardous substance, petroleum or other deleterious material, including but not limited to any non-containerized commodity or material, on or adjacent to Railway's Property, in or near any surface water, swamp, wetlands or waterways, while performing any work under this Agreement, Contractor must immediately: (a) notify the Railway's Resource Operations Center at 1(800) 832-5452, of such discovery: (b) take safeguards necessary to protect its employees, subcontractors, agents and/or third parties: and (c) exercise due care with respect to the release, including the taking of any appropriate measure to minimize the impact of such release.

1.09 Personal Injury Reporting

- 1.09.01 The Railway is required to report certain injuries as a part of compliance with Federal Railroad Administration (FRA) reporting requirements. Any personal injury sustained by an employee of the Contractor, subcontractor or Contractor's invitees while on the Railway's Property must be reported immediately (by phone mail if unable to contact in person) to the Railway's representative in charge of the project. The Non-Employee Personal Injury Data Collection Form contained herein is to be completed and sent by Fax to the Railway at 1(817) 352-7595 and to the Railway's Project Representative no later than the close of shift on the date of the injury.

NON-EMPLOYEE PERSONAL INJURY DATA COLLECTION .

INFORMATION REQUIRED TO BE COLLECTED PURSUANT TO FEDERAL REGULATION. IT SHOULD BE USED FOR COMPLIANCE WITH FEDERAL REGULATIONS ONLY AND IS NOT INTENDED TO PRESUME ACCEPTANCE OF RESPONSIBILITY OR LIABILITY.

1. Accident City/St _____ 2. Date: _____ Time:
County: _____ 3. Temperature: _____ 4. Weather
(if non-Railway location)

5. Social Security #

6. Name (last, first, mi)

7. Address: Street: _____ City: _____ St._____ Zip:

8. Date of Birth: _____ and/or Age _____ Gender:
(if available)

9. (a) Injury: _____ (b) Body Part:
(i.e. (a) Laceration (b) Hand)

11. Description of Accident (To include location, action, result, etc.):

12. Treatment:
? First Aid Only
? Required Medical Treatment
? Other Medical Treatment

13. Dr. Name _____ 30. Date:

14. Dr. Address:
Street: _____ City: _____ St: _____ Zip:

15. Hospital Name:

16. Hospital Address:
Street: _____ City: _____ St: _____ Zip:

17. Diagnosis:

FAX TO
RAILWAY AT (817) 352-7595
AND COPY TO
RAILWAY ROADMASTER FAX

DRAFT LAW DEPARTMENT APPROVED

EXHIBIT "C-1"

Agreement
Between
BNSF RAILWAY COMPANY
and the
CONTRACTOR

BNSF RAILWAY COMPANY
Attention: Manager Public Projects

Railway File: US DOT No. 026577K
Agency Project: Placentia Overhead Widening

Gentlemen:

The undersigned (hereinafter called, the "Contractor"), has entered into a contract (the "Contract") dated _____, 2010, with the State of California ("STATE") for the performance of certain work in connection with the following project: Widening of Placentia Overhead Bridge off of BNSF Railway's San Bernardino Subdivision, MP 43.46, US DOT #026577K. Performance of such work will necessarily require contractor to enter BNSF RAILWAY COMPANY ("Railway") right of way and property ("Railway Property"). The Contract provides that no work will be commenced within Railway Property until the Contractor employed in connection with said work for **STATE** (i) executes and delivers to Railway an Agreement in the form hereof, and (ii) provides insurance of the coverage and limits specified in such Agreement and Section 3 herein. If this Agreement is executed by a party who is not the Owner, General Partner, President or Vice President of Contractor, Contractor must furnish evidence to Railway certifying that the signatory is empowered to execute this Agreement on behalf of Contractor.

Accordingly, in consideration of Railway granting permission to Contractor to enter upon Railway Property and as an inducement for such entry, Contractor, effective on the date of the Contract, has agreed and does hereby agree with Railway as follows:

Section 1. RELEASE OF LIABILITY AND INDEMNITY

Contractor hereby waives, releases, indemnifies, defends and holds harmless Railway for all judgments, awards, claims, demands, and expenses (including attorneys' fees), for injury or death to all persons, including Railway's and Contractor's officers and employees, and for loss and damage to property belonging to any person, arising in any manner from Contractor's or any of Contractor's subcontractors' acts or omissions or any work performed on or about Railway's property or right-of-way. **THE LIABILITY ASSUMED BY CONTRACTOR WILL NOT BE AFFECTED BY THE FACT, IF IT IS A FACT, THAT THE DESTRUCTION, DAMAGE, DEATH, OR INJURY WAS OCCASIONED BY OR CONTRIBUTED TO BY THE NEGLIGENCE OF RAILWAY, ITS AGENTS, SERVANTS, EMPLOYEES OR OTHERWISE, EXCEPT TO THE EXTENT THAT SUCH CLAIMS ARE PROXIMATELY CAUSED BY THE WILLFUL MISCONDUCT OR SOLE NEGLIGENCE OF RAILWAY.**

THE INDEMNIFICATION OBLIGATION ASSUMED BY CONTRACTOR INCLUDES ANY CLAIMS, SUITS OR JUDGMENTS BROUGHT AGAINST RAILWAY UNDER THE FEDERAL EMPLOYEE'S LIABILITY ACT, INCLUDING CLAIMS FOR STRICT LIABILITY UNDER THE SAFETY APPLIANCE ACT OR THE LOCOMOTIVE INSPECTION ACT, WHENEVER SO CLAIMED.

Contractor further agrees, at its expense, in the name and on behalf of Railway, that it will adjust and settle all claims made against Railway, and will, at Railway's discretion, appear and defend any suits or actions of law or in equity brought against Railway on any claim or cause of action arising or growing out of or in any manner

connected with any liability assumed by Contractor under this Agreement for which Railway is liable or is alleged to be liable. Railway will give notice to Contractor, in writing, of the receipt or dependency of such claims and thereupon Contractor must proceed to adjust and handle to a conclusion such claims, and in the event of a suit being brought against Railway, Railway may forward summons and complaint or other process in connection therewith to Contractor, and Contractor, at Railway's discretion, must defend, adjust, or settle such suits and protect, indemnify, and save harmless Railway from and against all damages, judgments, decrees, attorney's fees, costs, and expenses growing out of or resulting from or incident to any such claims or suits.

In addition to any other provision of this Agreement, in the event that all or any portion of this Article shall be deemed to be inapplicable for any reason, including without limitation as a result of a decision of an applicable court, legislative enactment or regulatory order, the parties agree that this Article shall be interpreted as requiring Contractor to indemnify Railroad to the fullest extent permitted by applicable law. **THROUGH THIS AGREEMENT THE PARTIES EXPRESSLY INTEND FOR CONTRACTOR TO INDEMNIFY RAILROAD FOR RAILROAD'S ACTS OF NEGLIGENCE.**

It is mutually understood and agreed that the assumption of liabilities and indemnification provided for in this Agreement suryive any termination of this Agreement.

Section 2. TERM

This Agreement is effective from the date of the Contract until (i) the completion of the project set forth herein, and (ii) full and complete payment to Railway of any and all sums or other amounts owing and due hereunder.

Section 3. INSURANCE

Contractor must, at its sole cost and expense, procure and maintain during the life of this Agreement the following insurance coverage:

A. Commercial General Liability insurance. This insurance must contain broad form contractual liability with a combined single limit of a minimum of $5,000,000 each occurrence and an aggregate limit of at least $10,000,000. Coverage must be purchased on a post 1998 ISO occurrence form or equivalent and include coverage for, but not limit to the following:

- Bodily Injury and Property Damage
- Personal Injury and Advertising Injury
- Fire legal liability
- Products and completed operations

This policy must also contain the following endorsements, which must be indicated on the certificate of insurance:

- It is agreed that any workers' compensation exclusion does not apply to ***Railroad*** payments related to the Federal Employers Liability Act or a ***Railroad*** Wage Continuation Program or similar programs and any payments made are deemed not to be either payments made or obligations assumed under any Workers Compensation, disability benefits, or unemployment compensation law or similar law.
- The definition of insured contract must be amended to remove any exclusion or other limitation for any work being done within 50 feet of railroad property.
- Any exclusions related to the explosion, collapse and underground hazards must be removed.

No other endorsements limiting coverage as respects obligations under this Agreement may be included on the policy.

B. Business Automobile Insurance. This insurance must contain a combined single limit of at least $1,000,000 per occurrence, and include coverage for, but not limited to the following:

- Bodily injury and property damage

- Any and all vehicles owned, used or hired

C. Workers Compensation and Employers Liability insurance including coverage for, but not limited to:
- California's statutory liability under the worker's compensation laws of the state(s) in which the work is to be performed. If optional under State law, the insurance must cover all employees anyway.
- Employers' Liability (Part B) with limits of at least $500,000 each accident, $500,000 by disease policy limit, $500,000 by disease each employee.

D. Railroad Protective Liability insurance naming only the ***Railroad*** as the Insured with coverage of at least $5,000,000 per occurrence and $10,000,000 in the aggregate. The policy Must be issued on a standard ISO form CG 00 35 10 93 and include the following:
- Endorsed to include the Pollution Exclusion Amendment (ISO form CG 28 31 10 93)
- Endorsed to include the Limited Seepage and Pollution Endorsement.
- Endorsed to remove any exclusion for punitive damages.
- No other endorsements restricting coverage may be added.
- The original policy must be provided to the ***Railroad*** prior to performing any work or services under this Agreement

Other Requirements:

All policies (applying to coverage listed above) must not contain an exclusion for punitive damages and certificates of insurance must reflect that no exclusion exists.

Contractor agrees to waive its right of recovery against ***Railroad*** for all claims and suits against ***Railroad.*** In addition, its insurers, through the terms of the policy or policy endorsement, waive their right of subrogation against ***Railroad*** for all claims and suits. The certificate of insurance must reflect the waiver of subrogation endorsement. Contractor further waives its right of recovery, and its insurers also waive their right of subrogation against ***Railroad*** for loss of its owned or leased property or property under contractor's care, custody or control.

Contractor's insurance policies through policy endorsement, must include wording which states that the policy is primary and non-contributing with respect to any insurance carried by ***Railroad.*** The certificate of insurance must reflect that the above wording is included in evidenced policies.

All policy(ies) required above (excluding Workers Compensation and if applicable, Railroad Protective) must include a severability of interest endorsement and ***Railroad*** must be named as an additional insured with respect to work performed under this agreement. Severability of interest and naming ***Railroad*** as additional insured must be indicated on the certificate of insurance.

Contractor is not allowed to self-insure without the prior written consent of ***Railroad.*** If granted by ***Railroad,*** any deductible, self-insured retention or other financial responsibility for claims must be covered directly by contractor in lieu of insurance. Any and all ***Railroad*** liabilities that would otherwise, in accordance with the provisions of this ***Agreement,*** be covered by contractor's insurance will be covered as if contractor elected not to include a deductible, self-insured retention or other financial responsibility for claims.

Prior to commencing the Work, contractor must furnish to ***Railroad*** an acceptable certificate(s) of insurance including an original signature of the authorized representative evidencing the required coverage, endorsements, and amendments and referencing the contract audit/folder number if available. The policy(ies) must contain a provision that obligates the insurance company(ies) issuing such policy(ies) to notify ***Railroad*** in writing at least 30 days prior to any cancellation, non-renewal, substitution or material alteration. This cancellation provision must be indicated on the certificate of insurance. Upon request from ***Railroad,*** a certified duplicate original of any required policy must be furnished. Contractor should send the certificate(s) to the following address:

BNSF RAILWAY COMPANY
PO Box 12010-BN
Hemet, CA 92546-8010
Fax number: 951-766-2299

Any insurance policy must be written by a reputable insurance company acceptable to ***Railroad*** or with a current Best's Guide Rating of A- and Class VII or better, and authorized to do business in the state(s) in which the service is to be provide.

Contractor represents that this ***Agreement*** has been thoroughly reviewed by contractor's insurance agent(s)/broker(s), who have been instructed by contractor to procure the insurance coverage required by this ***Agreement***. Allocated Loss Expense must be in addition to all policy limits for coverages referenced above. Not more frequently than once every five years, ***Railroad*** may reasonably modify the required insurance coverage to reflect then-current risk management practices in the railroad industry and underwriting practices in the insurance industry.

If any portion of the operation is to be subcontracted by contractor, contractor must require that the subcontractor provide and maintain the insurance coverages set forth herein, naming ***Railroad*** as an additional insured, and requiring that the subcontractor release, defend and indemnify ***Railroad*** to the same extent and under the same terms and conditions as contractor is required to release, defend and indemnify ***Railroad*** herein.

Failure to provide evidence as required by this section will entitle, but not require, ***Railroad*** to terminate this ***Agreement*** immediately. Acceptance of a certificate that does not comply with this section will not operate as a waiver of contractor's obligations hereunder.

The fact that insurance (including, without limitation, self-insurance) is obtained by contractor will not be deemed to release or diminish the liability of contractor including, without limitation, liability under the indemnity provisions of this ***Agreement***. Damages recoverable by ***Railroad*** will not be limited by the amount of the required insurance coverage.

For purposes of this section, ***Railroad*** means "Burlington Northern Santa Fe Corporation", "BNSF RAILWAY COMPANY" and the subsidiaries, successors, assigns and affiliates of each.

Section 4. EXHIBIT "C" CONTRACTOR REQUIREMENTS

The Contractor must observe and comply with all provisions, obligations, requirements and limitations contained in the Contract, and the Contractor Requirements set forth on Exhibit "C" attached to the Contract and this Agreement, , including, but not be limited to, payment of all costs incurred for any damages to Railway roadbed, tracks, and/or appurtenances thereto, resulting from use, occupancy, or presence of its employees, representatives, or agents or subcontractors on or about the construction site.

Section 5. TRAIN DELAY

Contractor is responsible for and hereby indemnifies and holds harmless Railway (including its affiliated railway companies, and its tenants) for, from and against all damages arising from any unscheduled delay to a freight or passenger train which affects Railway's ability to fully utilize its equipment and to meet customer service and contract obligations. Contractor will be billed, as further provided below, for the economic losses arising from loss of use of equipment, contractual loss of incentive pay and bonuses and contractual penalties resulting from train delays, whether caused by Contractor, or subcontractors, or by the Railway performing work under this Agreement. Railway agrees that it will not perform any act to unnecessarily cause train delay.

For loss of use of equipment, Contractor will be billed the current freight train hour rate per train as determined from Railway's records. Any disruption to train traffic may cause delays to multiple trains at the same time for the same period.

Additionally, the parties acknowledge that passenger, U.S. mail trains and certain other grain, intermodal, coal and freight trains operate under incentive/penalty contracts between Railway and its customer(s). Under these arrangements, if Railway does not meet its contract service commitments, Railway may suffer loss of performance or incentive pay and/or be subject to penalty payments. Contractor is responsible for any train performance and incentive penalties or other contractual economic losses actually incurred by Railway which are attributable to a train delay caused by Contractor or its subcontractors.

The contractual relationship between Railway and its customers is proprietary and confidential. In the event of a train delay covered by this Agreement, Railway will share information relevant to any train delay to the extent consistent with Railway confidentiality obligations. Damages for train delay for certain trains may be $382.20 per hour per incident. **THE RATE THEN IN EFFECT AT THE TIME OF PERFORMANCE BY THE CONTRACTOR HEREUNDER WILL BE USED TO CALCULATE THE ACTUAL COSTS OF TRAIN DELAY PURSUANT TO THIS AGREEMENT.**

Contractor and its subcontractors must give Railway's representative (Greg Rousseau – 909-386-4079) four (4) weeks advance notice of the times and dates for proposed work windows. Railway and Contractor will establish mutually agreeable work windows for the project. Railway has the right at any time to revise or change the work windows due to train operations or service obligations. Railway will not be responsible for any additional costs or expenses resulting from a change in work windows. Additional costs or expenses resulting from a change in work windows shall be accounted for in Contractor's expenses for the project.

Contractor and subcontractors must plan, schedule, coordinate and conduct all Contractor's work so as to not cause any delays to any trains.

Kindly acknowledge receipt of this letter by signing and returning to the Railway two original copies of this letter, which, upon execution by Railway, will constitute an Agreement between us.

_____	
(Contractor)	**BNSF Railway Company**
By:_____	By:_____
Printed Name:_____	Name:_____
Title:_____	Manager Public Projects
Contact Person: _____	Accepted and effective this _____day of 20__.
Address: _____	
_____	
City:_____State:___Zip:____	
Fax: _____	
Phone: _____	
E-mail:_____	

State of California Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: NAHID BAGHBANIAN,
Office of Office Engineer

Date: December 16, 2009

File: 12-ORA-57-PM 16.0/18.4
E.A. 0F0311
SR-57 NORTHBOUND WIDENING
BNSF RAILROAD: SOUTH PLACENTIA OH, BR # 55-450, PM 16.63
(MP 165.90, US DOT #026688C and PUC #002-167.90AC)
BNSF RAILROAD: PLACENTIA OH, BR #55-449, PM 16.84/16.87
(MP43.46, US DOT #026577K and PUC #002B-43.40A)

From: KATHY J. ANDERSON, Branch Chief
R/W Acquisition, Condemnation and Railroads
District 12 - Irvine

Subject: **RAILROAD CLEARANCE**

The above-referenced project is now ready to list as far as the BNSF Railroad is concerned. This clearance is subject to final execution of the Construction and Maintenance Agreements, and fund allocation by the California Transportation Commission.

The railroad long clauses for insertion into the contract special provisions are attached.

Attachments

cc: Pija Ansari, Project Manager
Mili Lim, Branch Chief
Joel Robinson, Project Engineer
Evy Washington, Railroad Agent
Daniel Okoro, HQ R/W R/R
Elaine Lewis, HQ R/W R/R

DRAFT

EXHIBIT "C"
CONTRACTOR REQUIREMENTS

1.01 General

- **1.01.01** The Contractor must cooperate with **BNSF RAILWAY COMPANY**, hereinafter referred to as "Railway" where work is over or under on or adjacent to Railway property and/or right-of-way, hereafter referred to as "Railway Property", during the construction of the widening of the Placentia Overhead Bridge on BNSF Railway's San Bernardino Subdivision, MP 43.46, US DOT# 026577K and PUC #002B-43.40A.

- **1.01.02** The Contractor must execute and deliver to the Railway duplicate copies of the Exhibit "C-1" Agreement, in the form attached hereto, obligating the Contractor to provide and maintain in full force and effect the insurance called for under Section 3 of said Exhibit "C-1". Questions regarding procurement of the Railroad Protective Liability Insurance should be directed to Rosa Martinez at Marsh, USA, 214-303-8519.

- **1.01.03** The Contractor must plan, schedule and conduct all work activities so as not to interfere with the movement of any trains on Railway Property.

- **1.01.04** The Contractor's right to enter Railway's Property is subject to the absolute right of Railway to cause the Contractor's work on Railway's Property to cease if, in the opinion of Railway, Contractor's activities create a hazard to Railway's Property, employees, and/or operations. Railway will have the right to stop construction work on the Project if any of the following events take place: (i) Contractor (or any of its subcontractors) performs the Project work in a manner contrary to the plans and specifications approved by Railway; (ii) Contractor (or any of its subcontractors), in Railway's opinion, prosecutes the Project work in a manner which is hazardous to Railway property, facilities or the safe and expeditious movement of railroad traffic; (iii) the insurance described in the attached Exhibit C-1 is canceled during the course of the Project; or (iv) Contractor fails to pay Railway for the Temporary Construction License or the Easement. The work stoppage will continue until all necessary actions are taken by Contractor or its subcontractor to rectify the situation to the satisfaction of Railway's Division Engineer or until additional insurance has been delivered to and accepted by Railway. In the event of a breach of (i) this Agreement, (ii) the Temporary Construction License, or (iii) the Easement, Railway may immediately terminate the Temporary Construction License or the Easement. Any such work stoppage under this provision will not give rise to any liability on the part of Railway. Railway's right to stop the work is in addition to any other rights Railway may have including, but not limited to, actions or suits for damages or lost profits. In the event that Railway desires to stop construction work on the Project, Railway agrees to immediately notify the following individual in writing:

  Kathy J. Anderson, Branch Chief
  Right of Way Department
  3337 Michelson Drive, Suite 380
  Irvine, California 92612-8894

- **1.01.05** The Contractor is responsible for determining and complying with all Federal, State and Local Governmental laws and regulations, including, but not limited to environmental laws and regulations (including but not limited to the Resource Conservation and Recovery Act, as amended; the Clean Water Act, the Oil Pollution Act, the Hazardous Materials Transportation Act, CERCLA), and health and safety laws and regulations. The Contractor hereby indemnifies, defends and holds harmless Railway for, from and against all fines or penalties imposed or assessed by Federal, State and Local Governmental Agencies against the Railway which arise out of Contractor's work under this Agreement.

- **1.01.06** The Contractor must notify the Railroad – Melvin V. Thomas, Railway's Manager Public Projects, telephone number 909-386-4472 at least thirty (30) calendar days before commencing any work on Railway Property. Contractors notification to Railway, must refer to Railroad's file 026577K.

- **1.01.07** For any bridge demolition and/or falsework above any tracks or any excavations located with any part of the excavations located within, whichever is greater, twenty-five (25) feet of the nearest track or intersecting a slope from the plane of the top of rail on a 2 horizontal to 1 vertical slope beginning at eleven (11) feet from centerline of the nearest track, both measured perpendicular to center line of track, the Contractor must furnish the Railway five sets of working drawings showing details of construction affecting Railway Property and tracks. The working drawing must include the proposed method of installation and removal of falsework, shoring or cribbing, not included in the contract plans and two sets of structural calculations of any falsework, shoring or cribbing. For all excavation and shoring submittal plans, the current "BNSF-UPRR Guidelines for Temporary Shoring" must be used for determining the design loading conditions to be used in shoring design, and all calculations and submittals must be in accordance with the current "BNSF-UPRR Guidelines for Temporary Shoring". All submittal drawings and calculations must be stamped by a registered professional engineer licensed to practice in the state the project is located. All calculations must take into consideration railway surcharge loading and must be designed to meet American Railway Engineering and Maintenance-of-Way Association (previously known as American Railway Engineering Association) Coopers E-80 live loading standard. All drawings and calculations must be stamped by a registered professional engineer licensed to practice in the state the project is located. The Contractor must not begin work until notified by the Railway that plans have been approved. The Contractor will be required to use lifting devices such as, cranes and/or winches to place or to remove any falsework over Railway's tracks. In no case will the Contractor be relieved of responsibility for results obtained by the implementation of said approved plans.

- **1.01.08** Subject to the movement of Railway's trains, Railway will cooperate with the Contractor such that the work may be handled and performed in an efficient manner. The Contractor will have no claim whatsoever for any type of damages or for extra or additional compensation in the event his work is delayed by the Railway.

1.02 Contractor Safety Orientation

- **1.02.01 No employee of the Contractor, its subcontractors, agents or invitees may enter Railway Property without first having completed Railway's Engineering Contractor Safety Orientation, found on the web site www.contractororientation.com. The Contractor must ensure that each of its employees, subcontractors, agents or invitees completes Railway's Engineering Contractor Safety Orientation through internet sessions before any work is performed on the Project. Additionally, the Contractor must ensure that each and every one of its employees, subcontractors, agents or invitees possesses a card certifying completion of the Railway Contractor Safety Orientation before entering Railway Property. The Contractor is responsible for the cost of the Railway Contractor Safety Orientation. The Contractor must renew the Railway Contractor Safety Orientation annually. Further clarification can be found on the web site or from the Railway's Representative.**

1.03 Railway Requirements

- **1.03.01** The Contractor must take protective measures as are necessary to keep railway facilities, including track ballast, free of sand, debris, and other foreign objects and materials resulting from his operations. Any damage to railway facilities resulting from Contractor's operations will be repaired or replaced by Railway and the cost of such repairs or replacement must be paid for by the Agency.

- **1.03.02** The Contractor must notify the Railway's Division Superintendent Mark Kirschinger at 909-386-4150 and provide blasting plans to the Railway for review seven (7) calendar days prior to conducting any blasting operations adjacent to or on Railway's Property.

- **1.03.03** The Contractor must abide by the following temporary clearances during construction:

  - 15' Horizontally from centerline of nearest track
  - 21'-6" Vertically above top of rail
  - 27'-0" Vertically above top of rail for electric wires carrying less than 750 volts
  - 28'-0" Vertically above top of rail for electric wires carrying 750 volts to 15,000 volts
  - 30'-0" Vertically above top of rail for electric wires carrying 15,000 volts to 20,000 volts
  - 34'-0" Vertically above top of rail for electric wires carrying more than 20,000 volts

- **1.03.04** Upon completion of construction, the following clearances shall be maintained:

    - 25' – 3" Horizontally from centerline of nearest track
    - 23' 10" Vertically above top of rail

- **1.03.05** Any infringement within State statutory clearances due to the Contractor's operations must be submitted to the Railway and to the State of California and must not be undertaken until approved in writing by the Railway, and until the State of California has obtained any necessary authorization from the State Regulatory Authority for the infringement. No extra compensation will be allowed in the event the Contractor's work is delayed pending Railway approval, and/or the State Regulatory Authority's approval.

- **1.03.06** In the case of impaired vertical clearance above top of rail, Railway will have the option of installing tell-tales or other protective devices Railway deems necessary for protection of Railway operations. The cost of tell-tales or protective devices will be borne by the Agency.

- **1.03.07** The details of construction affecting the Railway's Property and tracks not included in the contract plans must be submitted to the Railway by State of California for approval before work is undertaken and this work must not be undertaken until approved by the Railway.

- **1.03.08** At other than public road crossings, the Contractor must not move any equipment or materials across Railway's tracks until permission has been obtained from the Railway. The Contractor must obtain a "Temporary Construction Crossing Agreement" from the Railway prior to moving his equipment or materials across the Railways tracks. The temporary crossing must be gated and locked at all times when not required for use by the Contractor. The temporary crossing for use of the Contractor will be constructed and, at the completion of the project, removed at the expense of the Contractor.

- **1.03.09** Discharge, release or spill on the Railway Property of any hazardous substances, oil, petroleum, constituents, pollutants, contaminants, or any hazardous waste is prohibited and Contractor must immediately notify the Railway's Resource Operations Center at 1(800) 832-5452, of any discharge, release or spills in excess of a reportable quantity. Contractor must not allow Railway Property to become a treatment, storage or transfer facility as those terms are defined in the Resource Conservation and Recovery Act or any state analogue.

- **1.03.10** The Contractor upon completion of the work covered by this contract, must promptly remove from the Railway's Property all of Contractor's tools, equipment, implements and other materials, whether brought upon said property by said Contractor or any Subcontractor, employee or agent of Contractor or of any Subcontractor, and must cause Railway's Property to be left in a condition acceptable to the Railway's representative.

1.04 Contractor Roadway Worker on Track Safety Program and Safety Action Plan

- 1.04.01 Each Contractor that will perform work within 25 feet of the centerline of a track must develop and implement a Roadway Worker Protection/On Track Safety Program and work with Railway Project Representative to develop an on track safety strategy as described in the guidelines listed in the on track safety portion of the Safety Orientation. This Program must provide Roadway Worker protection/on track training for all employees of the Contractor, its subcontractors, agents or invitees. This training is reinforced at the job site through job safety briefings. Additionally, each Contractor must develop and implement the Safety Action Plan, as provided for on the web site **www.contractororientation.com**, which will be made available to Railway prior to commencement of any work on Railway Property. During the performance of work, the Contractor must audit its work activities. The Contractor must designate an on-site Project Supervisor who will serve as the contact person for the Railway and who will maintain a copy of the Safety Action Plan, safety audits, and Material Safety Datasheets (MSDS), at the job site.

Contractor shall have a background investigation performed on all of its employees, subcontractors and agents who will be performing any services on railroad property under this Agreement.

The background screening shall at a minimum meet the criteria defined by the e-RAILSAFE program outlined at http://www.e-railsafe.com in addition to any other applicable regulatory requirements. The e-RAILSAFE program uses rail industry background screening standards.

Contractor shall obtain consent from all employees screened in compliance with the e-RAILSAFE program criteria to release completed background information to BNSF. Contractor shall be subject to periodic audit to ensure compliance.

Contractor shall not permit any of its employees, subcontractors or agents to perform services on property hereunder who are not approved under e-RAILSAFE program standards. Railroad shall have the right to deny entry onto its premises to any of Contractor's employees, subcontractors or agents who do not display the authorized identification badge issued by a background screening service meeting the standards set forth for the e-RAILSAFE program or who pose a threat, in Railroad's reasonable opinion, to the safety or security of Railroad's operations.

Contractors shall ensure its employees, subcontractors and agents are United States citizens or legally working in this country under a work VISA.

1.05 Railway Flagger Services:

- **1.05.01** The Contractor must give Railway's Roadmaster (760) 255-7639 and Melvin V. Thomas, Railway's Manager Public Projects, telephone number (909) 386-4472 a minimum of thirty (30) calendar days advance notice when flagging services will be required so that the Roadmaster can make appropriate arrangements (i.e., bulletin the flagger's position). If flagging services are scheduled in advance by the Contractor and it is subsequently determined by the parties hereto that such services are no longer necessary, the Contractor must give the Roadmaster five (5) working days advance notice so that appropriate arrangements can be made to abolish the position pursuant to union requirements.

- **1.05.02** Unless determined otherwise by Railway's Project Representative, Railway flagger will be required and furnished when Contractor's work activities are located over, under and/or within twenty-five (25) feet measured horizontally from centerline of the nearest track and when cranes or similar equipment positioned beyond 25-feet from the track centerline could foul the track in the event of tip over or other catastrophic occurrence, but not limited thereto for the following conditions:

- **1.05.02a** When, upon inspection by Railway's Representative, other conditions warrant.

- **1.05.02b** When any excavation is performed below the bottom of tie elevation, if, in the opinion of Railway's representative, track or other Railway facilities may be subject to movement or settlement.

- **1.05.02c** When work in any way interferes with the safe operation of trains at timetable speeds.

- **1.05.02d** When any hazard is presented to Railway track, communications, signal, electrical, or other facilities either due to persons, material, equipment or blasting in the vicinity.

- **1.05.02e** Special permission must be obtained from the Railway before moving heavy or cumbersome objects or equipment which might result in making the track impassable.

- **1.05.03** Flagging services will be performed by qualified Railway flaggers.

- **1.05.03a** Flagging crew generally consists of one employee. However, additional personnel may be required to protect Railway Property and operations, if deemed necessary by the Railways Representative.

- **1.05.03b** Each time a flagger is called, the minimum period for billing will be the eight (8) hour basic day.

- **1.05.03c** The cost of flagger services provided by the Railway will be borne by the State. The estimated cost for one (1) flagger is approximately between $1,000.00 for an eight (8) hour basic day with time and one-half or double time for overtime, rest days and holidays. The estimated cost for each flagger includes vacation allowance, paid holidays, Railway and unemployment insurance, public liability and property damage insurance, health and welfare benefits, vehicle, transportation, meals, lodging, radio, equipment, supervision and other costs incidental to performing flagging services. Negotiations for Railway labor or collective bargaining agreements and rate changes authorized by appropriate Federal authorities may increase actual or estimated flagging rates. **THE FLAGGING RATE IN EFFECT AT THE TIME OF PERFORMANCE BY THE CONTRACTOR HEREUNDER WILL BE USED TO CALCULATE THE ACTUAL COSTS OF FLAGGING PURSUANT TO THIS PARAGRAPH.**

- **1.05.03d** The average train traffic on this route is _____ freight trains per 24-hour period at a timetable speed
- ____MPH and _____ passenger trains at a timetable speed of ____ MPH.

1.06 Contractor General Safety Requirements

- **1.06.01 Work in the proximity of railway track(s) is potentially hazardous where movement of trains and equipment can occur at any time and in any direction. All work performed by contractors within 25 feet of any track must be in compliance with FRA Roadway Worker Protection Regulations.**

- **1.06.02 Before beginning any task on Railway Property, a thorough job safety briefing must be conducted with all personnel involved with the task and repeated when the personnel or task changes. If the task is within 25 feet of any track, the job briefing must include the Railway's flagger, as applicable, and include the procedures the Contractor will use to protect its employees, subcontractors, agents or invitees from moving any equipment adjacent to or across any Railway track(s).**

- **1.06.03 Workers must not work within 25 feet of the centerline of any track without an on track safety strategy approved by the Railway's Project Representative. When authority is provided, every contractor employee must know: (1) who the Railway flagger is, and how to contact the flagger, (2) limits of the authority, (3) the method of communication to stop and resume work, and (4) location of the designated places of safety. Persons or equipment entering flag/work limits that were not previously job briefed, must notify the flagger immediately, and be given a job briefing when working within 25 feet of the center line of track.**

- **1.06.04 When Contractor employees are required to work on the Railway Property after normal working hours or on weekends, the Railroad's representative in charge of the project must be notified. A minimum of two employees must be present at all times.**

- **1.06.05** Any employees, agents or invitees of Contractor or its subcontractors under suspicion of being under the influence of drugs or alcohol, or in the possession of same, will be removed from the Railway's Property and subsequently released to the custody of a representative of Contractor management. Future access to the Railway's Property by that employee will be denied.

- **1.06.06** Any damage to Railway Property, or any hazard noticed on passing trains must be reported immediately to the Railway's representative in charge of the project. Any vehicle or machine which may come in contact with track, signal equipment, or structure (bridge) and could result in a train derailment must be reported immediately to the Railway representative in charge of the project and to the Railway's Resource Operations Center at 1(800) 832-5452. Local emergency numbers are to be obtained from the Railway representative in charge of the project prior to the start of any work and must be posted at the job site.

- **1.06.07** For safety reasons, all persons are prohibited from having pocket knives, firearms or other deadly weapons in their possession while working on Railway's Property.

- **1.06.08** All personnel protective equipment (PPE) used on Railway Property must meet applicable OSHA and ANSI specifications. Current Railway personnel protective equipment requirements are listed on the web site,

www.contractororientation.com, however, a partial list of the requirements include: a) safety glasses with permanently affixed side shields (no yellow lenses); b) hard hats c) safety shoe with: hardened toes, above-the-ankle lace-up and a defined heel; and d) high visibility retro-reflective work wear. The Railroad's representative in charge of the project is to be contacted regarding local specifications for meeting requirements relating to hi-visability work wear. Hearing protection, fall protection, gloves, and respirators must be worn as required by State and Federal regulations. **(NOTE – Should there be a discrepancy between the information contained on the web site and the information in this paragraph, the web site will govern.)**

- **1.06.09 THE CONTRACTOR MUST NOT PILE OR STORE ANY MATERIALS, MACHINERY OR EQUIPMENT CLOSER THAN 25'-0" TO THE CENTER LINE OF THE NEAREST RAILWAY TRACK. MATERIALS, MACHINERY OR EQUIPMENT MUST NOT BE STORED OR LEFT WITHIN 250 FEET OF ANY HIGHWAY/RAIL AT-GRADE CROSSINGS OR TEMPORARY CONSTRUCTION CROSSING, WHERE STORAGE OF THE SAME WILL OBSTRUCT THE VIEW OF A TRAIN APPROACHING THE CROSSING. PRIOR TO BEGINNING WORK, THE CONTRACTOR MUST ESTABLISH A STORAGE AREA WITH CONCURRENCE OF THE RAILROAD'S REPRESENTATIVE.**

- **1.06.10** Machines or vehicles must not be left unattended with the engine running. Parked machines or equipment must be in gear with brakes set and if equipped with blade, pan or bucket, they must be lowered to the ground. All machinery and equipment left unattended on Railway's Property must be left inoperable and secured against movement. (See internet Engineering Contractor Safety Orientation program for more detailed specifications)

- **1.06.11** Workers must not create and leave any conditions at the work site that would interfere with water drainage. Any work performed over water must meet all Federal, State and Local regulations.

- **1.06.12** All power line wires must be considered dangerous and of high voltage unless informed to the contrary by proper authority. For all power lines the minimum clearance between the lines and any part of the equipment or load must be; 200 KV or below - 15 feet; 200 to 350 KV - 20 feet; 350 to 500 KV - 25 feet; 500 to 750 KV - 35 feet; and 750 to 1000 KV - 45 feet. If capacity of the line is not known, a minimum clearance of 45 feet must be maintained. A person must be designated to observe clearance of the equipment and give a timely warning for all operations where it is difficult for an operator to maintain the desired clearance by visual means.

1.07 Excavation

- **1.07.01** Before excavating, the Contractor must determine whether any underground pipe lines, electric wires, or cables, including fiber optic cable systems are present and located within the Project work area. The Contractor must determine whether excavation on Railway's Property could cause damage to buried cables resulting in delay to Railway traffic and disruption of service to users. Delays and disruptions to service may cause business interruptions involving loss of revenue and profits. Before commencing excavation, the Contractor must contact **BNSF's Field Engineering Representative (909)-386-44079 and** Melvin V. Thomas, Railway's Manager Public Projects, telephone number (909) 386-4472. All underground and overhead wires will be considered HIGH VOLTAGE and dangerous until verified with the company having ownership of the line. **It is the Contractor's responsibility to notify any other companies that have underground utilities in the area and arrange for the location of all underground utilities before excavating.**

- **1.07.02** The Contractor must cease all work and notify the Railway immediately before continuing excavation in the area if obstructions are encountered which do not appear on drawings. If the obstruction is a utility and the owner of the utility can be identified, then the Contractor must also notify the owner immediately. If there is any doubt about the location of underground cables or lines of any kind, no work must be performed until the exact location has been determined. There will be no exceptions to these instructions.

- **1.07.03** All excavations must be conducted in compliance with applicable OSHA regulations and, regardless of depth, must be shored where there is any danger to tracks, structures or personnel.

- **1.07.04** Any excavations, holes or trenches on the Railway's Property must be covered, guarded and/or protected when not being worked on. When leaving work site areas at night and over weekends, the areas must be secured and left in a condition that will ensure that Railway employees and other personnel who may be working or passing through the area are protected from all hazards. All excavations must be back filled as soon as possible.

1.08 Hazardous Waste, Substances and Material Reporting

- **1.08.01** If Contractor discovers any hazardous waste, hazardous substance, petroleum or other deleterious material, including but not limited to any non-containerized commodity or material, on or adjacent to Railway's Property, in or near any surface water, swamp, wetlands or waterways, while performing any work under this Agreement, Contractor must immediately: (a) notify the Railway's Resource Operations Center at 1(800) 832-5452, of such discovery: (b) take safeguards necessary to protect its employees, subcontractors, agents and/or third parties: and (c) exercise due care with respect to the release, including the taking of any appropriate measure to minimize the impact of such release.

1.09 Personal Injury Reporting

- 1.09.01 The Railway is required to report certain injuries as a part of compliance with Federal Railroad Administration (FRA) reporting requirements. Any personal injury sustained by an employee of the Contractor, subcontractor or Contractor's invitees while on the Railway's Property must be reported immediately (by phone mail if unable to contact in person) to the Railway's representative in charge of the project. The Non-Employee Personal Injury Data Collection Form contained herein is to be completed and sent by Fax to the Railway at 1(817) 352-7595 and to the Railway's Project Representative no later than the close of shift on the date of the injury.

NON-EMPLOYEE PERSONAL INJURY DATA COLLECTION

INFORMATION REQUIRED TO BE COLLECTED PURSUANT TO FEDERAL REGULATION. IT SHOULD BE USED FOR COMPLIANCE WITH FEDERAL REGULATIONS ONLY AND IS NOT INTENDED TO PRESUME ACCEPTANCE OF RESPONSIBILITY OR LIABILITY.

1. Accident City/St _____ 2. Date: _____ Time:
   County: _____ 3. Temperature: _____ 4. Weather
   (if non-Railway location)

5. Social Security #

6. Name (last, first, mi)

7. Address: Street: _____ City: _____ St._____ Zip:

8. Date of Birth: _____ and/or Age _____ Gender:
   (if available)

9. (a) Injury: _____ (b) Body Part:
   (i.e. (a) Laceration (b) Hand)

11. Description of Accident (To include location, action, result, etc.):

12. Treatment:
    - ? First Aid Only
    - ? Required Medical Treatment
    - ? Other Medical Treatment

13. Dr. Name _____ 30. Date:

14. Dr. Address:
    Street: _____ City: _____ St: _____ Zip:

15. Hospital Name:

16. Hospital Address:
    Street: _____ City: _____ St: _____ Zip:

17. Diagnosis:

FAX TO
RAILWAY AT (817) 352-7595
AND COPY TO
RAILWAY ROADMASTER FAX

DRAFT LAW DEPARTMENT APPROVED

EXHIBIT "C-1"

Agreement
Between
BNSF RAILWAY COMPANY
and the
CONTRACTOR

BNSF RAILWAY COMPANY
Attention: Manager Public Projects

Railway File: US DOT No. 026577K
Agency Project: Placentia Overhead Widening

Gentlemen:

The undersigned (hereinafter called, the "Contractor"), has entered into a contract (the "Contract") dated _____, 2010, with the State of California ("STATE") for the performance of certain work in connection with the following project: Widening of Placentia Overhead Bridge off of BNSF Railway's San Bernardino Subdivision, MP 43.46, US DOT #026577K. Performance of such work will necessarily require contractor to enter BNSF RAILWAY COMPANY ("Railway") right of way and property ("Railway Property"). The Contract provides that no work will be commenced within Railway Property until the Contractor employed in connection with said work for **STATE** (i) executes and delivers to Railway an Agreement in the form hereof, and (ii) provides insurance of the coverage and limits specified in such Agreement and Section 3 herein. If this Agreement is executed by a party who is not the Owner, General Partner, President or Vice President of Contractor, Contractor must furnish evidence to Railway certifying that the signatory is empowered to execute this Agreement on behalf of Contractor.

Accordingly, in consideration of Railway granting permission to Contractor to enter upon Railway Property and as an inducement for such entry, Contractor, effective on the date of the Contract, has agreed and does hereby agree with Railway as follows:

Section 1. RELEASE OF LIABILITY AND INDEMNITY

Contractor hereby waives, releases, indemnifies, defends and holds harmless Railway for all judgments, awards, claims, demands, and expenses (including attorneys' fees), for injury or death to all persons, including Railway's and Contractor's officers and employees, and for loss and damage to property belonging to any person, arising in any manner from Contractor's or any of Contractor's subcontractors' acts or omissions or any work performed on or about Railway's property or right-of-way. **THE LIABILITY ASSUMED BY CONTRACTOR WILL NOT BE AFFECTED BY THE FACT, IF IT IS A FACT, THAT THE DESTRUCTION, DAMAGE, DEATH, OR INJURY WAS OCCASIONED BY OR CONTRIBUTED TO BY THE NEGLIGENCE OF RAILWAY, ITS AGENTS, SERVANTS, EMPLOYEES OR OTHERWISE, EXCEPT TO THE EXTENT THAT SUCH CLAIMS ARE PROXIMATELY CAUSED BY THE WILLFUL MISCONDUCT OR SOLE NEGLIGENCE OF RAILWAY.**

THE INDEMNIFICATION OBLIGATION ASSUMED BY CONTRACTOR INCLUDES ANY CLAIMS, SUITS OR JUDGMENTS BROUGHT AGAINST RAILWAY UNDER THE FEDERAL EMPLOYEE'S LIABILITY ACT, INCLUDING CLAIMS FOR STRICT LIABILITY UNDER THE SAFETY APPLIANCE ACT OR THE LOCOMOTIVE INSPECTION ACT, WHENEVER SO CLAIMED.

Contractor further agrees, at its expense, in the name and on behalf of Railway, that it will adjust and settle all claims made against Railway, and will, at Railway's discretion, appear and defend any suits or actions of law or in equity brought against Railway on any claim or cause of action arising or growing out of or in any manner

connected with any liability assumed by Contractor under this Agreement for which Railway is liable or is alleged to be liable. Railway will give notice to Contractor, in writing, of the receipt or dependency of such claims and thereupon Contractor must proceed to adjust and handle to a conclusion such claims, and in the event of a suit being brought against Railway, Railway may forward summons and complaint or other process in connection therewith to Contractor, and Contractor, at Railway's discretion, must defend, adjust, or settle such suits and protect, indemnify, and save harmless Railway from and against all damages, judgments, decrees, attorney's fees, costs, and expenses growing out of or resulting from or incident to any such claims or suits.

In addition to any other provision of this Agreement, in the event that all or any portion of this Article shall be deemed to be inapplicable for any reason, including without limitation as a result of a decision of an applicable court, legislative enactment or regulatory order, the parties agree that this Article shall be interpreted as requiring Contractor to indemnify Railroad to the fullest extent permitted by applicable law. **THROUGH THIS AGREEMENT THE PARTIES EXPRESSLY INTEND FOR CONTRACTOR TO INDEMNIFY RAILROAD FOR RAILROAD'S ACTS OF NEGLIGENCE.**

It is mutually understood and agreed that the assumption of liabilities and indemnification provided for in this Agreement survive any termination of this Agreement.

Section 2. TERM

This Agreement is effective from the date of the Contract until (i) the completion of the project set forth herein, and (ii) full and complete payment to Railway of any and all sums or other amounts owing and due hereunder.

Section 3. INSURANCE

Contractor must, at its sole cost and expense, procure and maintain during the life of this Agreement the following insurance coverage:

A. Commercial General Liability insurance. This insurance must contain broad form contractual liability with a combined single limit of a minimum of $5,000,000 each occurrence and an aggregate limit of at least $10,000,000. Coverage must be purchased on a post 1998 ISO occurrence form or equivalent and include coverage for, but not limit to the following:

- Bodily Injury and Property Damage
- Personal Injury and Advertising Injury
- Fire legal liability
- Products and completed operations

This policy must also contain the following endorsements, which must be indicated on the certificate of insurance:

- It is agreed that any workers' compensation exclusion does not apply to ***Railroad*** payments related to the Federal Employers Liability Act or a ***Railroad*** Wage Continuation Program or similar programs and any payments made are deemed not to be either payments made or obligations assumed under any Workers Compensation, disability benefits, or unemployment compensation law or similar law.
- The definition of insured contract must be amended to remove any exclusion or other limitation for any work being done within 50 feet of railroad property.
- Any exclusions related to the explosion, collapse and underground hazards must be removed.

No other endorsements limiting coverage as respects obligations under this Agreement may be included on the policy.

B. Business Automobile Insurance. This insurance must contain a combined single limit of at least $1,000,000 per occurrence, and include coverage for, but not limited to the following:

- Bodily injury and property damage

- Any and all vehicles owned, used or hired

C. Workers Compensation and Employers Liability insurance including coverage for, but not limited to:
   - California's statutory liability under the worker's compensation laws of the state(s) in which the work is to be performed. If optional under State law, the insurance must cover all employees anyway.
   - Employers' Liability (Part B) with limits of at least $500,000 each accident, $500,000 by disease policy limit, $500,000 by disease each employee.

D. Railroad Protective Liability insurance naming only the ***Railroad*** as the Insured with coverage of at least $5,000,000 per occurrence and $10,000,000 in the aggregate. The policy Must be issued on a standard ISO form CG 00 35 10 93 and include the following:
   - Endorsed to include the Pollution Exclusion Amendment (ISO form CG 28 31 10 93)
   - Endorsed to include the Limited Seepage and Pollution Endorsement.
   - Endorsed to remove any exclusion for punitive damages.
   - No other endorsements restricting coverage may be added.
   - The original policy must be provided to the ***Railroad*** prior to performing any work or services under this Agreement

Other Requirements:

All policies (applying to coverage listed above) must not contain an exclusion for punitive damages and certificates of insurance must reflect that no exclusion exists.

Contractor agrees to waive its right of recovery against ***Railroad*** for all claims and suits against ***Railroad***. In addition, its insurers, through the terms of the policy or policy endorsement, waive their right of subrogation against ***Railroad*** for all claims and suits. The certificate of insurance must reflect the waiver of subrogation endorsement. Contractor further waives its right of recovery, and its insurers also waive their right of subrogation against ***Railroad*** for loss of its owned or leased property or property under contractor's care, custody or control.

Contractor's insurance policies through policy endorsement, must include wording which states that the policy is primary and non-contributing with respect to any insurance carried by ***Railroad***. The certificate of insurance must reflect that the above wording is included in evidenced policies.

All policy(ies) required above (excluding Workers Compensation and if applicable, Railroad Protective) must include a severability of interest endorsement and ***Railroad*** must be named as an additional insured with respect to work performed under this agreement. Severability of interest and naming ***Railroad*** as additional insured must be indicated on the certificate of insurance.

Contractor is not allowed to self-insure without the prior written consent of ***Railroad***. If granted by ***Railroad***, any deductible, self-insured retention or other financial responsibility for claims must be covered directly by contractor in lieu of insurance. Any and all ***Railroad*** liabilities that would otherwise, in accordance with the provisions of this ***Agreement***, be covered by contractor's insurance will be covered as if contractor elected not to include a deductible, self-insured retention or other financial responsibility for claims.

Prior to commencing the Work, contractor must furnish to ***Railroad*** an acceptable certificate(s) of insurance including an original signature of the authorized representative evidencing the required coverage, endorsements, and amendments and referencing the contract audit/folder number if available. The policy(ies) must contain a provision that obligates the insurance company(ies) issuing such policy(ies) to notify ***Railroad*** in writing at least 30 days prior to any cancellation, non-renewal, substitution or material alteration. This cancellation provision must be indicated on the certificate of insurance. Upon request from ***Railroad***, a certified duplicate original of any required policy must be furnished. Contractor should send the certificate(s) to the following address:

BNSF RAILWAY COMPANY
PO Box 12010-BN
Hemet, CA 92546-8010
Fax number: 951-766-2299

Any insurance policy must be written by a reputable insurance company acceptable to ***Railroad*** or with a current Best's Guide Rating of A- and Class VII or better, and authorized to do business in the state(s) in which the service is to be provide.

Contractor represents that this ***Agreement*** has been thoroughly reviewed by contractor's insurance agent(s)/broker(s), who have been instructed by contractor to procure the insurance coverage required by this ***Agreement***. Allocated Loss Expense must be in addition to all policy limits for coverages referenced above. Not more frequently than once every five years, ***Railroad*** may reasonably modify the required insurance coverage to reflect then-current risk management practices in the railroad industry and underwriting practices in the insurance industry.

If any portion of the operation is to be subcontracted by contractor, contractor must require that the subcontractor provide and maintain the insurance coverages set forth herein, naming ***Railroad*** as an additional insured, and requiring that the subcontractor release, defend and indemnify ***Railroad*** to the same extent and under the same terms and conditions as contractor is required to release, defend and indemnify ***Railroad*** herein.

Failure to provide evidence as required by this section will entitle, but not require, ***Railroad*** to terminate this ***Agreement*** immediately. Acceptance of a certificate that does not comply with this section will not operate as a waiver of contractor's obligations hereunder.

The fact that insurance (including, without limitation, self-insurance) is obtained by contractor will not be deemed to release or diminish the liability of contractor including, without limitation, liability under the indemnity provisions of this ***Agreement***. Damages recoverable by ***Railroad*** will not be limited by the amount of the required insurance coverage.

For purposes of this section, ***Railroad*** means "Burlington Northern Santa Fe Corporation", "BNSF RAILWAY COMPANY" and the subsidiaries, successors, assigns and affiliates of each.

Section 4. EXHIBIT "C" CONTRACTOR REQUIREMENTS

The Contractor must observe and comply with all provisions, obligations, requirements and limitations contained in the Contract, and the Contractor Requirements set forth on Exhibit "C" attached to the Contract and this Agreement, , including, but not be limited to, payment of all costs incurred for any damages to Railway roadbed, tracks, and/or appurtenances thereto, resulting from use, occupancy, or presence of its employees, representatives, or agents or subcontractors on or about the construction site.

Section 5. TRAIN DELAY

Contractor is responsible for and hereby indemnifies and holds harmless Railway (including its affiliated railway companies, and its tenants) for, from and against all damages arising from any unscheduled delay to a freight or passenger train which affects Railway's ability to fully utilize its equipment and to meet customer service and contract obligations. Contractor will be billed, as further provided below, for the economic losses arising from loss of use of equipment, contractual loss of incentive pay and bonuses and contractual penalties resulting from train delays, whether caused by Contractor, or subcontractors, or by the Railway performing work under this Agreement. Railway agrees that it will not perform any act to unnecessarily cause train delay.

For loss of use of equipment, Contractor will be billed the current freight train hour rate per train as determined from Railway's records. Any disruption to train traffic may cause delays to multiple trains at the same time for the same period.

Additionally, the parties acknowledge that passenger, U.S. mail trains and certain other grain, intermodal, coal and freight trains operate under incentive/penalty contracts between Railway and its customer(s). Under these arrangements, if Railway does not meet its contract service commitments, Railway may suffer loss of performance or incentive pay and/or be subject to penalty payments. Contractor is responsible for any train performance and incentive penalties or other contractual economic losses actually incurred by Railway which are attributable to a train delay caused by Contractor or its subcontractors.

The contractual relationship between Railway and its customers is proprietary and confidential. In the event of a train delay covered by this Agreement, Railway will share information relevant to any train delay to the extent consistent with Railway confidentiality obligations. Damages for train delay for certain trains may be $382.20 per hour per incident. **THE RATE THEN IN EFFECT AT THE TIME OF PERFORMANCE BY THE CONTRACTOR HEREUNDER WILL BE USED TO CALCULATE THE ACTUAL COSTS OF TRAIN DELAY PURSUANT TO THIS AGREEMENT.**

Contractor and its subcontractors must give Railway's representative (Greg Rousseau – 909-386-4079) four (4) weeks advance notice of the times and dates for proposed work windows. Railway and Contractor will establish mutually agreeable work windows for the project. Railway has the right at any time to revise or change the work windows due to train operations or service obligations. Railway will not be responsible for any additional costs or expenses resulting from a change in work windows. Additional costs or expenses resulting from a change in work windows shall be accounted for in Contractor's expenses for the project.

Contractor and subcontractors must plan, schedule, coordinate and conduct all Contractor's work so as to not cause any delays to any trains.

Kindly acknowledge receipt of this letter by signing and returning to the Railway two original copies of this letter, which, upon execution by Railway, will constitute an Agreement between us.

_____	
(Contractor)	**BNSF Railway Company**
By:_____	By:_____
Printed Name:_____	Name:_____
Title:_____	Manager Public Projects
Contact Person: _____	Accepted and effective this _____day of 20__.
Address: _____	
_____	
City:_____ State:___ Zip:____	
Fax: _____	
Phone: _____	
E-mail:_____	

DRAFT

EXHIBIT "C"
CONTRACTOR REQUIREMENTS

1.01 General

- **1.01.01** The Contractor must cooperate with **BNSF RAILWAY COMPANY**, hereinafter referred to as "Railway" where work is over or under on or adjacent to Railway property and/or right-of-way, hereafter referred to as "Railway Property", during the construction of the widening of the South Placentia Overhead Bridge on BNSF Railway's Orange Subdivision, MP 165.90, US DOT# 026688C and PUC #002-167.90AC.

- **1.01.02** The Contractor must execute and deliver to the Railway duplicate copies of the Exhibit "C-1" Agreement, in the form attached hereto, obligating the Contractor to provide and maintain in full force and effect the insurance called for under Section 3 of said Exhibit "C-1". Questions regarding procurement of the Railroad Protective Liability Insurance should be directed to Rosa Martinez at Marsh, USA, 214-303-8519.

- **1.01.03** The Contractor must plan, schedule and conduct all work activities so as not to interfere with the movement of any trains on Railway Property.

- **1.01.04** The Contractor's right to enter Railway's Property is subject to the absolute right of Railway to cause the Contractor's work on Railway's Property to cease if, in the opinion of Railway, Contractor's activities create a hazard to Railway's Property, employees, and/or operations. Railway will have the right to stop construction work on the Project if any of the following events take place: (i) Contractor (or any of its subcontractors) performs the Project work in a manner contrary to the plans and specifications approved by Railway; (ii) Contractor (or any of its subcontractors), in Railway's opinion, prosecutes the Project work in a manner which is hazardous to Railway property, facilities or the safe and expeditious movement of railroad traffic; (iii) the insurance described in the attached Exhibit C-1 is canceled during the course of the Project; or (iv) Contractor fails to pay Railway for the Temporary Construction License or the Easement. The work stoppage will continue until all necessary actions are taken by Contractor or its subcontractor to rectify the situation to the satisfaction of Railway's Division Engineer or until additional insurance has been delivered to and accepted by Railway. In the event of a breach of (i) this Agreement, (ii) the Temporary Construction License, or (iii) the Easement, Railway may immediately terminate the Temporary Construction License or the Easement. Any such work stoppage under this provision will not give rise to any liability on the part of Railway. Railway's right to stop the work is in addition to any other rights Railway may have including, but not limited to, actions or suits for damages or lost profits. In the event that Railway desires to stop construction work on the Project, Railway agrees to immediately notify the following individual in writing:

  Kathy J. Anderson, Branch Chief
  Right of Way Department
  3337 Michelson Drive, Suite 380
  Irvine, California 92612-8894

- **1.01.05** The Contractor is responsible for determining and complying with all Federal, State and Local Governmental laws and regulations, including, but not limited to environmental laws and regulations (including but not limited to the Resource Conservation and Recovery Act, as amended; the Clean Water Act, the Oil Pollution Act, the Hazardous Materials Transportation Act, CERCLA), and health and safety laws and regulations. The Contractor hereby indemnifies, defends and holds harmless Railway for, from and against all fines or penalties imposed or assessed by Federal, State and Local Governmental Agencies against the Railway which arise out of Contractor's work under this Agreement.

- **1.01.06** The Contractor must notify the Railroad – Melvin V. Thomas, Railway's Manager Public Projects, telephone number 909-386-4472 at least thirty (30) calendar days before commencing any work on Railway Property. Contractors notification to Railway, must refer to Railroad's file 026688C.

- **1.01.07** For any bridge demolition and/or falsework above any tracks or any excavations located with any part of the excavations located within, whichever is greater, twenty-five (25) feet of the nearest track or intersecting a slope from the plane of the top of rail on a 2 horizontal to 1 vertical slope beginning at eleven (11) feet from centerline of the nearest track, both measured perpendicular to center line of track, the Contractor must furnish the Railway five sets of working drawings showing details of construction affecting Railway Property and tracks. The working drawing must include the proposed method of installation and removal of falsework, shoring or cribbing, not included in the contract plans and two sets of structural calculations of any falsework, shoring or cribbing. For all excavation and shoring submittal plans, the current "BNSF-UPRR Guidelines for Temporary Shoring" must be used for determining the design loading conditions to be used in shoring design, and all calculations and submittals must be in accordance with the current "BNSF-UPRR Guidelines for Temporary Shoring". All submittal drawings and calculations must be stamped by a registered professional engineer licensed to practice in the state the project is located. All calculations must take into consideration railway surcharge loading and must be designed to meet American Railway Engineering and Maintenance-of-Way Association (previously known as American Railway Engineering Association) Coopers E-80 live loading standard. All drawings and calculations must be stamped by a registered professional engineer licensed to practice in the state the project is located. The Contractor must not begin work until notified by the Railway that plans have been approved. The Contractor will be required to use lifting devices such as, cranes and/or winches to place or to remove any falsework over Railway's tracks. In no case will the Contractor be relieved of responsibility for results obtained by the implementation of said approved plans.

- **1.01.08** Subject to the movement of Railway's trains, Railway will cooperate with the Contractor such that the work may be handled and performed in an efficient manner. The Contractor will have no claim whatsoever for any type of damages or for extra or additional compensation in the event his work is delayed by the Railway.

1.02 Contractor Safety Orientation

- **1.02.01 No employee of the Contractor, its subcontractors, agents or invitees may enter Railway Property without first having completed Railway's Engineering Contractor Safety Orientation, found on the web site www.contractororientation.com. The Contractor must ensure that each of its employees, subcontractors, agents or invitees completes Railway's Engineering Contractor Safety Orientation through internet sessions before any work is performed on the Project. Additionally, the Contractor must ensure that each and every one of its employees, subcontractors, agents or invitees possesses a card certifying completion of the Railway Contractor Safety Orientation before entering Railway Property. The Contractor is responsible for the cost of the Railway Contractor Safety Orientation. The Contractor must renew the Railway Contractor Safety Orientation annually. Further clarification can be found on the web site or from the Railway's Representative.**

1.03 Railway Requirements

- **1.03.01** The Contractor must take protective measures as are necessary to keep railway facilities, including track ballast, free of sand, debris, and other foreign objects and materials resulting from his operations. Any damage to railway facilities resulting from Contractor's operations will be repaired or replaced by Railway and the cost of such repairs or replacement must be paid for by the Agency.

- **1.03.02** The Contractor must notify the Railway's Division Superintendent Mark Kirschinger at 909-386-4150 and provide blasting plans to the Railway for review seven (7) calendar days prior to conducting any blasting operations adjacent to or on Railway's Property.

- **1.03.03** The Contractor must abide by the following temporary clearances during construction:

  - 15' Horizontally from centerline of nearest track
  - 21'-6" Vertically above top of rail
  - 27'-0" Vertically above top of rail for electric wires carrying less than 750 volts
  - 28'-0" Vertically above top of rail for electric wires carrying 750 volts to 15,000 volts
  - 30'-0" Vertically above top of rail for electric wires carrying 15,000 volts to 20,000 volts
  - 34'-0" Vertically above top of rail for electric wires carrying more than 20,000 volts

- **1.03.04** Upon completion of construction, the following clearances shall be maintained:

    - 25' – 3" Horizontally from centerline of nearest track
    - 23' 10" Vertically above top of rail

- **1.03.05** Any infringement within State statutory clearances due to the Contractor's operations must be submitted to the Railway and to the State of California and must not be undertaken until approved in writing by the Railway, and until the State of California has obtained any necessary authorization from the State Regulatory Authority for the infringement. No extra compensation will be allowed in the event the Contractor's work is delayed pending Railway approval, and/or the State Regulatory Authority's approval.

- **1.03.06** In the case of impaired vertical clearance above top of rail, Railway will have the option of installing tell-tales or other protective devices Railway deems necessary for protection of Railway operations. The cost of tell-tales or protective devices will be borne by the Agency.

- **1.03.07** The details of construction affecting the Railway's Property and tracks not included in the contract plans must be submitted to the Railway by State of California for approval before work is undertaken and this work must not be undertaken until approved by the Railway.

- **1.03.08** At other than public road crossings, the Contractor must not move any equipment or materials across Railway's tracks until permission has been obtained from the Railway. The Contractor must obtain a "Temporary Construction Crossing Agreement" from the Railway prior to moving his equipment or materials across the Railways tracks. The temporary crossing must be gated and locked at all times when not required for use by the Contractor. The temporary crossing for use of the Contractor will be constructed and, at the completion of the project, removed at the expense of the Contractor.

- **1.03.09** Discharge, release or spill on the Railway Property of any hazardous substances, oil, petroleum, constituents, pollutants, contaminants, or any hazardous waste is prohibited and Contractor must immediately notify the Railway's Resource Operations Center at 1(800) 832-5452, of any discharge, release or spills in excess of a reportable quantity. Contractor must not allow Railway Property to become a treatment, storage or transfer facility as those terms are defined in the Resource Conservation and Recovery Act or any state analogue.

- **1.03.10** The Contractor upon completion of the work covered by this contract, must promptly remove from the Railway's Property all of Contractor's tools, equipment, implements and other materials, whether brought upon said property by said Contractor or any Subcontractor, employee or agent of Contractor or of any Subcontractor, and must cause Railway's Property to be left in a condition acceptable to the Railway's representative.

1.04 Contractor Roadway Worker on Track Safety Program and Safety Action Plan

- 1.04.01 Each Contractor that will perform work within 25 feet of the centerline of a track must develop and implement a Roadway Worker Protection/On Track Safety Program and work with Railway Project Representative to develop an on track safety strategy as described in the guidelines listed in the on track safety portion of the Safety Orientation. This Program must provide Roadway Worker protection/on track training for all employees of the Contractor, its subcontractors, agents or invitees. This training is reinforced at the job site through job safety briefings. Additionally, each Contractor must develop and implement the Safety Action Plan, as provided for on the web site **www.contractororientation.com**, which will be made available to Railway prior to commencement of any work on Railway Property. During the performance of work, the Contractor must audit its work activities. The Contractor must designate an on-site Project Supervisor who will serve as the contact person for the Railway and who will maintain a copy of the Safety Action Plan, safety audits, and Material Safety Datasheets (MSDS), at the job site.

Contractor shall have a background investigation performed on all of its employees, subcontractors and agents who will be performing any services on railroad property under this Agreement.

The background screening shall at a minimum meet the criteria defined by the e-RAILSAFE program outlined at http://www.e-railsafe.com in addition to any other applicable regulatory requirements. The e-RAILSAFE program uses rail industry background screening standards.

Contractor shall obtain consent from all employees screened in compliance with the e-RAILSAFE program criteria to release completed background information to BNSF. Contractor shall be subject to periodic audit to ensure compliance.

Contractor shall not permit any of its employees, subcontractors or agents to perform services on property hereunder who are not approved under e-RAILSAFE program standards. Railroad shall have the right to deny entry onto its premises to any of Contractor's employees, subcontractors or agents who do not display the authorized identification badge issued by a background screening service meeting the standards set forth for the e-RAILSAFE program or who pose a threat, in Railroad's reasonable opinion, to the safety or security of Railroad's operations.

Contractors shall ensure its employees, subcontractors and agents are United States citizens or legally working in this country under a work VISA.

1.05 Railway Flagger Services:

- **1.05.01** The Contractor must give Railway's Roadmaster (760) 255-7639 and Melvin V. Thomas, Railway's Manager Public Projects, telephone number (909) 386-4472 a minimum of thirty (30) calendar days advance notice when flagging services will be required so that the Roadmaster can make appropriate arrangements (i.e., bulletin the flagger's position). If flagging services are scheduled in advance by the Contractor and it is subsequently determined by the parties hereto that such services are no longer necessary, the Contractor must give the Roadmaster five (5) working days advance notice so that appropriate arrangements can be made to abolish the position pursuant to union requirements.

- **1.05.02** Unless determined otherwise by Railway's Project Representative, Railway flagger will be required and furnished when Contractor's work activities are located over, under and/or within twenty-five (25) feet measured horizontally from centerline of the nearest track and when cranes or similar equipment positioned beyond 25-feet from the track centerline could foul the track in the event of tip over or other catastrophic occurrence, but not limited thereto for the following conditions:

- **1.05.02a** When, upon inspection by Railway's Representative, other conditions warrant.

- **1.05.02b** When any excavation is performed below the bottom of tie elevation, if, in the opinion of Railway's representative, track or other Railway facilities may be subject to movement or settlement.

- **1.05.02c** When work in any way interferes with the safe operation of trains at timetable speeds.

- **1.05.02d** When any hazard is presented to Railway track, communications, signal, electrical, or other facilities either due to persons, material, equipment or blasting in the vicinity.

- **1.05.02e** Special permission must be obtained from the Railway before moving heavy or cumbersome objects or equipment which might result in making the track impassable.

- **1.05.03** Flagging services will be performed by qualified Railway flaggers.

- **1.05.03a** Flagging crew generally consists of one employee. However, additional personnel may be required to protect Railway Property and operations, if deemed necessary by the Railways Representative.

- **1.05.03b** Each time a flagger is called, the minimum period for billing will be the eight (8) hour basic day.

- **1.05.03c** The cost of flagger services provided by the Railway will be borne by the State. The estimated cost for one (1) flagger is approximately between $1,000.00 for an eight (8) hour basic day with time and one-half or double time for overtime, rest days and holidays. The estimated cost for each flagger includes vacation allowance, paid holidays, Railway and unemployment insurance, public liability and property damage insurance, health and welfare benefits, vehicle, transportation, meals, lodging, radio, equipment, supervision and other costs incidental to performing flagging services. Negotiations for Railway labor or collective bargaining agreements and rate changes authorized by appropriate Federal authorities may increase actual or estimated flagging rates. **THE FLAGGING RATE IN EFFECT AT THE TIME OF PERFORMANCE BY THE CONTRACTOR HEREUNDER WILL BE USED TO CALCULATE THE ACTUAL COSTS OF FLAGGING PURSUANT TO THIS PARAGRAPH.**

- **1.05.03d** The average train traffic on this route is _____ freight trains per 24-hour period at a timetable speed
- _____ MPH and ____ passenger trains at a timetable speed of ____ MPH.

1.06 Contractor General Safety Requirements

- **1.06.01 Work in the proximity of railway track(s) is potentially hazardous where movement of trains and equipment can occur at any time and in any direction. All work performed by contractors within 25 feet of any track must be in compliance with FRA Roadway Worker Protection Regulations.**

- **1.06.02 Before beginning any task on Railway Property, a thorough job safety briefing must be conducted with all personnel involved with the task and repeated when the personnel or task changes. If the task is within 25 feet of any track, the job briefing must include the Railway's flagger, as applicable, and include the procedures the Contractor will use to protect its employees, subcontractors, agents or invitees from moving any equipment adjacent to or across any Railway track(s).**

- **1.06.03 Workers must not work within 25 feet of the centerline of any track without an on track safety strategy approved by the Railway's Project Representative. When authority is provided, every contractor employee must know: (1) who the Railway flagger is, and how to contact the flagger, (2) limits of the authority, (3) the method of communication to stop and resume work, and (4) location of the designated places of safety. Persons or equipment entering flag/work limits that were not previously job briefed, must notify the flagger immediately, and be given a job briefing when working within 25 feet of the center line of track.**

- **1.06.04 When Contractor employees are required to work on the Railway Property after normal working hours or on weekends, the Railroad's representative in charge of the project must be notified. A minimum of two employees must be present at all times.**

- **1.06.05** Any employees, agents or invitees of Contractor or its subcontractors under suspicion of being under the influence of drugs or alcohol, or in the possession of same, will be removed from the Railway's Property and subsequently released to the custody of a representative of Contractor management. Future access to the Railway's Property by that employee will be denied.

- **1.06.06** Any damage to Railway Property, or any hazard noticed on passing trains must be reported immediately to the Railway's representative in charge of the project. Any vehicle or machine which may come in contact with track, signal equipment, or structure (bridge) and could result in a train derailment must be reported immediately to the Railway representative in charge of the project and to the Railway's Resource Operations Center at 1(800) 832-5452. Local emergency numbers are to be obtained from the Railway representative in charge of the project prior to the start of any work and must be posted at the job site.

- **1.06.07** For safety reasons, all persons are prohibited from having pocket knives, firearms or other deadly weapons in their possession while working on Railway's Property.

- **1.06.08** All personnel protective equipment (PPE) used on Railway Property must meet applicable OSHA and ANSI specifications. Current Railway personnel protective equipment requirements are listed on the web site,

www.contractororientation.com, however, a partial list of the requirements include: a) safety glasses with permanently affixed side shields (no yellow lenses); b) hard hats c) safety shoe with: hardened toes, above-the-ankle lace-up and a defined heel; and d) high visibility retro-reflective work wear. The Railroad's representative in charge of the project is to be contacted regarding local specifications for meeting requirements relating to hi-visability work wear. Hearing protection, fall protection, gloves, and respirators must be worn as required by State and Federal regulations. **(NOTE – Should there be a discrepancy between the information contained on the web site and the information in this paragraph, the web site will govern.)**

- **1.06.09 THE CONTRACTOR MUST NOT PILE OR STORE ANY MATERIALS, MACHINERY OR EQUIPMENT CLOSER THAN 25'-0" TO THE CENTER LINE OF THE NEAREST RAILWAY TRACK. MATERIALS, MACHINERY OR EQUIPMENT MUST NOT BE STORED OR LEFT WITHIN 250 FEET OF ANY HIGHWAY/RAIL AT-GRADE CROSSINGS OR TEMPORARY CONSTRUCTION CROSSING, WHERE STORAGE OF THE SAME WILL OBSTRUCT THE VIEW OF A TRAIN APPROACHING THE CROSSING. PRIOR TO BEGINNING WORK, THE CONTRACTOR MUST ESTABLISH A STORAGE AREA WITH CONCURRENCE OF THE RAILROAD'S REPRESENTATIVE.**

- **1.06.10** Machines or vehicles must not be left unattended with the engine running. Parked machines or equipment must be in gear with brakes set and if equipped with blade, pan or bucket, they must be lowered to the ground. All machinery and equipment left unattended on Railway's Property must be left inoperable and secured against movement. (See internet Engineering Contractor Safety Orientation program for more detailed specifications)

- **1.06.11** Workers must not create and leave any conditions at the work site that would interfere with water drainage. Any work performed over water must meet all Federal, State and Local regulations.

- **1.06.12** All power line wires must be considered dangerous and of high voltage unless informed to the contrary by proper authority. For all power lines the minimum clearance between the lines and any part of the equipment or load must be; 200 KV or below - 15 feet; 200 to 350 KV - 20 feet; 350 to 500 KV - 25 feet; 500 to 750 KV - 35 feet; and 750 to 1000 KV - 45 feet. If capacity of the line is not known, a minimum clearance of 45 feet must be maintained. A person must be designated to observe clearance of the equipment and give a timely warning for all operations where it is difficult for an operator to maintain the desired clearance by visual means.

1.07 Excavation

- **1.07.01** Before excavating, the Contractor must determine whether any underground pipe lines, electric wires, or cables, including fiber optic cable systems are present and located within the Project work area. The Contractor must determine whether excavation on Railway's Property could cause damage to buried cables resulting in delay to Railway traffic and disruption of service to users. Delays and disruptions to service may cause business interruptions involving loss of revenue and profits. Before commencing excavation, the Contractor must contact **BNSF's Field Engineering Representative (909)-386-44079 and** Melvin V. Thomas, Railway's Manager Public Projects, telephone number (909) 386-4472. All underground and overhead wires will be considered HIGH VOLTAGE and dangerous until verified with the company having ownership of the line. **It is the Contractor's responsibility to notify any other companies that have underground utilities in the area and arrange for the location of all underground utilities before excavating.**

- **1.07.02** The Contractor must cease all work and notify the Railway immediately before continuing excavation in the area if obstructions are encountered which do not appear on drawings. If the obstruction is a utility and the owner of the utility can be identified, then the Contractor must also notify the owner immediately. If there is any doubt about the location of underground cables or lines of any kind, no work must be performed until the exact location has been determined. There will be no exceptions to these instructions.

- **1.07.03** All excavations must be conducted in compliance with applicable OSHA regulations and, regardless of depth, must be shored where there is any danger to tracks, structures or personnel.

- **1.07.04** Any excavations, holes or trenches on the Railway's Property must be covered, guarded and/or protected when not being worked on. When leaving work site areas at night and over weekends, the areas must be secured and left in a condition that will ensure that Railway employees and other personnel who may be working or passing through the area are protected from all hazards. All excavations must be back filled as soon as possible.

1.08 Hazardous Waste, Substances and Material Reporting

- **1.08.01** If Contractor discovers any hazardous waste, hazardous substance, petroleum or other deleterious material, including but not limited to any non-containerized commodity or material, on or adjacent to Railway's Property, in or near any surface water, swamp, wetlands or waterways, while performing any work under this Agreement, Contractor must immediately: (a) notify the Railway's Resource Operations Center at 1(800) 832-5452, of such discovery: (b) take safeguards necessary to protect its employees, subcontractors, agents and/or third parties: and (c) exercise due care with respect to the release, including the taking of any appropriate measure to minimize the impact of such release.

1.09 Personal Injury Reporting

- 1.09.01 The Railway is required to report certain injuries as a part of compliance with Federal Railroad Administration (FRA) reporting requirements. Any personal injury sustained by an employee of the Contractor, subcontractor or Contractor's invitees while on the Railway's Property must be reported immediately (by phone mail if unable to contact in person) to the Railway's representative in charge of the project. The Non-Employee Personal Injury Data Collection Form contained herein is to be completed and sent by Fax to the Railway at 1(817) 352-7595 and to the Railway's Project Representative no later than the close of shift on the date of the injury.

NON-EMPLOYEE PERSONAL INJURY DATA COLLECTION

INFORMATION REQUIRED TO BE COLLECTED PURSUANT TO FEDERAL REGULATION. IT SHOULD BE USED FOR COMPLIANCE WITH FEDERAL REGULATIONS ONLY AND IS NOT INTENDED TO PRESUME ACCEPTANCE OF RESPONSIBILITY OR LIABILITY.

1. Accident City/St _____ 2. Date: _____ Time:
   County: _____ 3. Temperature: _____ 4. Weather
   (if non-Railway location)

5. Social Security #

6. Name (last, first, mi)

7. Address: Street: _____ City: _____ St._____ Zip:

8. Date of Birth: _____ and/or Age _____ Gender:
   (if available)

9. (a) Injury: _____ (b) Body Part:
   (i.e. (a) Laceration (b) Hand)

11. Description of Accident (To include location, action, result, etc.):

12. Treatment:
    - ? First Aid Only
    - ? Required Medical Treatment
    - ? Other Medical Treatment

13. Dr. Name _____ 30. Date:

14. Dr. Address:
    Street: _____ City: _____ St: _____ Zip:

15. Hospital Name:

16. Hospital Address:
    Street: _____ City: _____ St: _____ Zip:

17. Diagnosis:

FAX TO
RAILWAY AT (817) 352-7595
AND COPY TO
RAILWAY ROADMASTER FAX

DRAFT LAW DEPARTMENT APPROVED

EXHIBIT "C-1"

Agreement
Between
BNSF RAILWAY COMPANY
and the
CONTRACTOR

BNSF RAILWAY COMPANY
Attention: Manager Public Projects

Railway File: US DOT No. 026688C
Agency Project: South Placentia Overhead Widening

Gentlemen:

The undersigned (hereinafter called, the "Contractor"), has entered into a contract (the "Contract") dated _____, 2010, with the State of California ("STATE") for the performance of certain work in connection with the following project: Widening of South Placentia Overhead Bridge off of BNSF Railway's Orange Subdivision, MP 165.90, US DOT #026688C. Performance of such work will necessarily require contractor to enter BNSF RAILWAY COMPANY ("Railway") right of way and property ("Railway Property"). The Contract provides that no work will be commenced within Railway Property until the Contractor employed in connection with said work for **STATE** (i) executes and delivers to Railway an Agreement in the form hereof, and (ii) provides insurance of the coverage and limits specified in such Agreement and Section 3 herein. If this Agreement is executed by a party who is not the Owner, General Partner, President or Vice President of Contractor, Contractor must furnish evidence to Railway certifying that the signatory is empowered to execute this Agreement on behalf of Contractor.

Accordingly, in consideration of Railway granting permission to Contractor to enter upon Railway Property and as an inducement for such entry, Contractor, effective on the date of the Contract, has agreed and does hereby agree with Railway as follows:

Section 1. RELEASE OF LIABILITY AND INDEMNITY

Contractor hereby waives, releases, indemnifies, defends and holds harmless Railway for all judgments, awards, claims, demands, and expenses (including attorneys' fees), for injury or death to all persons, including Railway's and Contractor's officers and employees, and for loss and damage to property belonging to any person, arising in any manner from Contractor's or any of Contractor's subcontractors' acts or omissions or any work performed on or about Railway's property or right-of-way. **THE LIABILITY ASSUMED BY CONTRACTOR WILL NOT BE AFFECTED BY THE FACT, IF IT IS A FACT, THAT THE DESTRUCTION, DAMAGE, DEATH, OR INJURY WAS OCCASIONED BY OR CONTRIBUTED TO BY THE NEGLIGENCE OF RAILWAY, ITS AGENTS, SERVANTS, EMPLOYEES OR OTHERWISE, EXCEPT TO THE EXTENT THAT SUCH CLAIMS ARE PROXIMATELY CAUSED BY THE WILLFUL MISCONDUCT OR SOLE NEGLIGENCE OF RAILWAY.**

THE INDEMNIFICATION OBLIGATION ASSUMED BY CONTRACTOR INCLUDES ANY CLAIMS, SUITS OR JUDGMENTS BROUGHT AGAINST RAILWAY UNDER THE FEDERAL EMPLOYEE'S LIABILITY ACT, INCLUDING CLAIMS FOR STRICT LIABILITY UNDER THE SAFETY APPLIANCE ACT OR THE LOCOMOTIVE INSPECTION ACT, WHENEVER SO CLAIMED.

Contractor further agrees, at its expense, in the name and on behalf of Railway, that it will adjust and settle all claims made against Railway, and will, at Railway's discretion, appear and defend any suits or actions of law or in equity brought against Railway on any claim or cause of action arising or growing out of or in any manner

connected with any liability assumed by Contractor under this Agreement for which Railway is liable or is alleged to be liable. Railway will give notice to Contractor, in writing, of the receipt or dependency of such claims and thereupon Contractor must proceed to adjust and handle to a conclusion such claims, and in the event of a suit being brought against Railway, Railway may forward summons and complaint or other process in connection therewith to Contractor, and Contractor, at Railway's discretion, must defend, adjust, or settle such suits and protect, indemnify, and save harmless Railway from and against all damages, judgments, decrees, attorney's fees, costs, and expenses growing out of or resulting from or incident to any such claims or suits.

In addition to any other provision of this Agreement, in the event that all or any portion of this Article shall be deemed to be inapplicable for any reason, including without limitation as a result of a decision of an applicable court, legislative enactment or regulatory order, the parties agree that this Article shall be interpreted as requiring Contractor to indemnify Railroad to the fullest extent permitted by applicable law. **THROUGH THIS AGREEMENT THE PARTIES EXPRESSLY INTEND FOR CONTRACTOR TO INDEMNIFY RAILROAD FOR RAILROAD'S ACTS OF NEGLIGENCE.**

It is mutually understood and agreed that the assumption of liabilities and indemnification provided for in this Agreement survive any termination of this Agreement.

Section 2. TERM

This Agreement is effective from the date of the Contract until (i) the completion of the project set forth herein, and (ii) full and complete payment to Railway of any and all sums or other amounts owing and due hereunder.

Section 3. INSURANCE

Contractor must, at its sole cost and expense, procure and maintain during the life of this Agreement the following insurance coverage:

A. Commercial General Liability insurance. This insurance must contain broad form contractual liability with a combined single limit of a minimum of $5,000,000 each occurrence and an aggregate limit of at least $10,000,000. Coverage must be purchased on a post 1998 ISO occurrence form or equivalent and include coverage for, but not limit to the following:

- Bodily Injury and Property Damage
- Personal Injury and Advertising Injury
- Fire legal liability
- Products and completed operations

This policy must also contain the following endorsements, which must be indicated on the certificate of insurance:

- It is agreed that any workers' compensation exclusion does not apply to ***Railroad*** payments related to the Federal Employers Liability Act or a ***Railroad*** Wage Continuation Program or similar programs and any payments made are deemed not to be either payments made or obligations assumed under any Workers Compensation, disability benefits, or unemployment compensation law or similar law.
- The definition of insured contract must be amended to remove any exclusion or other limitation for any work being done within 50 feet of railroad property.
- Any exclusions related to the explosion, collapse and underground hazards must be removed.

No other endorsements limiting coverage as respects obligations under this Agreement may be included on the policy.

B. Business Automobile Insurance. This insurance must contain a combined single limit of at least $1,000,000 per occurrence, and include coverage for, but not limited to the following:

- Bodily injury and property damage

- Any and all vehicles owned, used or hired

C. Workers Compensation and Employers Liability insurance including coverage for, but not limited to:
- California's statutory liability under the worker's compensation laws of the state(s) in which the work is to be performed. If optional under State law, the insurance must cover all employees anyway.
- Employers' Liability (Part B) with limits of at least $500,000 each accident, $500,000 by disease policy limit, $500,000 by disease each employee.

D. Railroad Protective Liability insurance naming only the ***Railroad*** as the Insured with coverage of at least $5,000,000 per occurrence and $10,000,000 in the aggregate. The policy Must be issued on a standard ISO form CG 00 35 10 93 and include the following:
- Endorsed to include the Pollution Exclusion Amendment (ISO form CG 28 31 10 93)
- Endorsed to include the Limited Seepage and Pollution Endorsement.
- Endorsed to remove any exclusion for punitive damages.
- No other endorsements restricting coverage may be added.
- The original policy must be provided to the ***Railroad*** prior to performing any work or services under this Agreement

Other Requirements:

All policies (applying to coverage listed above) must not contain an exclusion for punitive damages and certificates of insurance must reflect that no exclusion exists.

Contractor agrees to waive its right of recovery against ***Railroad*** for all claims and suits against ***Railroad***. In addition, its insurers, through the terms of the policy or policy endorsement, waive their right of subrogation against ***Railroad*** for all claims and suits. The certificate of insurance must reflect the waiver of subrogation endorsement. Contractor further waives its right of recovery, and its insurers also waive their right of subrogation against ***Railroad*** for loss of its owned or leased property or property under contractor's care, custody or control.

Contractor's insurance policies through policy endorsement, must include wording which states that the policy is primary and non-contributing with respect to any insurance carried by ***Railroad***. The certificate of insurance must reflect that the above wording is included in evidenced policies.

All policy(ies) required above (excluding Workers Compensation and if applicable, Railroad Protective) must include a severability of interest endorsement and ***Railroad*** must be named as an additional insured with respect to work performed under this agreement. Severability of interest and naming ***Railroad*** as additional insured must be indicated on the certificate of insurance.

Contractor is not allowed to self-insure without the prior written consent of ***Railroad***. If granted by ***Railroad***, any deductible, self-insured retention or other financial responsibility for claims must be covered directly by contractor in lieu of insurance. Any and all ***Railroad*** liabilities that would otherwise, in accordance with the provisions of this ***Agreement***, be covered by contractor's insurance will be covered as if contractor elected not to include a deductible, self-insured retention or other financial responsibility for claims.

Prior to commencing the Work, contractor must furnish to ***Railroad*** an acceptable certificate(s) of insurance including an original signature of the authorized representative evidencing the required coverage, endorsements, and amendments and referencing the contract audit/folder number if available. The policy(ies) must contain a provision that obligates the insurance company(ies) issuing such policy(ies) to notify ***Railroad*** in writing at least 30 days prior to any cancellation, non-renewal, substitution or material alteration. This cancellation provision must be indicated on the certificate of insurance. Upon request from ***Railroad***, a certified duplicate original of any required policy must be furnished. Contractor should send the certificate(s) to the following address:

BNSF RAILWAY COMPANY
PO Box 12010-BN
Hemet, CA 92546-8010
Fax number: 951-766-2299

Any insurance policy must be written by a reputable insurance company acceptable to ***Railroad*** or with a current Best's Guide Rating of A- and Class VII or better, and authorized to do business in the state(s) in which the service is to be provide.

Contractor represents that this ***Agreement*** has been thoroughly reviewed by contractor's insurance agent(s)/broker(s), who have been instructed by contractor to procure the insurance coverage required by this ***Agreement.*** Allocated Loss Expense must be in addition to all policy limits for coverages referenced above.
Not more frequently than once every five years, ***Railroad*** may reasonably modify the required insurance coverage to reflect then-current risk management practices in the railroad industry and underwriting practices in the insurance industry.

If any portion of the operation is to be subcontracted by contractor, contractor must require that the subcontractor provide and maintain the insurance coverages set forth herein, naming ***Railroad*** as an additional insured, and requiring that the subcontractor release, defend and indemnify ***Railroad*** to the same extent and under the same terms and conditions as contractor is required to release, defend and indemnify ***Railroad*** herein.

Failure to provide evidence as required by this section will entitle, but not require, ***Railroad*** to terminate this ***Agreement*** immediately. Acceptance of a certificate that does not comply with this section will not operate as a waiver of contractor's obligations hereunder.

The fact that insurance (including, without limitation, self-insurance) is obtained by contractor will not be deemed to release or diminish the liability of contractor including, without limitation, liability under the indemnity provisions of this ***Agreement.*** Damages recoverable by ***Railroad*** will not be limited by the amount of the required insurance coverage.

For purposes of this section, ***Railroad*** means "Burlington Northern Santa Fe Corporation", "BNSF RAILWAY COMPANY" and the subsidiaries, successors, assigns and affiliates of each.

Section 4. EXHIBIT "C" CONTRACTOR REQUIREMENTS

The Contractor must observe and comply with all provisions, obligations, requirements and limitations contained in the Contract, and the Contractor Requirements set forth on Exhibit "C" attached to the Contract and this Agreement, , including, but not be limited to, payment of all costs incurred for any damages to Railway roadbed, tracks, and/or appurtenances thereto, resulting from use, occupancy, or presence of its employees, representatives, or agents or subcontractors on or about the construction site.

Section 5. TRAIN DELAY

Contractor is responsible for and hereby indemnifies and holds harmless Railway (including its affiliated railway companies, and its tenants) for, from and against all damages arising from any unscheduled delay to a freight or passenger train which affects Railway's ability to fully utilize its equipment and to meet customer service and contract obligations. Contractor will be billed, as further provided below, for the economic losses arising from loss of use of equipment, contractual loss of incentive pay and bonuses and contractual penalties resulting from train delays, whether caused by Contractor, or subcontractors, or by the Railway performing work under this Agreement. Railway agrees that it will not perform any act to unnecessarily cause train delay.

For loss of use of equipment, Contractor will be billed the current freight train hour rate per train as determined from Railway's records. Any disruption to train traffic may cause delays to multiple trains at the same time for the same period.

Additionally, the parties acknowledge that passenger, U.S. mail trains and certain other grain, intermodal, coal and freight trains operate under incentive/penalty contracts between Railway and its customer(s). Under these arrangements, if Railway does not meet its contract service commitments, Railway may suffer loss of performance or incentive pay and/or be subject to penalty payments. Contractor is responsible for any train performance and incentive penalties or other contractual economic losses actually incurred by Railway which are attributable to a train delay caused by Contractor or its subcontractors.

The contractual relationship between Railway and its customers is proprietary and confidential. In the event of a train delay covered by this Agreement, Railway will share information relevant to any train delay to the extent consistent with Railway confidentiality obligations. Damages for train delay for certain trains may be $382.20 per hour per incident. **THE RATE THEN IN EFFECT AT THE TIME OF PERFORMANCE BY THE CONTRACTOR HEREUNDER WILL BE USED TO CALCULATE THE ACTUAL COSTS OF TRAIN DELAY PURSUANT TO THIS AGREEMENT.**

Contractor and its subcontractors must give Railway's representative (Greg Rousseau – 909-386-4079) four (4) weeks advance notice of the times and dates for proposed work windows. Railway and Contractor will establish mutually agreeable work windows for the project. Railway has the right at any time to revise or change the work windows due to train operations or service obligations. Railway will not be responsible for any additional costs or expenses resulting from a change in work windows. Additional costs or expenses resulting from a change in work windows shall be accounted for in Contractor's expenses for the project.

Contractor and subcontractors must plan, schedule, coordinate and conduct all Contractor's work so as to not cause any delays to any trains.

Kindly acknowledge receipt of this letter by signing and returning to the Railway two original copies of this letter, which, upon execution by Railway, will constitute an Agreement between us.

_____	
(Contractor)	**BNSF Railway Company**
By:_____	By:_____
Printed Name:_____	Name:_____
Title:_____	Manager Public Projects
Contact Person: _____	Accepted and effective this _____day of 20__.
Address: _____	
_____	
City:_____State:___Zip:____	
Fax: _____	
Phone: _____	
E-mail:_____	

NOTICE TO APPLICANT
PRIOR TO SUBMITTING THIS APPLICATION FOR A SUBSURFACE EXCAVATION, CONTACT "UNDERGROUND SERVICE ALERT", TELEPHONE NO. 1-800-422-4133, FOR EXISTING UNDERGROUND STRUCTURAL DATA.

PUBLIC RIGHT OF WAY ENCROACHMENT PERMIT

City of Placentia
ENGINEERING DIVISION
401 E. Chapman Avenue
Placentia, CA 92870
PH: (714)993-8131

-------APPLICANT MUST COMPLETE ALL SPACES WITHIN HEAVY BORDER-------

APPLICANT'S NAME	ADDRESS	PHONE

CONTRACTOR'S NAME	ADDRESS	PHONE

CITY LICENSE NUMBER	NAME AND PHONE NO. OF AFTER-WORK HOURS CONTACT	DATE OF APPLICATION

LOCATION OF WORK	DESCRIPTION OF WORK (SUBMIT 4 COPIES OF PLAN WITH APPLICATION)
EST. STARTING DATE:	
EST. COMPLETION DATE:	WORK TO BE PERFORMED TO STDS. AND SPECS. AS DESIGNATED BY THE CITY ENGINEER

CONDITIONS OF PERMIT

THE APPLICANT AGREES TO THE FOLLOWING CONDITIONS FOR ISSUANCE OF THIS PERMIT:

1. THE CITY OF PLACENTIA AND ANY OFFICER OR EMPLOYEE THEREOF SHALL BE SAVED HARMLESS BY THE APPLICANT FROM ANY LIABILITY OR RESPONSIBILITY FOR ANY ACCIDENT, LOSS OR DAMAGE TO PERSONS OR PROPERTY HAPPENING OR OCCURRING AS THE PROXIMATE RESULT OF ANY WORK UNDERTAKEN UNDER THE TERMS OF THIS PERMIT AND THAT ALL OF SAID LIABILITIES ARE HEREBY ASSUMED BY THE APPLICANT.
2. IF ANY PART OF THIS INSTALLATION INTERFERES WITH THE FUTURE USE OR CONSTRUCTION OF STREET, OR PUBLIC UTILITY, IT SHALL BE REMOVED OR RELOCATED, AS DESIGNATED BY THE CITY, AT THE EXPENSE OF THE PERMITTEE OR HIS SUCCESSOR IN INTEREST.
3. ANY CONSTRUCTION OR REPAIR MADE OR RESULTING FROM THIS PERMIT, WHICH HAS FAILED, IN THE OPINION OF THE ISSUING OFFICE WITHIN ONE YEAR FROM COMPLETION, SHALL BE REPAIRED OR REPLACED BY AND AT THE EXPENSE OF THE APPLICANT.
4. BARRICADING SIGNS, ETC. SHALL BE PROVIDED TO EFFECT SAFE TRAFFIC CONTROL IN THE CONSTRUCTION AREA. THE "STATE OF CALIFORNIA, DEPARTMENT OF TRANSPORTATION MANUAL OF WARNING SIGNS, LIGHTS AND DEVICES FOR USE IN PERFORMANCE OF WORK UPON HIGHWAYS" WILL BE USED AS A GUIDE FOR SUCH TRAFFIC CONTROL, SUBJECT TO REQUIREMENTS OF THE ISSUING OFFICE. FAILURE TO INSTALL BARRICADES AND DEVICES WHICH ARE SUBSEQUENTLY PLACED BY THE CITY SHALL RESULT IN CHARGES TO THE APPLICANT OF $5 PER BARRICADE PER DAY PLUS $25.00 CALL OUT CHARGES.
5. THE CITY SHALL RESERVE THE RIGHT TO ADD OR DELETE ANY CONDITION OR REQUIREMENT OF THIS PERMIT SUBSEQUENT TO ITS ISSUANCE, WHICH IT MAY DEEM NECESSARY TO MEET CONSTRUCTION STANDARDS, PREVENT INTERFERENCE WITH TRAFFIC, OR ASSURE SAFETY OF PERSONS USING THE RIGHT-OF-WAY.
6. A VALIDATED COPY OF THIS PERMIT SHALL BE KEPT ON THE JOB SITE AND BE SHOWN, ON DEMAND, TO AUTHORIZED CITY REPRESENTATIVES OR LAW ENFORCEMENT OFFICERS. FAILURE TO PRODUCE A PERMIT WILL SUBJECT THE JOB TO IMMEDIATE CLOSE DOWN.
7. UPON NOTIFICATION BY THE CITY ENGINEER THAT UNDUE DELAY IN JOB COMPLETION HAS OCCURRED, THE CITY, AT ITS DISCRETION, MAY CANCEL THIS PERMIT AND CAUSE COMPLETION OF THE JOB BY CITY FORCES OR OTHER CONTRACTOR. ALL EXPENSES FOR SUCH WORK DONE SHALL BE BORNE BY THE PERMITTEE. A CONSECUTIVE 72 HR. PERIOD OF CEASED WORK SHALL CONSTITUTE UNDUE DELAY.
8. THE CITY SHALL BE NOTIFIED A MINIMUM OF 24-HOURS PRIOR TO START OF WORK FOR INSPECTION SCHEDULING.

I UNDERSTAND AND AGREE TO THE CONDITIONS AND REQUIREMENTS OF THIS APPLICATION FOR PERMIT. _____ SIGNATURE OF APPLICANT OR AUTHORIZED AGENT _____ DATE _____ PHONE

CHECKED REQUIREMENTS ARE APPLICABLE

- O NO EXCAVATION SHALL REMAIN OPEN OVERNIGHT.
- O ASPHALT CONCRETE SHALL BE SAWCUT PRIOR TO REPAIR.
- O PORTLAND CEMENT CONCRETE SHALL BE REMOVED TO EXISTING CONTROL JOINTS.
- O SAND BACKFILL OR NATIVE MATERIAL/30% SAND EQUIVALENCY IS REQUIRED ON ALL A.C. OR P.C.C. REPLACEMENT.
- O 90% COMPACTION, VERIFIED BY TESTS, IS REQUIRED IN DIRT EXCAVATED AREA.
- O TWO-WAY TRAFFIC LANES WILL BE OPEN AT ALL TIMES.
- O STREET SURFACE SHALL BE SAND SLURRIED TO LIMITS DESIGNATED BY CITY INSPECTOR AFTER PATCHING IS COMPLETED.
- O REPLACE PAVEMENT ON _____ WITH _____ FULL DEPTH ASPHALT OVER SAND BACKFILL.
- O _____
- O _____
- O _____

QUANTITIES	PER UNIT	FEE
MINIMUM INSPECTION		
MISC.	TOTAL INSPECTION FEE	
	ISSUANCE FEE	
	BOND DEPOSIT	REFUNDABLE 6 MOS. FROM ACCEPTANCE OF WORK
	TOTAL	

DISTRIBUTION -
WHITE - ENGINEERING
GREEN - PERMITTEE
YELLOW - INSPECTOR
PINK - MAINTENANCE
GOLD - FINANCE

CONDITIONS OF PERMIT HAVE BEEN COMPLETED
_____ CITY INSPECTOR _____ DATE

VALIDATION
_____ SIGNATURE _____ DATE

AMOUNT PAID

PERMIT NO.

CITY OF FULLERTON
ENGINEERING DEPARTMENT
GENERAL ENGINEERING SERVICES DIVISION
PUBLIC R/W EXCAVATION, CONSTRUCTION & ENCROACHMENT
APPLICATION AND PERMIT

Permit No.

Applicant _____ Phone _____

Address _____ City _____ Zip _____

Contractor _____ phone _____

Address _____

City Business License No. _____

Address/Location of Work _____

Description of Work _____

THIS APPLICATION BECOMES A PERMIT WHEN APPROVED AND VALIDATED.

Plan/File No. _____ Starting Date _____ Project File No. _____

FEES		ACCOUNT NO.'s	APPLICATION APPROVED
Issuance	$ _____	110-310-2180-4280-322	By _____
GES Plan Check	_____	110-310-2180-4260-322	
Water Eng. Plan Check	_____	344-310-2180-4614-323	Date _____
Inspection	_____	110-310-2180-4260-329	
Other	_____	_____	PERMIT VOID UNLESS WORK COMPLETED BY
Cash Deposit (Refundable)	_____	551-242	
Total	$ _____		

THE UNDERSIGNED PERMITTEE/APPLICANT HEREBY CERTIFIES AND AGREES:

1. UNDERGROUND SERVICE ALERT AT 1-800-422-4133 shall be notified at least 2 working days in advance of any excavation and an Underground Service Alert Inquiry Identification Number shall be obtained from Underground Service Alert. CONTACTING U.S.A. DOES NOT RELIEVE CONTRACTOR OF RESPONSIBILITY FOR LOCATING OR PROTECTING EXISTING UTILITIES.
2. A new permit shall be required in the event work is not completed prior to the expiration date. The City Engineer may extend the time limit of the permit due to excusable conditions.
3. The applicant shall make all arrangements and be responsible for the moving and protection of poles, hydrants, meters, trees, and other surface and subsurface facilities that interfere with the work under this permit.
4. The applicant hereby guarantees all materials utilized and all work performed under this permit for a period of one year from the date of acceptance. Failures will be corrected within two weeks after notifications, to the satisfaction of the City Engineer.
5. Failure to comply with the terms and conditions hereon shall be grounds for cancellation of permit and rejection of all work.
6. I have read this application and all statements hereon are correct and complete. I agree to perform all work in accordance with the Standard Specifications for Public Works Construction on file in the office of the City Engineer, and with all applicable city ordinances and codes.

I HAVE READ AND UNDERSTAND ALL OF THE ABOVE:

_____ Applicant's Signature _____ Date

PHONE INFORMATION

Location of City Utilities:	738-6886
City of Fullerton (Days)	738-6845
City of Fullerton (Nights)	738-6897
City of Fullerton (Police)	738-6800
City of Fullerton (Fire)	738-6502

APPLICANT SHALL CONTACT THE CITY INSPECTOR'S OFFICE AT 738-6845 AT LEAST 24 HOURS PRIOR TO ANY WORK

THIS PERMIT WITH APPROVED PLANS MUST BE ON THE JOB AT ALL TIMES.

DATE	INSPECTION RECORD REMARKS
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

CERTIFICATE OF INSPECTION: I hereby certify that all the work allowed by this permit has been constructed according to the plans and specifications.

By _____ _____

Inspector's Signature Date

APPLICANT

FOR ARTERIAL STREETS

Contractor shall be limited to closing a maximum of one lane at a time between 8:30 a.m. and 3:30 p.m. on Arterial Highways with the exception being on Harbor Boulevard from Berkeley Avenue south to the 91 Freeway which shall be between 8:30 a.m. to 11:30 a.m. and from 1:30 p.m. to 3:30 p.m. All lanes shall be open at all other times. A lighted arrow board is required before any lane may be closed. Lane closures shall be in accordance with the W.A.T.C.H. Manual.

A $2,000.00 cash bond shall be posted to guarantee compliance with the hours set forth above and/or to pay for any clean up or repair that the City finds necessary to have done due to the contractors inattention or failure to correct the problem in a timely manner. Deduction for repair and/or clean up shall be the cost of the work plus the City's overhead.

Failure of the Contractor to adhere to the lane closure limitations above will result in the City deducting from the Contractor's deposit an assessment of $250.00 for every 15 minutes or a portion thereof for said non-compliance.

HOLD HARMLESS

The Applicant agrees to defend, indemnify, and hold harmless the CITY OF FULLERTON, its officers, agents, employees, and volunteers from all loss, cost, and expense arising out of any liability of claim of liability for personal injury, bodily injury to persons, contractual liability and damage to property sustained or claimed to have been sustained arising out of activities of the Applicant or those of any of its officers, agents, or employees, whether such act is authorized by this Agreement or not; and the Applicant shall pay for any and all damage to the property of the CITY OF FULLERTON, or loss of theft of such property, done or caused by such persons. The CITY OF FULLERTON assumes no responsibility whatsoever for any property placed on the premises. The Applicant further agrees to waive all rights of subrogation against the CITY OF FULLERTON. The provisions of this Article do not apply to any damage or loss caused solely by the negligence of the CITY OF FULLERTON or any of its agents or employees.

_____ _____

Applicant Date

REFUNDABLE CASH DEPOSIT

To receive a refund of your cash deposit paid on this permit, you must request a final inspection and return your copy of the signed-off permit to the engineering counter.

_____ _____

Applicant Date

COUNTY PROPERTY PERMIT

7/14/2009

2009-00230

Ngo, Andy 3:32:57 PM
INSPECTION PHONE
714-567-7804

Inspection office shall be notified at least TWO (2) WORK DAYS PRIOR to commencing permitted use. FAILURE TO OBTAIN INSPECTION SHALL VOID THIS PERMIT

ENCROACHMENT PERMIT

COUNTY OF ORANGE
OC Public Works
County Property Permits
Main Office: 300 North Flower Street,
Santa Ana, California 92703-5001
or P.O. Box 4048, Santa Ana, California 92702-4048
(714) 834-3474 or (714) 834-5529
Fax: (714) 835-7425

Permit No: **2009-00230**
Effective Date: 7/14/2009 12:00 AM
Expiration Date: 1/14/2010 12:00 AM

PERMITTEE

Orange County Transportation Authority
550 South Main Street

Orange, CA 92863
714-560-6282

Contact Person Arshad Rashedi
Telephone No. 714-560-5874

FACILITY

Type	Facility Name	Number
	CARBON CREEK CHANNEL	B01
	PLACENTIA STORM CHANNEL	B01S03

PERMITTED USE: User of County property is hereby authorized as follows, subject to provisions attached hereto:

To install and maintain (4) storm drain entries within Orange County Flood Control District's Carbon Creek Channel (B01), Placentia Storm Channel (B01S03) rights-of-way, per attached plans and provisions and to the satisfaction of County inspection personnel.

PERMIT NOT EFFECTIVE UNTIL PERMITTED USE APPROVED BY ASSIGNED INSPECTOR.

THIS PERMIT IS NOT VALID UNTIL THE PERMITTEE FIRST OBTAINS A RIDER TO THIS PERMIT TO ADD THE SELECTED CONTRACTOR AND THE CONTRACTOR SUBMITS A VALID CERTIFICATE OF LIABILITY INSURANCE THAT MEETS COUNTY INSURANCE REQUIREMENTS.

CEQA Code 1 SWPPP: No

LOCATION OF WORK:

Carbon Creek Channel (B01) Sta.260+95.36 and 261+00.92
Placentia Storm Channel (B01S03) Sta. 84+40.68 and 91+35.66
TG: 739-D6 and 769-D1

Dimension/Type: (4) Storm drain entries Thomas Brother: see location Area: Placentia

CONSIDERATION:

Types	PWO#	Permit Fees	Surety	Penalty	Total	Total Fees: 1,712.38
FC	EF68210	1,712.38 (2061)	0.00 (2091)	0.00	1,712.38	

PERMITTEE'S ACCEPTANCE:

COUNTY APPROVAL:

Stanfield, Chuck 7/14/2009

PERMIT AND APPROVED PLANS SHALL BE MAINTAINED ON JOB SITE. PERMITTEE SHALL COMPLY WITH REGULATIONS PRINTED ON REVERSE SIDE OF PERMIT AND ATTACHMENTS. ALL UNDERGROUND WORK REQUIRES PRIOR 'UNDERGROUND SERVICE ALERT' COMPLIANCE. THIS PERMIT IS NON-TRANSFERABLE.

Note: Surety will not be refunded until Final Inspection is performed and submitted to County Property Permits.

ENCROACHMENT PERMIT

Payment	Trust	Check	Receipt	Date	Amount	Total Payment:	1,712.38
Check		654488	R0907253	7/9/2009	1,612.38		
Check		148176	R0901894	2/19/2009	100.00		

Surety Paid By:

TUF Invoice Paid By:

Contractor:

Engineer: RBF Consulting 14725 Alton Parkway, Irvine 92618-2027 Contact: John McCarthy (949) 855-5759 jmccarthy@rbf.com

Inspection: Subdivision & Permits Inspection CC: Operations & Maintenance

PERMIT INSPECTORS REPORT:

DATE WORK COMPLETED:_____

The permitted work was completed in satisfactory manner per instructions and/or the as-built plans and inspectors report submitted herewith for county files

Remarks:

Inspector:

Date

Permit Superintendent:

Date

Refund Recommended By:

Date

Refund Approved By:

Date:

MATERIALS REPORT

SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 16.2/18.6
EA 12-0F0311

EMI Project No. 08-115
Date: June 17, 2009

EARTH MECHANICS, INC.

Geotechnical and Earthquake Engineering

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

June 17, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Attention: Mr. Steve Huff

Subject: ***Materials Report for SR-57 Northbound Improvement Project***
Orange County, California
12-Ora-57, PM 16.2/18.6; EA 12-0F0311

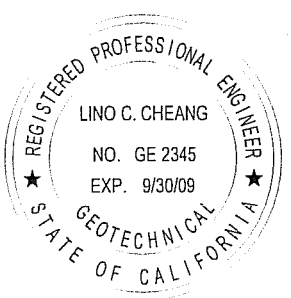
Dear Mr. Huff:

Attached is our Materials Report for the SR-57 Northbound Improvement project. The report contains our findings, conclusions, and recommendations for the design and construction of the proposed improvements. Specifically, this report addresses geotechnical and materials issues as described in Topic 114 of the California Department of Transportation (Caltrans) Highway Design Manual and Caltrans Test Method 130.

A draft version of this report dated February 17, 2009 was submitted to Caltrans for their review. Caltrans review comments were documented in an email dated April 9, 2009 and a copy of this email is included in Appendix D. Per Caltrans review comments, this Materials Report includes recommendations for treatment of subgrade with lime to mitigate expansive soils.

If you have questions regarding the information contained herein or requires additional information, please call our office.

Sincerely,
EARTH MECHANICS, INC.



Lino Cheang, GE 2345
Project Manager

LCC:lcc

MATERIALS REPORT
SR-57 NORTHBOUND IMPROVEMENT PROJECT
ORANGE COUNTY, CALIFORNIA
12-Ora-57, PM 16.2/18.6
EA 12-0F0311

Prepared for:

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Prepared by:

Earth Mechanics, Inc.
17660 Newhope Street, Suite E
Fountain Valley, California 92708

EMI Project Number: 08-115

June 17, 2009

TABLE OF CONTENTS

Section			Page
1.0	**GENERAL**		**1**
	1.1	Purpose and Scope of Work	1
	1.2	Project Description	1
		1.2.1 Climatic Conditions	2
		1.2.2 Terrain, Land Use, and Surface Drainage	3
		1.2.3 Regional Geology	3
	1.3	Pertinent Reports and Investigations	4
	1.4	Related Reports Prepared for the Proposed Improvements	4
	1.5	Limitations	4
2.0	**EXISTING FACILITIES AND PROPOSED IMPROVEMENTS**		**5**
	2.1	Existing Facilities	5
3.0	**ROADWAY and CULVERT Foundations**		**7**
	3.1	Geotechnical Investigation	7
	3.2	Laboratory Soil Testing	9
	3.3	Groundwater	10
	3.4	Foundation Treatment For General Fill Areas	10
	3.5	Drainage Systems	10
4.0	**CUTS AND EXCAVATIONS**		**11**
5.0	**EMBANKMENTS**		**11**
6.0	**CORROSION INVESTIGATIONS**		**11**
	6.1	Soil Corrosion Testing Results	11
	6.2	Soil Corrosivity	13
7.0	**STRUCTURAL PAVEMENT DESIGN**		**13**
	7.1	Existing Pavement sections	13
	7.2	Treatment for Expansion Soils	13
	7.3	Subgrade R-values	13
	7.4	Recommended Pavement Structural Sections	15
	7.5	Compaction and Remedial Grading	18
8.0	**MATERIALS AVAILABLE**		**18**
9.0	**RECOMMENDED MATERIALS SPECIFICATIONS**		**19**
	9.1	Review of Grading and Construction Plans	19
	9.2	General Earthwork Requirements	20
	9.3	Adjacent Structures	20
	9.4	Pavement	20
	9.5	Culvert Materials	20
	9.6	Inspection and Testing	22
10.0	**SOIL TESTING AND MATERIAL PROPERTIES SUMMARY**		**22**
11.0	**REFERENCES**		**23**

Page

TABLES

Table 1. Existing Facilities and Proposed Improvements, SR-57 Mainline 2
Table 2. Existing Pavement Information 6
Table 3. Soil Exploration Information 7
Table 4. Soil Corrosion Test Results 12
Table 5. R-Value Test Results 14
Table 6. Recommended Pavement Structural Sections, SR-57 Travel Lanes 16
Table 7. Recommended Pavement Structural Sections, SR-57 Shoulders 16
Table 8. Recommended Flexible Pavement Structural Sections, On- and Off-Ramps 17
Table 9. Recommended Rigid Pavement Structural Sections, Ramp Termini 17
Table 10. Recommended Pavement Structural Sections, MVP's 18
Table 11. Material Sources 19
Table 12. Existing and New Drainage Devices 21

FIGURES

Figure 1. Site Location Map 25
Figure 2. Regional Fault and Physiography Map 26
Figure 3. Exploratory Boring Location Map, Sheet 1 of 12 27
Figure 4. Exploratory Boring Location Map, Sheet 2 of 12 28
Figure 5. Exploratory Boring Location Map, Sheet 3 of 12 29
Figure 6. Exploratory Boring Location Map, Sheet 4 of 12 30
Figure 7. Exploratory Boring Location Map, Sheet 5 of 12 31
Figure 8. Exploratory Boring Location Map, Sheet 6 of 12 32
Figure 9. Exploratory Boring Location Map, Sheet 7 of 12 33
Figure 10. Exploratory Boring Location Map, Sheet 8 of 12 34
Figure 11. Exploratory Boring Location Map, Sheet 9 of 12 35
Figure 12. Exploratory Boring Location Map, Sheet 10 of 12 36
Figure 13. Exploratory Boring Location Map, Sheet 11 of 12 37
Figure 14. Exploratory Boring Location Map, Sheet 12 of 12 38

APPENDICES

Appendix A. Exploratory Boring Logs
Appendix B. Logs of Cone Penetration Test (CPT) Soundings
Appendix C. Laboratory Test Results
Appendix D. Caltrans Review Sheet (Email Dated April 9, 2009)

1.0 GENERAL

1.1 PURPOSE AND SCOPE OF WORK

This Materials Report presents findings and conclusions of a geotechnical investigation conducted by Earth Mechanics, Inc. (EMI) for proposed improvements at the State Route-57 (SR-57) northbound project located in Orange County. The purpose of the geotechnical investigation was to obtain subsurface information to develop design and construction recommendations to aid RBF Consulting (RBF) in preparing the project Plans, Specifications, and Estimates.

This report follows the requirements for a Materials Report in accordance with Topic 114 of the California Department of Transportation (Caltrans) Highway Design Manual (HDM, 2008) and is organized in general accordance with California Test (CT) 130 (Caltrans, 1981). The report provides geotechnical information and recommendations for pavement structural sections, earthwork, and addresses soil corrosion issues at the site as required by the HDM.

The following geotechnical services were completed for this project:

- Geotechnical field exploration consisting of drilling and logging forty-four (44) exploratory borings and fifteen (15) cone penetrometer tests (CPT's).
- Laboratory testing of selected soil samples.
- Pavement structural section design.
- Soil corrosivity evaluation.
- Preparation of this report presenting our findings, conclusions, and recommendations.

Work that was excluded from our scope included:

- Borrow and disposal site investigations, and
- Investigation and analysis for possible rehabilitation of existing pavements.

1.2 PROJECT DESCRIPTION

The project location is shown on Figure 1. The Department of Transportation (Caltrans) – District 12, in cooperation with the Orange County Transportation Authority (OCTA), proposed to widen northbound SR-57 by adding one northbound through lane. The project limits are between 0.2 miles south of Orangethorpe Avenue and 0.2 miles north of Yorba Linda Boulevard along northbound SR-57. SR-57 within the project limits generally consists of 2 HOV lanes and eight mixed-flow lanes. Within the project limits, there are interchanges located at Orangethorpe Avenue, Chapman Avenue, Nutwood Avenue and Yorba Linda Boulevard. Details of the existing Mainline configuration and proposed improvements along the Mainline are described in Table 1.

Table 1. Existing Facilities and Proposed Improvements, SR-57 Mainline

Location	Existing Facility	Proposed Improvement
Orangethorpe Ave Exit Ramp to Orangethorpe Ave Entrance Ramp	1 HOV lane and 5 mixed-flow lanes	Add 1 mixed-flow lane
Orangethorpe Ave Entrance Ramp to Chapman Ave Exit Ramp	1 HOV lane, 4 mixed-flow lanes, and 1 auxiliary lane	Add 1 mixed-flow lane
Chapman Ave Exit Ramp to Nutwood Ave Entrance Ramp	1 HOV lane and 4 mixed-flow lanes	Add 1 mixed-flow lane
Nutwood Ave Entrance Ramp to Yorba Linda Blvd Exit Ramp	1 HOV lane, 4 mixed-flow lanes and 1 auxiliary lane	Add 1 mixed-flow lane
Yorba Linda Blvd Exit Ramp to Yorba Linda Blvd North Entrance Ramp	1 HOV lane and 4 mixed-flow lanes	Add 1 mixed-flow lane

Other improvements (requiring geotechnical input) include: bridge widenings, new soundwalls, retaining walls and soundwall on retaining walls; some local widening and shifting of the on- and off-ramps; and new and extension of existing buried drainage devices.

1.2.1 CLIMATIC CONDITIONS

The weather in the Los Angeles Basin is a Mediterranean type climate with warm dry summers and mild winters. As is typical of a Mediterranean climate, most rainfall occurs in the winter months. The winter rains accompany northern Pacific storms that generally originate in the Gulf of Alaska region and sweep across California from the northwest. Occasional showers can occur during the summer months due to hot moist monsoonal air masses that spread northerly from the Gulf of Mexico and Gulf of California.

Another typical L.A. Basin weather characteristic results from the juxtaposition of cool marine waters and dry hot desert air. As the moist marine air masses drift over colder water a bank of low clouds and fog is formed which creeps inland for only a short distance before evaporating completely. Characteristically, this deck of clouds reaches inland as far as the bordering hills and mountains during the night, and then recedes to the vicinity of the coast during the day.

The average maximum temperatures in the project area are about 77 degrees Fahrenheit (F), and the average minimum temperatures are about 50 degrees. The warmest months are July through September when the maximum temperature averages above 87 degrees. The daily extreme high temperatures range from the 90s to more than 110 in the months of July through September. The hottest temperatures are commonly associated with Santa Ana winds which involve adiabatic heating due to a high-pressure cell over the Great Basin in Nevada and Utah to the east. The coolest months are December and January when the average low is about 42 degrees. Freezing temperatures occur rarely in the winter months, but generally do not result in a hard freeze.

The average annual precipitation is about 14 inches a year with the wettest months being January through March when rainfall averages about 2 to 3½ inches per month. The driest month is July when no precipitation is likely. Although snowfall is possible in the surrounding mountain ranges and rarely in the inland valleys, no snowfall is likely within the Los Angeles basin.

1.2.2 TERRAIN, LAND USE, AND SURFACE DRAINAGE

The project corridor is in the eastern part of the Los Angeles Basin along the southern margin of the Coyote Hills and the Puente Hills (Figure 2). Just north of the project corridor, the Puente Hills rise to an elevation of about 1,400 feet. The southwestern edge of the Puente Hills is paralleled by a series of low-elevation plains and hills; the Santa Fe Plain and the Coyote Hills are to the west of the project corridor, and the Richfield and Kraemer Hills are to the east. The elevations of these hills range from about 500 feet just west of the project to about 300 feet in the east. The ground upon which the project is located slopes gently to the south. Elevations along the project corridor range from about 280 feet in the north to about 200 feet on the south.

The areas immediately adjacent to the project corridor are fully developed into residential and commercial areas.

The project corridor traverses the ancient flood plains and alluvial fans of Fullerton Creek and the Santa Ana River. The major drainage in the area is the Santa Ana River which flows westerly south of the site. Fullerton Creek, a tributary to the Santa Ana River, drains southwesterly from the Puente Hills just west of the project corridor.

1.2.3 REGIONAL GEOLOGY

The site area is at the eastern edge of the Los Angeles physiographic basin, a large, relatively flat, low-lying, coastal plain surrounded by mountains on the north, east, and southeast (Figure 2). The floor of the Los Angeles Basin is relatively flat but slopes gradually southwesterly from an elevated marginal apron to sea level along the coastline. The western margin of the Los Angeles Basin is bordered by the sea and the Palos Verdes Hills. The eastern margin is bordered by the Puente Hills and Santa Ana Mountains. The Coyote Hills, Santa Fe Springs Plain, Richfield Hills, and Kramer Hills are low elevation uplifts along the southern margin of the Puente Hills.

The geologic structure at the site is quite simple and is characterized by flat-lying Quaternary sediments overlying gently folded Tertiary sedimentary rocks. These strata rise gently to the Coyote Hills, Richfield Hills, and Kraemer Hills where they are arched upward to form anticlinal folds. The site is on the south limb of these anticlines with the early Pleistocene and Tertiary age strata dipping gently to the south and overlain by younger flat-lying Quaternary sediments.

Geologic formations directly underlying the site comprise primarily river flood plain and alluvial fan alluvium. Materials within both these units are primarily sands with mixtures of silts, clays, and gravels. Bedding in the Quaternary units commonly is irregular, lenticular, and poorly developed. Crystalline basement rocks are about 16,000 feet deep below the site.

Regional studies (e.g. Morton, 2004; Morton and Miller, 1981; Durham and Yerkes, 1964; California Department of Water Resources, 1961) indicate that the site area is underlain by Quaternary sediments overlying older Quaternary and Tertiary sediments and sedimentary rocks.

The surficial deposits are primarily Holocene and Pleistocene alluvial fan deposits. Older formations exposed in the hills and underlying the corridor are, in descending order, the Pleistocene-age La Habra and Coyote Hills, the Pliocene Fernando, and Pliocene-Miocene-age Puente formations.

Along the corridor, the La Habra Formation is at an elevation of about sea level and therefore these older units are well below the level of interest for this project.

1.3 PERTINENT REPORTS AND INVESTIGATIONS

No previous geotechnical studies were performed specifically for the improvements addressed in this report.

1.4 RELATED REPORTS PREPARED FOR THE PROPOSED IMPROVEMENTS

A separate Geotechnical Design Report (EMI, 2009a) was prepared for the current geotechnical study to address geotechnical issues not addressed in this report. The GDR may be referred to for additional geotechnical information.

Also, separate Foundation Reports are being prepared for widening of the following undercrossings (UC's) and a tieback wall at Yorba Linda Boulevard overcrossing:

- Orangethorpe Avenue Undercrossing, Bridge No. 55-0459 (EMI, 2009b)
- South Placentia Overhead, Bridge No. 55-0450 (EMI, 2009c)
- Crowther Avenue Undercrossing, Bridge No. 55-0457 (EMI, 2009d)
- Placentia Overhead, Bridge No. 55-0449 (EMI, 2009e)
- Placentia Avenue Undercrossing, Bridge No. 55-0460 (EMI, 2009f)
- Chapman Avenue Undercrossing, Bridge No. 55-0456 (EMI, 2009g)
- Nutwood Avenue Undercrossing, Bridge No. 55-04649 (EMI, 2009h)
- Yorba Linda Boulevard Overcrossing (Modify), Bridge No. 55-0468 (EMI, 2009i)

1.5 LIMITATIONS

This report is intended for use by RBF Consulting, Orange County Transportation Authority, and the California Department of Transportation for the SR-57 Northbound Improvement Project. This report is based on the project as described herein and information obtained from exploratory borings drilled for this project at the approximate locations indicated on the attached plans. Findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses. Soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project site; however, subsurface conditions and characteristics of soils between exploratory borings can vary. The findings reflect an interpretation of the direct evidence obtained. The recommendations presented herein are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained herein are applicable to the specific design elements and locations that are the subject of this report. Data, opinions, and recommendations herein are not applicable to any other design elements or to any other locations and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

EMI has no responsibility for construction means, methods, techniques, sequences, or procedures, or for safety precautions or programs in connection with the construction, for the acts or omissions of the CONTRACTOR, or any other person performing any of the construction, or for the failure of any worker to carry out the construction in accordance with the Final Construction Drawings and Specifications.

Services performed by EMI were conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

2.0 EXISTING FACILITIES AND PROPOSED IMPROVEMENTS

2.1 EXISTING FACILITIES

SR-57 freeway connects Interstate 5 and SR-22 in the south to Interstate 210 to the north. It passes through the Cities of Orange, Anaheim, Placentia, Fullerton and Brea in Orange County and enters Los Angeles County to a junction with SR-60, Interstate 10 and Interstate 210. SR-57 was constructed about 30 years ago as an eight-lane freeway. In 1992, the median was paved to accommodate two High Occupancy Vehicle (HOV) lanes, one in each direction; also, an auxiliary lane and shoulder were added approximately from Orangethorpe Avenue to Placentia Avenue and from Nutwood Avenue to Yorba Linda Boulevard. More recently, an HOV direct connector was added at the SR-57/SR-91 interchange and the northbound mixed-flow through lanes immediately north of the interchange were shifted to the east.

Today, SR-57 northbound direction within the project limits generally consists of one HOV lane and four mixed-flow lanes except there are five mixed-flow lanes from the project southern limit to the Orangethorpe Avenue freeway entrance ramp. That fifth mixed-flow lane was added in 1996.

The "Typical Cross Sections" sheets provided by RBF show the following typical cross-sections for the existing Mainline and ramps:

Table 2. Existing Pavement Information

Time	Location	As-Built Section
	Mainline	
Original Construction	Inside Lanes	0.67' PCC 0.35' RMCTB Class B 0.48' Class 3 AB 0.50' Class 4 AS
	Outside Lanes	0.75' PCC 0.50' RMCTB Class A 0.25' RMCTB AB 0.50' Class 4 AS
	Shoulder	0.25' to 0.50' AC 0.50' & Var Class 3 AB Var Class 4 AS
1992 Widening	HOV Lanes	0.75' PCC 0.40' LCB 0.60' Class 3 AB
	Auxiliary Lane (from about South Placentia OH to Placentia UC and from about Nutwood Ave On-Ramp to Yorba Linda Blvd Loop On-Ramp)	0.85' PCC 0.25' ATPB 0.35' Class 2 or Class 3 AB 0.70' Class 4 AS
	Shoulder (from about South Placentia OH to Placentia UC and from about Nutwood Ave On-Ramp to Yorba Linda Blvd Loop On-Ramp)	0.45' AC 0.70' Class 2 AB 0.85' and 1.00' Class 4 AS
1996 Widening	Auxiliary Lane (from about Southern Project Limit to South Placentia OH)	0.85' AC 0.50' Class 2 AB
	Shoulder (from about Southern Project Limit to South Placentia OH)	0.45' AC 0.80' Class 2 AB
	Ramps	
Original Construction	Chapman Ave Off-Ramp (G-3 Ramp) and Nutwood Ave Off-Ramp (H-1 Ramp)	0.35' AC 0.65' CTB Class B 0.35' Class 3 AB 0.65' Class 4 AS
	Yorba Linda Blvd Loop On-Ramp and On-Ramp Travel Lanes (I-4 and I-3 Ramps); Yorba Linda Blvd Off-Ramp (I-5 Ramp, from Sta 62+25.64 to Sta 68+52.85)	0.35' AC 0.50' RMCTB Class B 0.35' Class 3 AB 0.80' Class 4 AS
	Yorba Linda Blvd Loop On-Ramp and On-Ramp Shoulders (I-4 and I-3 Ramps); Yorba Linda Blvd Off-Ramp (I-5 Ramp, from Sta 62+25.64 to Sta 68+52.85)	0.25' AC 0.60' Class 2 AB 1.15' Class 4 AS
1992 Widening	Nutwood Ave On-Ramp (H-8 Ramp) and Yorba Linda Blvd Off-Ramp (I-5 Ramp, from Sta 59+55 to Sta 62+25.64)	0.45' AC 0.60' Class 2 AB 0.90' Class 4 AS
1996 Widening	Orangethorpe Ave Off-Ramp and On-Ramp ("T" and "V" Ramps)	0.50'AC 0.25'ATPB 0.60' Class 2 AB
PCC = Portland Cement Concrete; AC = Asphalt Concrete; RMCTB = Road-Mixed Cement-Treated Base; ATPB = Asphalt-Treated Permeable Base; CTB = Cement-Treated Base; LCB = Lean Concrete Base; AB = Aggregate Base; AS = Aggregate Subbase.		

3.0 ROADWAY AND CULVERT FOUNDATIONS

3.1 GEOTECHNICAL INVESTIGATION

A geotechnical field investigation was conducted between August 25 and October 1, 2008. Forty-four (44) exploratory borings and fifteen (15) CPT's were accomplished under the supervision of EMI for the project. Soil exploration information is summarized in Table 3. Approximate locations of borings and CPT's completed by EMI for this project are shown on Figure 3 through Figure 14.

Table 3. Soil Exploration Information

Boring	Station	Offset (feet)	Station Line	GSE (ft)	GWE (ft)	Boring Depth (ft)	Method	Figure No.
A-08-001	471+5	97RT	"B" Line	225.4	NE	91.5	HSA	4
A-08-002	472+27	115RT	"B" Line	206.1	NE	71.5	HSA	4
A-08-003	473+35	90RT	"B" Line	227.8	NE	91.5	HSA	4
A-08-004	483+85	90RT	"B" Line	231.9	NE	90.4	HSA	5
A-08-005	485+12	90RT	"B" Line	233.5	NE	91.5	HSA	5
A-08-006	489+69	80RT	"B" Line	237.9	NE	90.5	HSA	6
A-08-007	491+67	80RT	"B" Line	239.5	NE	64.5	HSA	6
A-08-008	494+45	80RT	"B" Line	241.9	NE	96.5	HSA	6
A-08-009	496+47	80RT	"B" Line	243.7	NE	91.5	HSA	6
A-08-010	505+67	80RT	"B" Line	243.5	NE	106.5	HSA	7
A-08-011	507+45	100RT	"B" Line	217.4	NE	71.5	HSA	7
A-08-012	507+94	97RT	"B" Line	217.9	NE	71.5	HSA	7
A-08-013	510+43	89RT	"B" Line	241.3	NE	91.0	HSA	7
A-08-014	519+3	70RT	"B" Line	250.1	NE	90.9	HSA	8
A-08-015	521+9	71RT	"B" Line	252.1	NE	91.8	HSA	8
A-08-016	533+58	68RT	"B" Line	259.0	NE	90.8	HSA	9
A-08-017	535+70	66RT	"B" Line	258.0	NE	91.5	HSA	9
A-08-018	573+88	127RT	"B" Line	301.1	NE	61.5	HSA	13
A-08-019	574+55	127RT	"B" Line	301.1	NE	61.5	HSA	13
A-08-101	460+71	120RT	"B" Line	207.2	NE	31.5	HSA	3
A-08-102	63+10	8RT	"T" Line	207.3	NE	31.5	HSA	3
CPT-08-103	64+14	8RT	"T" Line	207.3	NE	69.2	CPT	3
CPT-08-104	65+40	8RT	"T" Line	207.3	NE	74.2	CPT	3
A-08-105	67+38	10LT	"T" Line	210.9	NE	71.5	HSA	3
A-08-106	68+88	28RT	"T" Line	205.4	NE	61.5	HSA	4
CPT-08-107	74+92	35RT	"V" Line	211.0	NE	65	CPT	4
A-08-108	76+75	32LT	"V" Line	228.7	NE	71.0	HSA	5
A-08-109	78+35	23RT	"V" Line	226.1	NE	71.5	HSA	5
CPT-08-110	80+39	9RT	"V" Line	228.2	NE	50.0	CPT	5
CPT-08-111	487+00	90RT	"B" Line	233.9	NE	60.9	CPT	5

Table 3. Soil Exploration Information (Cont'd)

Boring	Station	Offset (feet)	Station Line	GSE (ft)	GWE (ft)	Boring Depth (ft)	Method	Figure No.
CPT-08-112	499+75	79RT	"B" Line	244.1	NE	45.9	CPT	6
CPT-08-113	503+16	82RT	"B" Line	243.9	NE	48.4	CPT	7
CPT-08-114	13+38	30LT	"G-3" Line	242.0	NE	54.5	CPT	7
CPT-08-115	15+54	40LT	"G-3" Line	245.5	NE	64.1	CPT	8
A-08-116	16+15	46RT	"G-3" Line	231.8	NE	61.5	HSA	8
CPT-08-117	24+12	2LT	"H-1" Line	253.1	NE	79.7	CPT	8
CPT-08-118	26+5	14LT	"H-1" Line	252.4	NE	77.3	CPT	8
A-08-119	28+68	8LT	"H-1" Line	238.0	NE	61.5	HSA	8
CPT-08-120	529+40	80RT	"B" Line	255.9	NE	80.4	CPT	8
A-08-121	531+86	80RT	"B" Line	257.8	NE	31.5	HSA	9
A-08-122	537+80	72RT	"B" Line	257.3	NE	30.8	HSA	9
A-08-123	39+42	28RT	"H-8" Line	250.0	NE	31.5	HSA	9
A-08-124	40+97	34LT	"H-8" Line	253.6	NE	31.5	HSA	10
CPT-08-125	42+29	12RT	"H-8" Line	251.1	NE	80.2	CPT	10
A-08-126	43+20	10RT	"H-8" Line	251.0	NE	61.5	HSA	10
CPT-08-127	44+66	8RT	"H-8" Line	250.9	NE	79.6	CPT	10
A-08-128	46+84	16RT	"H-8" Line	251.0	NE	31.5	HSA	10
A-08-129	553+15	94RT	"B" Line	255.8	NE	11.5	HSA	11
A-08-130	557+90	80RT	"B" Line	260.0	NE	3.5	HSA	11
CPT-08-131	61+93	14RT	"I-5" Line	263.6	NE	80.2	CPT	12
A-08-132	62+86	12LT	"I-5" Line	264.5	NE	11.5	HSA	12
A-08-133	65+13	18RT	"I-5" Line	266.5	NE	11.5	HSA	12
A-08-134	570+55	90RT	"B" Line	269.4	NE	11.5	HSA	12
A-08-135	71+19	4LT	"I-4" Line	274.5	NE	2.0	HSA	13
A-08-136	66+5	10RT	"I-4" Line	288.0	NE	10.9	HSA	13
A-08-137	74+40	15RT	"I-3" Line	290.0	NE	31.5	HSA	13
A-08-138	78+30	2RT	"I-3" Line	283.0	NE	31.5	HSA	13
A-08-139	80+70	2RT	"I-3" Line	283.4	NE	3.0	HSA	14
A-08-140	85+76	5RT	"I-3" Line	285.6	NE	2.0	HSA	14

Notes:
1. Stations and offsets are measured relative to the identified Station Lines and are approximate.
2. GSE = Approximate Ground Surface Elevation.
3. GWE = Approximate Groundwater Elevation; NE = Groundwater Table Not Encountered.
4. HSA = Hollow-stem auger boring; CPT = Cone Penetrometer Test.

The HSA borings were excavated using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. Subsurface soils and conditions were logged and samples of soils were collected for laboratory testing. Large bulk samples of near-surface soils were logged and collected. Smaller soil samples were collected from borings generally at 5 feet vertical intervals by means of split-spoon

drive samplers; the Standard Penetration Test (SPT) sampler and the Modified California Drive (MCD) sampler were used to collect small disturbed and relatively undisturbed samples, respectively. The SPT sampler (2.4 inches OD) and MCD sampler (3.25 inches OD) were driven a total depth of 18 inches or until refusal, using a 140-pound hammer falling 30 inches. The blowcounts for the last 12 inches of penetration (or less penetration depths as noted on the logs) were recorded on the boring logs and were used to correlate with in-situ soil strengths. The MCD is a split-barrel sampler with a tapered cutting tip and lined with a series of 1-inch tall brass rings. Logs of the shallow borings (10-foot deep) are presented in the beginning of Appendix A, followed by the remaining logs in standard Caltrans Log-of-Test-Borings (LOTB) format.

The CPT soundings were performed using an electronic cone penetrometer in general accordance with current ASTM Standards (ASTM D5778 and ASTM D3441). The CPT equipment consisted of a cone penetrometer assembly mounted at the end of a series of hollow sounding rods. The cone penetrometer assembly consisted of a conical tip with a 60° apex angle and a projected cross sectional area of 1.55 in^2 (10 cm^2) and a cylindrical friction sleeve with a surface area of 23.25 in^2 (150 cm^2). The interior of the cone penetrometer is instrumented with strain gauges that allow simultaneous measurements of cone tip and friction sleeve resistance during penetration. The cone penetrometer assembly is continuously pushed into the soil by a set of hydraulic rams at a standard rate of 0.79 inch per second (20 mm per second) while the cone tip resistance and sleeve friction resistance are recorded every 1.967 inches (50 mm) and stored in digital form. A specially designed all-wheel drive 25-ton truck provides the required reaction weight for pushing the cone assembly and is also used to transport and house the testing equipment. The computer generated graphical logs include tip resistance, friction resistance, and friction ratio. Soil behavior type interpretations are based on guidelines by Robertson and Campanella (1989). Logs of the CPT soundings are presented in Appendix B.

3.2 LABORATORY SOIL TESTING

Soil samples were tested to obtain or derive relevant physical and engineering properties. To perform analyses related to the Materials Report, the following laboratory soil tests were conducted to supplement the observations recorded during the field investigation:

- No. 200 Wash
- Atterberg Limits
- Expansion Index
- Soil Corrosivity
- Maximum Density and Optimum Moisture Content
- In-situ Moisture Content and Dry Density
- R-Value

The laboratory tests were conducted in general accordance with California Test (CT) methods or American Society for Testing and Materials (ASTM) standards. Soil corrosivity results are presented in Table 4. R-value and No. 200 Wash test results on near-surface bulk samples are presented in Table 5. Other remaining laboratory test results are presented in Appendix C.

3.3 GROUNDWATER

During the recent field investigation conducted between August 25 and October 1, 2008, groundwater was not encountered down to a depth of than 100 feet from the freeway surface. The relatively deep water depth is confirmed by the historical groundwater maps published by the California Geological Survey (Seismic Hazard Zones Map – La Habra, and Anaheim and Newport Beach Quadrangles, CGS, 1997a, 1997b). These maps show the depth to groundwater to be greater than 50 feet.

3.4 FOUNDATION TREATMENT FOR GENERAL FILL AREAS

Vegetation on existing ground should be removed prior to fill placement or pavement construction. Cut and fill areas should be grubbed to a depth necessary to remove all roots, stumps, buried organic material, and all other objectionable material. Loose soils, created by the removal of roots, stumps, or other objectionable material, should be removed and the cavities should be properly backfilled.

Loose, soft, dry, wet, or otherwise unsuitable materials should be removed from areas to receive fill, or where utilities will be constructed. In fill areas, a minimum overexcavation of 18 inches is recommended; the overexcavation should be measured from the existing ground surface. Overexcavations should extend horizontally a minimum distance of 18 inches from the edges of new fills. In cut areas, the minimum overexcavation is 12 inches if the difference between the finished and existing grade is 2 feet or less, and overexcavation is not required if the difference between the finished and existing grade is greater than 2 feet. In cut areas, the overexcavation depth is measured from the future finished grade. Unless specified on the contract plans or specifications, the excavated soils (in both fill and cut areas) may be reused as compacted fill.

The overexcavation bottoms should be scarified to a minimum depth of 6 inches, moisture conditioned to near optimum moisture content, and compacted to at least 90 percent relative compaction. All overexcavation bottoms should be observed to be firm and unyielding prior to fill placement.

No special foundation treatment is recommended for proposed drainage structures at this site. Foundation treatment for the pavement subgrade is discussed in Section 7.0. Remedial excavations below retaining wall footings are addressed in the Wall Foundation Report (EMI, 2009j).

3.5 DRAINAGE SYSTEMS

The impact of fills, which are at least 5 feet high, on utilities and drainage structures that fall within a 45-degree projection below the footprint of fills was evaluated and is addressed in the GDR (EMI, 2009a).

4.0 CUTS AND EXCAVATIONS

There are two major cut areas:

(1) Between Orangethorpe Avenue On-Ramp and South Placentia OH: cut in excess of 20 feet in height will be required to remove an existing retaining wall (RW No. 480) and construct a new retaining wall (RW No. 476), and

(2) At Yorba Linda Boulevard OC: a vertical cut of about 15 feet into the existing abutment end slope adjacent to the freeway will be required to construct a new tieback wall (RW No. 574).

Stability of these proposed cuts has been addressed in the GDR (EMI, 2009a) for the retaining wall area between Orangethorpe Avenue On-Ramp and South Placentia OH, and in the foundation report for the Yorba Linda Boulevard tieback wall (EMI, 2009i). Only relatively minor cuts, approximately less than 2 feet, are anticipated in other areas to achieve finish grades within the proposed project limits. In addition, relatively minor excavations are necessary for remedial earthwork beneath new pavement sections, and minor to moderate excavations are necessary to accommodate construction of new drainage structures.

5.0 EMBANKMENTS

A sliver fill is required to accommodate the addition of a mixed flow lane and shoulder between the southern project limit to Nutwood Avenue On-Ramp. This sliver fill is retained on the east side by a series of retaining walls. The width of the sliver fill (at the top) varies and ranges from a few feet to about 25 feet. The fill height also varies and ranges from a few feet to almost 30 feet adjacent to the bridge abutments. From north of Nutwood Avenue On-Ramp to the northern project limit, some minor regrading and fill placement will be required to accommodate the added mixed flow lane and shoulder. Stability and settlement of the new fill have been addressed in the GDR (EMI, 2009a) for the project.

6.0 CORROSION INVESTIGATIONS

6.1 SOIL CORROSION TESTING RESULTS

Thirty-five (35) soil samples were tested to determine minimum resistivity, pH, soluble sulfate content, and soluble chloride content using procedures described in California Test Methods 417, 422, and 643, respectively. Minimum resistivities ranged from 490 to 2,000 ohm-cm. The pH ranged from 7.29 to 8.64. The soluble sulfate ranged from 50 to 1,000 parts per million (ppm), and the soluble chloride ranged from 123 to 416 ppm. The test results are summarized in Table 4.

Table 4. Soil Corrosion Test Results

Boring	*Station (Offset) / "Station Line"*	*Sample Depth (ft)*	*Soil Type*	*Minimum Resistivity (ohm-cm)*	*pH*	*Soluble Sulfate Content (ppm)*	*Soluble Chloride Content (ppm)*
A-08-001	471+5 (97RT)/"B" Line	10	SC	2000	8.64	450	153
A-08-003	473+35 (90RT)/"B" Line	10	CL	1100	8.43	300	216
A-08-004	483+85 (90RT)/"B" Line	15	SC	750	7.54	700	185
A-08-005	485+12 (90RT)/"B" Line	20	SC	2000	8.38	120	173
A-08-006	489+69 (80RT)/"B" Line	15	CL	1800	8.10	100	168
A-08-007	491+67 (80RT)/"B" Line	15	CL	740	7.69	500	162
A-08-008	494+45 (80RT)/"B" Line	10	CL	810	7.65	450	213
A-08-008	494+45 (80RT)/"B" Line	30	CL	510	7.36	750	208
A-08-009	496+47 (80RT)/"B" Line	25	CL	850	7.66	300	142
A-08-010	505+67 (80RT)/"B" Line	5	SC	1300	7.95	100	123
A-08-012	507+94 (97RT)/"B" Line	15	CL	850	7.42	50	245
A-08-013	510+43 (89RT)/"B" Line	21	CL	1050	7.84	200	238
A-08-014	519+3 (70RT)/"B" Line	10	CL	600	7.66	450	158
A-08-015	521+9 (71RT)/"B" Line	20	SC	840	7.60	350	182
A-08-016	533+58 (68RT)/"B" Line	25	CL	1040	7.69	150	312
A-08-016	533+58 (68RT)/"B" Line	35	CL	530	7.51	120	364
A-08-017	535+70 (66RT)/"B" Line	20	CL	490	7.29	250	362
A-08-018	573+88 (127RT)/"B" Line	5	CL	760	8.36	250	223
A-08-018	573+88 (127RT)/"B" Line	40	CL	900	7.85	80	296
A-08-019	574+55 (127RT)/"B" Line	10	CL	750	8.53	280	181
A-08-109	78+35 (23RT)/"V" Line	20	CL	700	7.73	1000	221
A-08-109	78+35 (23RT)/"V" Line	35	CL	500	7.55	300	270
A-08-116	16+15 (46RT)/"G-3" Line	25	CL	1100	8.33	280	159
A-08-119	28+68 (8LT)/"H-1" Line	5	CL	980	7.65	400	221
A-08-121	531+86 (80RT)/"B" Line	5	CL	1200	7.95	120	184
A-08-121	531+86 (80RT)/"B" Line	25	CL	940	7.69	50	280
A-08-122	537+80 (72RT)/"B" Line	15	CL	520	7.56	150	416
A-08-123	39+42 (28RT)/"H-8" Line	20	CL	980	7.86	120	315
A-08-124	40+97 (34LT)/"H-8" Line	5	CL	1800	8.28	250	175
A-08-126	43+20 (10RT)/"H-8" Line	2.5	CL	1090	8.35	80	159
A-08-126	43+20 (10RT)/"H-8" Line	25	CL	1100	7.85	120	262
A-08-128	46+84 (16RT)/"H-8" Line	5	CL	1500	7.86	50	153
A-08-132	62+86 (12LT)/"I-5" Line	10	CL	1500	8.17	50	163
A-08-137	74+40 (15RT)/"I-3" Line	2.5	CL	1060	8.34	50	168
A-08-138	78+30 (2RT)/"I-3" Line	5	CL	1200	8.18	50	171

6.2 SOIL CORROSIVITY

Based on the Caltrans Corrosion Guidelines (2003), soils are considered corrosive if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm or greater. Based on the test results and the Caltrans criteria, the on-site soils are not considered to be corrosive to bare metals and concrete.

7.0 STRUCTURAL PAVEMENT DESIGN

7.1 EXISTING PAVEMENT SECTIONS

The existing pavement sections within the project area have been presented in Table 2.

7.2 TREATMENT FOR EXPANSION SOILS

Per Caltrans HDM Section 614.4 (2008), subgrade with a Plasticity Index (PI) greater than 12 is considered to be "expansive", and special treatment of the subgrade is required. The same HDM Section 614.4 lists several options to mitigate the presence of expansive subgrade. The alternative which is most feasible for this project is treating the upper 0.65 feet of subgrade with lime. This option is also presented in the Caltrans review comments in Appendix D.

Plasticity Index tests were performed on all of the subgrade recovered by the soil borings. Results of the PI tests are presented on the Boring Location Plan in Figures 3 through 14 and on Table C-2 in Appendix C. Based on a conservative assessment of the above test results, we recommend treating the upper 0.65 feet of subgrade with lime in the following areas:

Mainline:	From Station 484+42 (South Placentia Overhead) to Station 546+90; and From Station 570+00 to Station 587+15 (Northern Project Limit).
Ramps:	Chapman Avenue Off-Ramp (G-3 Line); Nutwood Avenue Off and On-Ramp (H-1 and H-8 Lines); and Yorba Linda On-, Loop On- and Off-Ramp (I-3, I-4 and I-5 Lines).

7.3 SUBGRADE R-VALUES

Twenty-three (23) samples of on-site, near-surface soils were tested to determine their R-value. The R-values and fines content (Percent Passing No. 200 Sieve) for all 23 samples are presented in Figures 3 through 14 and in Table 5. In Table 5, the data is arranged starting at the south end of the project and proceeding to the north along SR-57.

Table 5. R-Value Test Results					
Boring	*Station (Offset)/ Station Line*	*Sample Depth (ft)*	*Soil Type*	*R-Value*	*% Passing #200 Sieve (%)*
A-08-101	460+71 (120RT)/"B" Line	2 to 5	SC	36	28.9
A-08-105	67+38 (10LT)/"T" Line	1 to 5	SC-SM	66	18.8
A-08-001	471+5 (97RT)/"B" Line	2.5 to 4	SC	33	30.2
A-08-108	76+75 (32LT)/"V" Line	0.5 to 5	SM	63	14.9
A-08-004	483+85 (90RT)/"B" Line	2.5 to 5	SC	49	25.7
A-08-007	491+67 (80RT)/"B" Line	1.5 to 5	SC	28	32.2
A-08-009	496+47 (80RT)/"B" Line	0 to 1.5	SC	17	47.9
A-08-012	507+94 (97RT)/"B" Line	1.5 to 5	SC	20	37.5
A-08-116	16+15 (46RT)/"G-3" Line	0 to 5	SP-SM	62	11.1
A-08-014	519+3 (70RT)/"B" Line	1 to 5	SM	60	12.3
A-08-119	28+68 (8LT)/"H-1" Line	1 to 5	SC	16	39.1
A-08-121	531+86 (80RT)/"B" Line	2 to 5	CL	16	50.7
A-08-016	533+58 (68RT)/"B" Line	1 to 5	SM	61	19.0
A-08-123	39+42 (28RT)/"H-8" Line	2.5 to 5	SC	17	38.9
A-08-124	40+97 (34LT)/"H-8" Line	0 to 5	CL	12	61.2
A-08-126	43+20 (10RT)/"H-8" Line	1.5 to 5	CL	9	67.9
A-08-129	553+15 (94RT)/"B" Line	0 to 5	SC-SM	48	26.8
A-08-133	65+13 (18RT)/"I-5" Line	0 to 5	SC	14	49.6
A-08-136	66+5 (10RT)/"I-4" Line	0 to 5	SC	17	40.6
A-08-018	573+88 (127RT)/"B" Line	1 to 5	CL	11	56.0
A-08-137	74+40 (15RT)/"I-3" Line	2 to 5	CL	8	72.8
A-08-138	78+30 (2RT)/"I-3" Line	0 to 5	SM	63	18.8
A-08-140	85+76 (5RT)/"I-3" Line	0 to 2	CL	11	67.3

We have the following observations based on an examination of the data in Table 5:

- R-value ranges from 8 to 66 with an average of 32,
- There is a good correlation between the fines content (Percent Passing No. 200 Sieve) and R-value: R-value is near 10 for fine-grained "CL" soils (fines content > 50%); R-value is 60 or greater for coarse-grained "SP-SM", "SM" and "SC-SM" soils with fines content less than 20%; and R-value is between about 50 and 15 for coarse-grained "SC" soils with fines content between 25 and 50%, respectively, and

- Fine-grained soils are usually encountered just south of Nutwood Avenue to the northern project limit. Out of the six (6) fine-grained "CL" soil samples tested, two samples were collected near the existing shoulder area adjacent to the SR-57 Mainline; three samples were collected at the ramps (Nutwood Avenue On-Ramp and Yorba Linda Boulevard On-Ramp); and one sample was collected on Yorba Linda Boulevard at the approach to the existing overcrossing. This distribution appears to indicate that most fine-grained near-surface soils are encountered at the ramps or city streets above and below SR-57 just south of Nutwood Avenue to the northern project limit.

Design R-Values for Mainline. Results obtained from the aerially deposited lead (ADL) investigation indicate presence of ADL soils within the project limits (EMI, 2009k). Therefore, onsite soils will be re-used to construct the sliver widening. These onsite soils will be either capped below the pavement or buried under at least a foot of clean soils.

Based on the results of the R-value testing, we recommend using a design R-value of

- "30" from Station 461+35 (southern project limit) to Station 495+55 (Placentia OH), and
- "15" from Station 495+55 to Station 587+15 (northern project limit).

The rigid pavement for the Mainline travel lane will be designed using a "Type II" subgrade soil with $10 \leq$ R-Value ≤ 40 and "South Coast" climate region.

Design R-Values for Ramps. Based on the existing data, we recommend the following design R-values:

- "30" for the Orangethorpe Avenue Off-Ramp (T-Line) and On-Ramp (V-Line), and Chapman Avenue Off-Ramp (G-3 Line),
- "15" for the Nutwood Avenue Off-Ramp (H-1 Line) and On-Ramp (H-8 Line) and Yorba Linda Boulevard Off-Ramp (I-5 Line) and Loop On-Ramp (I-4 Line), and
- "10" for Yorba Linda Boulevard On-Ramp (I-3 Line).

7.4 RECOMMENDED PAVEMENT STRUCTURAL SECTIONS

SR-57 Mainline Travel Lane. As described in Table 2, the existing rigid pavement is largely an "undrained" section except a "drained" section was used for the 1992 widening from about South Placentia OH (Station 485+00) to Placentia Avenue UC (Station 506+22) and from about Nutwood Ave On-Ramp (Station 538+38) to the Yorba Linda Boulevard Loop On-Ramp (Station 571+83). Although Caltrans prefers an undrained section for rigid pavement with TI > 10, the new pavement from about South Placentia Overhead (Station 485+00) to Placentia Avenue UC (Station 506+22) and from just north of Nutwood Avenue UC (Station 538+38) to the Yorba Linda Boulevard Loop On-Ramp (Station 570+00) must be designed as a drained section in order to provide drainage for the water captured below the existing adjacent drained pavement. In this case, the edge drain below the existing pavement must be relocated to below the new shoulder; details of the new edge drain should conform to Caltrans Standard Plans (2006b).

From the project southern limit to Orangethorpe Avenue UC and per OCTA and Caltrans direction, the new pavement can be flexible and undrained to match the existing adjacent section (even though Caltrans HDM Section 633.1(c) (2008) indicates that rigid pavement should be used for TI > 15.0). The existing flexible AC pavement to remain will have a 3-inch grind and overlay per OCTA and Caltrans direction. Recommended pavement sections for Mainline travel lanes are presented in Table 6 for a Traffic Index of 15.5 as provided by RBF.

Table 6. Recommended Pavement Structural Sections, SR-57 Travel Lanes

Location	*Subgrade Type*	*Design R-Value*	*Traffic Index*	*Recommended Sections*[1]
Project Southern Limit to Orangethorpe Ave UC	N.A.	30	15.5	0.80' HMA-A / 2.00' AB[2]
South Placentia OH to Placentia Ave UC and from just north of Nutwood Ave UC (Station 538+38) to Yorba Linda Blvd Loop On-Ramp (Station 570+00)	II	$10 \leq R \leq 40$	15.5	0.90' JPCP / 0.35' ATPB / 0.50' HMA-A / 0.70' AS *With Lateral Support*[3]
All Other Locations	II	$10 \leq R \leq 40$	15.5	1.05' JPCP / 0.50' HMA-A / 0.70' AS *No Lateral Support*

Notes:

1. *JPCP=Joint Plain Concrete Pavement; ATPB=Asphalt Treated Permeable Base; HMA-A=Hot Mix Asphalt, Type A; AB=Aggregate Base (Class 2); AS = Aggregate Subbase (Class 2).*
2. *Use PG 64-10 AC Binder.*
3. *"With Lateral Support" is required in order to match the ATPB layer of the existing adjacent pavement section.*

SR-57 Mainline Shoulder. Undrained pavement sections were designed in accordance with Caltrans HDM (2008). Recommended flexible and rigid pavement sections are given in Table 7 for a Traffic Index of 9.5 as provided by RBF.

Table 7. Recommended Pavement Structural Sections, SR-57 Shoulders

Design R-Value	*Location*	*Traffic Index*	*Flexible*[1]		*Rigid*[2]
			Full-Depth	*Composite*	*Composite*
30	Station 461+35 (southern project limit) to Station 495+55 (Placentia OH)	9.5	1.00' HMA-A	0.55' HMA-A / 1.00' AB	0.75' JPCP/0.35' HMA-A / 0.50' AS (No Lateral Support)
15	Station 495+55 to Station 587+15 (northern project limit)	9.5	1.15' HMA-A	0.55' HMA-A / 0.65' AB / 0.85' AS	

Notes:

(1) HMA-A=Hot Mixed Asphalt-Type A; AB=Aggregate Base (Class 2); AS=Aggregate Subbase (Class 2). Use PG 64-10 AC Binder.

(2) JPCP = Joint Plain Concrete Pavement.

Ramps. As described in Table 2, the existing pavement structural sections are undrained sections except drained sections were constructed at the Orangethorpe Avenue Off-Ramp and On-Ramp ("T" and "V" Ramps). Flexible pavement sections were designed in accordance with Section 633.1 of the Caltrans HDM (2008). Recommended flexible pavement (undrained and drained) sections are given in Table 8 for the on- and off-ramps using a Traffic Index of 12.0 as provided by the RBF. Drained sections are provided for the Orangethorpe Avenue On-Ramp (V-Line) only because existing drained sections along other ramps will be reconstructed using undrained sections.

Table 8. Recommended Flexible Pavement Structural Sections, On- and Off-Ramps

Design R-value	*Ramp*	*TI*	*Undrained*		*Drained*
			Full-Depth Sections	*Composite Sections*	*Composite Sections*
30	Orangethorpe Ave On-Ramp (V)	12	1.25' HMA-A	0.65' HMA-A / 1.40' AB	0.60' HMA-A / 0.25' ATPB / 1.20' AB
30	Orangethorpe Ave Off-Ramp (T); Chapman Ave Off-Ramp (G-3)	12	1.25' HMA-A	0.65' HMA-A / 1.40' AB	
15	Nutwood Ave Off-Ramp (H-1) and On-Ramp (H-8); Yorba Linda Blvd Off-Ramp (I-5) and Loop On-Ramp (I-4)	12	1.45' HMA-A	0.75' HMA-A / 0.65' AB / 1.15' AS	
10	Yorba Linda Blvd On-Ramp (I-3)	12	1.55' HMA-A	0.80' HMA-A / 0.55' AB / 1.35' AS	

HMA-A=Hot Mixed Asphalt-Type A; AB=Aggregate Base (Class 2); AS=Aggregate Subbase (Class 2); Use PG 64-10 AC Binder.

Off-Ramp Termini. According to Topic 626.1 of the Caltrans HDM (2008), rigid pavement is sometimes placed at off-ramp termini for the last 150 feet minimum. Recommended rigid pavement sections at Orangethorpe Avenue and Chapman Avenue Off-Ramps are presented in Table 9. Per agreement with OCTA, rigid pavement sections will not be used at other off-ramp termini within the project limits. Also, due to a limited traffic window during construction , rapid strength concrete can be substituted for Portland cement concrete.

Table 9. Recommended Rigid Pavement Structural Sections, Ramp Termini

Location	*Subgrade Type (Design R-Value)*	*Traffic Index = 12; No Lateral Support*
		Composite Sections
Orangethorpe Ave Off-Ramp (T); Chapman Ave Off-Ramp (G-3)	II ($10 \leq R \leq 40$)	0.85' RSC / 0.40' RSC Concrete Base / 0.60' AS

RSC=Rapid Strength Concrete Pavement; AS= Class 2 Aggregate Subbase.

Maintenance Vehicle Pullouts (MVP). MVP's are located on the Mainline, Orangethorpe Avenue Off-Ramp, Chapman Avenue Off-Ramp, and Yorba Linda Boulevard Off-Ramp and Loop On-Ramp.

Flexible pavement sections were designed in accordance with Section 633.1 of the Caltrans HDM (2008). Recommended flexible pavement (undrained) sections are given in Table 10 using a Traffic Index of 7.0 as provided by the RBF.

Table 10. Recommended Pavement Structural Sections, MVP's

Design R-value	*Location*	*TI*	*Undrained*	
			Full-Depth Sections	*Composite Sections*
30	Mainline Station 461+35 (southern project limit) to Station 495+55 (Placentia OH)	7.0	0.70' HMA-A	0.40' HMA-A / 0.65' AB
15	Mainline Station 495+55 to Station 587+15 (northern project limit)	7.0	0.80' HMA-A	0.50' HMA-A / 0.35' AB / 0.45' AS
30	Orangethorpe Ave Off-Ramp (T) and Chapman Ave Off-Ramp (G-3)	7.0	0.70' HMA-A	0.40' HMA-A / 0.65' AB
15	Yorba Linda Blvd Off-Ramp (I-5) and Loop On-Ramp (I-4)	7.0	0.80' HMA-A	0.50' HMA-A / 0.35' AB / 0.45' AS
HMA-A=Hot Mixed Asphalt-Type A; AB=Aggregate Base (Class 2); AS=Aggregate Subbase (Class 2). Use PG 64-10 AC Binder.				

7.5 COMPACTION AND REMEDIAL GRADING

Compaction of the subgrade should conform to requirements described in Section 19 of the Caltrans Standard Specifications (2006a).

We recommend a minimum overexcavation and recompaction of the upper 18 inches of soils in fill areas; the overexcavation depth is measured from the existing surface in both unpaved and paved areas. In cut areas, the minimum overexcavation and recompaction depth is 12inches if the difference between the finished and existing grade is 2 feet or less, and overexcavation and recompaction are not required if the difference between the finished and existing grade is greater than 2 feet. In cut areas, the overexcavation depth is measured from the finished grade in future unpaved areas or the finished grading plane (top of subgrade) in future paved areas. The overexcavation bottom should be scarified a minimum depth of 6 inches and compacted in-place to the required minimum relative compaction. Unless specified on the contract plans or specifications, the excavated soils (in both fill and cut areas) may be reused as compacted fill.

All overexcavation bottoms should be firm and unyielding prior to fill placement. If not, additional remedial grading may be required.

8.0 MATERIALS AVAILABLE

Construction materials can be supplied by public or private sources. Private sources of construction materials (including sand, gravel, base, concrete, and asphalt concrete) were not investigated. However, materials are available from several commercial suppliers located in Orange, Riverside, and San Bernardino Counties. Table 11 provides the name, location, and telephone number for several commercial sources that can supply materials for the project. The suppliers listed in Table 11

Prior to submitting bids and scheduling construction, contractors should verify the availability of materials from the suppliers listed in Table 11. A current listing of mining operations eligible to sell materials to the State can be found on the Internet at: *http://www.consrv.ca.gov/omr/index.htm*.

Pulverized pavement materials may result from the construction operation. Pulverized pavement materials may be used as base material if the pulverized material meets the quality requirements for bases given in the Caltrans Standard Specifications (2006a). Reuse of pulverized materials should be approved by Caltrans during construction.

Table 11. Material Sources

Operator	*Location/Telephone Number*
Sand and Gravel	
Associated Building Materials	Torrance/310-325-1811
Chief Eagle Inc.	Santa Ana/714-540-7788
E.D.S. Sand & Gravel, Inc.	Orange/714-997-8365
El Toro Materials Company	Lake Forest/949-837-6677
Hanson Aggregates	Irwindale/626-856-6762
Sierra SWPPP & Erosion Control Services	Aliso Viejo /866-500-2110
Southeast Construction Products	Whittier/562-943-0201
West Coast Sand & Gravel, Inc.	Buena Park/714-522-0282
Portland Cement Concrete	
A & A Ready Mix Concrete Company	Gardena/310-515-0933
Associated Ready Mix, Inc.	Fountain Valley/714-966-0231
Bison Ready Mix	Anaheim/714-936-2757
K&G Concrete Pumping	Santa Ana/714-910-9473
Standard Concrete Products, Inc.	Santa Ana/800-266-2738
Standard Ready Mix Concrete	Westminster/714-901-2219
Taylor Ready Mix Concrete	Gardena/310-532-7500
United Concrete Companies, Inc.	South Gate, 323-564-1866

9.0 RECOMMENDED MATERIALS SPECIFICATIONS

9.1 REVIEW OF GRADING AND CONSTRUCTION PLANS

Recommendations contained herein are based on preliminary plans. Final grading and construction plans should be reviewed by EMI to confirm that geotechnical recommendations were applied to the design and that no additional recommendations are required. Recommendations contained in this report may require revision or additional recommendations may be necessary based on the final design.

9.2 GENERAL EARTHWORK REQUIREMENTS

Earthwork should conform to requirements of Section 19 of the Caltrans Standard Specifications (2006a). Compaction of soil should be conducted in accordance with Section 19-5 of the Standard Specifications. Fills placed against existing embankments should be properly keyed and benched into the existing side slopes as described in Section 19-6.01 of the Caltrans Standard Specifications (2006a).

In the event that unanticipated soil conditions are encountered during earthwork activities, EMI should be notified to provide additional recommendations.

9.3 ADJACENT STRUCTURES

No excavation should be performed below an imaginary plane inclined at 45 degrees from the edge of any existing foundation without providing adequate support for the foundation. The contractor is responsible for worker safety in the field during construction. The contractor shall conform to all applicable occupational safety and health standards, rules, regulations, and orders established by the State of California. In addition, other State, County, or Municipal regulations may supersede the recommendations presented herein. If a trench shoring design and safety plan is required, the geotechnical consultant should review the plan to confirm that recommendations presented in this report have been applied to the design.

9.4 PAVEMENT

As indicated in Section 7.3, pavement structural sections are designed based on R-values of 10, 15 and 30. If the R-value of soils exposed during construction comes into question, the exposed soils should be sampled and tested during grading to verify the R-value. Soils placed beneath pavement sections should be inspected, sampled, and tested to verify the minimum required relative compaction.

HMA materials should conform to requirements of Section 39 of the Standard Specifications (2006a) and the Special Provisions.

9.5 CULVERT MATERIALS

We have obtained a list of the buried drainage devices from RBF that will be affected by this project. New devices and existing devices that may or may not need to be extended (designated as Remain-in-place) together with their material types are presented in Table 12.

Table 12. Existing and New Drainage Devices

Stationing	Station Line	Culvert/Pipe Type	Proposed Construction
464+20	SR-57 (B-Line)	RCB	Remain in-place
473+00		RCP	Remain in-place
474+00		CMP	Remain in-place
474+00		APC	New
486+00		RCP	Remain in-place
494+20		RCP	Remain in-place
504+50		RCP	Remain in-place
504+50		APC	New
505+60		RCB	Remain in-place
511+40		CMP	Remain in-place
512+50		APC	New
514+50		APC	New
515+00		CMP	Remain in-place
518+40		CMP	Remain in-place
518+40		APC	New
521+00		APC	New
522+00		CMP	Remain in-place
522+00		APC	New
525+80		CMP	Remain in-place
525+80		APC	New
529+20		APC	New
530+20		RCP	Remain in-place
530+20		ACP	New
115+00	Nutwood Ave (NA-Line)	RCB	Remain in-place
536+80	Nutwood Ave On-Ramp (H-8 Line)	CMP	Remain in-place
542+00	SR-57 (B-Line)	RCP	Remain in-place
542+00		ACP	New
565+00		RCP	Remain in-place
567+30	Yorba Linda Blvd Off-Ramp (I-5 Line)	RCP	Remain in-place
569+70	Yorba Linda Blvd Loop On-Ramp (I-4 Line)	RCP	Remain in-place
569+70		APC	New
570+50	SR-57 (B-Line)	RCP	Remain in-place
30+05	Yorba Linda Blvd (YL-Line)	RCP	Remain in-place
576+00	Yorba Linda On-Ramp (I-3 Line)	RCP	Remain in-place
579+10		RCP	Remain in-place
585+50	SR-57 (B-Line)	RCP	Remain in-place

RCB=Reinforced Concrete Box: RCP=Reinforced Concrete Pipe; CMP=Corrugated Metal Pipe, APC=Alternate Pipe Culvert.

For culvert materials, the corrosion test results in Table 4 were screened to select only the samples collected from the upper 20 feet of the subsurface. A total of 26 soil samples, collected from the

upper 20 feet of the subsurface, were evaluated. Based on our review of the data, the pH ranged from 7.3 to 8.6 and the minimum resistivity is between 490 and 2,000 ohm-cm. Also, the soluble sulfate contents ranged from 50 to 1,000 parts per million (ppm); and the soluble chloride contents ranged from 123 to 416 parts per million (ppm). EMI selected the following worst-case scenario corrosion values to use for determining culvert material requirements:

- Minimum Resistivity = 490 ohm-cm
- pH = 7.3
- Soluble Sulfate = 1,000 ppm
- Soluble Chloride = 416 ppm

Based on these corrosion values and using the CULVERT4 computer program developed by Caltrans, the following information is provided:

- Standard concrete mix design is suitable for Reinforced Concrete Pipe (RCP). Concrete cover should be a minimum 2 inches. The concrete mix design should include Type IP (MS) cement or Type II cement.
- Corrugated Steel pipe should be a minimum of 10-gage (0.138") or 14-gage (0.079") with bituminous coating on the soil side of the pipe to attain an estimated service life of 50 years under non-abrasive conditions with a flow velocity of 5 feet per second.
- Plastic pipe may be used (50-year service life); however, abrasion should be evaluated by the project civil engineer.
- Aluminum pipe or aluminized steel pipe should not be used due to corrosive soil conditions.

9.6 INSPECTION AND TESTING

Qualified geotechnical personnel should perform inspections and testing during the following stages of construction:

- Grading operations, including excavations and placement of compacted fill.
- Removal of existing pavement structural sections, curb and gutter, and concrete sidewalk.
- Preparation of pavement subgrade.
- Placement of aggregate base and subbase.
- Excavations for utility trenches and drainage structures.
- Removal or support of buried utilities or structures.
- Shoring installation, if necessary.
- When any unusual conditions are encountered.

10.0 SOIL TESTING AND MATERIAL PROPERTIES SUMMARY

Relevant soil exploration logs are presented in Appendices A and B. Materials testing results are presented in Appendix C of this report.

11.0 REFERENCES

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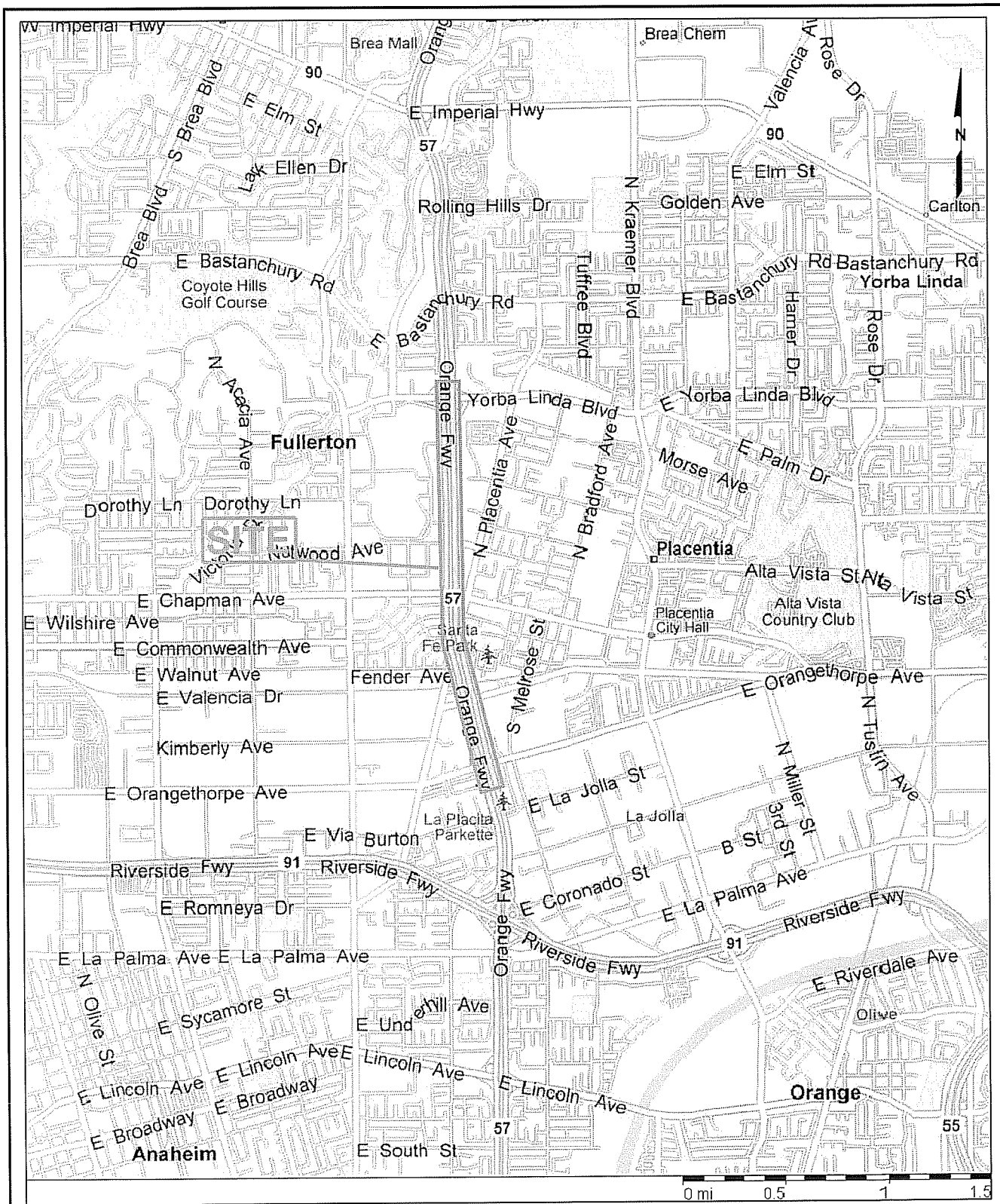

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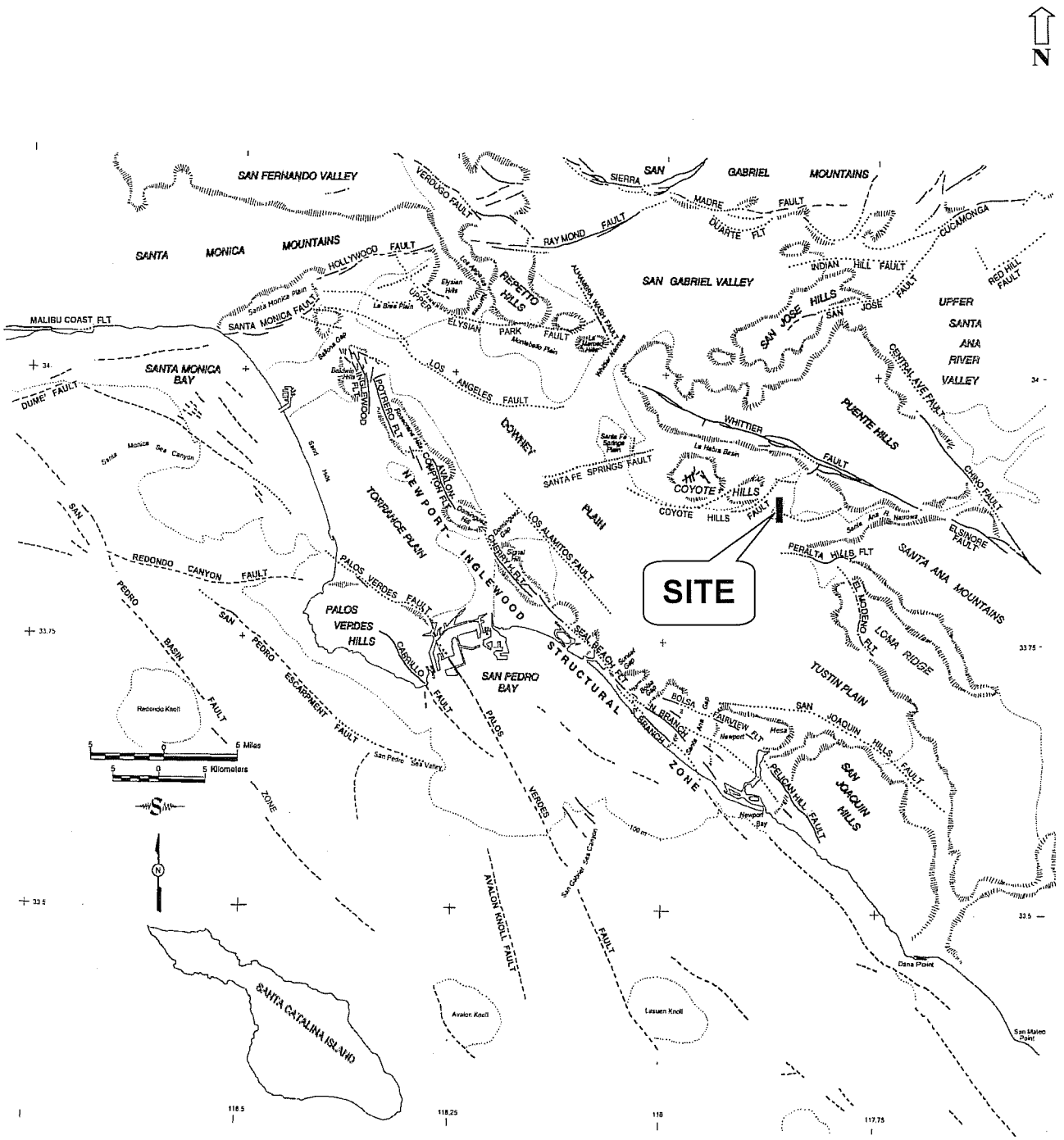
SR-57 Northbound Improvement Project

SITE LOCATION MAP

Figure 1

Project No. 08-115 **Date:** 12-24-08



ORANGETHORPE AVENUE UC (WIDEN)

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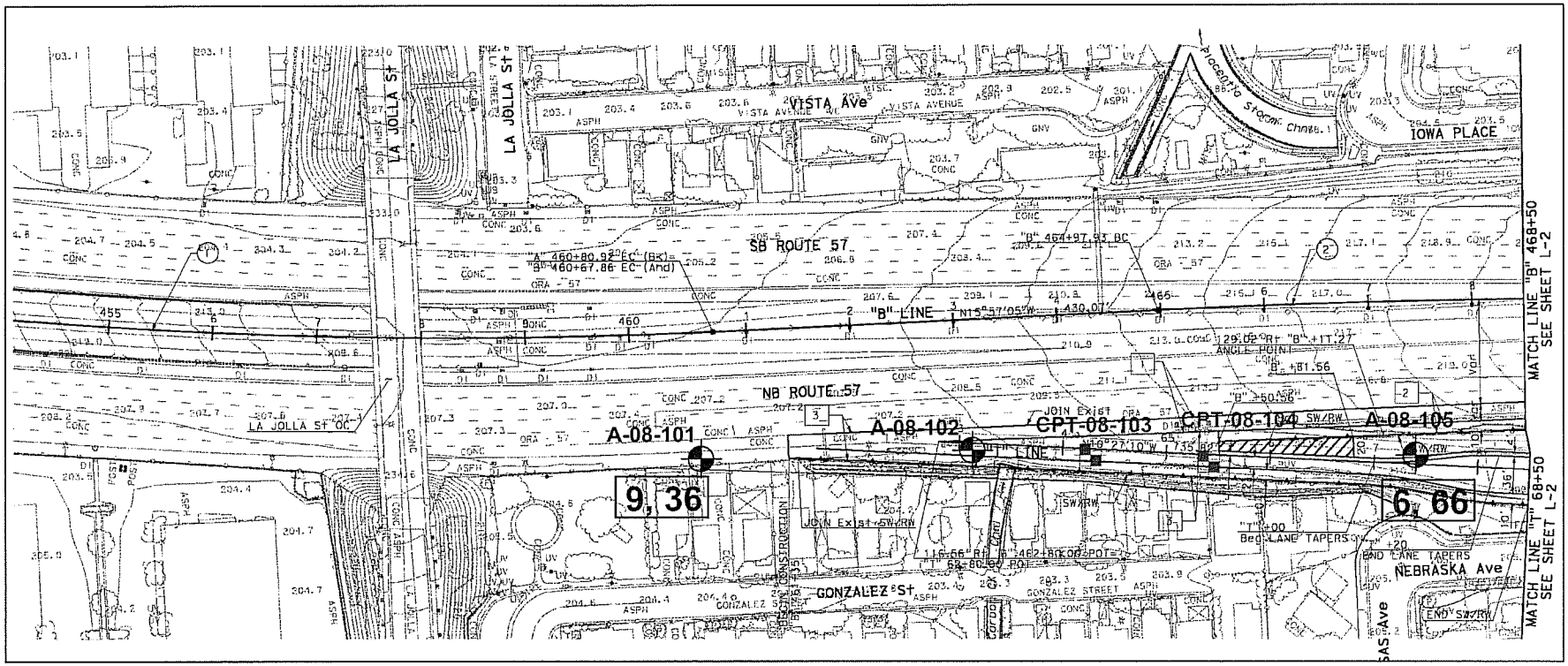
REGIONAL FAULT AND PHYSIOGRAPHIC MAP

Figure 2

Project No. 08-115 | Date: 12-11-08



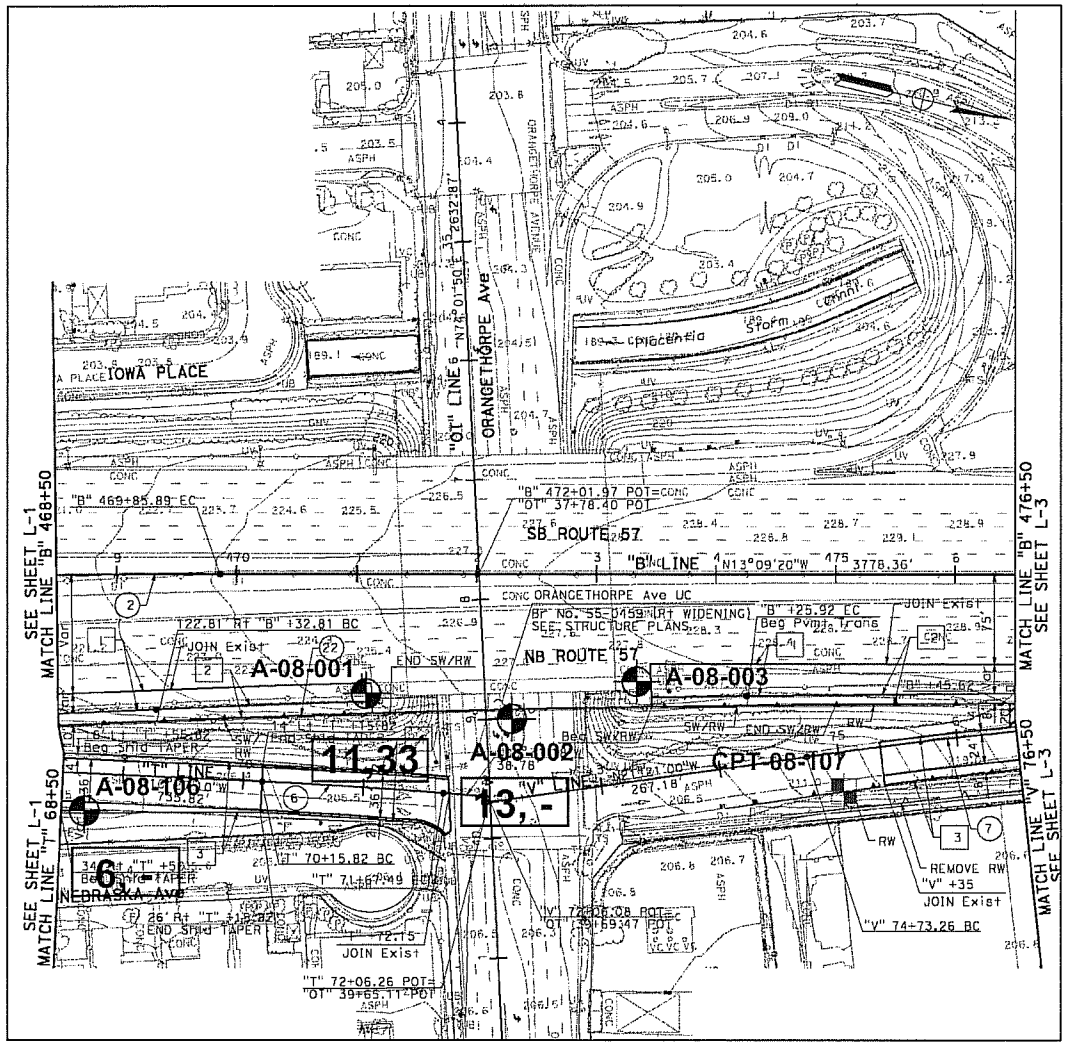
PI, R-Value

Hollow-Stem Auger Boring

Cone Penetrometer Test

0' 100' 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan	
	EMI Project No.: 08-115	Date: 06-09-09	Sheet 1 of 12	Figure 3



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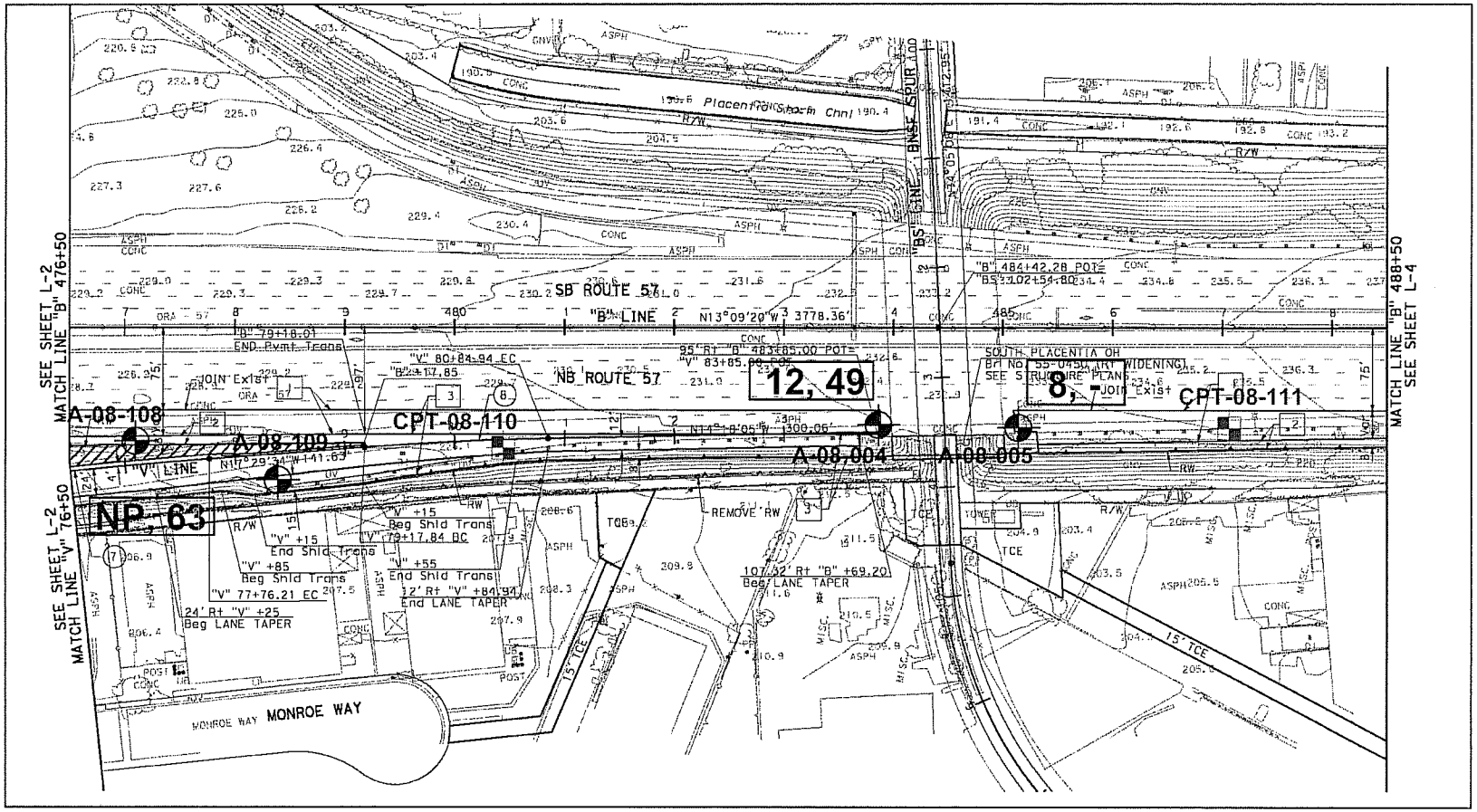
Hollow-Stem Auger Boring

Cone Penetrometer Test

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan
	EMI Project No.: 08-115	Date: 06-09-09	Sheet 2 of 12

Figure 4



PI, R-Value NP: Non-Plastic

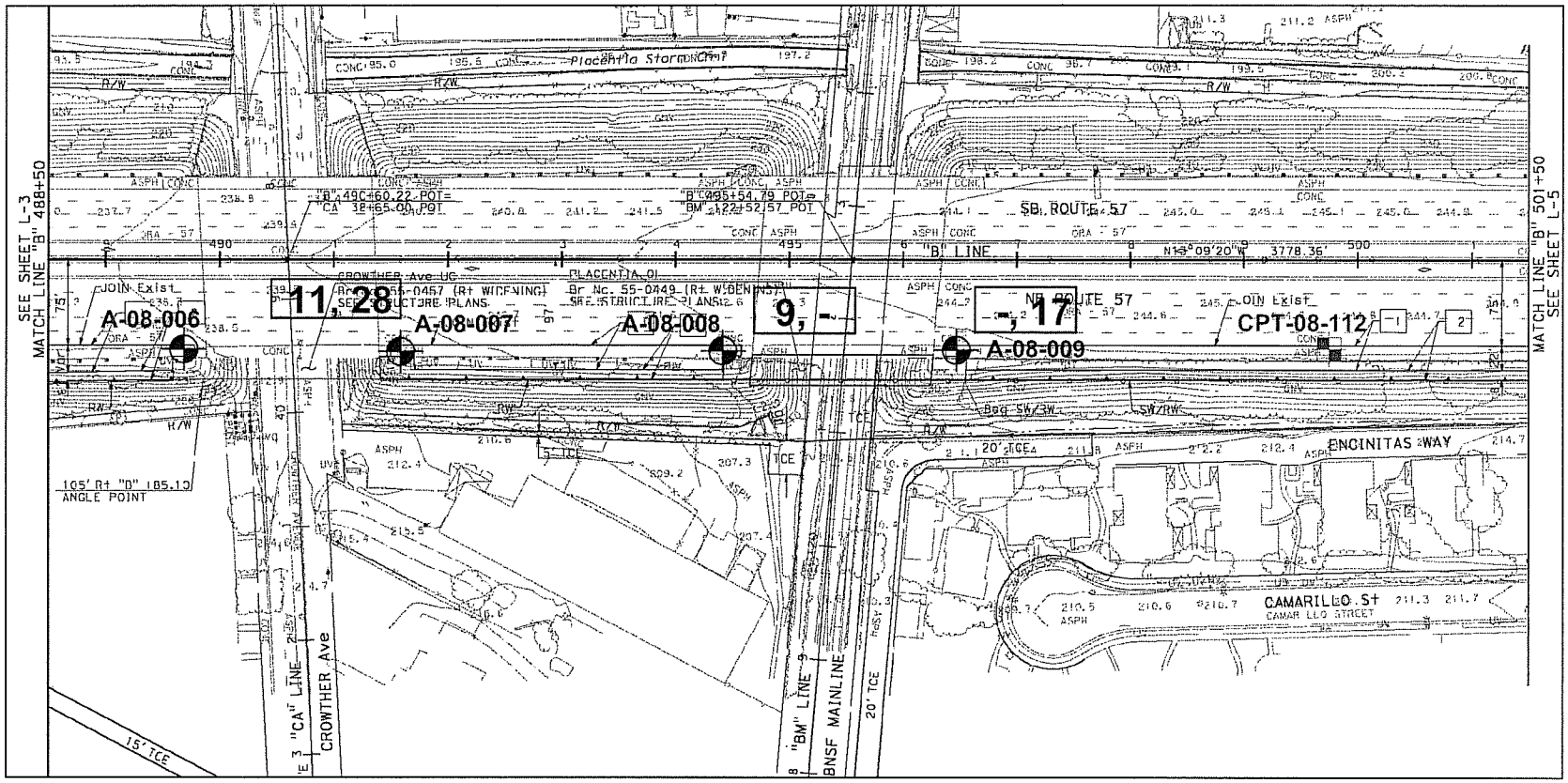
Hollow-Stem Auger Boring

Cone Penetrometer Test

0' 100' 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan
	EMI Project No.: 08-115	Date: 06-09-09	Sheet 3 of 12

Figure 5



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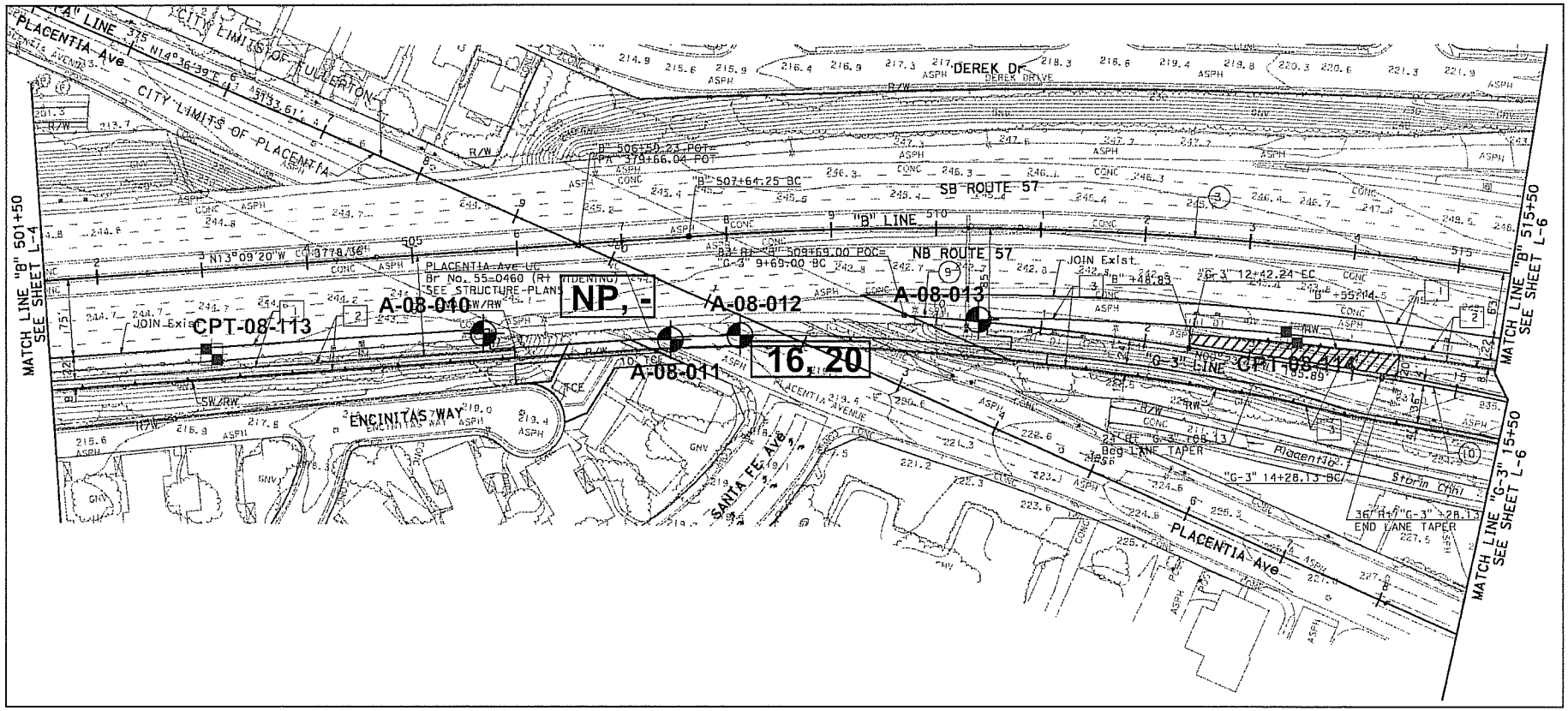
Hollow-Stem Auger Boring

Cone Penetrometer Test

0' 100' 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project	Boring Location Plan	
	EMI Project No.: 08-115 Date: 06-09-09	Sheet 4 of 12	Figure 6



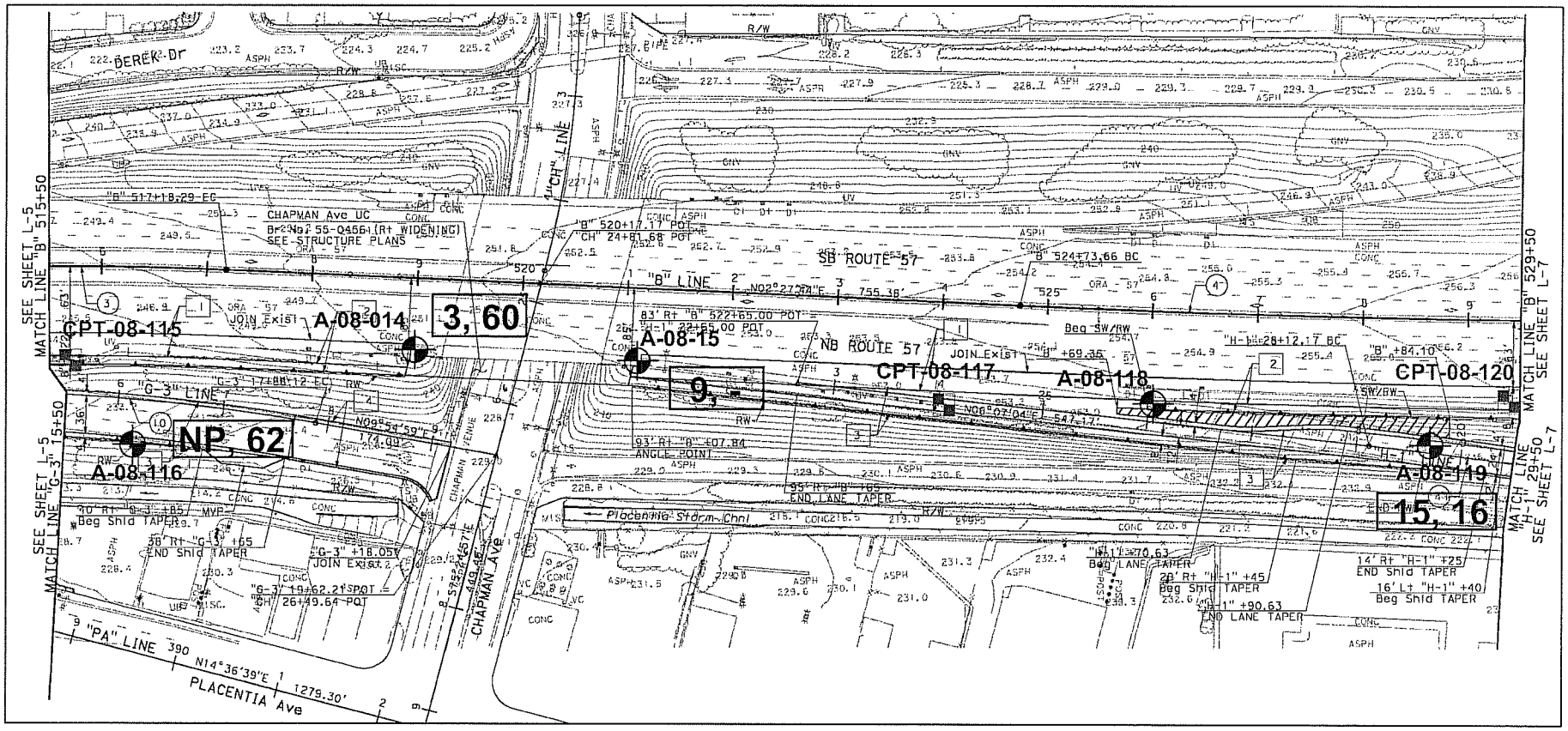
PI, R-Value NP: Non-Plastic

Hollow-Stem Auger Boring

Cone Penetrometer Test

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan
	EMI Project No.: 08-115	Date: 06-09-09	Sheet 5 of 12

Figure 7



PI, R-Value NP: Non-Plastic

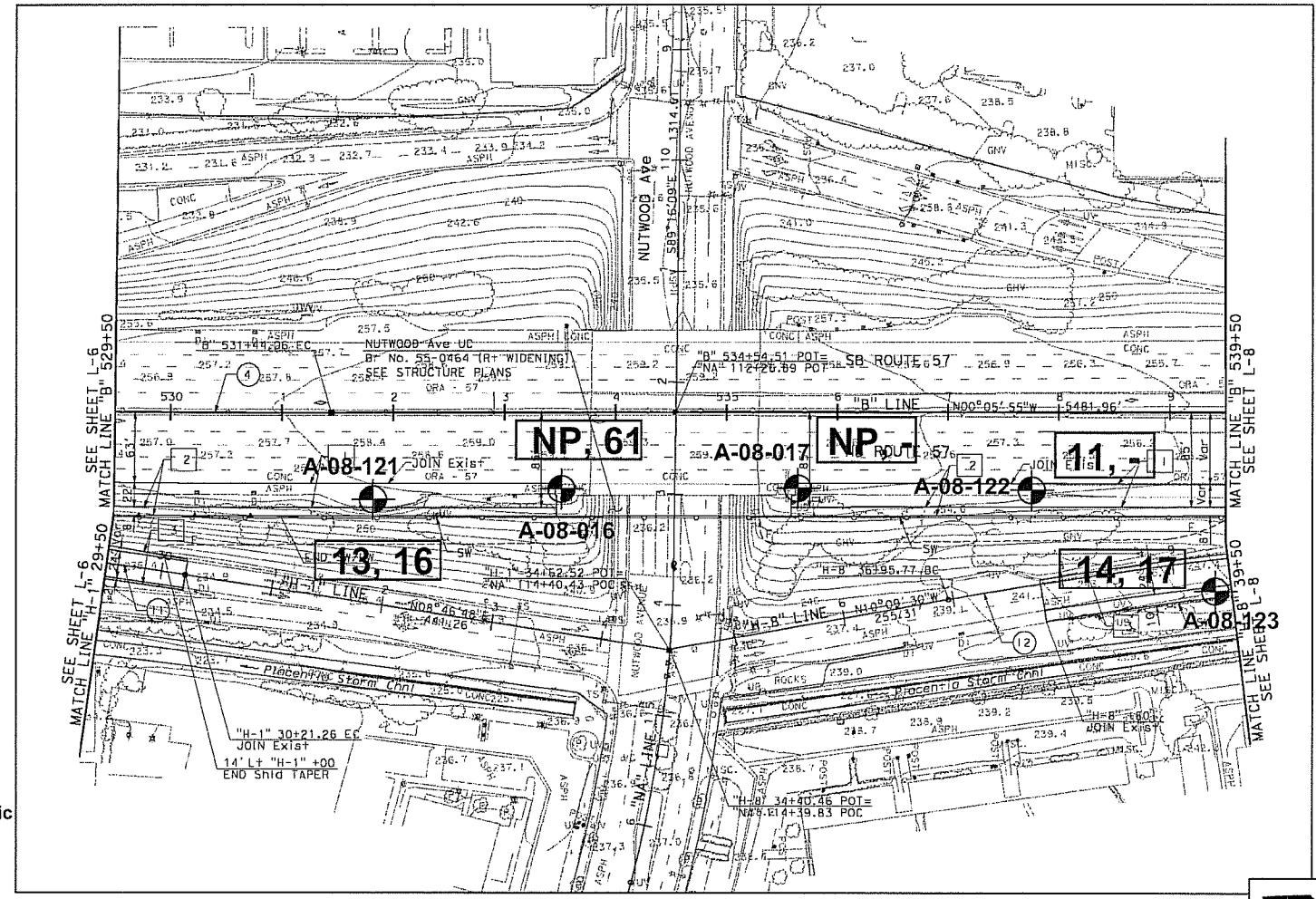
Hollow-Stem Auger Boring

Cone Penetrometer Test

0' 100' 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan
	EMI Project No.: 08-115	Date: 06-09-09	Sheet 6 of 12

Figure 8



NP: Non-Plastic

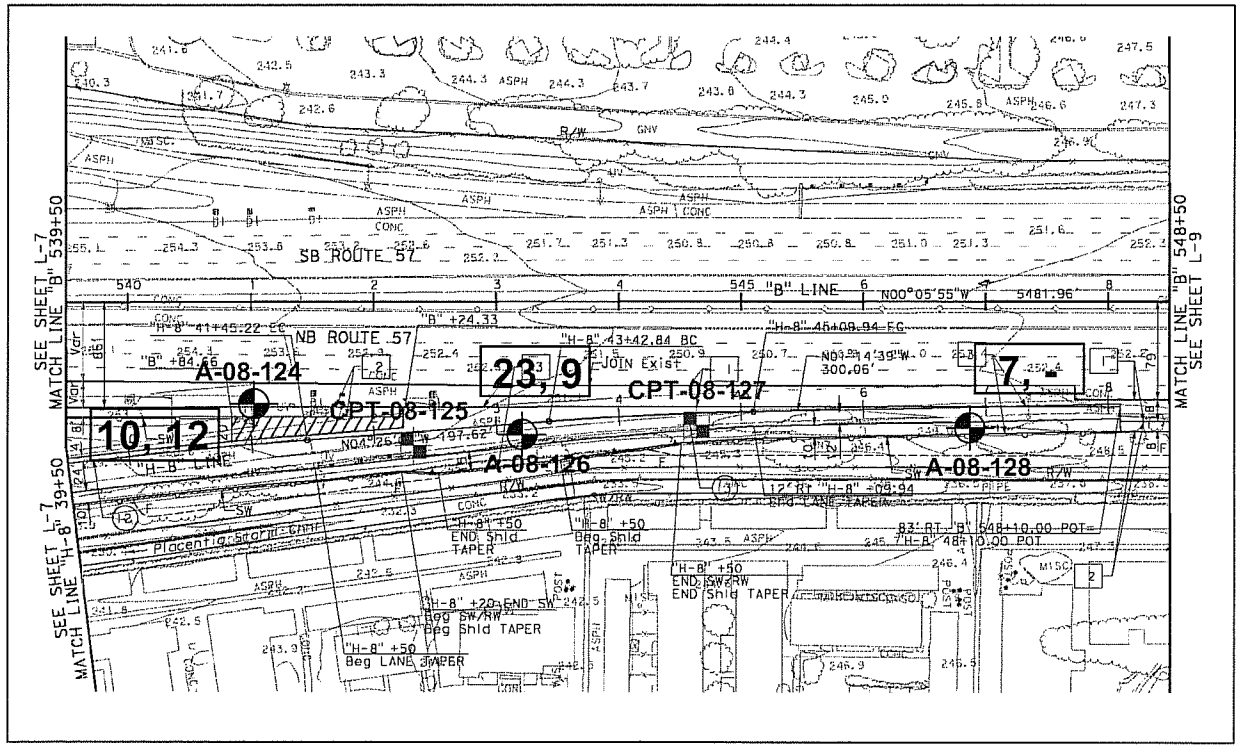
PI, R-Value

Hollow-Stem Auger Boring

0' 100' 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan
	EMI Project No.: 08-115	Date: 06-09-09	Sheet 7 of 12

Figure 9



PI, R-Value

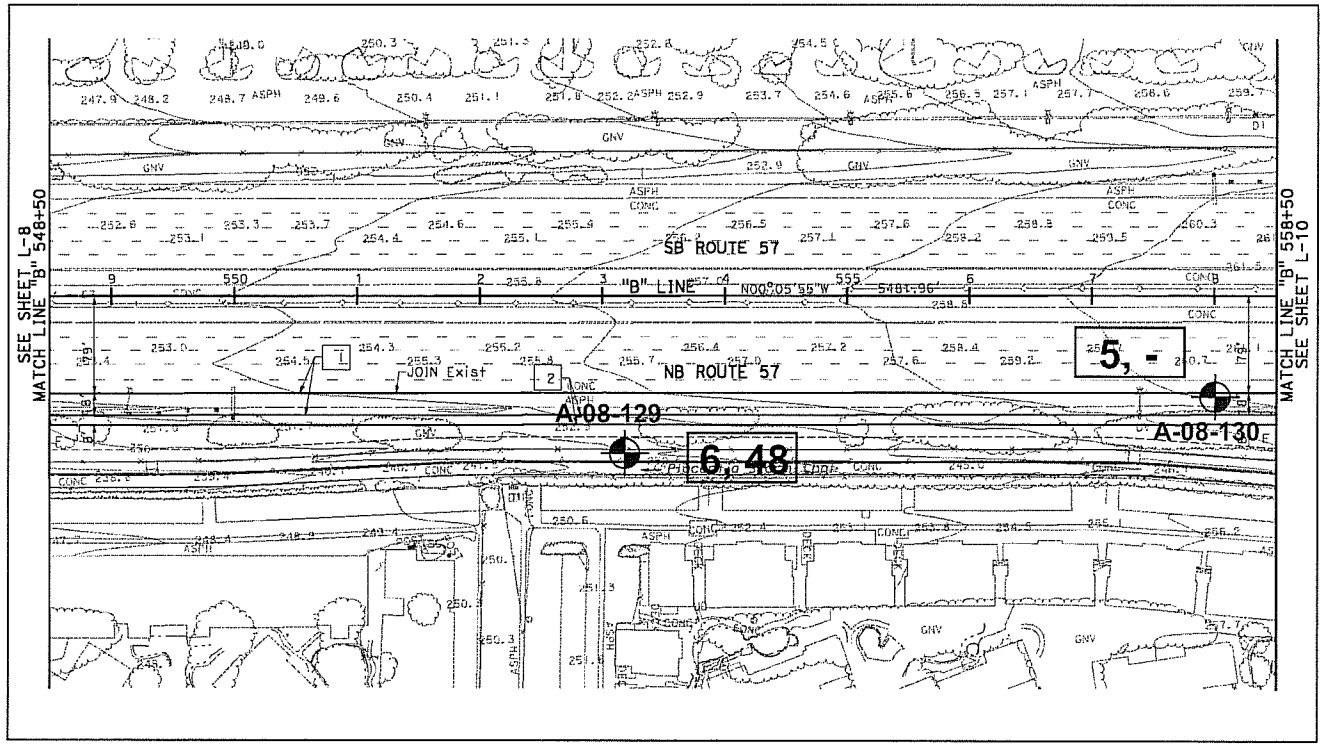
Hollow-Stem Auger Boring

Cone Penetrometer Test

0' 100' 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan
	EMI Project No.: 08-115	Date: 06-09-09	Sheet 8 of 12

Figure 10



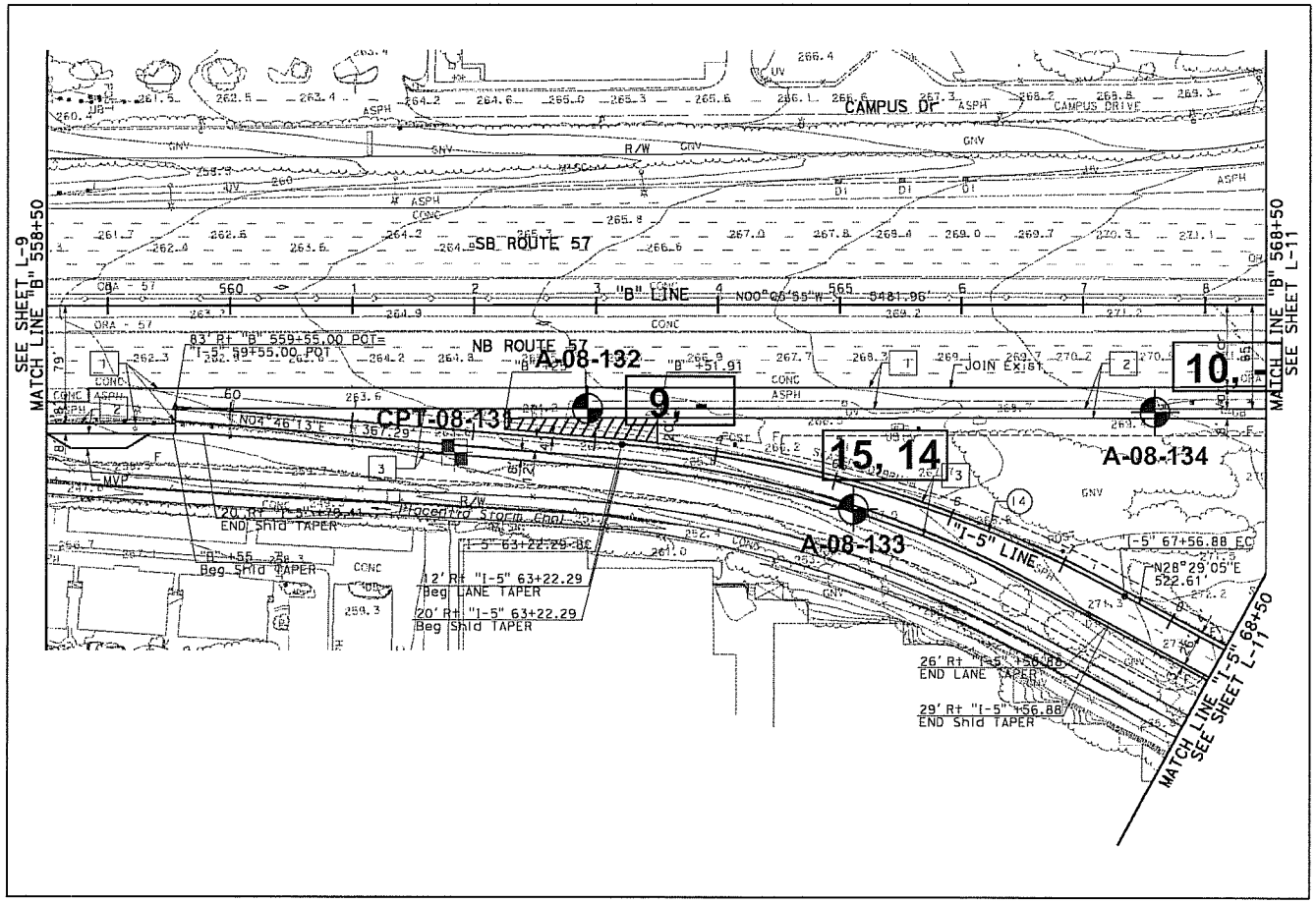
PI, R-Value

Hollow-Stem Auger Boring

0' 100' 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan
	EMI Project No.: 08-115	Date: 06-09-09	Sheet 9 of 12

Figure 11



PI, R-Value

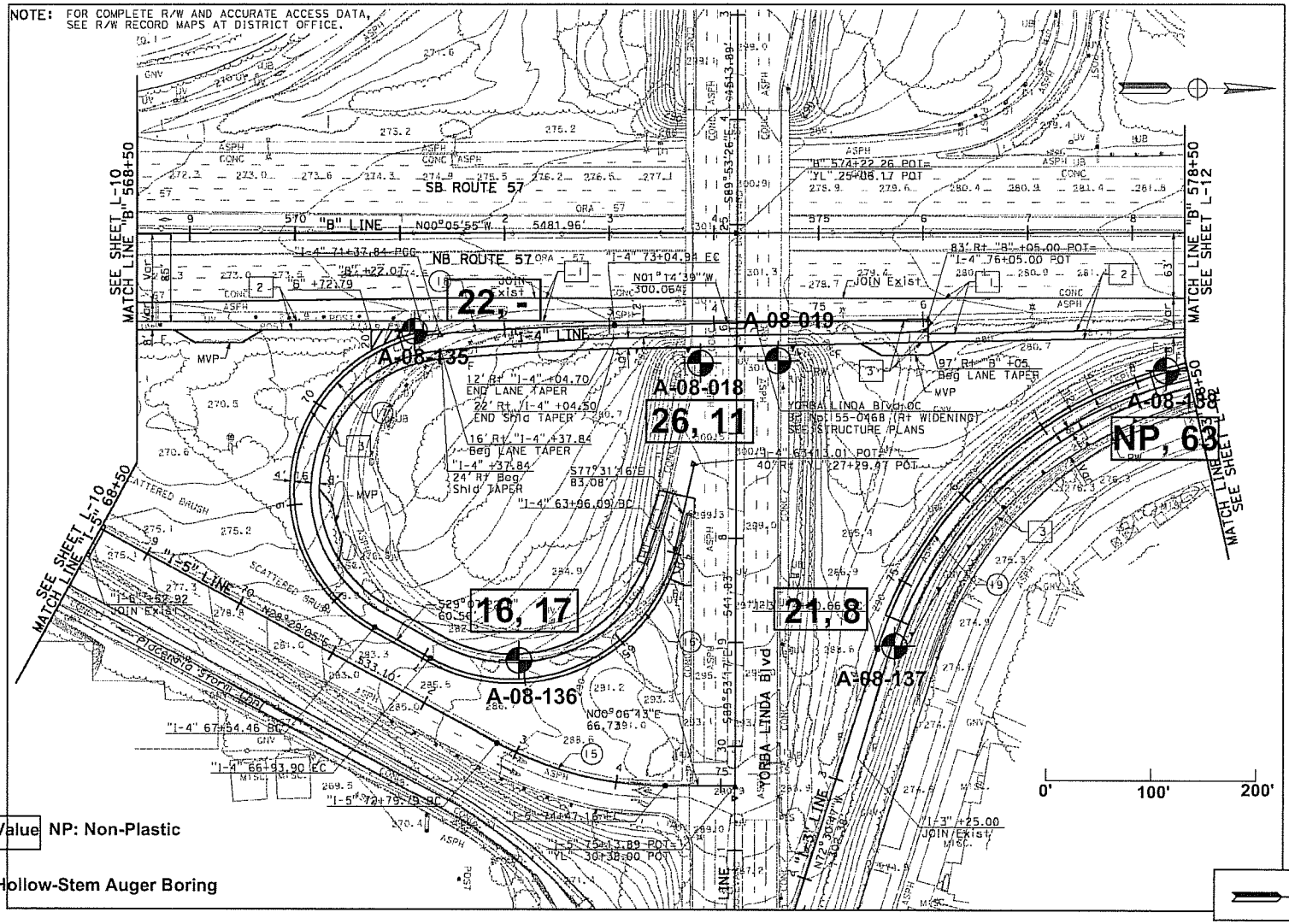
Hollow-Stem Auger Boring

Cone Penetrometer Test

0' 100' 200'

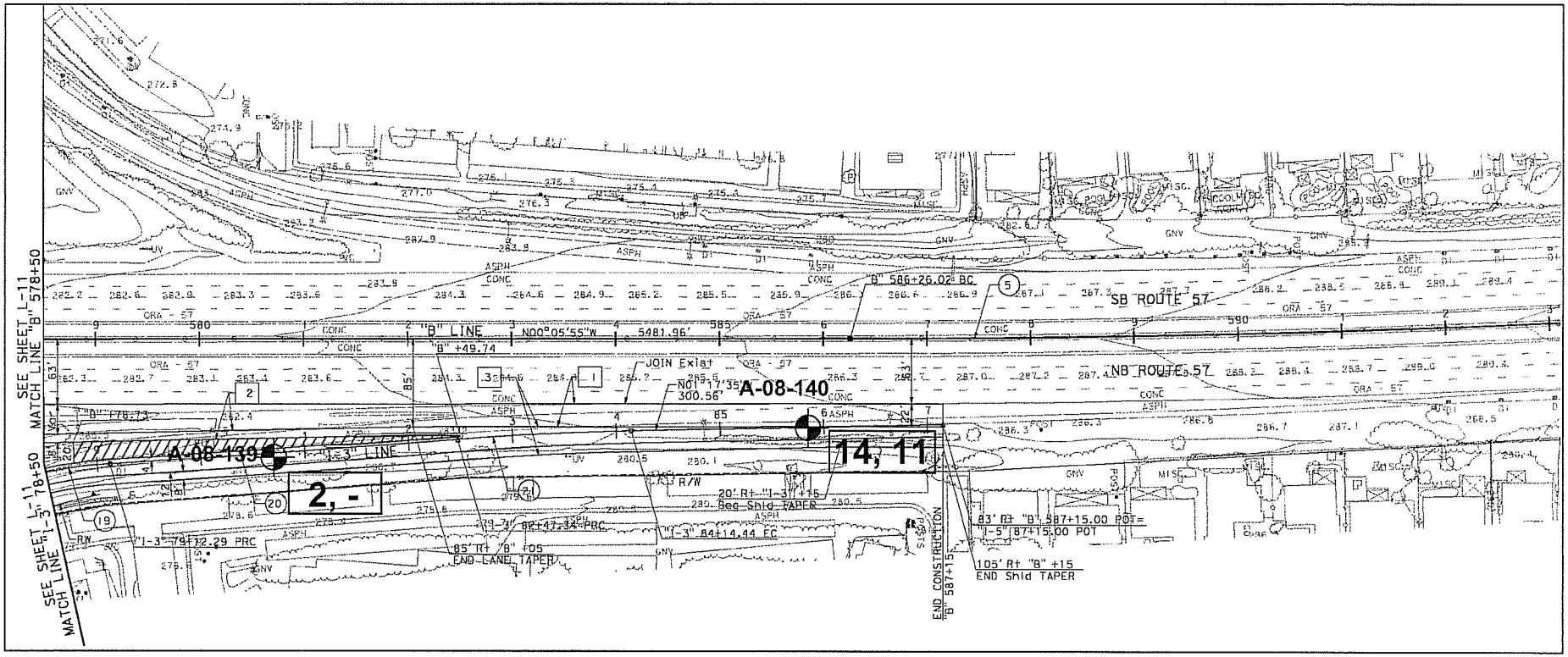
Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan
	EMI Project No.: 08-115	Date: 06-09-09	Sheet 10 of 12

Figure 12



Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan
	EMI Project No.: 08-115	Date: 06-09-09	Sheet 11 of 12

Figure 13



PI, R-Value

Hollow-Stem Auger Boring

0' 100' 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan
	EMI Project No.: 08-115	Date: 06-09-09	Sheet 12 of 12

Figure 14

Appendix A. Exploratory Boring Logs

Grade Elevation	27.3 FT ±				
Boring Depth	25 FT	Driller	2R DRILLING	SHEET 1 OF 1	
Borehole Diameter	8 INCHES	Type of Rig	HOLLOW STEM	Comments	
Date Drilled	12/18/97	Drive Wt.	140-LB		
Logged By	P. F. CHAN	Drop	30 INCHES		

Depth (ft)	Sample Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Weight (lb/ft³)	Tests/ Results
0	B	1			SILTY SAND (SM): DARK GREY-BROWN, MOIST, FINE TO MEDIUM			R, CP
5	D	2	20		SAND (SP): LIGHT OLIVE-GREY, MOIST, FINE TO COARSE, SLIGHTLY COMPACT, LOOSE WHEN HANDLED	14	106	DS
	S	3	20		SAND WITH SILT AND GRAVEL (SP-SM): LIGHT OLIVE-GREY, MOIST, FINE-TO COARSE, COMPACT, GRAVEL WITH DIA. UP TO 1/2 INCH	35	-	PA
10								
15	D	4	40			24	108	

1. 'Sample Type' – Graphical representation of sample type as shown below.
   S: Split Spoon – Standard Penetration Test Sample (SPT)
   D: Drive Sample – California Drive Sampler
   B: Bulk Sample – Obtained by collecting cuttings in a plastic bag
   T: Tube Sample – Thin-walled Tube Sample
   P: Thin-walled Pitcher Core Sample

2. 'Sample' – Sample Number

3. 'Blows/foot' – Number of blows required to advance sampler one foot (unless a distance is specified). Samplers in general were driven into the soil at the bottom of the hole with a 140-lb automatic trip hammer falling a standard 30 inches (as specified in header).

   'REC/RQD' – Sample Core Recovery (REC) in percent (%) and Rock Quality Designation (RQD) in percent (%). RQD is defined as the percentage of core in each run in which the spacing between natural fractures is greater than 4 inches. Mechanical breaks of the core are not considered.

4. 'Graphic Log' – Standard symbols for soil and rock types, as shown in Note B opposite

5. ▼ Groundwater elevation while drilling.

6. 'Geotechnical Description' (See also Note A, opposite).
   Soil – Soil classifications are in general accordance with the American Society for Testing and Materials (ASTM) D2488.84. Designations include consistency, moisture, and color. Field description have been modified to reflect results of laboratory analyses where deemed appropriate.

   Rock – Rock classifications generally include a rock type, color, moisture, mineral constituents, degree of weathering, alteration and the mechanical properties of the rock.

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SR-57 Northbound Improvement Project

EMI Project No.: 08-115 | Date: 12-18-08

LEGEND FOR LETTER-SIZE GEOTECHNICAL BORING LOGS (SHEET 1 OF 2)

7. 'Moisture Content' and 'Total Unit Weight' determined by laboratory testing.

8. 'Tests/Results' – Identify types of laboratory tests performed on samples collected from the field investigation. Abbreviations of tests are provided below:

C	Consolidation (ASTM D 2435)	P	Permeability (CTM 220)	SG	Specific Gravity (AASHTO T 100)
CL	Collapse Potential (ASTM D 5333)	PA	Particle Size Analysis (ASTM D 422)	SL	Shrinkage Limit (ASTM D 427)
CP	Compaction Curve (CTM 216)	PI	Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)	SW	Swell Potential (ASTM D 4546)
CR	Corrosivity Testing (CTM 643, CTM 422, CTM 417)	PL	Point Load Index (ASTM D 5731)	TV	Pocket Torvane
CU	Consolidated Undrained Triaxial (ASTM D 4767)	PM	Pressure Meter	UC	Unconfined Compression–Soil (ASTM D 2166)
DS	Direct Shear (ASTM D 3080)	PP	Pocket Penetrometer		Unconfined Compression–Rock (ASTM D 2938)
EI	Expansion Index (ASTM D 4829)	R	R–Value (CTM 301)	UU	Unconsolidated Undrained Triaxial (ASTM D 2850)
M	Moisture Content (ASTM D 2216)	SE	Sand Equivalent (CTM 217)	UW	Unit Weight (ASTM D 4767)
OC	Organic Content–% (ASTM D 2974)			VS	Vane Shear (AASHTO T 223)

Criteria for Describing Moisture Condition

Description	Criteria (After ASTM D 2488)
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

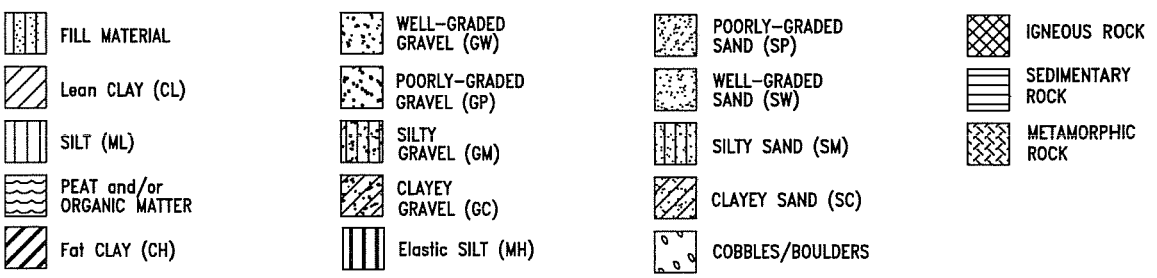
Relative Density of Coarse–Grained Soil

Blows/foot	Relative Density	Field Test (After Sowers, 1979)
0 – 4	Very Loose	Easily penetrated 12" with 0.5–inch steel rod pushed by hand
5 – 10	Loose	Easily penetrated with 0.5–inch steel rod pushed by hand
11 – 30	Medium Dense	Easily penetrated with 0.5–inch steel rod driven by 5–lb hammer
31 – 50	Dense	Penetrated a foot with 0.5–inch steel rod driven by 5–lb hammer
> 50	Very Dense	Penetrated a few inches with 0.5–inch steel rod driven by 5–lb hammer

Consistency of Cohesive Soils

Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

Legend of Earth Materials



Earth Mechanics, Inc.
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SR–57 Northbound Improvement Project

EMI Project No.: 08–115 | Date: 12–18–08

LEGEND FOR LETTER–SIZE GEOTECHNICAL BORING LOGS (SHEET 2 OF 2)

LOG OF BORING NO. A-08-129

Grade Elevation:	255.8 feet				
Boring Depth:	11.5 feet	Driller:	2R Drilling	SHEET 1 OF 1	
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler	
Date Drilled:	9-02-08	Drive Wt. (lbs):	140		
Logged By:	R.J.	Drop (inches):	30		

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			CLAYEY SAND with GRAVEL (SC): medium dense, dark brown, moist, 27% coarse to fine GRAVEL, 48% coarse to fine SAND, 25% fines, low plasticity			R,CP,PA
2.5	S	1	17		CLAYEY SAND (SC): medium dense, dark yellowish brown, moist, about 3% fine GRAVEL, about 67% coarse to fine SAND, about 30% fines, medium plasticity	11	-	
5	D	2	31		SANDY lean CLAY (CL): hard, very dark yellowish brown, moist, about 40% fine SAND, about 60% fines, medium plasticity	14	137	PP>4.5 tsf
7.5								
10	S	3	9		SILTY SAND (SM): medium dense, dark yellowish brown, moist, about 70% medium to fine SAND, about 30% fines, nonplastic	7	-	
12.5					Terminated Boring at 11.5 feet depth. No groundwater encountered.			
15								
17.5								

Earth Mechanics, Inc.
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SR-57 Northbound Improvement Project

Project No. 08-115 Date: 12-18-08

LOG OF BORING NO. A-08-130

Grade Elevation:	260.0 feet			
Boring Depth:	3.5 feet	Driller:	2R Drilling	SHEET 1 OF 1
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler
Date Drilled:	8-29-08	Drive Wt. (lbs):	140	
Logged By:	R.J.	Drop (inches):	30	

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			CLAYEY SAND (SC): medium dense, yellowish brown, moist, few coarse to fine GRAVEL, mostly coarse to fine SAND, little fines, low plasticity			
2.5	D	1	24		SANDY lean CLAY (CL): hard, dark yellowish brown, moist, about 40% fine SAND, about 60% fines, medium plasticity	9	127	PP>4.5 tsf
					Terminated Boring at 3.5 feet depth. No groundwater encountered.			
5								
7.5								
10								
12.5								
15								
17.5								

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SR-57 Northbound Improvement Project

Project No. 08-115 Date: 12-18-08

LOG OF BORING NO. A-08-132

Grade Elevation:	264.5 feet			
Boring Depth:	11.5 feet	Driller:	2R Drilling	SHEET 1 OF 1
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler
Date Drilled:	9-04-08	Drive Wt. (lbs):	140	
Logged By:	R.J.	Drop (inches):	30	

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			SILTY SAND (SM): medium dense, brown, moist, mostly coarse to fine SAND, little fines, trace fine GRAVEL, nonplastic			
2.5	D	1	14		SILTY SAND with GRAVEL (SM): loose , dark yellowish brown, moist, 19% fine GRAVEL, 66% medium to fine SAND , 15% fines, nonplastic	25	124	PA,DS
					Lean CLAY with SAND (CL): medium stiff, olive-gray, moist, about 20% fine SAND, about 80% fines, medium plasticity			
5	S	2	11		SANDY lean CLAY (CL): stiff, dark yellowish brown, moist, about 45% fine SAND, about 55% fines, medium plasticity	14	-	
7.5								
10	D	3	18		SILTY SAND (SM): loose, dark yellowish brown, moist, about 70% medium to fine SAND, about 30% fines, nonplastic	14	124	CR
12.5					Terminated Boring at 11.5 feet depth. No groundwater encountered.			
15								
17.5								

Earth Mechanics, Inc.
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SR-57 Northbound Improvement Project

Project No. 08-115 Date: 12-18-08

LOG OF BORING NO. A-08-133

Grade Elevation:	266.5 feet			
Boring Depth:	11.5 feet	Driller:	2R Drilling	SHEET 1 OF 1
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler
Date Drilled:	9-04-08	Drive Wt. (lbs):	140	
Logged By:	R.J.	Drop (inches):	30	

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			CLAYEY SAND to SANDY lean CLAY (SC/CL): medium dense, dark brown, moist, 6% coarse to fine GRAVEL, 44% coarse to fine SAND, 50% fines, low plasticity			R,CP,PA
2.5	S	1	13		CLAYEY SAND (SC): medium dense, dark yellowish brown, moist, about 65% coarse to fine SAND, about 35% fines, medium plasticity	13	-	
5	D	2	34			12	136	
7.5								
10	S	3	2		SANDY lean CLAY (CL): soft, very dark yellowish brown, moist, about 40% fine SAND, about 60% fines, medium plasticity	20	-	
12.5					Terminated Boring at 11.5 feet depth. No groundwater encountered.			
15								
17.5								

LOG OF BORING NO. A-08-134

Grade Elevation:	269.4 feet				
Boring Depth:	11.5 feet	Driller:	2R Drilling	SHEET 1 OF 1	
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler	
Date Drilled:	9-03-08	Drive Wt. (lbs):	140		
Logged By:	R.J.	Drop (inches):	30		

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			CLAYEY SAND (SC): medium dense, dark brown, moist, trace coarse to fine GRAVEL, mostly coarse to fine SAND, little fines, low plasticity			
2.5	D	1	16		becomes loose, dark yellowish brown, moist, about 2% fine GRAVEL, about 73% coarse to fine SAND, about 25% fines, medium plasticity	13	130	DS
5	S	2	8			14	-	
7.5								
10	D	3	14		SILTY CLAYEY SAND (SC-SM): loose, dark yellowish brown, moist, 51% medium to fine SAND, about 49% fines, low plasticity	14	122	PA
12.5					Terminated Boring at 11.5 feet depth. No groundwater encountered.			
15								
17.5								

LOG OF BORING NO. A-08-135

Grade Elevation:	274.9 feet			
Boring Depth:	2 feet	Driller:	2R Drilling	SHEET 1 OF 1
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler
Date Drilled:	9-04-08	Drive Wt. (lbs):	140	
Logged By:	R.J.	Drop (inches):	30	

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			CLAYEY SAND (SC): medium dense, yellowish brown, moist, few coarse to fine GRAVEL, mostly coarse to fine SAND, little fines, low plasticity			
2.5					Terminated Boring at 2 feet depth. No groundwater encountered.			
5								
7.5								
10								
12.5								
15								
17.5								

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SR-57 Northbound Improvement Project

Project No. 08-115 Date: 12-18-08

LOG OF BORING NO. A-08-136

Grade Elevation:	288.0 feet				
Boring Depth:	10.9 feet	Driller:	2R Drilling	SHEET 1 OF 1	
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler	
Date Drilled:	9-04-08	Drive Wt. (lbs):	140		
Logged By:	R.J.	Drop (inches):	30		

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			SILTY SAND (SM): medium dense, dark brown, moist, 9% fine GRAVEL, 50% coarse to fine SAND, 41% fines, nonplastic			R, PA
2.5	D	1	69		becomes dense, yellowish brown, moist, about 12% fine GRAVEL, about 68% coarse to fine SAND, about 20% fines	7	130	DS
5	S	2	32			9	-	
7.5								
10	D	3	50/5"		No Recovery			
					Terminated Boring at 10.9 feet depth. No groundwater encountered.			
12.5								
15								
17.5								

LOG OF BORING NO. A-08-139

Grade Elevation:	283.4 feet				
Boring Depth:	3 feet	Driller:	2R Drilling	SHEET 1 OF 1	
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler	
Date Drilled:	9-05-08	Drive Wt. (lbs):	140		
Logged By:	R.J.	Drop (inches):	30		

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			SILTY SAND (SM): medium dense, yellowish brown, moist, few coarse to fine GRAVEL, mostly coarse to fine SAND, little fines, nonplastic			
2.5					Terminated Boring at 3 feet depth. No groundwater encountered.			
5								
7.5								
10								
12.5								
15								
17.5								

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SR-57 Northbound Improvement Project

Project No. 08-115 Date: 12-18-08

LOG OF BORING NO. A-08-140

Grade Elevation:	285.6 feet				
Boring Depth:	2 feet	Driller:	2R Drilling	SHEET 1 OF 1	
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler	
Date Drilled:	9-05-08	Drive Wt. (lbs):	140		
Logged By:	R.J.	Drop (inches):	30		

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			CLAYEY SAND (SC): medium dense, dark brown, moist, 37% coarse to fine SAND, 63% fines, low plasticity			R,CP,PA,PI EI
2.5					Terminated Boring at 2 feet depth. No groundwater encountered.			
5								
7.5								
10								
12.5								
15								
17.5								

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SR-57 Northbound Improvement Project

Project No. 08-115 Date: 12-18-08

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

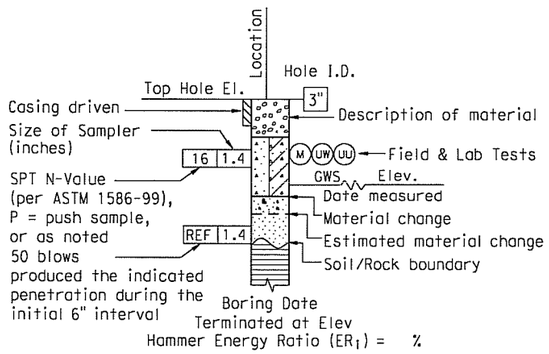
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

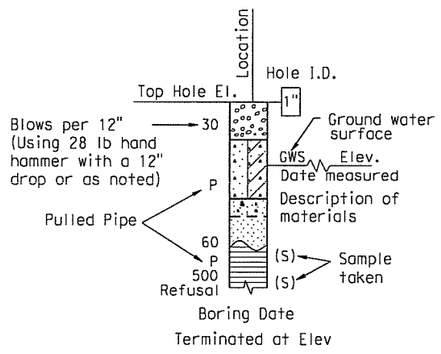
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

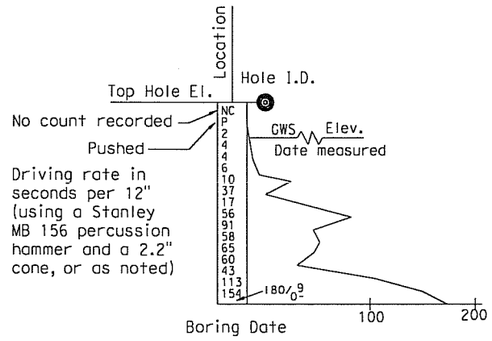
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



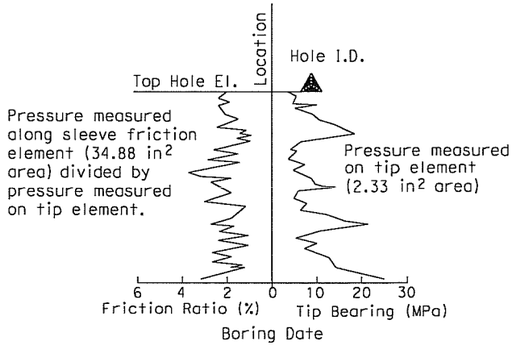
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0078 POST MILES 16.2/18.6	SOIL LEGEND LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

DATE PLOTTED => 6/DATE
TIME PLOTTED => 07:17

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 4427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166); Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0078
POST MILES 16.2/18.6

SOIL LEGEND
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031U

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

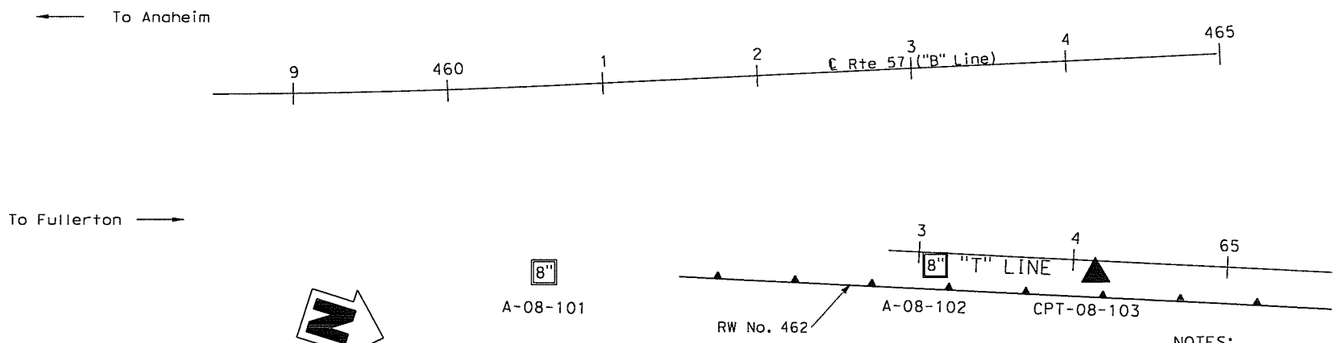
DATE PLOTTED => 9DATE
TIME PLOTTED => 8TIME
USERNAME => SUSER

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang No. C 66394 EXP. 6-30-10 REGISTERED PROFESSIONAL ENGINEER GEOTECHNICAL STATE OF CALIFORNIA

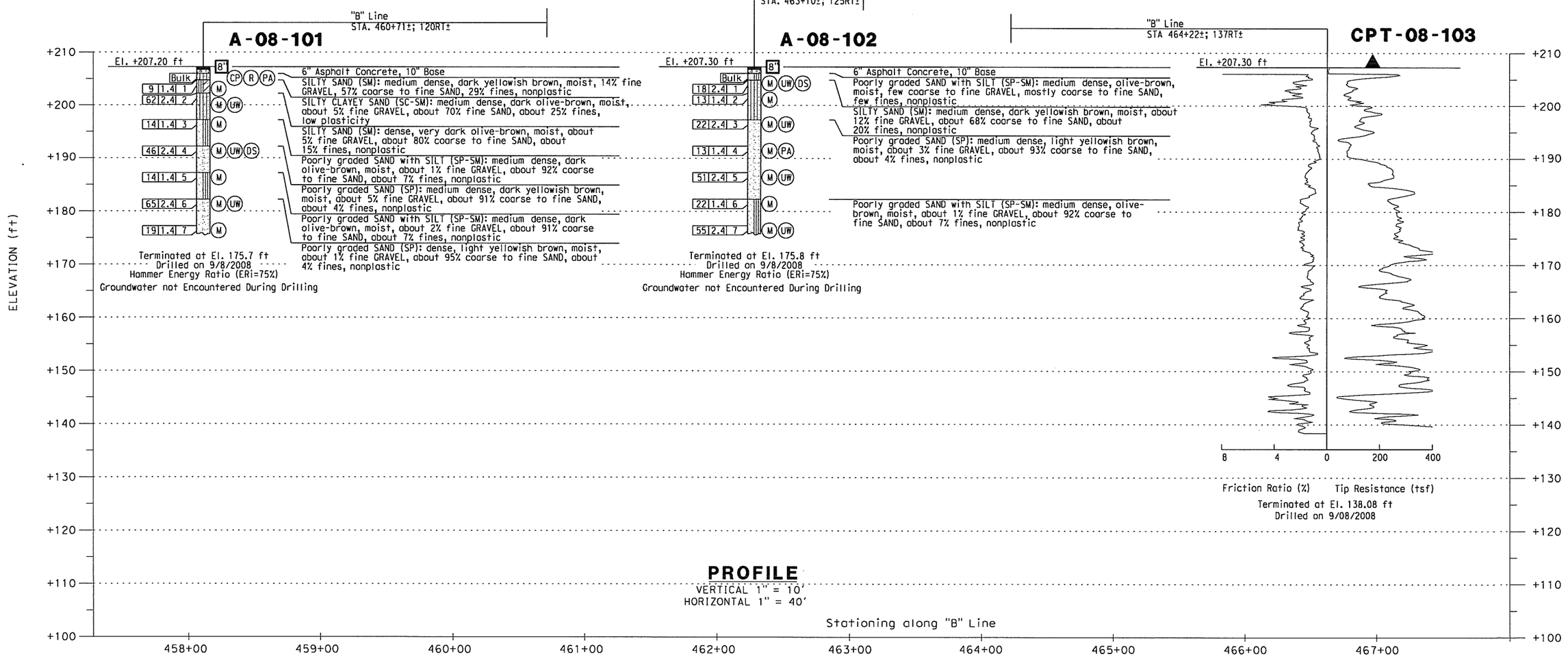
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:
(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.

PLAN
1" = 50'



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0078	RW No. 462	
SIGN OFF DATE	CHECKED BY: L. Cheang				POST MILES 16.0	LOG OF TEST BORINGS No. 3	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS
0 1 2 3

CU 12
EA 0F031J

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)
4/30/09

SHEET 38 OF 46

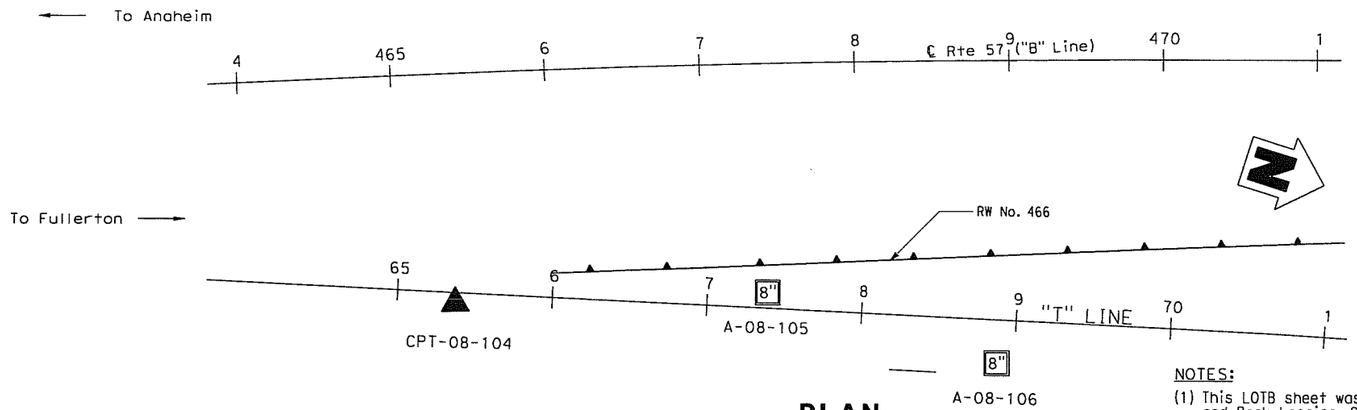
THE PLOTTED 11 SHEET
DATE PLOTTED 11 SHEET

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:
(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
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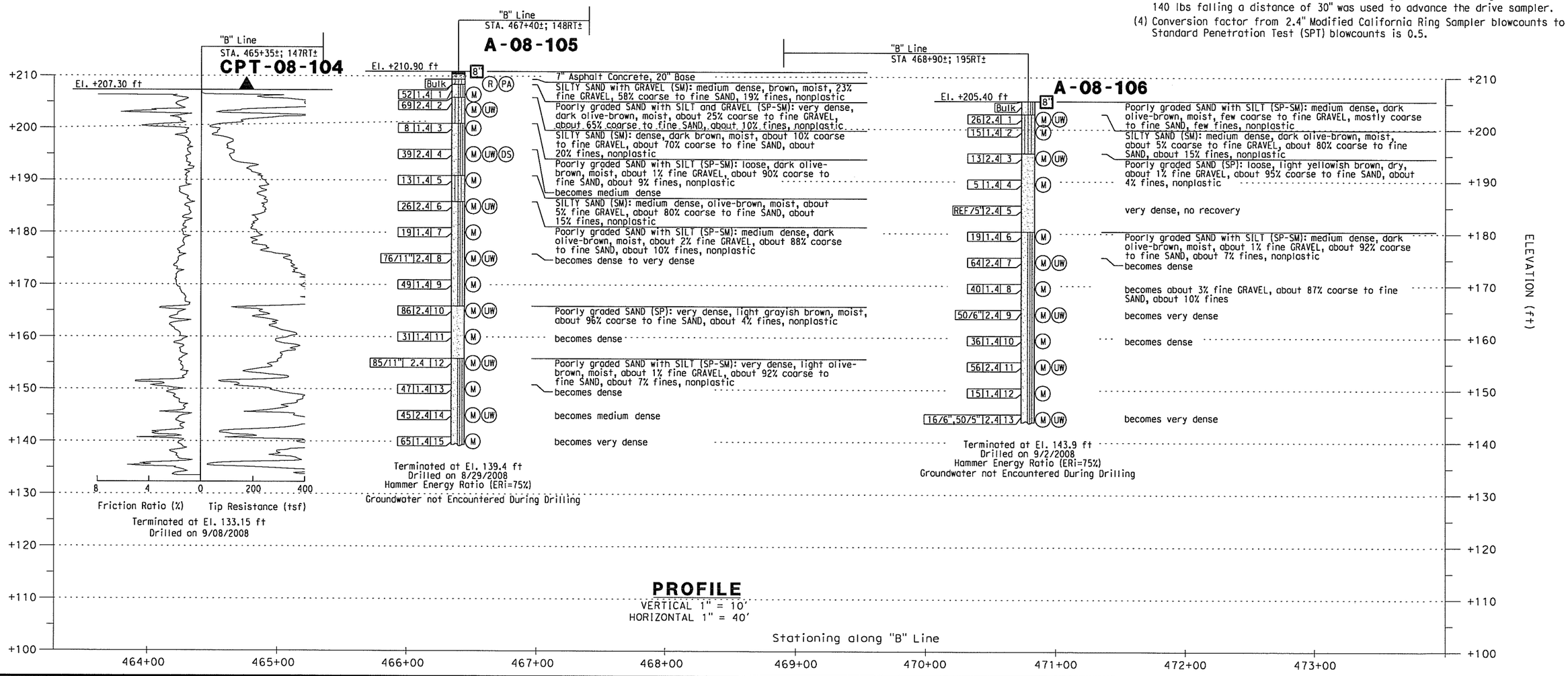


PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0079
SIGN OFF DATE	CHECKED BY: L. Cheang				POST MILES 16.1

RW No. 466
LOG OF TEST BORINGS No. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031U

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

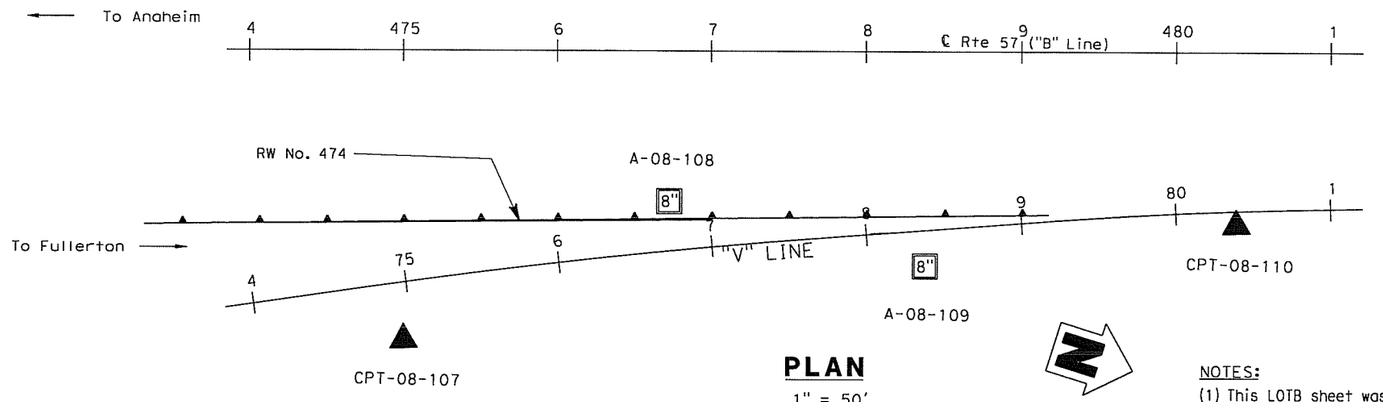
SHEET 39 OF 46

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN

1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
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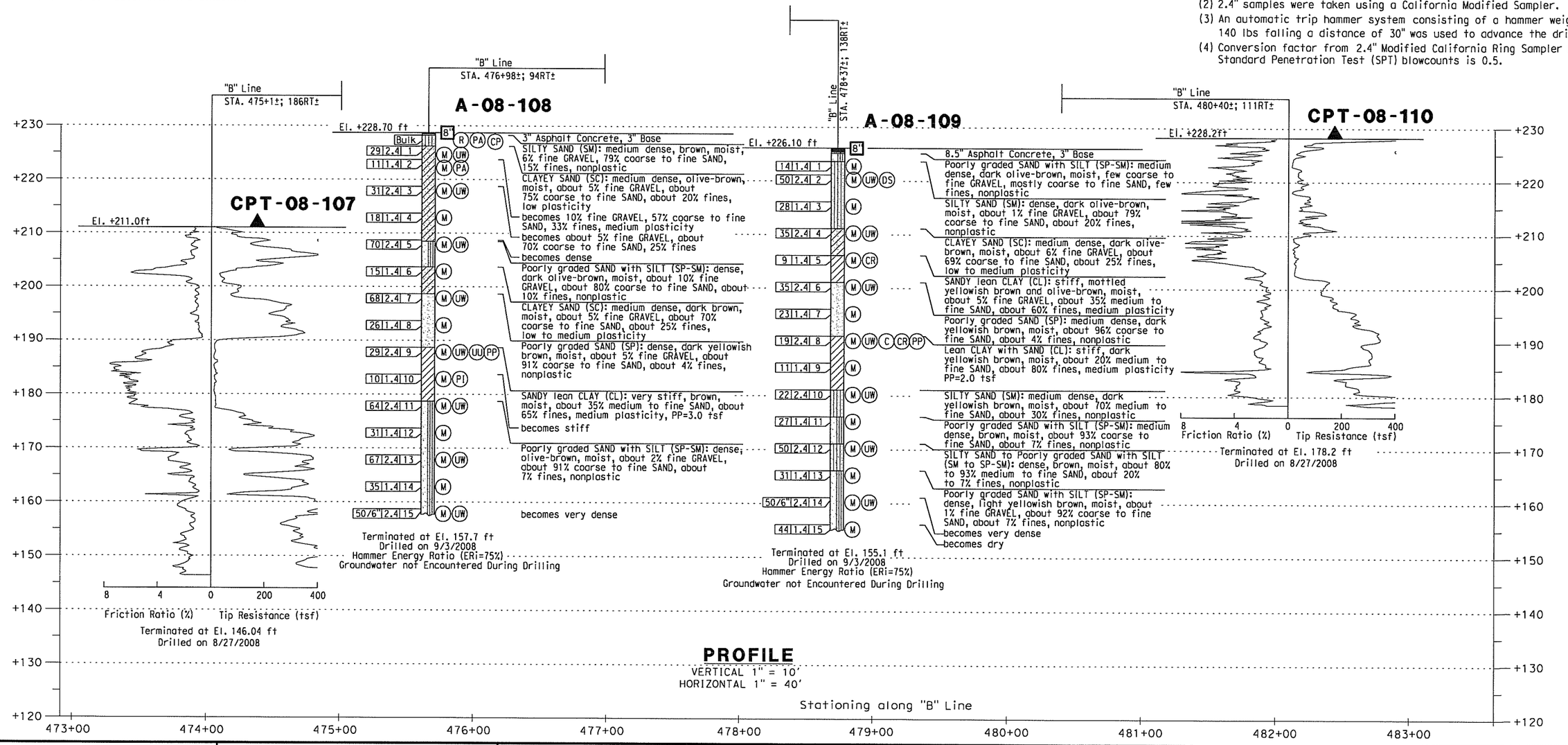


PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0080
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2

RETAINING WALL No. 474

LOG OF TEST BORINGS No. 6

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

CU 12
EA 0F031U

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 40 OF 46

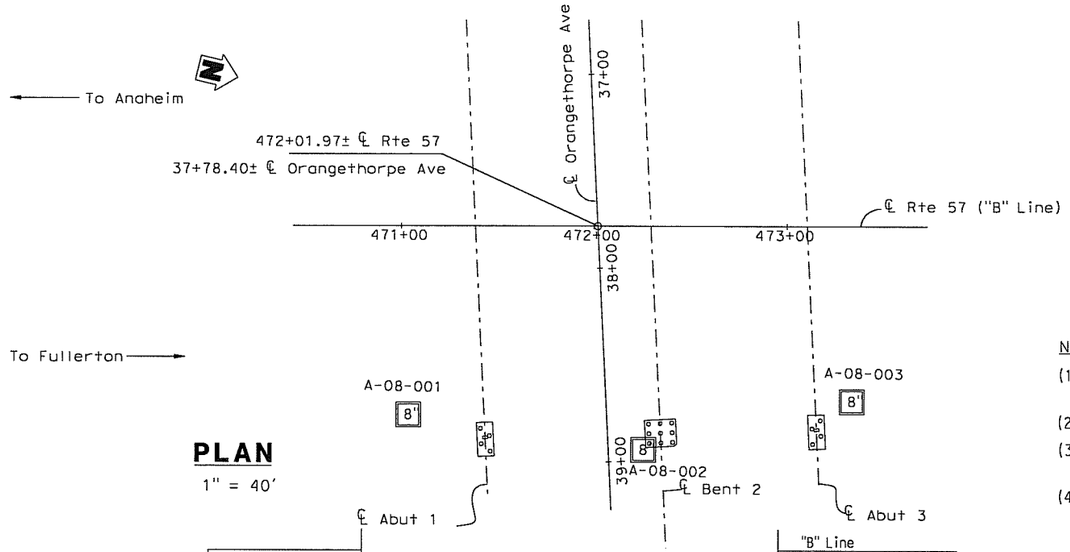
DATE PLOTTED => 8/13/09
TIME PLOTTED => 07:11

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 40'

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lino Cheang
REGISTERED ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER L. CHEANG NO. GE 2345 EXP. 9-30-09 GEOTECHNICAL STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

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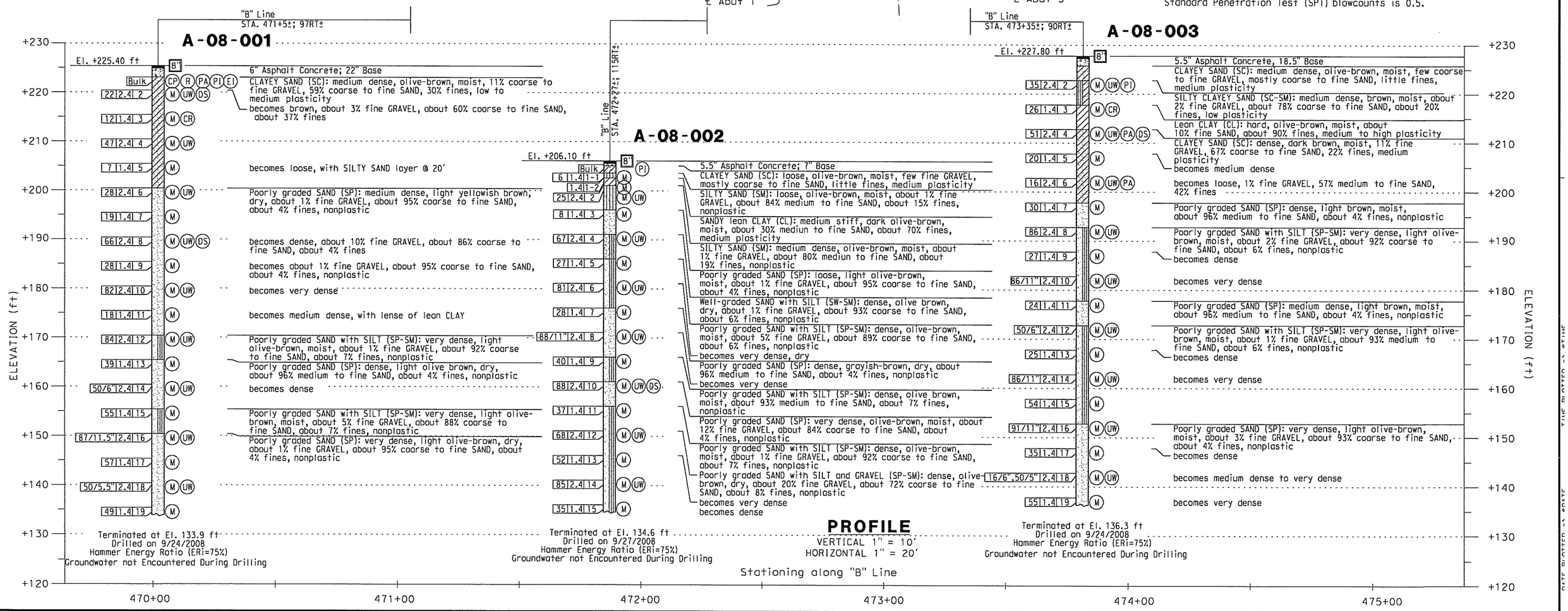

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0459 POST MILES 16.4

ORANGETHORPE AVENUE UC (WIDEN)
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS
CU 12 EA 0F031U
DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY)
SHEET OF
DATE PLOTTED => 6/JUNE
FILE PLOTTED => eTitle

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
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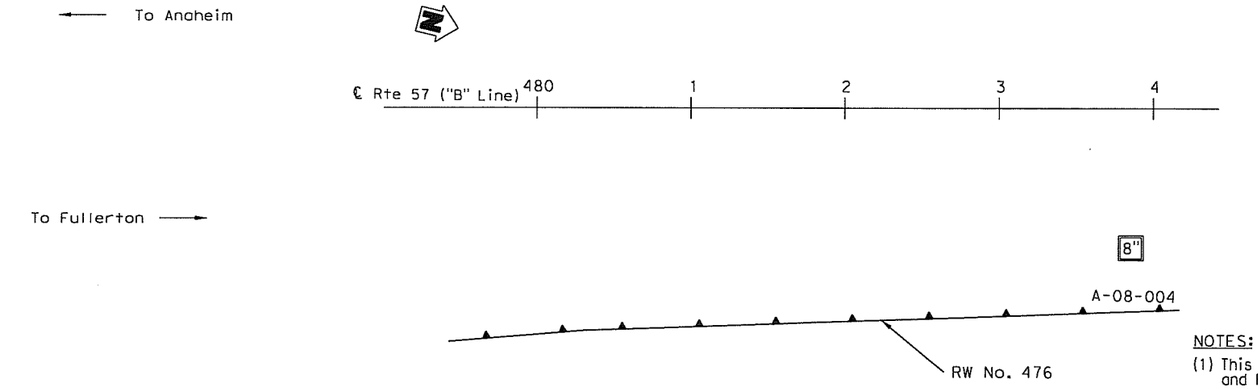


PLAN
1" = 40'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

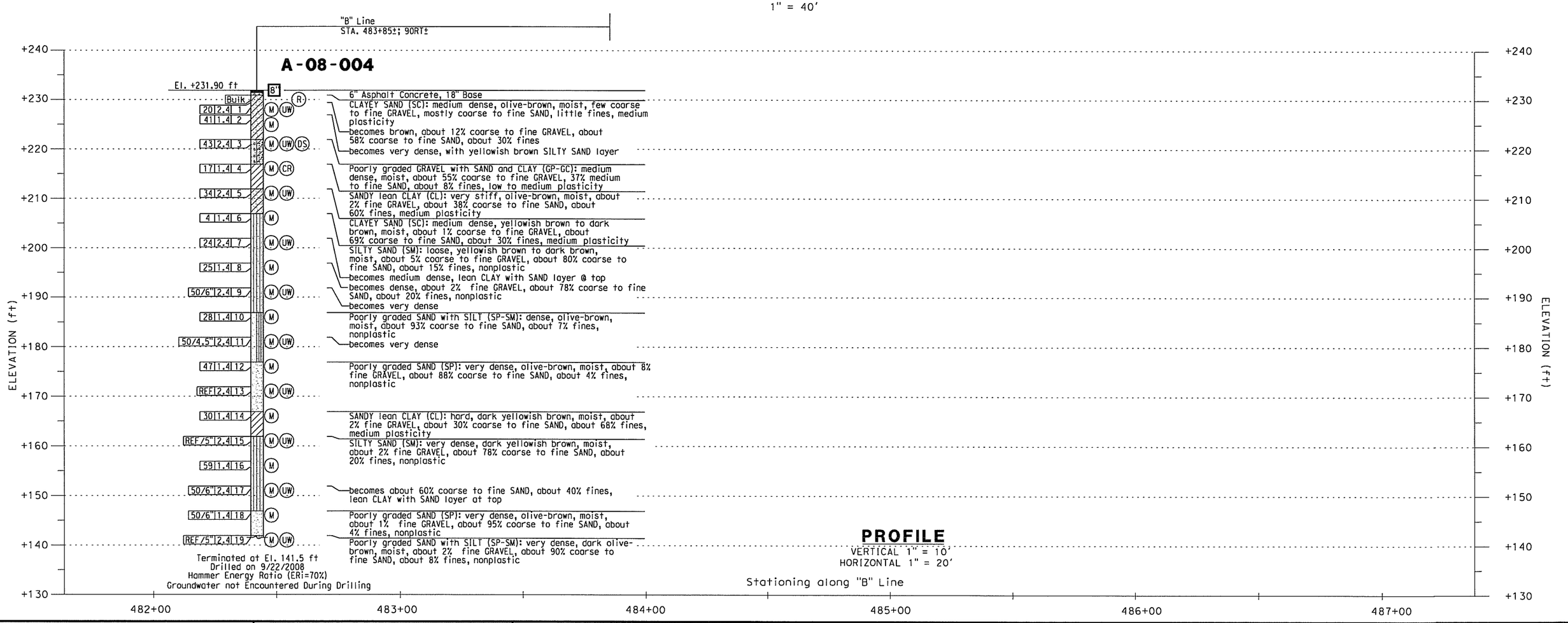
REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:
(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0081 / POST MILES 16.3

RETAINING WALL No. 476
LOG OF TEST BORINGS No. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

CU 12
EA 0F031U

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 17 OF 17

DATE PLOTTED => 04/10/09
TIME PLOTTED => 08:47

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

Chien-Tai Yang, No. C 66394, Exp. 6-30-10, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

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EARTH MECHANICS, INC.
17660 NEWHOPE ST, SUITE E
FOUNTAIN VALLEY, CA 92708

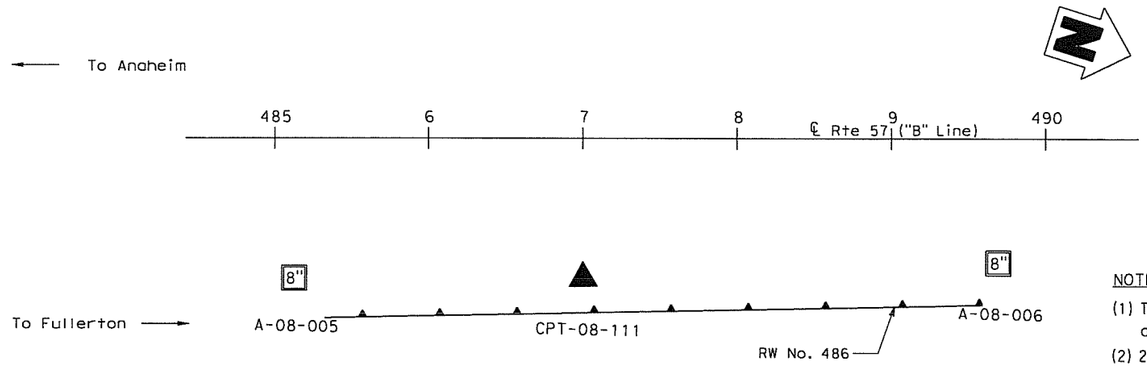
ORANGE COUNTY
TRANSPORTATION AUTHORITY
550 SOUTH MAIN STREET
ORANGE, CA 92863

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 50'

NOTES:

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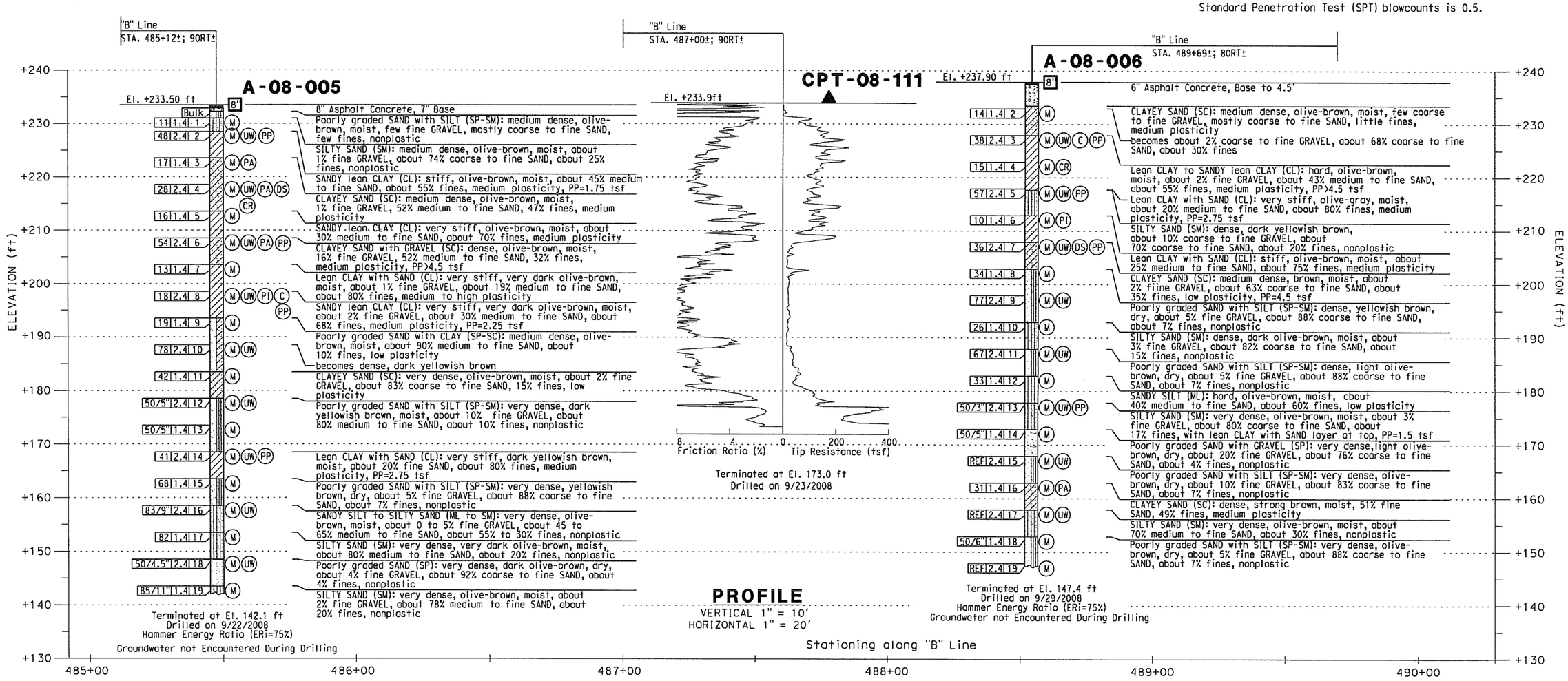

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

LOG OF TEST BORINGS NO. 3
RW No. 486
SCALE AS SHOWN

R-19

$USER | CALCULATED-DESIGNED BY | CHECKED BY | CONSULTANT FUNCTIONAL SUPERVISOR | STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | $DATE | $TIME | REVISED BY | DATE REVISED | LAST REVISION
CHIEN-TAI YANG | LINO CHEANG | LINO CHEANG | $REQUEST

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

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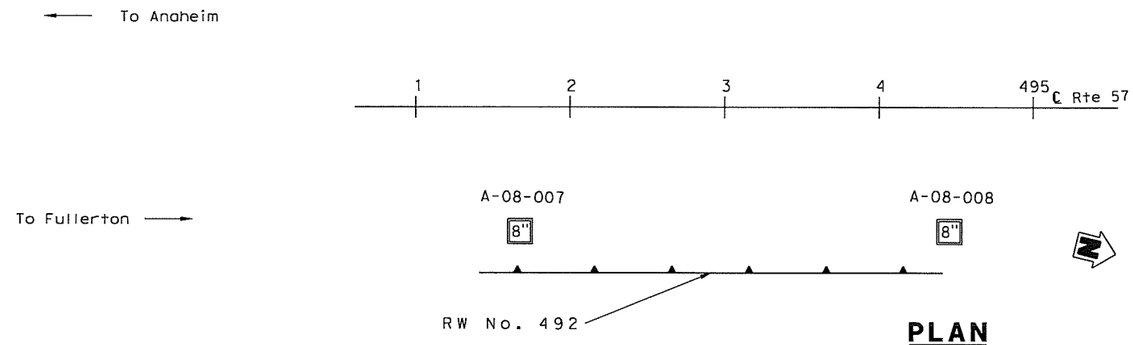

PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:
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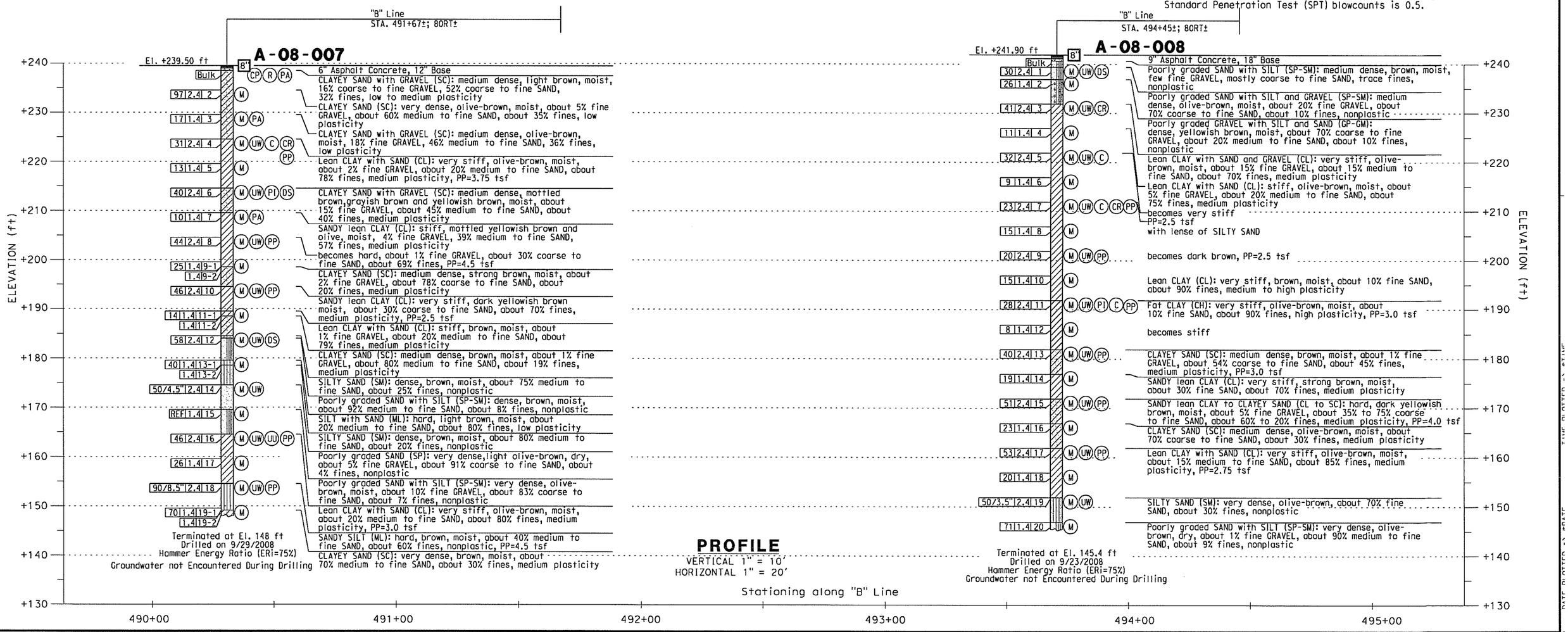

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0082 / POST MILES 16.6
SIGN OFF DATE	CHECKED BY: L. Cheang				RW No. 492 LOG OF TEST BORINGS No. 7

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12 EA 0F031U

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET 41 OF 46

DATE PLOTTED: 4/30/2009 TIME PLOTTED: 14:57

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171

Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872

Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

NOTES:

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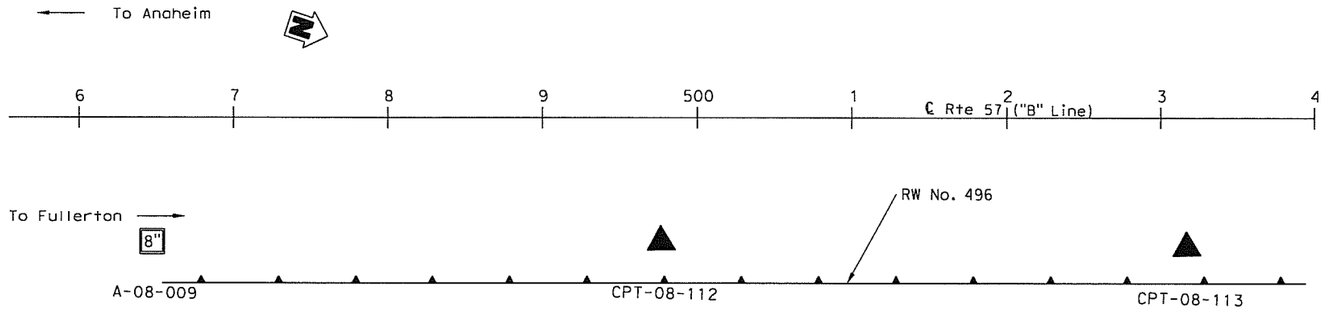


PLAN

1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

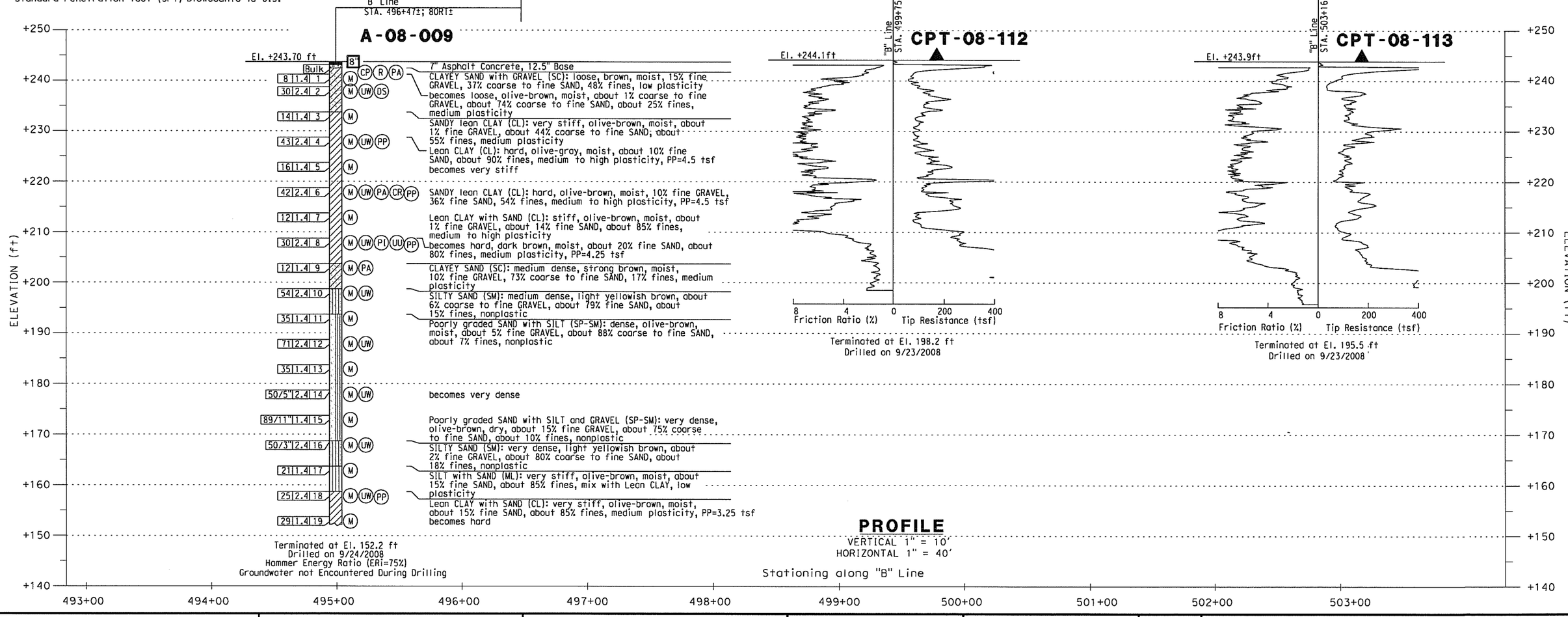
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

Stationing along "B" Line

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER

BRIDGE NO.	RETAINING WALL No. 496
55E0083	LOG OF TEST BORINGS No. 3
POST MILES 16.7	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031U

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 23 OF 24

DATE PLOTTED => 6/11/09

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

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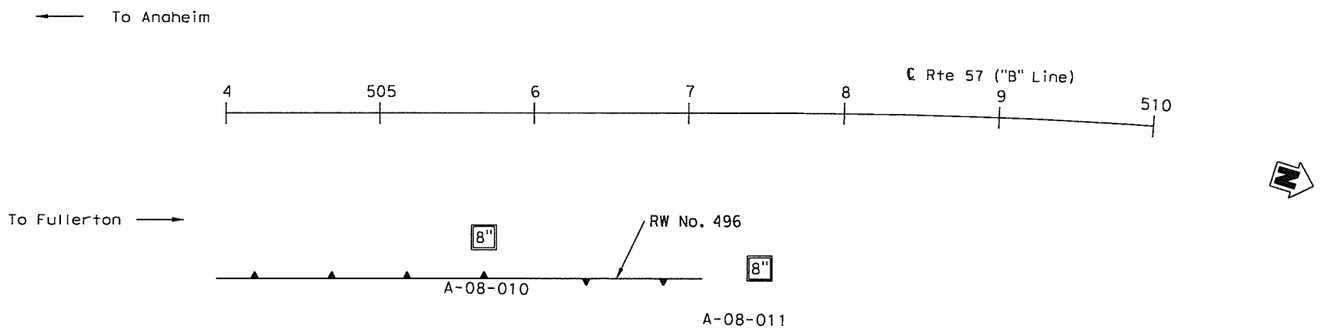

PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang, No. C 66394, Exp. 6-30-10, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:
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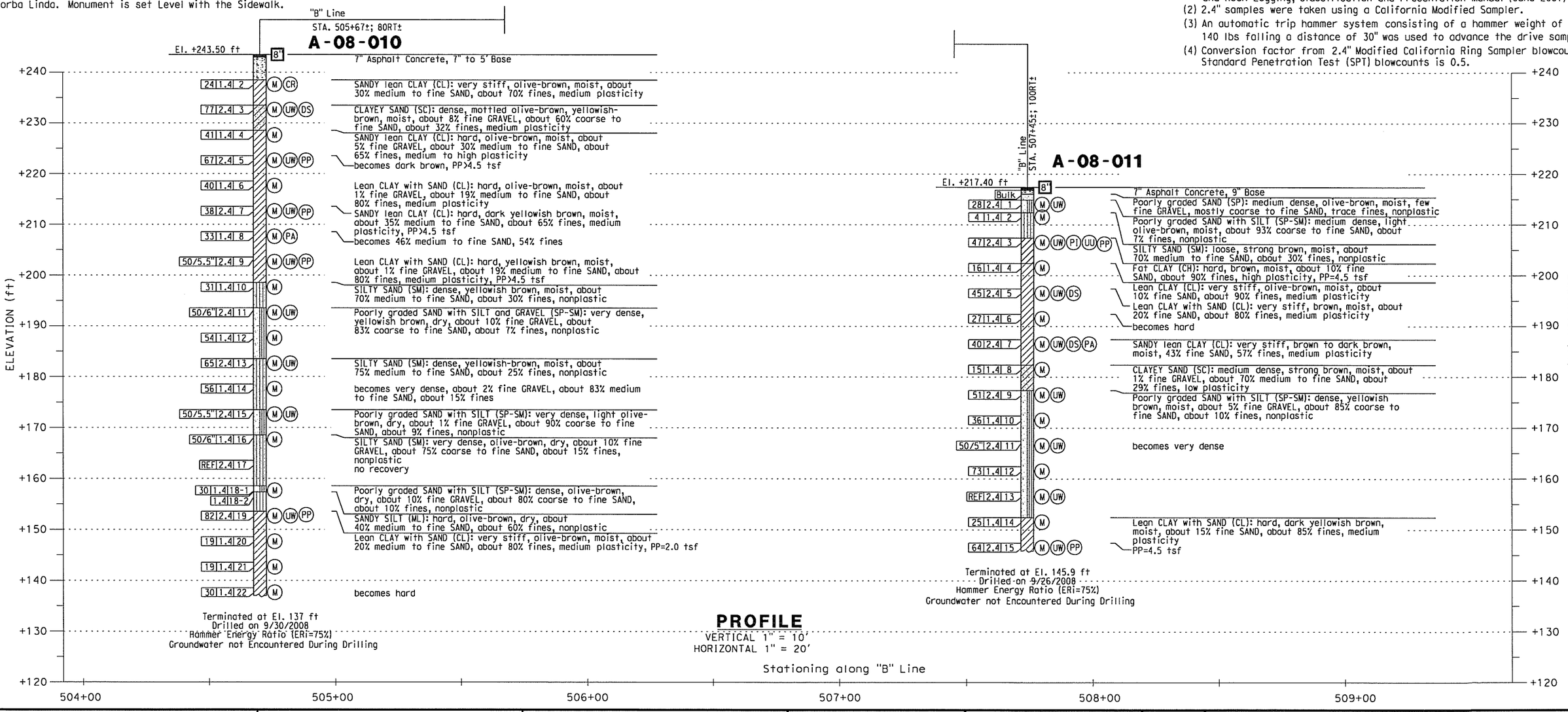

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER	BRIDGE NO. 55E0083; POST MILES 16.7
	CHECKED BY: L. Cheang				RETAINING WALL No. 496 — LOG OF TEST BORINGS No. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3 4

CU 12
EA 0F031U

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)
4/30/09

SHEET 24 OF 24

DATE PLOTTED => 8/14/09
FILENAME => bt1nw

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
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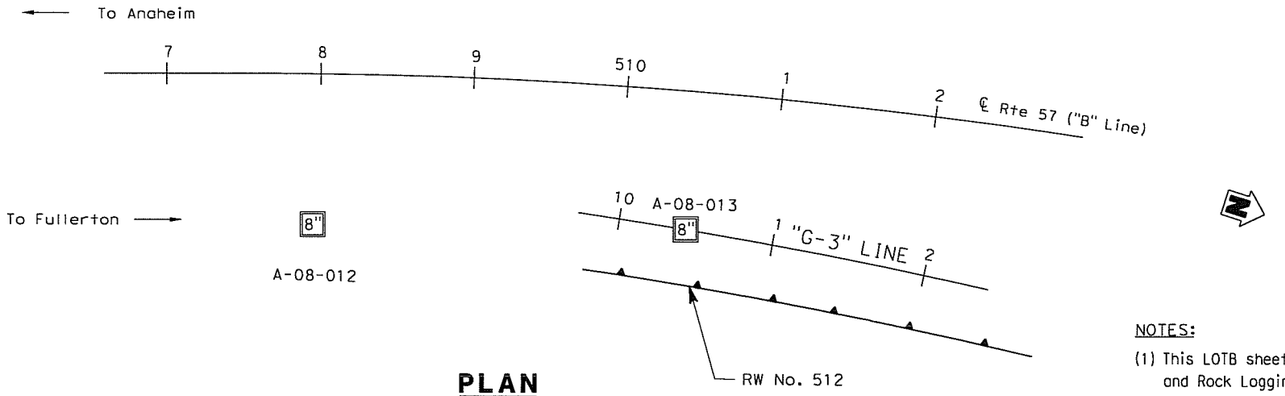

PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL STATE OF CALIFORNIA — REGISTERED PROFESSIONAL ENGINEER

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EARTH MECHANICS, INC.
17660 NEWHOPE ST, SUITE E
FOUNTAIN VALLEY, CA 92708

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 SOUTH MAIN STREET
ORANGE, CA 92863

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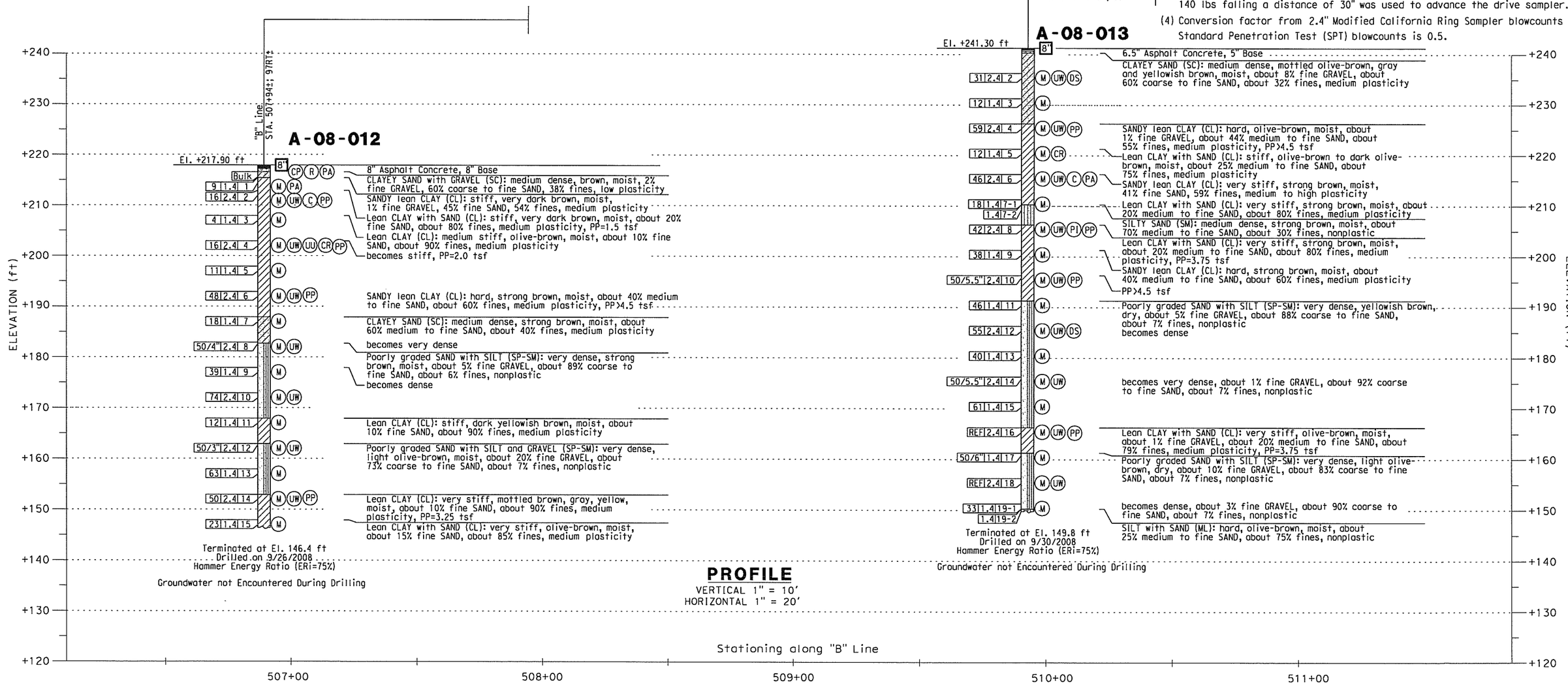

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

LOG OF TEST BORINGS NO. 4
RW No. 512
SCALE AS SHOWN

R-20

$FREQUEST | $TIME | $DATE | $USER
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR: LINO CHEANG
CALCULATED-DESIGNED BY: CHIEN-TAI YANG
CHECKED BY: LINO CHEANG
DATE REVISED
REVISED BY
Caltrans

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang, No. C 66394, Exp. 6-30-10, CIVIL, STATE OF CALIFORNIA

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EARTH MECHANICS, INC.
17660 NEWHOPE ST, SUITE E
FOUNTAIN VALLEY, CA 92708

ORANGE COUNTY
TRANSPORTATION AUTHORITY
550 SOUTH MAIN STREET
ORANGE, CA 92863

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
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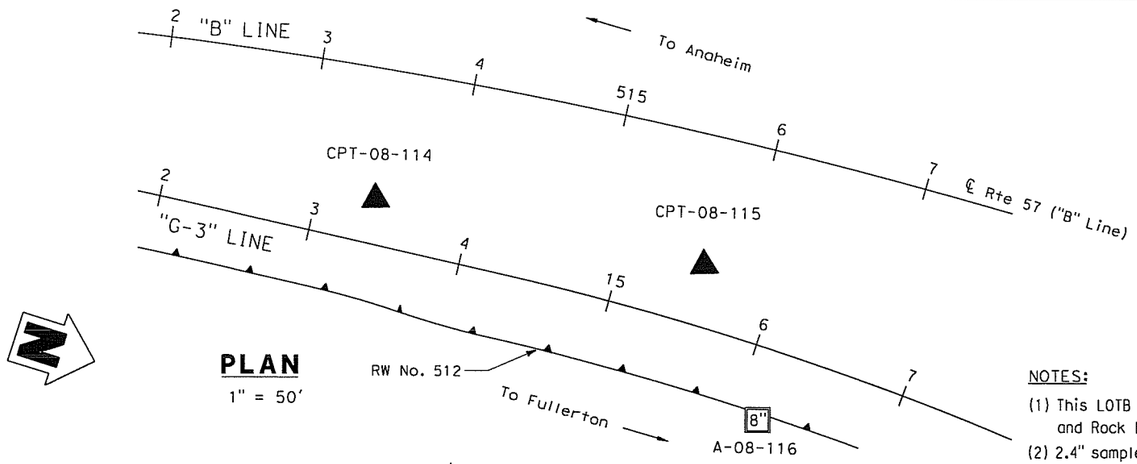

PLAN
1" = 50'

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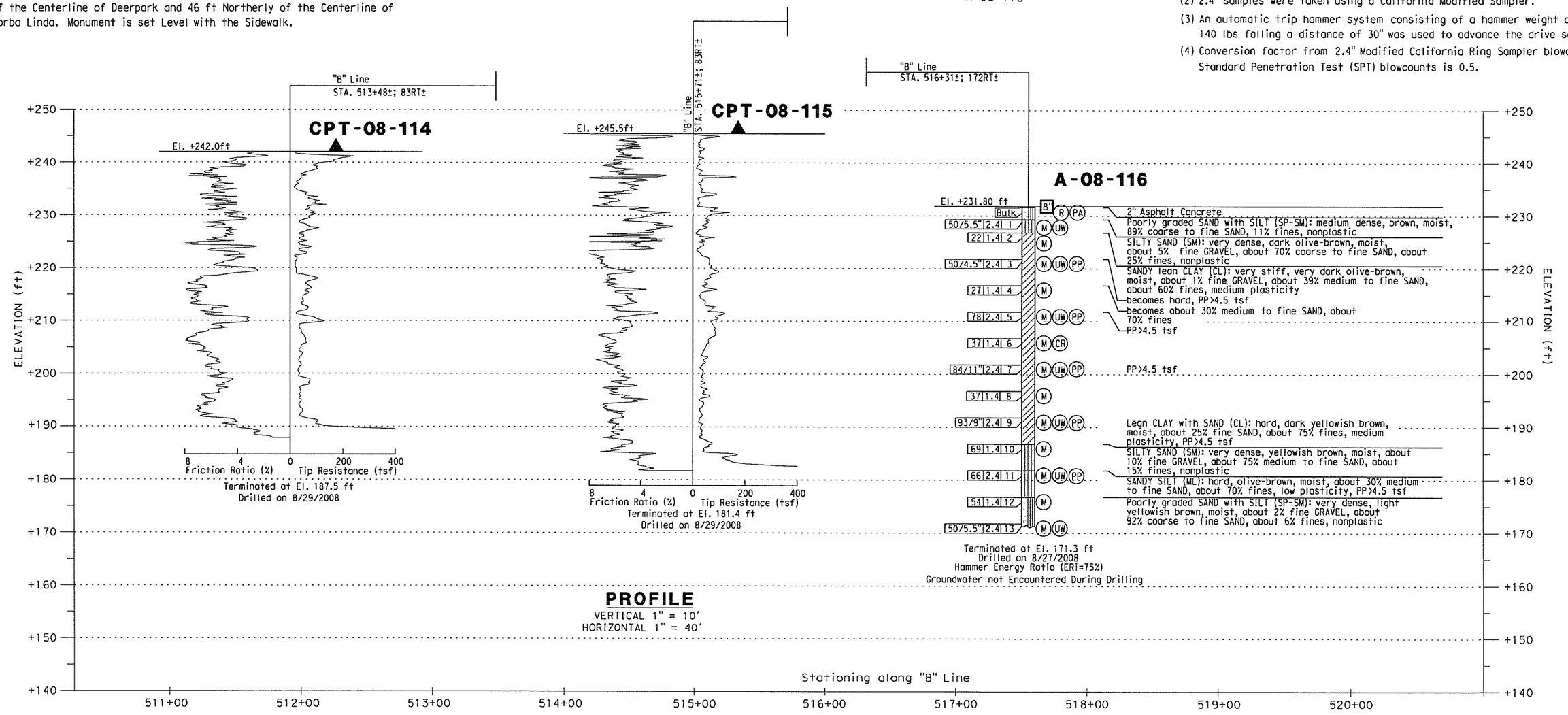

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

LOG OF TEST BORINGS NO. 5
RW No. 512

SCALE AS SHOWN

R-21

$USER | $DATE | $TIME
CALCULATED-DESIGNED BY
CHECKED BY
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
CONSULTANT FUNCTIONAL SUPERVISOR
LINO CHEANG
CHIEN-TAI YANG
LINO CHEANG
REVISED BY
DATE REVISED
Caltrans
BFREQUEST
TEST REVISION

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

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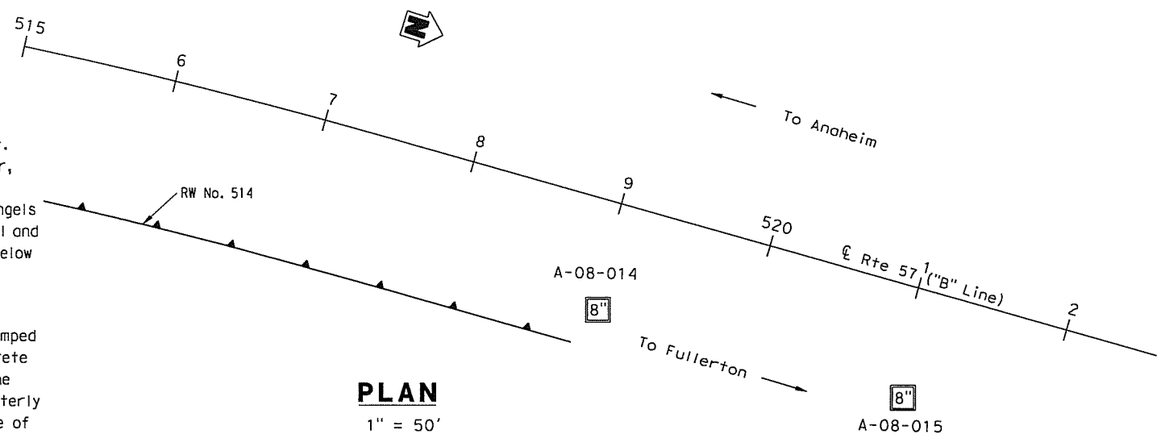


PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

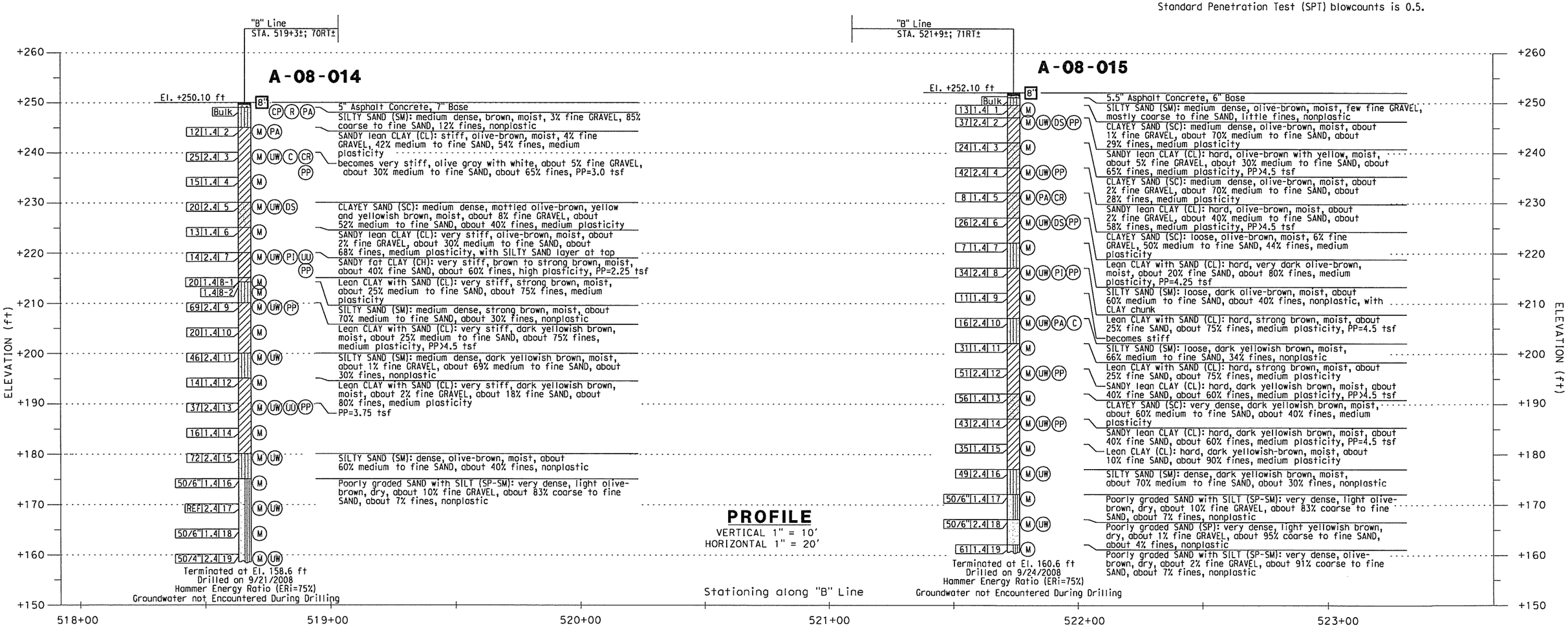
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

EARTH MECHANICS, INC.
17660 NEWHOPE ST, SUITE E
FOUNTAIN VALLEY, CA 92708

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 SOUTH MAIN STREET
ORANGE, CA 92863

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

LOG OF TEST BORINGS NO. 7
RW No. 514

SCALE AS SHOWN

R-22

REVISED BY | DATE REVISED
CHIEN-TAI YANG | LINO CHEANG
CALCULATED-DESIGNED BY | CHECKED BY
CONSULTANT FUNCTIONAL SUPERVISOR: LINO CHEANG
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
$USER $DATE $TIME
$REQUEST
LAST REVISION

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

REVISED BY	DATE REVISED

$DATE	CHIEN-TAI YANG	LINO CHEANG
$USER	CALCULATED-DESIGNED BY	CHECKED BY

CONSULTANT FUNCTIONAL SUPERVISOR	LINO CHEANG

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

$REQUEST $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

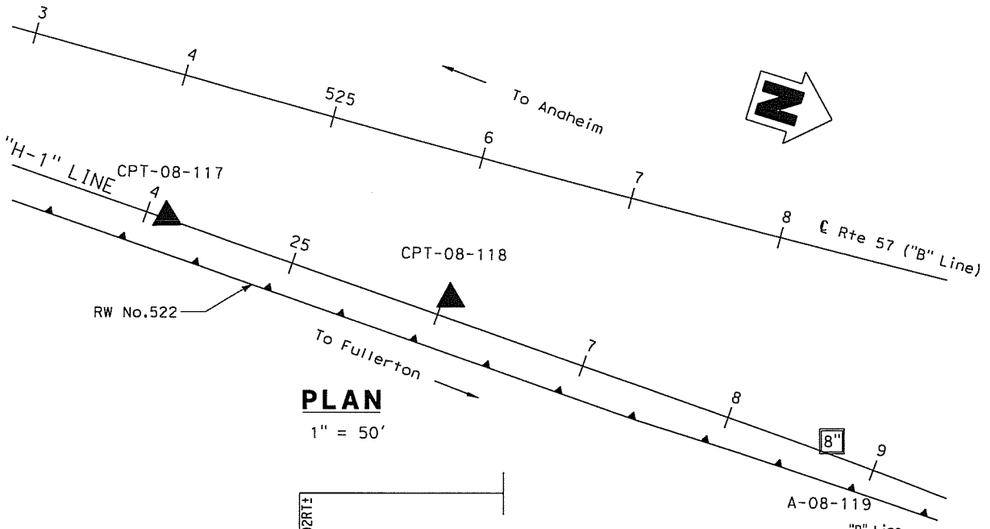
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

EARTH MECHANICS, INC.
17660 NEWHOPE ST, SUITE E
FOUNTAIN VALLEY, CA 92708

ORANGE COUNTY
TRANSPORTATION AUTHORITY
550 SOUTH MAIN STREET
ORANGE, CA 92863



PLAN
1" = 50'

NOTES:
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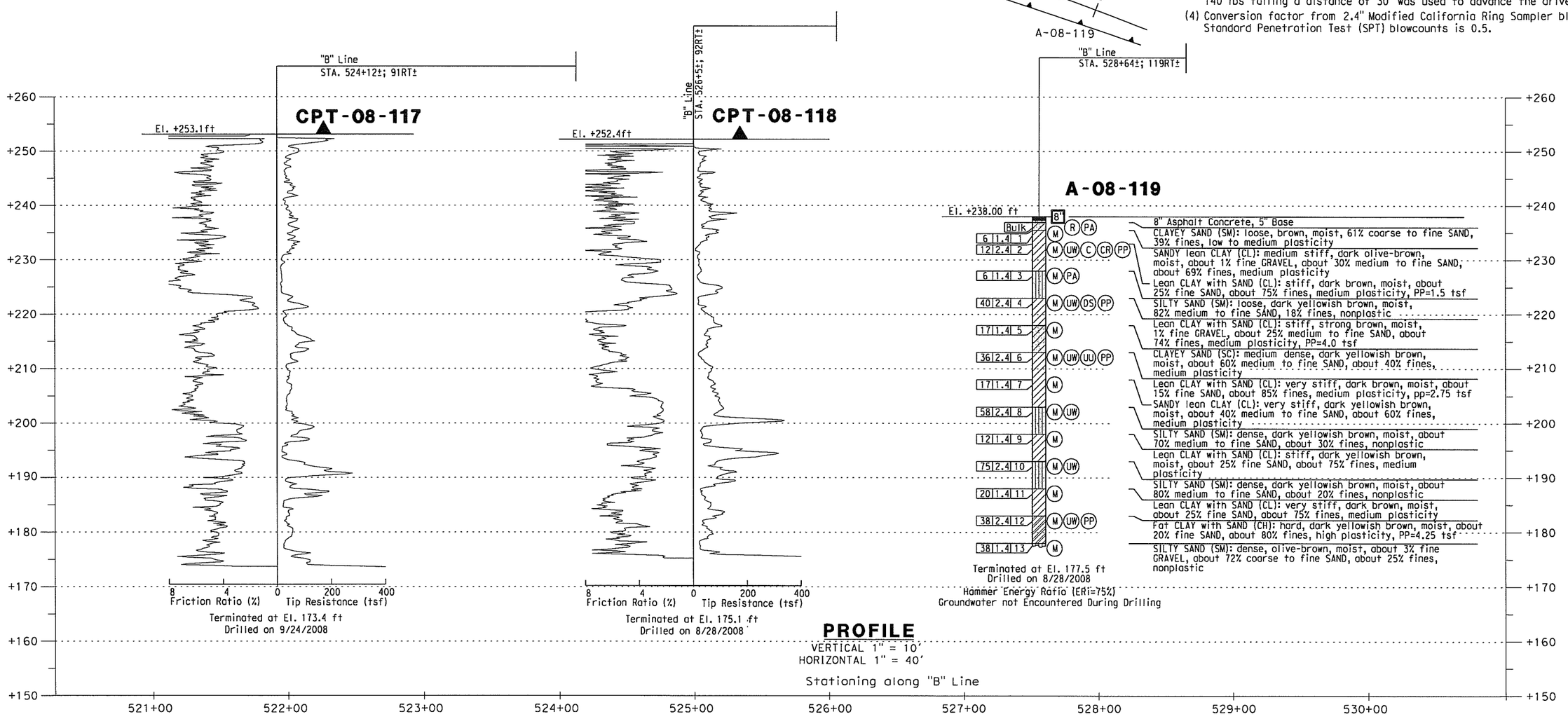


PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

LOG OF TEST BORINGS NO. 9
RW No. 522

SCALE AS SHOWN

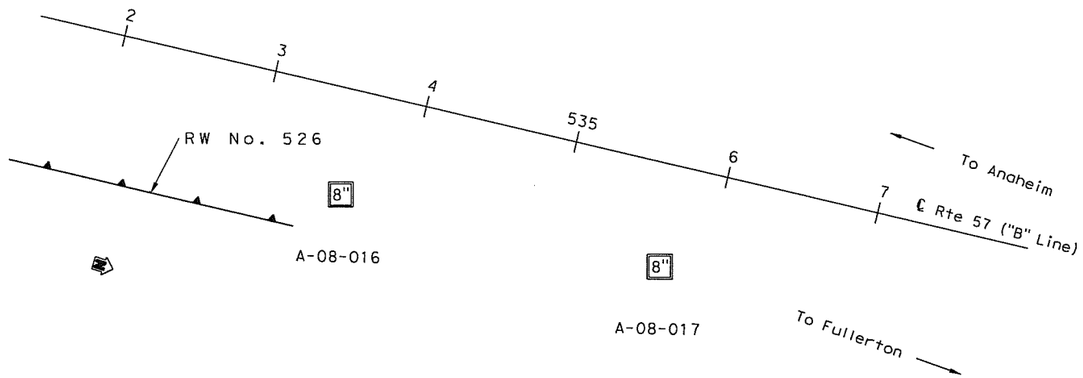
R-23

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

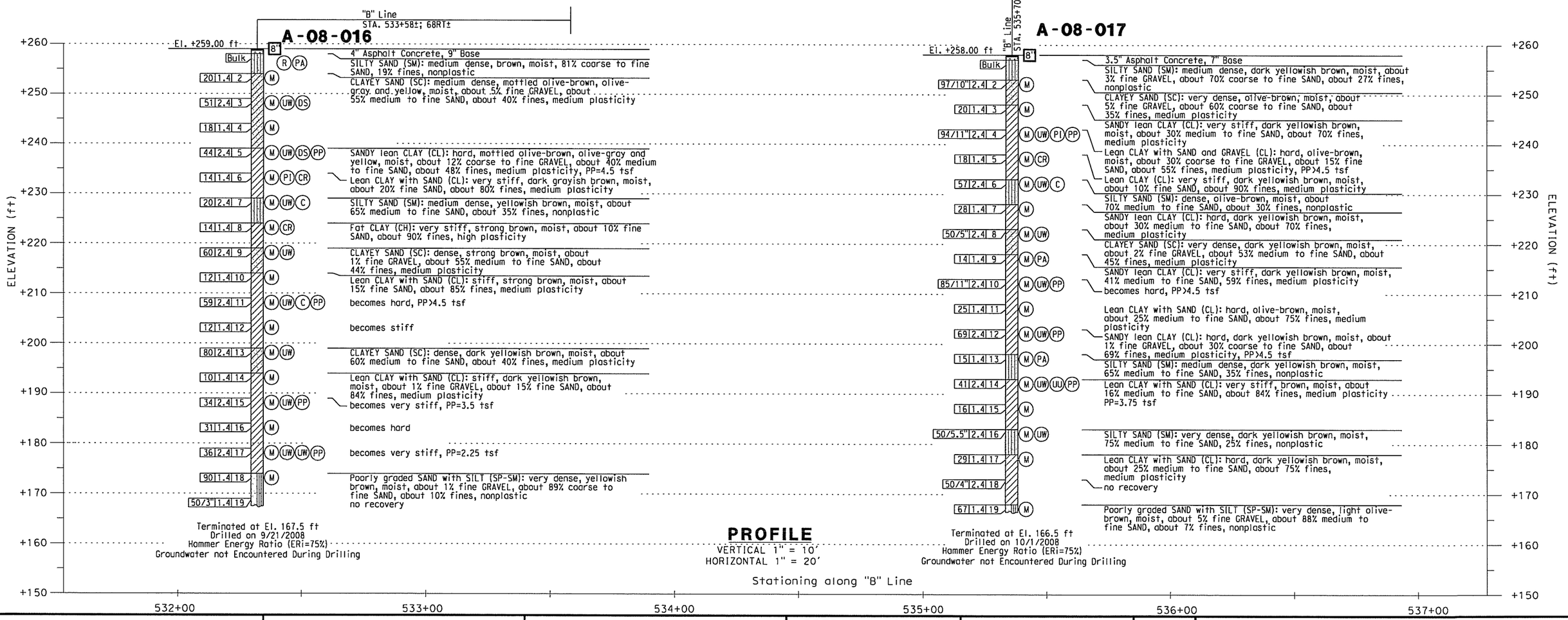
EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.

PLAN

1" = 50'



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0084
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 17.2

RW No. 526
LOG OF TEST BORINGS No. 9

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031U

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET 43 OF 46

DATE PLOTTED = 23-APR-2009
FILE PLOTTED = 23-APR

BENCHMARKS:

Vertical Datum NAVD 88
Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.
Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang, No. C 66394, Exp. 6-30-10, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

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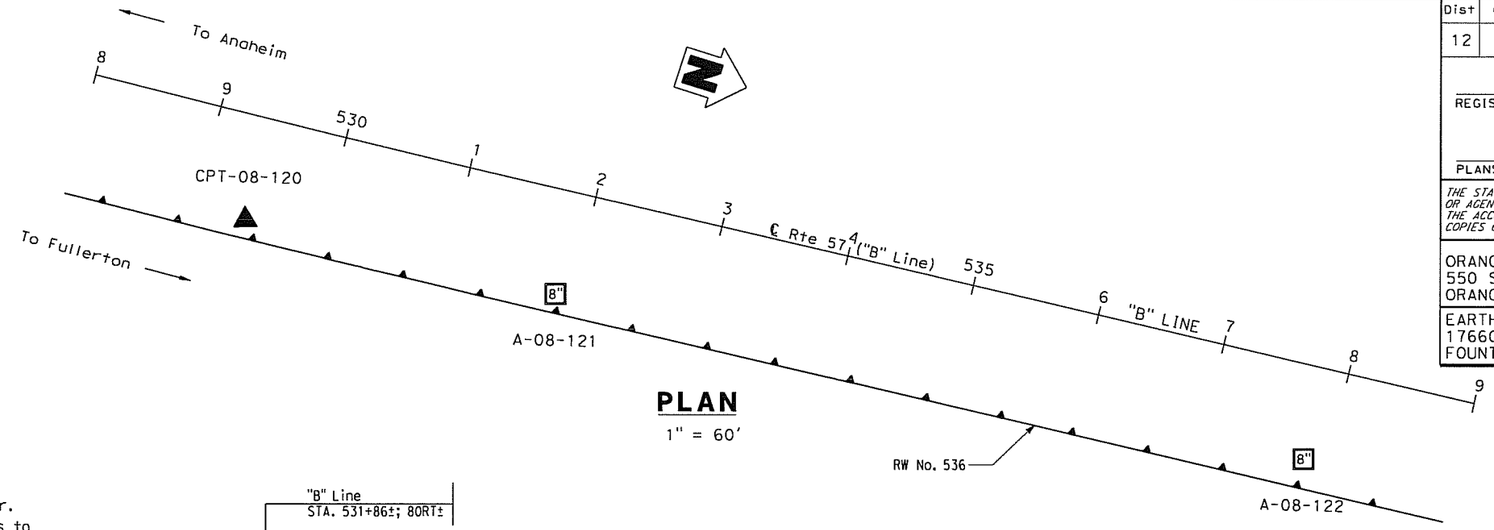
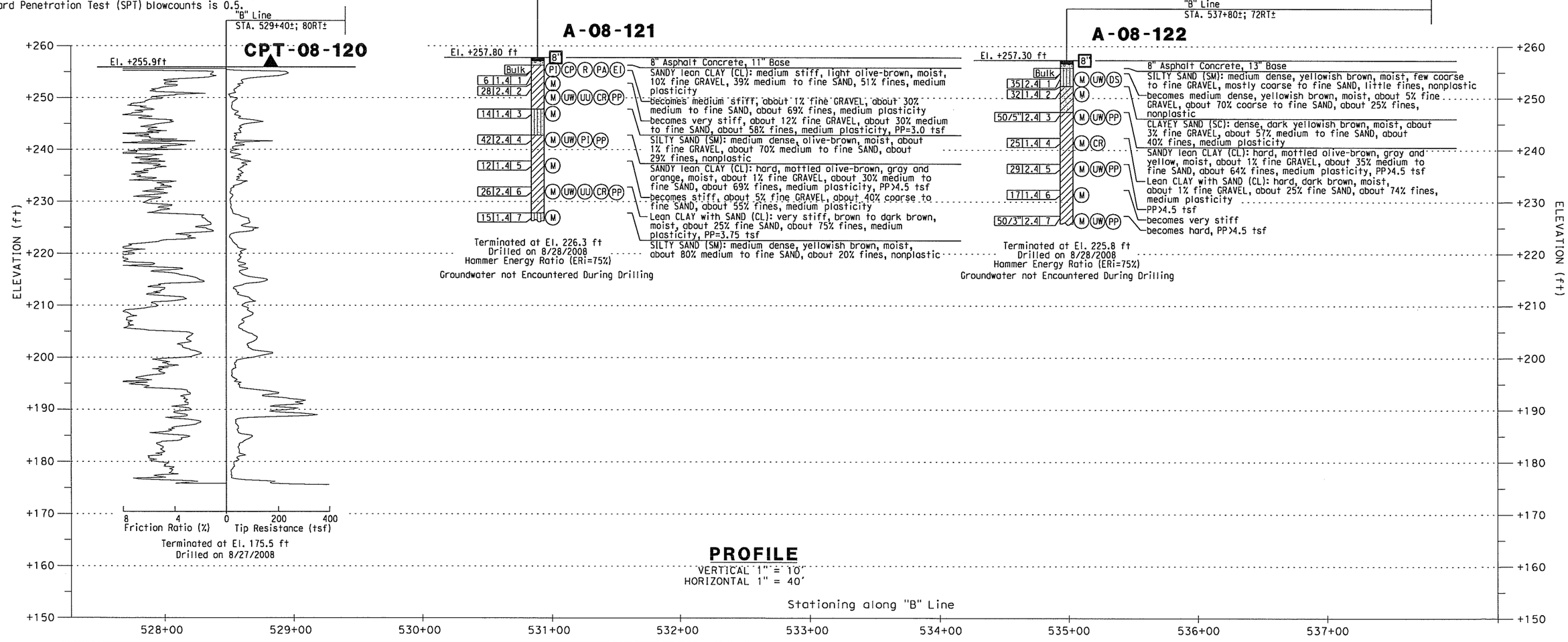
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN
1" = 60'



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER	BRIDGE NO. 55E0085 / POST MILES 17.4

RW No. 536
LOG OF TEST BORINGS No. 11

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3
CU 12 EA 0F031U
DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09
SHEET 44 OF 46

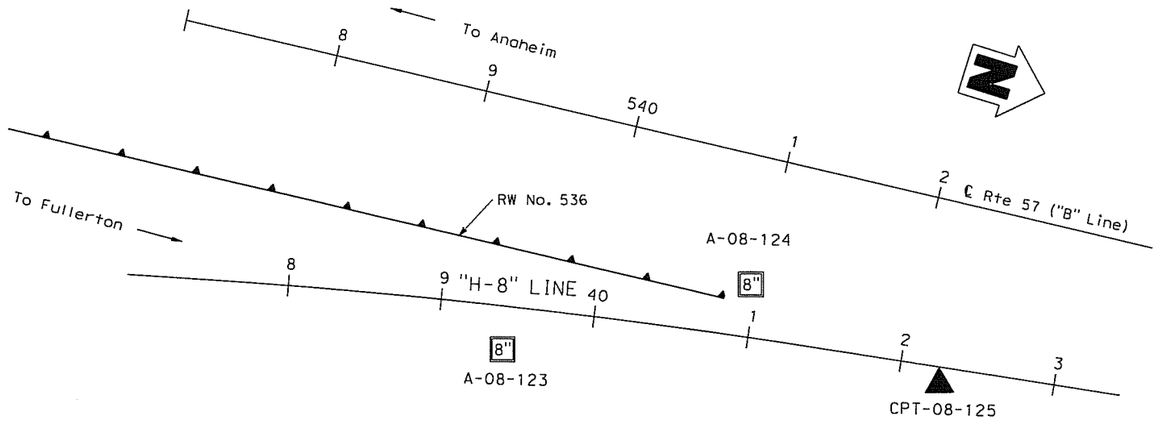
DATE PLOTTED => 20:47
TIME PLOTTED => 07/15/09
DGN: 0536_LOTB_11.dgn

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:
(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
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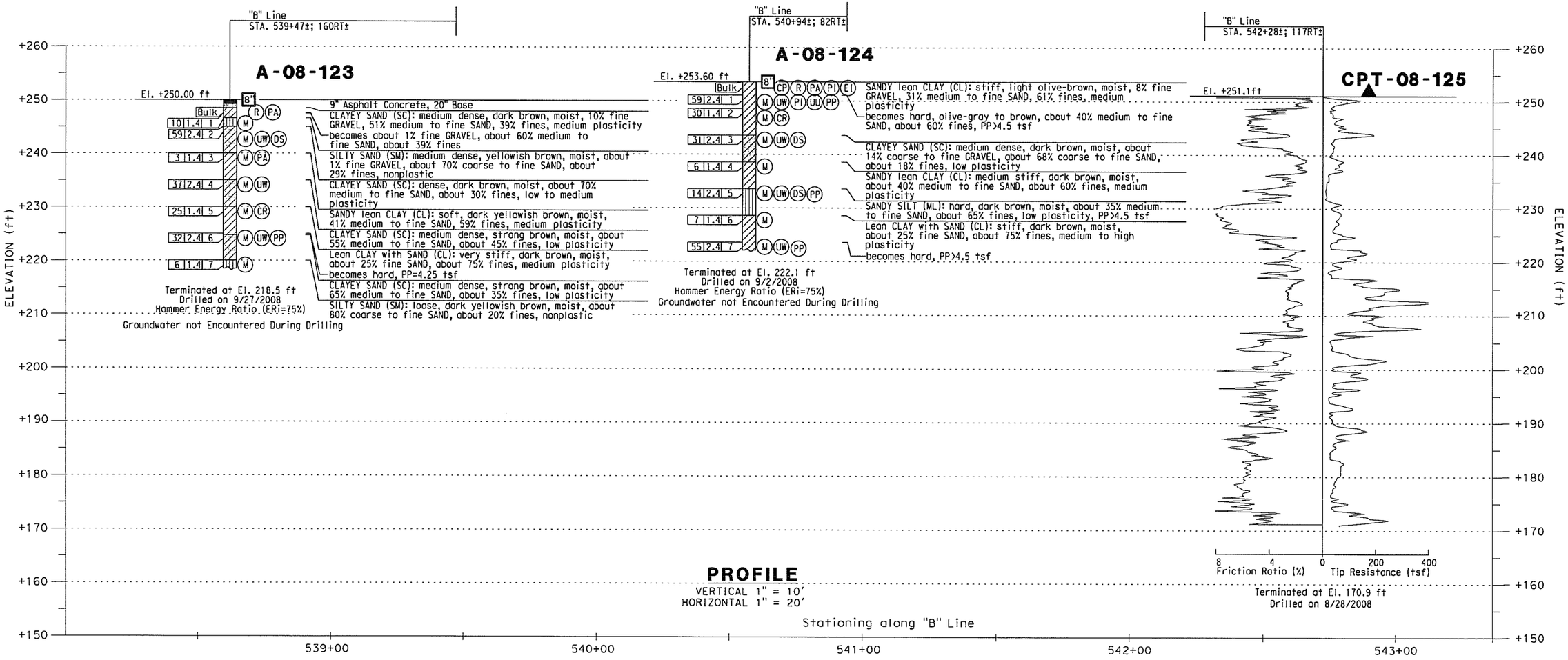

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0085 / POST MILES 17.4

RW No. 536
LOG OF TEST BORINGS No. 12

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12 EA 0F031U

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET 45 OF 46

DATE PLOTTED => 6/DATE
FILE PLOTTED => TIME

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

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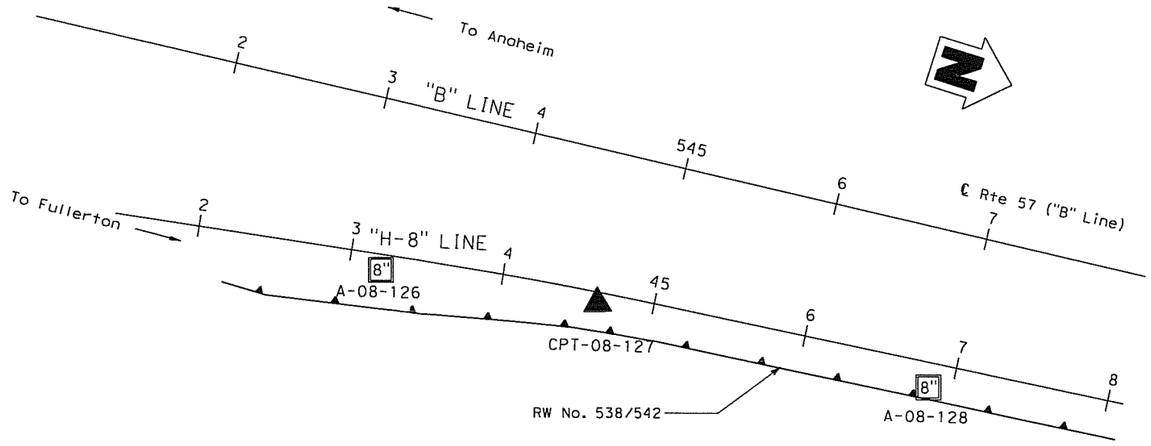

PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:
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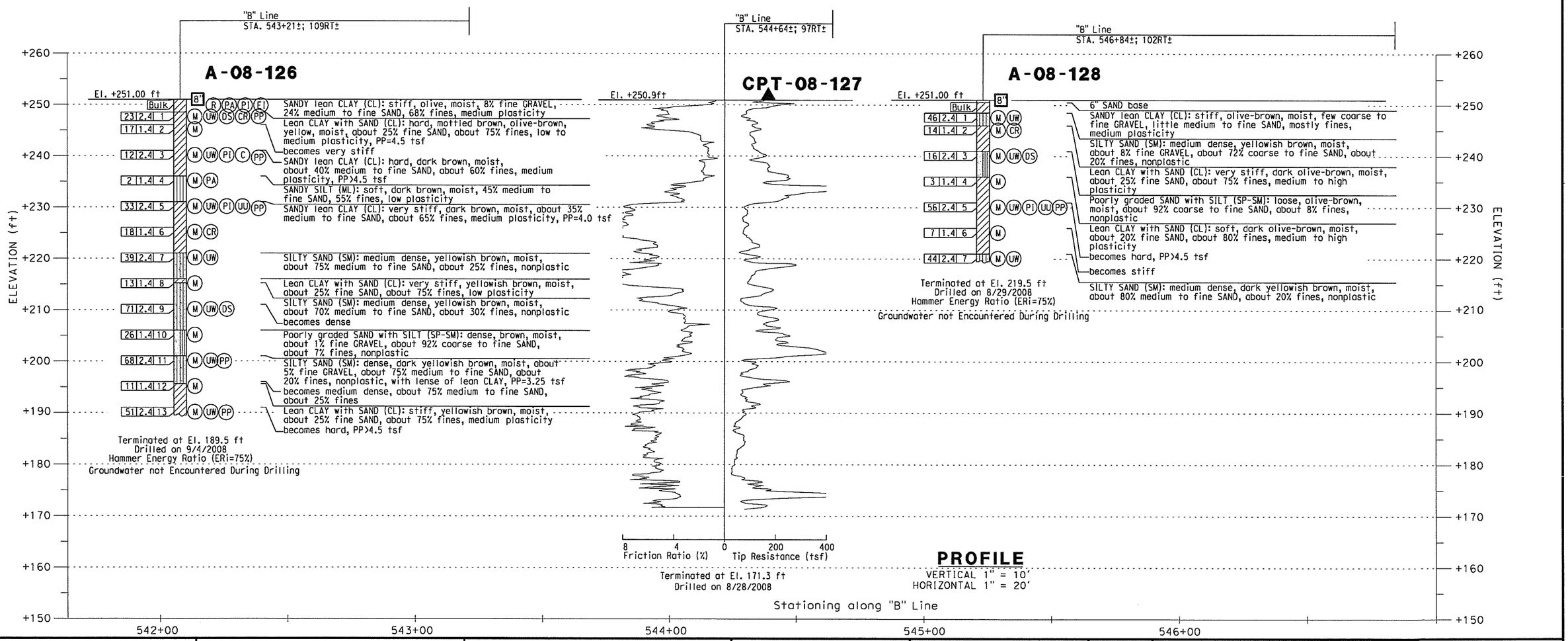

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0086 / POST MILES 17.5
SIGN OFF DATE	CHECKED BY: L. Cheang				

RW No. 538
LOG OF TEST BORINGS No. 14

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

CU 12
EA 0F031U

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 46 OF 46

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
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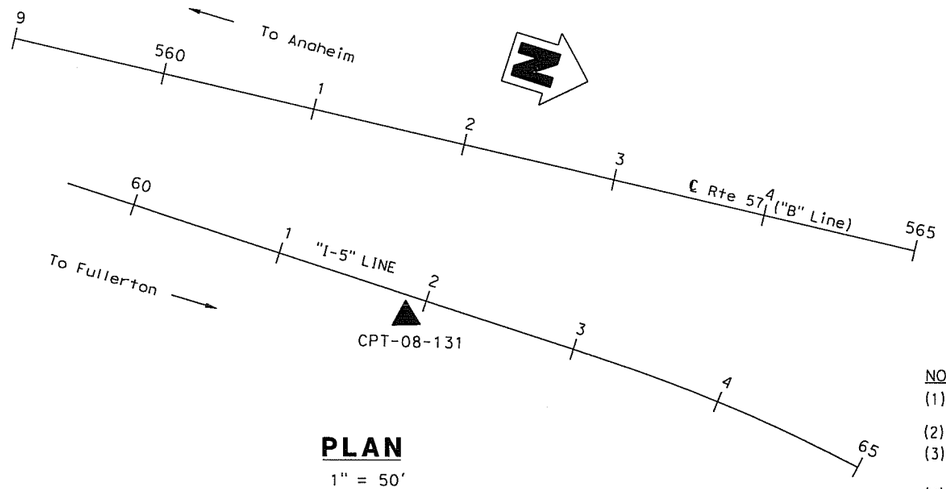

PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:
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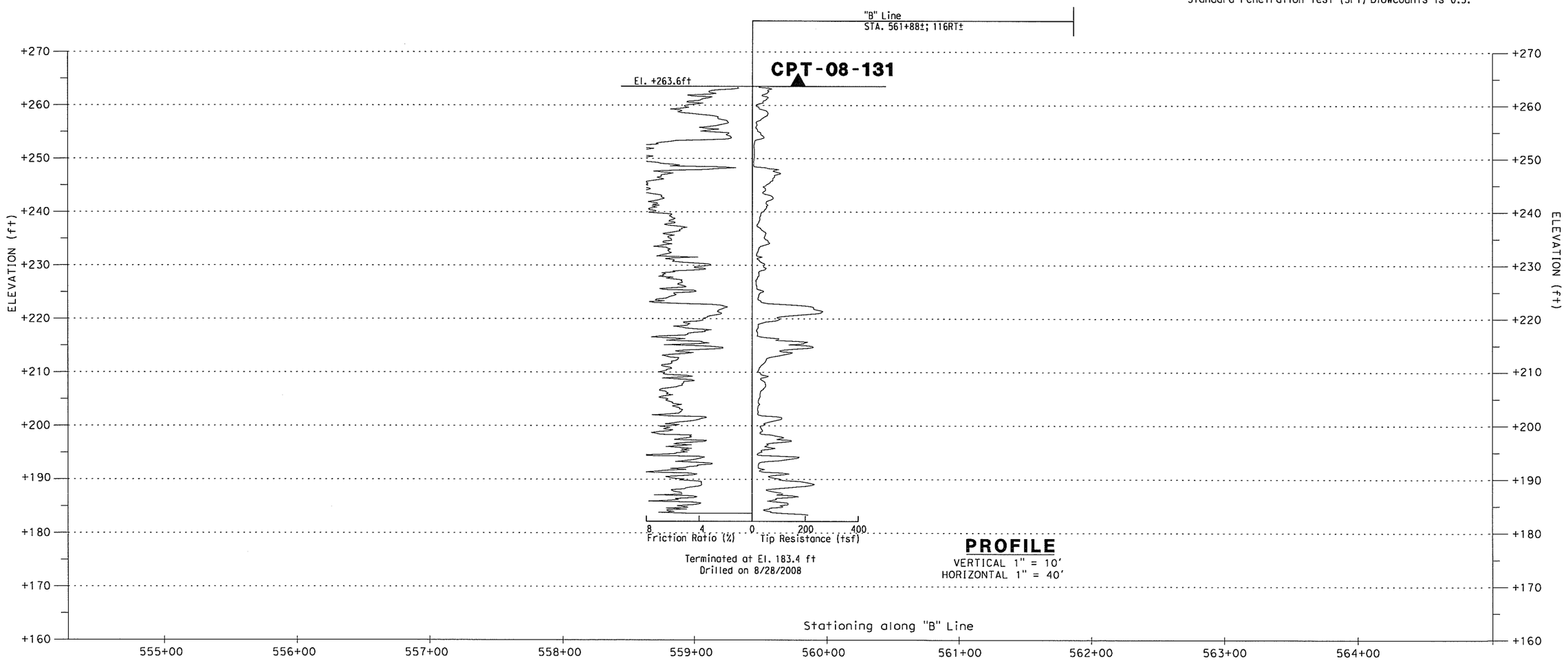

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

LOG OF TEST BORINGS NO. 13

SCALE AS SHOWN

XX-XX

REVISED BY | DATE REVISED | $TIME | $DATE | $USER | CALCULATED-DESIGNED BY | CHECKED BY | CONSULTANT FUNCTIONAL SUPERVISOR | STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | Caltrans | REQUEST | LAST REVISION

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
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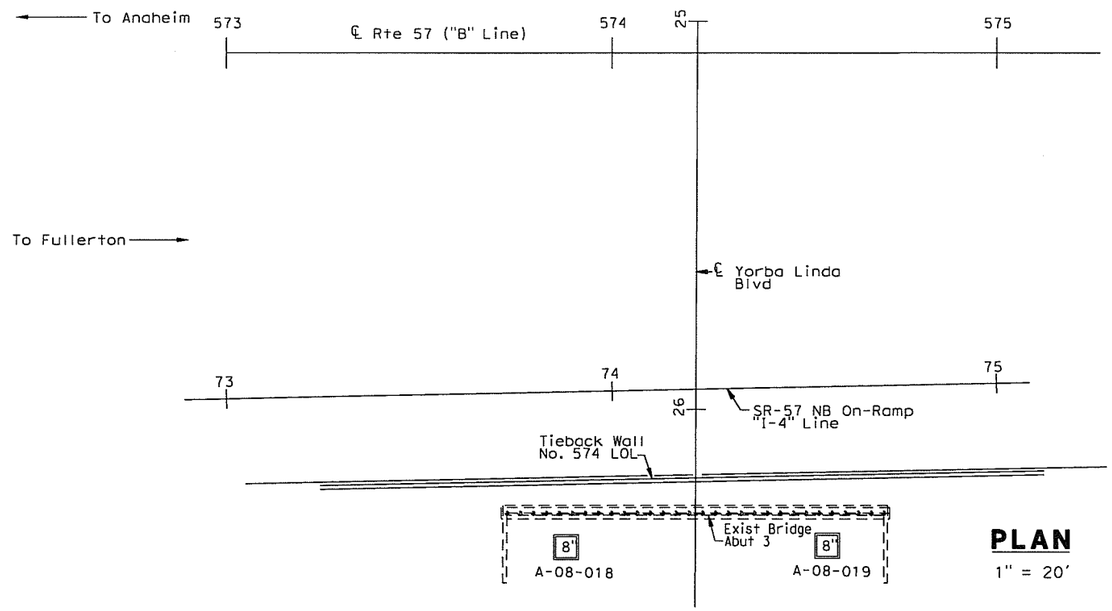

PLAN
1" = 20'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

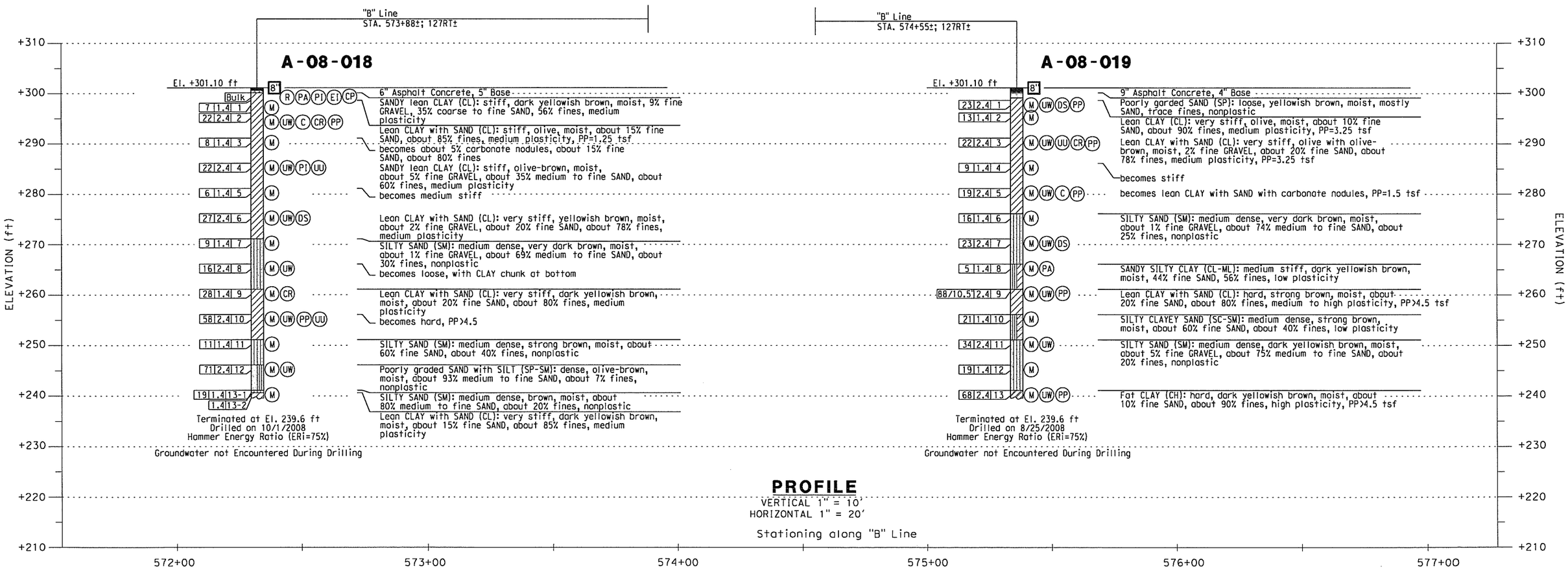
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0468 / POST MILES 18.4

YORBA LINDA BLVD OC (MODIFY)
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

CU 12
EA 0F031U

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 1/14/09 | 1/30/09

SHEET 12 OF 12

DATE PLOTTED = 2/2/09
TIME PLOTTED = 09:22

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57			

REGISTERED CIVIL ENGINEER — DATE

PLANS APPROVAL DATE

Chien-Tai Yang, No. C 66394, Exp. 6-30-10, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

EARTH MECHANICS, INC.
17660 NEWHOPE ST, SUITE E
FOUNTAIN VALLEY, CA 92708

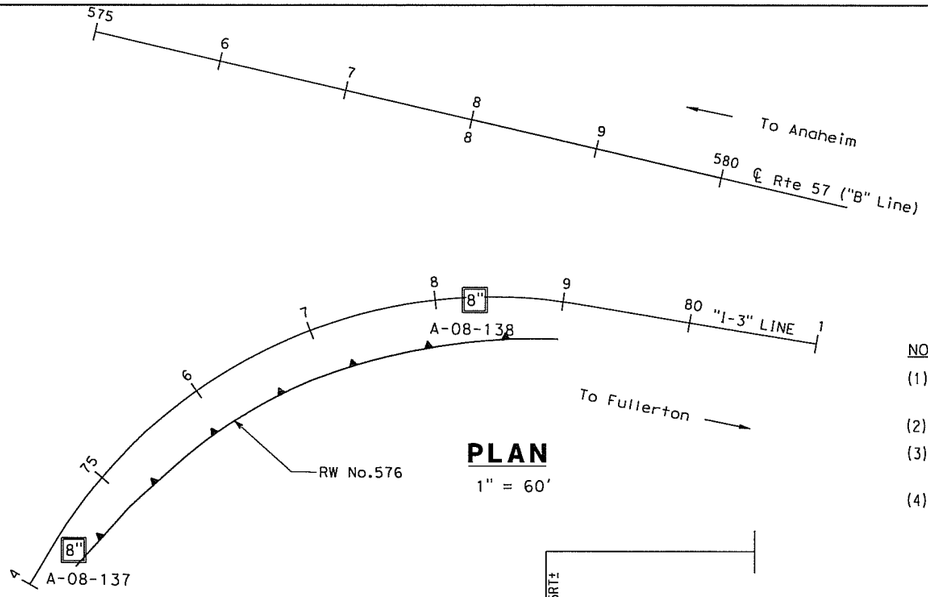
ORANGE COUNTY
TRANSPORTATION AUTHORITY
550 SOUTH MAIN STREET
ORANGE, CA 92863

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 60'

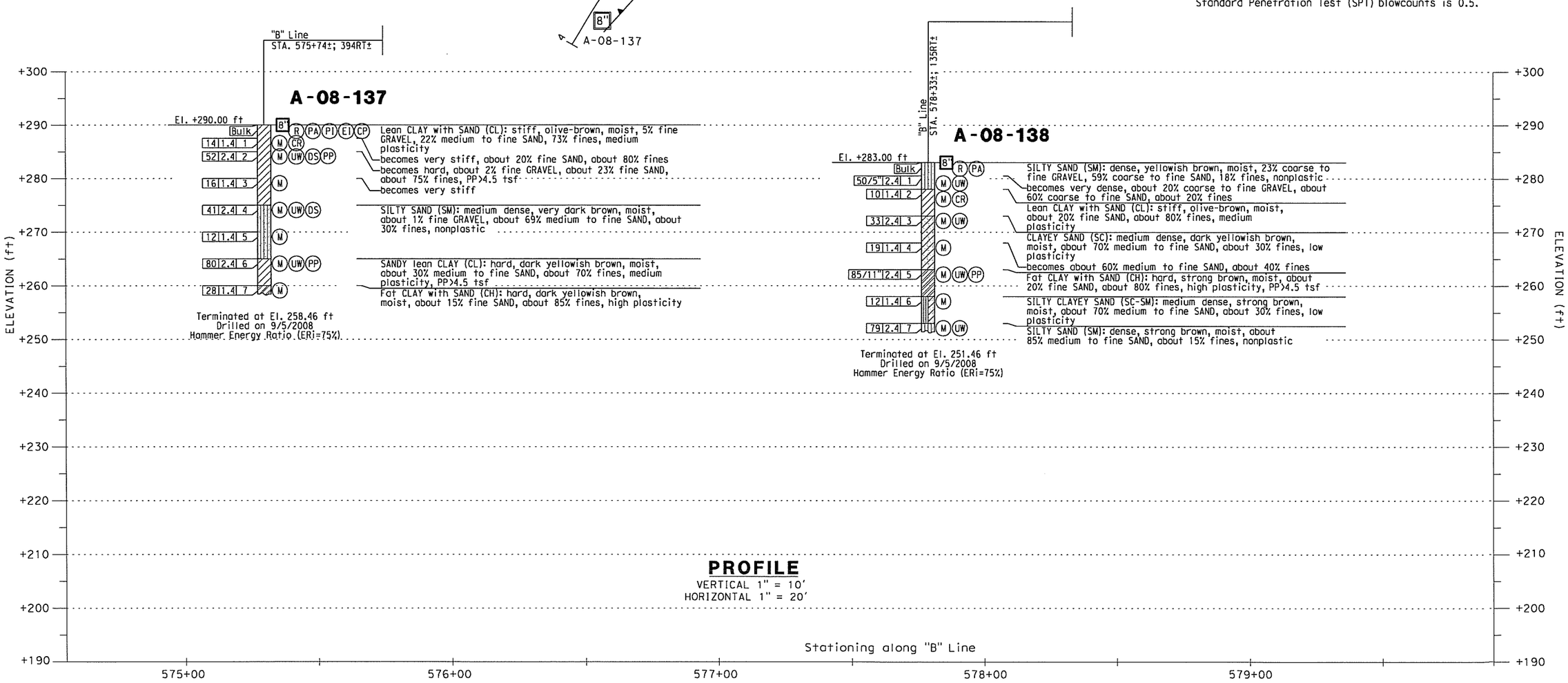
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

LOG OF TEST BORINGS NO. 10
RW No. 576
SCALE AS SHOWN

R-24

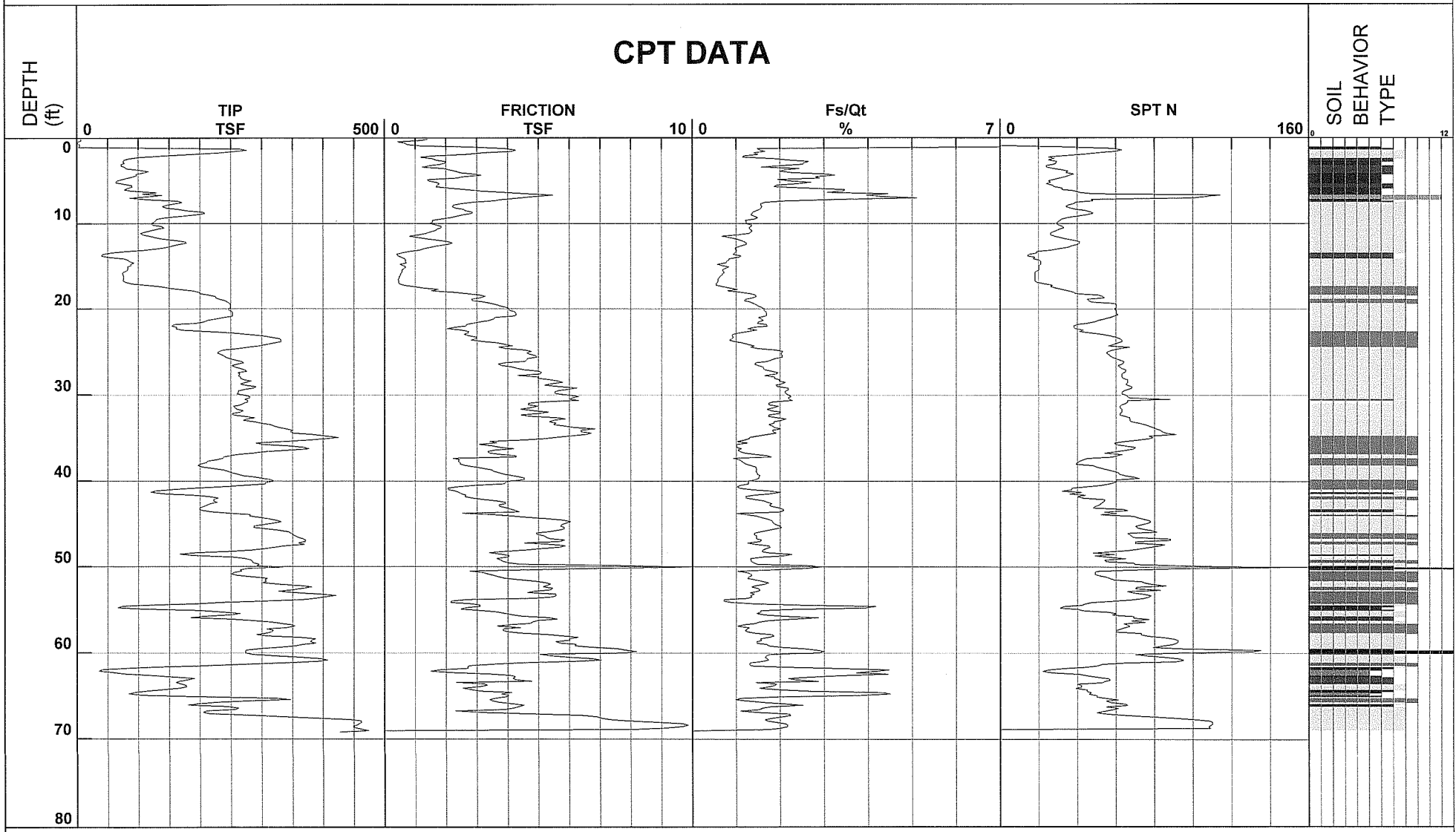
$USER $DATE $TIME
CHIEN-TAI YANG — CALCULATED-DESIGNED BY
LINO CHEANG — CHECKED BY
LINO CHEANG — CONSULTANT FUNCTIONAL SUPERVISOR
STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans
REVISED BY
DATE REVISED
$REQUEST
LAST REVISION

Appendix B. Logs of Cone Penetration Test (CPT) Soundings

Earth Mechanics

Location	57 Freeway Expansion	Operator	VO/ML	Filename	SDF(199).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-103	Date and Time	9/8/2008 10:46:04 PM	Maximum Depth	69.22 ft
Water Table Depth		0.00 ft			

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

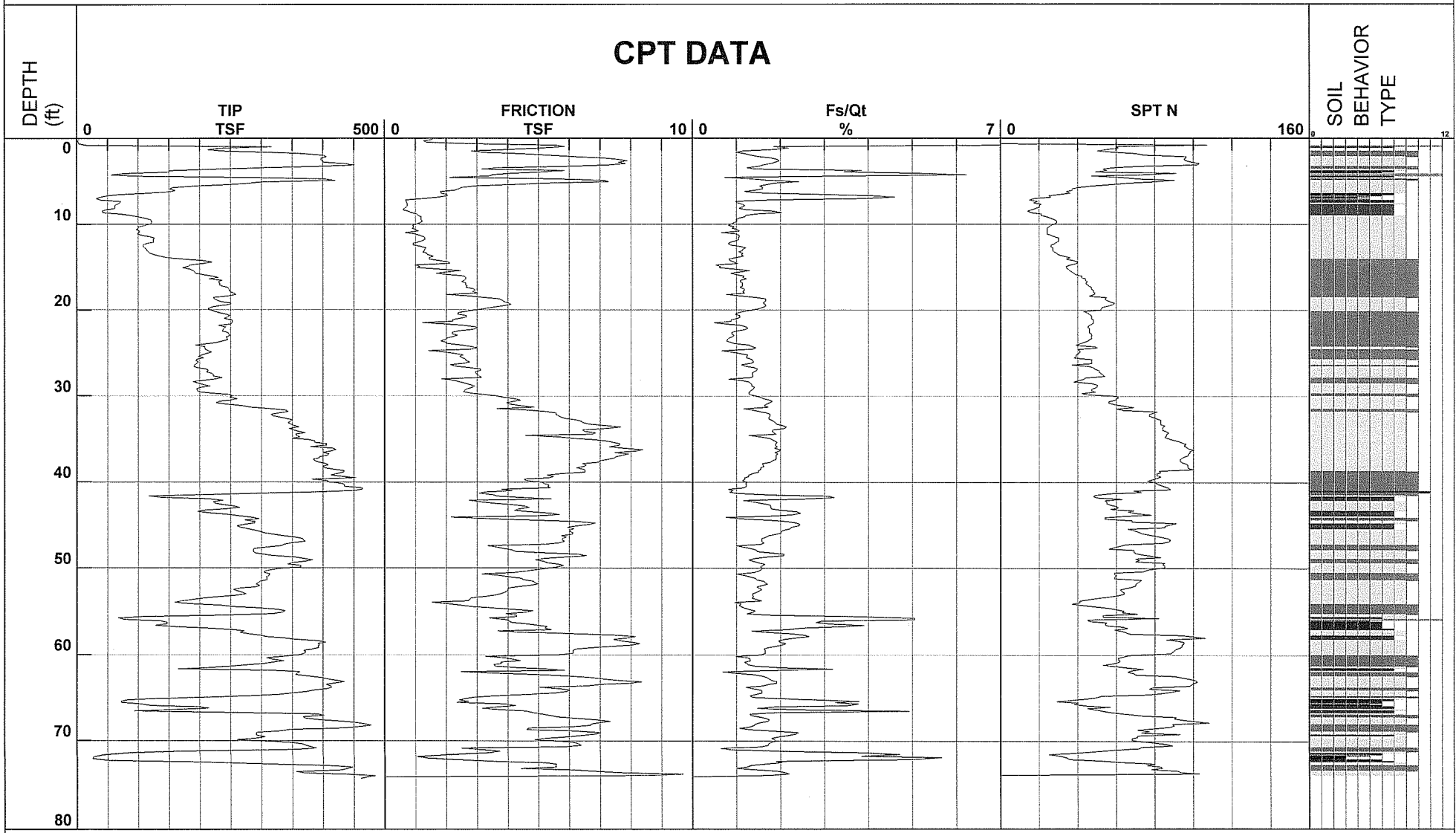
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	VO/ML	Filename	SDF(200).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-104	Date and Time	9/8/2008 11:36:38 PM	Maximum Depth	74.15 ft
Water Table Depth		0.00 ft			

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

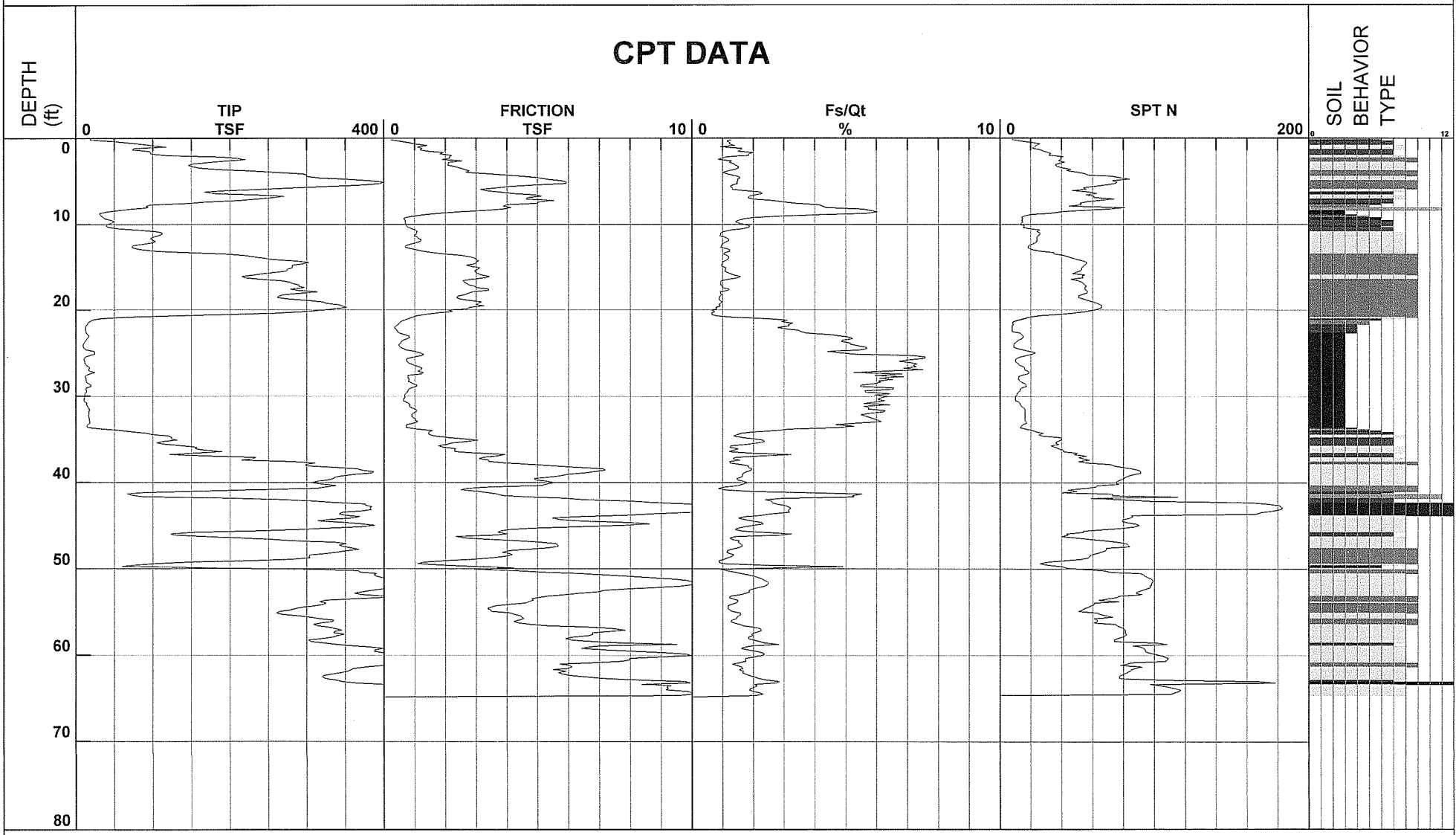
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	VO/ML	Filename	SDF(175).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-107	Date and Time	8/27/2008 9:37:45 AM	Maximum Depth	64.96 ft
Water Table Depth	80.00 ft				

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

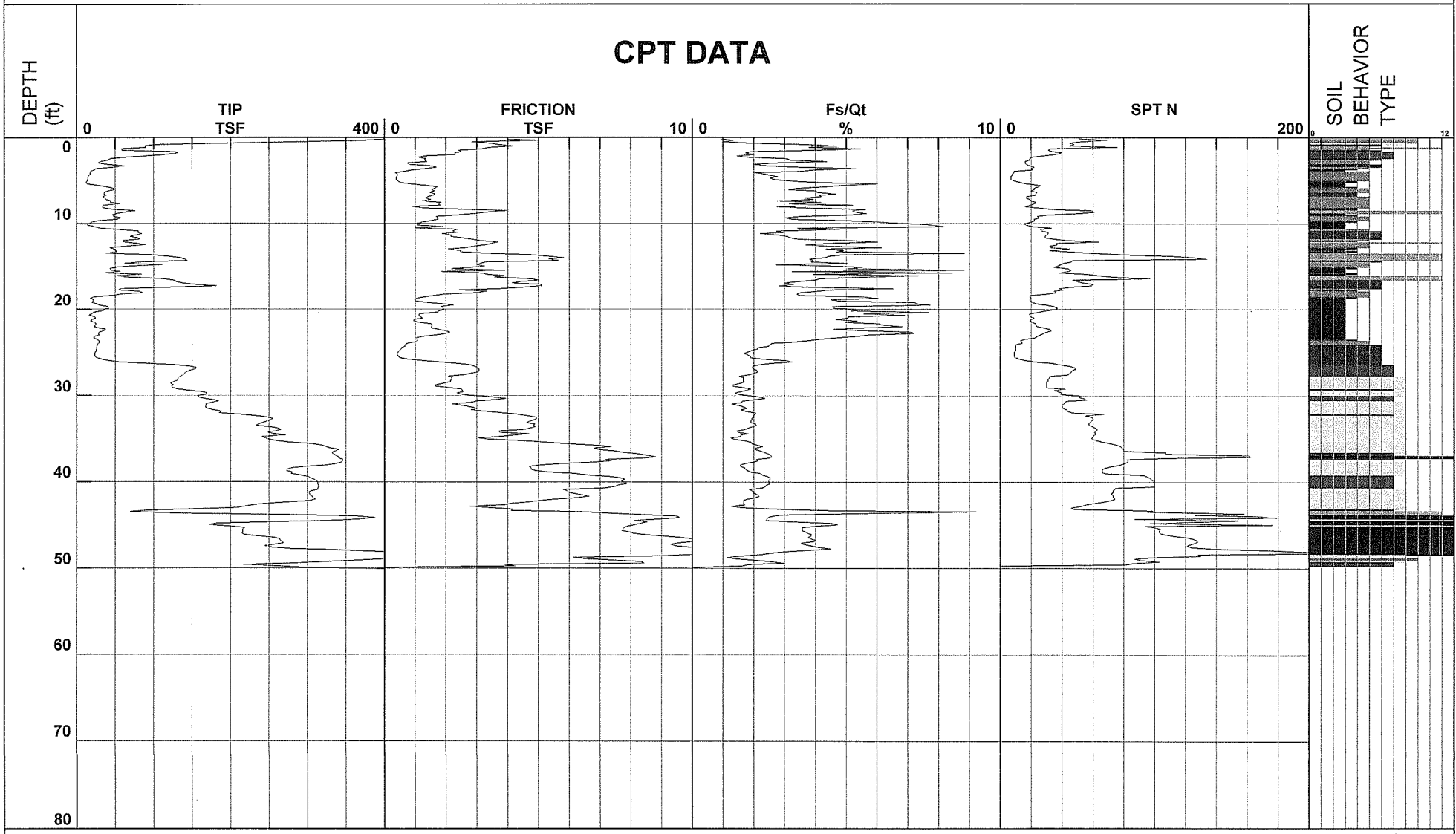
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	VO/ML	Filename	SDF(176).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-110	Date and Time	8/27/2008 11:04:54 AM	Maximum Depth	50.03 ft
Water Table Depth	80.00 ft				

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

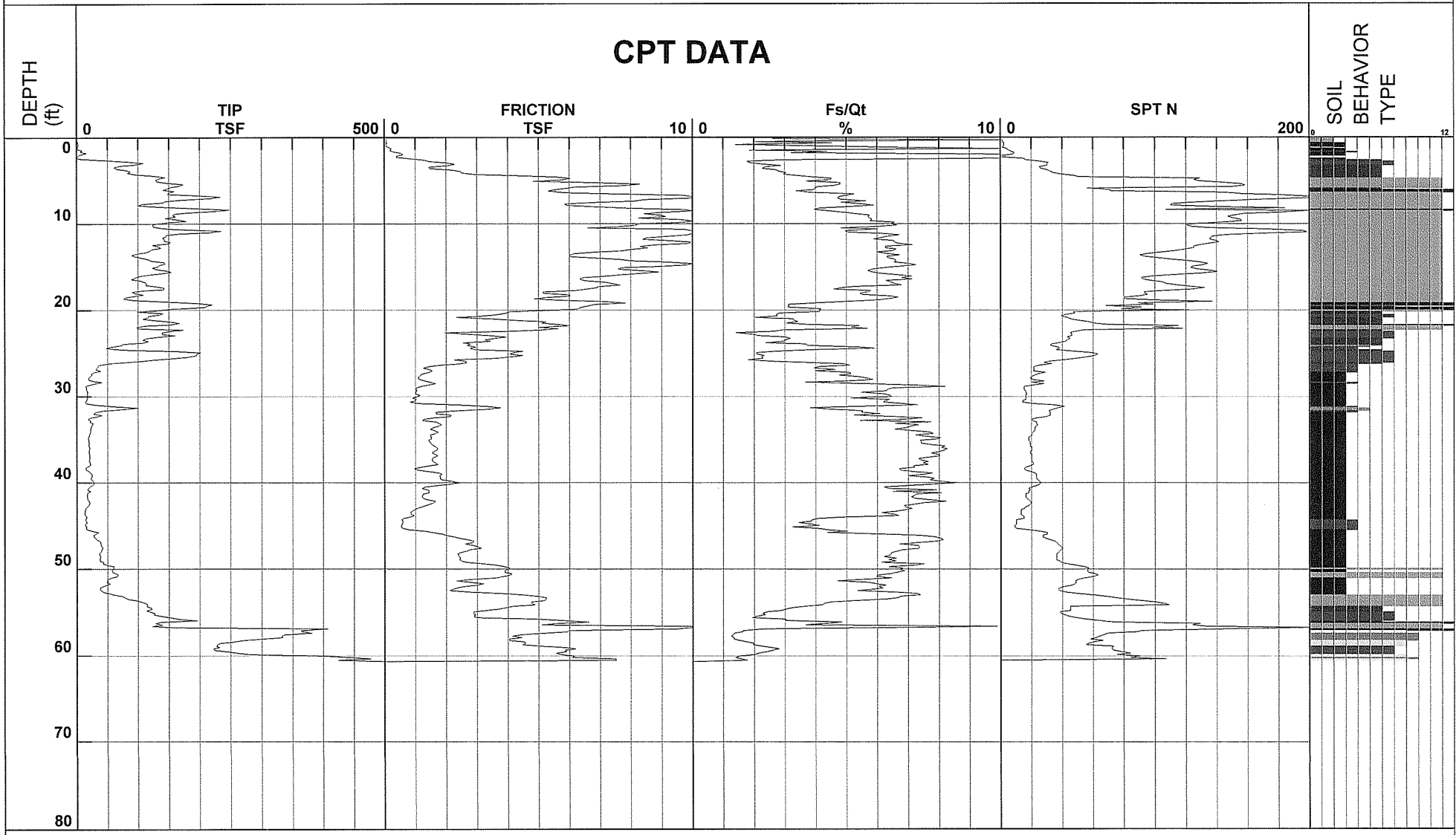
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	ML/VO	Filename	SDF(235).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-111	Date and Time	9/22/2008 11:15:44 PM	Maximum Depth	60.86 ft
Water Table Depth	80.00 ft				

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

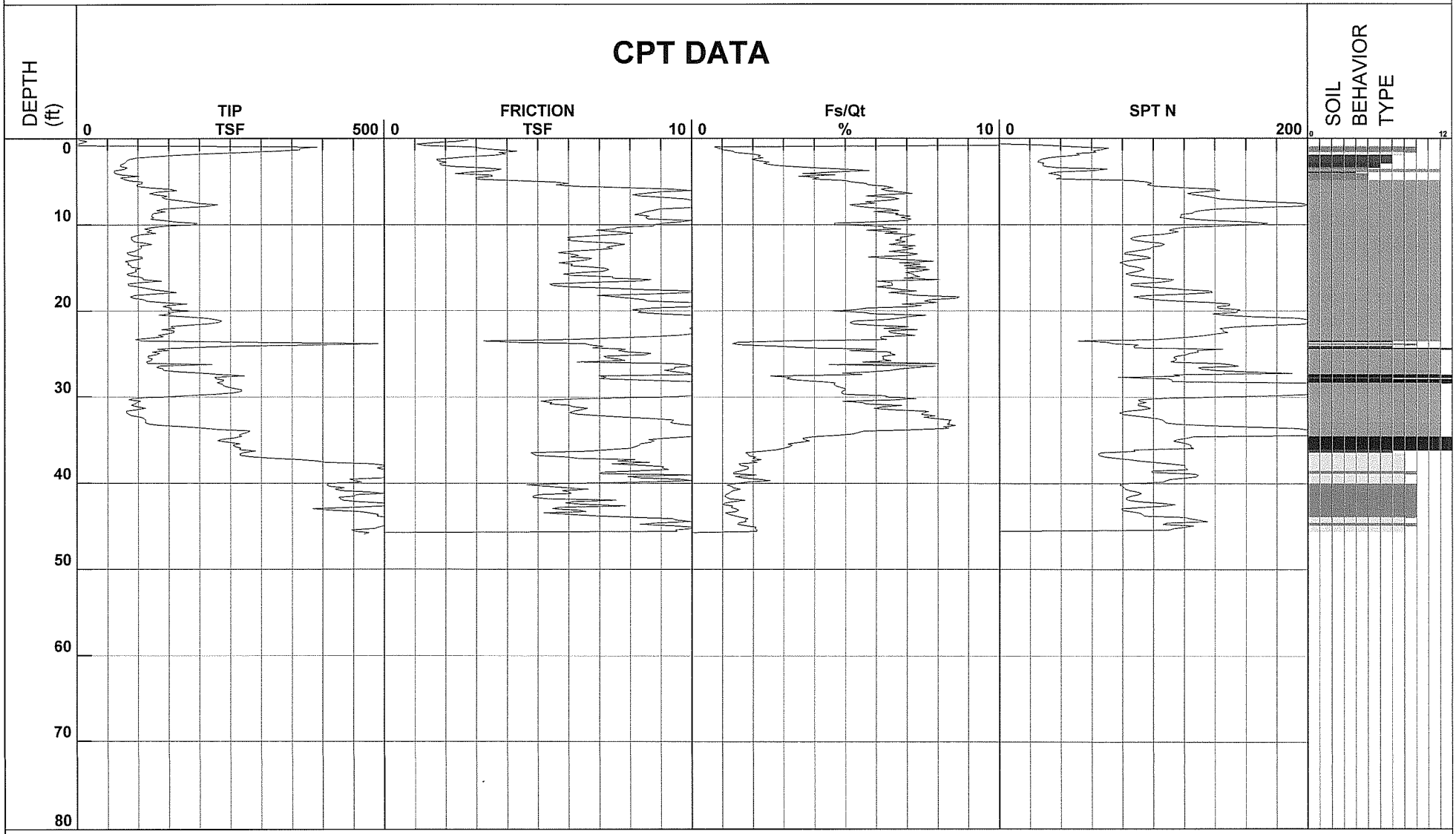
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	ML/VO	Filename	SDF(236).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-112	Date and Time	9/23/2008 10:34:17 PM	Maximum Depth	45.93 ft
Water Table Depth		0.00 ft			

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

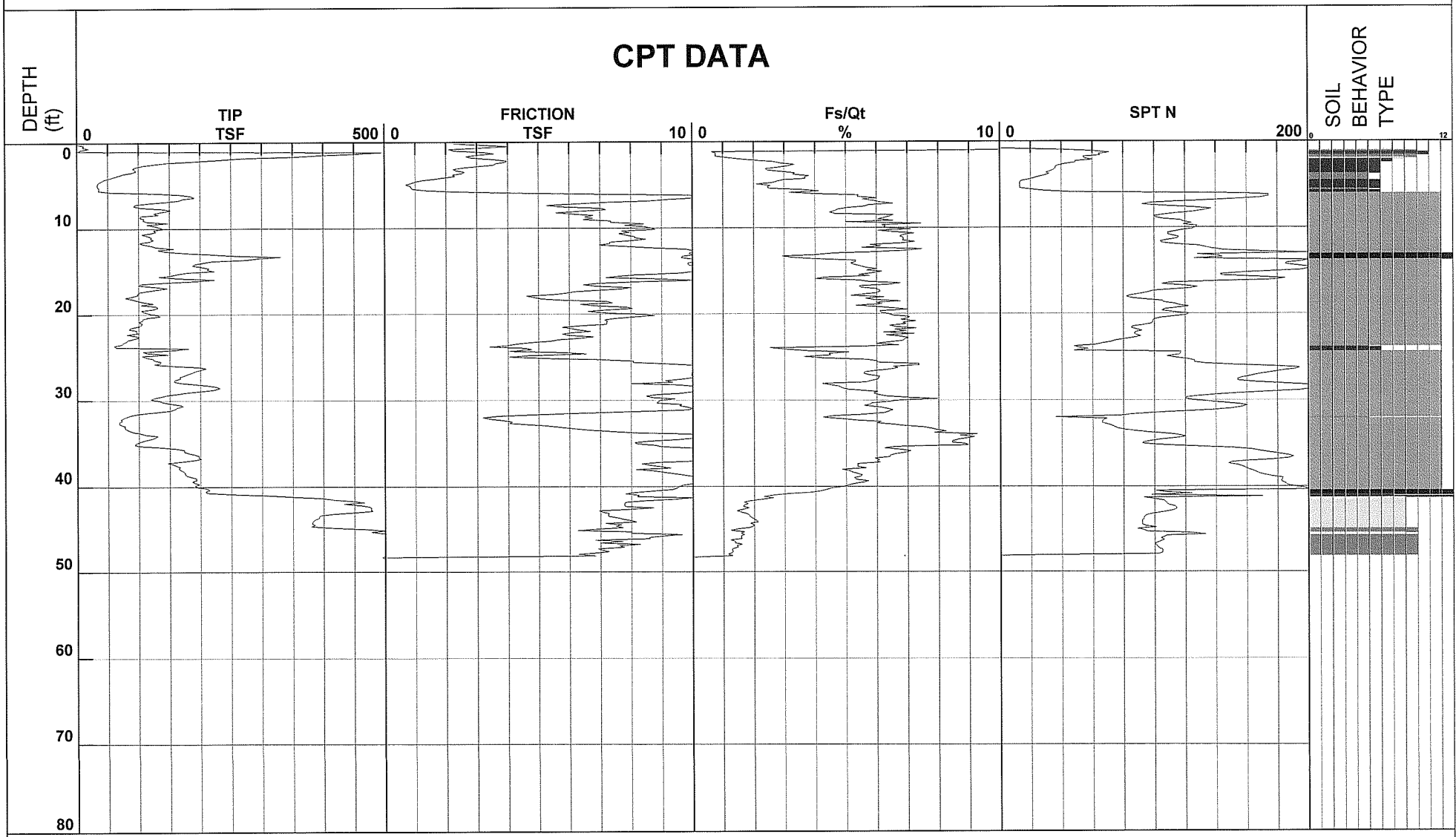
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	ML/VO	Filename	SDF(237).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-113	Date and Time	9/23/2008 11:35:11 PM	Maximum Depth	48.39 ft
Water Table Depth		0.00 ft			

CPT DATA



1 - sensitive fine grained
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3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

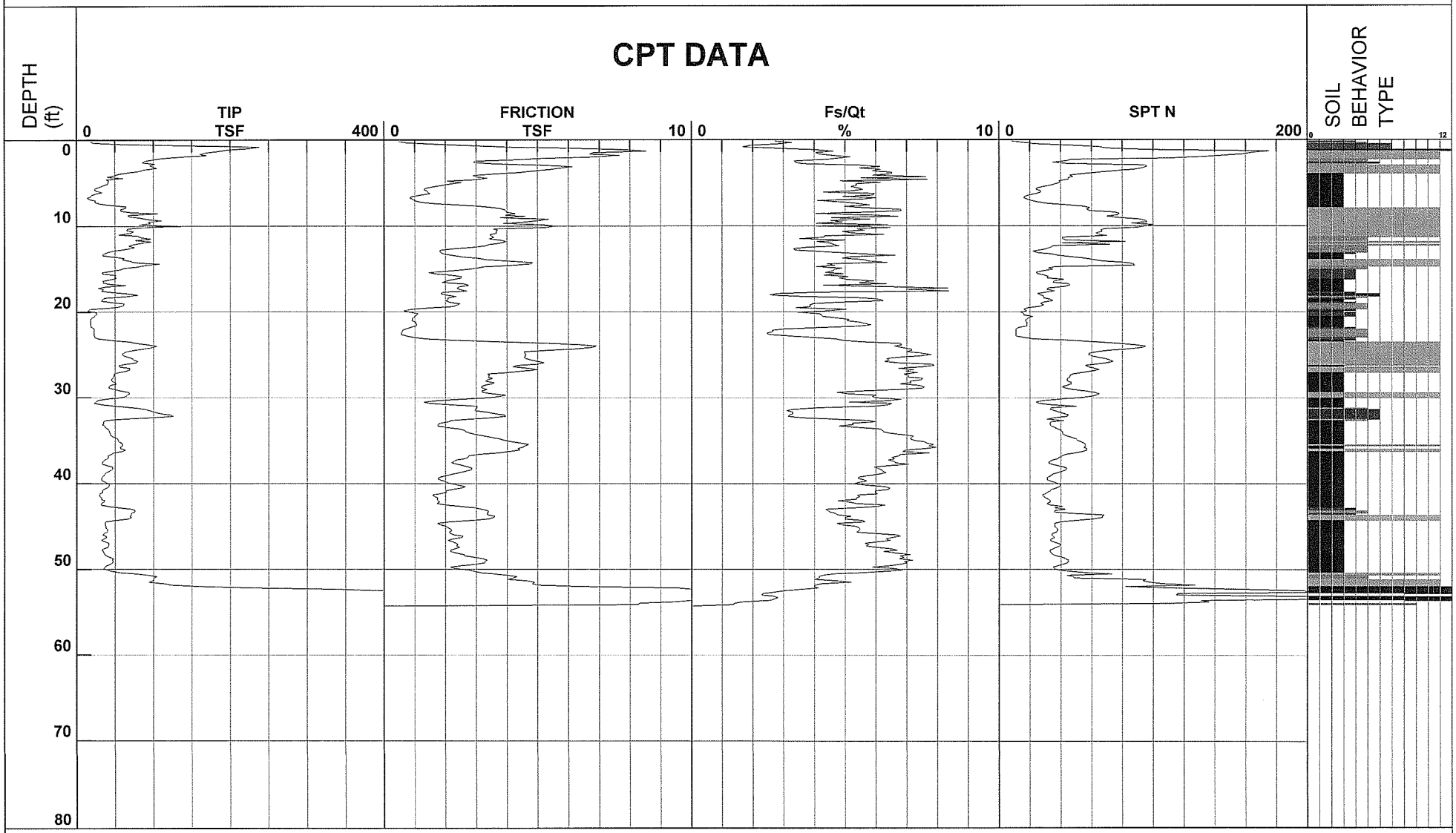
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	VO/ML	Filename	SDF(181).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-114	Date and Time	8/29/2008 9:19:49 AM	Maximum Depth	54.46 ft
Water Table Depth		80.00 ft			

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

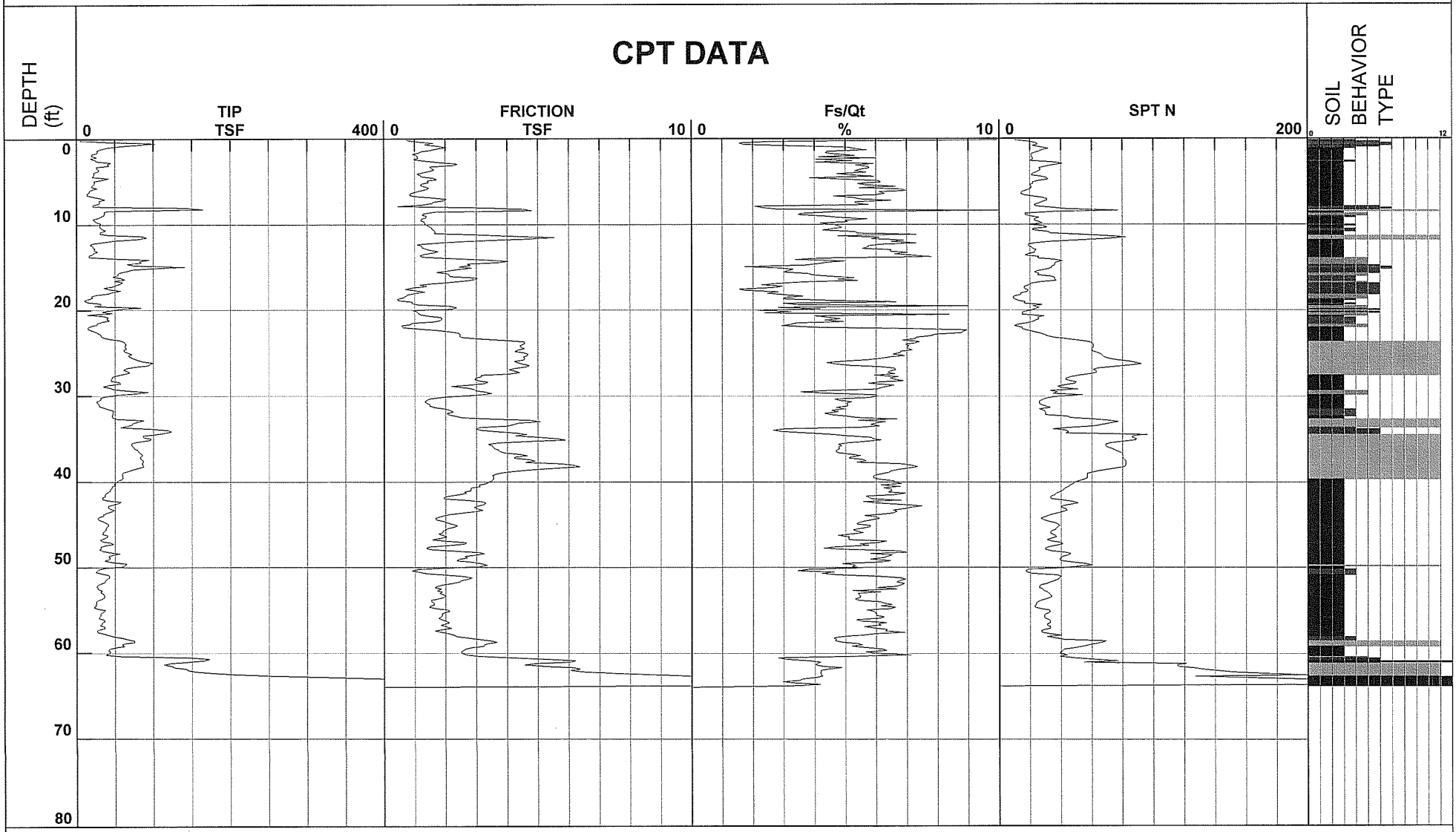
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	VO/ML	Filename	SDF(182).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-115	Date and Time	8/29/2008 10:27:27 AM	Maximum Depth	64.14 ft
Water Table Depth		80.00 ft			

CPT DATA



1 - sensitive fine grained
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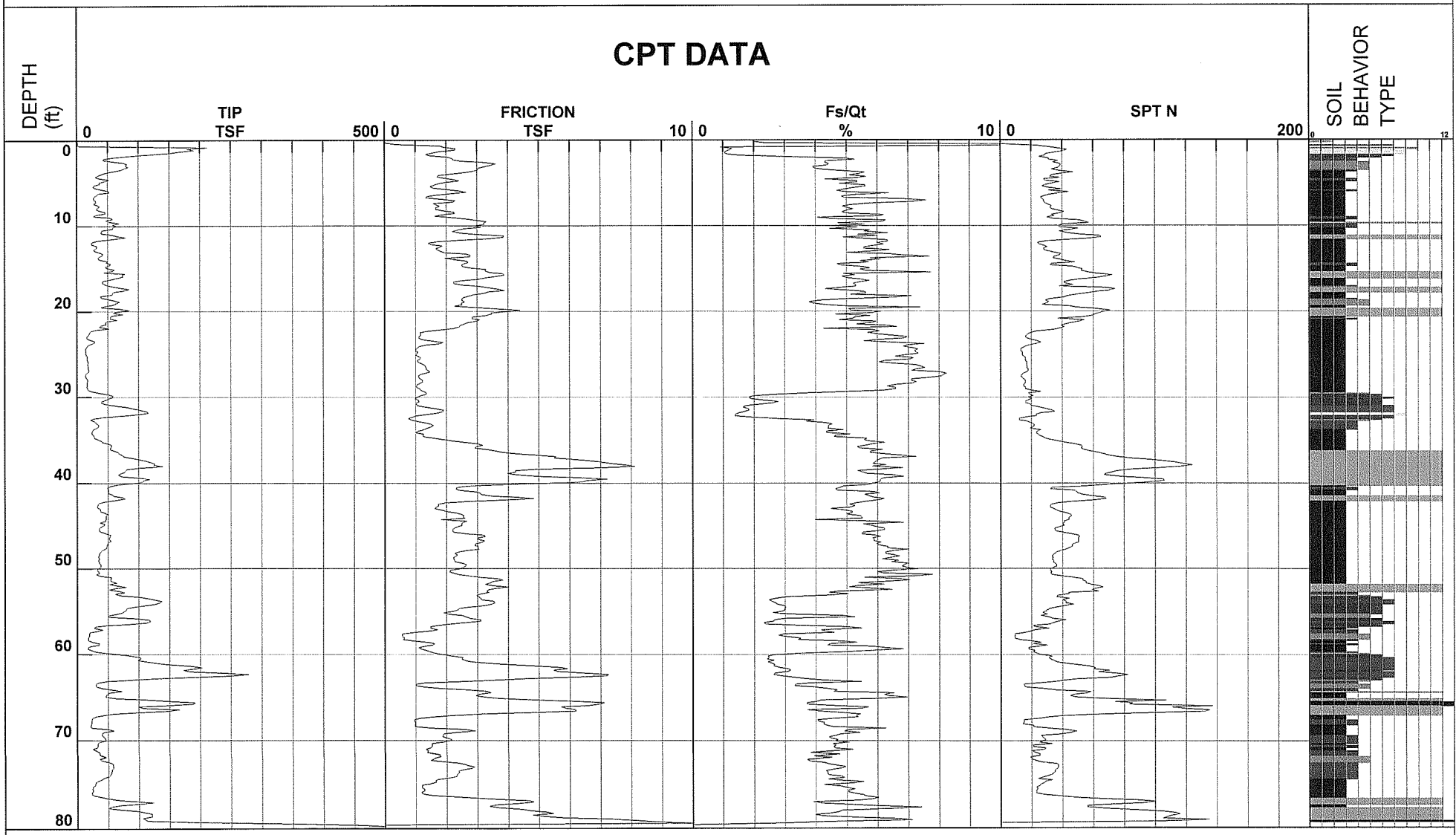
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	ML/VO	Filename	SDF(238).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-117	Date and Time	9/24/2008 10:55:38 PM	Maximum Depth	79.72 ft
Water Table Depth		0.00 ft			

CPT DATA



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7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

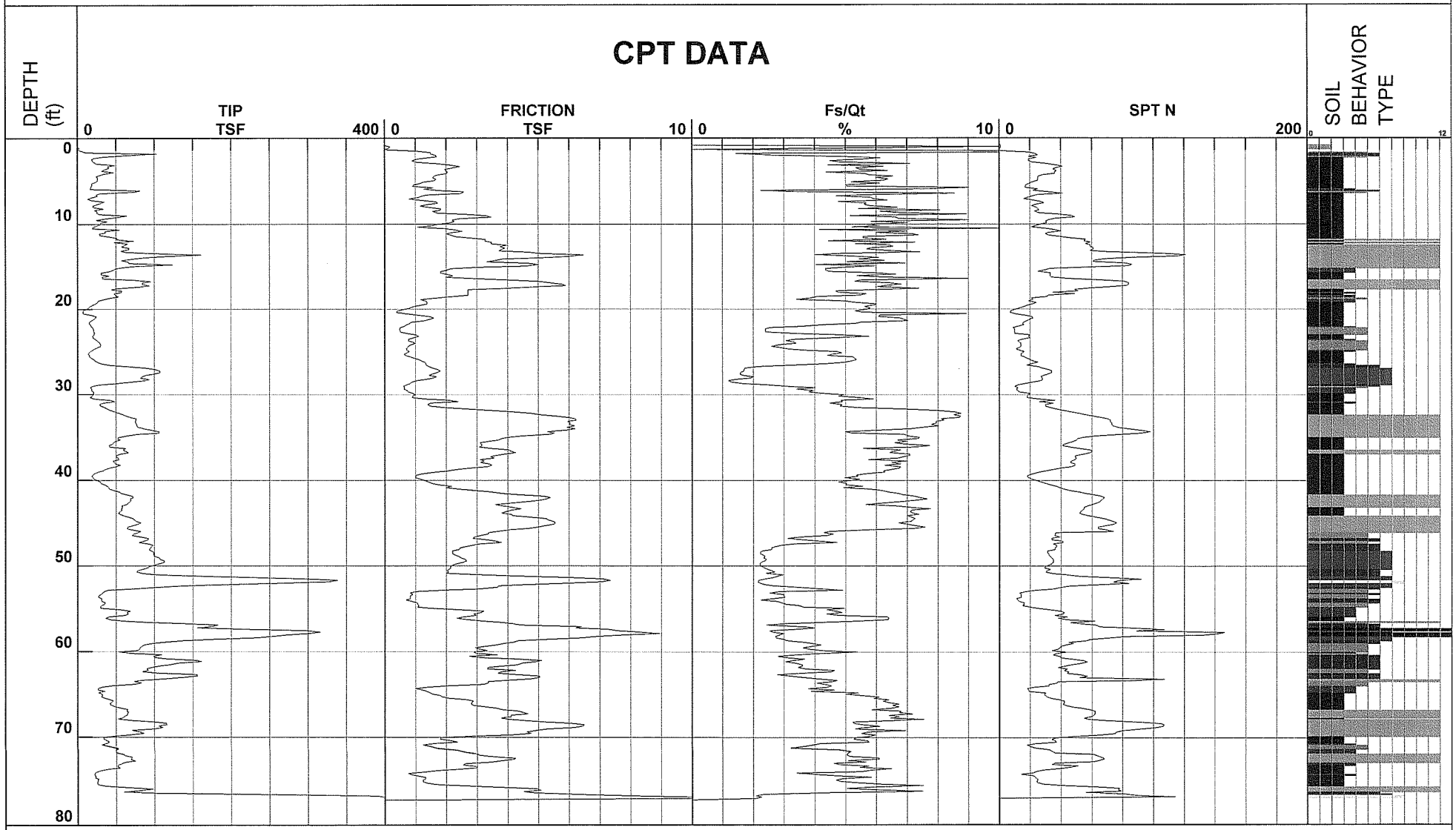
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	VO/ML	Filename	SDF(178).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-118	Date and Time	8/28/2008 10:10:13 AM	Maximum Depth	77.26 ft
Water Table Depth		80.00 ft			

CPT DATA



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8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

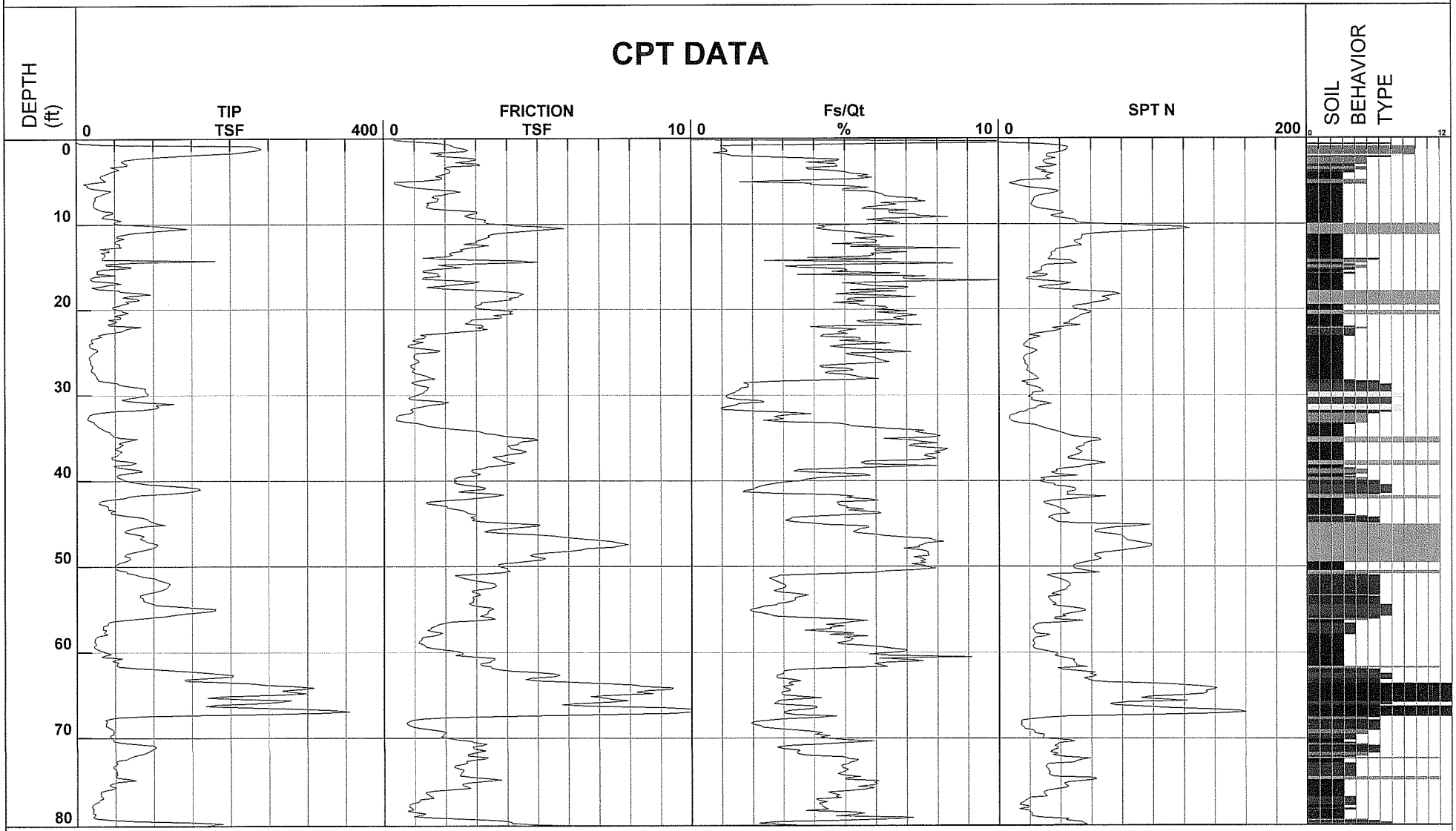
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	VO/ML	Filename	SDF(177).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-120	Date and Time	8/27/2008 1:06:33 PM	Maximum Depth	80.38 ft
Water Table Depth	80.00 ft				

CPT DATA



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11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

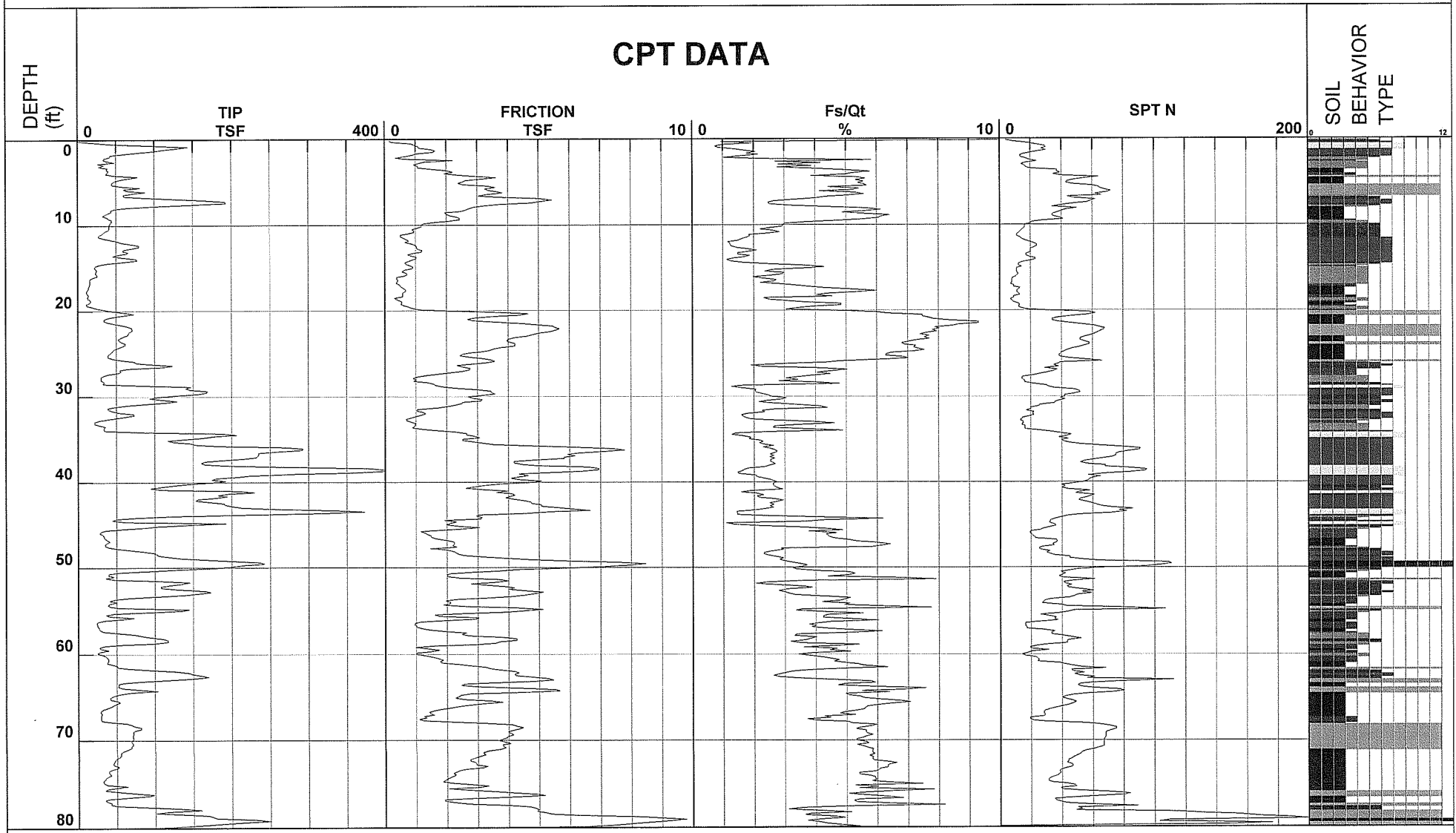
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	VO/ML	Filename	SDF(179).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-125	Date and Time	8/28/2008 11:23:49 AM	Maximum Depth	80.22 ft
Water Table Depth		80.00 ft			

CPT DATA



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11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

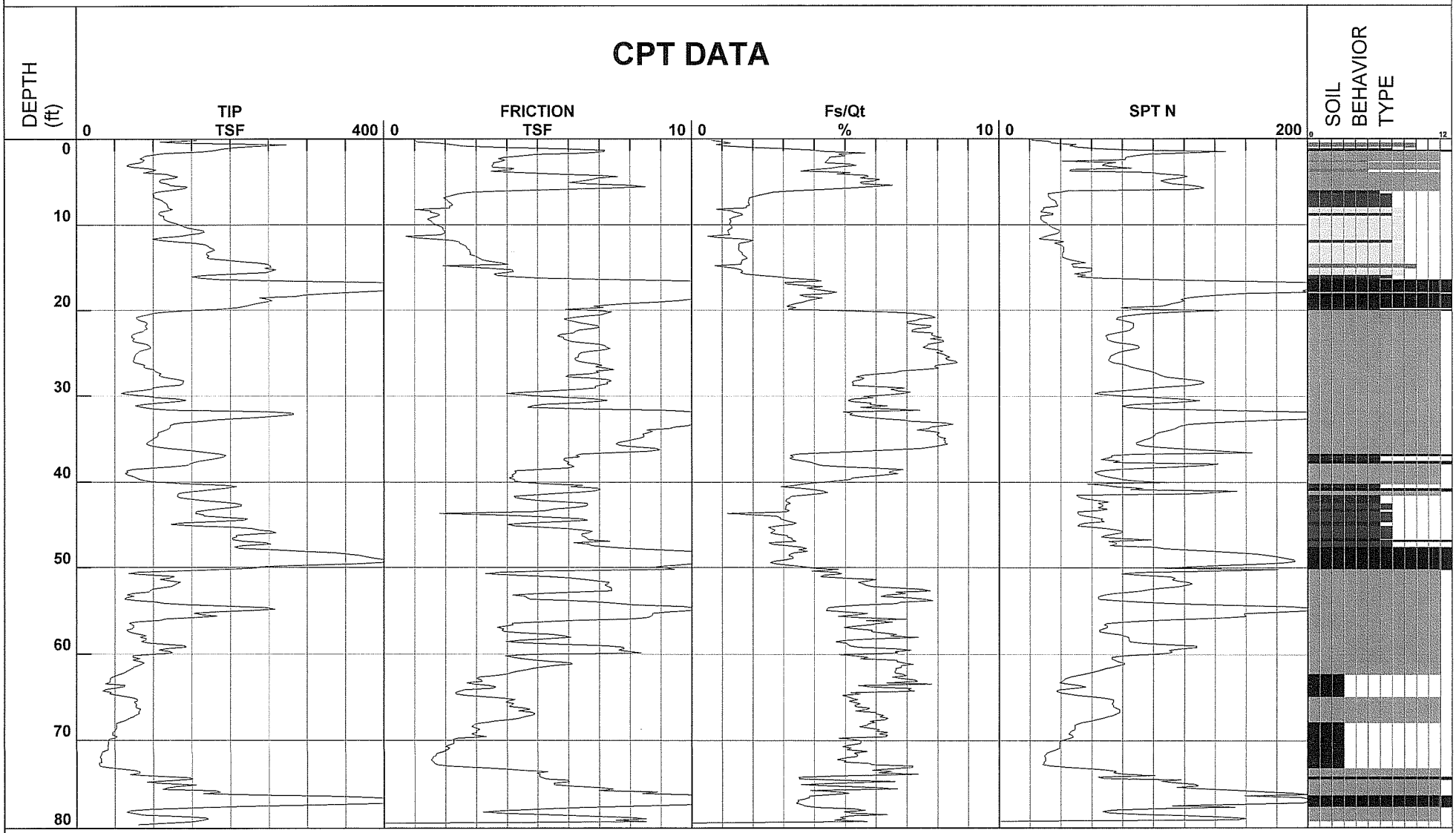
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	VO/ML	Filename	SDF(180).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-127	Date and Time	8/28/2008 1:25:32 PM	Maximum Depth	79.56 ft
Water Table Depth	80.00 ft				

CPT DATA



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7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

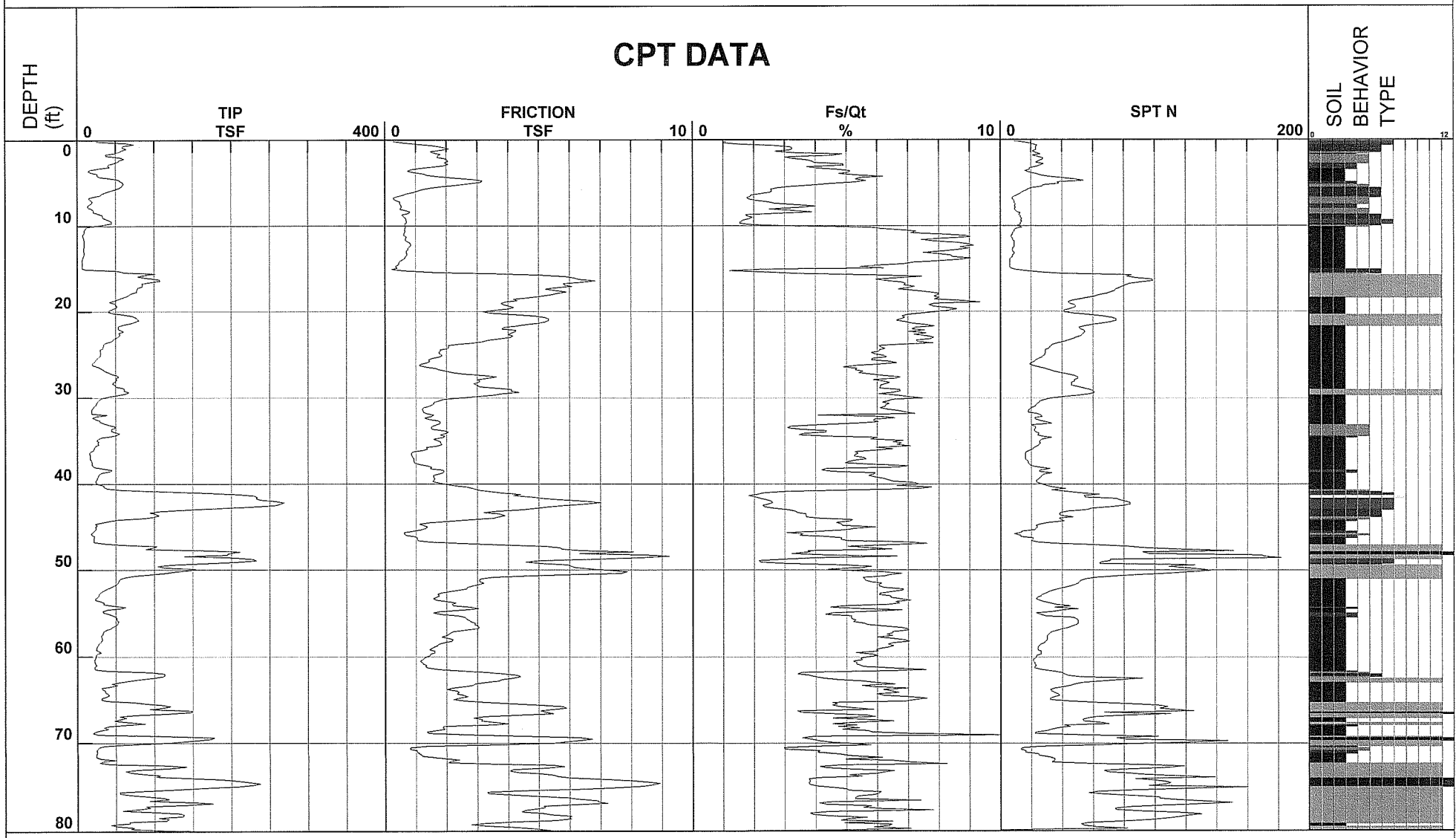
Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Earth Mechanics

Location	57 Freeway Expansion	Operator	VO/ML	Filename	SDF(183).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-131	Date and Time	8/29/2008 12:45:19 PM	Maximum Depth	80.22 ft
Water Table Depth		80.00 ft			

CPT DATA



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Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

Appendix C. Laboratory Test Results

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-001	D-2	5	SC	13.6	133.7									
A-08-001	S-3	10	SC	8.7							2000	8.6	450	153
A-08-001	D-4	15	SC	12.9	138.1									
A-08-001	S-5	20	SM/SC	13.9										
A-08-001	D-6	25	SP	2.7	106.8									
A-08-001	S-7	30	SP	3.4										
A-08-001	D-8	35	SP	3.0	123.8									
A-08-001	S-9	40	SP	2.7										
A-08-001	D-10	45	SP	3.6	115.2									
A-08-001	S-11	50	SP	6.3										
A-08-001	D-12	55	SP-SM	5.1	125.4									
A-08-001	S-13	66	SP	5.5										
A-08-001	D-14	65	SP	3.6	108.7									
A-08-001	S-15	70	SP-SM	3.6										
A-08-001	D-16	75	SP	2.9	112.9									
A-08-001	S-17	80	SP	3.2										
A-08-001	D-18	85	SP	3.8	107.1									
A-08-001	S-19	90	SP	2.9										
A-08-002	S-1-1	2.5	SM	8.6										
A-08-002	S-1-2	3.5	CL	16.5										
A-08-002	D-2	5	SM	14.5	122.9									
A-08-002	S-3	10	SP	3.3										
A-08-002	D-4	15	SW-SM	2.6	121.0									
A-08-002	S-5	20	SP-SM	3.3										
A-08-002	D-6	25	SP-SM	2.9	111.7									
A-08-002	S-7	30	SP	2.6										
A-08-002	D-8	35	SP-SM	2.2	110.1									
A-08-002	S-9	40	SP-SM	2.9										
A-08-002	D-10	45	SP	3.4	110.7									
A-08-002	S-11	50	SP-SM	4.3										
A-08-002	D-12	55	SP-SM	2.0	115.8									
A-08-002	S-13	60	SP-SM	3.4										
A-08-002	D-14	65	SP-SM	2.7	108.8									
A-08-002	S-15	70	SP-SM	2.8										
A-08-003	D-2	5	SC	8.5	141.2									
A-08-003	S-3	10	CL	16.8							1100	8.4	300	216
A-08-003	D-4	15	SC	6.9	140.9			11:67:22						
A-08-003	S-5	20	SC	15.2										
A-08-003	D-6	25	SC	16.9	124.3			1:57:42						
A-08-003	S-7	30	SP	2.7										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-003	D-8	35	SP-SM	2.7	115.1									
A-08-003	S-9	40	SP-SM	2.9										
A-08-003	D-10	45	SP-SM	2.9	112.8									
A-08-003	S-11	50	SP	3.2										
A-08-003	D-12	55	SP-SM	3.7	107.1									
A-08-003	S-13	60	SP-SM	7.1										
A-08-003	D-14	65	SP-SM	3.5	109.6									
A-08-003	S-15	70	SP-SM	3.6										
A-08-003	D-16	75	SP	2.0	106.3									
A-08-003	S-17	80	SP	3.4										
A-08-003	D-18	85	SP	2.3	111.8									
A-08-003	S-19	90	SP	2.6										
A-08-004	D-1	2.5	SC	9.4	134.3									
A-08-004	S-2	5	SC	14.4										
A-08-004	D-3	10	GP-GC	11.6	132.3									
A-08-004	S-4	15	CL	13.1							750	7.5	700	185
A-08-004	D-5	20	SC	8.6	136.5									
A-08-004	S-6	25	SM	5.6										
A-08-004	D-7	30	CL to SM	17.3	128.2	>4.5								
A-08-004	S-8	35	SM	6.6										
A-08-004	D-9	40	SM	6.4	127.2									
A-08-004	S-10	45	SP-SM	4.2										
A-08-004	D-11	50	SP-SM	3.7	112.2									
A-08-004	S-12	55	SP	2.8										
A-08-004	D-13	60	SP	2.7	122.0									
A-08-004	S-14	65	CL	14.7										
A-08-004	D-15	70	SM	8.9	117.7									
A-08-004	S-16	75	SM	11.2										
A-08-004	D-17	80	CL to SM	18.4	124.3	1.75								
A-08-004	S-18	85	SP	3.3										
A-08-004	D-19	90	SP-SM	5.4	112.9									
A-08-005	S-1	2.5	SM	7.1										
A-08-005	D-2	5	CL	10.8	104.1	1.75								
A-08-005	S-3	10	SC	13.0				1:52:47						
A-08-005	D-4	15	SC	13.5	117.9			1:51:48			2000	8.4	120	173
A-08-005	S-5	20	CL	18.6										
A-08-005	D-6	25	SC	12.5	132.2	>4.5		16:52:32						
A-08-005	S-7	30	CL	23.8										
A-08-005	D-8	35	CL	15.0	134.3	2.25				29/16/13				
A-08-005	S-9	40	SP-SC	7.6										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : *08-115* **Project Name :** RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-005	*D-10*	45	SP-SC	8.4	115.7									
A-08-005	*S-11*	50	SC	8.1										
A-08-005	*D-12*	55	SP-SM	7.4	120.4									
A-08-005	*S-13*	60	SP-SM	3.3										
A-08-005	*D-14*	65	CL	17.3	132.2	2.75								
A-08-005	*S-15*	70	SP-SM	2.7										
A-08-005	*D-16*	75	ML to SM	7.7	124.8									
A-08-005	*S-17*	80	SM	6.2										
A-08-005	*D-18*	85	SP	2.0	104.3									
A-08-005	*S-19*	90	SM	5.3										
A-08-006	*S-2*	5	SC	13.3										
A-08-006	*D-3*	10	CL	25.3	127.8	>4.5								
A-08-006	*S-4*	15	CL	16.5							1800	8.1	100	168
A-08-006	*D-5*	20	CL to SM	15.7	129.2	2.75								
A-08-006	*S-6*	25	CL	20.6						38/18/20				
A-08-006	*D-7*	30	SC	18.0	129.5	4.5								
A-08-006	*S-8*	35	SP-SM	2.8										
A-08-006	*D-9*	40	SP-SM	2.2	111.9									
A-08-006	*S-10*	45	SM	6.1										
A-08-006	*D-11*	50	SP-SM	1.7	121.0									
A-08-006	*S-12*	55	ML	20.5										
A-08-006	*D-13*	60	CL to SM	20.7	126.8	1.5								
A-08-006	*S-14*	65	SP	1.4										
A-08-006	*D-15*	70	SP-SM	2.2	122.8									
A-08-006	*S-16*	75	SC	13.5				0:51:49						
A-08-006	*D-17*	80	SM	7.8	126.3									
A-08-006	*S-18*	85	SP-SM	3.0										
A-08-006	*D-19*	90	SP-SM	2.8										
A-08-007	*D-2*	5	SC	9.6										
A-08-007	*S-3*	10	SC	12.4				18:46:36						
A-08-007	*D-4*	15	CL	16.8	122.1	3.75					740	7.7	500	162
A-08-007	*S-5*	20	CL	19.1										
A-08-007	*D-6*	25	SC	12.8	127.2					32/19/13				
A-08-007	*S-7*	30	CL	18.7				4:39:57						
A-08-007	*D-8*	35	CL	12.1	132.6	4.5								
A-08-007	*S-9*	40	CL	10.9										
A-08-007	*D-10*	45	CL	16.3	122.9	2.5								
A-08-007	*S-11*	50	CL	17.0										
A-08-007	*D-12*	55	SM	18.6	112.9									
A-08-007	*S-13*	60	ML	23.7										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-007	D-14	65	SP	1.3	113.8									
A-08-007	S-15	70	SP-SM	4.5										
A-08-007	D-16	75	CL	30.4	121.2	3								
A-08-007	S-17	80	CL	15.7										
A-08-007	D-18	85	ML	14.5	131.6	4.5								
A-08-007	S-19	90	ML to SC	9.8										
A-08-008	D-1	2.5	SP-SM	7.0	123.6									
A-08-008	S-2	5	GP-GM	2.7										
A-08-008	D-3	10	CL	17.9	126.7						810	7.7	450	213
A-08-008	S-4	15	CL	17.1										
A-08-008	D-5	20	CL	16.0	131.8									
A-08-008	S-6	25	CL	18.4										
A-08-008	D-7	30	CL	20.8	122.5	2.5					510	7.4	750	208
A-08-008	S-8	35	CL	20.1										
A-08-008	D-9	40	CL	18.4	122.3	2.5								
A-08-008	S-10	45	CL	33.6										
A-08-008	D-11	50	CH	32.5	118.3	3.0				58/19/39				
A-08-008	S-12	55	CL	38.4										
A-08-008	D-13	60	CL to SC	14.2	138.7	3.0								
A-08-008	S-14	65	CL	17.2										
A-08-008	D-15	70	CL to SC	11.9	141.2	4.0								
A-08-008	S-16	75	SC	14.5										
A-08-008	D-17	80	CL	20.5	131.2	2.75								
A-08-008	S-18	85	CL	18.3										
A-08-008	D-19	90	SM	16.3	134.3									
A-08-008	S-20	95	SP-SM	2.8										
A-08-009	S-1	2.5	SC	9.8										
A-08-009	D-2	5	SC	12.9	113.7									
A-08-009	S-3	10	CL	12.6										
A-08-009	D-4	15	CL	17.3	109.4	>4.5								
A-08-009	S-5	20	CL	17.8										
A-08-009	D-6	25	CL	15.6	119.7	4.5		10:36:54			850	7.7	300	142
A-08-009	S-7	30	CL	17.6										
A-08-009	D-8	35	CL	16.6	124.7	4.25				42/17/25				
A-08-009	S-9	40	SC	5.3				10:73:17						
A-08-009	D-10	45	SM	1.6	102.7									
A-08-009	S-11	50	SP-SM	2.3										
A-08-009	D-12	55	SP-SM	4.8	109.7									
A-08-009	S-13	60	SP-SM	2.4										
A-08-009	D-14	65	SP-SM	2.0	101.5									

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : *08-115* **Project Name :** RBF/SR-57 Northbound

Boring No .	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-009	*S-15*	70	SP-SM	1.8										
A-08-009	*D-16*	75	SM	8.3	104.1									
A-08-009	*S-17*	80	ML	31.6										
A-08-009	*D-18*	85	CL	21.5	129.5	3.5								
A-08-009	*S-19*	90	CL	22.1										
A-08-010	*S-2*	5	CL	10.5							1300	8.0	100	123
A-08-010	*D-3*	10	SC	9.6	133.2									
A-08-010	*S-4*	15	CL	11.3										
A-08-010	*D-5*	20	CL	11.3	134.6	>4.5								
A-08-010	*S-6*	25	CL	10.9										
A-08-010	*D-7*	30	CL	8.2	121.8	>4.5								
A-08-010	*S-8*	35	CL	7.2				0:46:54						
A-08-010	*D-9*	40	CL	9.2	127.4	>4.5								
A-08-010	*S-10*	45	SM	3.1										
A-08-010	*D-11*	50	SP-SM	0.9	128.8									
A-08-010	*S-12*	55	SP-SM	1.1										
A-08-010	*D-13*	60	SM	5.6	119.3									
A-08-010	*S-14*	65	SM	1.7										
A-08-010	*D-15*	70	SP-SM	0.9	118.6									
A-08-010	*S-16*	75	SM	1.3										
A-08-010	*S-18*	85	SP-SM	2.9										
A-08-010	*D-19*	90	CL	16.4	132.7	2.0								
A-08-010	*S-20*	95	CL	24.1										
A-08-010	*S-21*	100	CL	22.7										
A-08-010	*S-22*	105	CL	17.7										
A-08-011	*D-1*	2.5	SP-SM	4.2	117.9									
A-08-011	*S-2*	5	SM	11.1										
A-08-011	*D-3*	10	CH	27.1	116.6	4.5				66/28/38				
A-08-011	*S-4*	15	CL	30.8										
A-08-011	*D-5*	20	CL	19.5	122.3									
A-08-011	*S-6*	25	CL	12.7										
A-08-011	*D-7*	30	CL	12.5	135.5			0:43:57						
A-08-011	*S-8*	35	SC	6.9										
A-08-011	*D-9*	40	SP-SM	3.6	122.7									
A-08-011	*S-10*	45	SP-SM	6.6										
A-08-011	*D-11*	50	SP-SM	6.2	121.8									
A-08-011	*S-12*	55	SP-SM	4.5										
A-08-011	*D-13*	60	SP-SM	5.0	121.7									
A-08-011	*S-14*	65	CL	18.0										
A-08-011	*D-15*	70	CL	18.4	131.2	4.5								

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : *08-115* **Project Name :** RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-012	*S-1*	2.5	CL	15.4				1:45:54						
A-08-012	*D-2*	5	CL	22.4	124.8	1.5								
A-08-012	*S-3*	10	CL	30.4										
A-08-012	*D-4*	15	CL	36.7	112.8	2.0					850	7.4	50	245
A-08-012	*S-5*	20	CL	34.4										
A-08-012	*D-6*	25	CL	14.0	134.5	>4.5								
A-08-012	*S-7*	30	SC	14.9										
A-08-012	*D-8*	35	SP-SM	5.6	119.2									
A-08-012	*S-9*	40	SP-SM	9.9										
A-08-012	*D-10*	45	SP-SM	4.7	116.1									
A-08-012	*S-11*	50	CL	26.4										
A-08-012	*D-12*	55	SP-SM	2.1	128.7									
A-08-012	*S-13*	60	SP-SM	5.4										
A-08-012	*D-14*	65	CL	34.5	115.3	3.25								
A-08-012	*S-15*	70	CL	19.7										
A-08-013	*D-2*	5	SC	16.4	125.9									
A-08-013	*S-3*	10	SC	14.2										
A-08-013	*D-4*	15	CL	16.4	129.6	>4.5								
A-08-013	*S-5*	20	CL	16.2							1050	7.8	200	238
A-08-013	*D-6*	25	CL	15.3	133.4			0:41:59						
A-08-013	*S-7*	30	CL	22.0										
A-08-013	*D-8*	35	CL	22.1	121.2	3.75				38/22/16				
A-08-013	*S-9*	40	CL	14.8										
A-08-013	*D-10*	45	CL to SC	9.4	137.0	>4.5								
A-08-013	*S-11*	50	SP-SM	2.0										
A-08-013	*D-12*	55	SP-SM	1.3	113.6									
A-08-013	*S-13*	60	SP-SM	8.0										
A-08-013	*D-14*	65	SP-SM	2.0	104.9									
A-08-013	*S-15*	70	SP-SM	1.8										
A-08-013	*D-16*	75	CL	24.7	116.8	3.75								
A-08-013	*S-17*	80	SP-SM	2.2										
A-08-013	*D-18*	85	SP-SM	2.9										
A-08-013	*S-19-1*	90	SP-SM	2.3										
A-08-013	*S-19-2*	91	ML	23.6										
A-08-014	*S-2*	5	CL	18.7				4:42:54						
A-08-014	*D-3*	10	CL	17.5	137.0	3.0					600	7.7	450	158
A-08-014	*S-4*	15	CL	18.8										
A-08-014	*D-5*	20	SC	16.1	124.2									
A-08-014	*S-6*	25	CL	19.0										
A-08-014	*D-7*	30	CH	28.2	120.6	2.25				65/28/37				

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 **Project Name :** RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-014	S-8-1	35	CL	15.2										
A-08-014	S-8-2	35.8	SM	15.0										
A-08-014	D-9	40	CL	26.2	122.9	>4.5								
A-08-014	S-10	45	CL	19.8										
A-08-014	D-11	50	SM	10.3	130.6									
A-08-014	S-12	55	CL	19.1										
A-08-014	D-13	60	CL	20.7	127.3	3.75								
A-08-014	S-14	65	CL	25.8										
A-08-014	D-15	70	SM	8.3	138.1									
A-08-014	S-16	75	SP-SM	1.8										
A-08-014	D-17	80	SP-SM	1.7	115.6									
A-08-014	S-18	85	SP-SM	2.5										
A-08-014	D-19	90	SP-SM	1.8	107.6									
A-08-015	S-1	2.5	SC	12.6										
A-08-015	D-2	5	CL	14.6	121.0	>4.5								
A-08-015	S-3	10	SC	14.0										
A-08-015	D-4	15	CL	18.8	115.0	>4.5								
A-08-015	S-5	20	SC	17.5				6:50:44			840	7.6	350	182
A-08-015	D-6	25	CL	18.0	106.1	4.25								
A-08-015	S-7	30	SM	17.1										
A-08-015	D-8	35	CL	16.2	131.0	4.5				37/15/22				
A-08-015	S-9	40	CL	16.0										
A-08-015	D-10	45	SM	7.6	81.3			0:66:34						
A-08-015	S-11	50	CL	15.2										
A-08-015	D-12	55	CL	12.0	121.5	>4.5								
A-08-015	S-13	60	SC	11.1										
A-08-015	D-14	65	CL	17.0	119.1	4.5								
A-08-015	S-15	70	CL	25.8										
A-08-015	D-16	75	SM	9.0	121.4									
A-08-015	S-17	80	SP-SM	1.8										
A-08-015	D-18	85	SP	1.0	106.8									
A-08-015	S-19	90	SP-SM	2.0										
A-08-016	S-2	5	SC	13.9										
A-08-016	D-3	10	SC	15.5	126.8									
A-08-016	S-4	15	SC	17.2										
A-08-016	D-5	20	SC	20.2	130.3	4.5								
A-08-016	S-6	25	CL	19.8						35/17/18	1040	7.7	150	312
A-08-016	D-7	30	SM	9.7	124.2									
A-08-016	S-8	35	CH	17.5							530	7.5	120	364
A-08-016	D-9	40	SC	11.3	137.7									

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-016	S-10	45	CL	23.7										
A-08-016	D-11	50	CL	15.1	133.9	>4.5								
A-08-016	S-12	55	CL	19.0										
A-08-016	D-13	60	SC	13.1	138.2									
A-08-016	S-14	65	CL	26.2										
A-08-016	D-15	70	CL	18.2	125.1	3.5								
A-08-016	S-16	75	CL	16.2										
A-08-016	D-17	80	CL	20.2	126.7	2.25								
A-08-016	S-18	85	SP-SM	4.3										
A-08-138	D-7	30	SM	2.1	108.8									
A-08-017	D-2	5	SC	10.4										
A-08-017	S-3	10	CL	12.3										
A-08-017	D-4	15	CL	12.8	92.0	>4.5				30/20/10				
A-08-017	S-5	20	CL	19.9							490	7.3	250	362
A-08-017	D-6	25	SM	4.7	123.4									
A-08-017	S-7	30	CL	14.1										
A-08-017	D-8	35	SC	9.1	124.9									
A-08-017	S-9	40	CL	10.2				0:41:59						
A-08-017	D-10	45	CL	12.5	129.5	>4.5								
A-08-017	S-11	50	CL	13.8										
A-08-017	D-12	55	CL	17.4	129.9	>4.5								
A-08-017	S-13	60	SM	7.7				0:65:35						
A-08-017	D-14	65	CL	29.4	124.3	3.75								
A-08-017	S-15	70	CL	17.5										
A-08-017	D-16	75	SM	6.1	106.2									
A-08-017	S-17	80	CL	22.2										
A-08-017	S-19	90	SP-SM	1.0										
A-08-018	S-1	2.5	CL	28.7										
A-08-018	D-2	5	CL	24.4	120.2	1.25					760	8.4	250	223
A-08-018	S-3	10	CL	19.4										
A-08-018	D-4	15	CL	25.0	125.4					43/21/22				
A-08-018	S-5	20	CL	18.2										
A-08-018	D-6	25	CL	16.4	126.2									
A-08-018	S-7	30	SM	12.5										
A-08-018	D-8	35	SM	13.6	116.8									
A-08-018	S-9	40	CL	15.5							900	7.9	80	296
A-08-018	D-10	45	CL	14.9	133.4	>4.5								
A-08-018	S-11	50	SM	15.7										
A-08-018	D-12	55	SP-SM	2.0	106.4									
A-08-018	S-13-1	60	SM	3.8										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-018	S-13-2	60.5	CL	23.1										
A-08-019	D-1	2.5	CL	23.6	122.5	3.25								
A-08-019	S-2	5	CL	28.5										
A-08-019	D-3	10	CL	22.8	119.3	3.25					750	8.5	280	181
A-08-019	S-4	15	CL	23.6										
A-08-019	D-5	20	CL	21.7	120.4	1.5								
A-08-019	S-6	25	SM	3.7										
A-08-019	D-7	30	SM	6.6	118.8									
A-08-019	S-8	35	CL-ML	17.1				0:44:56						
A-08-019	D-9	40	CL	15.8	134.4	>4.5								
A-08-019	S-10	45	SC-SM	12.6										
A-08-019	D-11	50	SM	18.3	128.8									
A-08-019	S-12	55	SM	4.8										
A-08-019	D-13	60	CH	23.0	125.6	>4.5								
A-08-101	S-1	2.5	SC-SM	10.7										
A-08-101	D-2	5	SM	6.3	118.2									
A-08-101	S-3	10	SP-SM	3.7										
A-08-101	D-4	15	SP	2.7	119.8									
A-08-101	S-5	20	SP-SM	4.0										
A-08-101	D-6	25	SP	2.5	114.0									
A-08-101	S-7	30	SP	3.1										
A-08-102	D-1	2.5	SM	4.3	120.1									
A-08-102	S-2	5	SM	4.9										
A-08-102	D-3	10	SP	1.9	111.4									
A-08-102	S-4	15	SP	1.3				3:93:4						
A-08-102	D-5	20	SP	0.9	118.4									
A-08-102	S-6	25	SP-SM	2.6										
A-08-102	D-7	30	SP-SM	3.6	115.2									
A-08-105	S-1	2.5	SP-SM	7.3										
A-08-105	D-2	5	SM	10.2	132.6									
A-08-105	S-3	10	SP-SM	4.4										
A-08-105	D-4	15	SP-SM	5.5	109.7									
A-08-105	S-5	20	SM	7.9										
A-08-105	D-6	25	SP-SM	4.1	109.7									
A-08-105	S-7	30	SP-SM	6.2										
A-08-105	D-8	35	SP-SM	3.2	117.7									
A-08-105	S-9	40	SP-SM	2.7										
A-08-105	D-10	45	SP	3.5	106.1									
A-08-105	S-11	50	SP	2.4										
A-08-105	D-12	55	SP-SM	3.3	117.2									

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-105	S-13	60	SP-SM	2.8										
A-08-105	D-14	65	SP-SM	3.7	111.3									
A-08-105	S-15	70	SP-SM	2.9										
A-08-106	D-1	2.5	SM	3.6	114.5									
A-08-106	S-2	5	SM	5.9										
A-08-106	D-3	10	SP	1.9	104.4									
A-08-106	S-4	15	SP	2.3										
A-08-106	S-6	25	SP-SM	3.6										
A-08-106	D-7	30	SP-SM	4.1	115.0									
A-08-106	S-8	35	SP-SM	3.0										
A-08-106	D-9	40	SP-SM	3.5	117.6									
A-08-106	S-10	45	SP-SM	3.4										
A-08-106	D-11	50	SP-SM	3.1	106.4									
A-08-106	S-12	55	SP-SM	5.0										
A-08-106	D-13	60	SP-SM	4.5	124.3									
A-08-108	D-1	2.5	SC	8.5	131.3									
A-08-108	S-2	5	SC	11.9				10:57:33						
A-08-108	D-3	10	SC	9.6	134.4									
A-08-108	S-4	15	SC	10.5										
A-08-108	D-5	20	SC to SP-SM	3.4	134.2									
A-08-108	S-6	25	SC	15.7										
A-08-108	D-7	30	SP	3.1	115.9									
A-08-108	S-8	35	SP	10.5										
A-08-108	D-9	40	CL	17.0	127.0	3.0								
A-08-108	S-10	45	CL	19.4						33/20/13				
A-08-108	D-11	50	SP-SM	3.3	110.9									
A-08-108	S-12	55	SP-SM	4.2										
A-08-108	D-13	60	SP-SM	3.0	112.6									
A-08-108	S-14	65	SP-SM	2.5										
A-08-108	D-15	70	SP-SM	2.5	111.7									
A-08-109	S-1	2.5	SM	8.8										
A-08-109	D-2	5	SM	4.2	127.5									
A-08-109	S-3	10	SM	8.5										
A-08-109	D-4	15	SC	8.3	132.7									
A-08-109	S-5	20	CL	18.6							700	7.7	1000	221
A-08-109	D-6	25	SP	3.9	105.2									
A-08-109	S-7	30	SP	3.2										
A-08-109	D-8	35	CL	25.9	120.7	2.0					500	7.6	300	270
A-08-109	S-9	40	CL	23.3										
A-08-109	D-10	45	SM	19.6	129.0									

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-109	S-11	50	SP-SM	3.2										
A-08-109	D-12	55	SM to SP-SM	11.5	122.7									
A-08-109	S-13	60	SP-SM	4.1										
A-08-109	D-14	65	SP-SM	3.3	100.0									
A-08-109	S-15	70	SP-SM	2.4										
A-08-116	D-1	2.5	SM	5.3	128.7									
A-08-116	S-2	5	CL	7.5										
A-08-116	D-3	10	CL	11.4	133.8	>4.5								
A-08-116	S-4	15	CL	10.0										
A-08-116	D-5	20	CL	9.1	120.9	>4.5								
A-08-116	S-6	25	CL	12.0							1100	8.3	280	159
A-08-116	D-7	30	CL	9.2	115.9	>4.5								
A-08-116	S-8	35	CL	11.9										
A-08-116	D-9	40	CL	13.3	127.1	>4.5								
A-08-116	S-10	45	SM	1.2										
A-08-116	D-11	50	ML	13.8	121.9	>4.5								
A-08-116	S-12	55	SP-SM	1.2										
A-08-116	D-13	60	SP-SM	1.6	102.9									
A-08-119	S-1	2.5	CL	19.0										
A-08-119	D-2	5	CL	23.1	117.7	1.5					980	7.7	400	221
A-08-119	S-3	10	SM	8.7				0:82:18						
A-08-119	D-4	15	CL	17.6	130.2	4.0								
A-08-119	S-5	20	SC	15.0										
A-08-119	D-6	25	CL	26.4	124.7	2.75								
A-08-119	S-7	30	CL	15.8										
A-08-119	D-8	35	SM	5.6	115.2									
A-08-119	S-9	40	CL	25.7										
A-08-119	D-10	45	SM	5.0	104.0									
A-08-119	S-11	50	CL	18.3										
A-08-119	D-12	55	CH	24.1	125.7	4.25								
A-08-119	S-13	60	SM	12.7										
A-08-121	S-1	2.5	CL	17.5										
A-08-121	D-2	5	CL	18.6	131.0	3.0					1200	8.0	120	184
A-08-121	S-3	10	SM	15.4										
A-08-121	D-4	15	CL	18.4	126.6	>4.5				35/21/14				
A-08-121	S-5	20	CL	19.5										
A-08-121	D-6	25	CL	21.5	129.0	3.75					940	7.7	50	280
A-08-121	S-7	30	SM	5.8										
A-08-122	D-1	2.5	SM	6.7	119.0									
A-08-122	S-2	5	SC	9.8										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : *08-115* **Project Name :** RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-122	*S-3*	10	CL	9.0	129.3	>4.5								
A-08-122	*S-4*	15	CL	15.9							520	7.6	150	416
A-08-122	*D-5*	20	CL	10.3	116.9	>4.5								
A-08-122	*S-6*	25	CL	11.6										
A-08-122	*D-7*	30	CL	13.1	133.4	>4.5								
A-08-123	*S-1-1*	2.5	SC	16.1										
A-08-123	*S-1-2*	3.4	SM	15.6										
A-08-123	*D-2*	5	SC	11.1	134.2									
A-08-123	*S-3*	10	CL	17.7				0:41:59						
A-08-123	*D-4*	15	SC	10.8	136.0									
A-08-123	*S-5*	20	CL	20.7							980	7.9	120	315
A-08-123	*D-6*	25	CL	18.1	128.2	4.25								
A-08-123	*S-7*	30	SM	8.9										
A-08-124	*D-1*	2.5	CL	8.6	126.4	>4.5				38/17/21				
A-08-124	*S-2*	5	CL	10.0							1800	8.3	250	175
A-08-124	*D-3*	10	SC	13.8	128.2									
A-08-124	*S-4*	15	CL	16.1										
A-08-124	*D-5*	20	ML	10.0	121.2	>4.5								
A-08-124	*S-6*	25	CL	13.0										
A-08-124	*D-7*	30	CL	16.4	126.3	>4.5								
A-08-126	*D-1*	2.5	CL	18.3	124.1	4.5					1090	8.4	80	159
A-08-126	*S-2*	5	CL	18.1										
A-08-126	*D-3*	10	CL	12.2	127.2	>4.5				34/19/15				
A-08-126	*S-4*	15	ML	16.5				0:45:55						
A-08-126	*D-5*	20	CL	17.2	131.3	4.0				39/16/23				
A-08-126	*S-6*	25	CL	12.3							1100	7.9	120	262
A-08-126	*D-7*	30	SM	5.1	109.9									
A-08-126	*S-8-1*	35	CL	22.2										
A-08-126	*S-8-2*	35.8	SM	11.2										
A-08-126	*D-9*	40	SM	6.9	112.8									
A-08-126	*S-10*	45	SP-SM	3.2										
A-08-126	*D-11*	50	SM	4.5	118.3	3.25								
A-08-126	*S-12-1*	55	SM	8.0										
A-08-126	*S-12-2*	55.4	CL	26.9										
A-08-126	*D-13*	60	CL	15.0	130.9	>4.5								
A-08-128	*D-1*	2.5	SM	5.8	135.3									
A-08-128	*S-2*	5	CL	14.8							1500	7.9	50	153
A-08-128	*D-3*	10	SP-SM	4.7	108.9									
A-08-128	*S-4*	15	CL	10.5										
A-08-128	*D-5*	20	CL	18.1	130.4	>4.5				46/19/27				

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : *08-115* **Project Name :** RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-128	*S-6*	25	CL	27.8										
A-08-128	*D-7*	30	SM	5.6	109.8									
A-08-129	*S-1*	2.5	SC	11.0										
A-08-129	*D-2*	5	CL	13.8	136.8	>4.5								
A-08-129	*S-3*	10	SM	6.8										
A-08-130	*D-1*	2.5	CL	8.9	127.0	>4.5								
A-08-132	*D-1*	2.5	SM	24.6	124.3			19:66:15						
A-08-132	*S-2*	5	CL	14.4										
A-08-132	*D-3*	10	CL to SM	13.9	123.9						1500	8.2	50	163
A-08-133	*S-1*	2.5	SC	13.1										
A-08-133	*D-2*	5	SC	12.0	135.7									
A-08-133	*S-3*	10	CL	19.9										
A-08-134	*D-1*	2.5	SC	13.3	129.8									
A-08-134	*S-2*	5	SC	13.7										
A-08-134	*D-3*	10	SC-SM	13.7	121.9			0:51:49						
A-08-136	*D-1*	2.5	SM	6.7	129.9									
A-08-136	*S-2*	5	SM	8.5										
A-08-137	*S-1*	2.5	CL	16.7							1060	8.3	30	168
A-08-137	*D-2*	5	CL	15.5	126.0	>4.5								
A-08-137	*S-3*	10	CL	16.4										
A-08-137	*D-4*	15	SM	5.7	123.9									
A-08-137	*S-5*	20	SM	4.6										
A-08-137	*D-6*	25	CL	8.5	137.4	>4.5								
A-08-137	*S-7*	30	CH	15.1										
A-08-138	*D-1*	2.5	SM	4.2	134.1									
A-08-138	*S-2*	5	CL	18.0							1200	8.2	50	171
A-08-138	*D-3*	10	SC	8.5	115.2									
A-08-138	*S-4*	15	SC	10.1										
A-08-138	*D-5*	20	CH	14.6	135.2	>4.5								
A-08-138	*S-6*	25	SC-SM	8.5										

TABLE C-2. ATTERBERG LIMITS AND EXPANSION INDEX TEST RESULTS OF SURFICIAL BULK SAMPLES

Boring No.	Depth (ft)	Soil Type	Expansion Index	Percentage		
				Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)
A-08-101	2 to 5	SC		26	17	9
A-08-105	1 to 5	SC-SM		24	18	6
A-08-106	0 to 2	SC-SM		24	18	6
A-08-001	2.5 to 4	SC	10	26	15	11
A-08-002	1 to 5	SC		31	18	13
A-08-108	0.5 to 5	SP-SM			Non-Plastic	
A-08-004	2.5 to 5	SC	7	29	17	12
A-08-005	1.5 to 5	SC		27	19	8
A-08-007	1.5 to 5	SC		29	18	11
A-08-008	2.5 to 5	SC		24	15	9
A-08-011	1.5 to 5	SP			Non-Plastic	
A-08-012	1.5 to 5	SC	19	30	14	16
A-08-116	0 to 5	SP			Non-Plastic	
A-08-014	1 to 5	SM		20	17	3
A-08-015	1.5 to 2.5	SC		25	16	9
A-08-119	1 to 5	SC	6	29	14	15
A-08-121	2 to 5	CL	40	33	20	13
A-08-016	1 to 5	SM			Non-Plastic	
A-08-017	1.5 to 5	SM			Non-Plastic	
A-08-122	0 to 2	SC		29	18	11
A-08-123	2.5 to 5	SC	35	28	14	14
A-08-124	0 to 5	CL	64	29	19	10
A-08-126	1.5 to 5	CL	87	40	17	23
A-08-128	0 to 5	SC-SM		24	17	7
A-08-129	0 to 5	SC-SM		24	18	6
A-08-130	0 to 2.5	SC-SM		24	19	5
A-08-132	0 to 2.5	CL		28	19	9
A-08-133	0 to 5	SC	35	29	14	15
A-08-134	0 to 2.5	CL		28	18	10
A-08-135	0 to 2	CL		40	18	22
A-08-136	0 to 5	SC	32	30	14	16
A-08-018	1 to 5	CL	60	42	16	26
A-08-137	2 to 5	CL	94	43	22	21
A-08-138	0 to 5	SP-SM			Non-Plastic	
A-08-139	0 to 2	SM		21	19	2
A-08-140	0 to 2	CL	63	32	18	14

IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: 08-115

SAMPLE NUMBER : A-08-001 @ 2.5' - 4'

TESTED BY : RMC

SAMPLE LOCATION:

DATE : 27-Aug-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : BR. SANDY CLAY TO CLAYEY SAND W/ GRAVEL (SC/CL)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	-50	0	50	-100	
WT. SOIL + MOLD (GMS)	13300	13348	13392	13248	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	10.3	10.3	10.7	10.8	
WET DENSITY (PCF)	140.7	143.5	140.5	131.3	
CAN NUMBER	R2	2	R14	B1	
WET SOIL + TARE (GMS)	926.4	928.4	926.8	775.5	
DRY SOIL + TARE (GMS)	876.7	863.8	849.8	745.6	
TARE (GMS)	187.6	189.7	185.0	193.1	
DRY SOIL (GMS)	689.1	674.1	664.8	552.5	
WATER (GMS)	49.7	64.6	77	29.9	
MOISTURE CONTENT (%)	7.2	9.6	11.6	5.4	
DRY DENSITY (PCF)	131.2	130.9	125.9	124.6	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

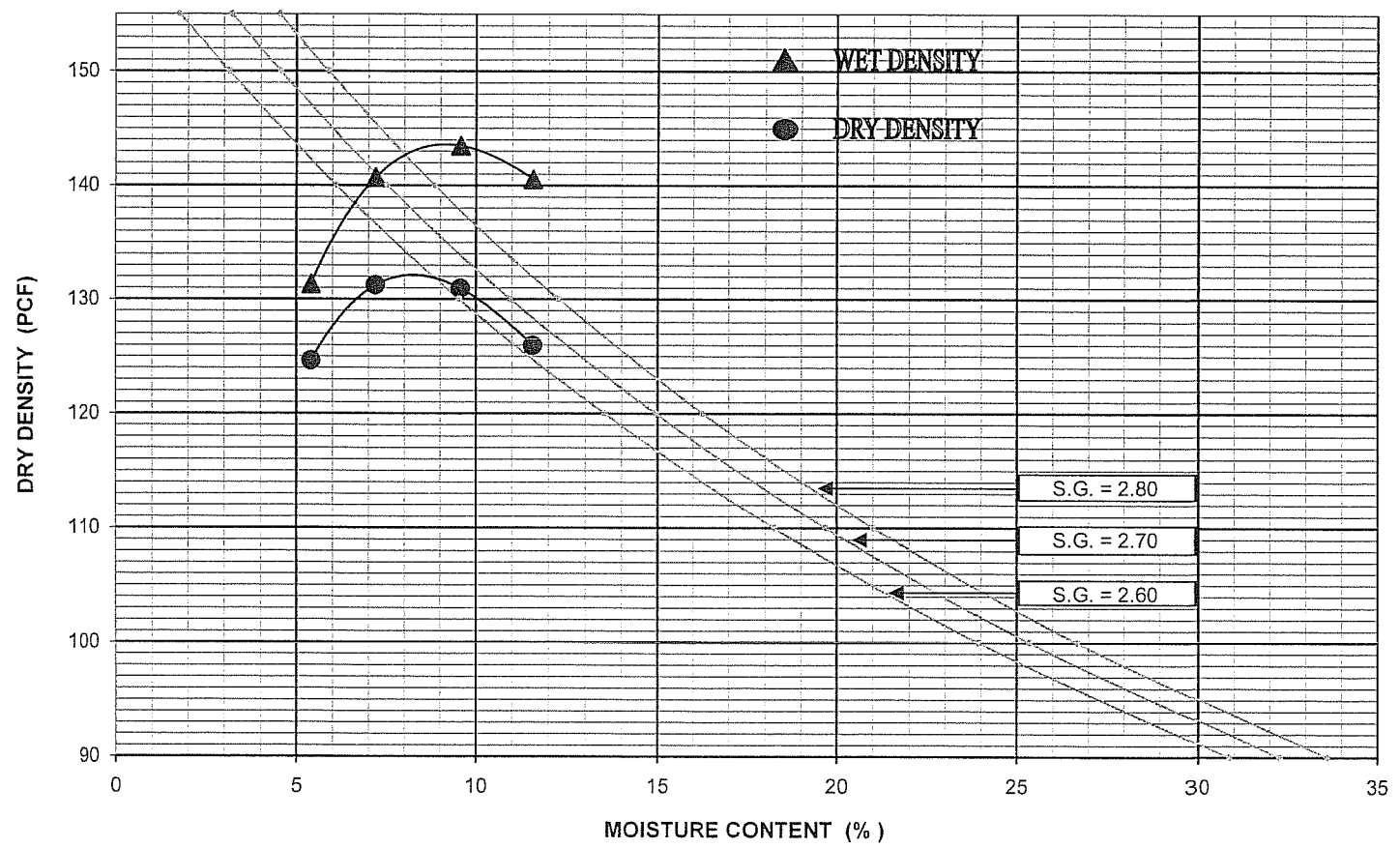
% RETAINED -

MAXIMUM WET DENSITY: 143.5 Pcf.

MAXIMUM DRY DENSITY: 132.0 Pcf.

OPT. MOIST. CONTENT : 8.5 %

REMARKS :



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IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: 08-115

SAMPLE NUMBER : A-08-007 @ 1.5' - 5'

TESTED BY : RMC

SAMPLE LOCATION:

DATE : 28-Oct-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : LT. BROWN CLAYEY SAND WITH GRAVEL (SC)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	0	60	120	160	
WT. SOIL + MOLD (GMS)	13349	13410	13468	13507	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	11.9	11.3	11.3	11.6	
WET DENSITY (PCF)	124.2	134.0	137.1	135.5	
CAN NUMBER	R14	R7	R16	R2	
WET SOIL + TARE (GMS)	787.6	850.4	842.1	856.9	
DRY SOIL + TARE (GMS)	756.5	798.8	777.4	777.8	
TARE (GMS)	185.0	188.3	187.3	187.5	
DRY SOIL (GMS)	571.5	610.5	590.1	590.3	
WATER (GMS)	31.1	51.6	64.7	79.1	
MOISTURE CONTENT (%)	5.4	8.5	11.0	13.4	
DRY DENSITY (PCF)	117.8	123.6	123.5	119.5	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

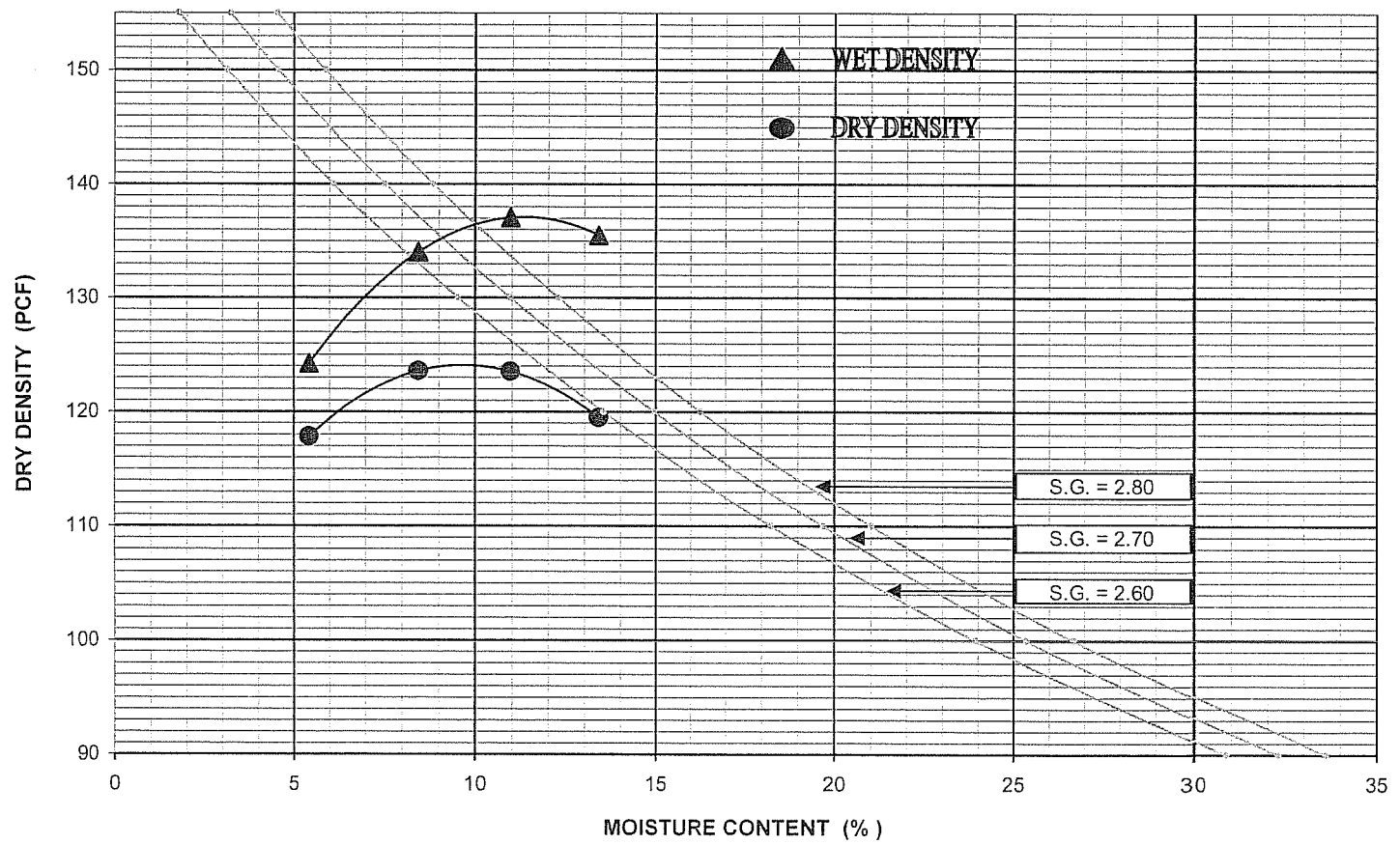
% RETAINED -

MAXIMUM WET DENSITY: 137.1 Pcf.

MAXIMUM DRY DENSITY: 124.0 Pcf.

OPT. MOIST. CONTENT : 9.5 %

REMARKS :



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IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: 08-115

SAMPLE NUMBER : A-08-009 @ 0 - 1.5'

TESTED BY : RMC

SAMPLE LOCATION:

DATE : 27-Aug-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : LT. BROWN SANDY CLAY (CL)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	-115	-60	0	50	
WT. SOIL + MOLD (GMS)	13239	13293	13350	13396	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	11.5	11.1	11.1	11.5	
WET DENSITY (PCF)	122.9	130.2	133.2	131.0	
CAN NUMBER	11	B1	R16	R7	
WET SOIL + TARE (GMS)	829.6	935.0	912.6	817.0	
DRY SOIL + TARE (GMS)	789.5	878.7	841.4	747.3	
TARE (GMS)	186.2	193.2	187.3	191.9	
DRY SOIL (GMS)	603.3	685.5	654.1	555.4	
WATER (GMS)	40.1	56.3	71.2	69.7	
MOISTURE CONTENT (%)	6.6	8.2	10.9	12.5	
DRY DENSITY (PCF)	115.2	120.3	120.1	116.4	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

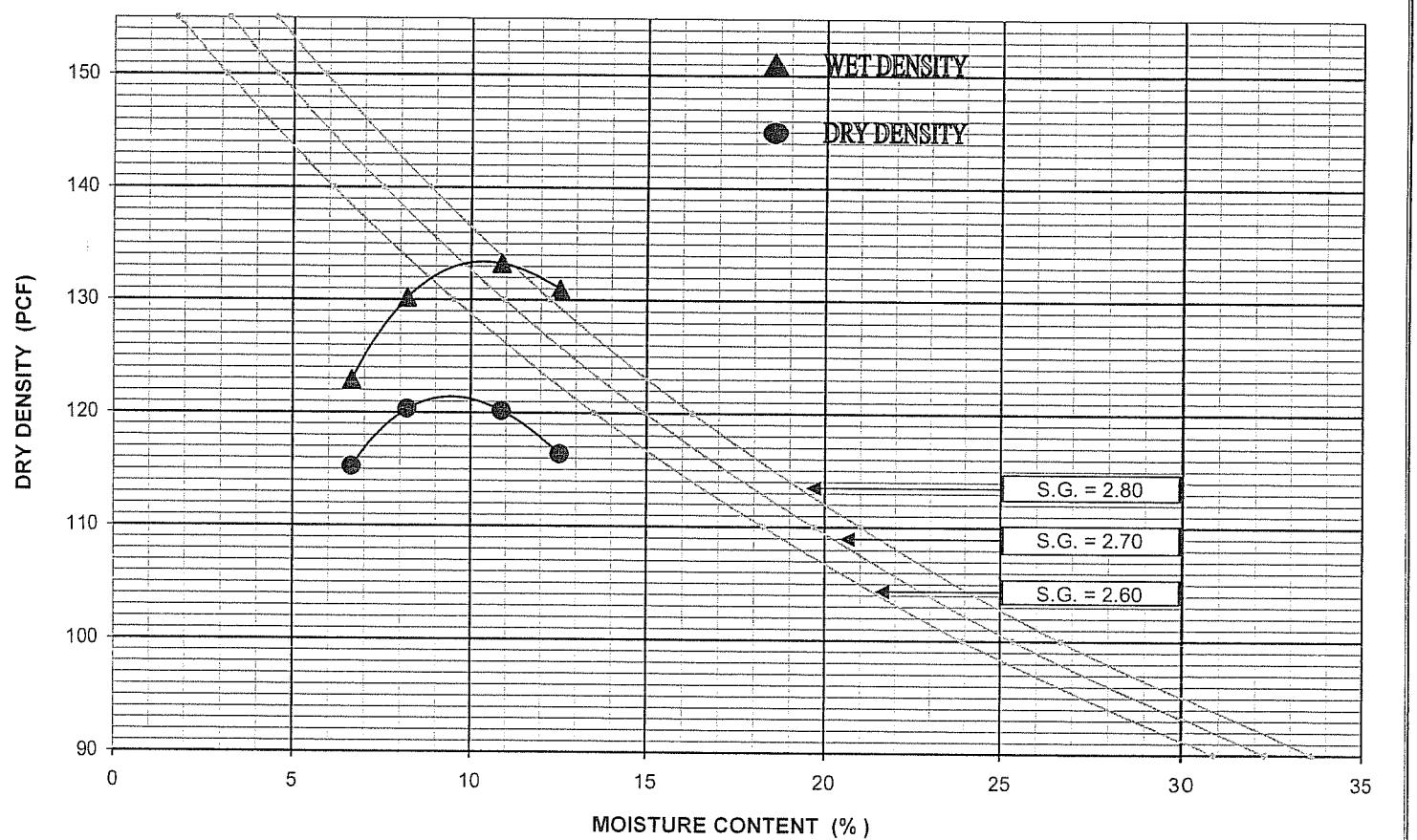
% RETAINED -

MAXIMUM WET DENSITY: 133.5 Pcf.

MAXIMUM DRY DENSITY: 121.5 Pcf.

OPT. MOIST. CONTENT : 9.5 %

REMARKS :



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IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: 08-115

SAMPLE NUMBER : A-08-012 @ 1.5' - 5'

TESTED BY : RMC

SAMPLE LOCATION:

DATE : 29-Oct-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : BROWN SANDY CLAY W/ GRAVEL (SC)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	-140	-60	0	-35	
WT. SOIL + MOLD (GMS)	13211	13289	13353	13314	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	10.6	10.4	10.8	10.4	
WET DENSITY (PCF)	131.7	138.7	137.1	140.1	
CAN NUMBER	R2	R15	R9	R16	
WET SOIL + TARE (GMS)	845.0	832.4	823.6	805.4	
DRY SOIL + TARE (GMS)	793.2	769.5	744.8	736.6	
TARE (GMS)	187.6	188.6	188.9	187.3	
DRY SOIL (GMS)	605.6	580.9	555.9	549.3	
WATER (GMS)	51.8	62.9	78.8	68.8	
MOISTURE CONTENT (%)	8.6	10.8	14.2	12.5	
DRY DENSITY (PCF)	121.4	125.2	120.1	124.5	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

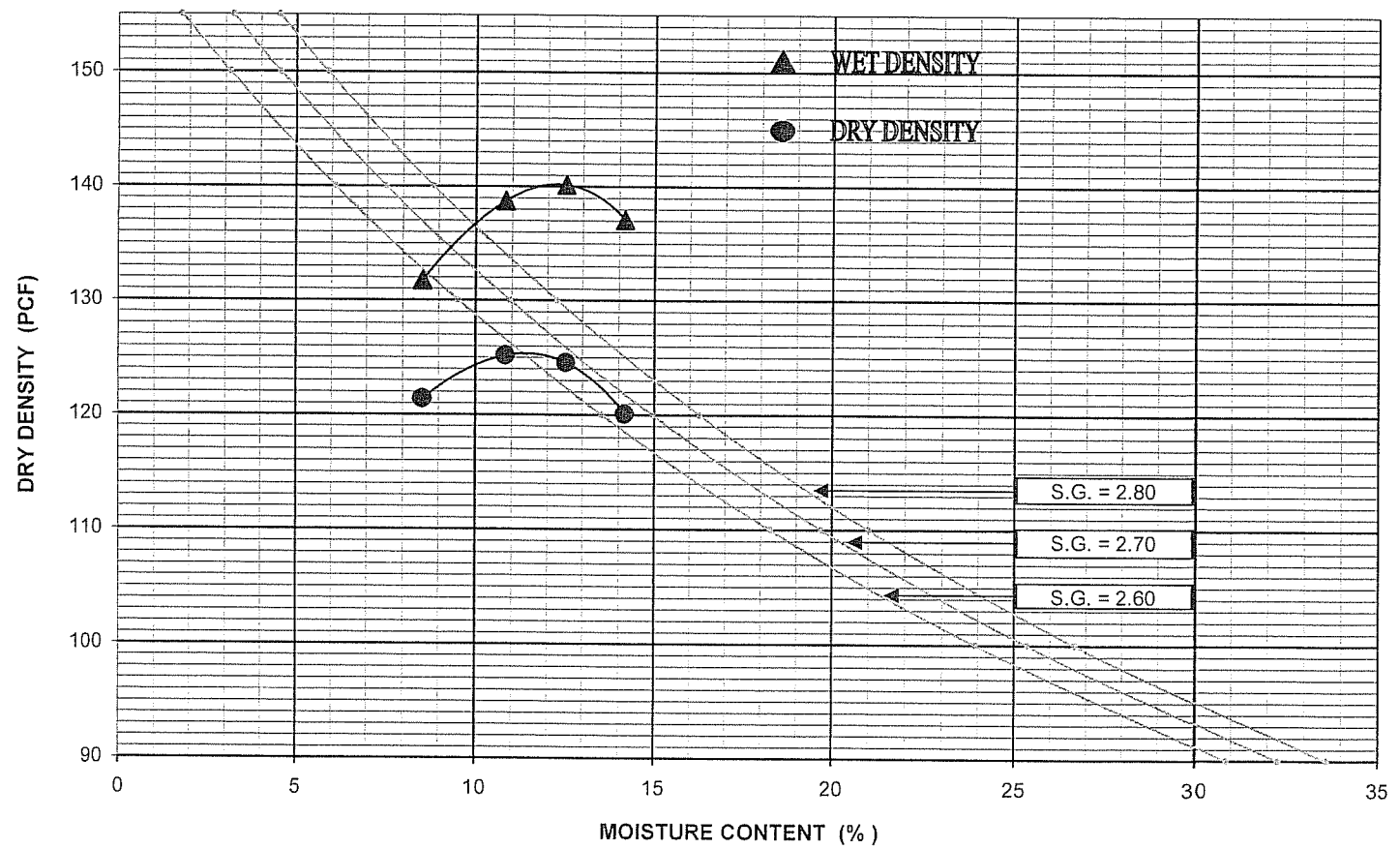
% RETAINED -

MAXIMUM WET DENSITY: 140.0 Pcf.

MAXIMUM DRY DENSITY: 125.5 Pcf.

OPT. MOIST. CONTENT : 11.5 %

REMARKS :



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IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: 08-115

SAMPLE NUMBER : A-08-014 @ 1' - 5'

TESTED BY : RB

SAMPLE LOCATION:

DATE : 11-Nov-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : BROWN SILTY SAND (SM)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	-75	0	75	150	
WT. SOIL + MOLD (GMS)	13275	13349	13425	13498	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	11.3	11.0	11.0	11.3	
WET DENSITY (PCF)	126.8	134.4	138.5	138.5	
CAN NUMBER	Z1	B	2	N	
WET SOIL + TARE (GMS)	1120.2	1285.3	1302.6	1180.4	
DRY SOIL + TARE (GMS)	1055.7	1180.8	1169.2	1042.1	
TARE (GMS)	191.5	195.0	189.4	191.8	
DRY SOIL (GMS)	864.2	985.8	979.8	850.3	
WATER (GMS)	64.5	104.5	133.4	138.3	
MOISTURE CONTENT (%)	7.5	10.6	13.6	16.3	
DRY DENSITY (PCF)	118.0	121.5	121.9	119.1	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

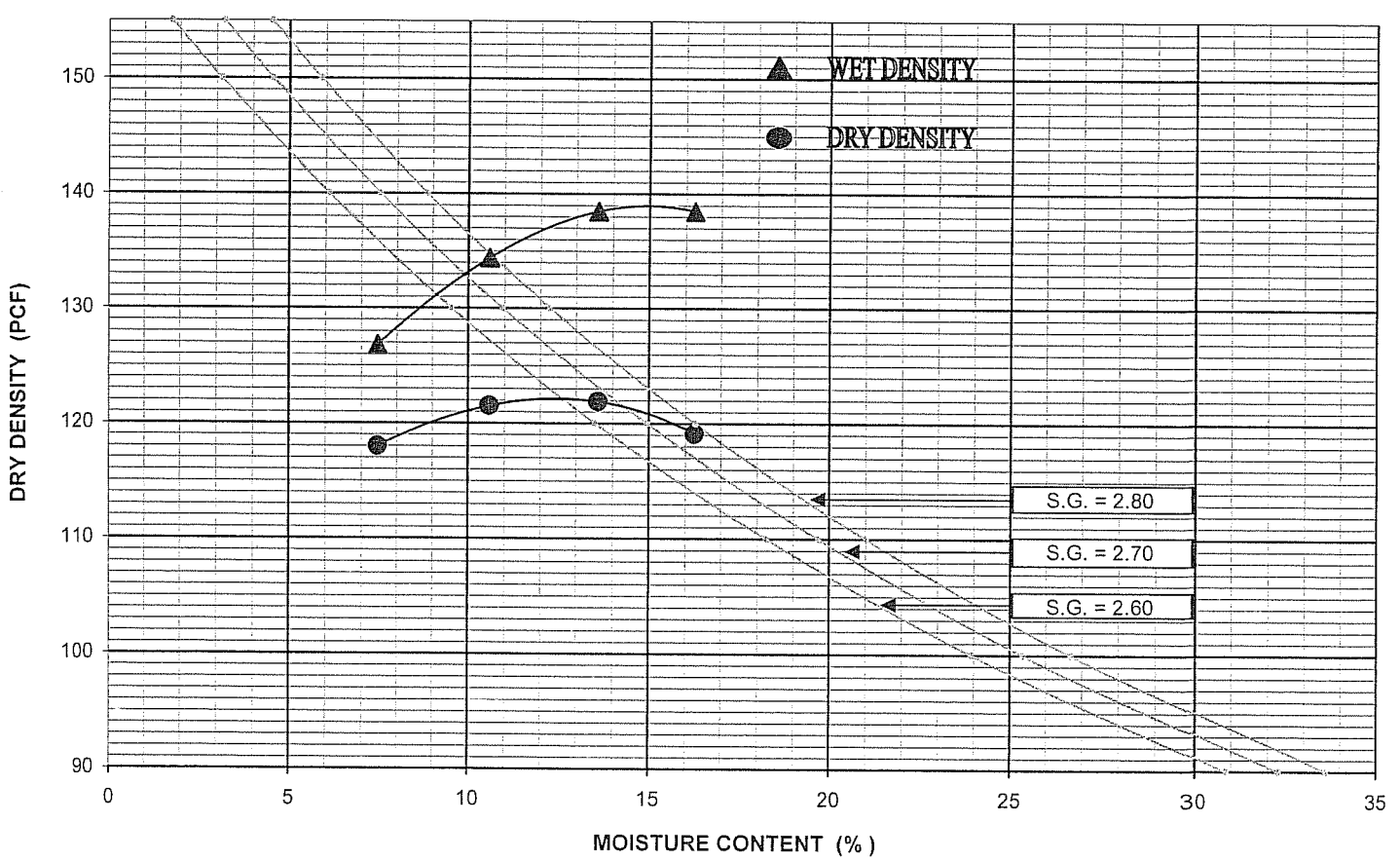
% RETAINED -

MAXIMUM WET DENSITY: 139.0 Pcf.

MAXIMUM DRY DENSITY: 122.0 Pcf.

OPT. MOIST. CONTENT : 12.5 %

REMARKS :



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IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: 08-115

SAMPLE NUMBER : A-08-018 @ 1' - 5'

TESTED BY : RMC

SAMPLE LOCATION:

DATE : 28-Oct-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : LT. BROWN SANDY CLAY (CL)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	-50	0	60	120	
WT. SOIL + MOLD (GMS)	13299	13225	13277	13349	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	12.0	10.4	10.4	11.3	
WET DENSITY (PCF)	120.7	135.1	138.0	130.8	
CAN NUMBER	R14	L	Q	Z	
WET SOIL + TARE (GMS)	832.6	971.1	923.6	952.0	
DRY SOIL + TARE (GMS)	786.5	901.3	841.7	852.8	
TARE (GMS)	185.1	202.6	189.0	191.9	
DRY SOIL (GMS)	601.4	698.7	652.7	660.9	
WATER (GMS)	46.1	69.8	81.9	99.2	
MOISTURE CONTENT (%)	7.7	10.0	12.5	15.0	
DRY DENSITY (PCF)	112.1	122.8	122.6	113.7	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

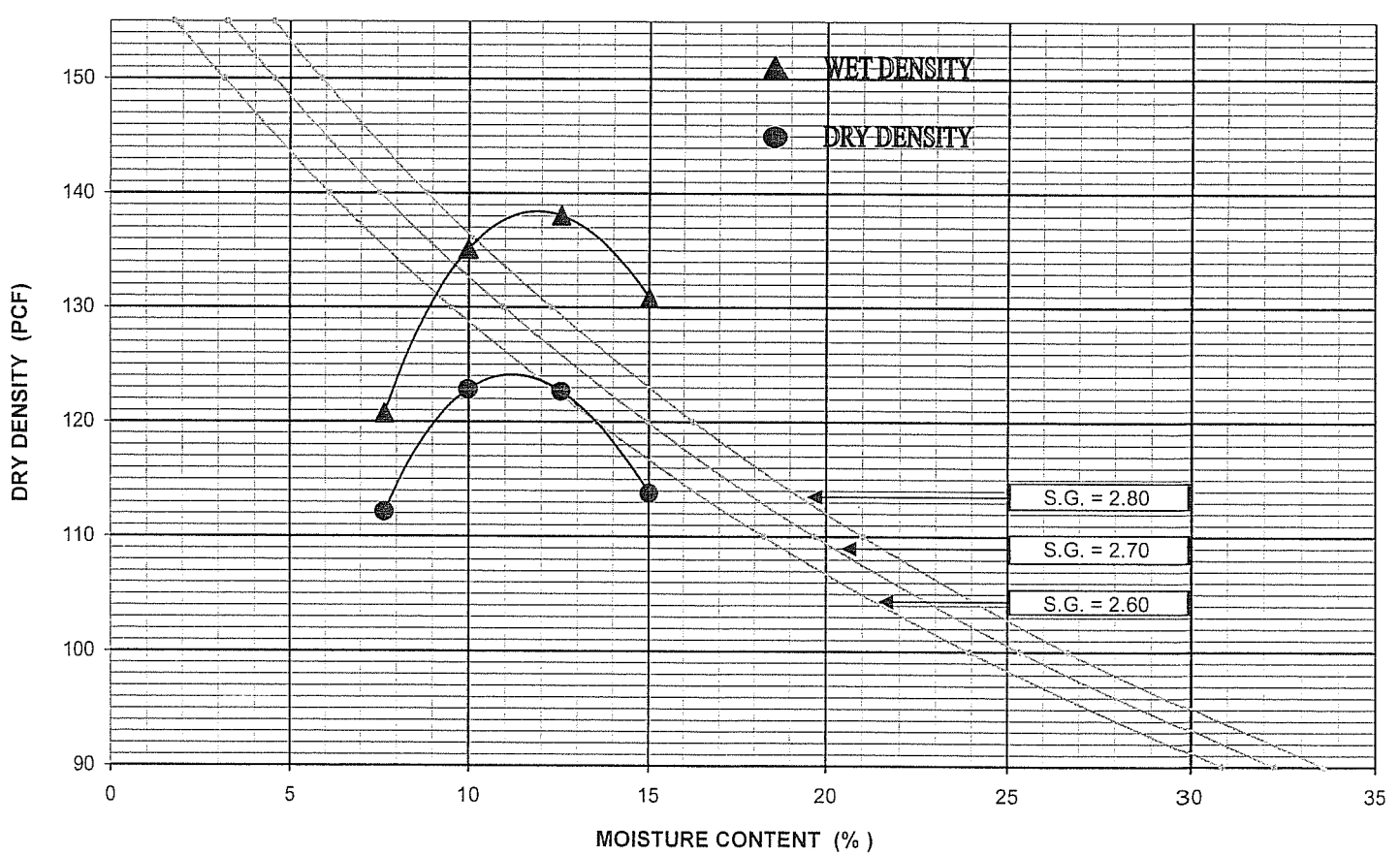
% RETAINED -

MAXIMUM WET DENSITY: 138.5 Pcf.

MAXIMUM DRY DENSITY: 124.0 Pcf.

OPT. MOIST. CONTENT : 11.5 %

REMARKS :



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IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: 08-115

SAMPLE NUMBER : A-08-101 @ 2' - 5'

TESTED BY : RMC

SAMPLE LOCATION:

DATE : 10/30/08.

SAMPLE DESCRIPTIONS / CLASSIFICATION : BR. SANDY CLAY TO CLAYEY SAND W/ GRAVEL (SM)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	-	0	60	120	
WT. SOIL + MOLD (GMS)	13315	13346	13405	13468	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	10.6	10.3	10.5	11.1	
WET DENSITY (PCF)	137.6	143.3	143.9	139.5	
CAN NUMBER	R2	R16	R7	B1	
WET SOIL + TARE (GMS)	824.5	883.0	870.7	839.1	
DRY SOIL + TARE (GMS)	788.0	831.3	808.1	768.6	
TARE (GMS)	185.0	187.3	188.3	192.9	
DRY SOIL (GMS)	603	644	619.8	575.7	
WATER (GMS)	36.5	51.7	62.6	70.5	
MOISTURE CONTENT (%)	6.1	8.0	10.1	12.2	
DRY DENSITY (PCF)	129.7	132.7	130.7	124.3	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

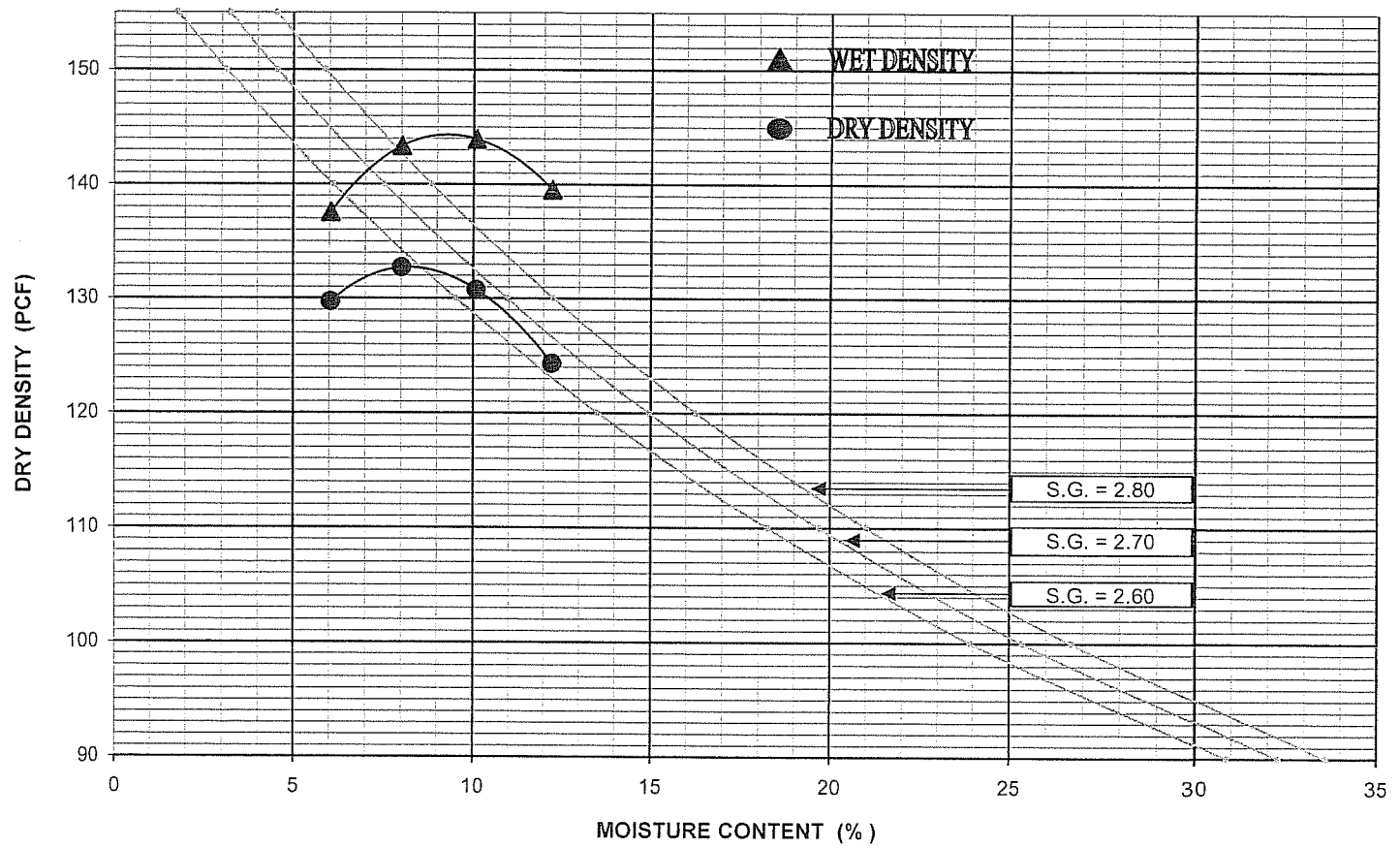
% RETAINED -

MAXIMUM WET DENSITY: 144.5 Pcf.

MAXIMUM DRY DENSITY: 133.0 Pcf.

OPT. MOIST. CONTENT : 8.5 %

REMARKS :



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IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: 08-115

SAMPLE NUMBER : A-08-108 @ 0.5' - 5'

TESTED BY : RB

SAMPLE LOCATION:

DATE : 10-Nov-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : BROWN SILTY SAND (SM)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	-55	0	75	150	
WT. SOIL + MOLD (GMS)	13296	13352	13425	13498	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	10.9	10.6	10.8	11.3	
WET DENSITY (PCF)	132.3	139.3	141.0	138.6	
CAN NUMBER	Z1	2	A	N	
WET SOIL + TARE (GMS)	1174.6	1088.9	1208.7	1174.6	
DRY SOIL + TARE (GMS)	1123.3	1023.6	1115.9	1069.4	
TARE (GMS)	191.7	189.7	188.5	191.7	
DRY SOIL (GMS)	931.6	833.9	927.4	877.7	
WATER (GMS)	51.3	65.3	92.8	105.2	
MOISTURE CONTENT (%)	5.5	7.8	10.0	12.0	
DRY DENSITY (PCF)	125.4	129.2	128.2	123.8	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

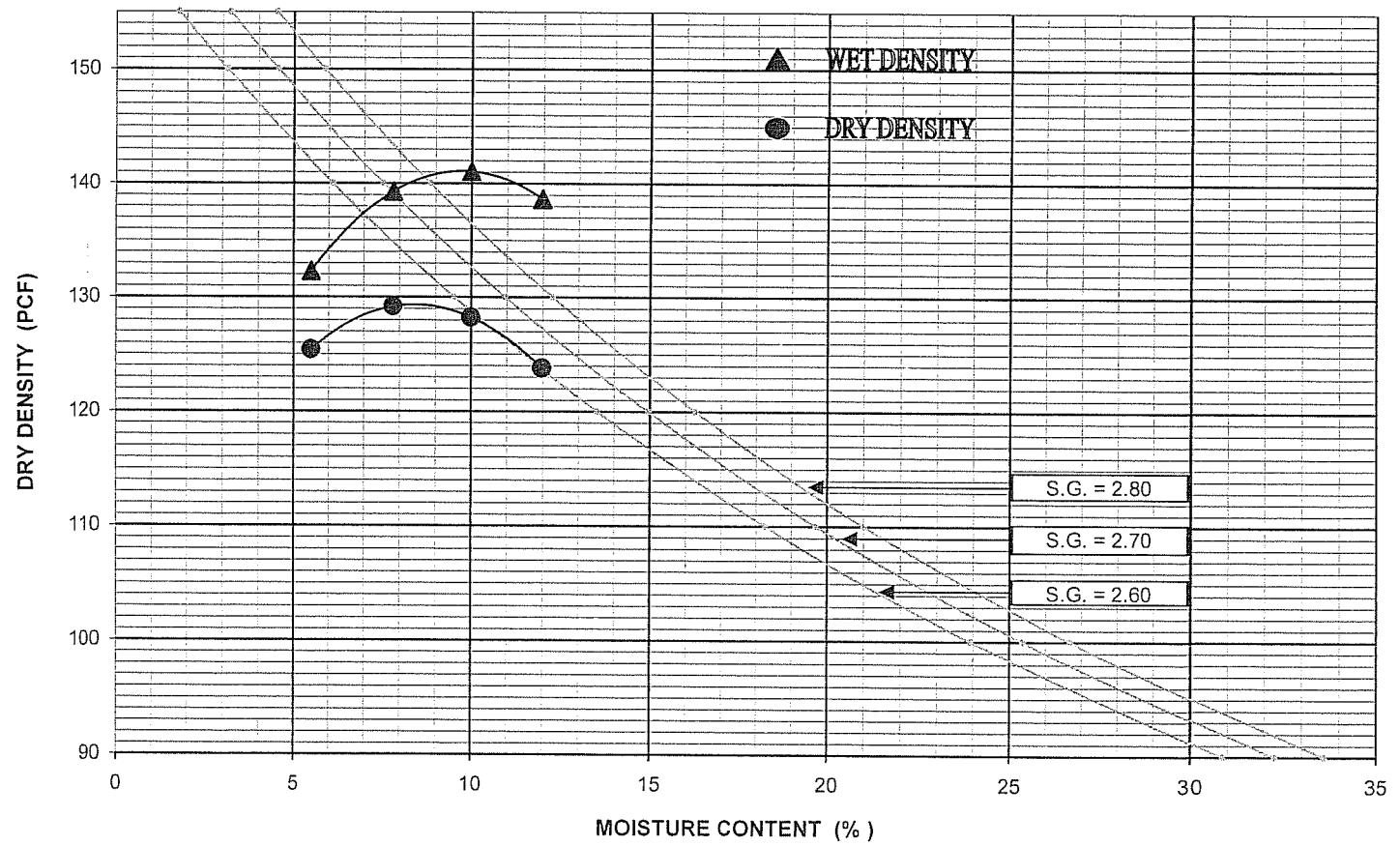
% RETAINED -

MAXIMUM WET DENSITY: 141.0 Pcf.

MAXIMUM DRY DENSITY: 129.5 Pcf.

OPT. MOIST. CONTENT : 8.5 %

REMARKS :



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IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: 08-115

SAMPLE NUMBER : A-08-121 @ 2' - 5'

TESTED BY : RMC

SAMPLE LOCATION:

DATE : 23-Oct-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : GRAYISH BROWN SANDY CLAY (CL)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	-150	-100	-50	0	
WT. SOIL + MOLD (GMS)	13200	13255	13300	13350	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	11.6	10.7	10.6	11.0	
WET DENSITY (PCF)	119.8	133.0	136.7	134.4	
CAN NUMBER	R13	R9	R7	R2	
WET SOIL + TARE (GMS)	821.2	832.9	905.2	908.1	
DRY SOIL + TARE (GMS)	778.6	773.5	827.0	817.1	
TARE (GMS)	188.6	188.9	188.3	187.5	
DRY SOIL (GMS)	590	584.6	638.7	629.6	
WATER (GMS)	42.6	59.4	78.2	91	
MOISTURE CONTENT (%)	7.2	10.2	12.2	14.5	
DRY DENSITY (PCF)	111.8	120.7	121.8	117.5	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

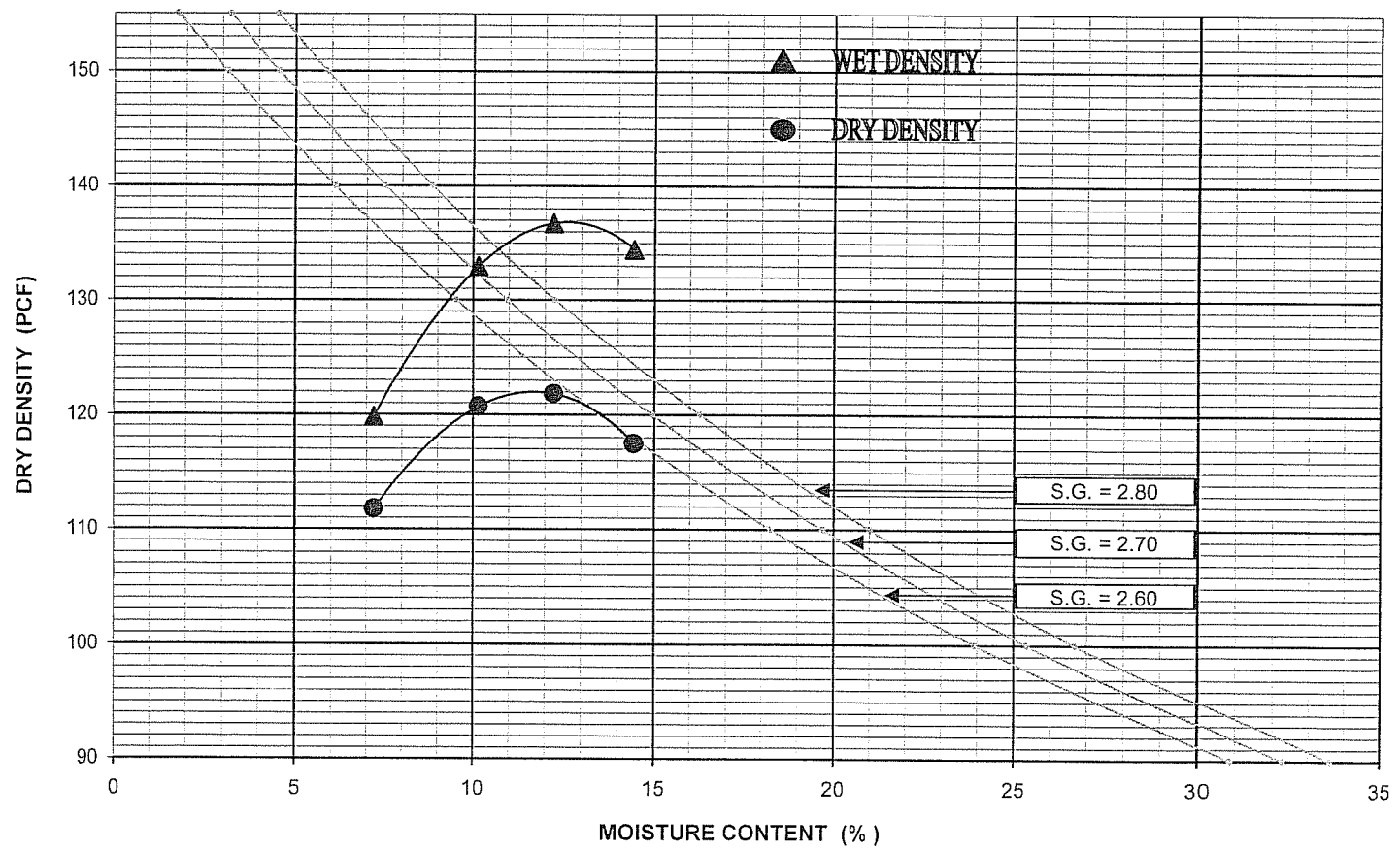
% RETAINED -

MAXIMUM WET DENSITY: 137.0 Pcf.

MAXIMUM DRY DENSITY: 122.0 Pcf.

OPT. MOIST. CONTENT : 11.5 %

REMARKS :



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IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: 08-115

SAMPLE NUMBER : A-08-124 @ 1.5' - 5'

TESTED BY : RMC

SAMPLE LOCATION:

DATE : 10-Nov-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : LT. BROWN SANDY CLAY (CL)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	65	150	200	0	
WT. SOIL + MOLD (GMS)	13415	13497	13630	13349	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	11.5	11.8	12.6	12.0	
WET DENSITY (PCF)	131.9	132.7	130.5	123.2	
CAN NUMBER	R7	R16	R15	Z1	
WET SOIL + TARE (GMS)	880.2	846.9	882.4	861.2	
DRY SOIL + TARE (GMS)	796.1	752.4	774.9	792.6	
TARE (GMS)	188.3	187.3	188.6	185.0	
DRY SOIL (GMS)	607.8	565.1	586.32	607.6	
WATER (GMS)	84.1	94.5	107.5	68.6	
MOISTURE CONTENT (%)	13.8	16.7	18.3	11.3	
DRY DENSITY (PCF)	115.9	113.7	110.3	110.7	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

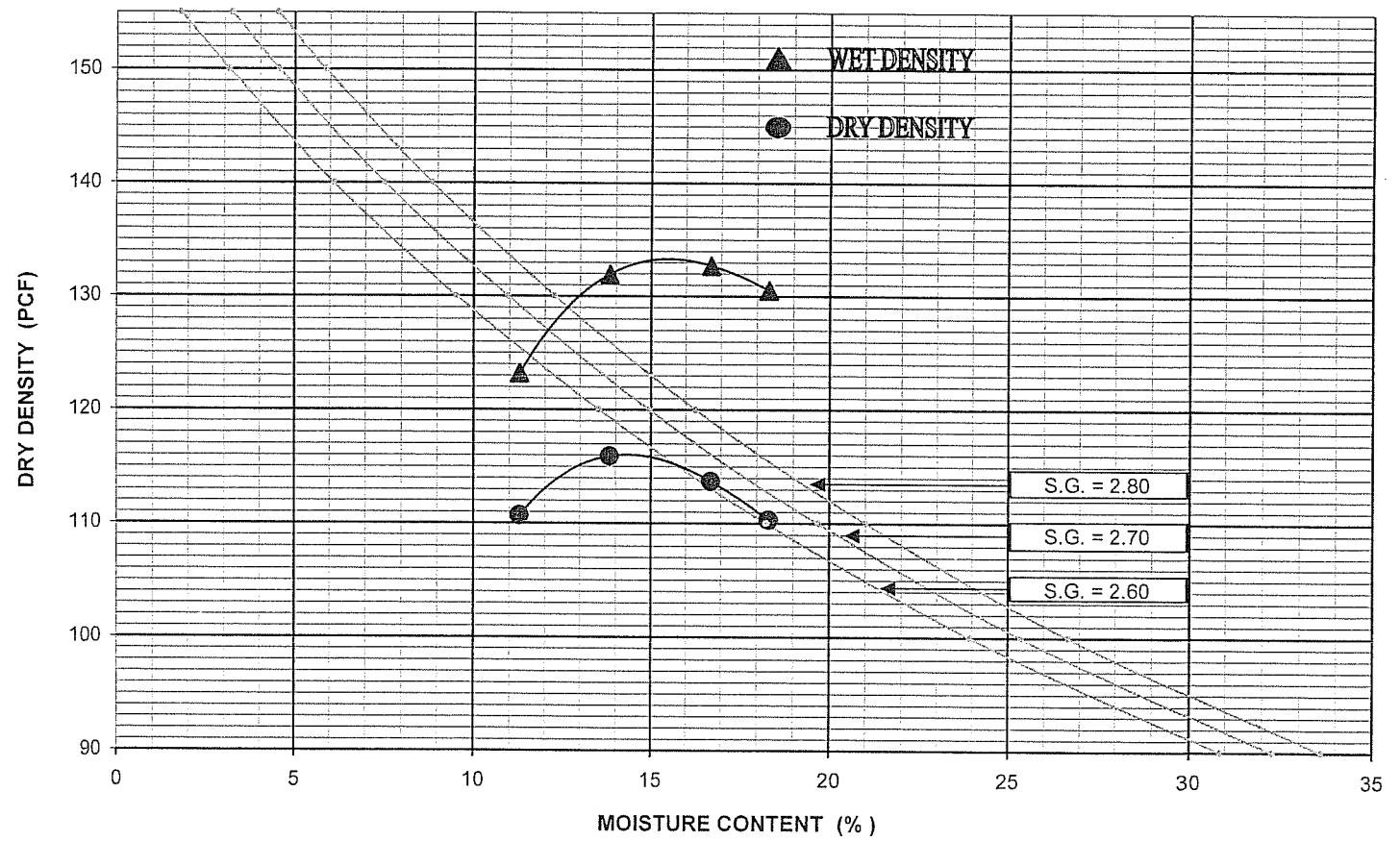
% RETAINED -

MAXIMUM WET DENSITY: 133.5 Pcf.

MAXIMUM DRY DENSITY: 116.0 Pcf.

OPT. MOIST. CONTENT : 14.5 %

REMARKS :



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IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: 08-115

SAMPLE NUMBER : A-08-126 @ 1.5' - 5'

TESTED BY : RMC

SAMPLE LOCATION:

DATE : 23-Oct-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : LT. BROWN SANDY CLAY (CL)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	-155	-100	-55	0	
WT. SOIL + MOLD (GMS)	13200	13250	13298	13348	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	11.4	11.1	11.1	11.4	
WET DENSITY (PCF)	121.9	127.9	130.5	129.6	
CAN NUMBER	B	B1	N	Y	
WET SOIL + TARE (GMS)	857.9	824.1	840.1	816.1	
DRY SOIL + TARE (GMS)	792.2	751.1	755.2	725.3	
TARE (GMS)	195.2	193.1	191.7	196.4	
DRY SOIL (GMS)	597.0	558.0	563.5	528.9	
WATER (GMS)	65.7	73.0	84.9	90.8	
MOISTURE CONTENT (%)	11.0	13.1	15.1	17.2	
DRY DENSITY (PCF)	109.8	113.1	113.4	110.6	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

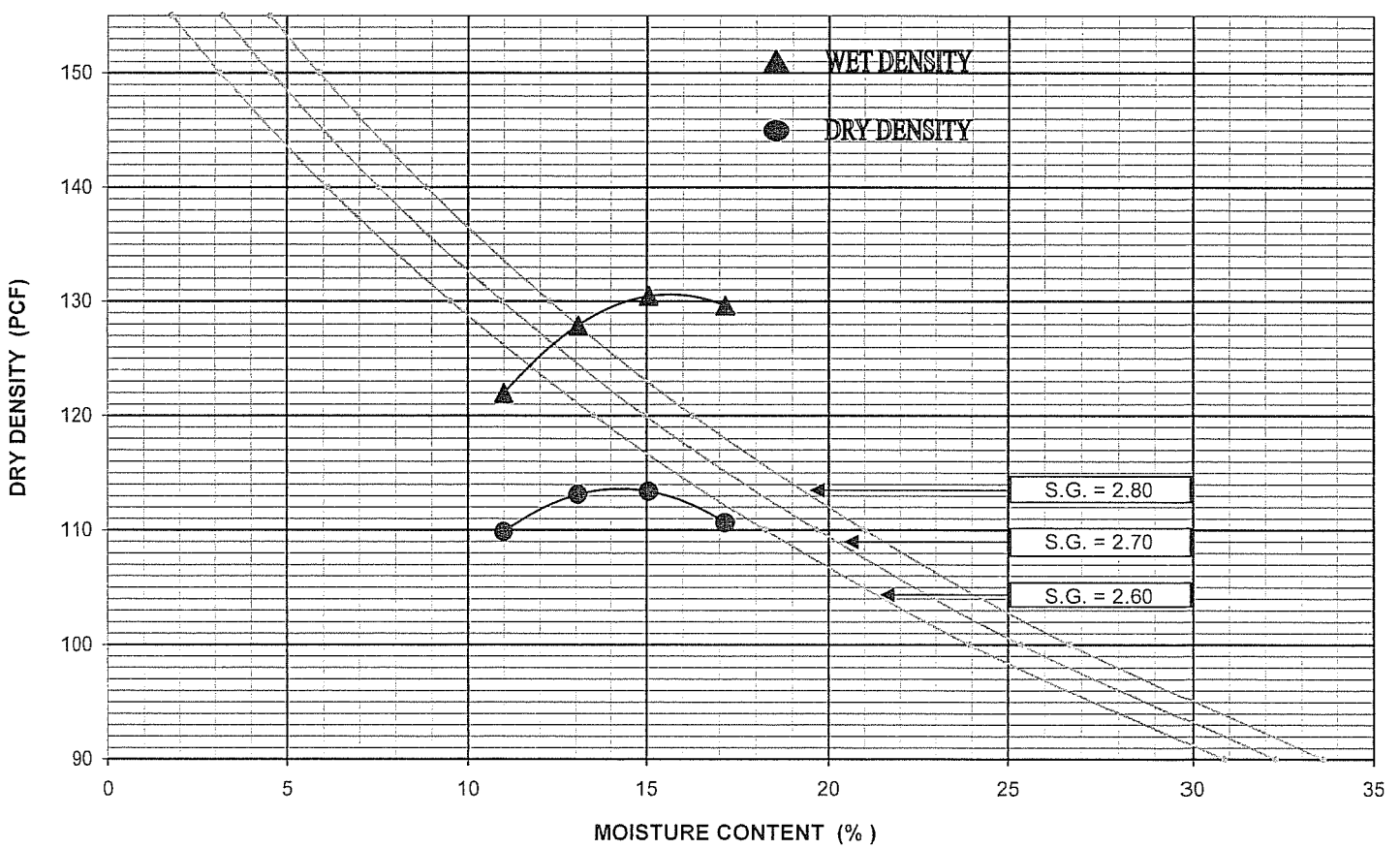
% RETAINED -

MAXIMUM WET DENSITY: 130.5 Pcf.

MAXIMUM DRY DENSITY: 113.5 Pcf.

OPT. MOIST. CONTENT : 14.5 %

REMARKS :



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IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: EMI#08-115

SAMPLE NUMBER :

TESTED BY : RMC

SAMPLE LOCATION: A-08-129 @ 0 - 5'

DATE : 23-Oct-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : BROWN CLAYEY SAND WITH GRAVEL (SC)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	-	0	50	100	
WT. SOIL + MOLD (GMS)	13302	13351	13398	13447	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	11.1	10.6	10.6	11.1	
WET DENSITY (PCF)	130.0	138.8	141.5	136.9	
CAN NUMBER	2	Q	R16	Z1	
WET SOIL + TARE (GMS)	793.5	845.4	820.7	832.4	
DRY SOIL + TARE (GMS)	758.6	798.2	762.4	764.3	
TARE (GMS)	169.7	189.0	187.3	191.9	
DRY SOIL (GMS)	588.92	609.2	575.1	572.4	
WATER (GMS)	34.88	47.2	58.3	68.1	
MOISTURE CONTENT (%)	5.9	7.7	10.1	11.9	
DRY DENSITY (PCF)	122.7	128.9	128.4	122.3	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

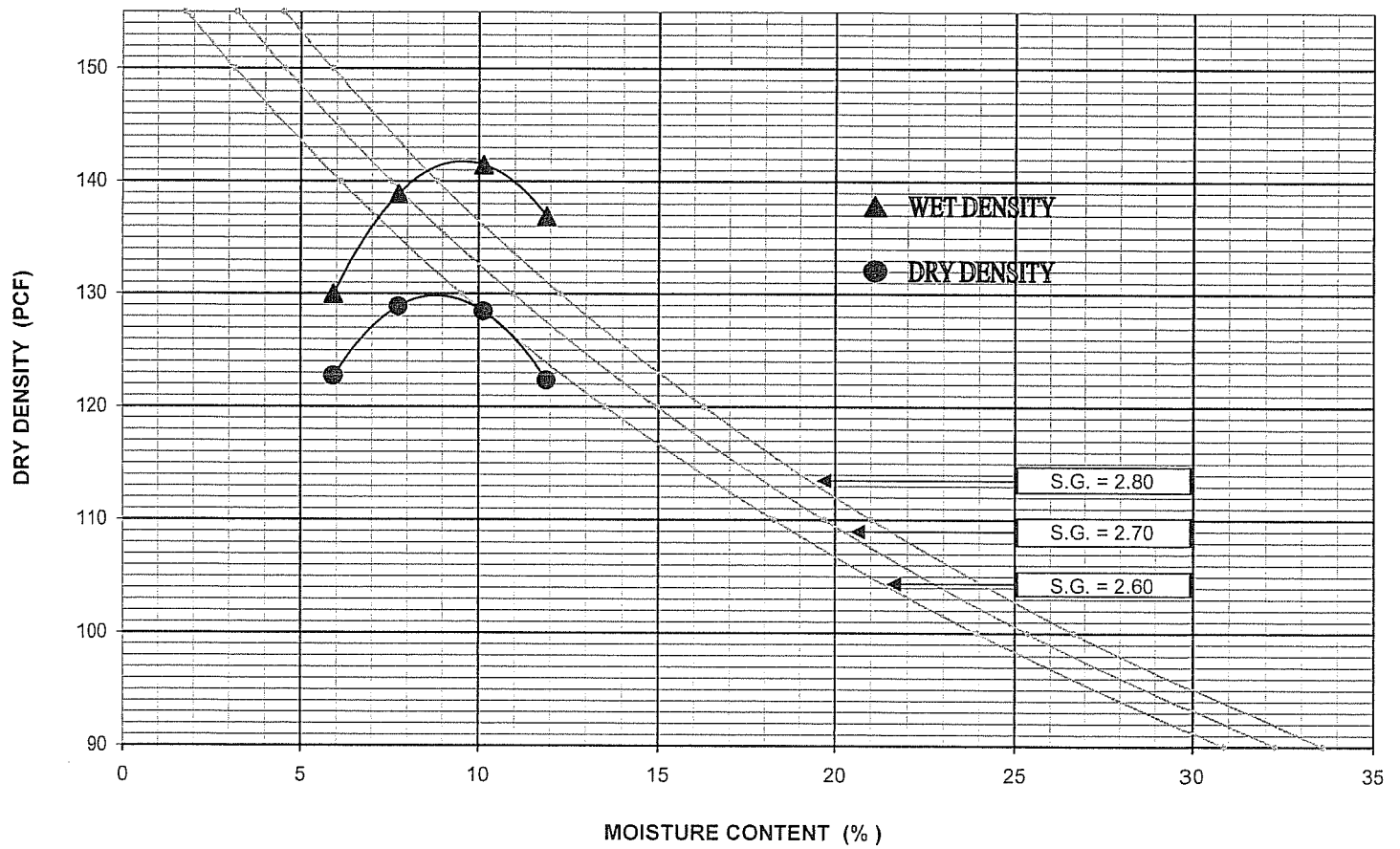
% RETAINED -

MAXIMUM WET DENSITY: 142.0 Pcf.

MAXIMUM DRY DENSITY: 130.0 Pcf.

OPT. MOIST. CONTENT : 9.0 %

REMARKS :



ZEISER KLING CONSULTANTS, INC.

1221 E. Dyer Road, Suite 105; Santa Ana, CA 92705

Tel: (714) 755-1355; Fax: (714) 755-1366

CA 216

IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: 08-115

SAMPLE NUMBER : A-08-133 @ 0' - 5'

TESTED BY : RB

SAMPLE LOCATION:

DATE : 11-Nov-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : BROWN CLAYEY SAND (SC)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	-75	0	75	150	
WT. SOIL + MOLD (GMS)	13277	13350	13424	13498	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	11.6	10.9	11.0	11.8	
WET DENSITY (PCF)	123.5	135.2	138.4	133.3	
CAN NUMBER	A	B1	L	Q	
WET SOIL + TARE (GMS)	1162.4	1227.5	1317.5	1251.0	
DRY SOIL + TARE (GMS)	1102.0	1136.2	1190.1	1104.4	
TARE (GMS)	188.4	193.0	202.3	188.8	
DRY SOIL (GMS)	913.6	943.2	987.8	915.6	
WATER (GMS)	60.4	91.3	127.4	146.6	
MOISTURE CONTENT (%)	6.6	9.7	12.9	16.0	
DRY DENSITY (PCF)	115.8	123.3	122.6	114.9	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

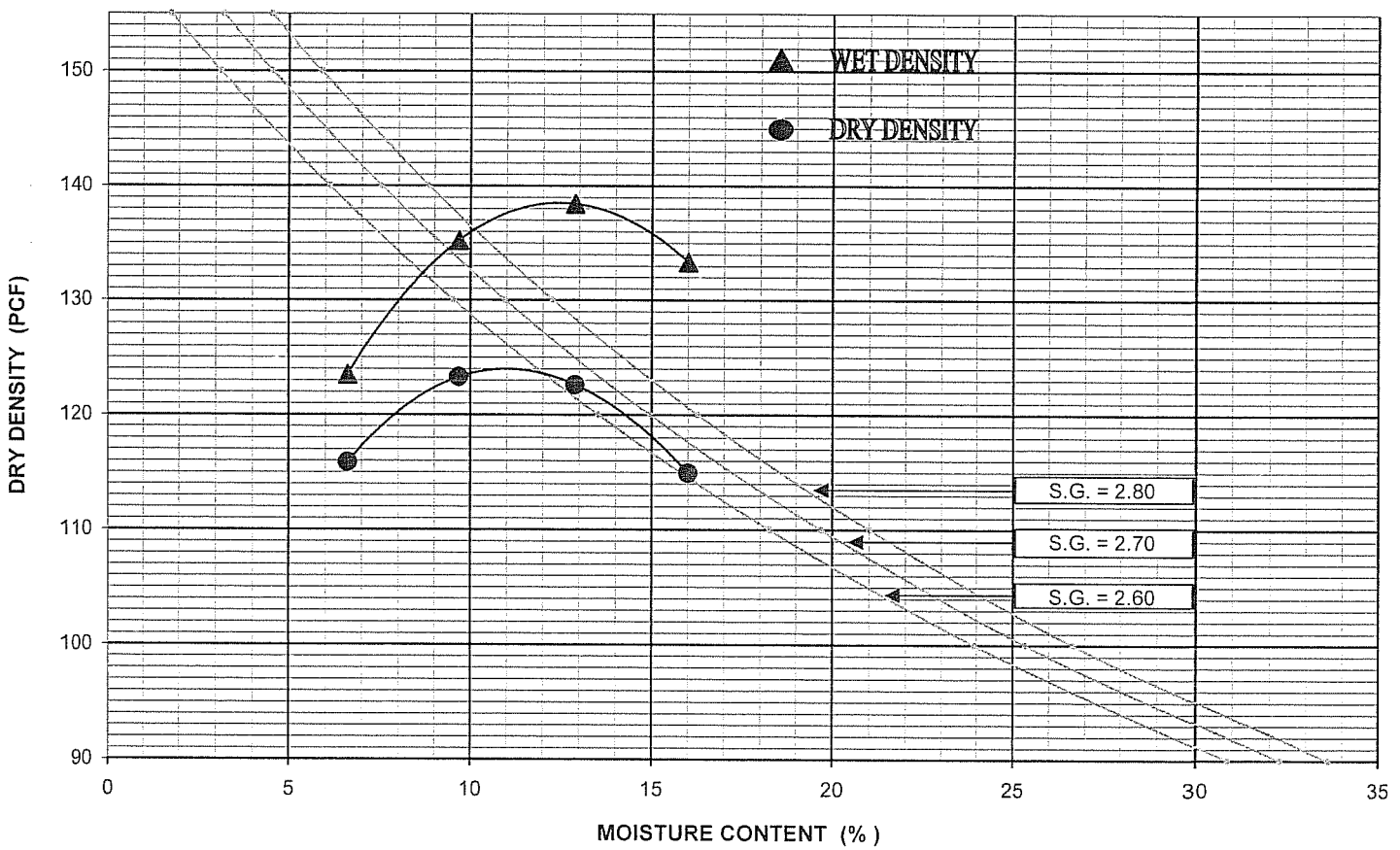
% RETAINED -

MAXIMUM WET DENSITY: 138.5 Pcf.

MAXIMUM DRY DENSITY: 124.0 Pcf.

OPT. MOIST. CONTENT : 11.5 %

REMARKS :



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IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: 08-115

SAMPLE NUMBER : A-08-137 @ 1.5' - 5'

TESTED BY : RMC

SAMPLE LOCATION:

DATE : 23-Oct-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : LT. BROWN SANDY CLAY (CL)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	-50	0	50	100	
WT. SOIL + MOLD (GMS)	13300	13348	13393	13460	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	12.0	11.7	11.7	12.0	
WET DENSITY (PCF)	120.8	126.3	128.6	128.7	
CAN NUMBER	R12	R15	L	R14	
WET SOIL + TARE (GMS)	823.3	841.2	846.0	895.9	
DRY SOIL + TARE (GMS)	756.6	761.9	758.5	782.9	
TARE (GMS)	189.4	188.6	202.6	185.0	
DRY SOIL (GMS)	567.2	573.3	555.9	597.9	
WATER (GMS)	66.7	79.3	87.5	113.0	
MOISTURE CONTENT (%)	11.8	13.8	15.7	18.9	
DRY DENSITY (PCF)	108.1	110.9	111.1	108.2	

INITIAL WET WT. OF SPECIMEN: 2500 gms.

SCALPED ON SIEVE SIZE : 3/4"

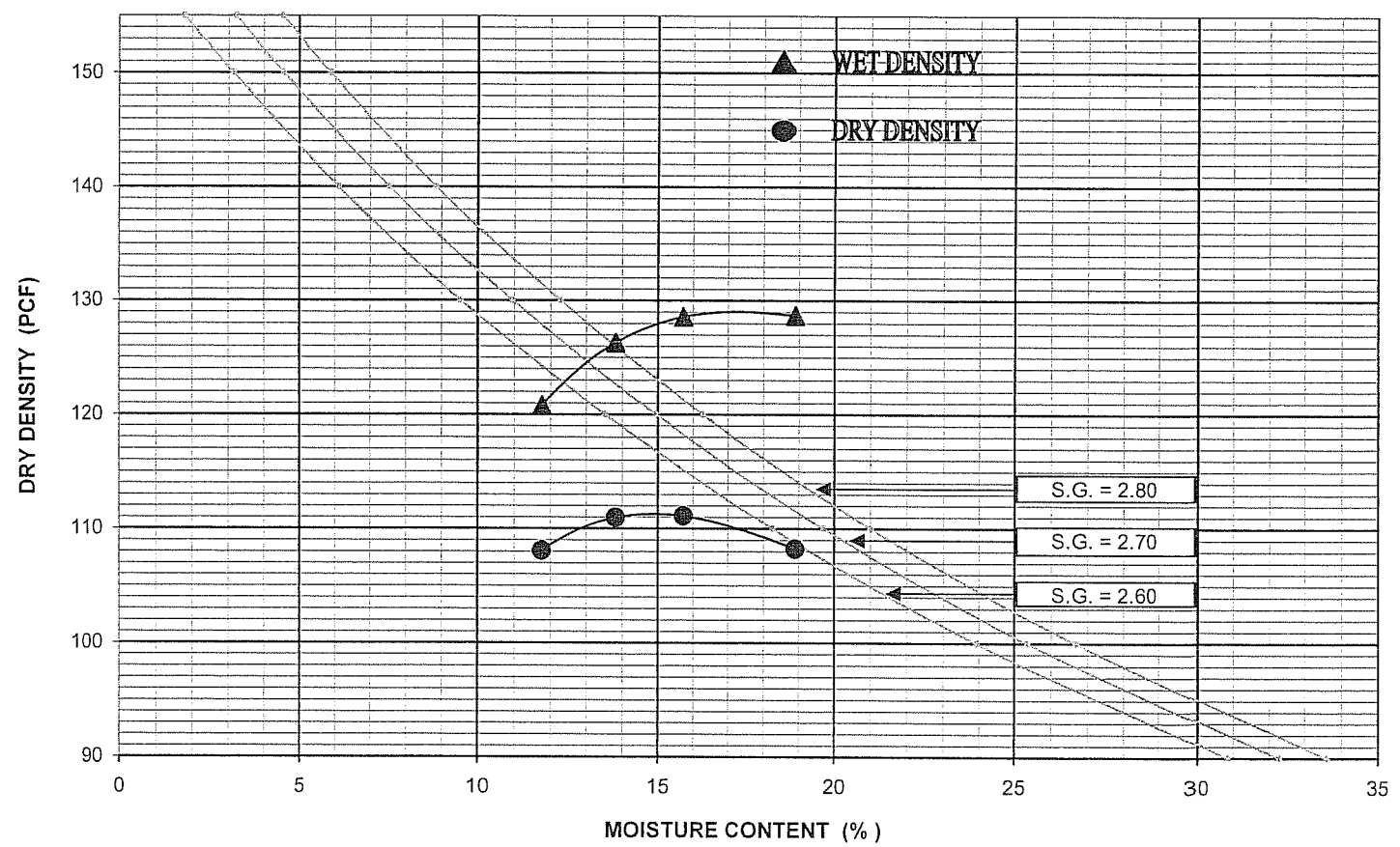
% RETAINED -

MAXIMUM WET DENSITY: 129.0 Pcf.

MAXIMUM DRY DENSITY: 111.5 Pcf.

OPT. MOIST. CONTENT : 15.0 %

REMARKS :



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IMPACT TEST DATA

JOB NAME : SR-57 - NB

JOB NUMBER: EMI#08-115

SAMPLE NUMBER :

TESTED BY : RMC

SAMPLE LOCATION: A-08-140 @ 0 - 2'

DATE : 23-Oct-08

SAMPLE DESCRIPTIONS / CLASSIFICATION : GRAYISH BROWN SANDY CLAY (CL)

TRIAL NUMBER	1	2	3	4	5
WATER ADDED (ML)	75	125	175	225	
WT. SOIL + MOLD (GMS)	13224	13275	13327	13372	
WT.OF MOLD (GMS)	10852	10852	10852	10852	
TAMPER RDG./ HT.(IN.)	11.8	11.0	11.3	12.0	
WET DENSITY (PCF)	118.5	129.3	128.4	123.2	
CAN NUMBER	Q	R2	R14	R9	
WET SOIL + TARE (GMS)	803.3	831.5	843.3	861.5	
DRY SOIL + TARE (GMS)	744.2	757.1	753.7	756.6	
TARE (GMS)	189.1	187.5	184.9	188.8	
DRY SOIL (GMS)	555.06	569.6	568.78	567.8	
WATER (GMS)	59.14	74.4	89.62	104.9	
MOISTURE CONTENT (%)	10.7	13.1	15.8	18.5	
DRY DENSITY (PCF)	107.1	114.3	110.9	104.0	

INITIAL WET WT. OF SPECIMEN: 2300 gms.

SCALPED ON SIEVE SIZE : 3/4"

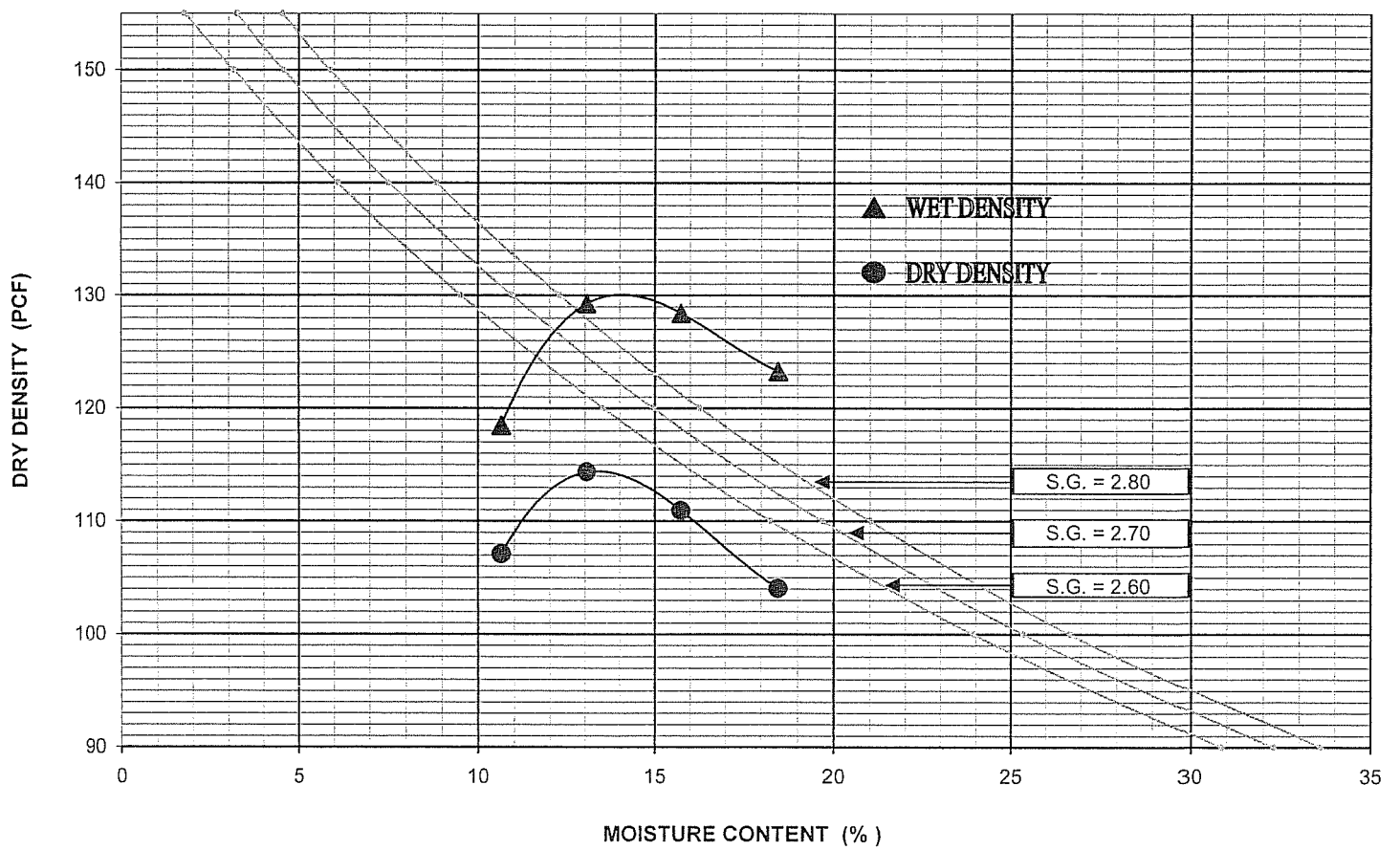
% RETAINED -

MAXIMUM WET DENSITY: 130.0 Pcf.

MAXIMUM DRY DENSITY: 114.5 Pcf.

OPT. MOIST. CONTENT : 13.5 %

REMARKS :



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CA 216

Appendix D. Caltrans Review Sheet (Email Dated April 9, 2009)

Subject: Re: Fw: SR57 South Segment, 0F0311 - 12" Pipe Outlet at Sta. 496+00
From: Joel Robinson <joel_robinson@dot.ca.gov>
Date: Thu, 9 Apr 2009 19:25:42 -0400
To: Gonzalo Pena <GPENA@rbf.com>
CC: Mili Lim <mili_lim@dot.ca.gov>, Pija Ansari <pija_ansari@dot.ca.gov>, Bahman Panah <bahman_panah@dot.ca.gov>, Behdad Baseghi <behdad_baseghi@dot.ca.gov>

Gonzalo,

Our Materials Unit had the following comment on the Materials Report:

In the meeting that we had a few weeks ago, we discussed this. The draft materials report indicates that on site materials is generally CL materials with PI>12 which is an indicative of expansion potential. HDM requires removal of expansive material to 4 feet below finished grade or treatment with lime to a minimum depth of 0.65 ft. I recommend doing more shallow borings to determine exact locations for non expansive materials or just consider treating the entire project site. We need the final MR with PS&E package.

Bahman J. Panah, M.S., P.E.
Materials Branch
(949) 724-2180

Questions? Please call.

~Joel

Joel Robinson| California Department of Transportation, District 12, Design A

| Desk (949) 724-2302 | Fax (949) 724-2591 | E-mail: Joel_Robinson@dot.ca.gov

Mailing: 3337 Michelson Drive, Suite: CN 380 Irvine,CA 92612-8894

FINAL GEOTECHNICAL DESIGN REPORT

SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 16.2/18.6
EA 12-0F0311

EMI Project No. 08-115
Date: June 17, 2009

EARTH MECHANICS, INC.

Geotechnical and Earthquake Engineering

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

June 17, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Attention: Mr. Steve Huff

Subject: ***Final Geotechnical Design Report***
SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 16.2/18.6; EA 12-0F0311

Dear Mr. Huff:

Attached is our final Geotechnical Design Report (GDR) for the SR-57 Northbound Improvement project. The GDR describes the geotechnical conditions at the project site based on information obtained from our field investigation and laboratory soil testing.

Geotechnical analyses were performed and geotechnical conclusions were developed based on information obtained from our investigation and analyses. The GDR also contains recommendations, based on our analyses and conclusions, for design and construction of the proposed improvements.

An earlier version of this GDR, dated February 17, 2009, was prepared by EMI and reviewed by Caltrans. Copies of the review sheets and our responses are attached in Appendix D. This report has been revised to incorporate our responses to the review comments.

We appreciate the opportunity to provide geotechnical services for the subject project. If you have any questions please call us.

Sincerely,
EARTH MECHANICS, INC.

Chien-Tai Yang, RCE 66374
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
CHIEN-TAI YANG
NO. C66374
EXP. 6-30-2010
CIVIL
STATE OF CALIFORNIA

Lino Cheang, GE 2345
Project Manager

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

FINAL GEOTECHNICAL DESIGN REPORT

SR-57 NORTHBOUND IMPROVEMENT PROJECT
ORANGE COUNTY, CALIFORNIA
12-Ora-57, PM 16.2/18.6
EA 12-0F0311

Prepared for:

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Prepared by:

Earth Mechanics, Inc.
17660 Newhope Street, Suite E
Fountain Valley, California 92708

EMI Project Number: 08-115

June 17, 2009

TABLE OF CONTENTS

Section		Page
1.0	**INTRODUCTION**	**1**
2.0	**EXISTING FACILITIES AND PROPOSED IMPROVEMENTS**	**1**
3.0	**PERTINENT REPORTS AND INVESTIGATIONS**	**2**
3.1	Pertinent Previous Reports and Investigations	2
3.2	Related Reports Prepared for the Proposed Improvements	2
4.0	**PHYSICAL SETTING**	**3**
4.1	Climate	3
4.2	Topography and Drainage	3
4.3	Man-Made and Natural Features of Engineering and Construction Significance	4
4.3.1	Man Made Features	4
4.3.2	Natural Features	6
4.4	Regional Geology and Seismicity	6
4.4.1	Physiography	6
4.4.2	Geologic Structure	6
4.4.3	Geologic Hazards	7
4.4.4	Seismicity	7
4.5	Soil Survey Mapping	9
5.0	**EXPLORATION**	**9**
5.1	Drilling and Sampling	9
5.2	Geologic Mapping	11
5.3	Geophysical Studies	12
5.4	Instrumentation	12
5.5	Exploration Notes	12
6.0	**GEOTECHNICAL TESTING**	**12**
6.1	In-Situ Testing	12
6.2	Laboratory Testing	12
7.0	**GEOTECHNICAL CONDITIONS**	**12**
7.1	Site Geology	12
7.1.1	Lithology	12
7.1.2	Geologic Structure	12
7.1.3	Natural Slope Stability	13
7.2	Subsurface Soil Conditions	13
7.2.1	Stratigraphy	13
7.2.2	Material Strength Parameters	14
7.2.3	Expansion Potential	16
7.2.4	Settlement Potential	16
7.3	Water	16
7.3.1	Surface Water	16
7.3.2	Groundwater	17
7.4	Project Site Seismicity	17

7.4.1 Ground Motions 17
7.4.2 Ground Rupture 18

8.0 GEOTECHNICAL ANALYSES AND DESIGN 18

8.1 Dynamic Analyses 18
8.1.1 Parameter Selection 18
8.1.2 Evaluation 18
8.2 Cuts and Excavations 19
8.2.1 Slope Stability 19
8.2.2 Rippability 20
8.2.3 Earthwork Factors 20
8.3 Embankments 20
8.3.1 Description 20
8.3.2 Settlement 21
8.3.3 Stability 21
8.4 Earth Retaining Structures 22
8.5 Culvert Foundations 22
8.6 Other 22

9.0 MATERIAL SOURCES 22

10.0 MATERIAL DISPOSAL 23

11.0 CONSTRUCTION CONSIDERATIONS 23

11.1 Construction Advisories 23
11.2 Construction Considerations that Influence Design 23
11.3 Construction Considerations that Influence Specifications 23
11.4 Construction Monitoring and Instrumentation 24
11.5 Hazardous Waste Considerations 24
11.6 Differing Site Conditions 24

12.0 RECOMMENDATIONS AND SPECIFICATIONS 25

13.0 LIMITATIONS 26

14.0 REFERENCES 27

Page

TABLES

Table 1. Existing Facilities and Proposed Improvements, SR-57 Mainline 2
Table 2. Existing and New Drainage Devices 5
Table 3. Soil Exploration Information 10
Table 4. Explanation of Laboratory Tests Performed 13
Table 5. Idealized Soil Profiles and Strength Parameters 14
Table 6. Seismic Design Parameters 18
Table 7. Earthwork Factors 20

FIGURES

Figure 1. Site Location Map 30
Figure 2. Regional fault and Physiographic Map 31
Figure 3. Geographical Map 32
Figure 4. Ground Motion Contour Map 33
Figure 5. Exploratory Boring Location Map (1 of 12) 34
Figure 6. Exploratory Boring Location Map (2 of 12) 35
Figure 7. Exploratory Boring Location Map (3 of 12) 36
Figure 8. Exploratory Boring Location Map (4 of 12) 37
Figure 9. Exploratory Boring Location Map (5 of 12) 38
Figure 10. Exploratory Boring Location Map (6 of 12) 39
Figure 11. Exploratory Boring Location Map (7 of 12) 40
Figure 12. Exploratory Boring Location Map (8 of 12) 41
Figure 13. Exploratory Boring Location Map (9 of 12) 42
Figure 14. Exploratory Boring Location Map (10 of 12) 43
Figure 15. Exploratory Boring Location Map (11 of 12) 44
Figure 16. Exploratory Boring Location Map (12 of 12) 45
Figure 17. Sound Wall and Retaining Wall Plan 46

APPENDICES

Appendix A. Exploratory Boring Logs
Appendix B. Laboratory Soil Test Results
Appendix C. Analyses and Calculations
Appendix D. Caltrans Review Comments and EMI Responses

1.0 INTRODUCTION

This Geotechnical Design Report (GDR) presents the findings and conclusions of a geotechnical study conducted by Earth Mechanics, Inc. (EMI) for the State Route (SR)-57 Northbound Improvement project located in Orange County. The purpose of the geotechnical study was to obtain subsurface information and develop design and construction recommendations to assist RBF Consulting (RBF) in preparing the project Plans, Specifications, and Estimates. The project location is shown on the Site Location Map in Figure 1.

EMI's scope of work included preparing this GDR per Topic 113 of the Caltrans Highway Design Manual (HDM, 2008). This report was prepared in accordance with the "Guidelines for Preparing Geotechnical Design Reports" (2006a) and addresses slope stability and settlement potential due to placement of additional fill for proposed roadway widening. Recommendations for pavement structural sections and corrosion issues are addressed in the Materials Report for this project (EMI, 2009a).

The geotechnical scope of work for preparing this GDR included the following tasks:

- Geotechnical field exploration including drilling and logging forty-four (44) exploratory borings and fifteen (15) cone penetrometer tests (CPT's).
- Laboratory testing of selected subsurface soil samples.
- Evaluation of slope stability, settlement, and liquefaction potential of subsurface soils.
- Development of recommendations for earthwork.
- Preparation of this report.

The purpose of this report is to document subsurface geotechnical conditions, provide analyses of anticipated site conditions as they pertain to the project described herein, and recommend design and construction criteria for the roadway portions of the project. This report also establishes a geotechnical baseline to be used in assessing the existence and scope of changed site conditions.

This report is intended for use by the project roadway design engineer, construction personnel, bidders, and contractors.

2.0 EXISTING FACILITIES AND PROPOSED IMPROVEMENTS

The project location is shown in Figure 1. The Department of Tansportation (Caltrans) – District 12, in cooperation with the Orange County Transportation Authority (OCTA), proposed to widen northbound SR-57 by adding one northbound through lane. The project limits are between 0.2 miles south of Orangethorpe Avenue and 0.2 miles north of Yorba Linda Boulevard along northbound SR-57. Within the project limits, there are interchanges located at Orangethorpe Avenue, Chapman Avenue, Nutwood Avenue and Yorba Linda Boulevard. Details of the existing configuration and proposed improvements along the Mainline are described in Table 1.

Table 1. Existing Facilities and Proposed Improvements, SR-57 Mainline

Location	*Existing Facility (Northbound Direction)*	*Proposed Improvements*
Orangethorpe Ave Exit Ramp to Orangethorpe Ave Entrance Ramp	1 HOV lane and 5 mixed-flow lanes	Add 1 mixed-flow lane
Orangethorpe Ave Entrance Ramp to Chapman Ave Exit Ramp	1 HOV lane, 4 mixed-flow lanes, and 1 auxiliary lane	Add 1 mixed-flow lane
Chapman Ave Exit Ramp to Nutwood Ave Entrance Ramp	1 HOV lane and 4 mixed-flow lanes	Add 1 mixed-flow lane
Nutwood Ave Entrance Ramp to Yorba Linda Blvd Exit Ramp	1 HOV lane, 4 mixed-flow lanes and 1 auxiliary lane	Add 1 mixed-flow lane
Yorba Linda Blvd Exit Ramp to Yorba Linda Blvd North Entrance Ramp	1 HOV lane and 4 mixed-flow lanes	Add 1 mixed-flow lane

Other improvements (requiring geotechnical input) include: new soundwalls, retaining walls and soundwall on retaining walls; some local widening and shifting of the on- and off-ramps; and new and extension of existing buried drainage devices. The wall foundation recommendations are included in a separate foundation report (2009j).

3.0 PERTINENT REPORTS AND INVESTIGATIONS

3.1 Pertinent Previous Reports and Investigations

No previous geotechnical studies were performed specifically for the improvements addressed in this report.

3.2 Related Reports Prepared for the Proposed Improvements

A separate Materials Report (EMI, 2009a) has been prepared for the project, which addresses pavement structural section design and soil corrosion issues for buried drainage devices. The Materials Report may be referred to for additional geotechnical information.

Also, separate Foundation Reports are being prepared for widening of the following bridges and a tieback wall (EMI, 2009b thru 2009i):

- Orangethorpe Avenue Undercrossing (Bridge No. 55-0459)
- South Placentia Overhead (Bridge No. 55-0450)
- Crowther Avenue Undercrossing (Bridge No. 55-0457)
- Placentia Overhead (Bridge No. 55-0449)
- Placentia Avenue Undercrossing (Bridge No. 55-0460)
- Chapman Avenue Undercrossing (Bridge No. 55-0456)
- Nutwood Avenue Undercrossing (Bridge No. 55-04649)
- Tieback Wall at Yorba Linda Boulevard (Bridge No. 55-0468)

A separate Foundation Report (EMI, 2009j) is being prepared for retaining walls and sound walls.

In addition to the above Material and Foundation Reports, EMI has prepared a report addressing Aerially-Deposited Lead (ADL) content in soils within the project limits (EMI, 2009k).

4.0 PHYSICAL SETTING

4.1 Climate

The weather in the Los Angeles Basin is a Mediterranean type climate with warm dry summers and mild winters. As is typical of a Mediterranean climate, most rainfall occurs in the winter months. The winter rains accompany northern Pacific storms that generally originate in the Gulf of Alaska region and sweep across California from the northwest. Occasional showers can occur during the summer months due to hot moist monsoonal air masses that spread northerly from the Gulf of Mexico and Gulf of California.

Another typical L.A. Basin weather characteristic results from the juxtaposition of cool marine waters and dry hot desert air. As the moist marine air masses drift over colder water a bank of low clouds and fog is formed which creeps inland for only a short distance before evaporating completely. Characteristically, this deck of clouds reaches inland as far as the bordering hills and mountains during the night, and then recedes to the vicinity of the coast during the day.

The average maximum temperatures in the project area are about 77 degrees Fahrenheit, and the average minimum temperatures are about 50 degrees. The warmest months are July through September when the maximum temperature averages above 87-88 degrees. The daily extreme high temperatures range from the 90s to more than 110 in the months of July through September. The hottest temperatures are commonly associated with Santa Ana winds which involve adiabatic heating due to a high-pressure cell over the Great Basin in Nevada and Utah to the east. The coolest months are December and January when the average low is about 42 degrees. Freezing temperatures occur rarely in the winter months, but generally do not result in a hard freeze.

The average annual precipitation is about 14 inches a year with the wettest months being January through March when rainfall averages about 2 to 3½ inches per month. The driest month is July when no precipitation is likely. Although snowfall is possible in the surrounding mountain ranges and rarely in the inland valleys, no snowfall is likely within the Los Angeles basin.

4.2 Topography and Drainage

The project corridor is in the eastern part of the Los Angeles Basin along the southern margin of the Coyote Hills and the Puente Hills (Figure 2). Just north of the project corridor, the Puente Hills rise to an elevation of about 1,400 feet. The southwestern edge of the Puente Hills is paralleled by a series of low-elevation plains and hills; the Santa Fe Plain and the Coyote Hills are to the west of the project corridor, and the Richfield and Kraemer Hills are to the east. The elevations of these hills range from about 500 feet just west of the project to about 300 feet in the east. The ground upon which the project is located slopes gently to the south. Elevations along the project corridor range from about 280 feet in the north to about 200 feet on the south.

The project corridor traverses the ancient flood plains and alluvial fans of Fullerton Creek and the Santa Ana River. The major drainage in the area is the Santa Ana River which flows westerly south of the site. Fullerton Creek, a tributary to the Santa Ana River, drains southwesterly from the Puente Hills just west of the project corridor.

4.3 Man-Made and Natural Features of Engineering and Construction Significance

4.3.1 Man Made Features

Utilities. Based on project utility plans, numerous utilities lie within the project area. Many existing utilities appear to cross beneath the SR-57 mainline and along the local streets. The existing utilities crossing beneath the SR-57 mainline include:

- Southern California Edison (SCE) 12 kV electrical lines at about Stations 459+10, 471+50, 490+20, 507+00 and 534+10, and 66kV electrical lines at about Stations 472+90 and 507+00;
- Southern California Gas (SCG) high pressure (HP) gas lines varying from 2-inch to 8-inch at about Stations 468+90, 469+10, 471+80, 490+90 and 520+00, a 30-inch HP gas line at about Station 472+50, and a 24-inch HP gas line at about Station 506+40;
- AT&T phone lines at about Stations 468+70, 471+60 and 490+95;
- Water pipes owned by Golden State Water Company (GSW) and City of Fullerton including 6-inch to 12-inch PVC pipes, 8-inch to 12-inch CIP pipes, and 20-inch to 24-inch conductor pipes located at about Stations 458+90, 467+30, 472+70, 490+90, 506+30, 520+55, 534+20 and 573+05;
- City of Fullerton sewer lines including 8-inch to 10-inch VCP pipes at about Stations 472+55, 520+60 and 534+70, and Orange County Sanitation District 45-inch pipe sewer at about Station 572+90;
- Cable lines (including fiber optic) owned by Comcast and Sprint at about Stations 471+80, 490+45, 495+45 and 534+15; and
- a Chevron 6-inch oil pipe at about station 547+05.

On the west side of the SR-57, the existing utilities include:

- SCE 12 kV electrical lines along Vista Avenue and north of Yorba Linda Boulevard,
- a GSW 6-inch water PVC pipe along Iowa Place,
- a City of Fullerton 6-inch water PVC pipe along Derek Drive, and
- a SCG 3-inch gas line along Campus Drive.

On the east side of SR-57, the existing utilities include:

- SCE 12 kV electrical lines along Gonzalez Street and north of Yorba Linda,
- a GSW 8-inch water PVC pipe along Nebraska Avenue,
- a City of Fullerton 6-inch water CIP pipe north of Nutwood Avenue, and
- SCG 2-inch gas lines along Gonzalez Street and Nebraska Avenue.

The locations of the existing utilities are shown on in the project Utility Plans. Based on the information provided by the civil engineers, only Edison transmission lines at Orangethorpe Avenue and Placentia Avenue will be relocated and the remaining existing utilities will be protected in place. The utilities to be protected in place will not impact or be impacted by the proposed construction within Caltrans right-of-way.

Culverts. We have obtained a list of the buried drainage devices from RBF that will be affected by this project. New devices and existing devices that will be extended (designated as Remain-in-place) together with their material types are presented in Table 2.

Table 2. Existing and New Drainage Devices

Stationing	*Station Line*	*Culvert/Pipe Type*	*Proposed Construction*
464+20	SR-57 (B-Line)	RCB	Remain in-place
473+00		RCP	Remain in-place
474+00		CMP	Remain in-place
474+00		APC	New
486+00		RCP	Remain in-place
494+20		RCP	Remain in-place
504+50		RCP	Remain in-place
504+50		APC	New
505+60		RCB	Remain in-place
511+40		CMP	Remain in-place
512+50		APC	New
514+50		APC	New
515+00		CMP	Remain in-place
518+40		CMP	Remain in-place
518+40		APC	New
521+00		APC	New
522+00		CMP	Remain in-place
522+00		APC	New
525+80		CMP	Remain in-place
525+80		APC	New
529+20		APC	New
530+20		RCP	Remain in-place
530+20		ACP	New
115+00	Nutwood Ave (NA-Line)	RCB	Remain in-place
536+80	Nutwood Ave On-Ramp (H-8 Line)	CMP	Remain in-place
542+00	SR-57 (B-Line)	RCP	Remain in-place
542+00		ACP	New
565+00		RCP	Remain in-place
567+30	Yorba Linda Blvd Off-Ramp (I-5 Line)	RCP	Remain in-place
569+70	Yorba Linda Blvd Loop On-Ramp (I-4 Line)	RCP	Remain in-place
569+70		APC	New
570+50	SR-57 (B-Line)	RCP	Remain in-place
30+05	Yorba Linda Blvd (YL-Line)	RCP	Remain in-place
576+00	Yorba Linda On-Ramp (I-3 Line)	RCP	Remain in-place
579+10		RCP	Remain in-place
585+50	SR-57 (B-Line)	RCP	Remain in-place

RCB=Reinforced Concrete Box: RCP=Reinforced Concrete Pipe; CMP=Corrugated Metal Pipe, APC=Alternate Pipe Culvert.

Fill. The SR-57 mainlines as well as ramps and connectors are constructed on top of earthen embankments of varying height. These earthen embankments are composed of fill soils that may have been derived from areas immediately adjacent to the mainline. Actual thickness of fills throughout the project area is unknown and documentation of placement of existing fills was not reviewed by EMI. At Orangethorpe Avenue on the south end of the project corridor, fill materials encountered in the borings consist predominantly of sandy materials including sand, silty sand and clayey sand. Fine-grained clayey soils in fill materials increase gradually to the north. North of the Placentia Overhead, the clayey materials including lean clay with sand, sandy lean clay, and silty clay, become dominant (more than 60%) in the fill. Some sandy silt and silty sand layers were found to be interlayered with the clayey fill soils.

4.3.2 Natural Features

No natural features are present that affect the project design or construction. Moderate to dense low-growth vegetation is present on existing unpaved ground and slopes, which must be removed prior to placing compacted fill. Loose, soft, dry, wet, unstable, or otherwise unsuitable materials should be removed from areas to receive fill. Excavation bottoms should be firm and unyielding prior to placement of new fill. Foundation treatment is addressed in Section 11 of this report.

4.4 Regional Geology and Seismicity

4.4.1 Physiography

The site area is at the eastern edge of the Los Angeles physiographic basin, a large, relatively flat, low-lying, coastal plain surrounded by mountains on the north, east, and southeast (Figure 2). The floor of the Los Angeles Basin is relatively flat but slopes gradually southwesterly from an elevated marginal apron to sea level along the coastline. The western margin of the Los Angeles Basin is bordered by the sea and the Palos Verdes Hills. The eastern margin is bordered by the Puente Hills and Santa Ana Mountains. The Coyote Hills, Santa Fe Springs Plain, Richfield Hills, and Kramer Hills are low elevation uplifts along the southern margin of the Puente Hills.

4.4.2 Geologic Structure

The geologic structure at the site is quite simple and is characterized by flat-lying Quaternary sediments overlying gently folded Tertiary sedimentary rocks. These strata rise gently to the Coyote Hills, Richfield Hills, and Kraemer Hills where they are arched upward to form anticlinal folds. The site is on the south limb of these anticlines with the early Pleistocene and Tertiary age strata dipping gently to the south and overlain by younger flat-lying Quaternary sediments.

The nearest active or potentially active surface faults are the Peralta Hills and Whittier faults (Figure 2). The low-elevation plains and hills along the eastern margin of the Los Angeles Basin are underlain by a series of east-west trending, en echelon, faults and folds in the subsurface; the major faults within this trend are, from north to south, the Los Angeles (Las Cienegas), Santa Fe Springs, and Coyote Hills faults (Figure 2). This group of faults is known as the Puente Hills fault system. Other poorly known segments of this thrust fault system underlie the Richfield and Kramer hills. All of these faults are blind thrust or reverse faults that approach within about a

mile or so of the ground surface. They are identified on seismic reflection geophysical data only and are below the depths of oil wells.

The Peralta Hills fault may be related to the Puente Hills fault system. The Peralta Hills fault is exposed along the south flank of the Peralta Hills where it displaces Tertiary-age rocks upward and over younger Quaternary alluvium. The fault extends westerly below the Santa Ana River channel where it creates barriers to ground-water flow (Figure 3). The barriers extend about to the SR-57 freeway just north of the Lincoln Avenue (Morton and Miller, 1981). The location of the Peralta Hills fault is well up on the flank of the hills rather than at the base of the hills indicating that it is not the only fault responsible for uplift and folding of the Peralta Hills. There must be a deeper unknown blind thrust fault below the Peralta Hills thrust fault but this feature has never been directly identified.

The Whittier fault is a major strike slip fault that extends northwesterly along the southwest flank of the Puente Hills northeast of the site (Figure 2). The Whittier fault is associated with the Chino fault and the Elsinore fault and together these faults form a major fault system that extends from the Los Angeles Basin into northern Mexico.

The El Modeno fault is a north-south trending feature within Loma Ridge, one of the foothills of the Santa Ana Mountains, southeast of the site. The feature is poorly known but is known to displace Holocene soil in Loma Ridge. Although the fault is grouped with the Peralta Hills fault on the Caltrans seismic hazard map (EMP on Figure 4), it appears to be a discrete normal or strike-slip fault unrelated to the thrust faults of the Peralta Hills. Although the fault must be considered active because it displaces Holocene soil, the feature has a very long (thousands of years) recurrence interval.

4.4.3 Geologic Hazards

There are no steep slopes within the corridor so landsliding is not likely. There are no active faults through the project area so surface fault rupture is not likely. There are no known volcanos in the site region. The site is far from the sea on elevated land so tsunamis are not a hazard.

The site is not identified on the State seismic hazard maps of the Anaheim and La Habra quadrangle as being susceptible to liquefaction (California Geological Survey/Division of Mines and Geology, 1997a and 1997b). This is due primarily to the depth of historically highest ground water being greater than 50 feet.

4.4.4 Seismicity

The project site is in seismically active southern California. The present-day seismotectonic stress field in the Los Angeles region is one of north-northeasterly compression. This is indicated by the geologic structures, by earthquake focal-mechanism solutions, and by geodetic measurements. These data suggest compression rates of between 0.2 and 0.35 inch per year (5 and 9 mm/yr) across the greater Los Angeles area.

Historical epicenter maps show widespread seismicity throughout the Los Angeles Basin. Although historical earthquakes occur in proximity to known faults, they are difficult to directly associate with mapped faults. Part of this difficulty is due to the fact that the basin is underlain by several subsurface thrust faults (blind faults). Earthquakes in the region occur primarily as loose clusters along the Newport-Inglewood Structural Zone, along the southern margin of the Santa Monica Mountains, the southern margin of the Santa Susana and San Gabriel Mountains, and in the Coyote Hills-Puente Hills area.

The largest historical earthquake within the Los Angeles Basin was the 1933 Long Beach earthquake of M_W=6.4 (M_L = 6.3) which is generally believed to have been associated with the Newport-Inglewood Structural Zone. The association of the 1933 event with the NISZ was based on abundant ground failures along the NISZ trend, but no unequivocal surface rupture was identified. Hauksson and Gross (1991) reevaluated the seismicity data and relocated the 1933 earthquake hypocenter to a depth of about 6 miles below the Huntington Beach-Newport Beach city boundary.

Other damaging earthquakes in the Los Angeles region include the 1971 San Fernando, the 1987 Whittier, and the 1994 Northridge events. The 1971 San Fernando (M_L= 6.4, M_W=6.7) earthquake occurred along the northern margin of the San Fernando Valley and produced a surface rupture which coincided partly with a zone of mapped surface faults along the mountain-valley margin. The more-recent 1987 Whittier earthquake (M_L=5.9, M_W=5.9) and the 1994 Northridge (M_L=6.4, M_W = 6.7) earthquake were not associated with surface faulting. Such events indicate that seismic hazards analysis must consider subsurface faulting as well as surface faulting. The Whittier event occurred at a depth of about 10 miles on a northerly dipping thrust fault dipping from the Coyote Hills area, under the Repetto and Puente Hills, to below the San Gabriel Valley. The Northridge event occurred at a depth of about 12 miles on a south-dipping reverse fault below the San Fernando Valley.

Another significant earthquake in the region was the 1812 earthquake which caused damage at the San Juan Capistrano Mission. The location and magnitude of the 1812 earthquake are unknown but geological studies (Jacoby et al., 1988; Fumal et al., 1993; Weldon et al., 2004) postulated that it did not occur in the Capistrano area, but rather was a large (M> 7.0) distant event on the San Andreas fault in the Wrightwood area of the San Gabriel Mountains.

The earliest documented earthquake in the region was reported by the Portola expedition as they camped along the Santa Ana River in 1769. This event has been attributed by various geoscientists to just about every fault in the area but it could very well have been a distant event that shook a wide area, as did the 1971 San Fernando, the 1987 Whittier, and the 1994 Northridge events, as well as many other more-distant events (for example, 1992 Landers event).

A recent magnitude 5.4 (M_W) earthquake occurred on 29 July 2008 below the Puente Hills northeast of the site at a depth of about 10 miles. This event was a reverse type fault with a left-lateral component of slip. The causative fault is unknown. The epicenter is between the Whittier and Chino faults. The orientation of the preferred focal plane of the focal mechanism solution is somewhat compatible with the Whittier fault. The Whittier fault may have a reverse component of slip but is believed to be primarily a right-lateral fault. Furthermore dip of the preferred focal plane and the distribution of aftershocks are not very compatible with the Whittier fault. The northerly dipping buried thrust faults under the Peralta Hills, Richfield Hills, or Kraemer Hills could have been the source because the preferred focal plane dips northeasterly similar to the

northerly dipping faults. However, the distribution of the aftershocks does not seem compatible with the orientations of these faults.

4.5 Soil Survey Mapping

Soil Survey maps were not reviewed for the project. Native soils in the area have been disturbed by previous construction and agricultural activity.

5.0 EXPLORATION

5.1 Drilling and Sampling

A geotechnical field investigation was conducted between August 25 and October 1, 2008. Forty-four (44) exploratory borings and fifteen (15) cone penetrometer tests (CPT's) were accomplished under the supervision of EMI for the project. Soil exploration information is summarized in Table 3. Approximate locations of borings and CPT's are shown on Figure 5 through Figure 16.

The hollow-stem auger (HSA) borings were excavated using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. Subsurface soils and conditions were logged and samples of soils were collected for laboratory testing. Large bulk samples of near-surface soils were logged and collected. Smaller soil samples were collected from borings generally at 5 feet vertical intervals by means of split-spoon drive samplers; the Standard Penetration Test (SPT) sampler and the Modified California Drive (MCD) sampler were used to collect small disturbed and relatively undisturbed samples, respectively. The SPT sampler (2.4 inches OD) and MCD sampler (3.25 inches OD) were driven a total depth of 18 inches or until refusal, using a 140-pound hammer falling 30 inches. The blowcounts for the last 12 inches of penetration (or less penetration depths as noted on the logs) were recorded on the boring logs and were used to correlate in-situ soil strengths. The MCD is a split-barrel sampler with a tapered cutting tip and lined with a series of 1-inch tall brass rings.

The CPT soundings were performed using an electronic cone penetrometer in general accordance with current ASTM Standards (ASTM D5778 and ASTM D3441). The CPT equipment consisted of a cone penetrometer assembly mounted at the end of a series of hollow sounding rods. The cone penetrometer assembly consisted of a conical tip with a 60° apex angle and a projected cross sectional area of 1.55 in^2 (10 cm^2) and a cylindrical friction sleeve with a surface area of 23.25 in^2 (150 cm^2). The interior of the cone penetrometer is instrumented with strain gauges that allow simultaneous measurements of cone tip and friction sleeve resistance during penetration. The cone penetrometer assembly is continuously pushed into the soil by a set of hydraulic rams at a standard rate of 0.79 inch per second (20 mm per second) while the cone tip resistance and sleeve friction resistance are recorded every 1.967 inches (50 mm) and stored in digital form. A specially designed all-wheel drive 25-ton truck provides the required reaction weight for pushing the cone assembly and is also used to transport and house the testing equipment. The computer generated graphical logs include tip resistance, friction resistance, and friction ratio. Soil behavior type interpretations are based on guidelines by Robertson and Campanella (1989).

Table 3. Soil Exploration Information

Boring	*Station*	*Offset (feet)*	*Station Line*	*GSE (ft)*	*GWE (ft)*	*Boring Depth (ft)*	*Method*	*Figure No.*
A-08-001	471+5	97RT	SR-57	225.4	NE	91.5	HSA	6
A-08-002	472+27	115RT	SR-57	206.1	NE	71.5	HSA	6
A-08-003	473+35	90RT	SR-57	227.8	NE	91.5	HSA	6
A-08-004	483+85	90RT	SR-57	231.9	NE	90.4	HSA	7
A-08-005	485+12	90RT	SR-57	233.5	NE	91.5	HSA	7
A-08-006	489+69	80RT	SR-57	237.9	NE	90.5	HSA	8
A-08-007	491+67	80RT	SR-57	239.5	NE	64.5	HSA	8
A-08-008	494+45	80RT	SR-57	241.9	NE	96.5	HSA	8
A-08-009	496+47	80RT	SR-57	243.7	NE	91.5	HSA	8
A-08-010	505+67	80RT	SR-57	243.5	NE	106.5	HSA	9
A-08-011	507+45	100RT	SR-57	217.4	NE	71.5	HSA	9
A-08-012	507+94	97RT	SR-57	217.9	NE	71.5	HSA	9
A-08-013	510+43	89RT	SR-57	241.3	NE	91.0	HSA	9
A-08-014	519+3	70RT	SR-57	250.1	NE	90.9	HSA	10
A-08-015	521+9	71RT	SR-57	252.1	NE	91.8	HSA	10
A-08-016	533+58	68RT	SR-57	259.0	NE	90.8	HSA	11
A-08-017	535+70	66RT	SR-57	258.0	NE	91.5	HSA	11
A-08-018	573+88	127RT	SR-57	301.1	NE	61.5	HSA	15
A-08-019	574+55	127RT	SR-57	301.1	NE	61.5	HSA	15
A-08-101	460+71	120RT	SR-57	207.2	NE	31.5	HSA	5
A-08-102	463+10	125RT	SR-57	207.3	NE	31.5	HSA	5
CPT-08-103	464+22	137RT	SR-57	207.3	NE	69.2	CPT	5
CPT-08-104	465+35	147RT	SR-57	207.3	NE	74.2	CPT	5
A-08-105	467+40	148LT	SR-57	210.9	NE	71.5	HSA	5
A-08-106	468+90	195RT	SR-57	205.4	NE	61.5	HSA	6
CPT-08-107	475+01	186RT	SR-57	211.0	NE	65	CPT	6
A-08-108	476+98	94RT	SR-57	228.7	NE	71.0	HSA	7
A-08-109	478+37	138RT	SR-57	226.1	NE	71.5	HSA	7
CPT-08-110	480+40	111RT	SR-57	228.2	NE	50.0	CPT	7
CPT-08-111	487+00	90RT	SR-57	233.9	NE	60.9	CPT	7
CPT-08-112	499+75	79RT	SR-57	244.1	NE	45.9	CPT	8
CPT-08-113	503+16	82RT	SR-57	243.9	NE	48.4	CPT	9
CPT-08-114	513+48	83RT	SR-57	242.0	NE	54.5	CPT	9
CPT-08-115	515+71	83RT	SR-57	245.5	NE	64.1	CPT	10

Table 3 (cont.). Soil Exploration Information

Boring	*Station*	*Offset (feet)*	*Station Line*	*GSE (ft)*	*GWE (ft)*	*Boring Depth (ft)*	*Method*	*Figure No.*
A-08-116	516+31	172RT	SR-57	231.8	NE	61.5	HSA	10
CPT-08-117	524+12	91RT	SR-57	253.1	NE	79.7	CPT	10
CPT-08-118	526+05	92RT	SR-57	252.4	NE	77.3	CPT	10
A-08-119	528+64	119RT	SR-57	238.0	NE	61.5	HSA	10
CPT-08-120	529+40	80RT	SR-57	255.9	NE	80.4	CPT	10
A-08-121	531+86	80RT	SR-57	257.8	NE	31.5	HSA	11
A-08-122	537+80	72RT	SR-57	257.3	NE	30.8	HSA	11
A-08-123	539+47	160RT	SR-57	250.0	NE	31.5	HSA	11
A-08-124	540+94	82RT	SR-57	253.6	NE	31.5	HSA	12
CPT-08-125	542+28	117RT	SR-57	251.1	NE	80.2	CPT	12
A-08-126	543+21	109RT	SR-57	251.0	NE	61.5	HSA	12
CPT-08-127	544+64	97RT	SR-57	250.9	NE	79.6	CPT	12
A-08-128	546+84	102RT	SR-57	251.0	NE	31.5	HSA	12
A-08-129	553+15	94RT	SR-57	255.8	NE	11.5	HSA	13
A-08-130	557+90	80RT	SR-57	260.0	NE	3.5	HSA	13
CPT-08-131	561+88	116RT	SR-57	263.6	NE	80.2	CPT	14
A-08-132	562+86	99RT	SR-57	264.5	NE	11.5	HSA	14
A-08-133	565+04	165RT	SR-57	266.5	NE	11.5	HSA	14
A-08-134	570+55	90RT	SR-57	269.4	NE	11.5	HSA	14
A-08-135	571+18	96RT	SR-57	274.5	NE	2.0	HSA	15
A-08-136	572+14	421RT	SR-57	288.0	NE	10.9	HSA	15
A-08-137	574+40	394RT	SR-57	290.0	NE	31.5	HSA	15
A-08-138	578+33	135RT	SR-57	283.0	NE	31.5	HSA	15
A-08-139	580+71	112RT	SR-57	283.4	NE	3.0	HSA	16
A-08-140	585+76	91RT	SR-57	285.6	NE	2.0	HSA	16

Notes:
1. Stations and offsets are measured relative to the identified Station Lines and are approximate.
2. SR-57 = "B"-Line
3. GSE = Approximate Ground Surface Elevation.
4. GWE = Approximate Groundwater Elevation; NE = Groundwater Table Not Encountered.
5. HSA = Hollow-stem auger boring; CPT = Cone Penetrometer Test.

5.2 Geologic Mapping

Geologic mapping was not considered necessary and therefore was not performed for the project.

5.3 Geophysical Studies

Geophysical studies were not necessary and therefore were not performed for the project.

5.4 Instrumentation

Instrumentation was not necessary and therefore not installed as part of the field investigation program.

5.5 Exploration Notes

No unique conditions were encountered or observed during the field exploration.

6.0 GEOTECHNICAL TESTING

6.1 In-Situ Testing

Blowcounts from the SPT and MCD samplers were recorded during the exploration. In addition, CPT soundings were conducted; tip resistance, sleeve friction, and friction ratio were determined and correlated with soil type and soil strength.

6.2 Laboratory Testing

Laboratory tests were performed to determine relevant physical characteristics and engineering properties of soils that exist at the site. Selected soil samples were tested to determine soil type, shear strength parameters, consolidation characteristics, and corrosion potential. A list of tests performed, the corresponding test methods, and purpose of testing is presented in Table 4.

The laboratory soil tests were conducted in general accordance with California Test methods or American Society for Testing and Materials standards. Laboratory test results are presented in Appendix B.

7.0 GEOTECHNICAL CONDITIONS

7.1 Site Geology

7.1.1 Lithology

Geologic formations directly underlying the site are comprised primarily of river flood plain and alluvial fan alluvium. Materials within both these units are primarily sands with mixtures of silts, clays, and gravels. Bedding in the Quaternary units commonly is irregular, lenticular, and poorly developed. Crystalline basement rocks are about 16,000 feet deep below the site.

7.1.2 Geologic Structure

The geologic structure of the site is described in detail in Section 4.4.2.

Table 4. Explanation of Laboratory Tests Performed

Type of Test	*Applicable Test Method*	*Purpose*
Dry Density	ASTM[1] D 2937	Estimate in-situ soil density
Moisture Content	ASTM D 2216	Estimate in-situ soil moisture content
Pocket Pentrometer	See Note 3	Determine consistency of cohesive soils
Atterberg Limit	ASTM D 4318	Determine plasticity of cohesive soils
No. 200 Wash	ASTM D 1140	Estimate percentage of gravel, sand, and fines content
Direct Shear	ASTM D 3080	Estimate strength parameters of soil
UU Triaxial Test	ASTM D 2850	Estimate undrained shear strength of soil
Consolidation	ASTM D 2435	Estimate soil consolidation characteristics
Compaction Testing	CT 216	Determine compaction characteristics of site soil
R-Value	CT-301	Determine resistance value of site soil
Soil pH	CT[2] 532/643	Determine corrosion potential of site soil
Minimum Resistivity	CT 532/643	Determine corrosion potential of site soil
Sulfate Content	CT 417	Determine corrosion potential of site soil
Chloride Content	CT 422	Determine corrosion potential of site soil

Notes:
1. ASTM = American Society for Testing and Materials.
2. CT = California Test Method.
3. Based on Appendix A in Caltrans Soil and Rock Logging, Classification, and Presentation Manual.

7.1.3 Natural Slope Stability

There are no steep natural slopes within the project corridor.

The site is not identified on State seismic hazard maps of the La Habra and Anaheim and Newport Beach quadrangles as being susceptible to seismically-induced landsliding (California Geological Survey/Division of Mines and Geology, 1997a and 1997b).

7.2 Subsurface Soil Conditions

7.2.1 Stratigraphy

Regional studies (e.g. Morton, 2004; Morton and Miller, 1981; Durham and Yerkes, 1964; California Department of Water Resources, 1961) indicate that the site area is underlain by Quaternary sediments overlying older Quaternary and Tertiary sediments and sedimentary rocks.

The surficial deposits are primarily Holocene and Pleistocene alluvial fan deposits (Figure 3). Older formations exposed in the hills and underlying the corridor are, in descending order, the Pleistocene-age La Habra and Coyote Hills, the Pliocene Fernando, and Pliocene-Miocene-age Puente formations. Along the corridor, the La Habra Formation is at an elevation of about sea level and therefore these older units are well below the level of interest for this project.

7.2.2 Material Strength Parameters

Due to the extent of the project (about 2.4 miles long), the varying ground surface elevations, and the varied stratigraphy observed in exploratory boreholes and CPT's, idealized subsurface profiles were developed between each major street (or railroad) crossing the mainline. The idealized soil profiles and design strength parameters for evaluation and design are presented in Table 5.

Table 5. Idealized Soil Profiles and Strength Parameters

Approx. Elevation (ft)	*Predominant Soil Type*	*Total Unit Weight (pcf)*	*Friction Angle (degree)*	*Cohesion/ Undrained Shear Strength (psf)*	*Expansion Potential*
South of Orangethorpe Ave					
+225.4 to +180	Silty Sand, Sand with Silt, and Poorly-graded Sand	120	30-34	150-100	very low to low
+180 to +130	Sand with Silt and Sand	123-128	35-40	100-25	very low to low
Between Orangethorpe Ave and South Placentia OH (OCTA Railroad)					
+231.9 to +190	Clayey and Silty Sand and Sand with Silt	120	31-34	150-100	very low to low
+190 to +180	Sandy Lean Clay	120	-	1,200	low to medium
+180 to +145	Sand with Silt	123-128	35-38	100-50	very low to low
Between South Placentia OH (OCTA Railroad) and Crowther Ave					
+241.0 to +227	Clayey and Silty Sand	120	31	150	very low to low
+227 to +195	Lean Clay with Sand and Sandy Lean Clay	120	-	1,200-1,800	low to medium
+195 to +140	Sand with Silt and Poorly-graded Sand	123-128	34-40	100-25	very low to low
Between Crowther Ave and Placentia OH (BNSF Railroad)					
+241.9 to +230	Clayey and Silty Sand	120	31	150	very low to low
+230 to +190	Lean Clay with Sand and Sandy Lean Clay	120	-	1,200-1,800	low to medium
+190 to +165	Sand with Silt and Poorly-graded Sand	123-128	32-40	150-25	very low to low
+165 to +155	Lean Clay with Sand	120	-	2,000-2,500	low to medium
+155 to +145	Sand with Silt and Silty Sand	125-128	36-40	100-25	very low to low

Table 5 (cont). Idealized Soil Profiles and Strength Parameters

Approx. Elevation (ft)	*Predominant Soil Type*	*Total Unit Weight (pcf)*	*Friction Angle (degree)*	*Cohesion/ Undrained Shear Strength (psf)*	*Expansion Potential*
Between Placentia OH (BNSF Railroad) and Placentia Ave					
+243.7 to +235	Clayey Sand	120	30-31	150	very low to low
+235 to +200	Lean Clay with Sand and Sandy Lean Clay	120-123	-	1,500-2,500	low to medium
+200 to +165	Sand with Silt and Silty Sand	123-128	34-40	150-50	very low to low
+165 to +135	Lean Clay with Sand and Sandy Lean Clay	123-125	-	2,000-3,000	low to medium
Between Placentia Ave and Chapman Ave					
+250.1 to +235	Clayey Sand	120	30-31	150	very low to low
+235 to +200	Lean Clay with Sand and Sandy Lean Clay	120-125	-	1,500-3,000	low to medium
+200 to +165	Sand with Silt and Silty Sand	123-128	34-40	150-50	very low to low
Between Chapman Ave and Nutwood Ave					
+253.1 to +223	Lean Clay with Sand and Sandy Lean Clay	120-123	-	1,200-2,000	low to medium
+223 to +218	Silty Sand	120	30	150	very low to low
+218 to +203	Lean Clay with Sand and Sandy Lean Clay	123-125	-	1,500-3,000	low to medium
+203 to +188	Silty and Clayey Sand	123-125	32-35	150-50	very low to low
+188 to +178	Lean Clay with Sand and Sandy Lean Clay	123-125	-	2,500-3,000	low to medium
+178 to +163	Sand with Silt and Silty Sand	123-128	34-40	150-50	very low to low
Between Nutwood Ave and Yorba Linda Blvd					
+258 to +245	Silty and Clayey Sand	120	30-32	150	very low to low
+245 to +225	Lean Clay with Sand and Sandy Lean Clay	120-125	-	1,500-3,000	low to medium
+225 to +195	Sand with Silt and Silty Sand	120-125	31-35	150-50	very low to low
+195 to +175	Lean Clay with Sand and Sandy Lean Clay	120-125	-	1,500-2,500	low to medium
+175 to +170	Sand with Silt and Silty Sand	125-128	36-40	50	very low to low

Table 5 (cont). Idealized Soil Profiles and Strength Parameters

Approx. Elevation (ft)	*Predominant Soil Type*	*Total Unit Weight (pcf)*	*Friction Angle (degree)*	*Cohesion/ Undrained Shear Strength (psf)*	*Expansion Potential*
North of Yorba Linda Blvd					
+290 to +277	Lean Clay with Sand and Sandy Lean Clay	120-123	-	1,200-2,000	low to medium
+277 to +267	Silty and Clayey Sand	120-123	31-32	150	very low to low
+267 to +255	Lean Clay with Sand and Fat Clay	120-123	-	1,800-2,500	low to high
+255 to +240	Silty and Clayey Sand	120-123	32-34	150-100	very low to low

7.2.3 Expansion Potential

Based on the field boring logs and various laboratory tests, on-site fine-grained soils are anticipated to have an expansion potential varying from very low to high. Sandy soils encountered in boreholes are very low to low expansive. Lean clay could be low to medium expansive. Fat clay encountered in several borings could be highly expansive. On-site native soils and existing fill materials within the project area are considered suitable for use as compacted fill for slopes. However, fine-grained native soils and existing fills that are expansive should not be placed behind retaining walls. Additional laboratory tests may be required during earthwork operations to verify the expansion potential of soils used in specific areas.

7.2.4 Settlement Potential

Based on consolidation test results, clayey soils at the site are susceptible to consolidation settlement. Settlement due to embankment construction is discussed in Section 8.3 of this report.

7.3 Water

7.3.1 Surface Water

Under the natural regime, much of the project corridor was within the flood plains of Fullerton Creek and the Santa Ana River. However, the natural surface drainage has been highly modified and the rivers are now largely confined within concrete/rip rap-lined aqueducts.

Scour. This site is located within an area that is presently improved; roadway surfaces are paved and drainage is controlled by engineered facilities. Therefore, scour is not considered a design issue.

Erosion. Surficial soils within the project area contain some amount of cohesive fines; therefore, the soils are not easily eroded. However, slope areas that may consist of sandy surficial soils

(with little to no cohesive fines) are susceptible to rilling, piping, and accelerated erosion. Presently, there is minor to moderate vegetation covering the slopes adjacent to the on-ramps and off-ramps. Erosion of the existing slope faces was observed to be minimal.

In general, the erosion potential of soils within the project area is considered low to moderate; however, provisions for site drainage, slope planting and other measures in accordance with Caltrans requirements should be fulfilled to provide adequate protection against erosion. To minimize erosion of slopes, surface water should not be directed to flow over slope faces. Faces of finished slopes should be planted as soon as possible, after grading is completed, to minimize erosion.

7.3.2 Groundwater

The depth to groundwater is poorly known along the project corridor. The California Geological Survey (1997a and 1997b) estimates the historically highest (i.e. shallowest) groundwater within the project corridor. At Orangethorpe Avenue on the south end of the project corridor, the historically highest groundwater is estimated to have been at a depth of about 55 feet (about El. +150 feet). The groundwater deepens gradually to the north, and, at Chapman Avenue, the groundwater is about 80 feet below the ground surface (about El. +150 feet). On the northern end, at Yorba Linda Boulevard, the groundwater is more than 100 feet deep (about El. +170 feet).

7.4 Project Site Seismicity

There are no clusters or alignments of earthquakes within the project corridor. The regional seismicity is discussed above.

7.4.1 Ground Motions

The principal faults that might generate earthquakes which could affect the seismic design are shown on Figure 2 and listed on Table 6 along with their maximum earthquakes and expected ground motions at the site. The maximum earthquakes are from the Caltrans seismic hazard map (Mualchin, 1996) except for the Coyote Hills fault zone which is not shown on the Caltrans ground-motion contour map. Maximum horizontal bedrock acceleration is based on the larger of the attenuation equations of Mualchin (1996a) and Sadigh et al (1997). The location of the projection of the eastern segment of the Coyote Hills fault is shown on Figure 3. This location is less than a mile from the northern end of the project corridor. If this location is used with the maximum earthquake of 7.1 as suggested by Cao et al. (2003), the maximum ground motion would be close to 0.7g.

Table 6. Seismic Design Parameters

Fault or Fault Zone	*Style of Faulting*[1]	*Maximum Credible Earthquake (MCE) Magnitude (M)*	*Approximate Distance From Site*[2] *(mile)*	*Peak Bedrock Acceleration*[3] *(g)*
El Modeno-Peralta Hills (EMP)	REVERSE	6.5	0.6 to 2.7	0.6 to 0.8
Puente Hills (Coyote Hills segment)	REVERSE	7.1[4]	2.7 to 4.6	0.6 to 0.7
Whittier-Elsinore (WEE)	STRIKE SLIP	7.5	3.5 to 5.2	0.5 to 0.6

Notes:
1. Style of faulting as indicated in "A Technical Report to Accompany the Caltrans Seismic Hazard Map," by Mualchin (Caltrans, 1996b).
2. Distance from fault to the project site was obtained from the Caltrans Seismic Hazard Map (1996a).
3. Maximum horizontal bedrock acceleration is based on the larger of the attenuation equations of Mualchin (1996a) and Sadigh et al (1997).
4. Magnitude from Cao et al., 2003

7.4.2 Ground Rupture

There are no active faults through the project area, therefore the potential for ground rupture is remote to nil.

8.0 GEOTECHNICAL ANALYSES AND DESIGN

8.1 Dynamic Analyses

8.1.1 Parameter Selection

The peak bedrock acceleration (PBA) at the project site is estimated to be 0.7 to 0.8g. The PBA was used to evaluate liquefaction potential. For analyzing global slope stability, Caltrans guidelines (2006b) recommend using a horizontal seismic coefficient equal to one-third of the PBA but not exceeding 0.20. Therefore, a horizontal seismic coefficient of 0.2 was used in the slope stability analysis.

8.1.2 Evaluation

Liquefaction potential and seismically-induced settlement are discussed below.

Liquefaction. Liquefaction is the loss of shear strength in generally cohesionless, saturated soils when the pore-water pressure induced in the soil by a seismic event becomes equal to or exceeds the overburden pressure. The primary factors influencing the potential for liquefaction include: groundwater elevation, soil type and grain-size characteristics, relative density of the soil, initial confining pressure, and intensity and duration of ground shaking. Soils most susceptible to liquefaction are saturated low-density sands and silty sands within 50 feet of the ground surface.

Liquefaction potential of soils, within the project area, is considered low due to absence of groundwater within the depths of interest. Consequently, liquefaction is not anticipated to impact the design of the proposed improvements.

Seismically-Induced Settlement. Seismic settlement of onsite soils is expected to be minimal due to absence of groundwater within the depths of interest.

8.2 Cuts and Excavations

There are two major cut areas:

(1) Between Orangethorpe Avenue On-Ramp and South Placentia OH: cut in excess of 20 feet in height will be required to remove an existing retaining wall (RW No. 480) and construct a new retaining wall (RW No. 476) (See Figure 17), and

(2) At Yorba Linda Boulevard OC: a vertical cut of about 15 feet into the existing abutment end slope adjacent to the freeway will be required to construct a new tieback wall (RW No. 574) (See Figure 17).

Only relatively minor cuts, approximately less than 2 feet, are anticipated in other areas to achieve finish grades within the proposed project limits. In addition, relatively minor excavations are necessary for remedial earthwork beneath new pavement sections, and minor to moderate excavations are necessary to accommodate construction of new drainage structures.

Per Caltrans HDM Topic 304, 4H:1V side slopes or flatter should be used where possible. In the cut area adjacent to RW 476, a 2H:1V cut slope will be located in front of new retaining wall.

8.2.1 Slope Stability

We do not anticipate any slope stability issues for minor cuts and excavations. Side slopes with a steepness of 4H:1V or flatter will be globally and surficially stable. Therefore, we only conducted global slope stability analyses for the critical (highest) sections for the slopes in the cut areas described above and surficial stability analyses for the 2H:1V side slope near RW No. 476.

Global Stability. The global stability was evaluated, under static and pseudo-static conditions, using the computer program PCSTABL (Achilleos, 1988). The stability of a slope under static conditions is considered adequate if the calculated factor-of-safety is at least 1.5. Analysis indicates that the proposed cut slope meets the required minimum factor of safety for static design. The global stability of the cut slope under the pseudo-static condition was also evaluated. A seismic coefficient of 0.2 was used in the analysis. Results of the analysis indicate that the factor-of-safety for the pseudo-static condition is greater than 1.1, which meets the minimum required by Caltrans.

Surficial Stability. Surficial stability of the cut slope was evaluated using the infinite slope method. Based on borings, soils expected to be exposed in the cuts should have a friction angle of 31° and a minimum cohesion of 150 psf. Based on our calculations, surficial stability of cut slopes with a 2H:1V gradient is marginally stable. We recommend overexcavation of the upper 4 feet of materials below the slope face and replace with properly compacted soils with a minimum friction angle of 32° and a minimum cohesion of 200 psf. After this remedial measure is implemented, cut slopes with a gradient of 2H:1V or flatter are surficially stable with a factor-of-safety greater than 1.5.

8.2.2 Rippability

Excavations are anticipated to be performed within existing artificial fill and native soil. These on-site materials can be excavated using conventional heavy-duty earth-moving equipment and the materials are not expected to pose a rippability problem.

8.2.3 Earthwork Factors

The volume change of on-site materials upon excavation and compaction will vary with soil type and soil density. Although accurate grading factors cannot be determined, the following estimates are provided for determining preliminary earthwork quantities.

Table 7. Earthwork Factors

Material	*Volume Change after Compaction*
Sandy Soil	+5 percent to -5 percent
Clayey Soil	-5 percent to -15 percent

Bulking occurs when in-place materials are excavated for disposal or reuse as compacted fills. Excavated materials may be assumed to bulk 3 to 10 percent for hauling purposes.

8.3 Embankments

8.3.1 Description

A sliver fill is required to accommodate the addition of a mixed flow lane and shoulder between the southern project limit to the Nutwood Avenue On-Ramp. This sliver fill is retained on the east side by a series of retaining walls (See Figure 17). The width of the sliver fill (at the top) varies from a few feet to about 25 feet. The fill height also varies from a few feet to almost 30 feet adjacent to the bridge abutments. From north of the Nutwood Avenue On-Ramp to the northern project limit, some minor regrading and fill placement (less than 2 feet) will be required to accommodate the added mixed flow lane and shoulder.

Per Caltrans HDM Topic 304, 4H:1V side slopes or flatter should be used where possible. Some bridge end slopes have inclinations of 1.5H:1V. Between the southern project limit to the Nutwood Avenue On-Ramp, 2H:1V and 3H:1V fill slopes will be constructed in front of proposed retaining walls.

8.3.2 Settlement

From north of the Nutwood Avenue On-Ramp to the northern project limit, minor regrading and fill placement does not pose a settlement problem. However, settlement is expected due to the fill placement between the southern project limit and the Nutwood Avenue On-Ramp, and relatively large settlements are anticipated to occur adjacent to the bridge abutments due to thick fills. Based on the calculations in Appendix C, the maximum settlements are less than 3.5 inches due to fill placement to widen the existing embankment.

8.3.3 Stability

Slope stability analyses were conducted for end slopes at each of the seven bridge sites. In addition, the following critical (highest) sections along the retaining walls were analyzed:

- RW 462: 16-foot-high sound walls on retaining walls at Sta.463+40,
- RW 466: 14-foot-high sound walls on retaining walls at Sta. 471+20,
- RW 474: sound wall on 12-foot-high retaining wall at about Sta. 473+25,
- RW 476: 22-foot-high MSE wall at about Sta. 479+00,
- RW 486: 16-foot-high Type 1 wall at about Sta. 489+80,
- RW 492: 18-foot-high Type 1 wall at about Sta. 491+50,
- RW 496: 26-foot-high MSE wall at about Sta. 505+60,
- RW 512: 18-foot-high Type 1 wall at about Sta. 511+60,
- RW 514: 14-foot-high Type 1 wall at about Sta. 519+15,
- RW 522: 14-foot-high Type 1 wall at about Sta. 527+00,
- RW 526: sound wall on 12-foot-high retaining wall at about Sta. 529+00,
- RW 536: sound wall on 14-foot-high retaining wall at about Sta. 535+35,
- RW 538: sound wall on 8-foot-high retaining wall at about Sta. 541+00, and
- RW 576: 14-foot-high Type 1 wall at about Sta. 575+00.

Global Stability. Stability of fill slopes and global stability for retaining walls was evaluated, under static and pseudo-static conditions, using the computer program PCSTABL (Achilleos, 1988) and SLIDE (RocScience, 2007). Analysis indicates that the above fill embankments meet the required minimum factor of safety of 1.5 for static design. For global slope stability under the pseudo-static condition, a seismic coefficient of 0.2 was used in the analysis. Results of the analysis indicate that the factor-of-safety for the pseudo-static condition is greater than 1.1, which meets the minimum required by Caltrans.

Surficial Stability. Surficial stability of fill slopes was evaluated using the infinite slope method for those side slopes steeper than 4H:1V. The soils expected to be exposed in the fills are assumed to have a friction angle of 32° and minimum cohesion of 200 psf. Based on our analysis, proposed 2H:1V slopes or flatter are expected to be surficially stable with a factor-of-safety greater than 1.5.

Slope having an inclination of 1.5H:1V or steeper should be paved. Surficial stability is not a design issue for paved slopes since slope surfaces are protected.

8.4 Earth Retaining Structures

In order to add one northbound through lane along SR-57, several retaining walls are proposed along the SR-57 mainline, and the on- and off-ramps. Design recommendations for these walls are provided in a separate foundation report (EMI, 2009j).

8.5 Culvert Foundations

Due to proposed realignment of the Orangethorpe Avenue Off-Ramp (Station 63+50, T-Line), the existing RCB culvert at Carbon Creek Channel is required to be extended. This extended RCB culvert will replace a portion of concrete open channel. The existing RCB culvert is to remain in place and a new inlet headwall for the new culvert will be constructed. The RCB extension and headwalls do not require any special foundations or foundation treatment. Other existing culverts, that will be extended, are less than 3 feet size and also do not require special foundations and foundation treatment.

8.6 Other

Soil Corrosivity. Thirty-five (35) soil samples were tested to determine minimum resistivity, pH, soluble sulfate content, and soluble chloride content using procedures described in California Test Methods 417, 532, and 643. Minimum resistivities ranged from 490 to 2,000 ohm-cm. The pH ranged from 7.29 to 8.64. The soluble sulfate ranged from 50 to 1,000 parts per million (ppm), and the soluble chloride ranged from 123 to 416 ppm.

According to Caltrans criteria (Corrosion Guidelines, 2003), soils are corrosive if the pH is 5.5 or less, or chloride concentration is 500 parts per million (ppm) or greater, or sulfate concentration is 2,000 ppm or greater. Based on the test results, the on-site soils are very low-corrosive.

9.0 MATERIAL SOURCES

The Materials Report (EMI, 2009a) provides a list of potential commercial suppliers for sand, gravel, aggregate base, and concrete. Pulverizing existing pavement, during construction, might be performed. Pulverized AC material (or Reclaimed Asphalt Pavement – RAP) can be used as aggregate base (AB) provied the material meets the quality requirements of AB specified in Section 26 "Aggregate Bases" of the Caltrans Standard Specifications (2006c). Pulverized AC material may also be used within Aggregated Subbase (AS), if it meets the requirements of Section 25 "Aggregate Subbases" of the Caltrans Standard Specifications (2006c). Pulverized AC material may also be used within certain Hot Mix Asphalt (HMA) mixes, such as HMA Type

A, if pulverized AC material and its processing complies with Standard Special Provision (SSP) # S1-020H.

10.0 MATERIAL DISPOSAL

Based on information provided by the civil designer, the project requires import material to achieve proposed grades. Therefore, no material or only minor amounts of on-site materials are anticipated to require disposal.

11.0 CONSTRUCTION CONSIDERATIONS

11.1 Construction Advisories

All work should be performed in accordance with the Caltrans Standard Specifications (2006c) except as indicated in the Special Provisions prepared for the project improvements.

11.2 Construction Considerations that Influence Design

No construction considerations influenced the analysis or design of proposed improvements described in this report.

11.3 Construction Considerations that Influence Specifications

Special Provisions that are influenced by geotechnical factors include shoring requirements, dewatering requirements, and corrosion protection specifications. Temporary construction slopes, bracing, and shoring should be made the contractor's responsibility. Also, specific activities for dewatering including preparing a dewatering plan is the responsibility of the contractor; however, dewatering is not expected to be necessary for the project.

Complete removal of compressible surficial materials including topsoil, loose or soft alluvium, and unsuitable fill is required prior to fill placement. A minimum overexcavation and recompaction of 18 inches is recommended within all areas to receive compacted fill, and the overexcavation depth is measured from the existing grade. The overexcavation should extend horizontally a minimum distance of 18 inches from edges of new fills. In cut areas, the minimum overexcavation and recompaction depth is 12 inches if the difference between the finished and existing grade is 2 feet or less, and overexcavation is not required if the difference between the finished and existing grade is greater than 2 feet. In cut areas, the overexcavation depth is measured from the finished grade. Unless specified on the contract plans or specifications, the excavated soils (in both fill and cut areas) may be reused as compacted fill.

Overexcavations should be performed beneath all new embankments and structures. Bottoms of overexcavations should be firm and unyielding prior to placing compacted fill. Remedial excavations, in areas where new pavement is proposed and below retaining wall footings, are addressed in the Materials report (EMI, 2009a) and Wall Foundation report (EMI, 2009j), respectively.

11.4 Construction Monitoring and Instrumentation

Qualified geotechnical personnel should perform inspections and materials testing during the following stages of construction:

- Grading operations, including excavations and placement of compacted fill.
- Excavations for spread footings and Cast-in-Drilled-Hole (CIDH) piles.
- Excavations for drainage structures and utility trenches.
- Removal or support of buried structures or utilities.
- Shoring installation, if necessary.
- When any unusual conditions are encountered.

Temporary backcuts and shoring, if used during earthwork or construction, should be monitored by the contractor and qualified geotechnical personnel.

11.5 Hazardous Waste Considerations

Evaluating the presence and concentration of hazardous contaminants is beyond EMI's scope of work and therefore is not addressed herein. EMI has assumed that no hazardous or contaminated materials exist within the project area; therefore, no hazardous waste considerations are provided. If for any reason hazardous or toxic materials are believed to exist within the project area, an environmental consultant should be retained.

A separate report prepared by EMI (2009j) presents the results of an Aerially-Deposited Lead (ADL) testing investigation for the project. ADL testing was performed in general accordance with Caltrans procedures.

11.6 Differing Site Conditions

The analyses and recommendations contained in this report are based on the data obtained from the review of available geologic references, our site reconnaissance, soil borings, and laboratory testing. The soil boring and CPT logs indicate subsurface conditions only at specific locations and times drilled, and only to the depths penetrated. Boring and CPT logs do not necessarily reflect subsurface variations that may exist between such locations. If variations in subsurface conditions from those described in this report are noted during construction, the recommendations presented in this report must be re-evaluated. In the event that any changes in the nature, design, or location of the proposed facilities occur, the conclusions and recommendations in this report should not be considered valid unless the changes are reviewed and conclusions of this report are verified in writing by the designer. Therefore, upon encountering any site conditions that are perceived to differ materially from those conditions anticipated in this report, the resident engineer should contact the geotechnical designer immediately.

12.0 RECOMMENDATIONS AND SPECIFICATIONS

Below are recommendations for the proposed improvements. If designers have questions or disagree with the recommendations, or, if variations in subsurface conditions from those described herein are observed during construction, the geotechnical designer should be contacted to verify the applicability of the recommendations. Recommendations in this report may require modification based on actual subsurface conditions encountered during construction.

- Minor to significant amounts of earthwork, depending on the area of improvement, are expected. In areas where compacted fill will be placed, complete removal of compressible surficial materials including topsoil, loose or soft alluvium or fill soil, dry or saturated soil, or otherwise unsuitable material is required prior to fill placement. A minimum overexcavation and recompaction of 18 inches is recommended within all areas to receive compacted fill, and the overexcavation depth is measured from the existing grade. The overexcavation should extend horizontally a minimum distance of 18 inches from edges of new fills. In cut areas, the minimum overexcavation and recompaction depth is 12 inches if the difference between the finished and existing grade is 2 feet or less, and overexcavation is not required if the difference between the finished and existing grade is greater than 2 feet. In cut areas, the overexcavation depth is measured from the finished grade. Unless specified on the contract plans or specifications, the excavated soils (in both fill and cut areas) may be reused as compacted fill.

  Actual depths and extent of remedial removals should be determined in the field by qualified geotechnical personnel during earthwork activities. Remedial excavations, in areas where new pavement is proposed and below retaining wall footings, are addressed in the Materials report (EMI, 2009a) and Wall Foundation report (EMI, 2009j), respectively.

- All overexcavations should be observed by qualified geotechnical personnel to verify that firm and unyielding bottoms are exposed. Overexcavated areas should be cleaned of loose soils and debris and should be observed to be firm and unyielding before receiving fill.

- Fills placed against sloping ground shall be keyed and benched into the sloping ground and placed as specified in Section 19-6 of the Caltrans Standard Specifications (Caltrans, 2006d).

- In areas where embankments or earth surcharge is placed (to accelerate settlement), settlement monitoring should be conducted to determine actual settlement magnitudes and consolidation time rates. Structural improvements, such as RCB and RCP culverts and any above-ground structures, should not be constructed until it has been determined that the remaining settlement is tolerable to the proposed structure. Care should be taken in the field to survey and protect the settlement monuments. Settlement measurements can be recorded daily or weekly and the measurements should be provided to the resident engineer or qualified geotechnical personnel for review prior to the construction of structural improvements.

- On-site soils are expected to have an expansion potential varying from very low to highly expansive. It appears that most existing fill soils in the south portion of the project (south of the Placentia Overhead) are sandy soils that have a either very low or low expansion potential, whereas, in the north portion of the project soils used for the fill possess medium expansion potential with some soils having high expansion potential. On-site native soil and existing fill material within the project area are considered suitable for use as compacted fill for slopes.

However, fine-grained native soils that are expansive should not be placed behind retaining walls. Additional laboratory tests may be required during earthwork operations to verify the expansion potential of soils used in specific areas.

- Therefore, to mitigate possible uneven upward movement of the buried drainage devices, we recommend surrounding the bottom of these drainage lines using Sand Bedding. The Sand Bedding cradling the invert of these drainage devices will reduce the uplift forces (if any) acting on the drainage devices, thus minimizing the potential of excessive vertical displacements. Limits and configurations of the Sand Bedding should conform to Caltrans Standard Plan Sheet A62D (2006). Material properties of the Sand Bedding should conform to Caltrans Standard Specifications, Section 19-3.025B (2006).

- In general, the erosion potential at this site is expected to be minor considering the provisions for site drainage, slope planting and other measures required by Caltrans. In order to minimize potential erosion, all finish slopes should be planted as soon as practical after grading. Local areas may require additional measures at the discretion of the geotechnical personnel present on-site during construction.

- Design of temporary construction slopes and shoring is the contractor's responsibility during construction.

- It shall be made the contractor's responsibility to control subsurface and surface water. The contractor should dewater the site as necessary, if groundwater is encountered. Water should not be allowed to stand in any excavations. If excavations become flooded, at least the bottom 8 inches of soil should be removed and replaced, and re-compacted to a minimum 95 percent relative compaction. Additional removals may be required at the discretion of the resident engineer or geotechnical personnel.

13.0 LIMITATIONS

This report is intended for use by RBF Consulting, the Orange County Transportation Authority, and the California Department of Transportation for the SR-57 Northbound Improvement Project. This report is based on the project as described herein and the information obtained from the exploratory borings and CPT's at the approximate locations shown on the attached plans. Findings and recommendations contained in this report are based on results of the field investigation, laboratory tests, and engineering analyses. In addition, soils and subsurface conditions encountered in the exploratory borings and CPT's are presumed to be representative of the project site; however, subsurface conditions and characteristics of soils at locations between exploratory borings can vary. Findings reflect an interpretation of the direct evidence obtained. Recommendations presented herein are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Modifications to the project plans or variations in subsurface conditions may require re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained herein are applicable to the specific design elements and locations which are the subject of this report. Data, opinions, and recommendations

herein have no applicability to any other design elements or to any other locations, and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

EMI is not responsible for construction means, methods, techniques, sequences, or procedures, or for safety precautions or programs in connection with the construction. EMI is not responsible for the acts or omissions of the Contractor, or any other person performing any construction, or for the failure of any worker to carry out construction in accordance with the Final construction drawings and specifications.

Services performed by EMI were conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

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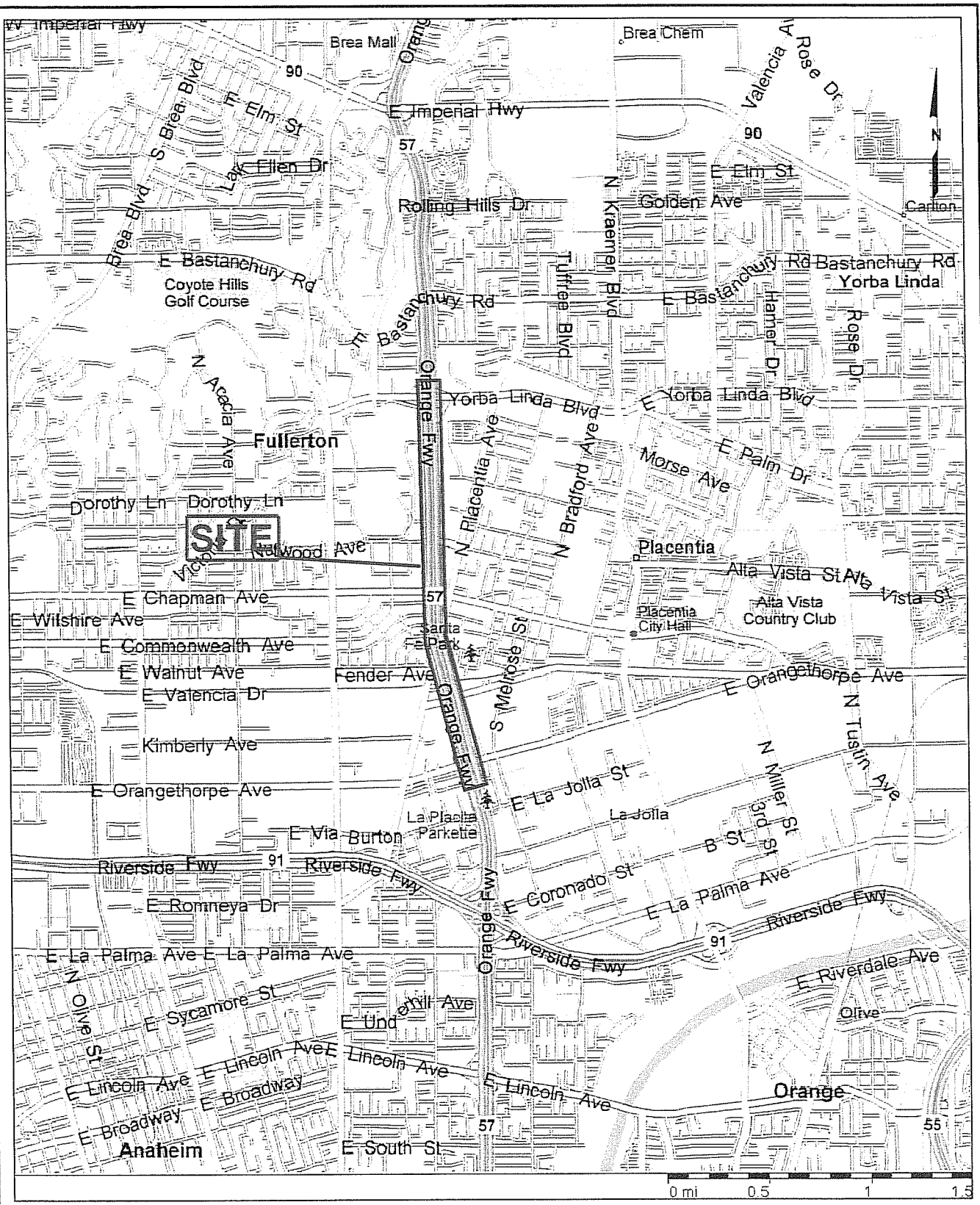


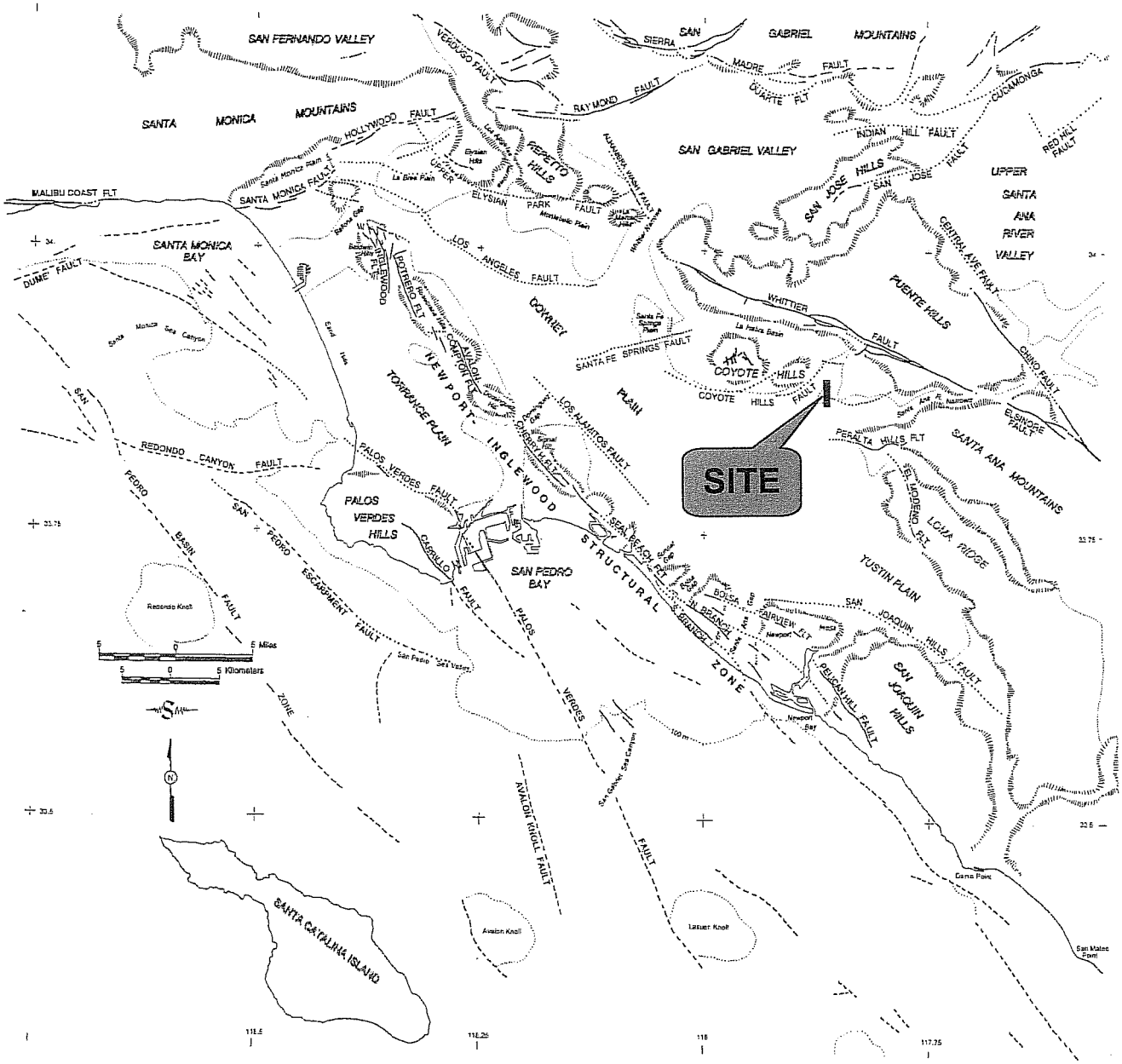
Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SITE LOCATION MAP

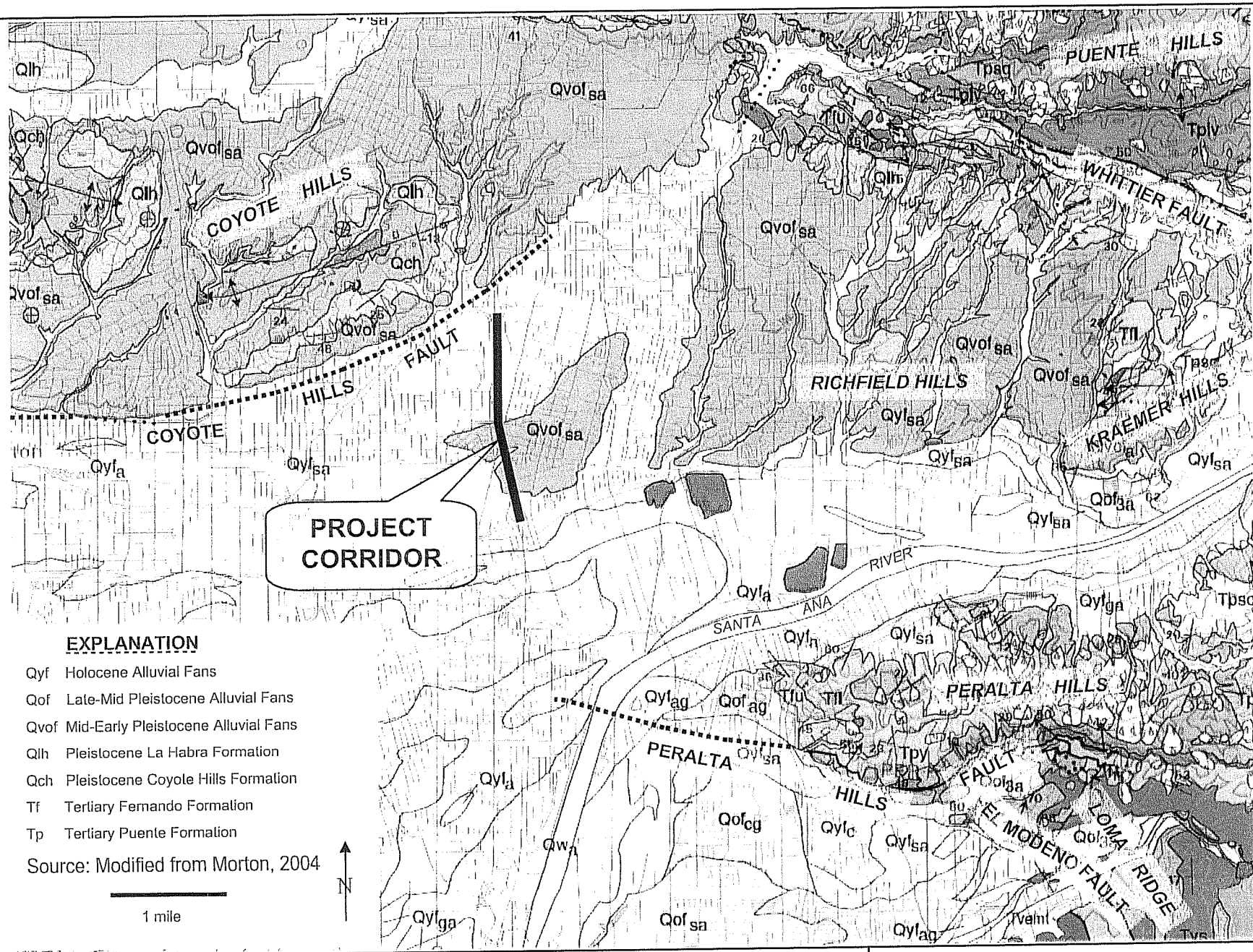
Figure 1

SR-57 Northbound Improvement Project

Project No. 08-115 | Date: 12-24-08



SR-57 Northbound Improvement Project	**REGIONAL FAULT AND PHYSIOGRAPHIC MAP**
Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	Figure 2
	Project No. 08-115 | Date: 12-30-08



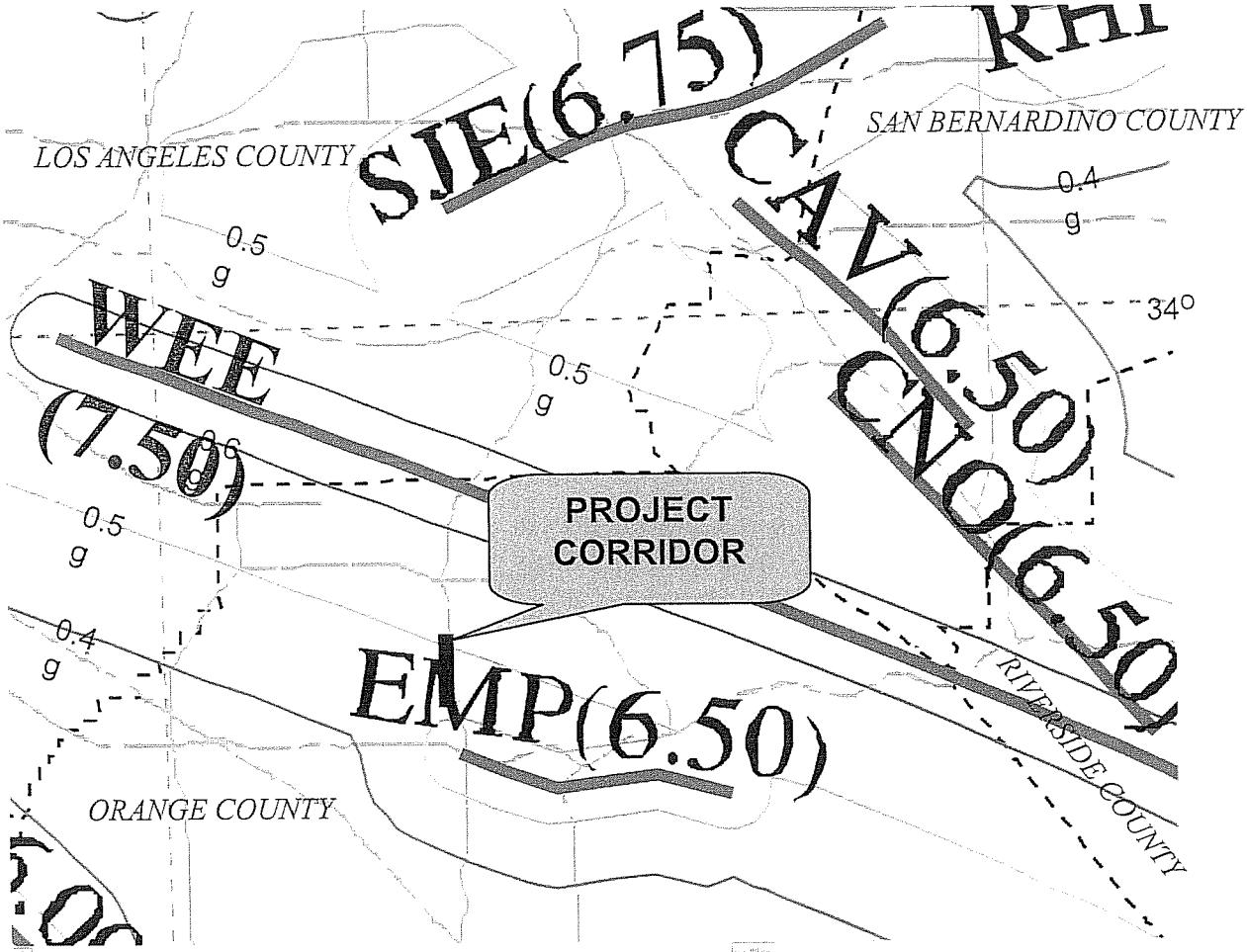
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

SR-57 Northbound Improvement Project

Project No. 08-115 | Date: 12-30-08

GEOLOGICAL MAP

Figure 3



FAULT NAMES

CAV CENTRAL AVENUE

CNO CHINO

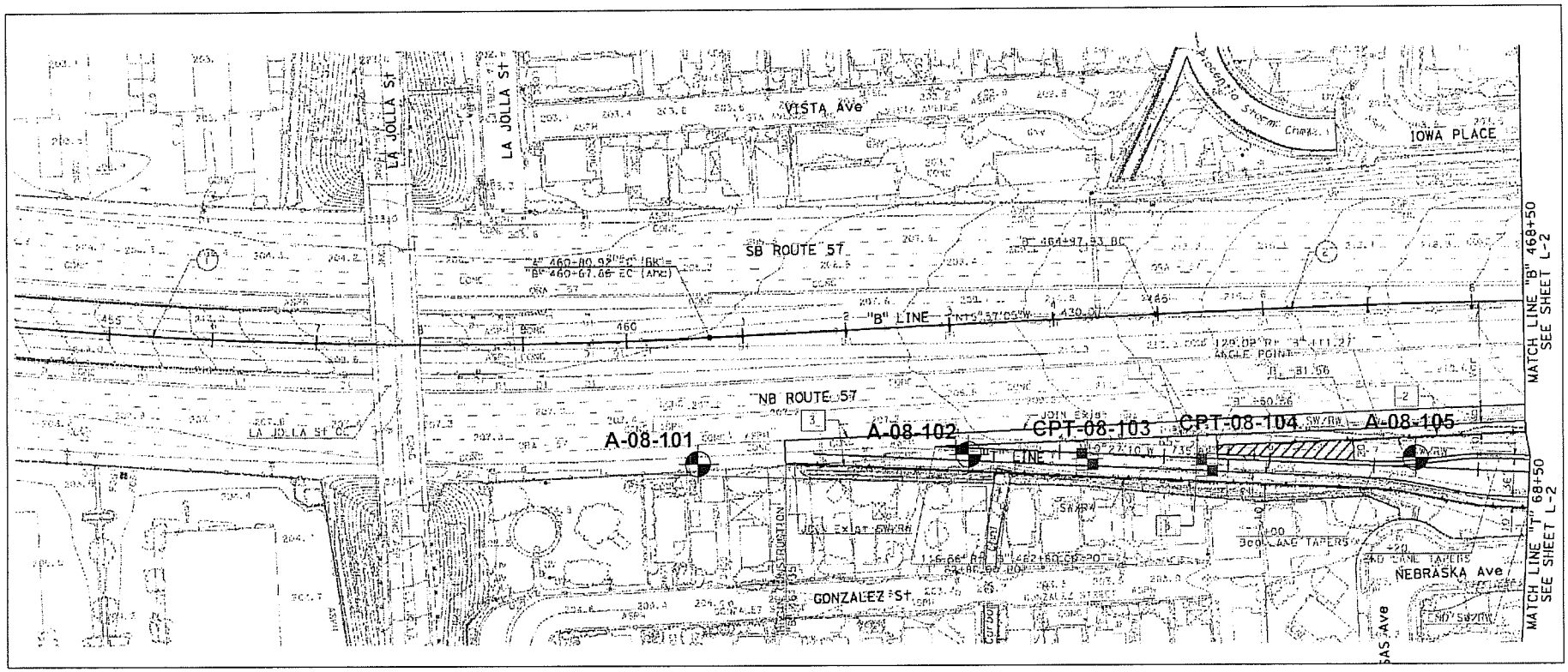
EMP EL MODENO-PERALTA HILLS

SJE SAN JOSE

WEE WHITTIER-ELSINORE

Modified From Mualchin, 1996

SR-57 Northbound Improvement Project	GROUND MOTION CONTOUR MAP
Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	Figure 4
Project No. 08-115	Date: 12-30-08

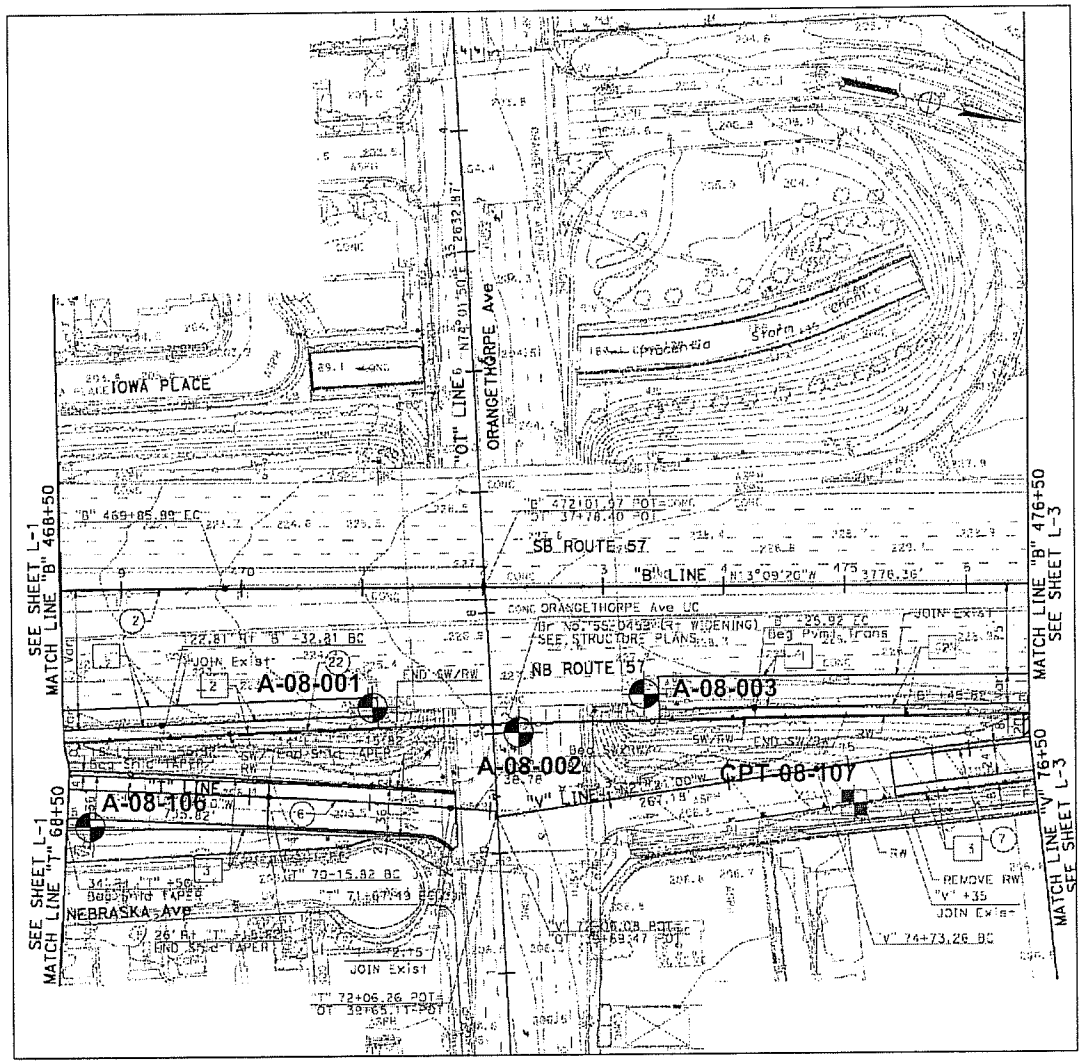


Hollow-Stem Auger Boring

Cone Penetrometer Test

0' 100' 200'

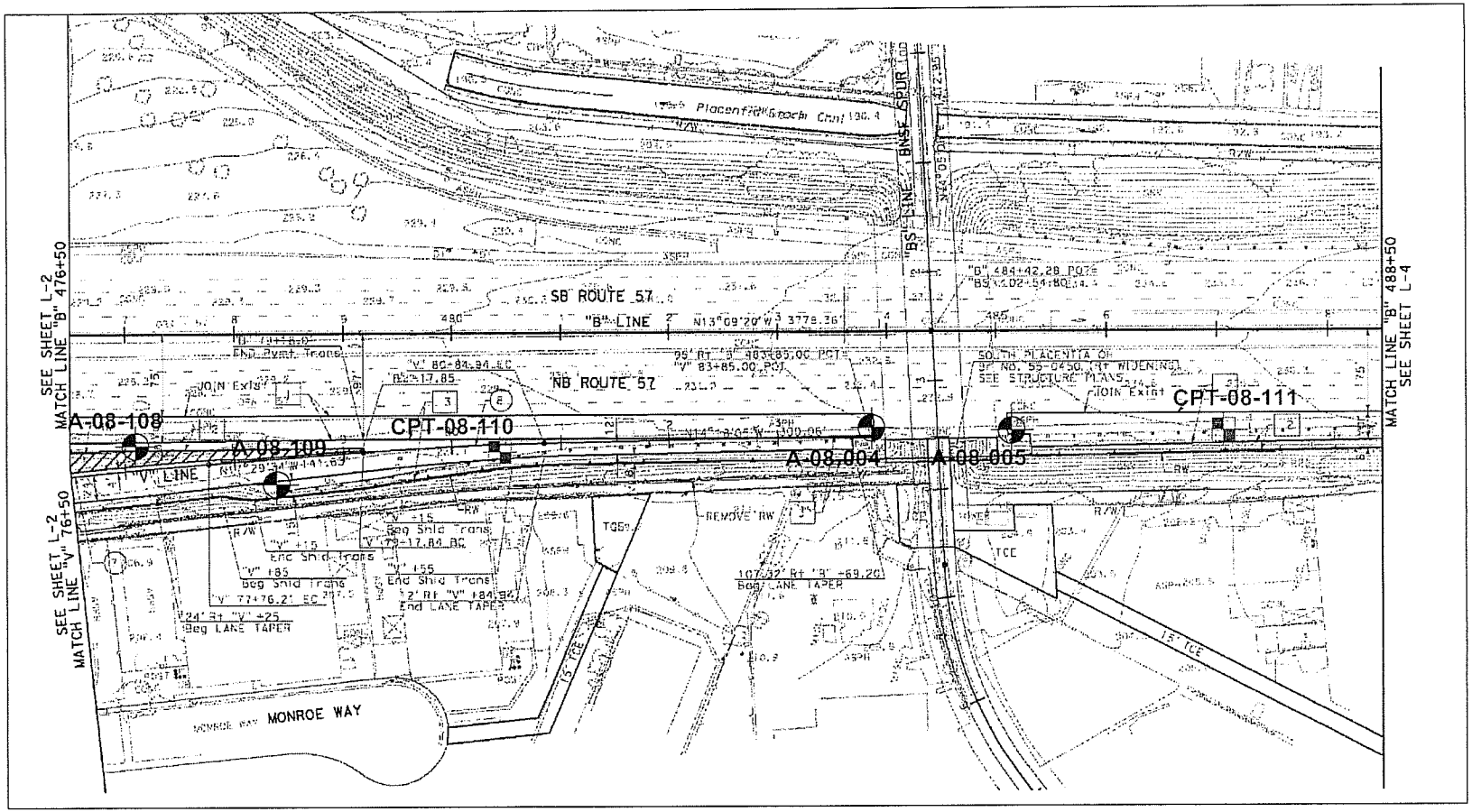
Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan Sheet 1 of 12
	EMI Project No.: 08-115	Date: 06-09-09	Figure 5



Hollow-Stem Auger Boring

Cone Penetrometer Test

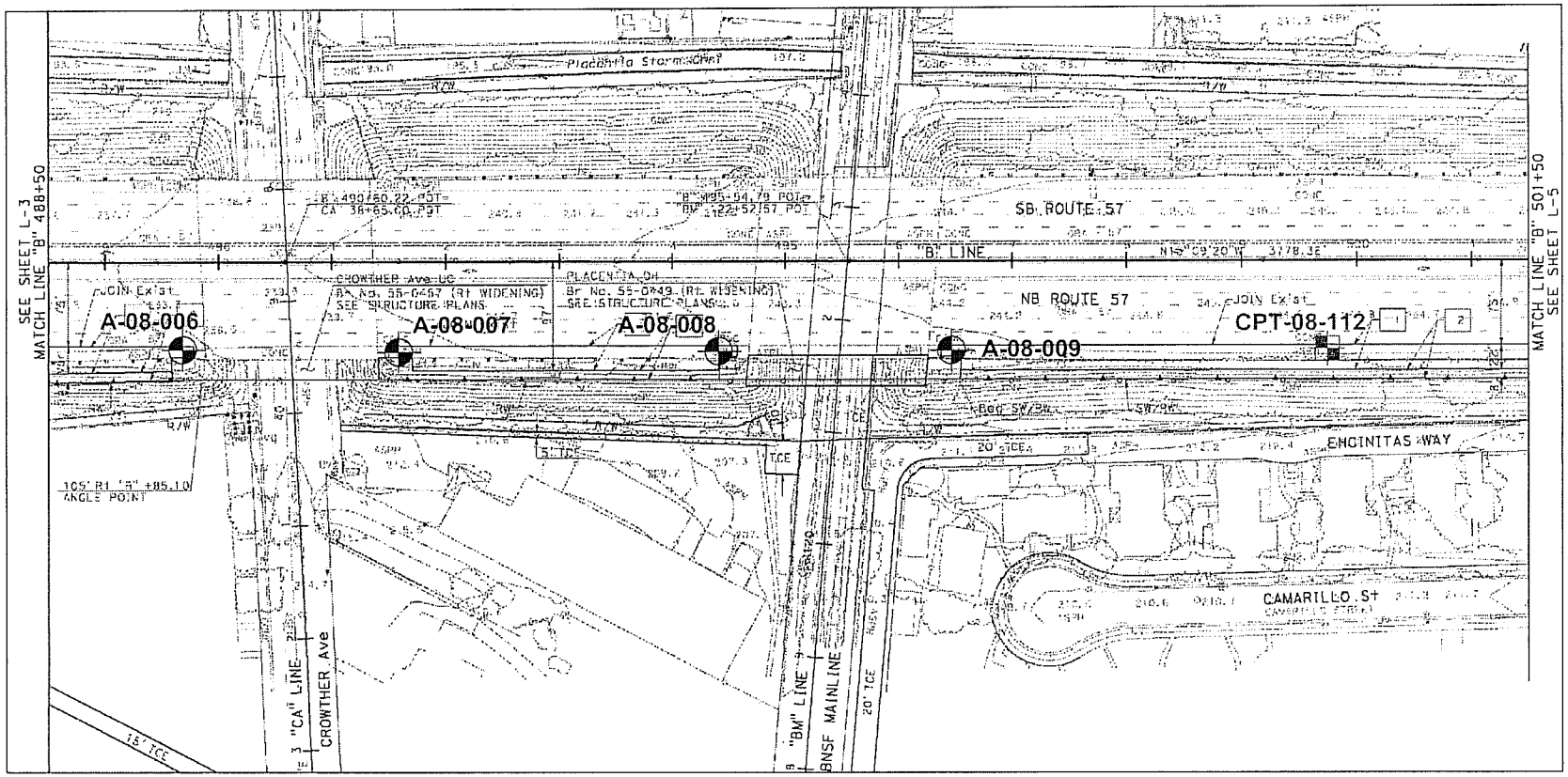
Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan Sheet 2 of 12
	EMI Project No.: 08-115	Date: 06-09-09	Figure 6



Hollow-Stem Auger Boring

Cone Penetrometer Test

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan Sheet 3 of 12
	EMI Project No.: 08-115	Date: 06-09-09	Figure 7

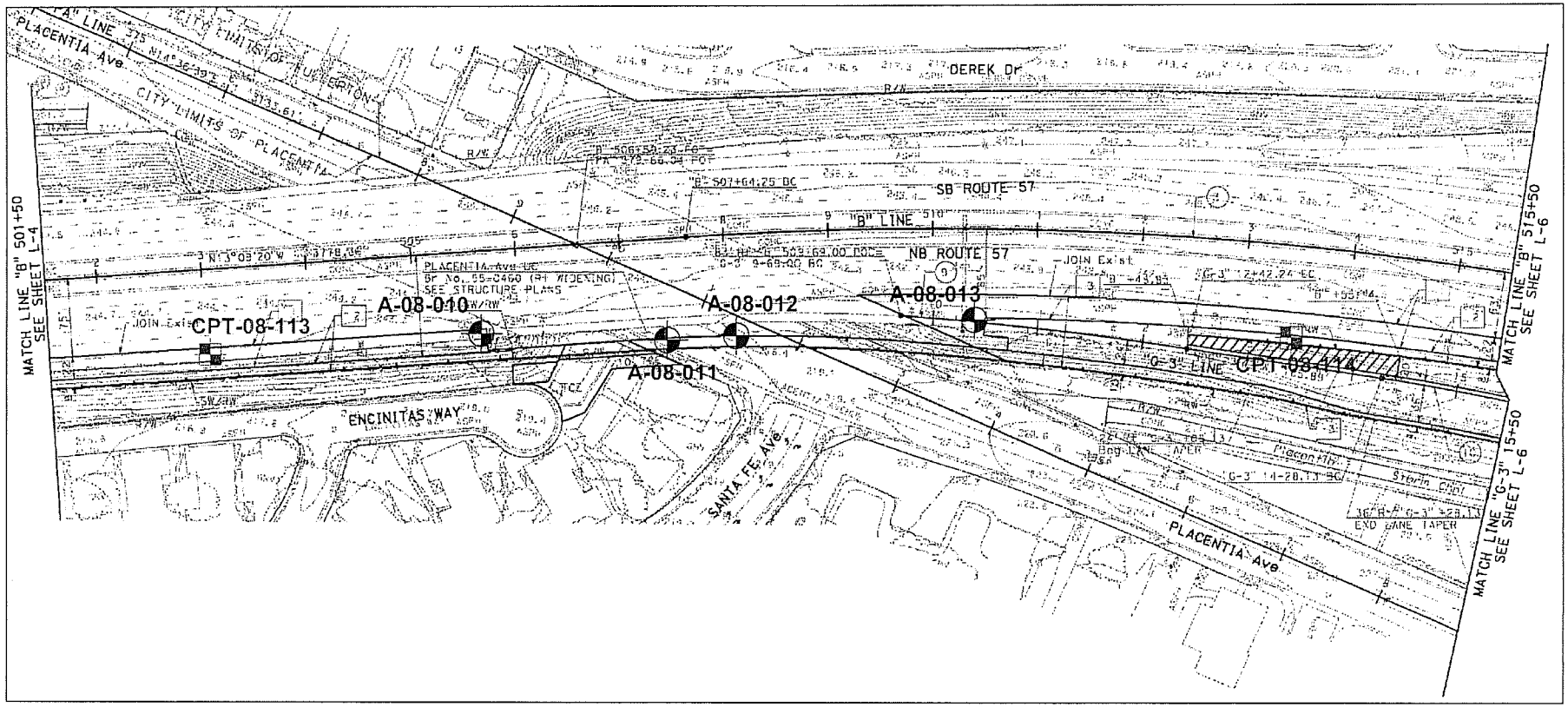


Hollow-Stem Auger Boring

Cone Penetrometer Test

0' 100' 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project	Boring Location Plan	
	EMI Project No.: 08-115 Date: 06-09-09	Sheet 4 of 12	Figure 8

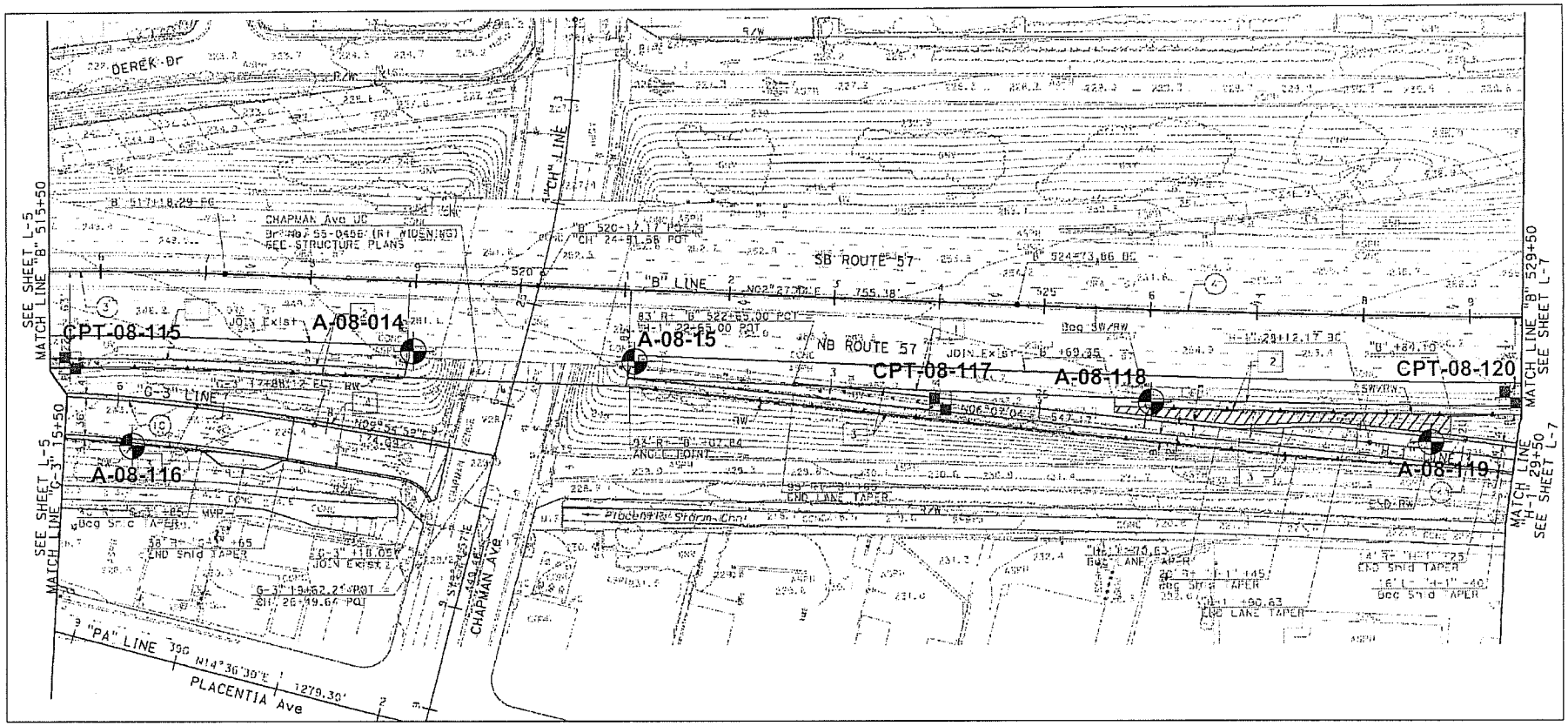


Hollow-Stem Auger Boring

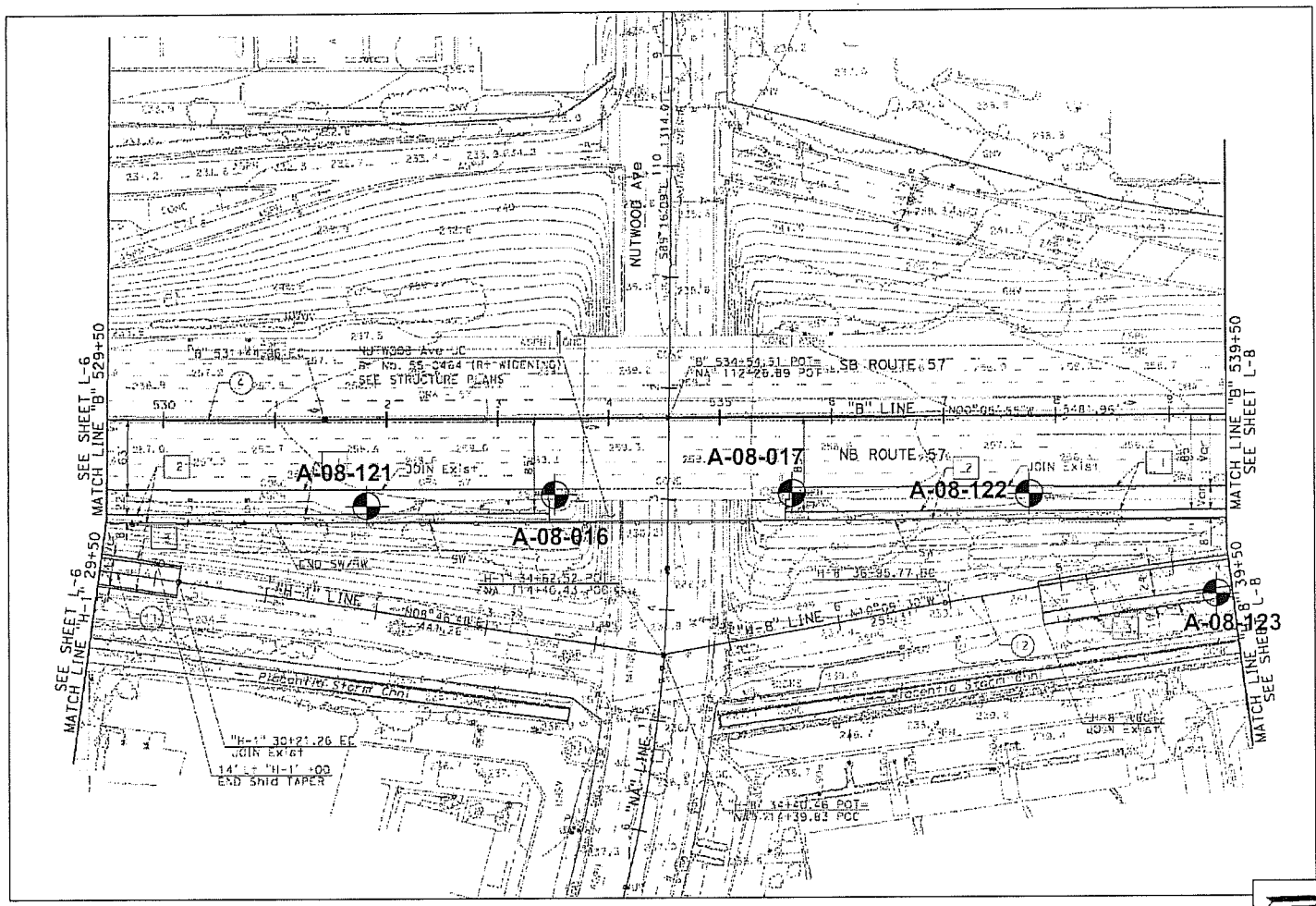
Cone Penetrometer Test

0' 100' 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	**SR-57 Northbound Improvement Project**	**Boring Location Plan**	
	EMI Project No.: 08-115 Date: 06-09-09	**Sheet 5 of 12**	Figure 9

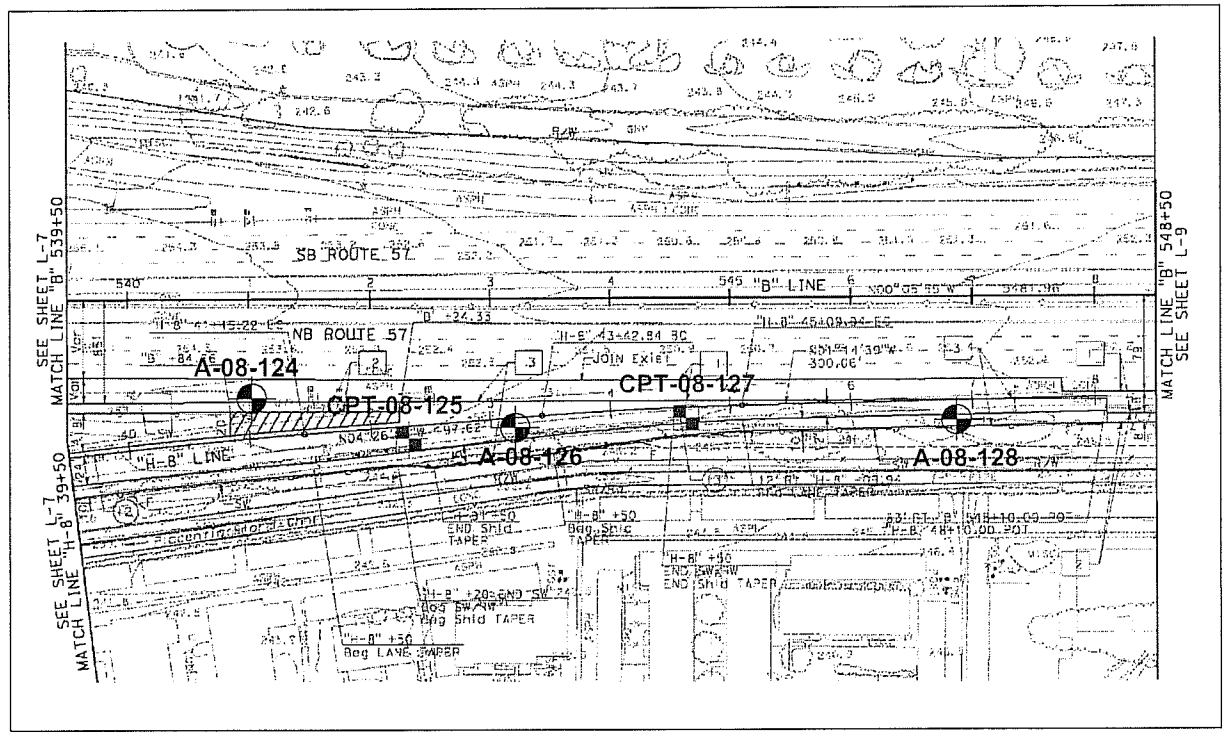


Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan Sheet 6 of 12
	EMI Project No.: 08-115	Date: 06-09-09	Figure 10



Hollow-Stem Auger Boring

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan Sheet 7 of 12
	EMI Project No.: 08-115	Date: 06-09-09	Figure 11

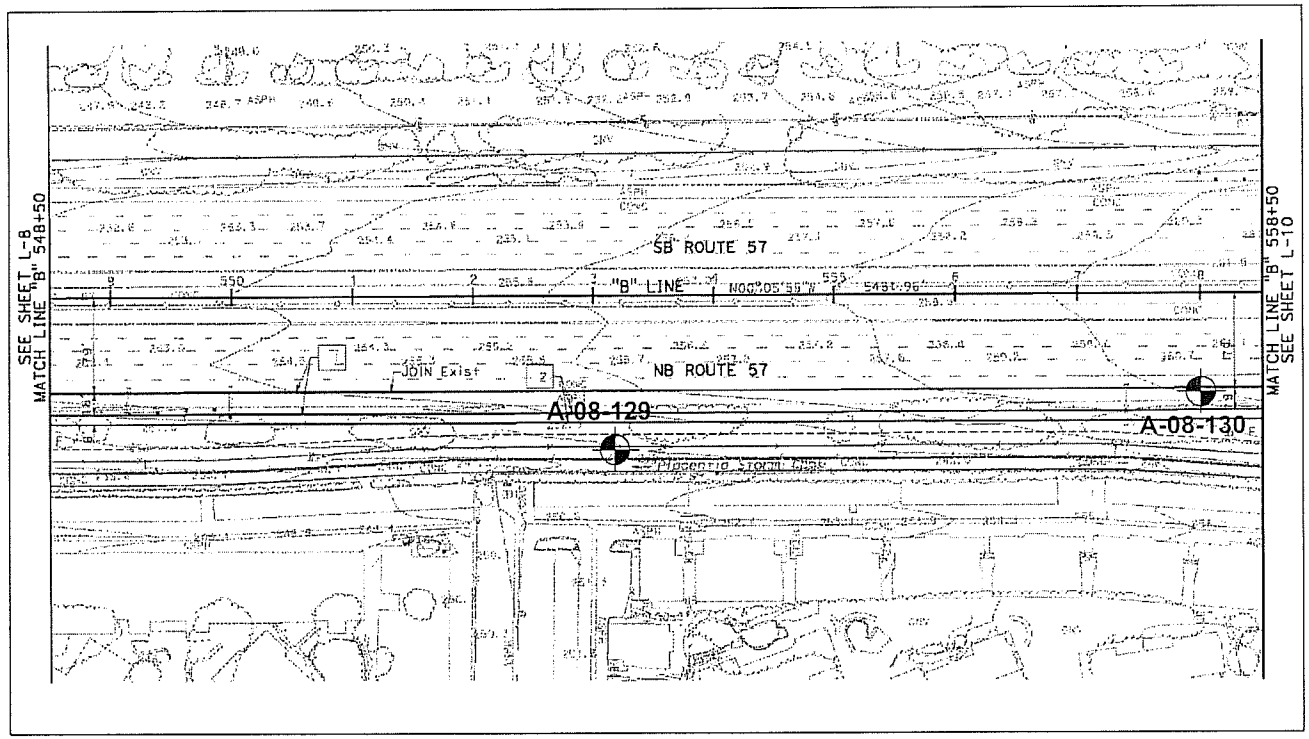


Hollow-Stem Auger Boring

Cone Penetrometer Test

0' 100' 200'

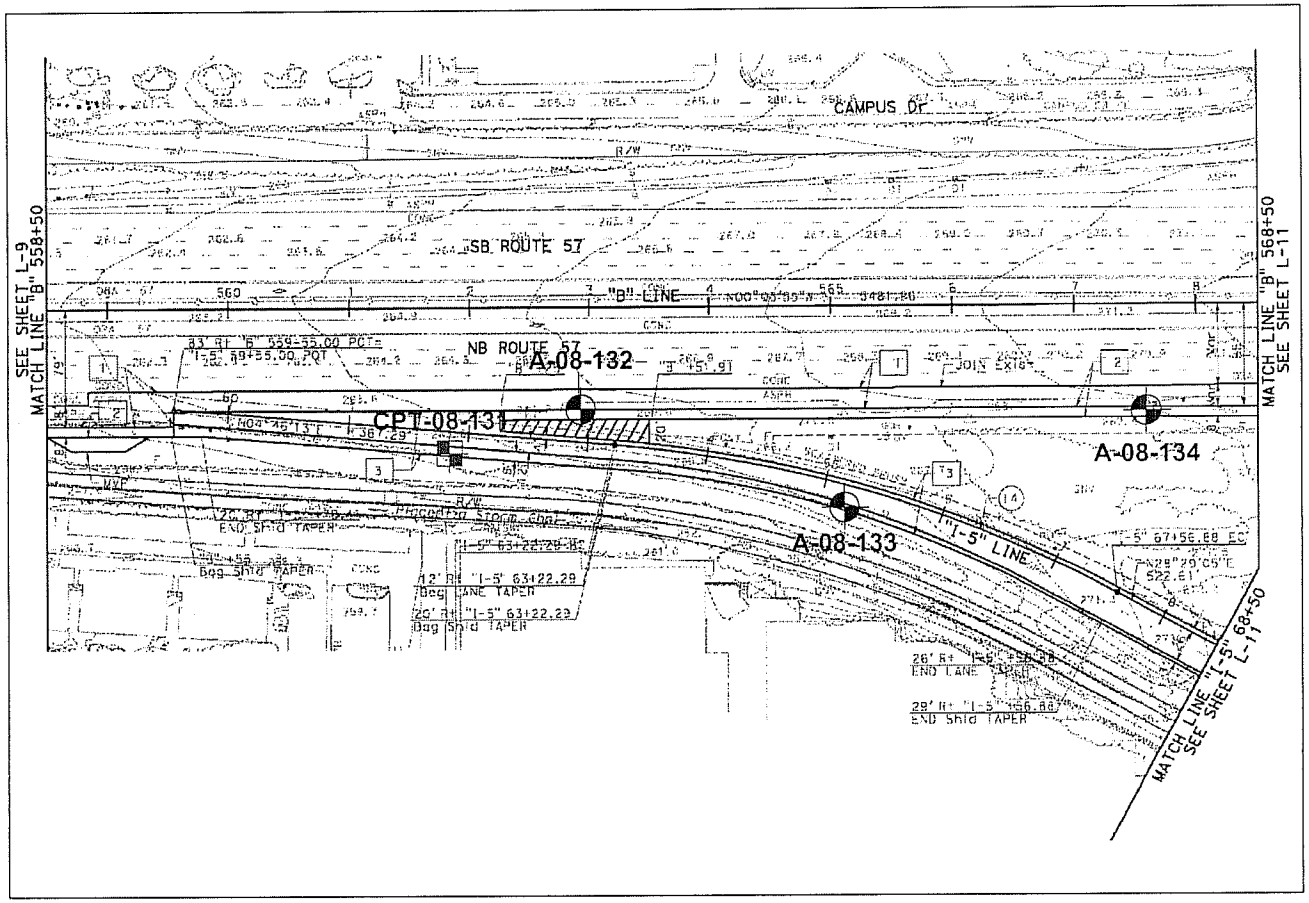
Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan Sheet 8 of 12
	EMI Project No.: 08-115	Date: 06-09-09	Figure 12



Hollow-Stem Auger Boring

0' 100' 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan Sheet 9 of 12
	EMI Project No.: 08-115	Date: 06-09-09	Figure 13

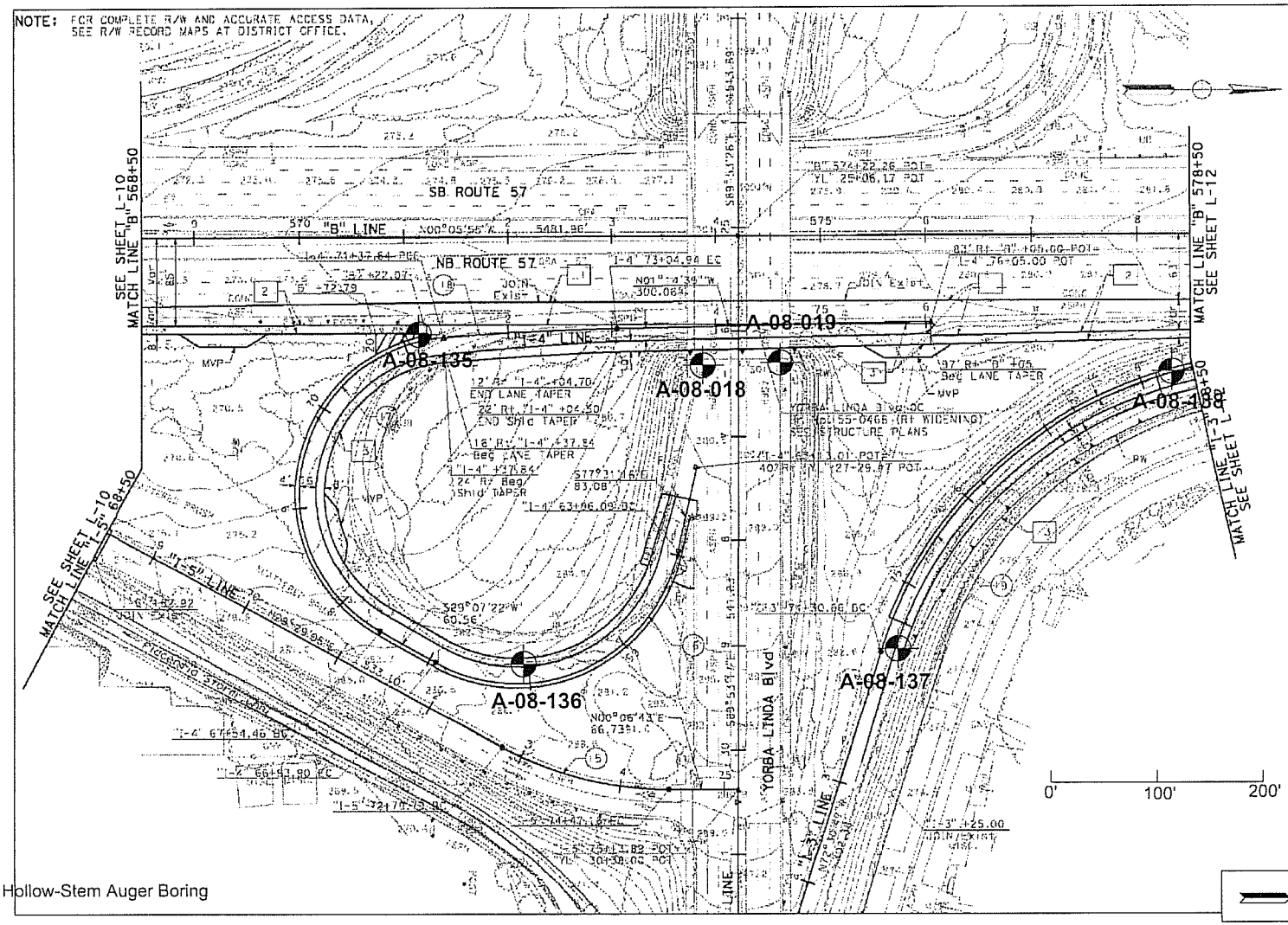


Hollow-Stem Auger Boring

Cone Penetrometer Test

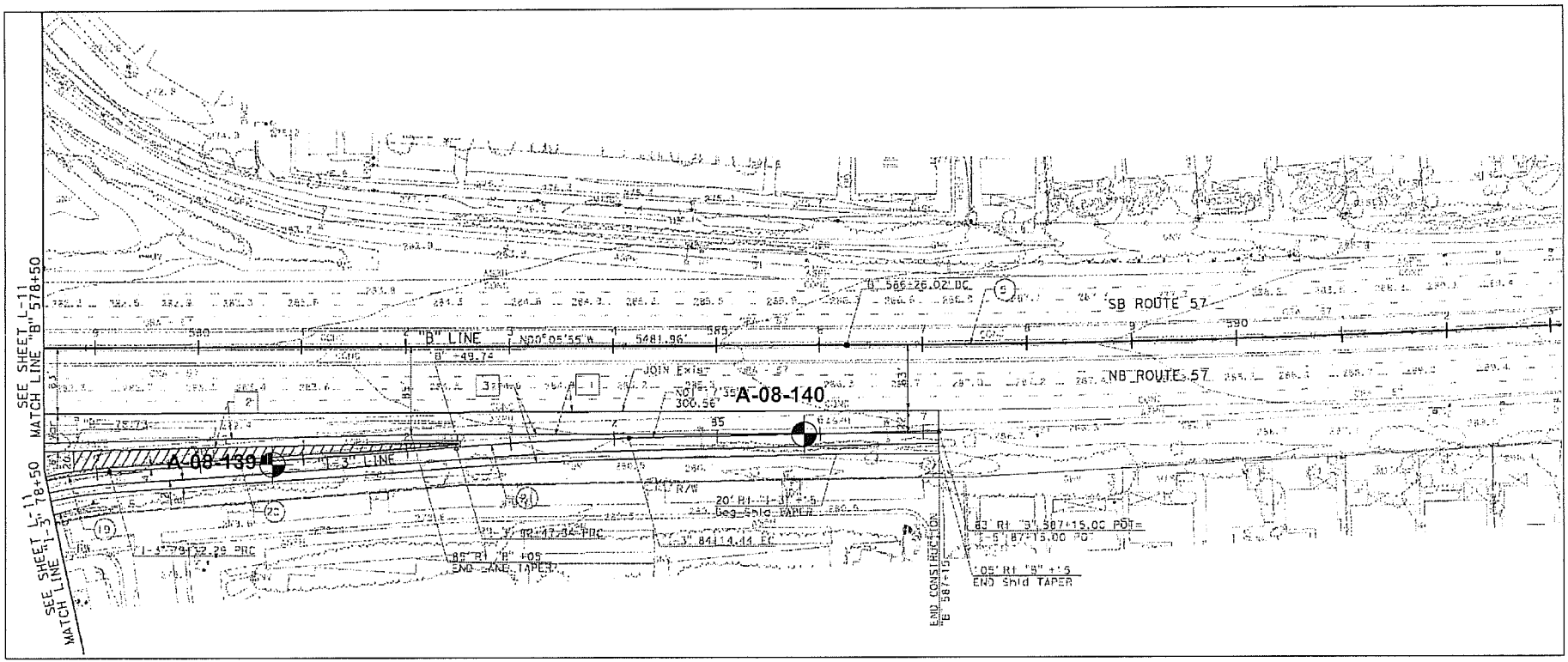
0' 100' 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan Sheet 10 of 12
	EMI Project No.: 08-115	Date: 06-09-09	Figure 14



Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project		Boring Location Plan
	EMI Project No.: 08-115	Date: 06-09-09	Sheet 11 of 12

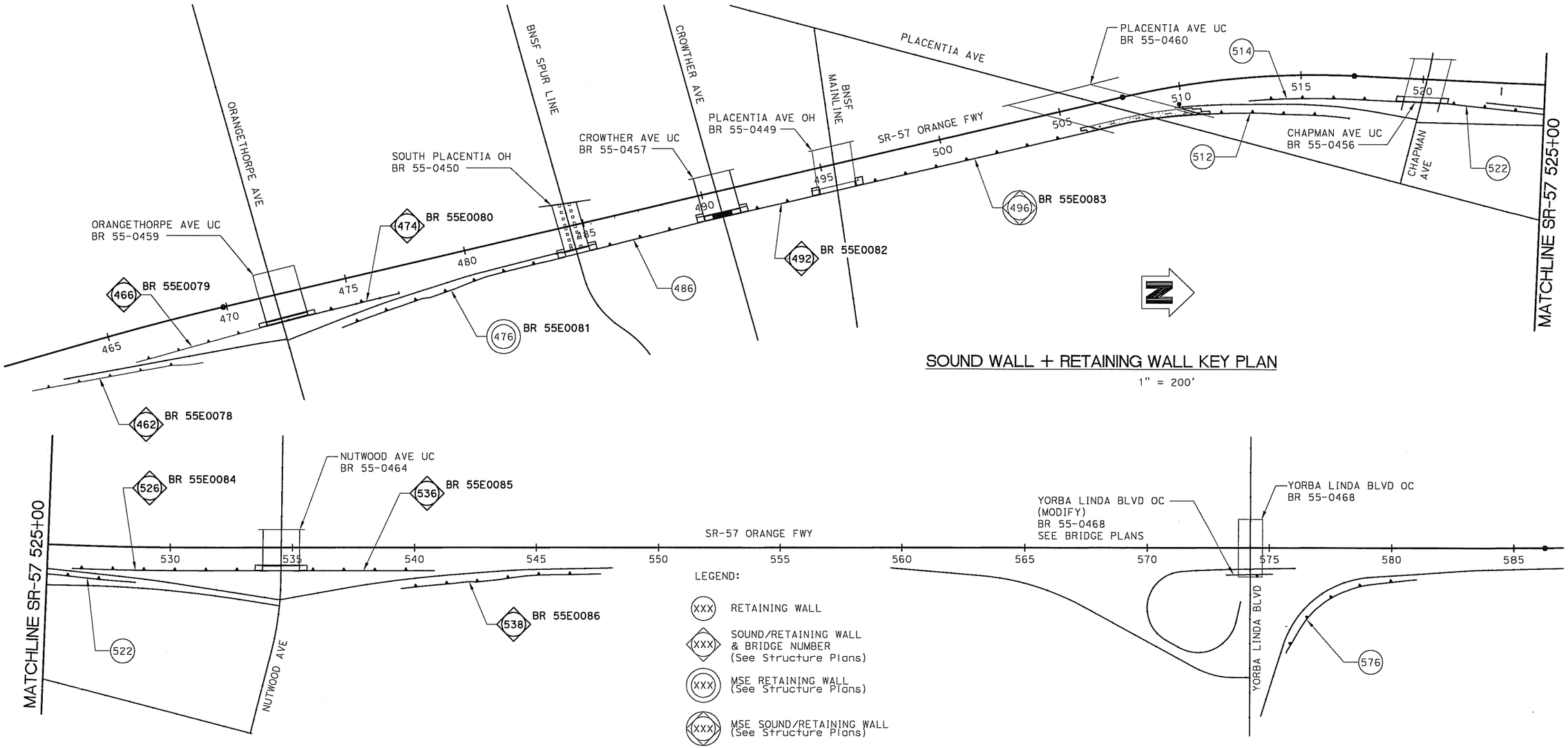
Figure 15



Hollow-Stem Auger Boring

0' 100' 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	**SR-57 Northbound Improvement Project**		**Boring Location Plan** **Sheet 12 of 12**
	EMI Project No.: 08-115	Date: 06-09-09	Figure 16



SOUND WALL + RETAINING WALL KEY PLAN

1" = 200'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	**SR-57 Northbound Improvement Project**		**Sound Wall & Retaining Wall Key Plan**
	EMI Project No.: 08-115	Date: 05-17-2009	**Figure 17**

APPENDIX A

EXPLORATORY BORING LOGS

All the exploratory boring logs in Appendix A are divided into four subsections for different structure types. Appendices A1 thru A3 contain the boring logs for Caltrans Type 1 retaining walls, sound walls on retaining walls, and MSE walls, respectively. Appendix A4 contains logs of borings (mostly 10-foot deep or less) for pavement design.

APPENDIX A1

EXPLORATORY BORING LOGS FOR CALTRANS TYPE 1 WALLS

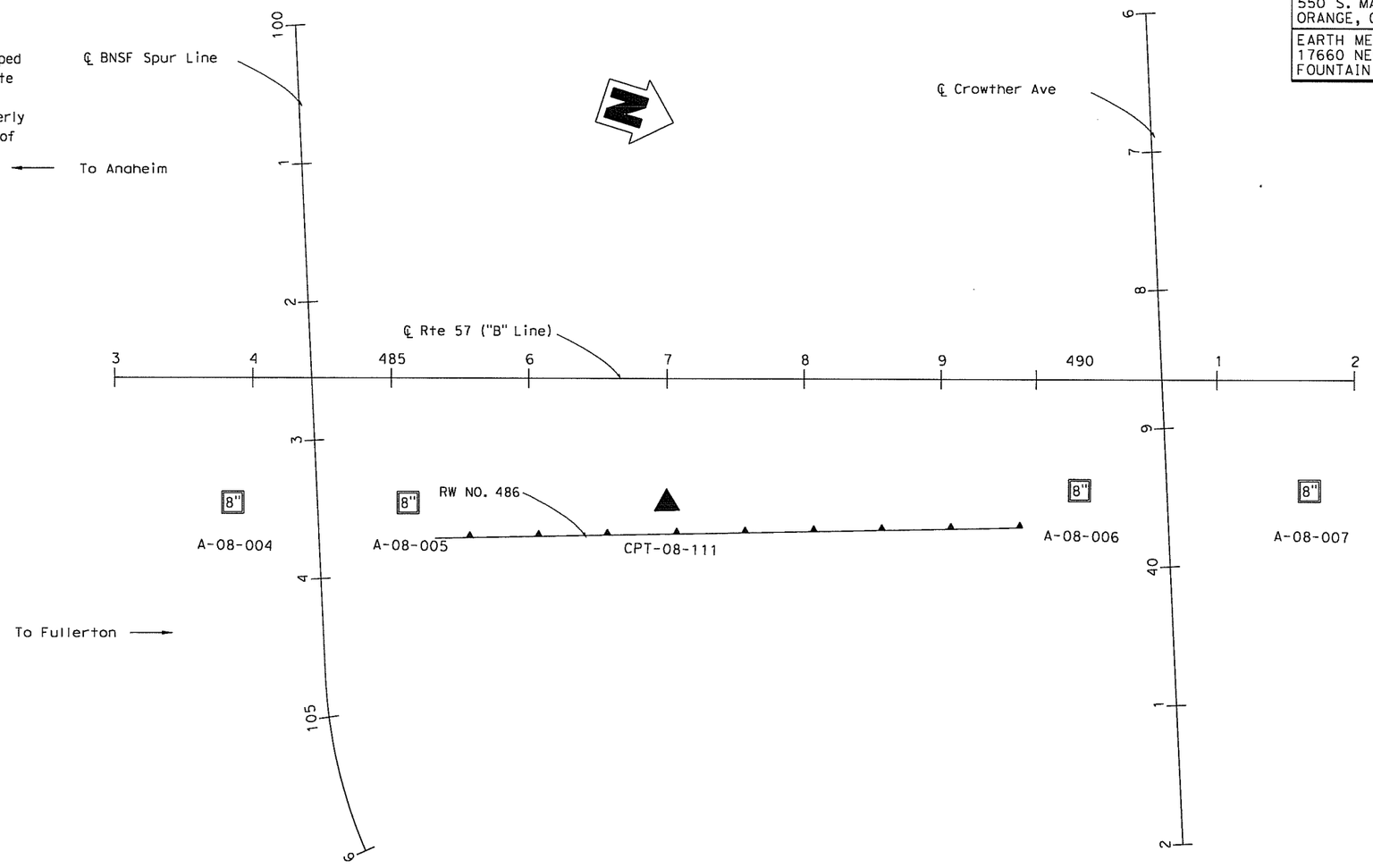
RW 486, RW 512, RW 514, RW 522, and RW 576

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

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17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fong
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.
POST MILES 16.2/18.6

RETAINING WALL NO. 486
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

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12	Ora	57	16.2/18.6		

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17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 486, LOG OF TEST BORINGS NO. 1"

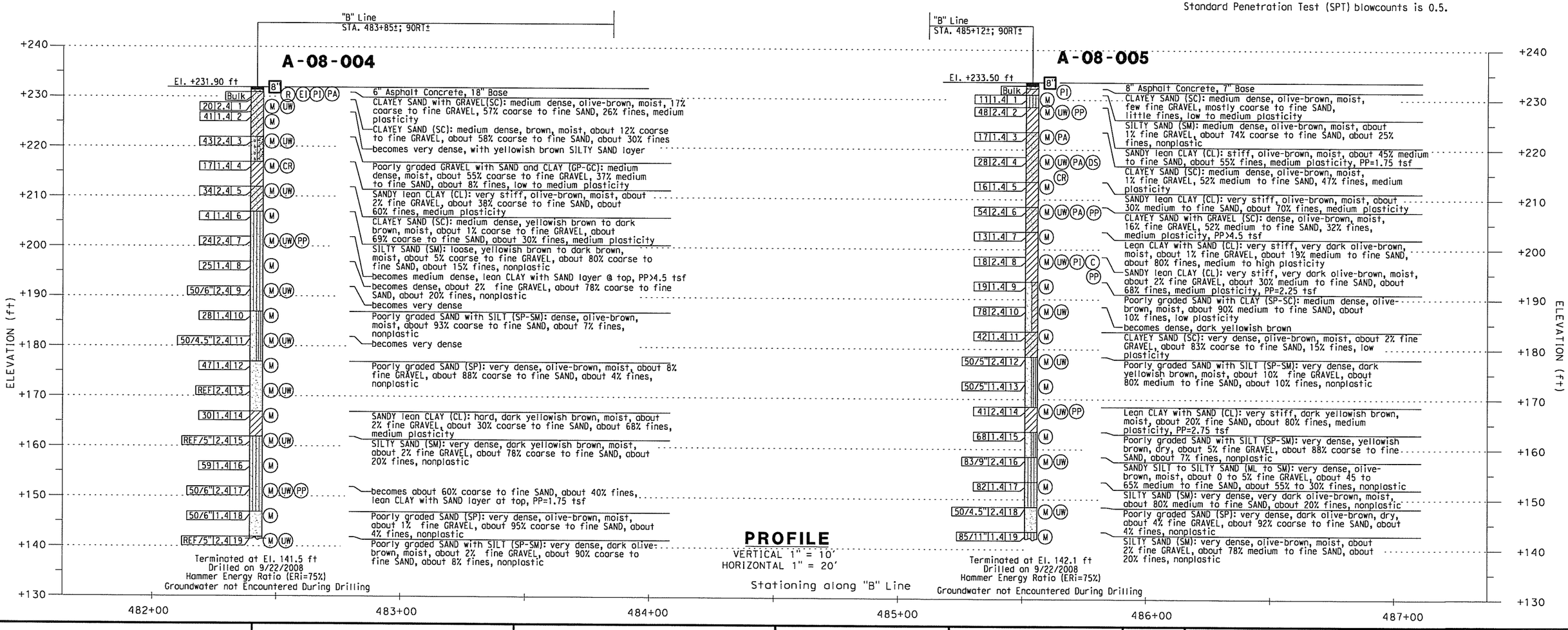
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		BRIDGE NO. / POST MILES 16.2/18.6

RETAINING WALL NO. 486
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

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DATE PLOTTED => $DATE
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12	Ora	57	16.2/18.6		

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No. C 66394
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FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 486, LOG OF TEST BORINGS NO. 1"

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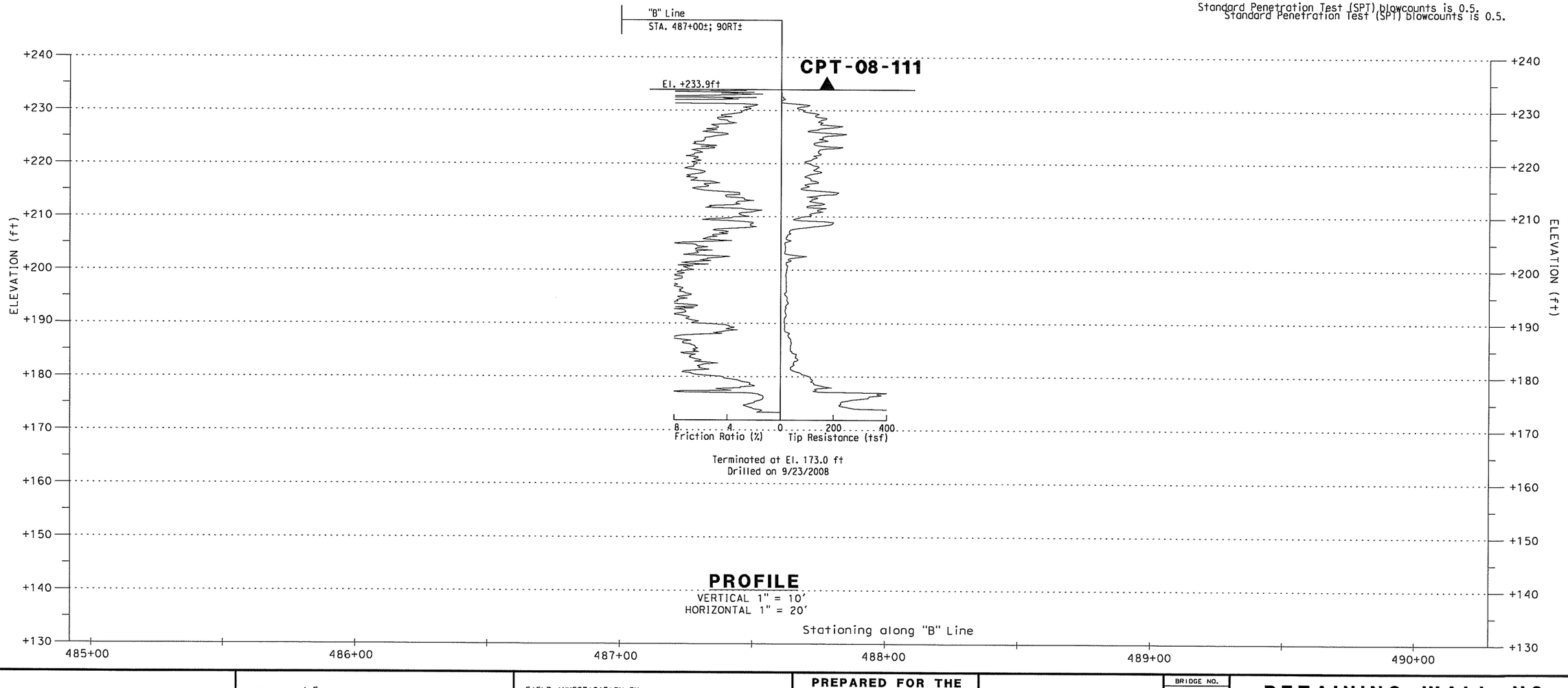
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.
Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.

POST MILES
16.2/18.6

RETAINING WALL NO. 486
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

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FOR PLAN VIEW SEE "RETAINING WALL NO. 486, LOG OF TEST BORINGS NO. 1"

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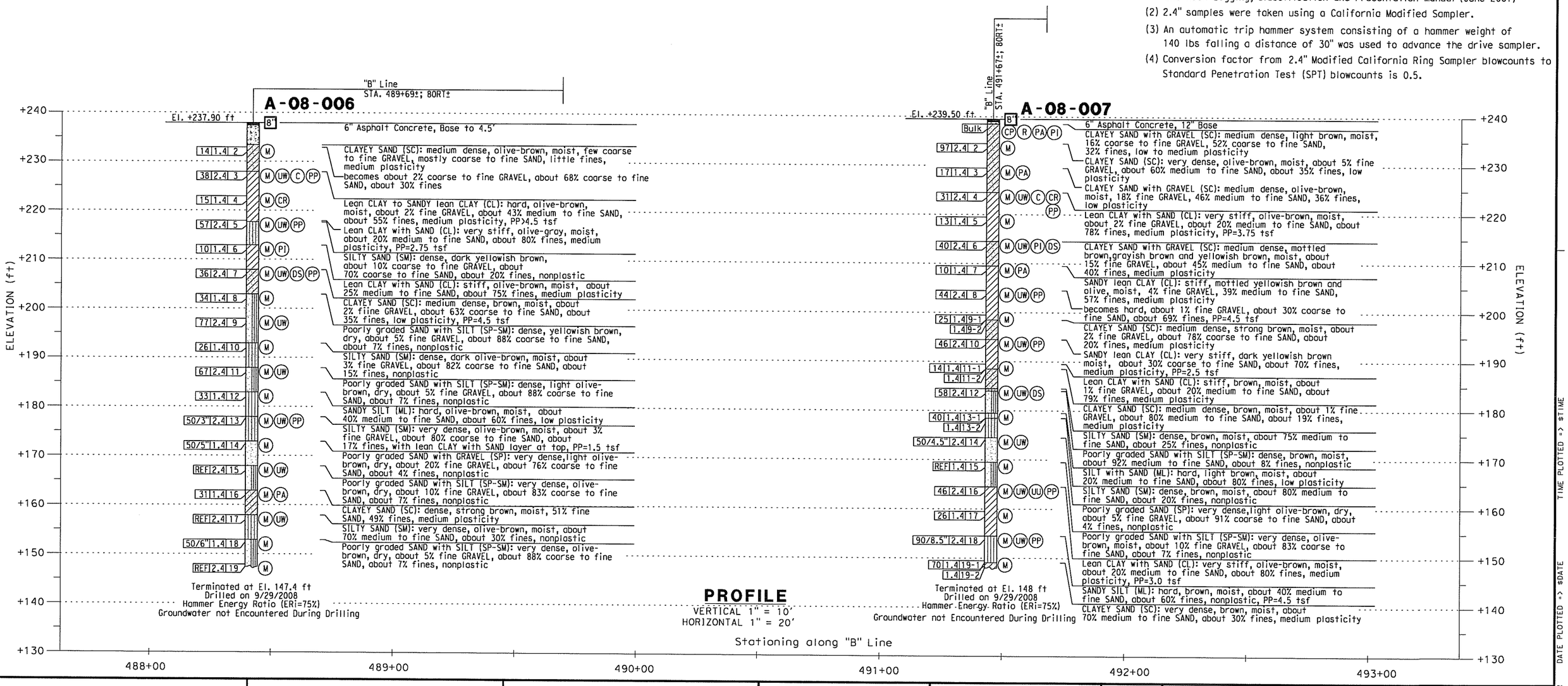

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6

RETAINING WALL NO. 486
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

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REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

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REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

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CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

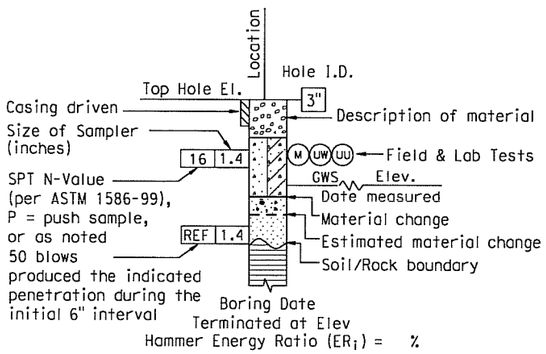
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

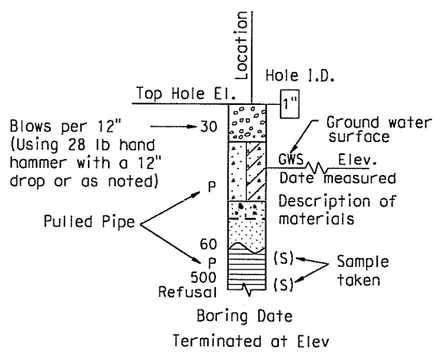
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

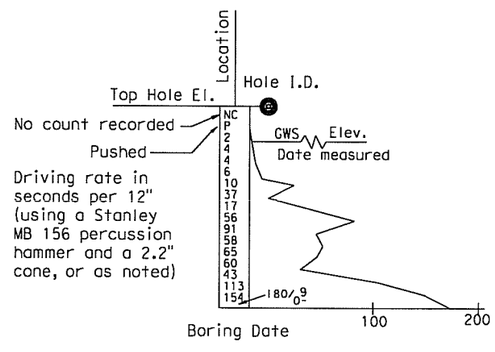
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



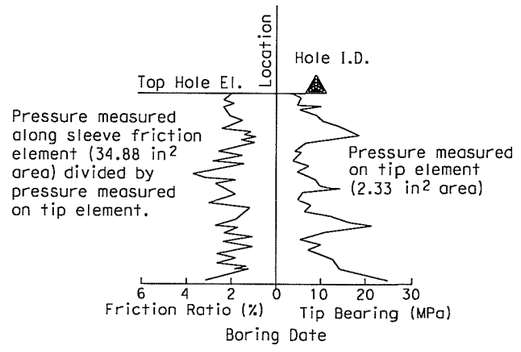
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6

RETAINING WALL NO. 486
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.
POST MILES 16.2/18.6

RETAINING WALL NO. 486
LOG OF TEST BORINGS NO. 6

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	467	491

Kul Bhushan 12/20/89
GEOTECHNICAL PROFESSIONAL

10-29-90
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — KUL BHUSHAN — No. GE 000144 — Exp. 12/31/1989 — GEOTECHNICAL — STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		
REGISTERED CIVIL ENGINEER			DATE		

RETAINING WALL NO. 486

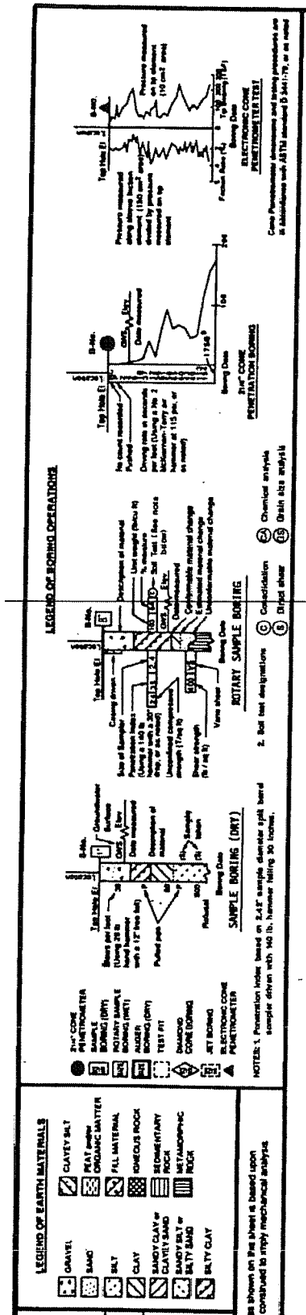
LOG OF TEST BORINGS NO. 7

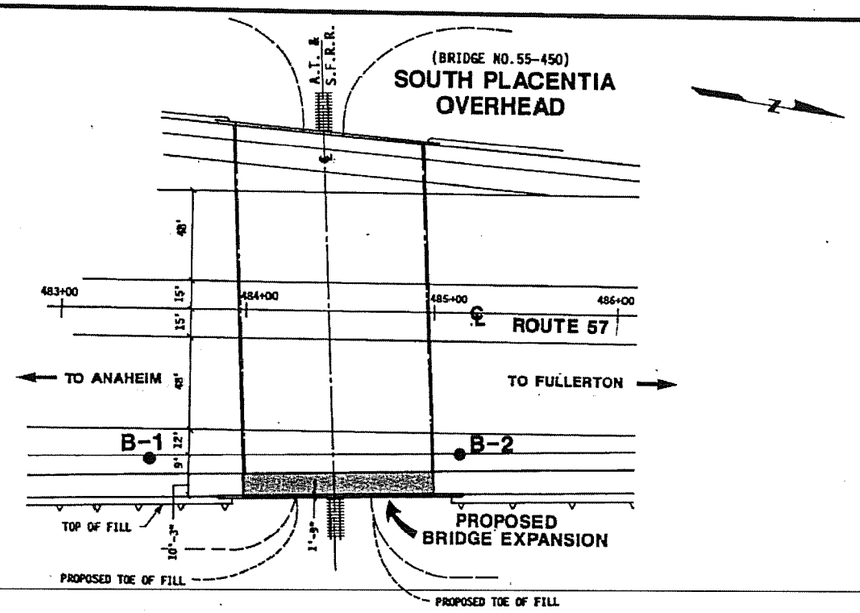
NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No.	
X	
Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER — LIND C. CHEANG — NO. GE 2345 — EXP. 9/30/89 — GEOTECHNICAL — STATE OF CALIFORNIA



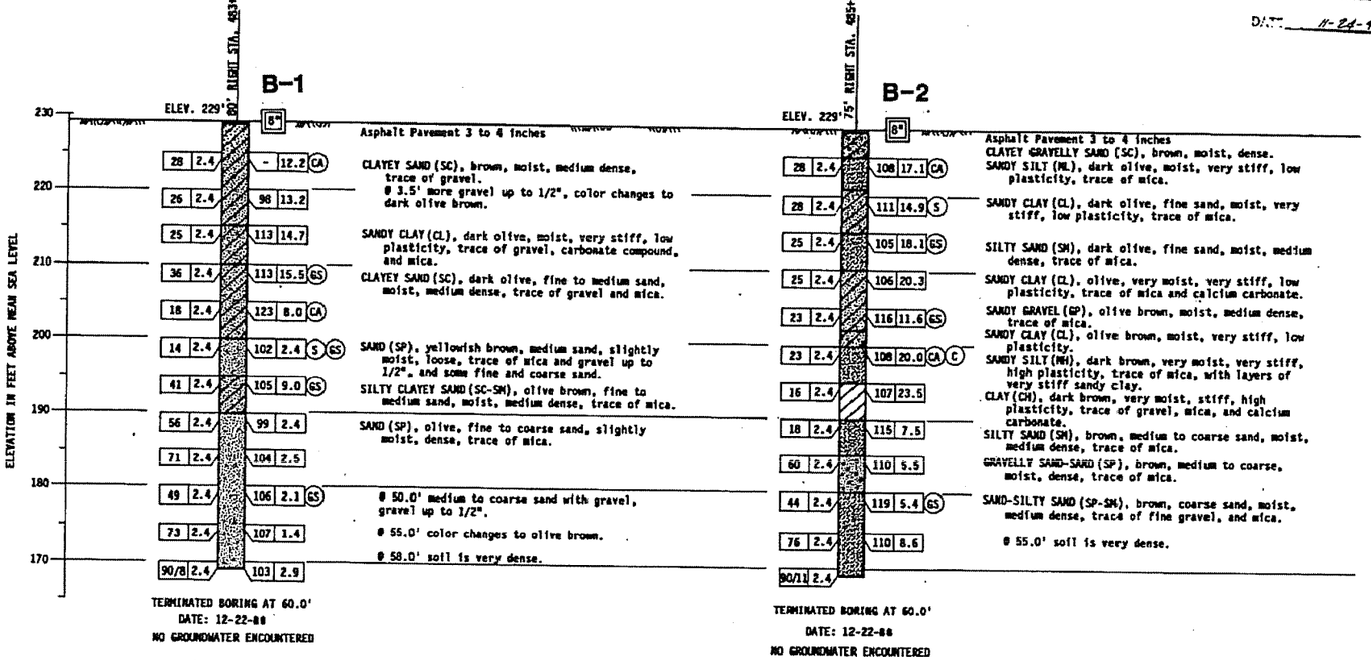


PLAN

SCALE: 1"=40'

PROFILE

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'



NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BM 535-D-70 — ELEVATION 257.37

FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60± AND 105 FEET NORTHERLY OF THE CENTERLINE OF NUTWOOD AVE..

AS BUILT — NO AS BUILT CHANGES
J. PALHEIRO
CORRECTIONS BY I. PANGLE
CONTRACT NO. 12-020184
DATE 11-24-92

DESIGN OVERSIGHT — SIGN OFF DATE 8-22-90

DRAWN BY B. BASMADJIAN
CHECKED BY H. ABDALLAH

S. MOHAMAD
FIELD INVESTIGATOR
DATE 12-28-89

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

PROJECT ENGINEER

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12208
EA 020180

BRIDGE NO. 55-450
POST MILE 16.7

SOUTH PLACENTIA OVERHEAD (WIDEN)

LOG OF TEST BORINGS

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 9 OF 10

FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	15G/21G	122	197

DATE APPROVED August 28, 1967

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER _____ DATE _____

RETAINING WALL NO. 486

LOG OF TEST BORINGS NO. 8

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

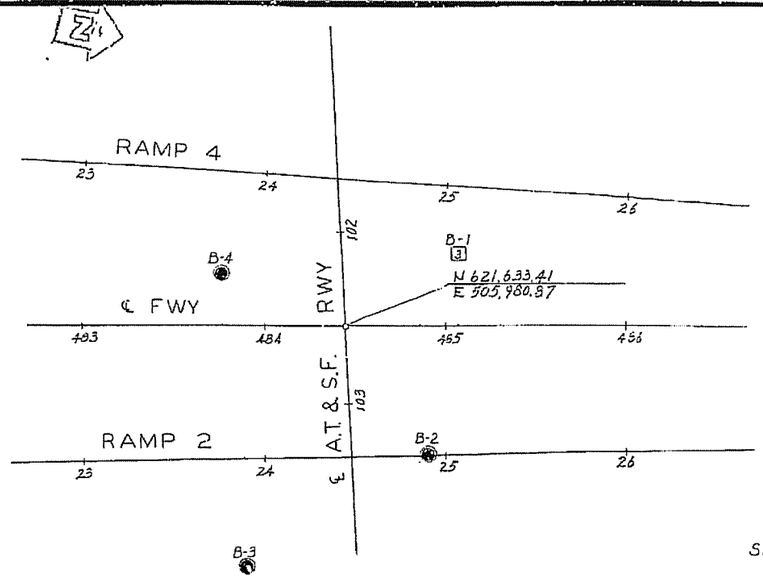
BRIDGE No. X

Sheet X of X

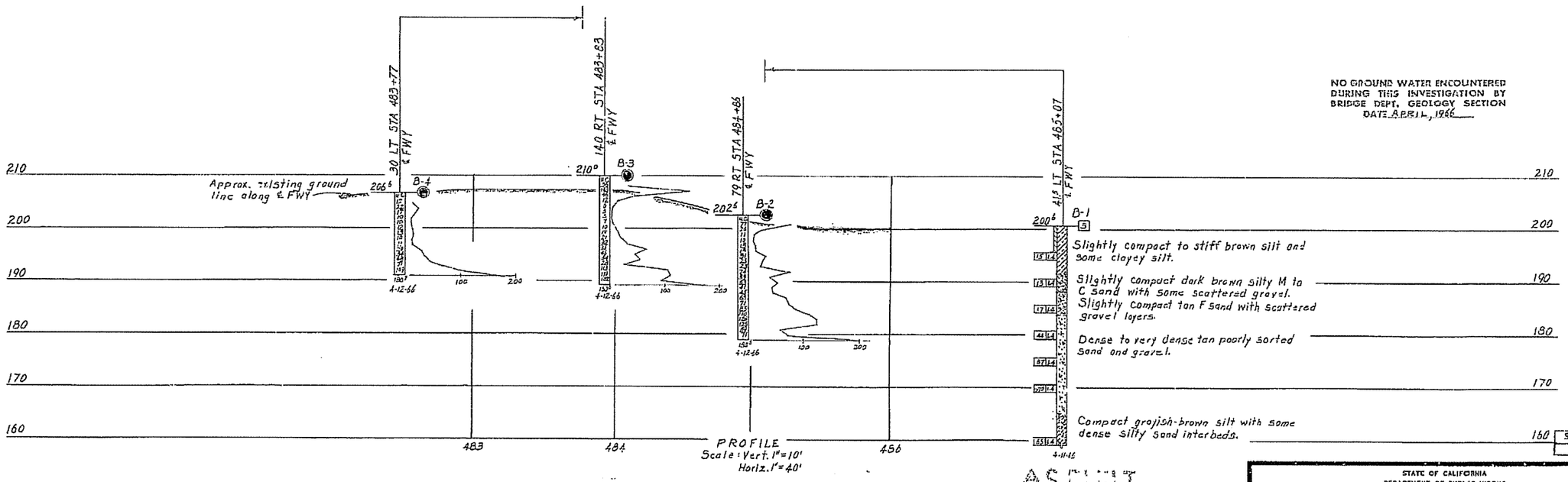
REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

BENCH MARK

B.M. 484-65 Elev. 205.336
Set R.R. spk. in N. side of P.P. # 102608 E. 135 Ft. W. of ℄ intersection Frwy. ℄ A.T. & S.F. R.R. spurline 26 Ft. S. of ℄ Tracks 15 Ft. above O/G.

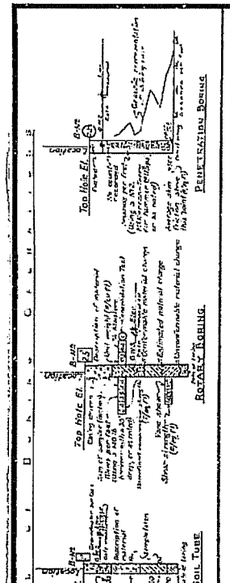


PLAN
Scale: 1" = 40'



PROFILE
Scale: Vert. 1" = 10'
Horiz. 1" = 40'

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE APRIL, 1966

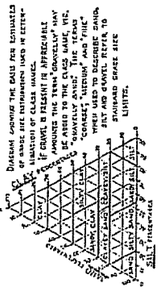


LEGEND OF EARTH MATERIALS

Gravel; Sand; Silt; Clay; Silty Clay or Clayey Silt; Peat "Pt" or Organic Matter; Fill Material; Igneous Rock; Sandy Clay or Clayey Sand; Sandy Silt or Silty Sand; Sedimentary Rock; Metamorphic Rock

Penetrometer; 2½" Core Penetrometer; Sampler Boring (SAV); Rotary Boring (RVC); Auger Boring (DRY); Jet Boring; Core Boring; Test Pit

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS



NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY	W.D. Crawford	4-15-66
DRAWN	W.C. Curtis	4-19-66
CHECKED	W. McCain	4-26-66

Original Signed by C. Robert Scott
Materials Engineer

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

AS BUILT PLANS
Contract No. 07-032124
Date Completed _____
Document No. 70000668

AS BUILT
CORRECTIONS BY [illegible] 7-28-09
CONTRACT NO. 07-032124
DATE 4-30-

Charge: 07206
W.A: 0.32121

Disregard prints bearing earlier numbers

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SOUTH PLACENTIA OVERHEAD

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-450 R/L | FILE | DRAWING 55450-13

PREL. DRAWING NO. PR- 78/27

SHEET 13 OF 18

122

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

RETAINING WALL NO. 486

LOG OF TEST BORINGS NO. 9

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 - EA: 0F0311

BRIDGE No. X

Sheet X of X

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

REGISTERED PROFESSIONAL ENGINEER — LINO C. CHEANG — NO. GE 2345 — EXP. 9/30/89 — GEOTECHNICAL — STATE OF CALIFORNIA

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	476	491

Kul Bhushan 12/28/89

GEOTECHNICAL PROFESSIONAL

10-29-90

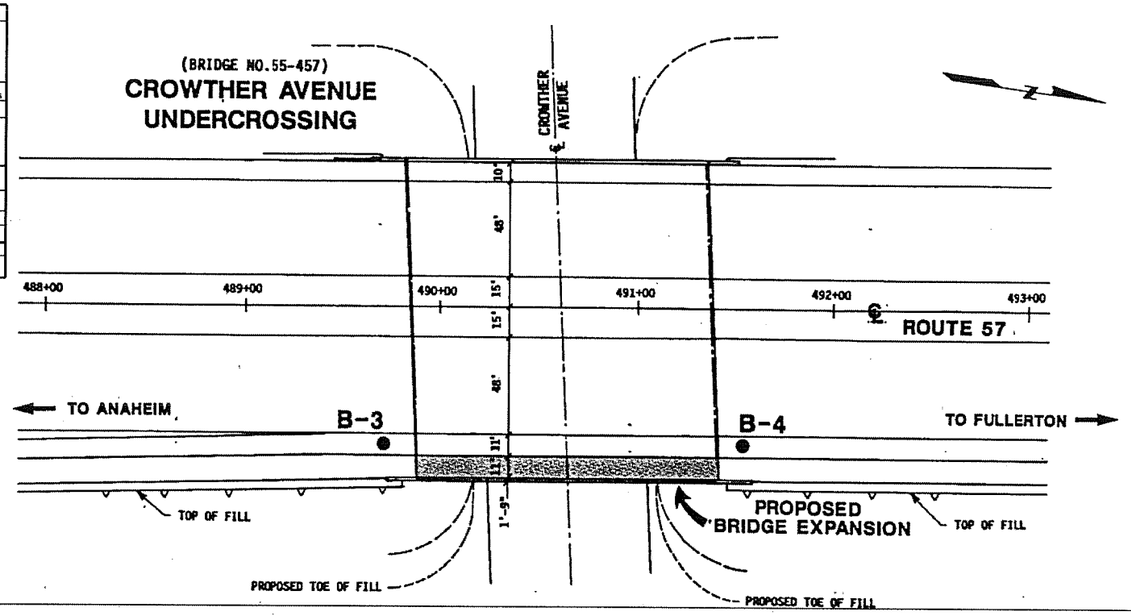
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — KUL BHUSHAN — No. GE 000144 — Exp. 12/31/1989 — GEOTECHNICAL — STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351

(BRIDGE NO.55-457)

CROWTHER AVENUE UNDERCROSSING

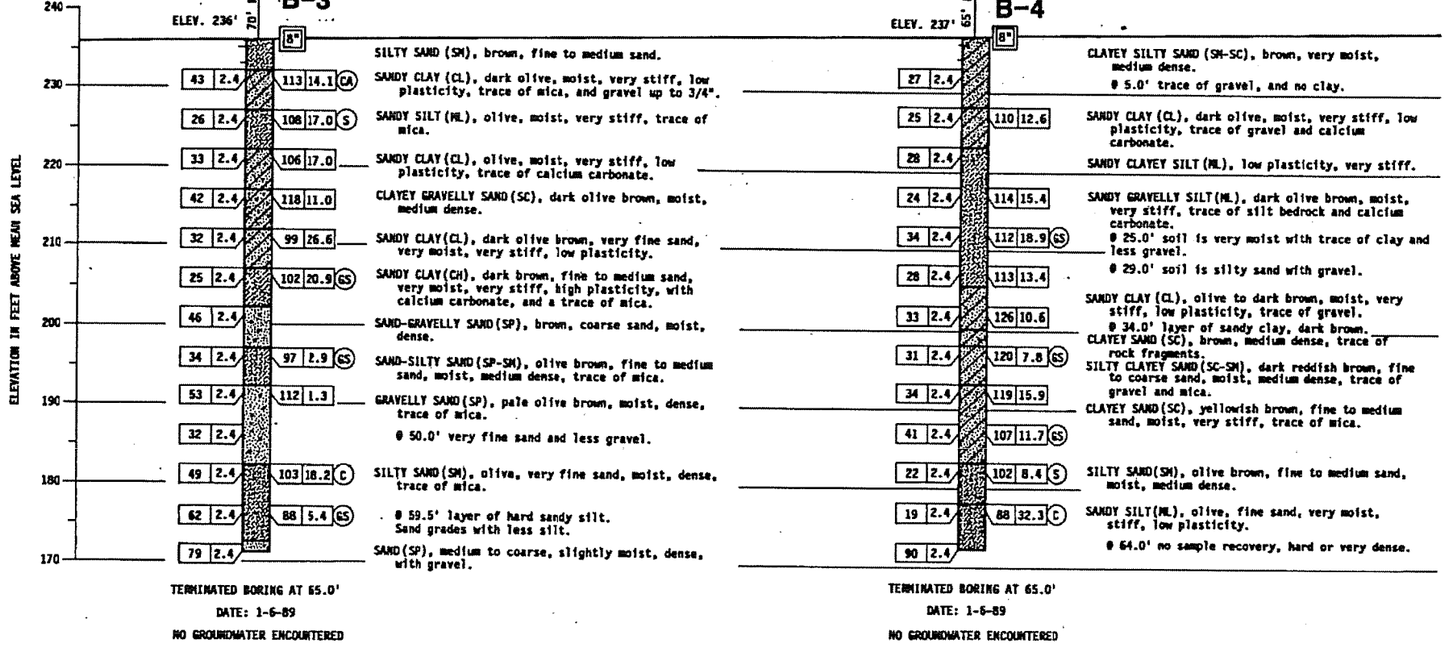


PLAN

SCALE: 1"=40'

PROFILE

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'



BM 535-D-70 — ELEVATION 257.37

FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60 AND 105 FEET NORTHERLY OF THE CENTERLINE OF NUTWOOD AVE..

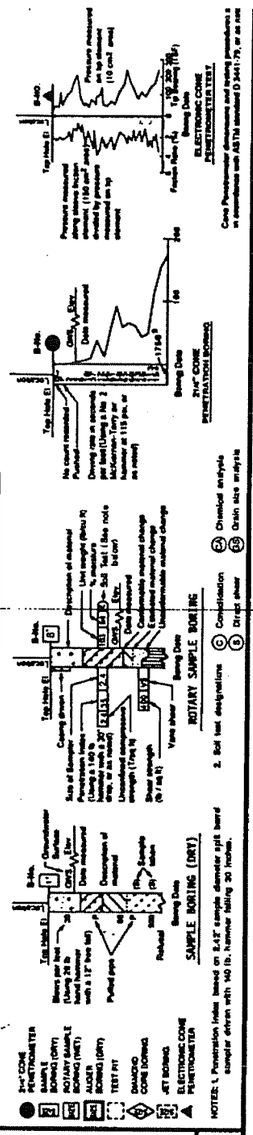
AS BUILT NO AS BUILT CHANGES
I. PINHEIRO
I. PANGLE

CORRECTIONS BY

CONTRACT NO. 12-020184

DATE 11-24-92

LEGEND OF BORING OPERATIONS



LEGEND OF EARTH MATERIALS

GRAVEL — SAND — SILT — CLAY — SANDY CLAY or CLAYEY SAND — SANDY SILT or SILTY SAND — SILTY CLAY — CLAYEY SILT — PEAT and/or ORGANIC MATTER — FILL MATERIAL — IGNEOUS ROCK — SEDIMENTARY ROCK — METAMORPHIC ROCK

NOTE Classification of earth material as shown on the sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

Penetration Index (Blows / Ft)	Granular	Cohesive
0-4	Very loose	Very soft
5-9	Loose	Soft
10-19	Slightly compact	Stiff
20-34	Compact	Very stiff
35-69	Dense	Hard
>70	Very dense	Very hard

DESIGN OVERSIGHT — SIGN OFF DATE 8-22-90

DRAWN BY B. BASMADJIAN

CHECKED BY H. ABDALLAH

S. MOHAMAD — FIELD INVESTIGATOR — DATE 12-28-89

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Gary Antonucci — PROJECT ENGINEER

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12208
EA 0F0311

BRIDGE NO. 55-457
POST MILE 16.8

CROWTHER AVE. UNDERCROSSING (WIDEN)

LOG OF TEST BORINGS

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

DIST	COUNTY	ROUTE	POST MILES – TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	11.1/21.2	477	491

N 622 234 755
E 502, 840. 305

STATE | COUNTY

Approved [illegible] 23, 1967

BENCH MARK

B.M. #811-465 Elev. 204.61

Set in S ⊥ curb Crowther Ave. @ BCR to E corner S. of Placentia Ave 292 W of E Fog 32 N. of ℄ Crowther Ave.

B-4 B-1 B-3 B-5 B-2

℄ FWY. RTE. 57

469 490 492 493

AS - BUILT PLAN —— FOR INFORMATION ONLY

Kul Bhushan
GEOTECHNICAL PROFESSIONAL
DATE APPROVED 10-29-90

CROWTHER AVENUE UC (WIDEN)
LOG OF TEST BORINGS

	BRIDGE No.
~~CU: 12208~~ EA: 020181	55 - 457

REGISTERED PROFESSIONAL ENGINEER
KUL BHUSHAN
NO CE 033144
Exp. 12-31-93
GEOTECHNICAL
STATE OF CALIFORNIA

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

RETAINING WALL NO. 486

LOG OF TEST BORINGS NO. 10

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 EA: 0F0311

BRIDGE No.	
X	
Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/89
GEOTECHNICAL
STATE OF CALIFORNIA

PLAN
Scale: 1" = 20'

℄ CROWTHER AVE.

AS BUILT
CORRECTIONS BY
CONTRACT NO.
D/T

AS BUILT
CONTRACT NUMBER 12- 020184
RESIDENT ENGINEER J. MUNERO & J. PAUGLE
COMPLETION DATE 11-24-92

AS BUILT PLANS
Contract No. 07-052124
Date Completed
Document No. 70000668

PROFILE
Scale: Vert. 1" = 10'
Horiz. 1" = 20'

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE Nov & Dec. 1965

Upper existing ground line along ℄ Fwy. RTE. 57

B-4 B-5 B-3 B-1 B-2

B'L'S Sta 489+87 ℄ Fwy. RTE. 57
To Rt. Sta 489+95 ℄ Fwy. RTE. 57
On ℄ Sta 491+03 ℄ Fwy. RTE. 57
ABT'S Sta 491+28 ℄ Fwy. RTE. 57
To Rt. Sta 491+35 ℄ Fwy. RTE. 57

Loose, brown, silty, very fine to medium sand. Loose, buff, gravelly, very fine to very coarse sand

Compact to dense, buff, gravelly, very fine to very coarse sand.

Dense, tan, silty, very fine to fine sand with occasional thin gravel layers.

11-11-65 12-6-65 11-11-65 11-12-65 11-11-65

489 490 491 492

210 200 190 180

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
Sheet of

CROWTHER AVENUE
UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-457 INL | DRAWING 55457-12

LEGEND OF EARTH MATERIALS

GRAVEL · SAND · SILT · CLAY · SILTY CLAY OR CLAYEY SILT · PEAT MOSS ORGANIC MATTER · FILL MATERIAL · IGNEOUS ROCK · SEDIMENTARY ROCK · METAMORPHIC ROCK · SANDY CLAY OR CLAYEY SAND · SANDY SILT OR SILTY SAND

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

Charge: 07205
W.A.: 032121

PREL. DRAWING NO. PR- 79/1

SHEET 9 OF 9

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

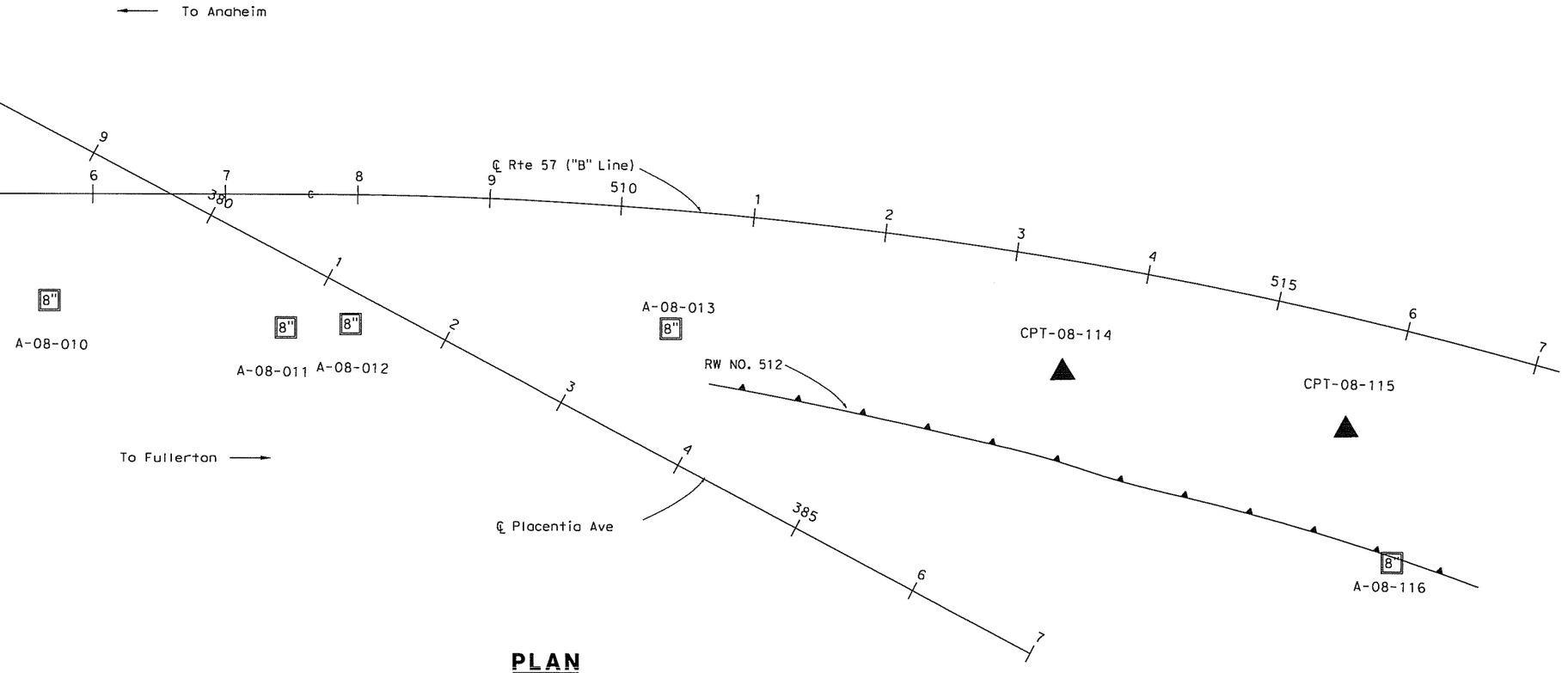
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN
1" = 50'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER	BRIDGE NO. / POST MILES 16.2/18.6	RETAINING WALL NO. 512 LOG OF TEST BORINGS NO. 1
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			CU 12 EA 0F0311	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09 — SHEET — OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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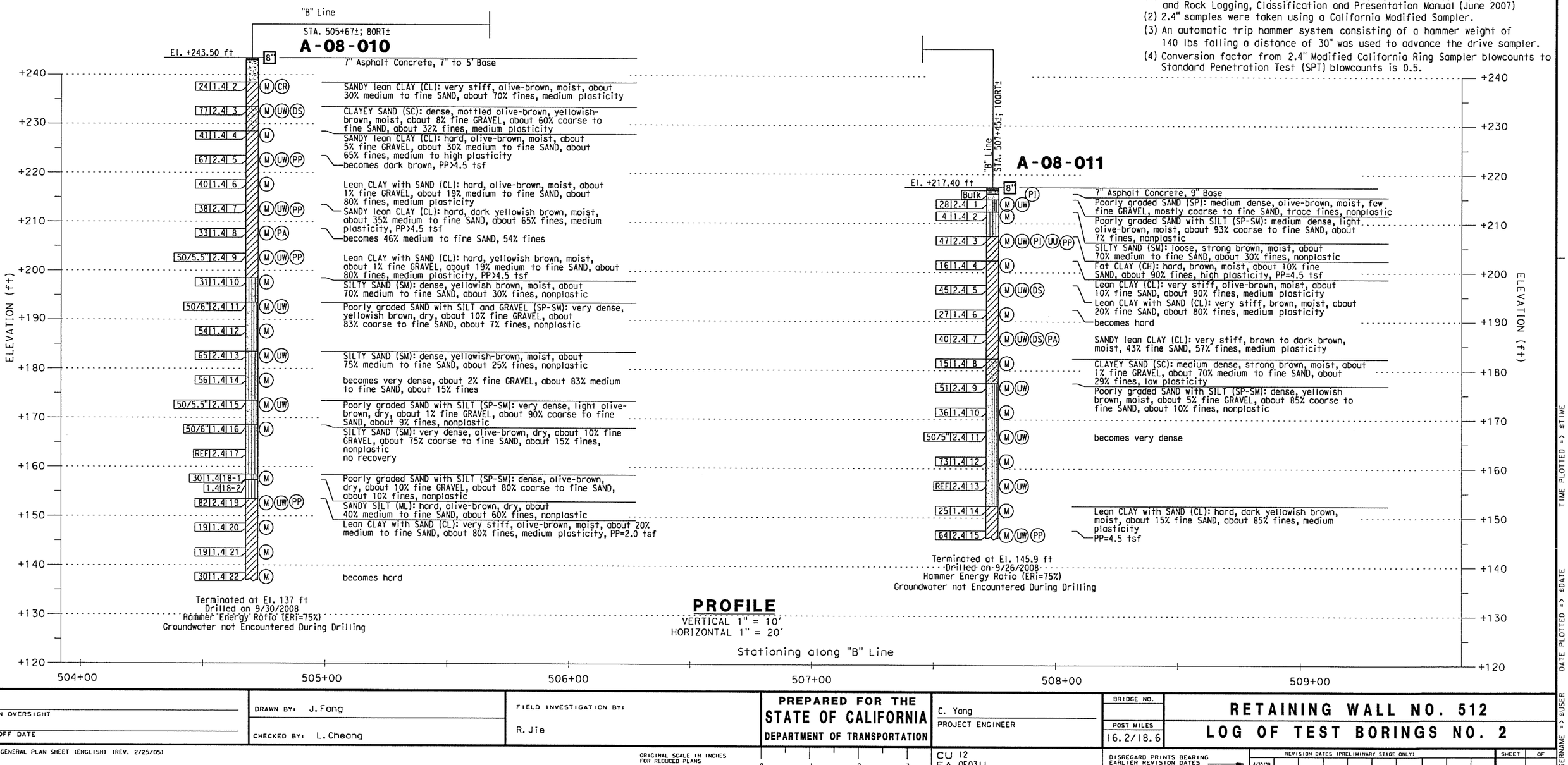
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 512, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6

RETAINING WALL NO. 512
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

USERNAME -> $USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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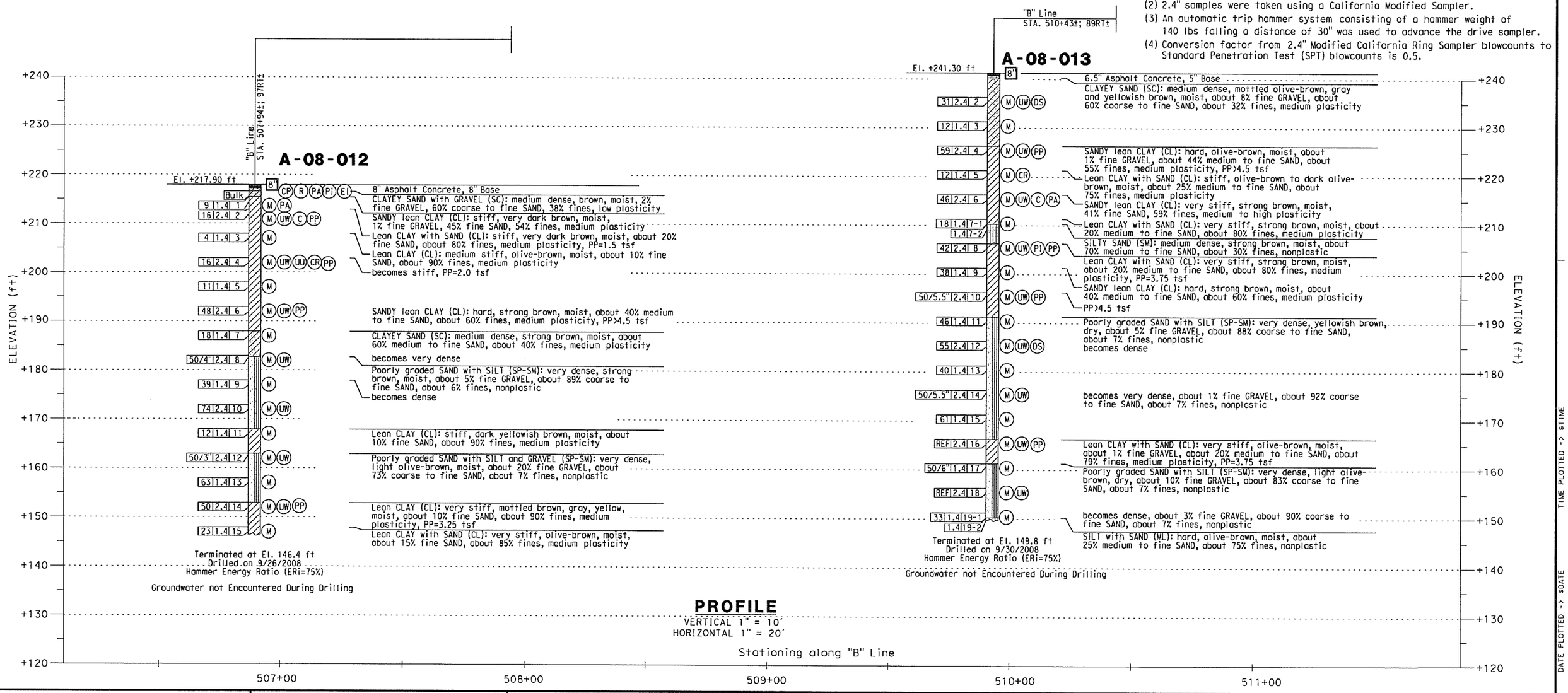
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 512, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6

RETAINING WALL NO. 512
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

USERNAME -> $USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 512, LOG OF TEST BORINGS NO. 1"

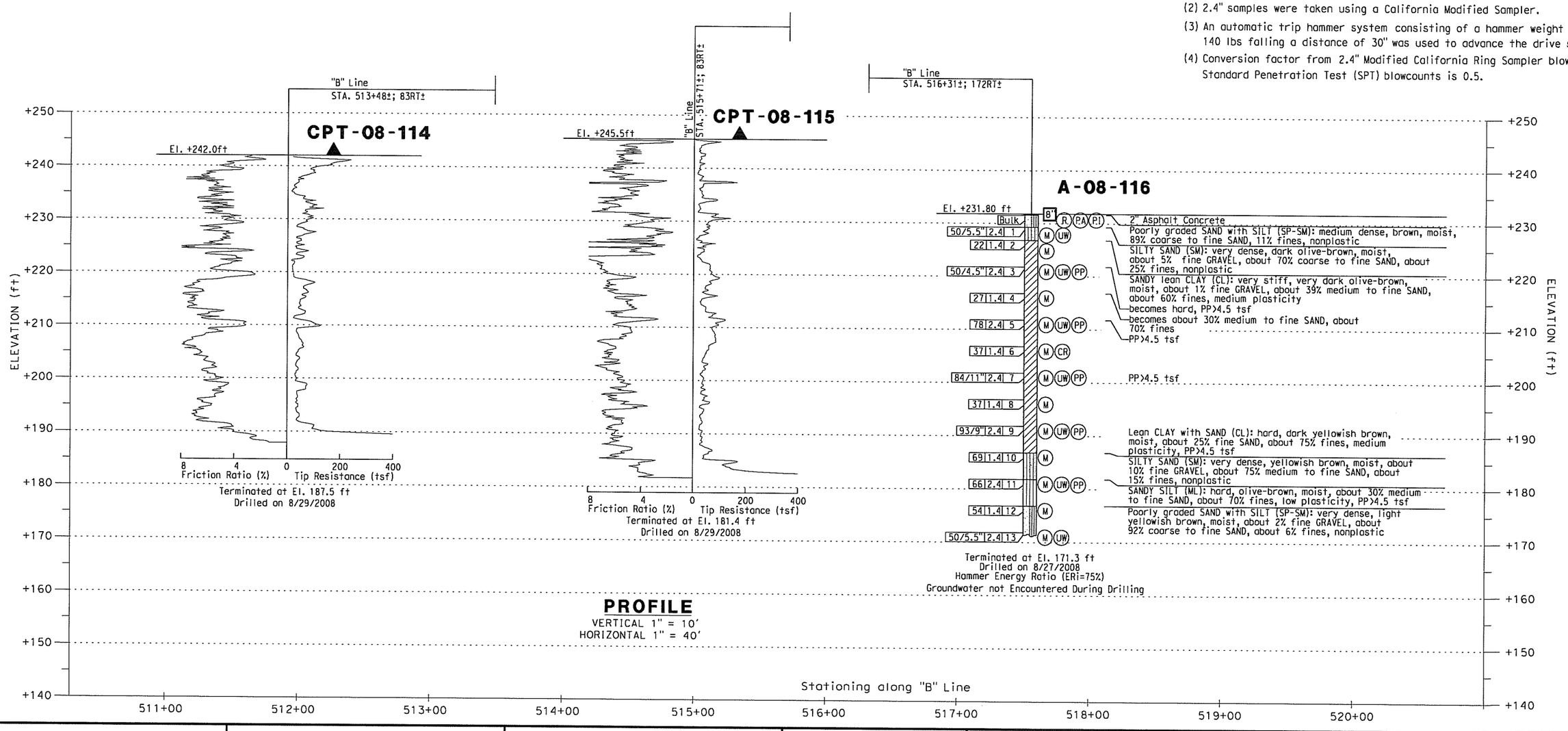
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.

POST MILES
16.2/18.6

RETAINING WALL NO. 512
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS
0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)
4/30/09

SHEET X OF X

DATE PLOTTED -> 6/DATE
TIME PLOTTED -> 8:11:50

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

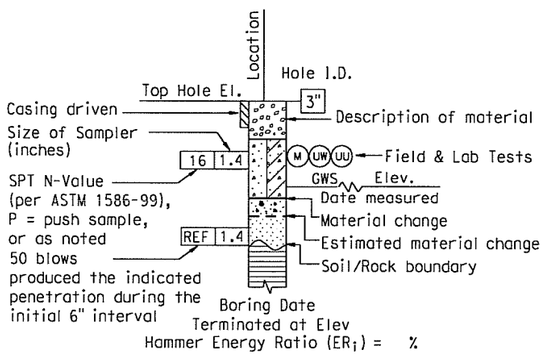
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

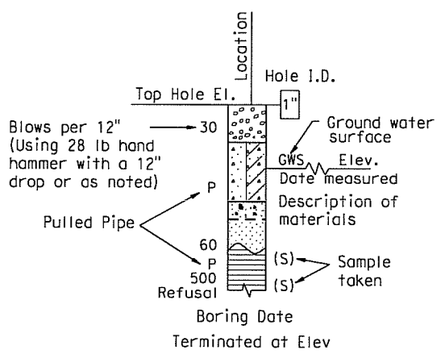
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

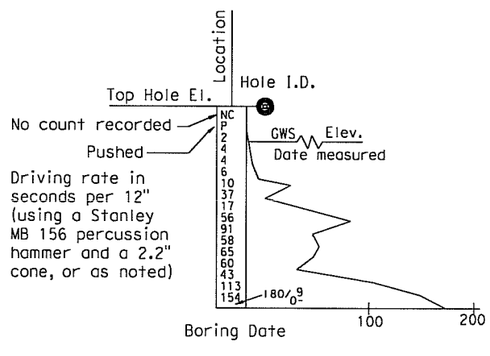
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



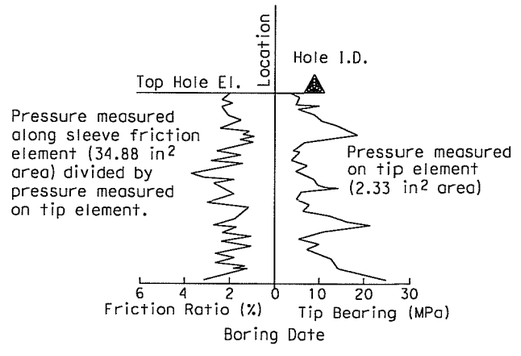
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6

RETAINING WALL NO. 512
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Chien-Tai Yang
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.
POST MILES 16.2/18.6

RETAINING WALL NO. 512
LOG OF TEST BORINGS NO. 6

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

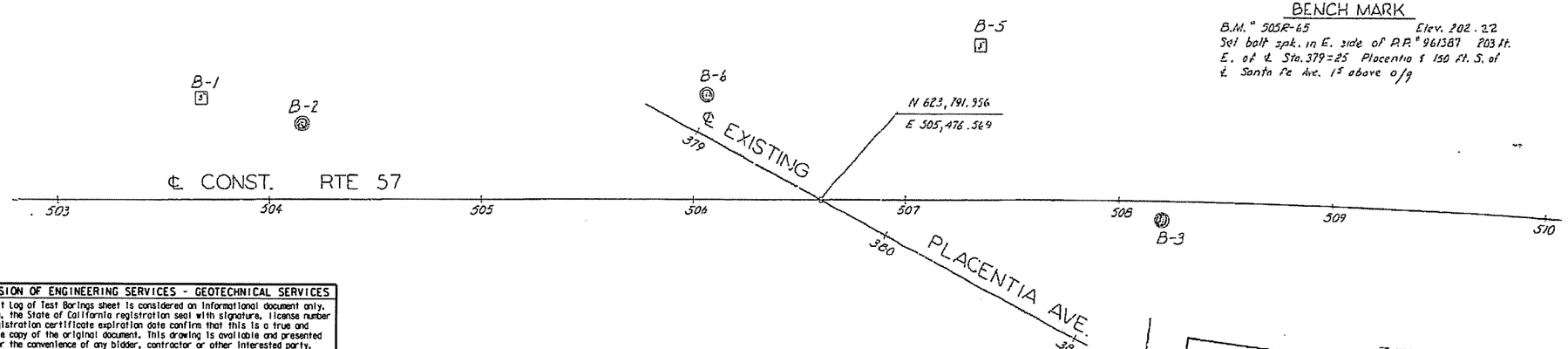
USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist.	County	Route	Postmile	Sheet No.	Total Sheets
07	ORA	57	15.4/18.6	173	197

August 28, 1967

BENCH MARK

B.M. " 505R-65 Elev. 202.22
Set bolt spk. in E. side of P.P. " 961387 203 ft. E. of ℄ Sta. 379+25 Placentia ± 150 ft. S. of ℄ Santa Fe Ave. 1' above o/g



PLAN
Scale 1" = 30'

AS BUILT
Contract No. 07-032124
Date Completed
Document No. 70000668

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER _____ DATE _____

RETAINING WALL NO. 512

LOG OF TEST BORINGS NO. 7

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 EA: 0F0311

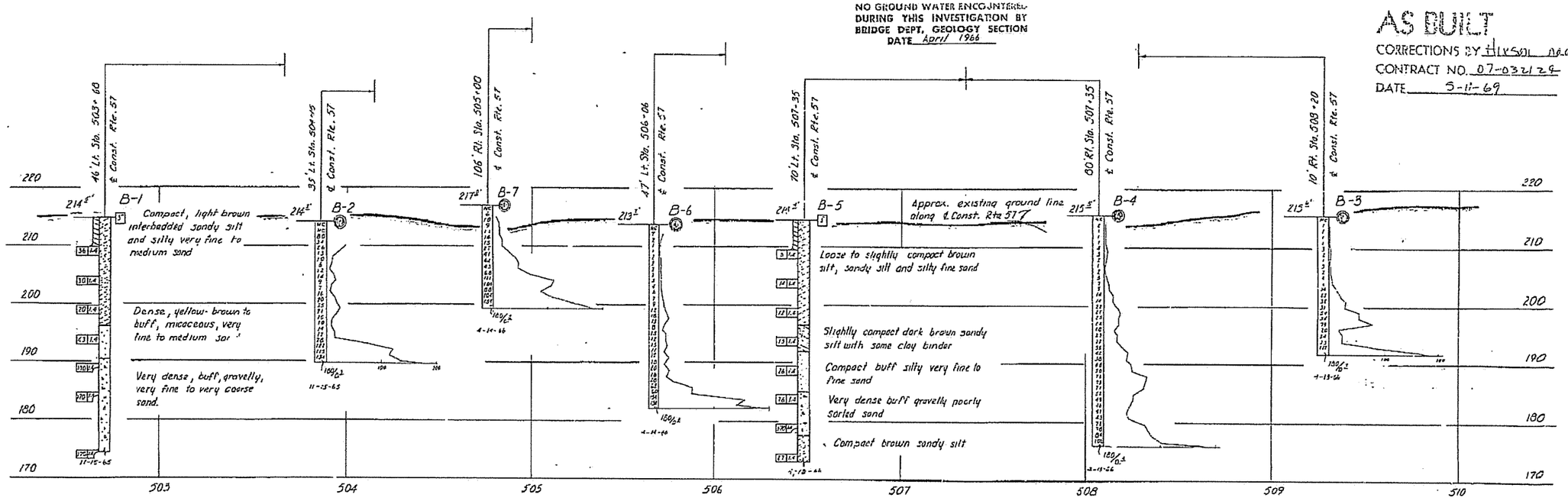
BRIDGE No. X

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER
LIND C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT., GEOLOGY SECTION
DATE April 1968

AS BUILT
CORRECTIONS BY Hixson dated 7-29-69
CONTRACT NO. 07-032124
DATE 5-11-69



PROFILE
Scale Vert. 1" = 10'
Horiz. 1" = 30'

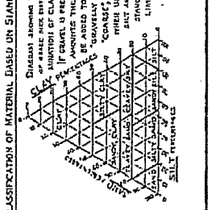
LEGEND OF SUBSURFACE OPERATIONS

- Penetrometer
- 2½" Core Penetrometer
- Sampler Boring (SAM)
- Rotary Boring (ROT)
- Auger Boring (AUG)
- Jet Boring
- Core Boring
- Test Pit
- Penetration Boring
- Rotary Boring
- 1st Soil Tube

LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Sandy Clay or Clayey Sand
- Silty Clay or Clayey Silt
- Peat and/or Organic Matter
- Fill Material
- Igneous Rock
- Sandy Silt or Silty Sand
- Sedimentary Rock
- Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS



NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

	By	Date
DRAWN	M. ALLRED	4-20-66
CHECKED	W. CAIN	5-10-66

Approved for Record
Engineer in Charge

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

173

SHEET	OF
26	26

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PLACENTIA AVENUE UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted	BRIDGE 55-460	FILE	DRAWING 55460-2

Charge 07208

Disregard prints bearing earlier numbers

PREL. DRAWING NO. PR-

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Chien-Tai Yang
REGISTERED CIVIL ENGINEER DATE

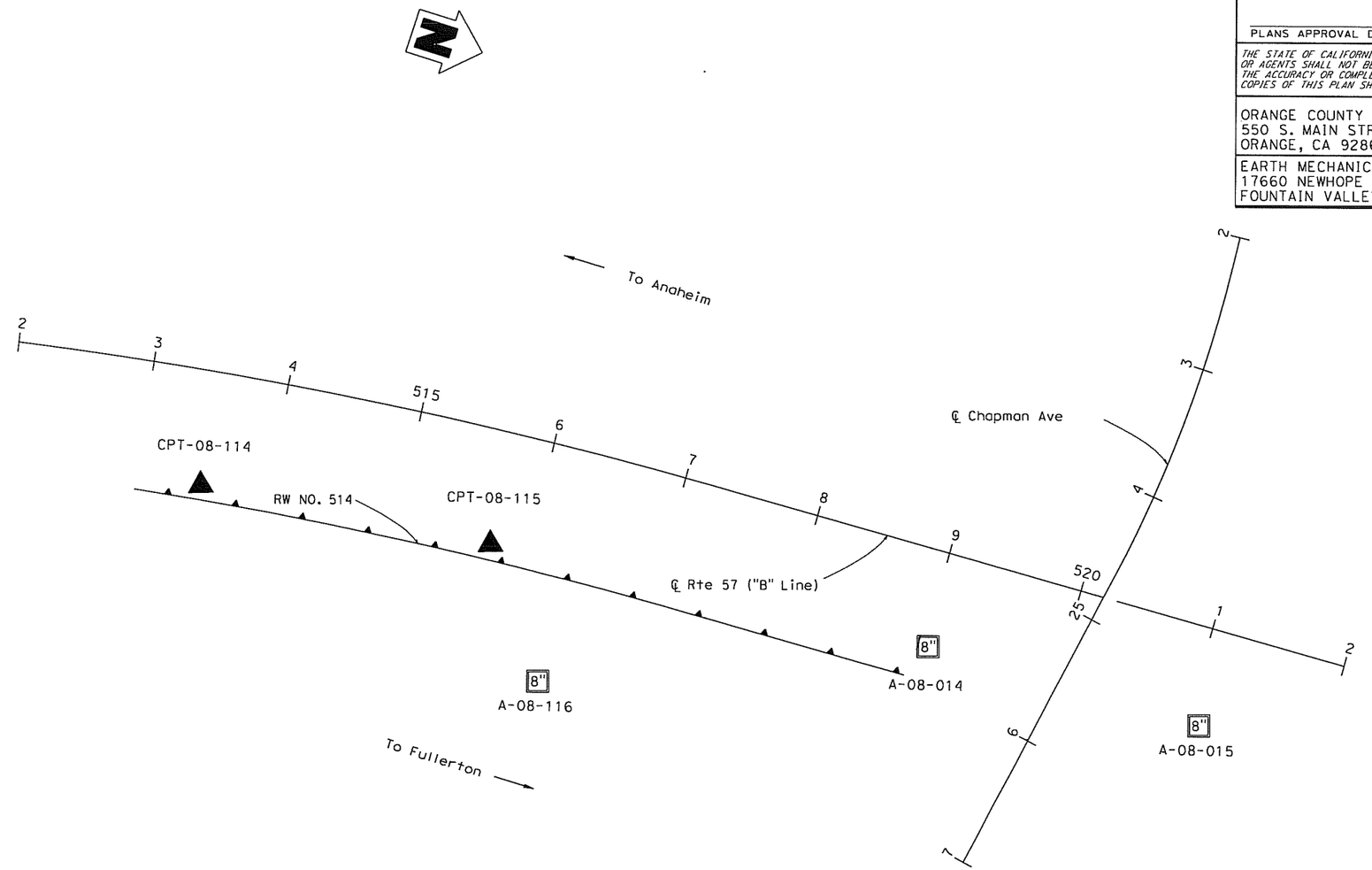
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN
1" = 50'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. / POST MILES 16.2/18.6

RETAINING WALL NO. 514
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Registered Professional Engineer — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — State of California

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 514, LOG OF TEST BORINGS NO. 1"

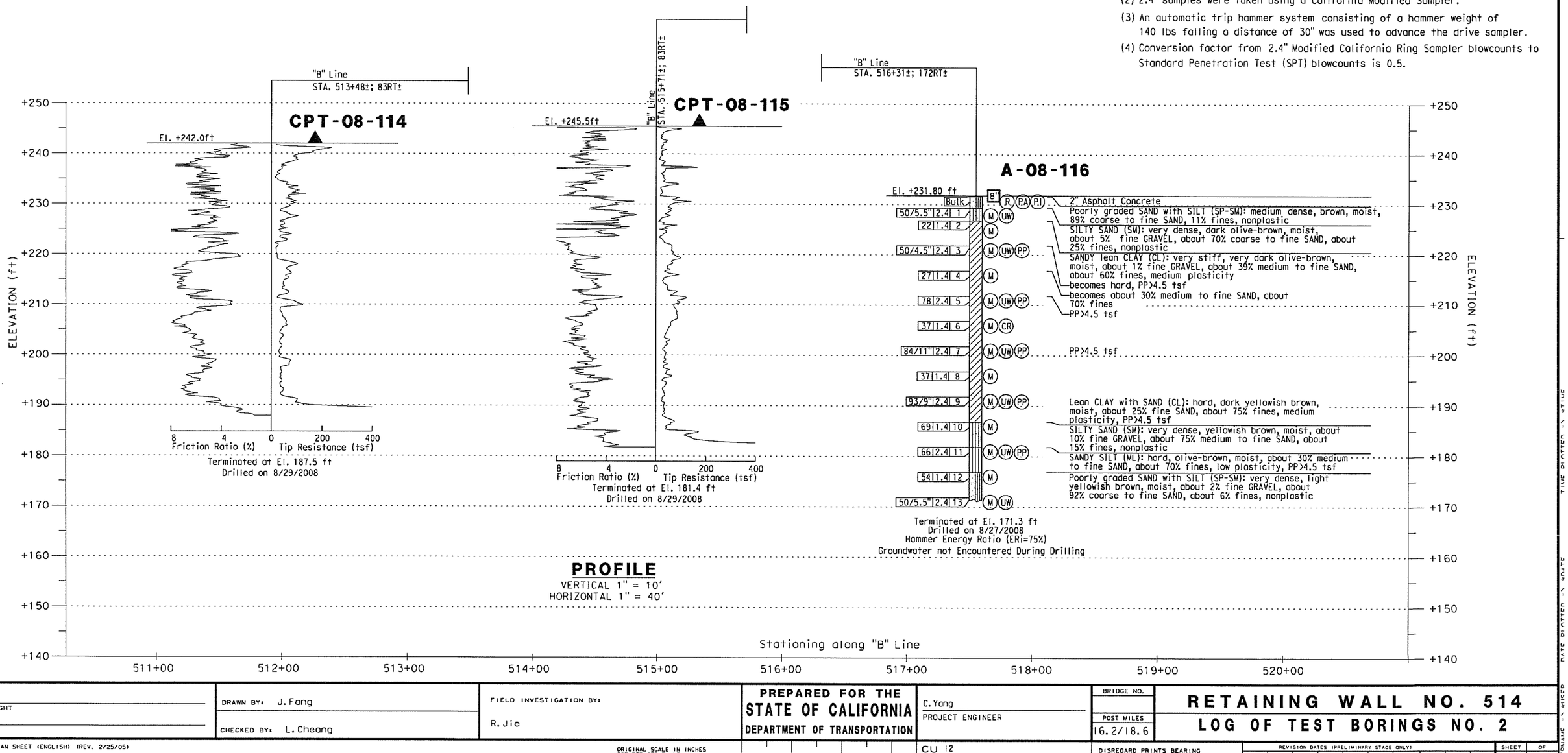
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO.
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6

RETAINING WALL NO. 514
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET	OF
X	X

DATE PLOTTED => 6/JUNE/2009
TIME PLOTTED => 07:11

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 514, LOG OF TEST BORINGS NO. 1"

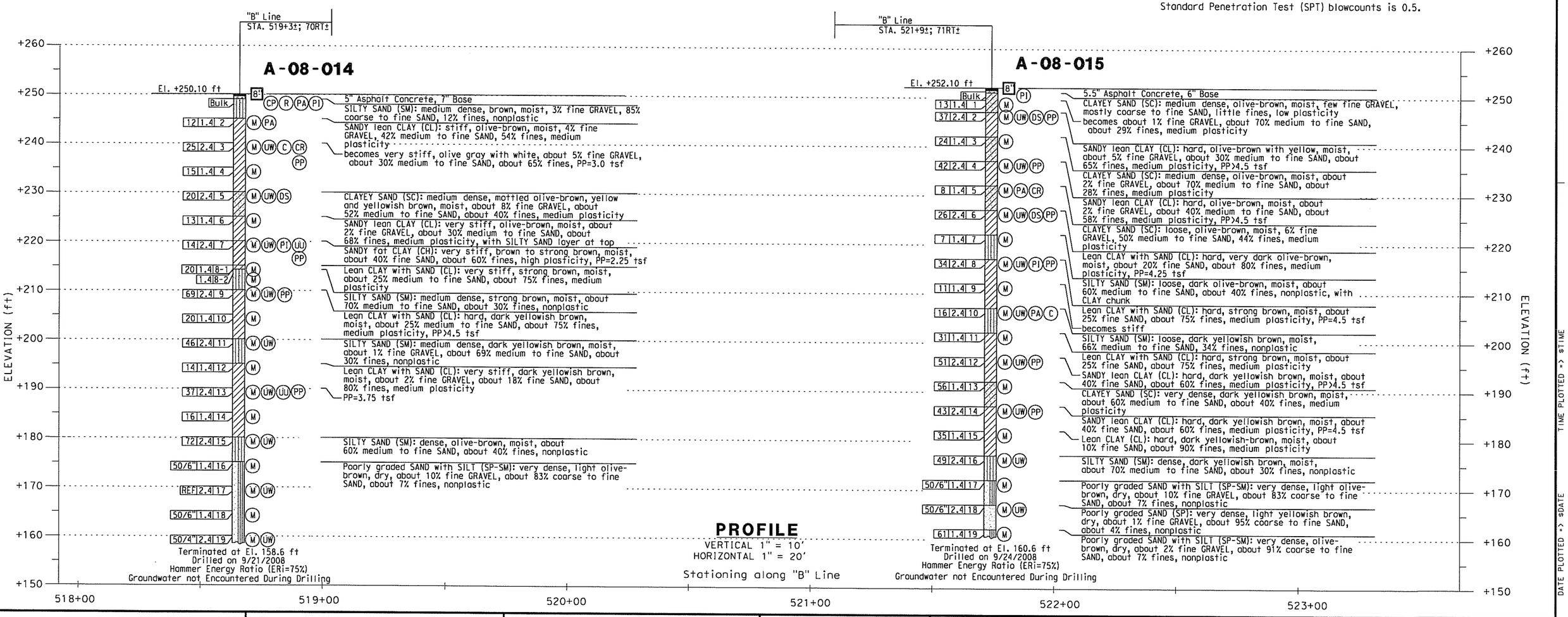
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.

POST MILES
16.2/18.6

RETAINING WALL NO. 514
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

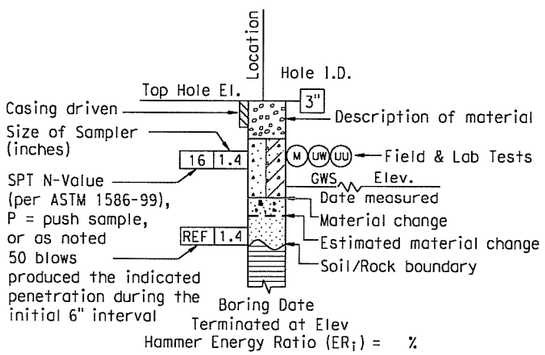
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

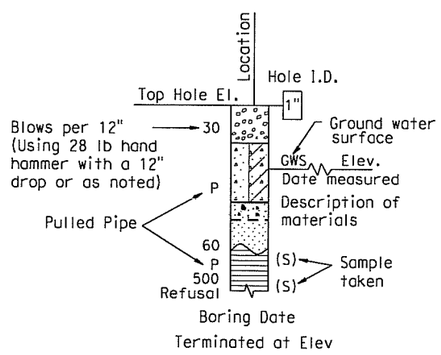
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

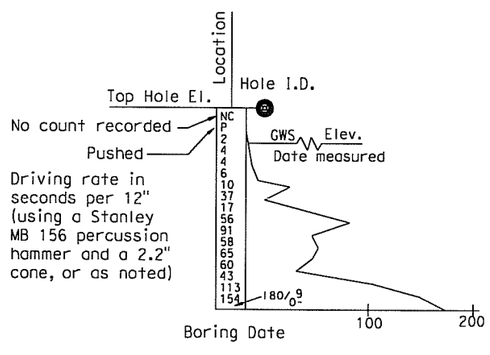
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



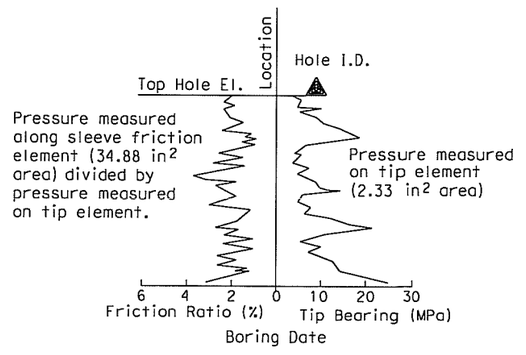
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6	RETAINING WALL NO. 514 LOG OF TEST BORINGS NO. 4
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			CU 12 EA 0F0311	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.

POST MILES 16.2/18.6

RETAINING WALL NO. 514
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER _____ DATE _____

RETAINING WALL NO. 514

LOG OF TEST BORINGS NO. 6

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No. X

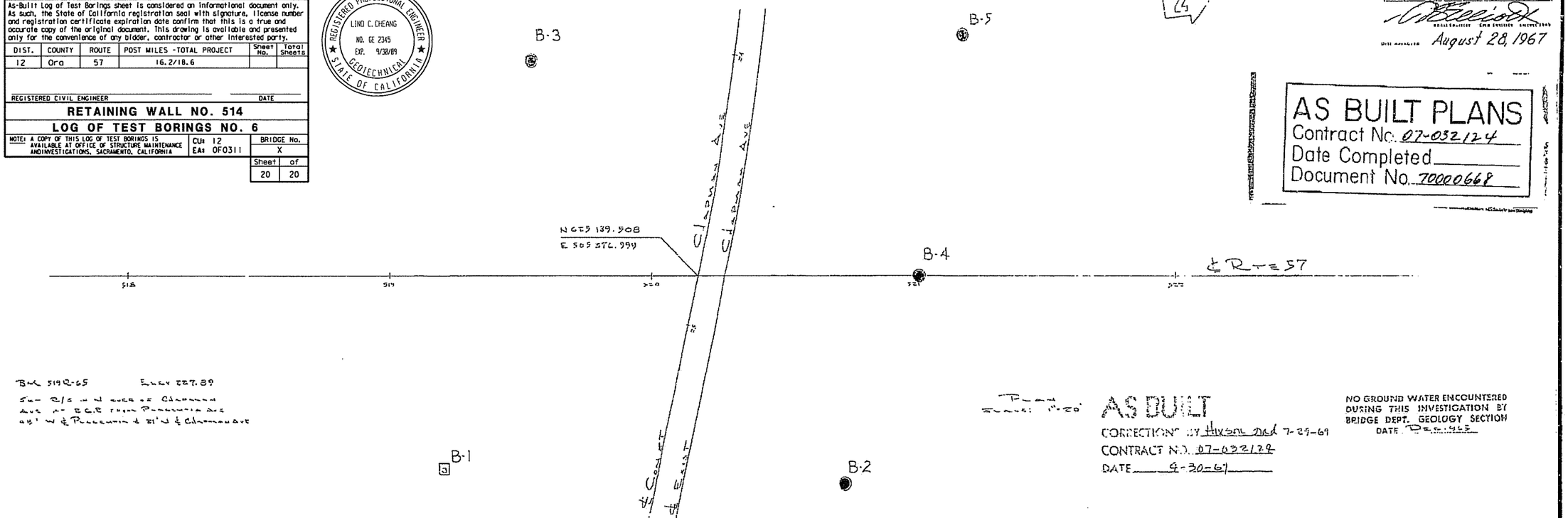
Sheet 20 of 20

REGISTERED PROFESSIONAL ENGINEER
LIND C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

7	CALIF.				
Dist	County	Route	Section	Sheet No.	Total Sheets
07	Ora	57	156/216	185	197

August 28, 1967

AS BUILT PLANS
Contract No. 07-032124
Date Completed _____
Document No. 70000668

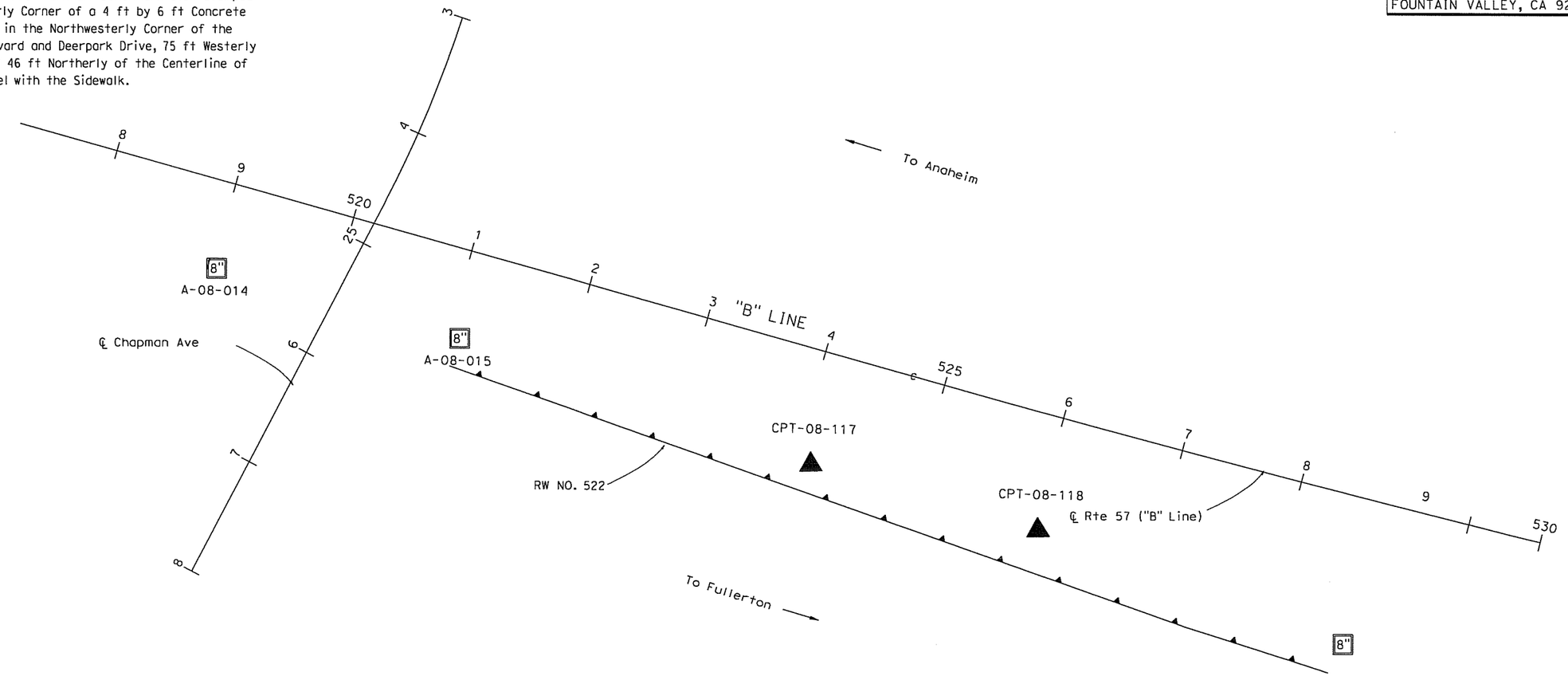


BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER	BRIDGE NO. / POST MILES 16.2/18.6

RETAINING WALL NO. 522
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

USERNAME -> $USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 522, LOG OF TEST BORINGS NO. 1"

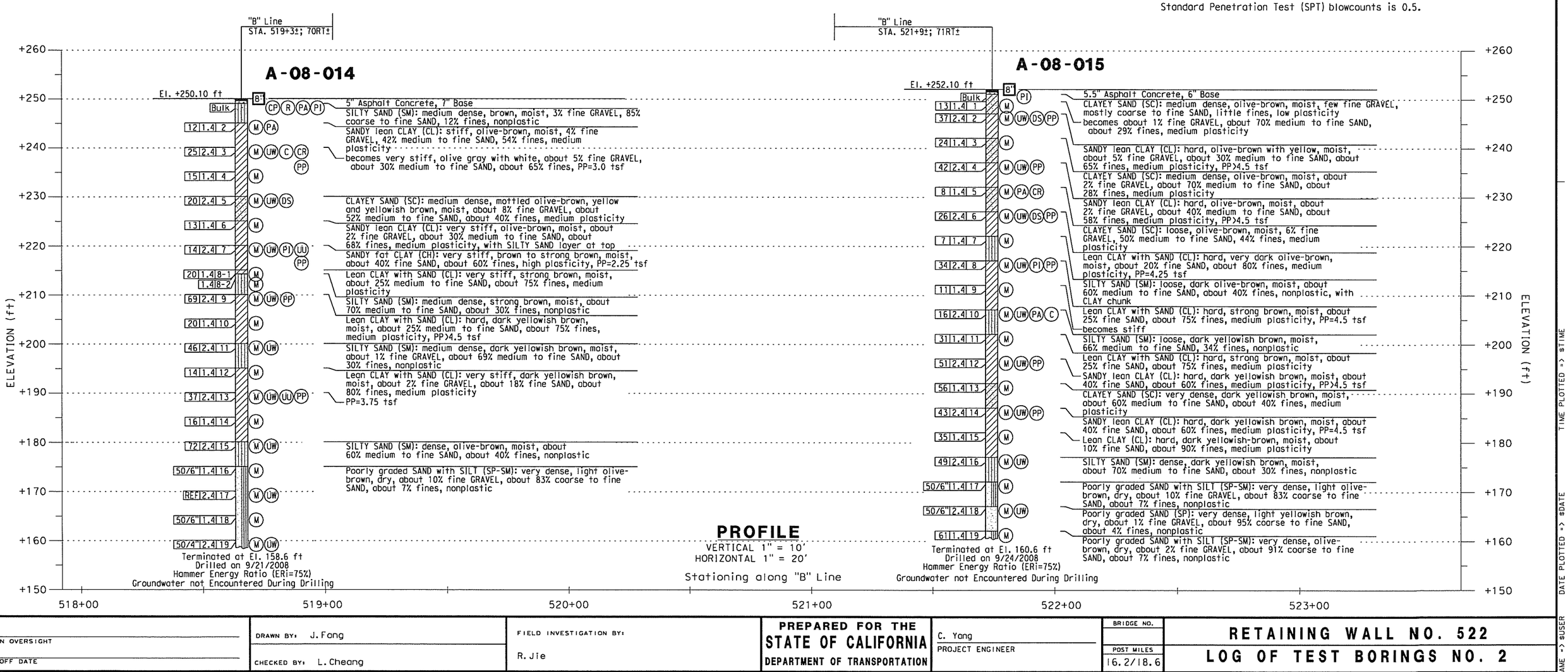
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO.
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6

RETAINING WALL NO. 522
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET OF

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
USERNAME => $USER

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 522, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
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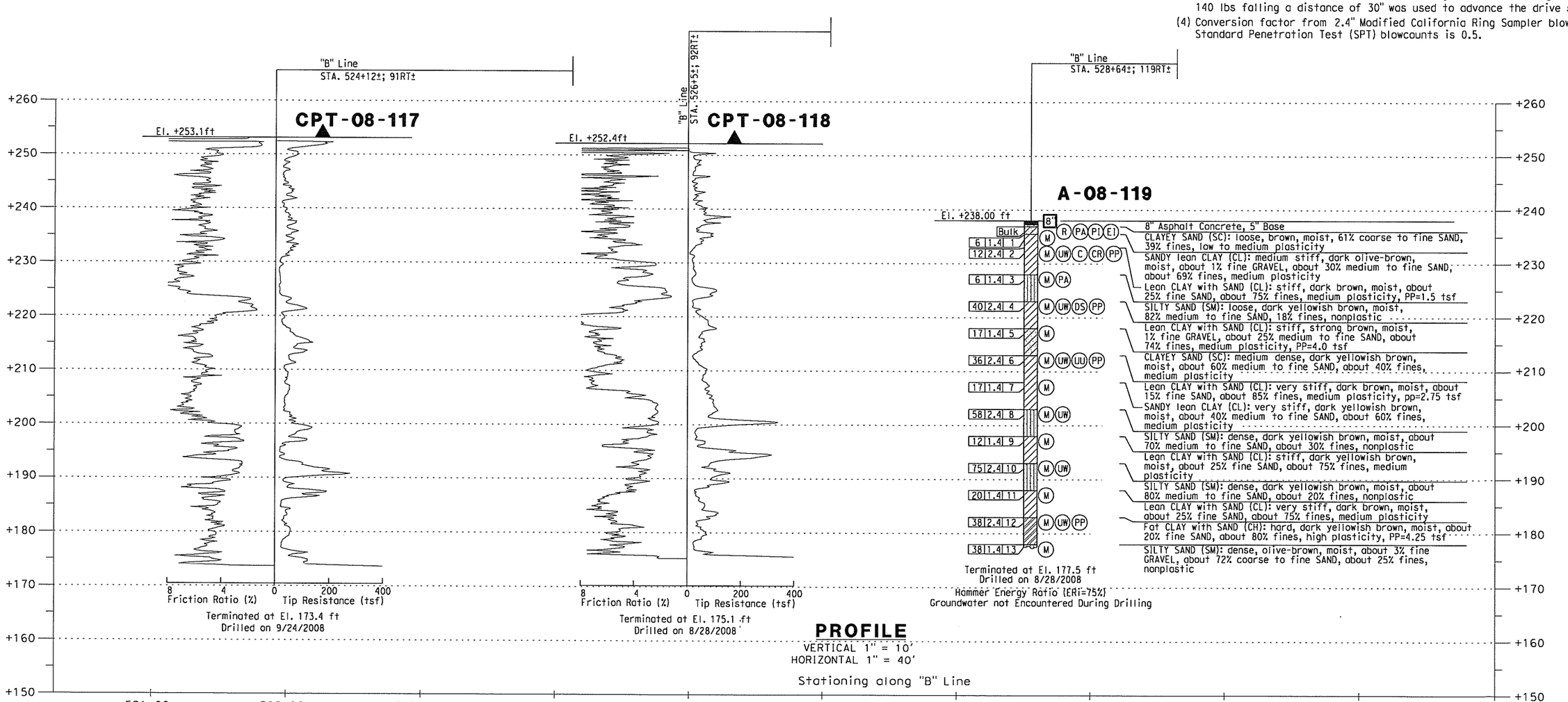

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6

RETAINING WALL NO. 522
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)									SHEET	OF
4/30/09									X	X

DATE PLOTTED => 8/15/08
ICEDNAME => SHEET

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
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ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

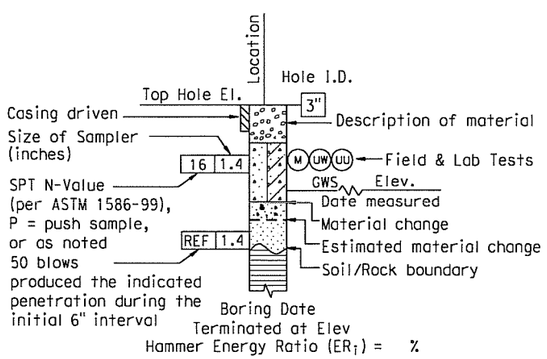
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

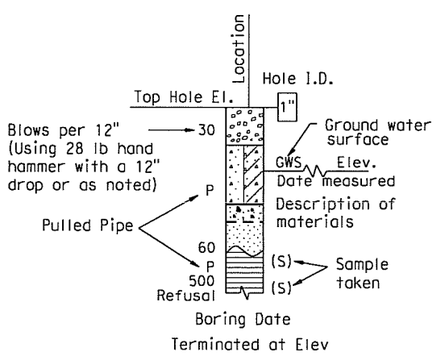
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

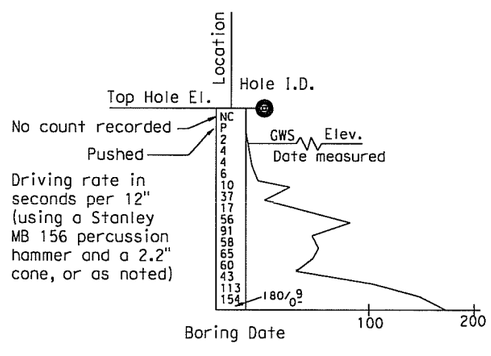
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



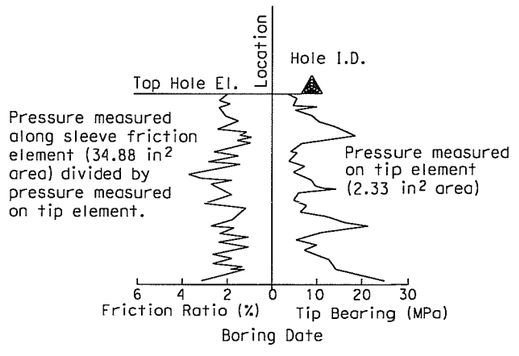
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6

RETAINING WALL NO. 522

LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) | SHEET | OF

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REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Chien-Tai Yang
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
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Loose	5 - 10
Medium Dense	11 - 30
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Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
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PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.
POST MILES 16.2/18.6

RETAINING WALL NO. 522
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
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DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT		
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER _____ DATE _____

RETAINING WALL NO. 522

LOG OF TEST BORINGS NO. 6

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No. X

Sheet 20 of 20

REGISTERED PROFESSIONAL ENGINEER
LIND C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

7	CALIF.				

Dist.	County	Route	Section	Sheet No.	Total Sheets
07	Ora	57	15.6/21.6	185	197

August 28, 1967

AS BUILT PLANS
Contract No. 07-032124
Date Completed _____
Document No. 70000668

B-3 B-5 B-4 B-1 B-2

N 675 139.508
E 505 572.999

Chapman Ave
Chapman Ave
± Center
± East
± R = 57

BM 5192-65 Elev 227.89
Set 2½" I.D. in N side of Chapman Ave at ECR from Pennsylvania Ave 81' W & Pennsylvania & 81' N & Chapman Ave

AS BUILT
CORRECTIONS BY Hixson Dad 7-29-69
CONTRACT NO. 07-032124
DATE 9-30-67

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE Dec. 1965

B-1 Elev. 224 ±
B-3 Elev. 223 ±
B-2 Elev. 225 ±
B-4 Elev. 225 ±
B-5 Elev. 225 ±

Approx. Finish Ground Line Alg. ℄ Rte 57 Fwy.

Trace Sonic 1"=10'

LEGEND OF EARTH MATERIALS

Gravel	Silty Clay or Clayey Silt	Penetrometer			
Sand	Peat and Organic Matter	2½" Cone Penetrometer			
Silt	Fill Material	Sampler Boring (Dry)	Rotary Boring (Wet)		
Clay	Igneous Rock	Auger Boring (Dry)	Jet Boring		
Sandy Clay or Clayey Sand	Sedimentary Rock	Core Boring			
Sandy Silt or Silty Sand	Metamorphic Rock	Test Pit			

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

Diagram showing the code for estimated situation of grade size limits.

Diagram showing the term "gravelly clay" applied to the case where the "gravelly" and "fine" constituents are in the same order, and the terms "coarse, medium" and "fine" with "sand" and "gravel" where the order is reversed. Standard grade size limits.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

Approved Recommended for Approval

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

DRAWN	
CHECKED	

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SHEET 12 OF 12

CHAPMAN AVENUE UNDERCROSSING

LOG OF TEST BORINGS

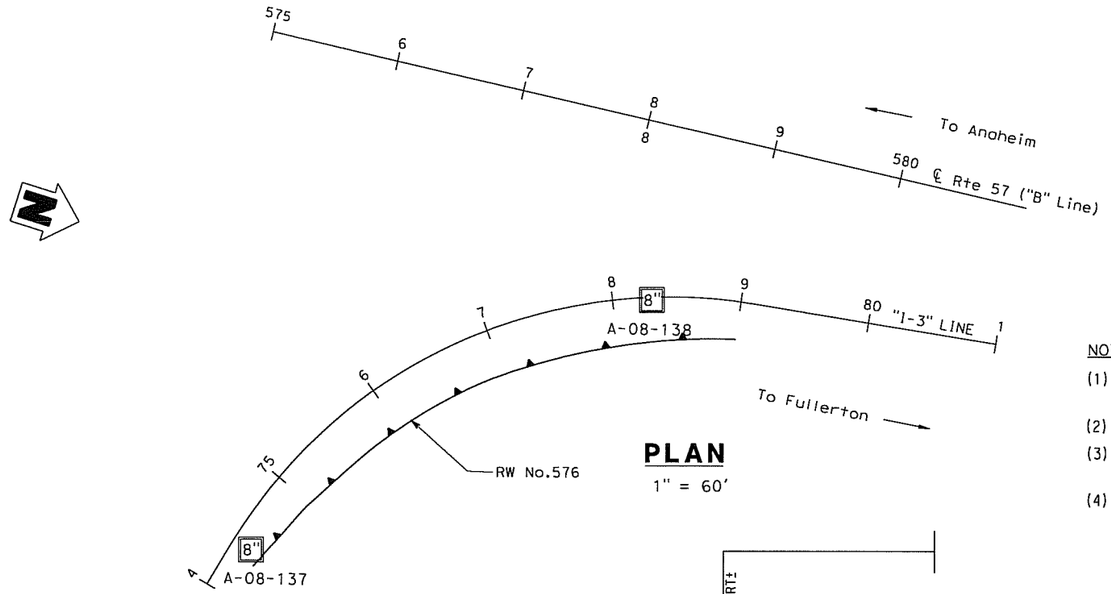
SCALE As Noted | BRIDGE 55-456 | FILE | DRAWING 55456-12

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 60'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

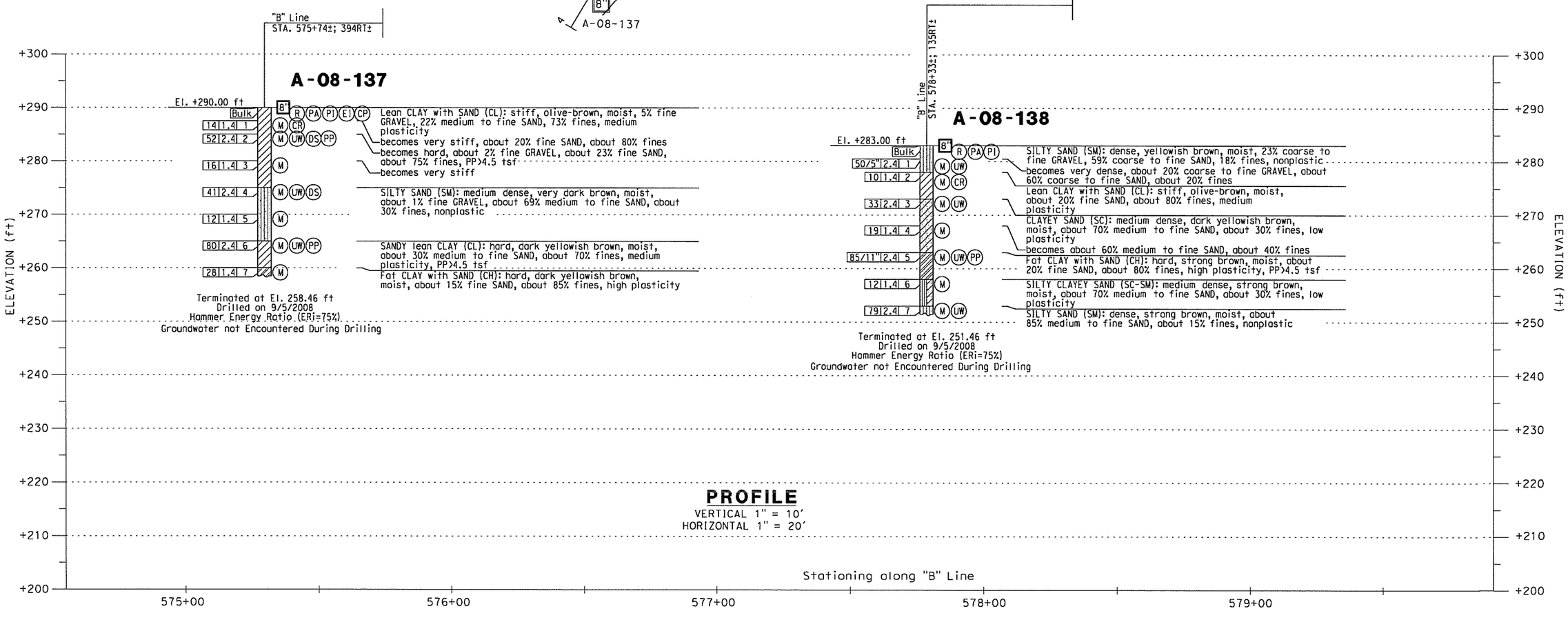
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. / POST MILES 16.2/18.6

RETAINING WALL NO. 576
LOG OF TEST BORINGS No. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET X OF X

DATE PLOTTED => 6/JUNE/09
TIME PLOTTED => 07:55

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

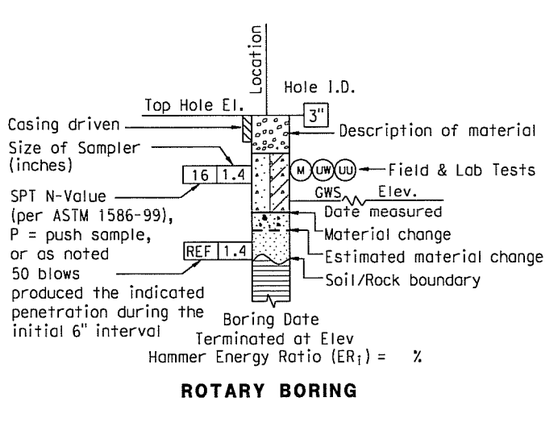
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

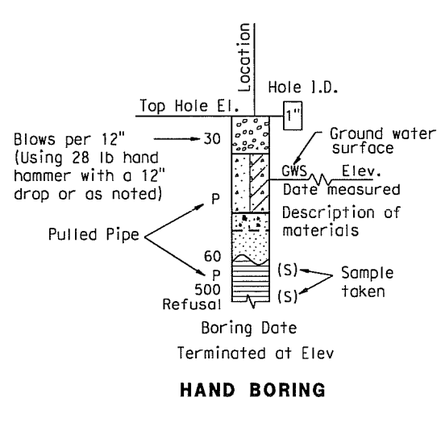
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

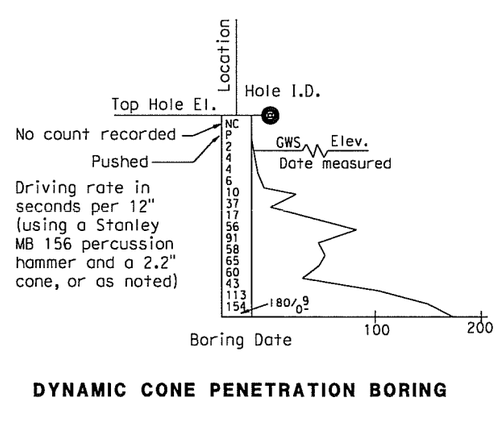
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



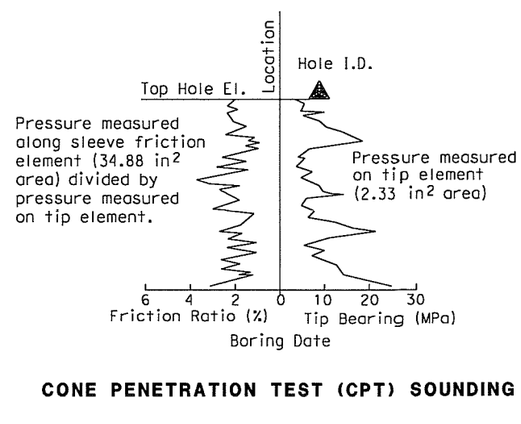
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6

RETAINING WALL NO. 576
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER
DATE PLOTTED => $DATE
TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.
POST MILES 16.2/18.6

RETAINING WALL NO. 576
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

APPENDIX A2

EXPLORATORY BORING LOGS FOR SOUND WALLS ON RETAINING WALLS

RW 462, RW 466, RW 474, RW 492, RW 526, RW 536, and RW 538

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Registered Professional Engineer — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — State of California

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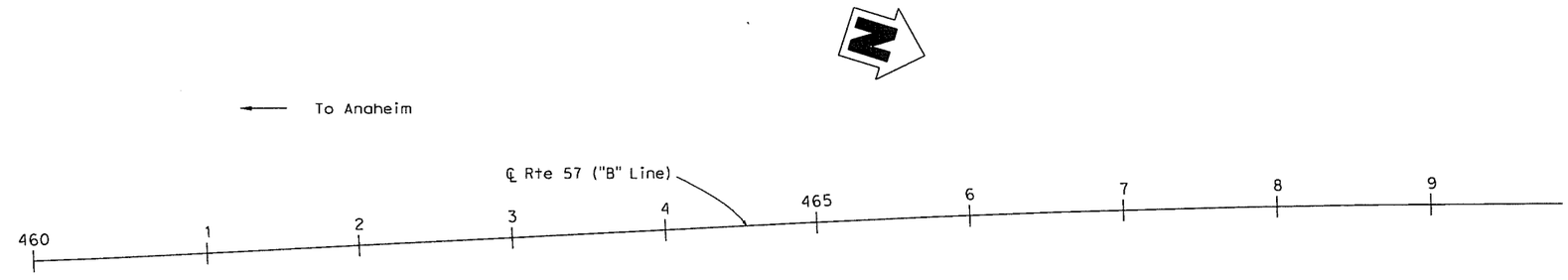
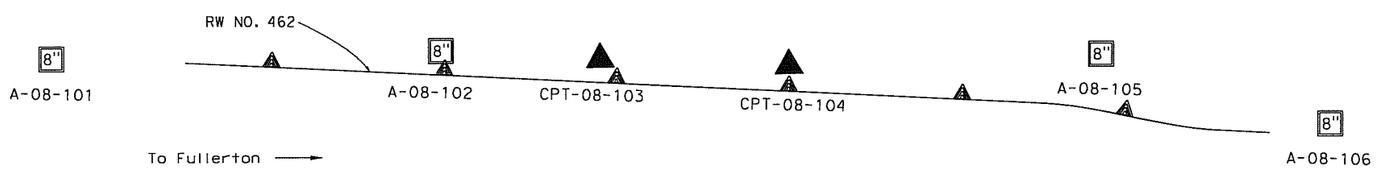
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708





PLAN

1" = 50'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER	BRIDGE NO. 55E0078 / POST MILES 16.2/18.6

RETAINING WALL NO. 462
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/08

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
NO. C 66394
EXP. 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

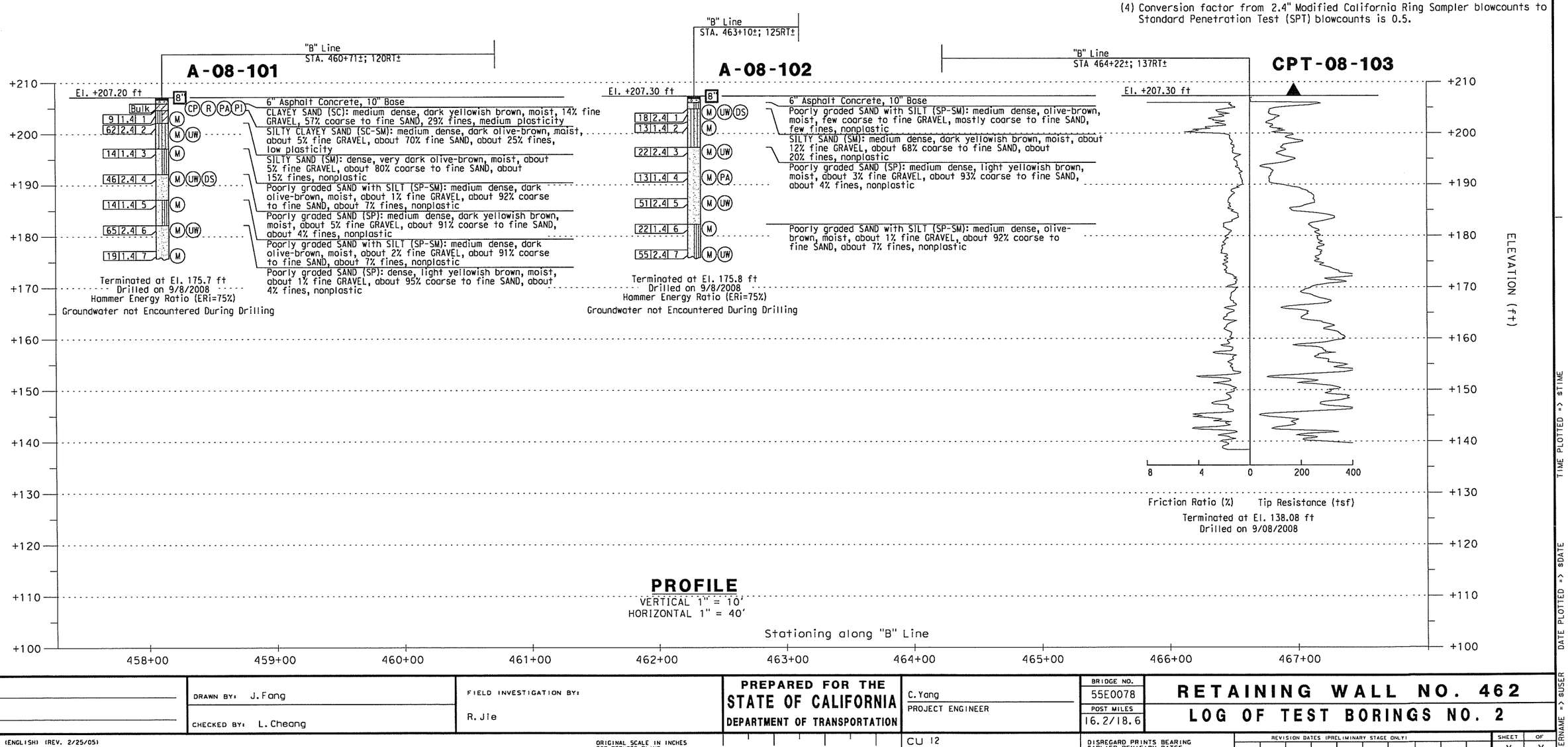
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 462, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0078 POST MILES 16.2/18.6	RETAINING WALL NO. 462 LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET X OF X

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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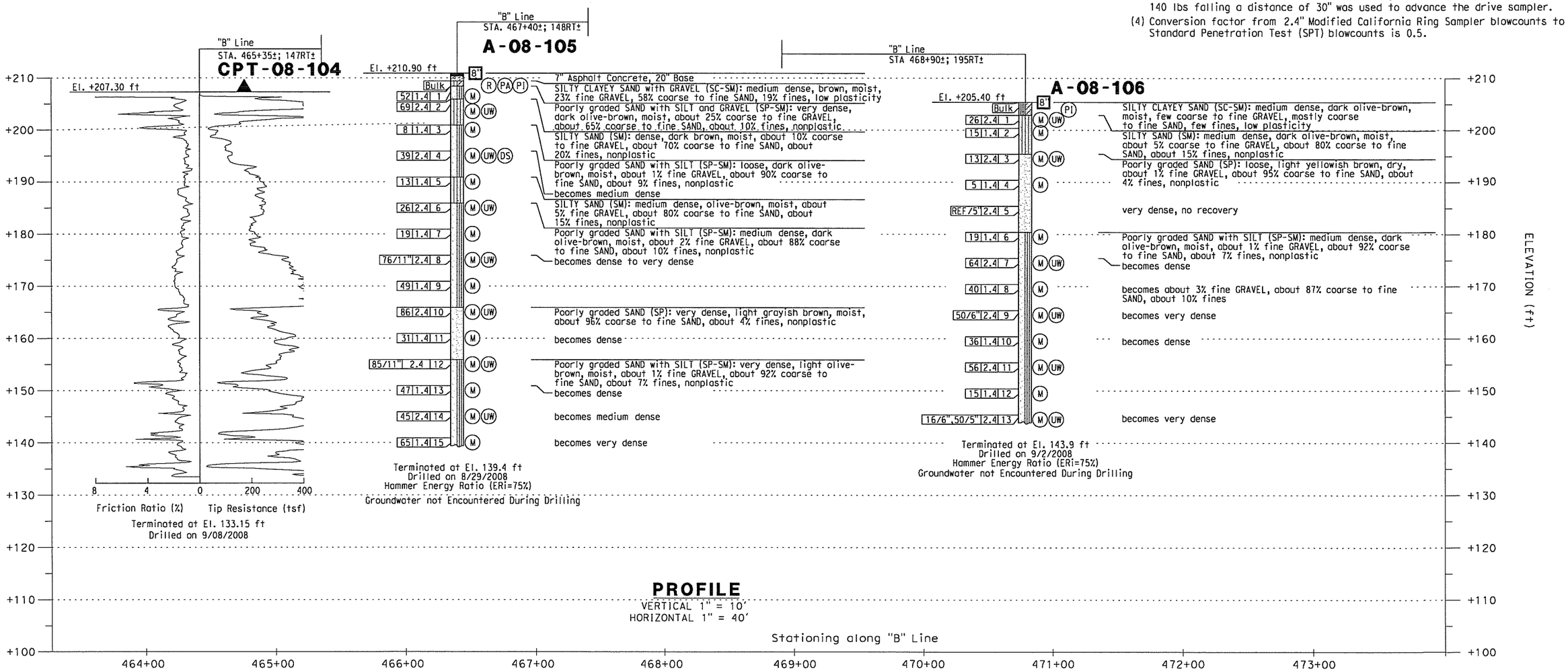
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 462, LOG OF TEST BORINGS NO. 1"

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0078	RETAINING WALL NO. 462	
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 3	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 39 OF 46

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
USERNAME => $USER

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

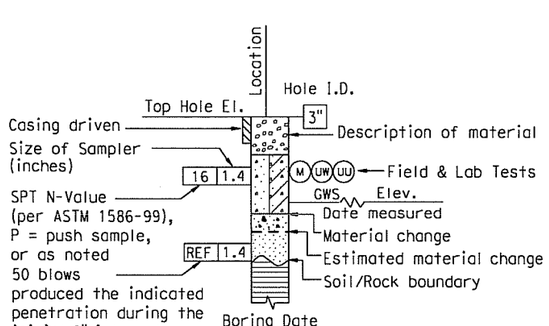
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

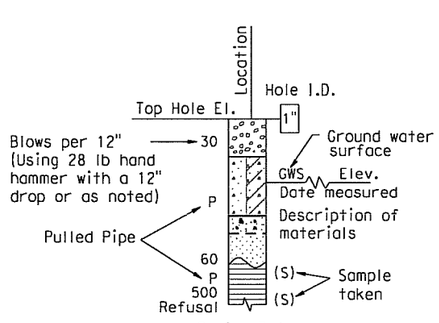
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

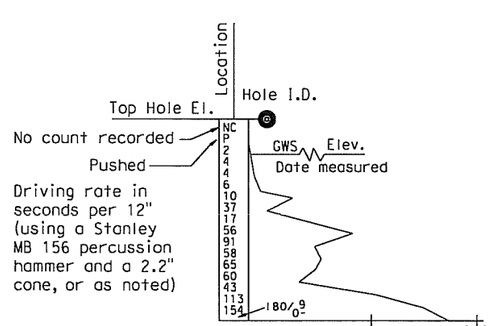
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



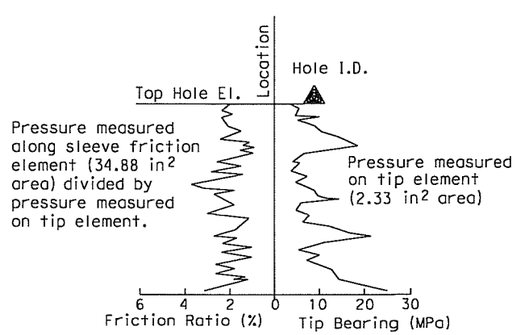
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0078 POST MILES 16.2/18.6

RETAINING WALL NO. 462

LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90)
Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166)
Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0078
POST MILES 16.2/18.6

RETAINING WALL NO. 462
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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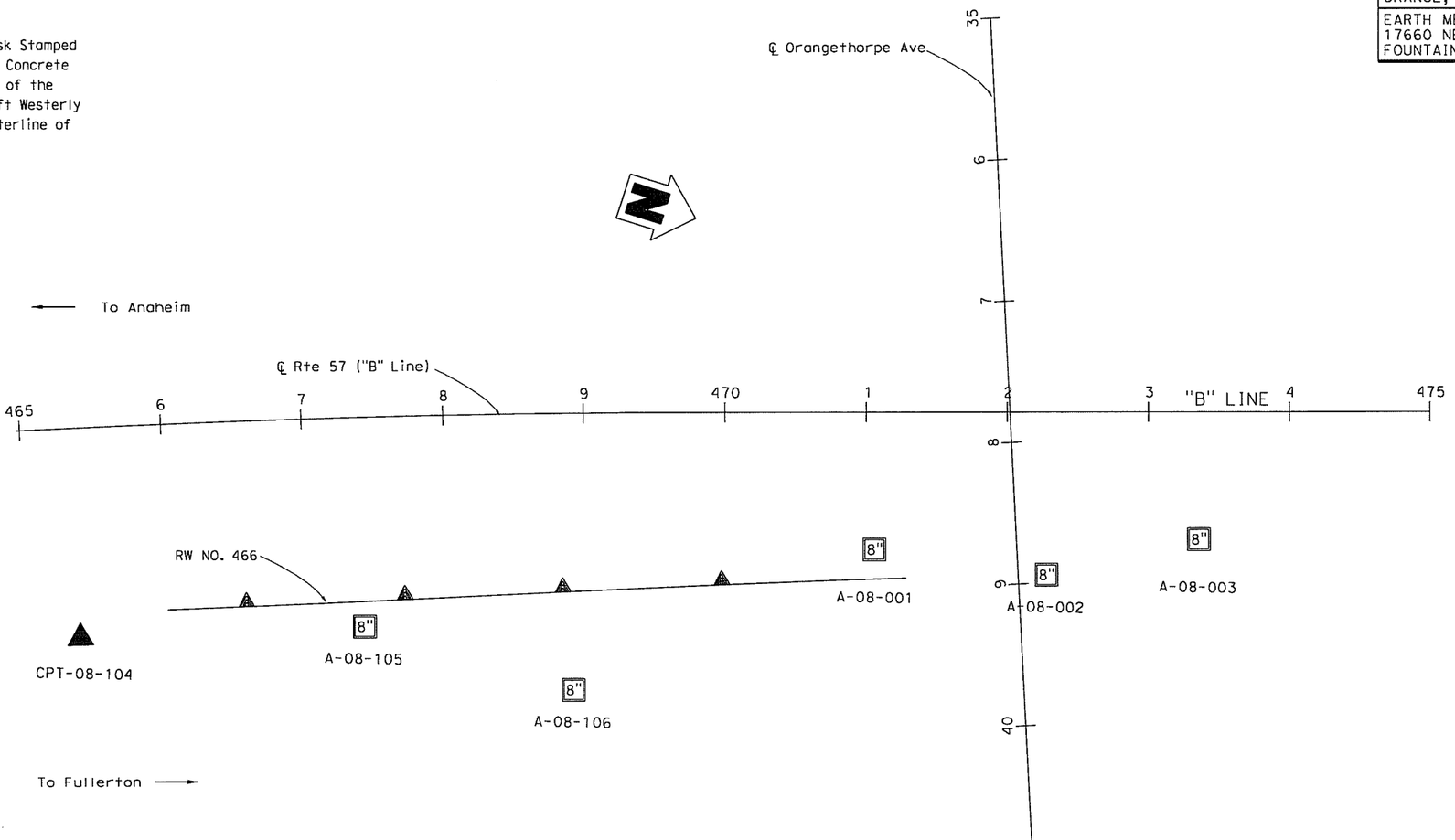
EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN
1" = 50'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER	BRIDGE NO. 55E0079 / POST MILES 16.2/18.6

RETAINING WALL NO. 466
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

USERNAME -> $USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 466, LOG OF TEST BORINGS NO. 1"

NOTES:
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(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
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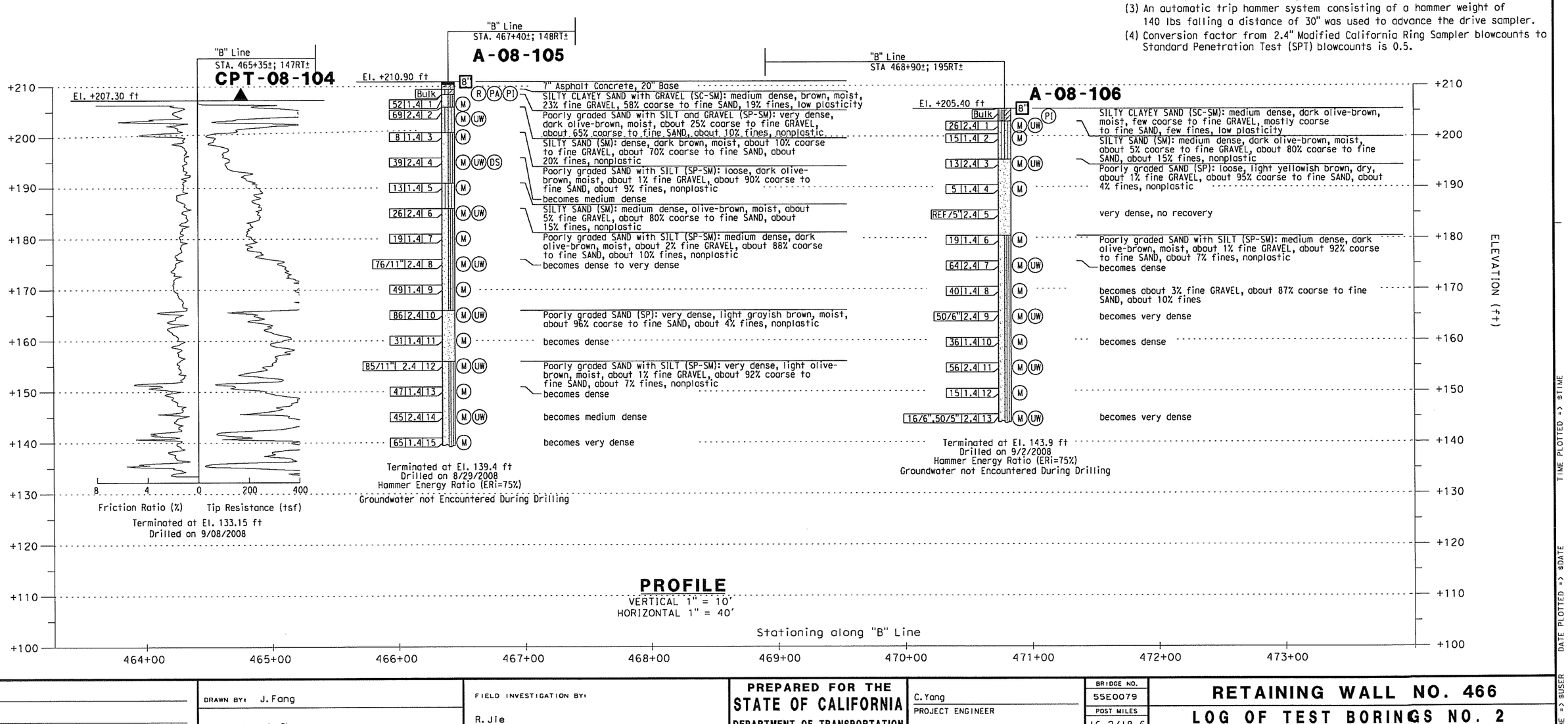

Bulk	52	69	8	39	13	26	19	76/11"	49	86	31	85/11"	47	45	65
Sample	1.4	2.4	1.4	2.4	1.4	2.4	1.4	2.4	1.4	2.4	1.4	2.4	1.4	2.4	1.4
Blows	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Moisture	M	M UW	M	M UW DS	M	M UW	M	M UW	M	M UW	M	M UW	M	M UW	M

Bulk	26	15	13	5	REF/5"	19	64	40	50/6"	36	56	15	16/6",50/5"
Sample	2.4	1.4	2.4	1.4	2.4	1.4	2.4	1.4	2.4	1.4	2.4	1.4	2.4
Blows	1	2	3	4	5	6	7	8	9	10	11	12	13
Moisture	M UW	M	M UW	M	M	M	M UW	M	M UW	M	M UW	M	M UW

ELEVATION (ft)	+210	+200	+190	+180	+170	+160	+150	+140	+130	+120	+110	+100
Stationing along "B" Line	464+00	465+00	466+00	467+00	468+00	469+00	470+00	471+00	472+00	473+00		

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO. 55E0079	RETAINING WALL NO. 466
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 2
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3		CU 12 EA 0F031I	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09	SHEET 39 OF 46

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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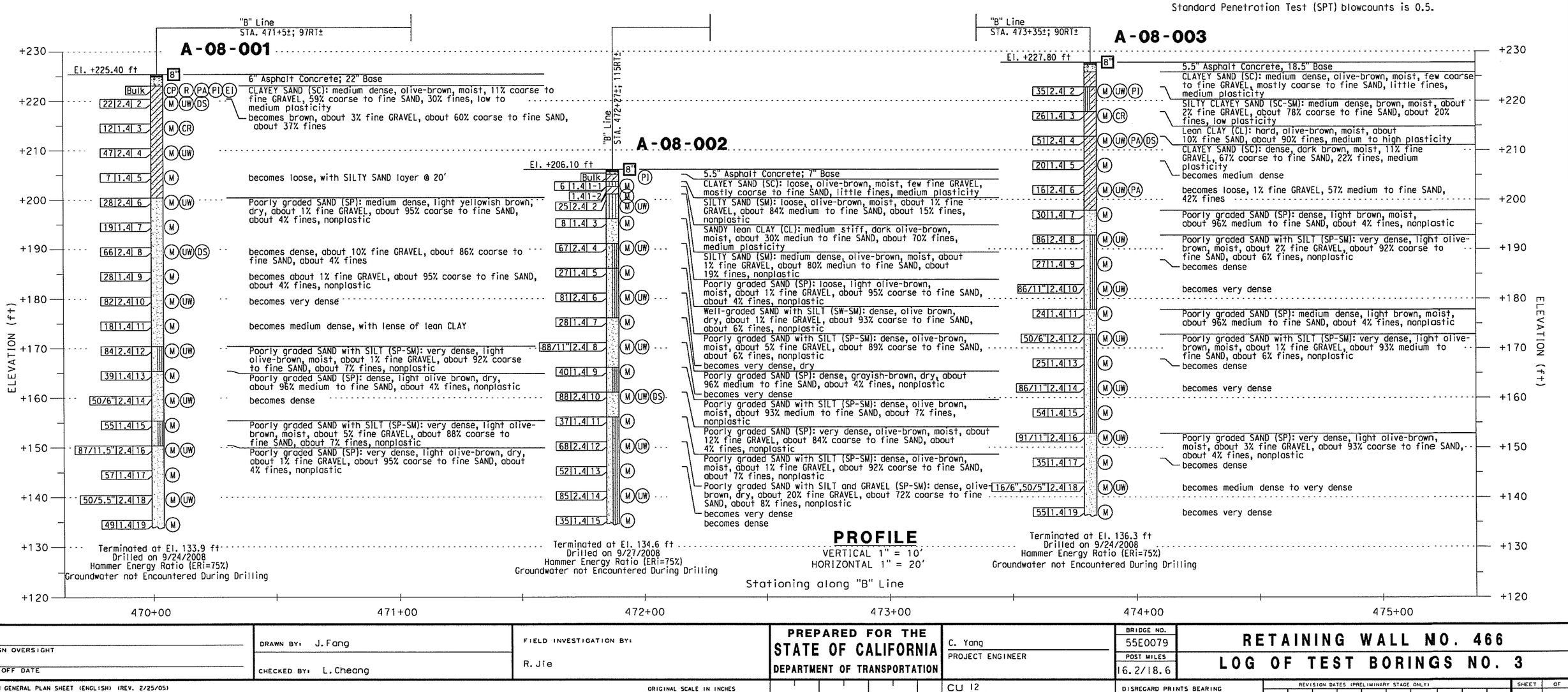

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0079 POST MILES 16.2/18.6

RETAINING WALL NO. 466
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET OF

DATE PLOTTED => $DATE
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USERNAME => $USER

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Chien-Tai Yang
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
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EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

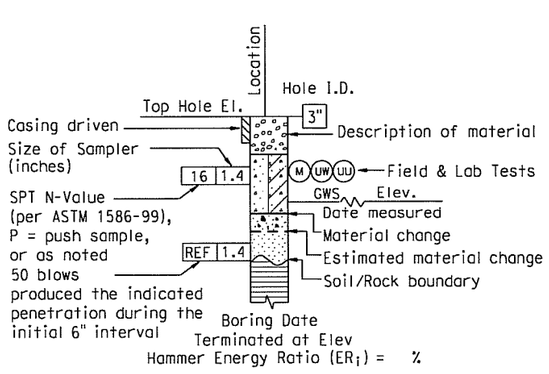
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

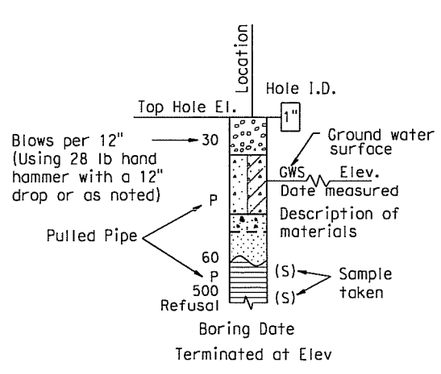
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

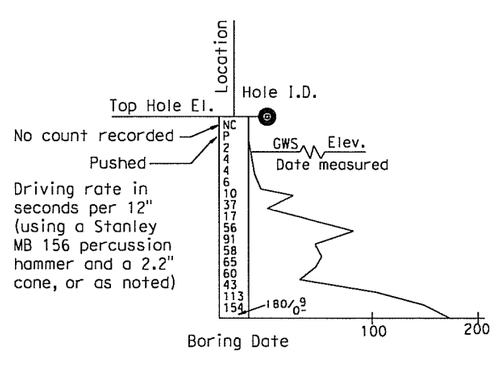
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



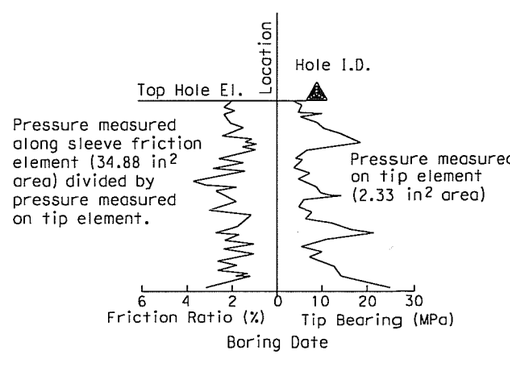
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0079	RETAINING WALL NO. 466
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0079
POST MILES 16.2/18.6

RETAINING WALL NO. 466
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57, 91	15.6/16.6, 5.0/6.7	726	852

REGISTERED PROFESSIONAL ENGINEER — LIND CHEANG — No. C 41401 — Exp. 09-30-99 — CIVIL — STATE OF CALIFORNIA

8-26-96
PLANS APPROVAL DATE

EARTH MECHANICS, INC.
Geotechnical & Earthquake Engineering
17660 NEWHOPE STREET, SUITE E ● FOUNTAIN VALLEY, CA. 92708
Phone (714) 751-3826

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DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

RETAINING WALL NO. 466

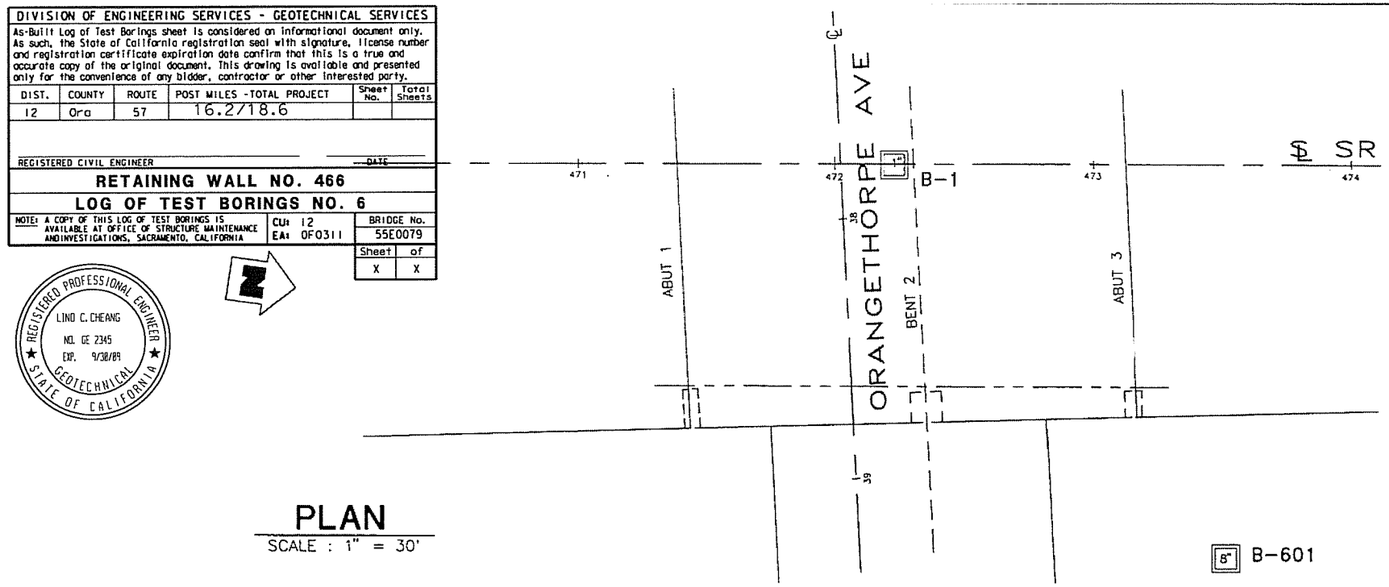
LOG OF TEST BORINGS NO. 6

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No.	
55E0079	
Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER — LIND C. CHEANG — No. GE 2345 — EXP. 9/30/99 — GEOTECHNICAL — STATE OF CALIFORNIA



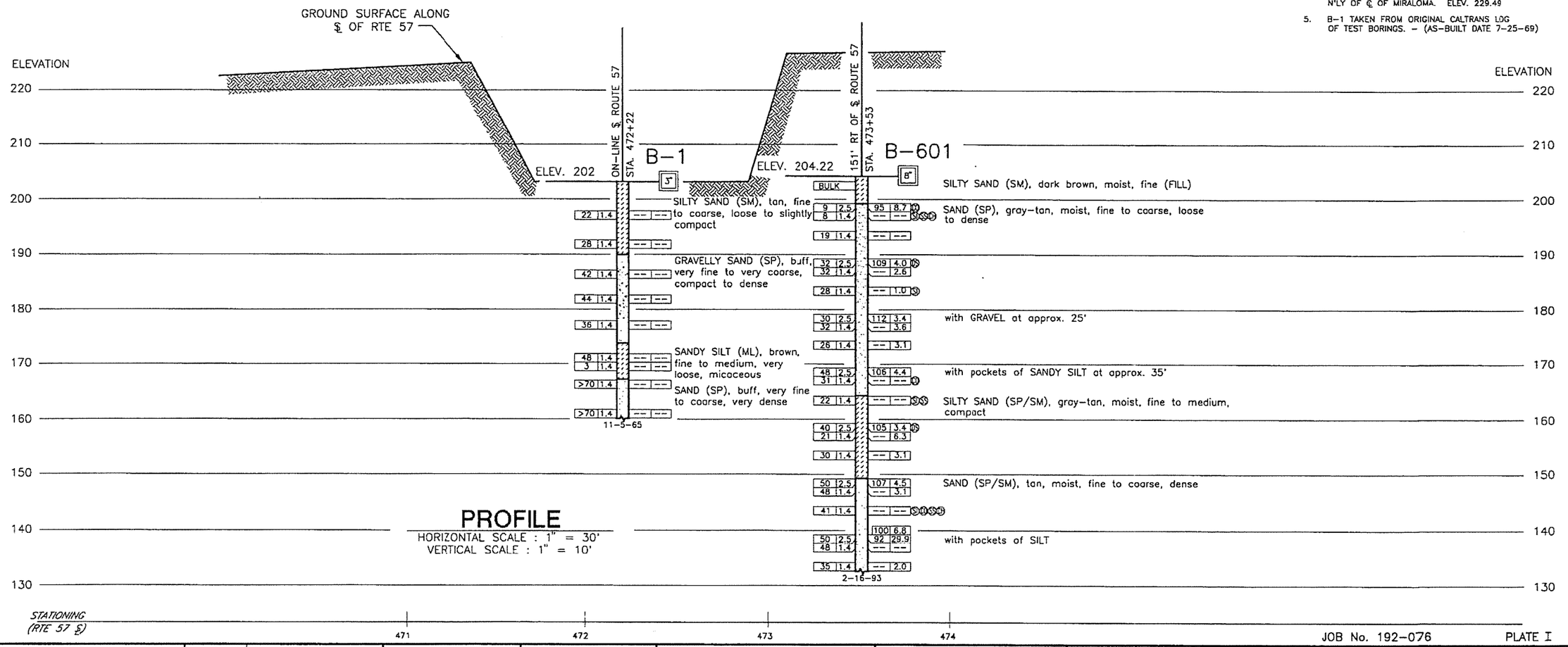
PLAN
SCALE : 1" = 30'

NO AS-BUILT CHANGES

AS BUILT
CORRECTIONS BY A.H. ALAHMAD
CONTRACT NO. 12-0125 U4
DATE 04-25-00

NOTES:

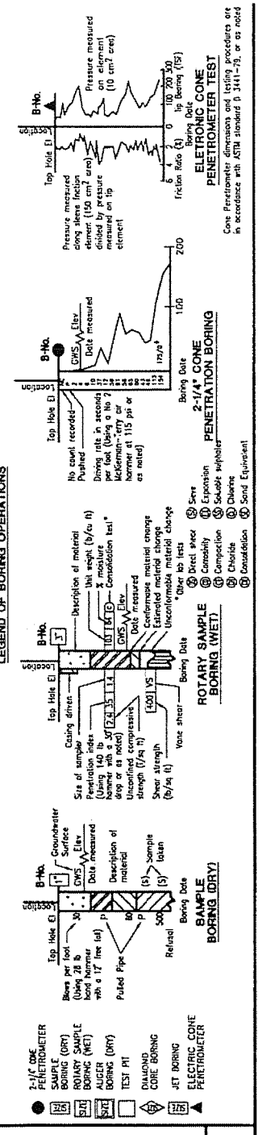
1. NO GROUNDWATER ENCOUNTERED.
2. ELEVATIONS BASED ON SURVEY BY COAST SURVEYING, INC.
3. BORING B-601 LOGGED BY ENRIQUE RIUTORT, STAFF ENGINEER.
4. BENCHMARK – 57/91-B-88(PM 15.9) –3.5 IN. DIA. CADT STA. MARK DISK SET IN EPOXY ON TOP OF PCC SIDEWALK ON THE NE'LY CORNER OF THE MIRALOMA AVE. BRIDGE OVER RTE-57 FWY, ABOUT 150 FT. E'LY OF ℄ OF RTE-57, 36 FT. N'LY OF ℄ OF MIRALOMA. ELEV. 229.49
5. B-1 TAKEN FROM ORIGINAL CALTRANS LOG OF TEST BORINGS. – (AS-BUILT DATE 7-25-69)



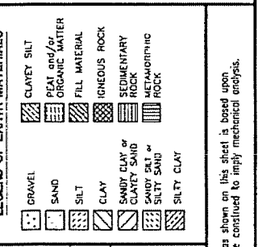
PROFILE
HORIZONTAL SCALE : 1" = 30'
VERTICAL SCALE : 1" = 10'

JOB No. 192-076 PLATE I

LEGEND OF BORING OPERATIONS



LEGEND OF EARTH MATERIALS



CONSISTENCY CLASSIFICATION FOR SOILS
According to the Standard Penetration Test

Penetration Index (blows/Ft)	Granular	Cohesive
0-4	Very loose	Very soft
5-9	Loose	Soft
10-19	Slightly compact	Stiff
20-34	Compact	Very stiff
35-69	Dense	Hard
>70	Very dense	Very hard

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BE NGUYEN — DESIGN OVERSIGHT — SIGN OFF DATE 3-13-96	DRAWN BY	JOE MAGLIATO	E.A. RIUTORT — FIELD INVESTIGATOR — DATE 2-16-93	M&T AGRA — Geotechnical and Environmental Services	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
	CHECK BY	E.A. RIUTORT			Y. NIEN WANG — PROJECT ENGINEER

BRIDGE NO.	ORANGETHORPE AVE UC (WIDEN)
55-0459	LOG OF TEST BORINGS
POST MILE 16.4	

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

CU 12209

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) — SHEET OF

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8-26-96
TO ACCOMPANY PLANS DATED

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57, 91	15.6/16.6, 5.0/6.7	727	852

Bridge No. 55-0459

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	Ora.	57	16.4/16.6	247	247

October 17, 1996

BENCH MARK
BM "472 R-62 Elev 203.41
Set P/S in S. curb Orangethorpe Ave. 134' E. of ℄ Orange Fwy. 100' W of ℄ Nebraska Ave.

B-1 N 620,443.821 E 504,258.785

℄ CONST. RTE 57

℄ SURVEY

STA. LINE ORANGETHORPE AVE.

PLAN
Scale: 1" = 20'

NO AS-BUILT CHANGES

AS BUILT
CORRECTIONS BY M.ALAHMAD
CONTRACT NO. 12-0125 U4
04-25-00

AS-BUILT PLANS
Contract No. 07-032114
Date Completed
Document No. 7000057

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

RETAINING WALL NO. 466

LOG OF TEST BORINGS NO. 7

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 EA: 0F0311

BRIDGE No. 55E0079

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER
LIND C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

LEGEND OF EXPLORATIONS
Penetrometer; 2½" Cone Penetrometer; Sample Borings (Hvy); Rotary Borings (Hvy); Auger Borings (Hvy); Jet Borings; Core Borings; Test Pit
1st Soil Type; Rotary Borings; Penetration Borings

LEGEND OF EARTH MATERIALS
Silty Clay or Clay; Fill Mix; Organic Matter; Fill Material; Igneous Rock; Sedimentary Rock; Metamorphic Rock; Gravels; Sands; Silt; Clay; Sandy Silt or Silty Sand

CLASSIFICATION OF MATERIAL BASED ON STANDARD CHART SOIL LIMITS

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

B-2 B-3 B-1 B-4 B-5

PROFILE
Scale: Vert. 1" = 10', Horiz. 1" = 20'

Appror. existing ground line along ℄ CONST. RTE 57

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE 11-95

Loose to slightly compact, fine silty, fine to coarse sand.
Compact to dense, buff, gravelly, very fine to very coarse sand.
Very dense, buff very fine to coarse sand.

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
10 10

ORANGETHORPE AVENUE OVERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-459 | FILE | DRAWING 55459-10

BE NGUYEN
DESIGN OVERSIGHT
3-13-96
SIGNOFF DATE

NOTE:
ADDITIONAL AS-BUILT FOUNDATION DATA MAY BE AVAILABLE AT THE OFFICE OF TRANSPORTATION MATERIALS AND RESEARCH 5900 FOLSOM BOULEVARD, SACRAMENTO, CALIFORNIA 95819

DESIGN	J. Hueser	CHECKED	D. Kuang
DETAILS	T. Elofson	CHECKED	D. Novak
QUANTITIES	J. Hueser	CHECKED	L. Woo

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Y. Nien Wang
PROJECT ENGINEER

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

CU 12209
EA 0125U1

BRIDGE No. 55-0459
POST MILE 16.4

ORANGETHORPE AVE UC (WIDEN)
AS-BUILT LOG OF TEST BORINGS

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 5/3/94

SHEET 15 OF 15

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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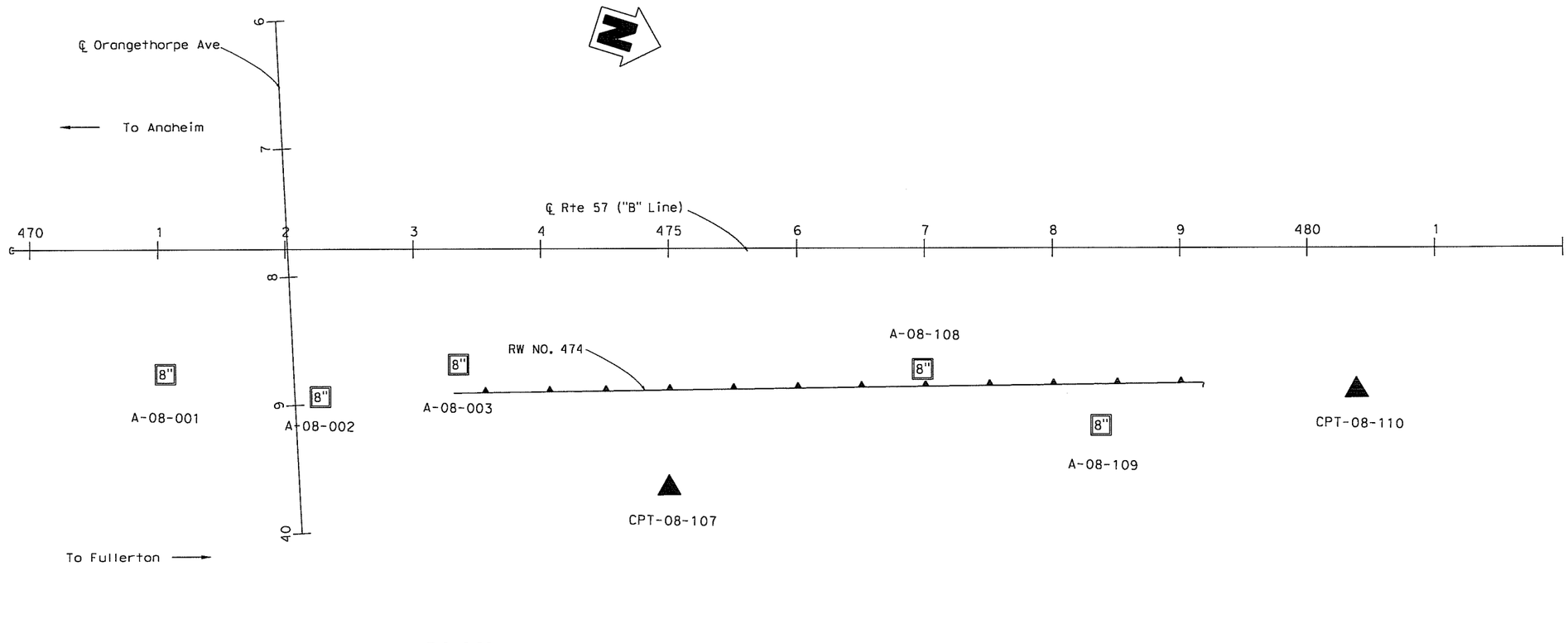
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN
1" = 50'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0080 / POST MILES 16.2/18.6

RETAINING WALL NO. 474
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 474, LOG OF TEST BORINGS NO. 1"

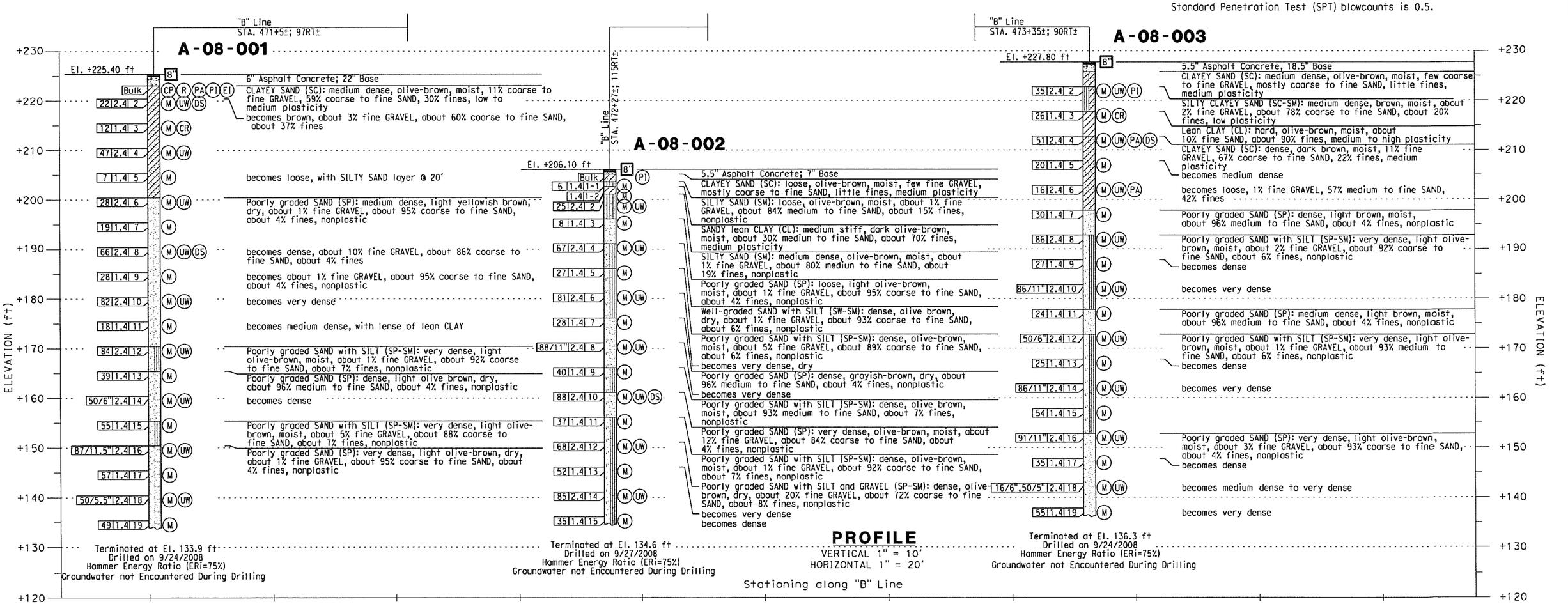
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0080 POST MILES 16.2/18.6

RETAINING WALL NO. 474
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

USERNAME => $USER
DATE PLOTTED => $DATE
TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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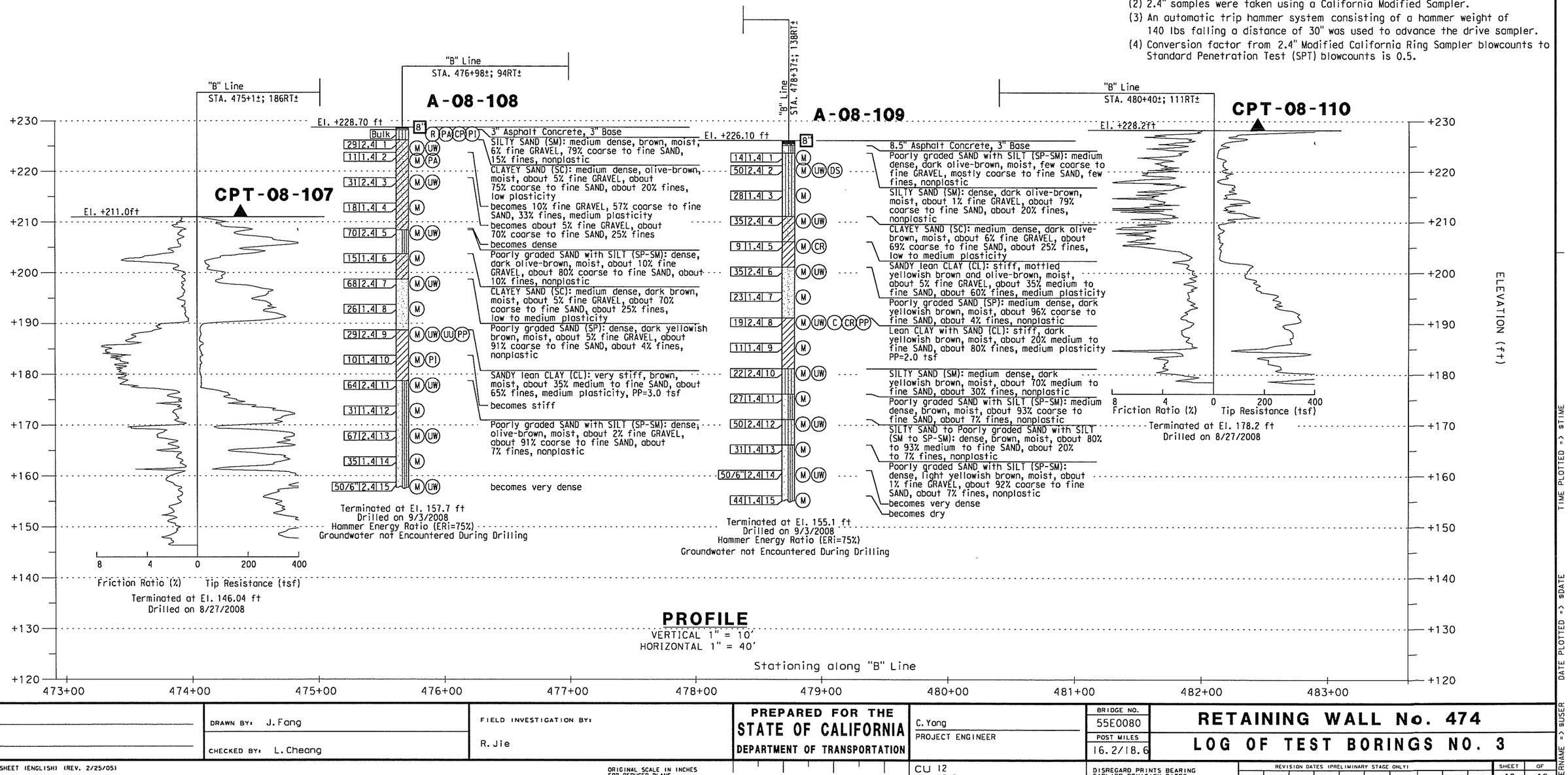
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 474, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0080
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6

RETAINING WALL No. 474

LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET 40 OF 46

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

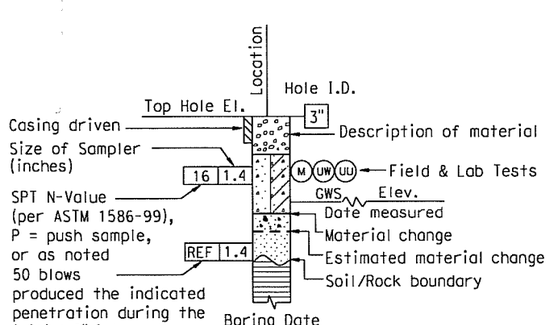
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

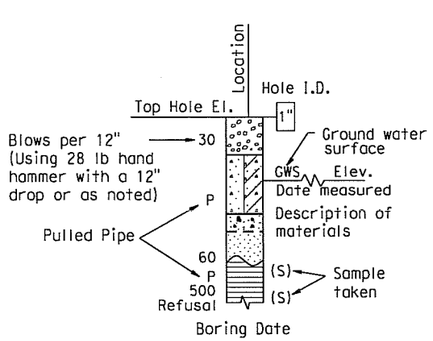
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

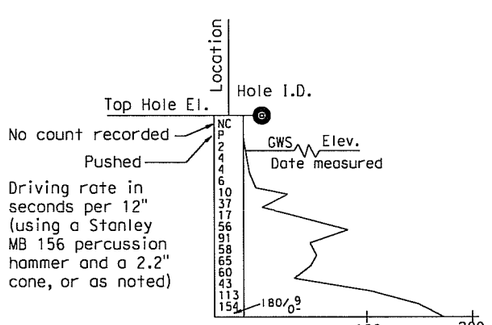
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



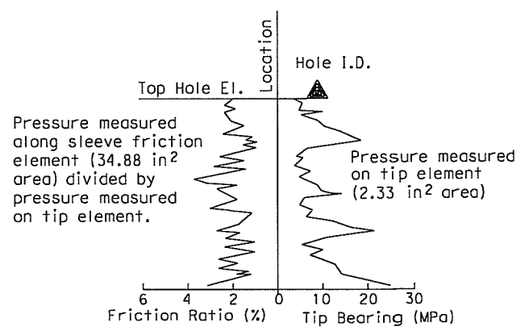
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0080 POST MILES 16.2/18.6	RETAINING WALL NO. 474 LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
USERNAME => $USER

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0080
POST MILES 16.2/18.6

RETAINING WALL NO. 474
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

USERNAME => $USER
DATE PLOTTED => $DATE
TIME PLOTTED => $TIME

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

RETAINING WALL NO. 474

LOG OF TEST BORINGS NO. 6

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 EA: 0F0311

BRIDGE No.	
55E0080	
Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER — LIND C. CHEANG — NO. GE 2345 — EXP. 9/30/09 — GEOTECHNICAL — STATE OF CALIFORNIA

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57, 91	15.6/16.6, 5.6/6.7	726	852

REGISTERED PROFESSIONAL ENGINEER — LIND C. HEANG — No. C 41401 — Exp. 09-30-99 — CIVIL — STATE OF CALIFORNIA

8-26-96
PLANS APPROVAL DATE

EARTH MECHANICS, INC.
Geotechnical & Earthquake Engineering
17660 NEWHOPE STREET, SUITE E ● FOUNTAIN VALLEY, CA. 92708
Phone (714) 751-3826

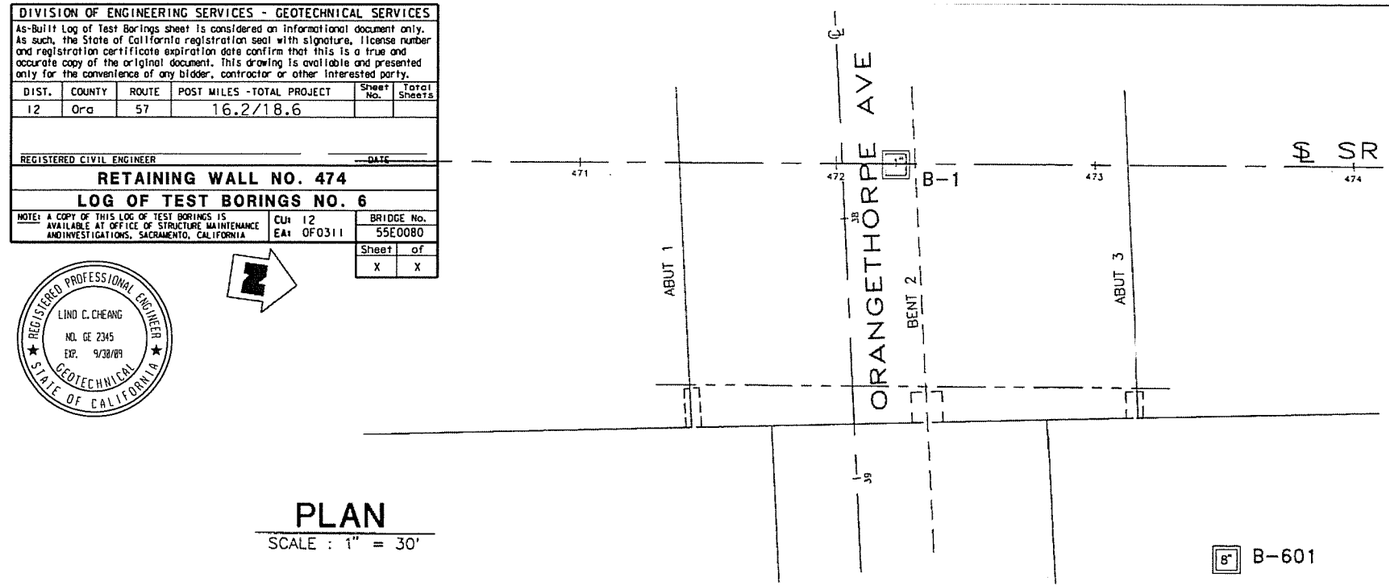
THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

NO AS-BUILT CHANGES

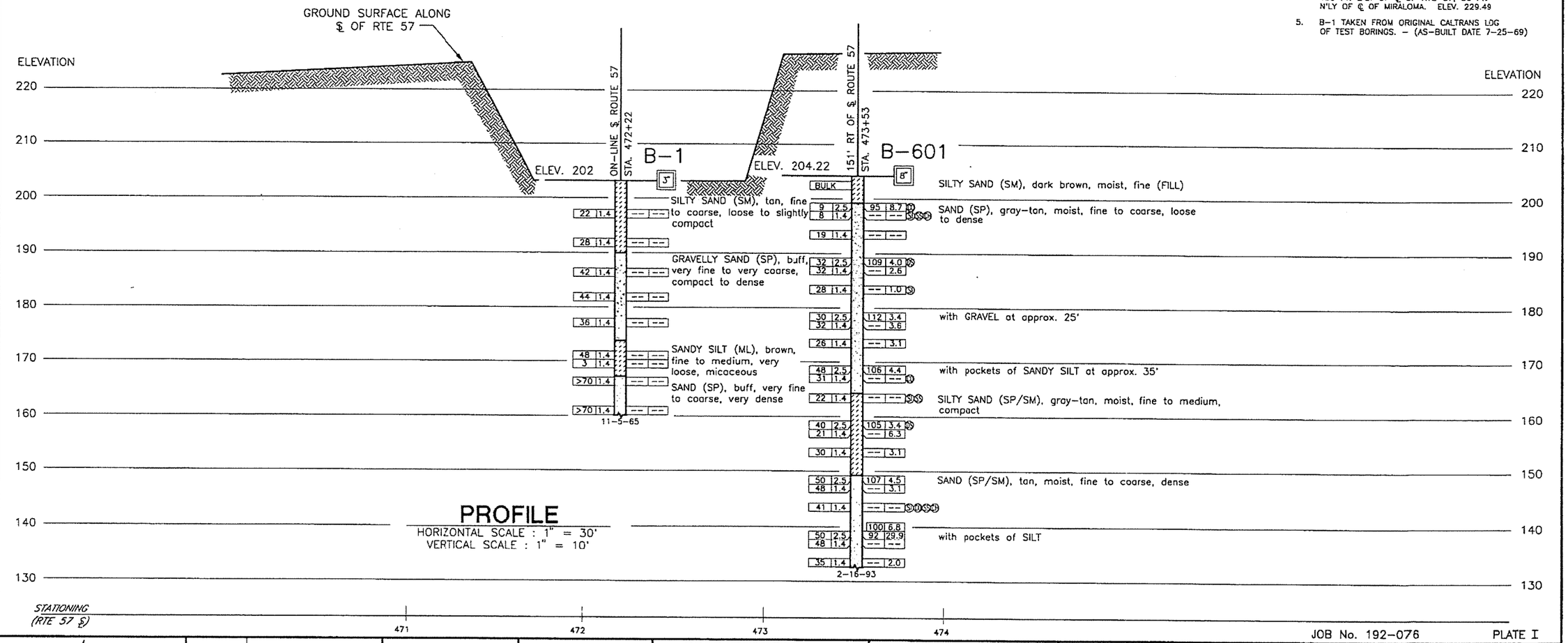
AS BUILT
CORRECTIONS BY AH ALAHMAD
CONTRACT NO. 12-0125 U4
DATE 04-25-00

NOTES:

1. NO GROUNDWATER ENCOUNTERED.
2. ELEVATIONS BASED ON SURVEY BY COAST SURVEYING, INC.
3. BORING B-601 LOGGED BY ENRIQUE RIUTORT, STAFF ENGINEER.
4. BENCHMARK – 57/91-B-88(PM 15.9) –3.5 IN. DIA. CADT STA. MARK DISK SET IN EPOXY ON TOP OF PCC SIDEWALK ON THE NE'LY CORNER OF THE MIRALONA AVE. BRIDGE OVER RTE-57 FWY, ABOUT 150 FT. E'LY OF ℄ OF RTE-57, 36 FT. N'LY OF ℄ OF MIRALOMA. ELEV. 229.49
5. B-1 TAKEN FROM ORIGINAL CALTRANS LOG OF TEST BORINGS. – (AS-BUILT DATE 7-25-69)

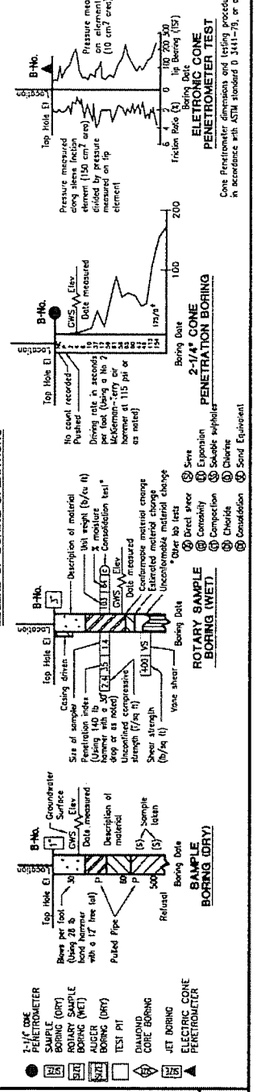


PLAN
SCALE : 1" = 30'



PROFILE
HORIZONTAL SCALE : 1" = 30'
VERTICAL SCALE : 1" = 10'

LEGEND OF BORING OPERATIONS



LEGEND OF EARTH MATERIALS

GRAVEL · SAND · SILT · CLAY · SANDY CLAY or CLAYEY SAND · SANDY SILT or SILTY SAND · SILTY CLAY · CLAYEY SILT · PEAT and/or ORGANIC MATTER · FILL MATERIAL · IGNEOUS ROCK · SEDIMENTARY ROCK · METAMORPHIC ROCK

CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

Penetration Index (blows/ft)	Granular	Cohesive
0–4	Very loose	Very soft
5–9	Loose	Soft
10–19	Slightly compact	Stiff
20–34	Compact	Very stiff
35–69	Dense	Hard
>70	Very dense	Very hard

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BE NGUYEN — DESIGN OVERSIGHT — SIGN OFF DATE 3-13-96	DRAWN BY	JOE MAGLIATO	E.A. RIUTORT — FIELD INVESTIGATOR — DATE 2-16-93
	CHECK BY	E.A. RIUTORT	

M&T AGRA — Geotechnical and Environmental Services

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Y. NIEN WANG — PROJECT ENGINEER

CU 12209

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

DISREGARD PRINTS BEARING EARLIER PRELIMINARY DATES

REVISION DATES (PRELIMINARY STAGE ONLY) | SHEET | OF

JOB No. 192-076 — PLATE I

BRIDGE NO.	
55-0459	
POST MILE	
16.4	

ORANGETHORPE AVE UC (WIDEN)

LOG OF TEST BORINGS

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

8-26-96
TO ACCOMPANY PLANS DATED

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57, 91	15.6/16.6, 5.0/6.7	727	852

BENCH MARK
BM #172 R-65
Set P/S in S. curb Orangethorpe Ave. 194 E. of ℄ Orange Fwy. 100' W of ℄ Nebraska Ave.
Elev 203.41

B-1 B-2 B-3 B-4 B-5

N 620,443.821
E 501,258.785

℄ CONST. RTE 57

℄ SURVEY LINE ORANGETHORPE AVE.

STA. 471 472 473 35 36 37 95 96

PLAN
Scale: 1" = 20'

PROFILE
Scale: Vert 1" = 10'
Horiz. 1" = 20'

Appox. existing ground line along ℄ CONST. RTE 57

B-2: 203' from STA. 471+46.46 ℄ CONST. RTE 57
B-3: 204' from STA. 471+41 ℄ CONST. RTE 57
B-1: 202' On line Sta. 472+22 ℄ CONST. RTE 57
B-4: 203' 6.8 Rt. Sta. 472+71 ℄ CONST. RTE 57
B-5: 202' 125.4 Lt. Sta. 472+71 ℄ CONST. RTE 57

Loose to slightly compact, fine silty, fine to coarse sand.
Compact to dense, buff, gravelly, very fine to very coarse sand.
Very dense, brown, cemented, sandy silt.
Very dense, buff very fine to coarse sand.

Elev 200 190 180 170
Sta 470 471 472 473 474

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE 11-8-65

NO AS-BUILT CHANGES

AS BUILT
CORRECTIONS BY AM ALAHMAD
CONTRACT NO. 12-0125 U4
04-25-00

AS-BUILT PLANS
Contract No. 07-032114
Date Completed
Document No. 7000057X

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

RETAINING WALL NO. 474

LOG OF TEST BORINGS NO. 7

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No. 55E0080

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER
LIND C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

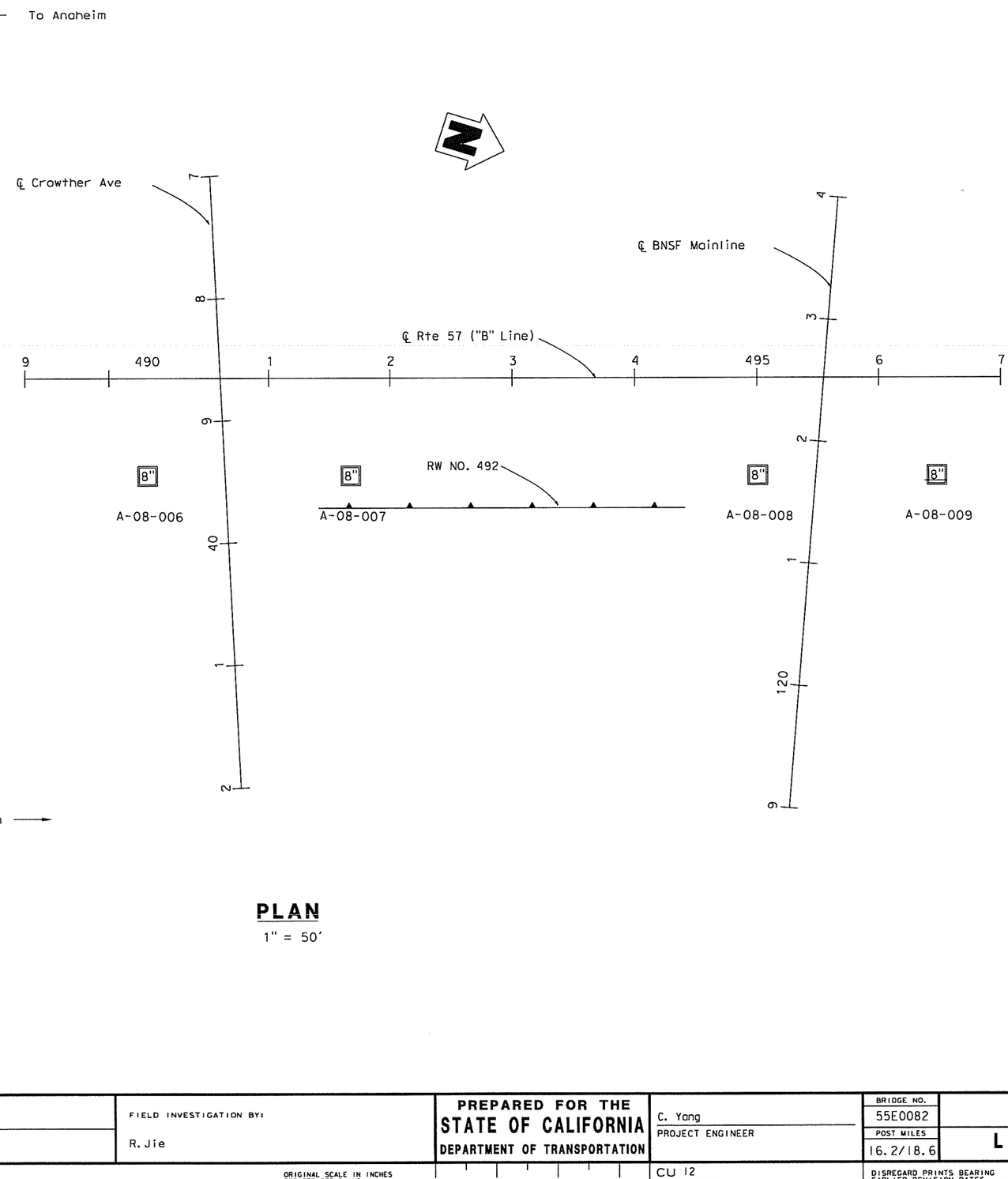
LEGEND OF BORING OPERATIONS
Penetrometer; 2½" Cone Penetrometer; Penetration Boring; Standard Boring (Dry); Rotary Boring (Dry); Rotary Boring (Wet); Auger Boring (Dry); Jet Boring; Cone Boring; Test Pit; Boring Number; Top Hole Elevation; Bottom Hole Elevation; Rotary Advance; Auger Advance; Jet Advance; Cone Advance; Standard Penetration Blow Count; Cone Penetration Blow Count; Undisturbed Sample; Disturbed Sample; Water Level at Time of Drilling; Water Level at Time Shown; Water Level at Time Shown Dry; Water Level at Time Shown Caved; Water Level at Time Shown Flowing; Water Level at Time Shown Sealed; Water Level at Time Shown Dry Caved; Water Level at Time Shown Dry Sealed; Water Level at Time Shown Caved Sealed; Water Level at Time Shown Dry Caved Sealed; Water Level at Time Shown Flowing Sealed; Water Level at Time Shown Flowing Caved; Water Level at Time Shown Flowing Caved Sealed; Water Level at Time Shown Flowing Dry; Water Level at Time Shown Flowing Dry Sealed; Water Level at Time Shown Flowing Dry Caved; Water Level at Time Shown Flowing Dry Caved Sealed; Water Level at Time Shown Flowing Dry Caved Sealed; Water Level at Time Shown Flowing Dry Caved Sealed

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0082
POST MILES 16.2/18.6

RETAINING WALL NO. 492
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
USERNAME => $USER

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 492, LOG OF TEST BORINGS NO. 1"

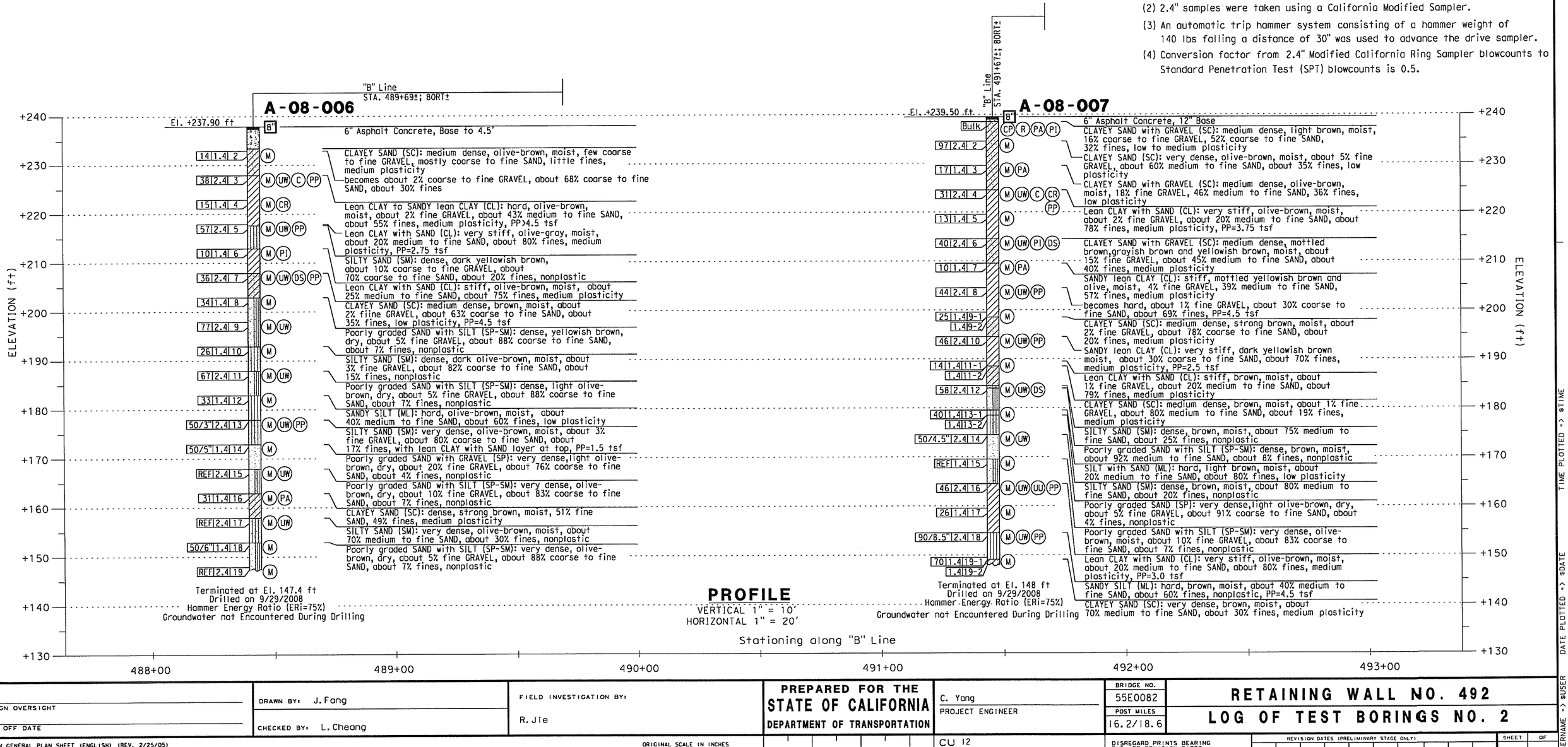
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0082 POST MILES 16.2/18.6

RETAINING WALL NO. 492
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3	CU 12 EA 0F031I	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09	SHEET / OF

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yong — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 492, LOG OF TEST BORINGS NO. 1"

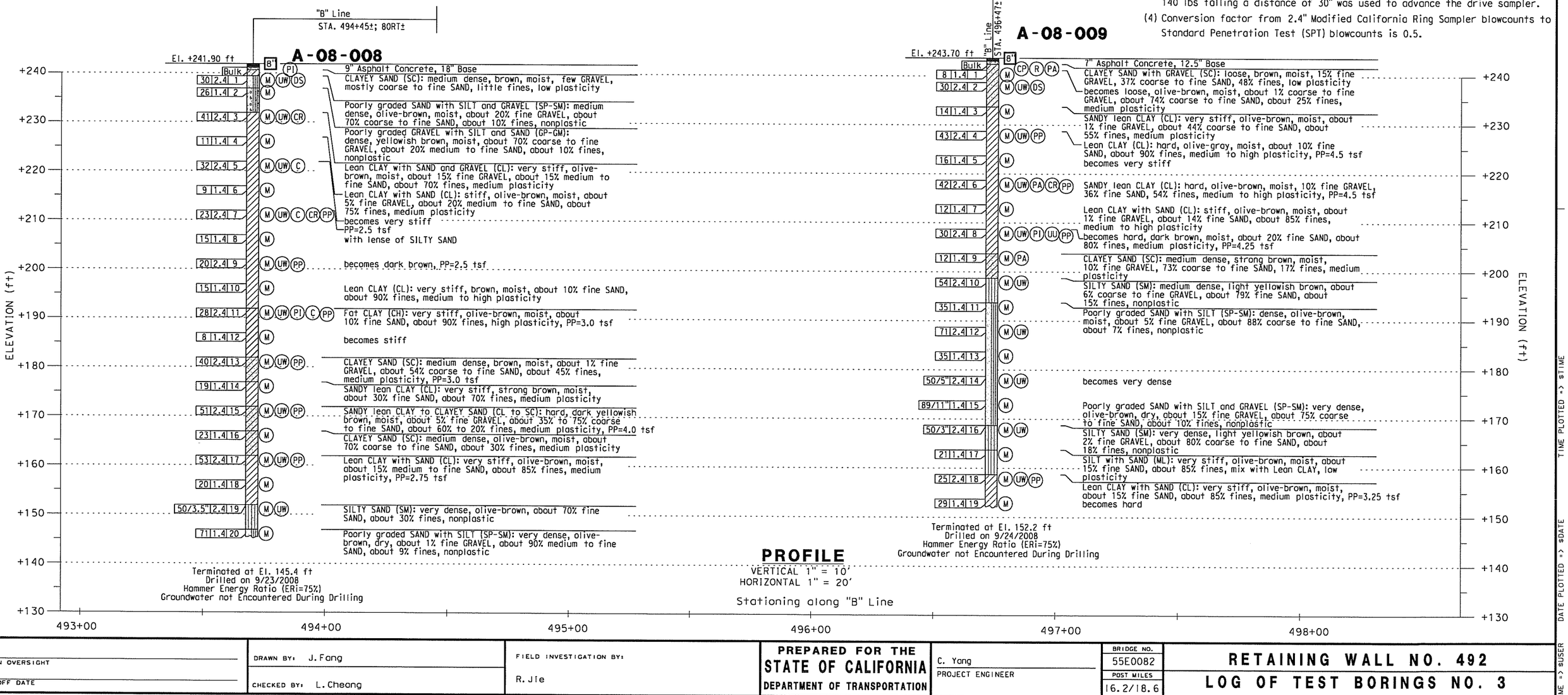
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO. 55E0082
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6

RETAINING WALL NO. 492
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET OF

USERNAME -> $USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

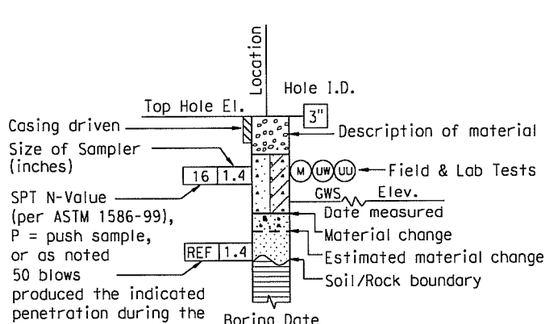
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

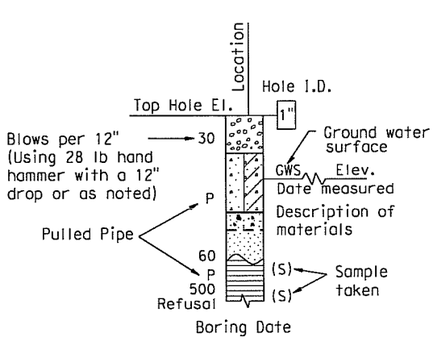
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

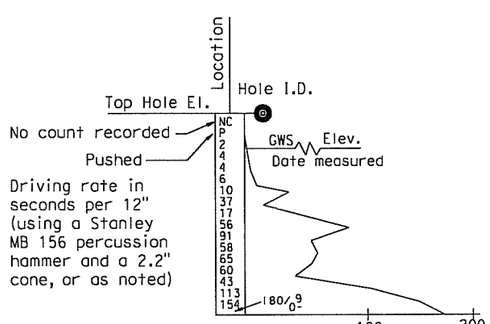
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



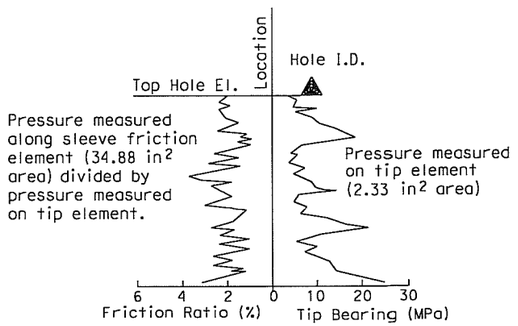
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0082	RETAINING WALL NO. 492
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0082
POST MILES 16.2/18.6

RETAINING WALL NO. 492
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	476	491

Karl Bhushan 12/28/89
GEOTECHNICAL PROFESSIONAL
10-29-90
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — KIRL BHUSHAN — No. GE 000144 — Exp. 12/31/1989 — GEOTECHNICAL — STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

RETAINING WALL NO. 492

LOG OF TEST BORINGS NO. 6

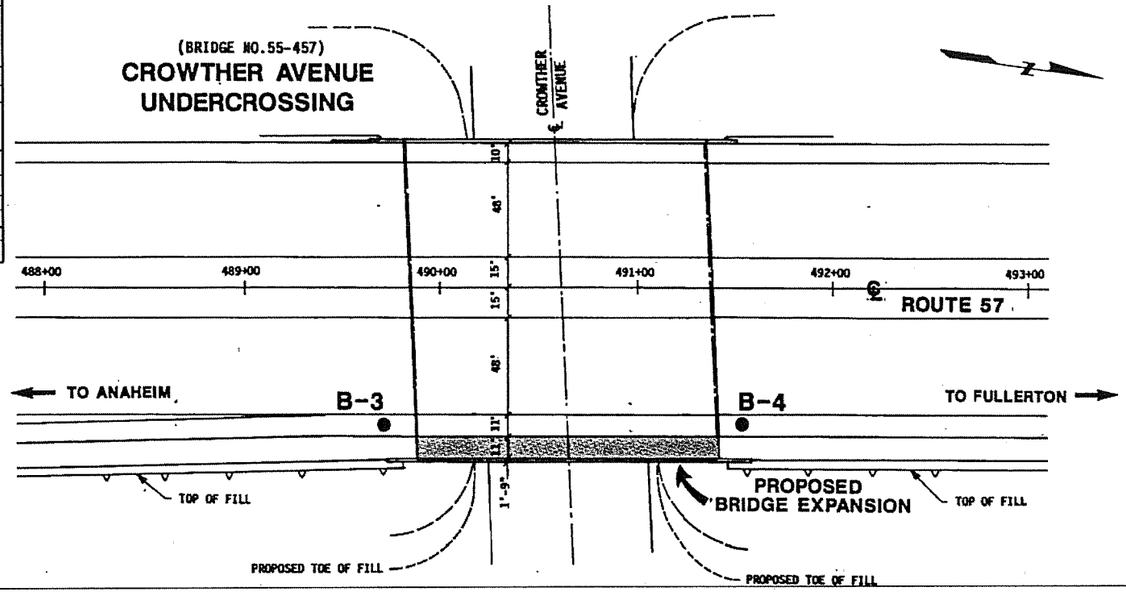
NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 - EA: 0F0311

BRIDGE No.	
55E0082	
Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER — LIND C. CHEANG — NO. GE 2345 — EXP. 9/30/89 — GEOTECHNICAL — STATE OF CALIFORNIA

(BRIDGE NO.55-457)
CROWTHER AVENUE UNDERCROSSING

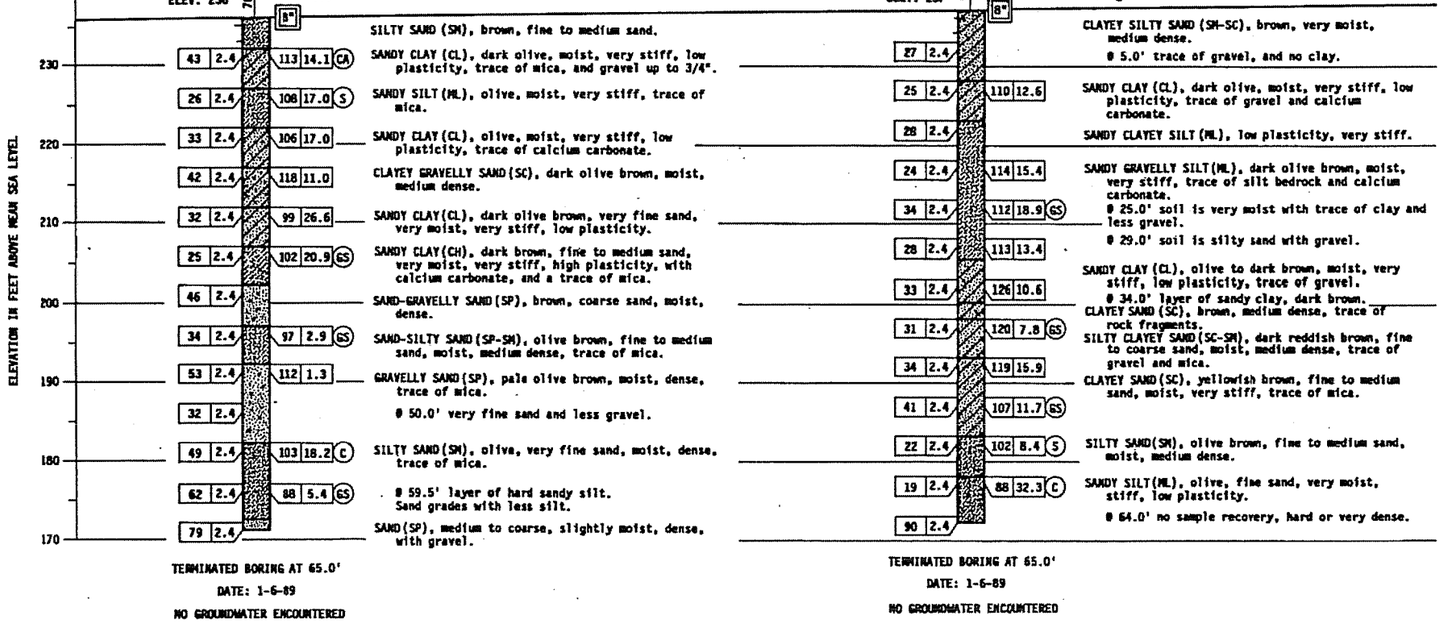


PLAN

SCALE: 1"=40'

PROFILE

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'

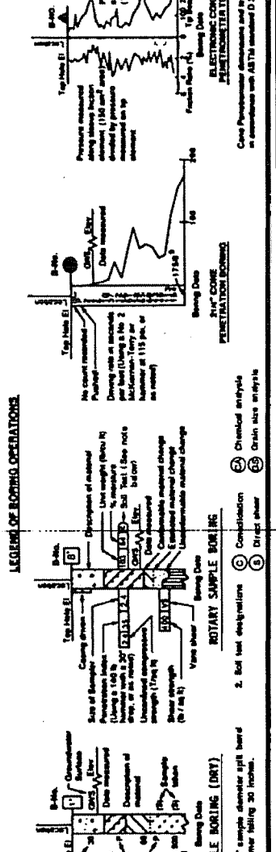


BM 535-D-70 ELEVATION 257.37

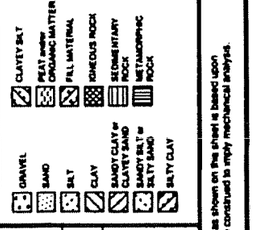
FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60 AND 105 FEET NORTHERLY OF THE CENTERLINE OF MUTWOOD AVE..

AS BUILT NO AS BUILT CHANGES
CORRECTIONS BY J. PINHEIRO I. PAVAGLE
CONTRACT NO. 12-020184
DATE 11-24-92

LEGEND OF BORING OPERATIONS



LEGEND OF EARTH MATERIALS



CONSISTENCY CLASSIFICATION FOR SOILS
According to the Standard Penetration Test

	Cohesive	Granular
Penetration Index (Blows / Ft)		
0-4	Very soft	Very loose
5-9	Soft	Loose
10-19	Firm	Slightly compact
20-34	Very stiff	Compact
35-69	Hard	Dense
>70	Very hard	Very dense

NOTE: Classification of earth material as shown on the sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

DESIGN SUPERVISOR		DRAWN BY	B.BASMADJIAN
SIGN OFF DATE	8-22-90	CHECKED BY	H.ABDALLAH
S. MOHAMAD			
FIELD INVESTIGATOR			
DATE	12-28-89		

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Gary Antonucci
PROJECT ENGINEER

BRIDGE NO.	CROWTHER AVE. UNDERCROSSING (WIDEN)
55-457	
POST MILE	LOG OF TEST BORINGS
16.8	

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

CU 12208
EA 0F0312

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

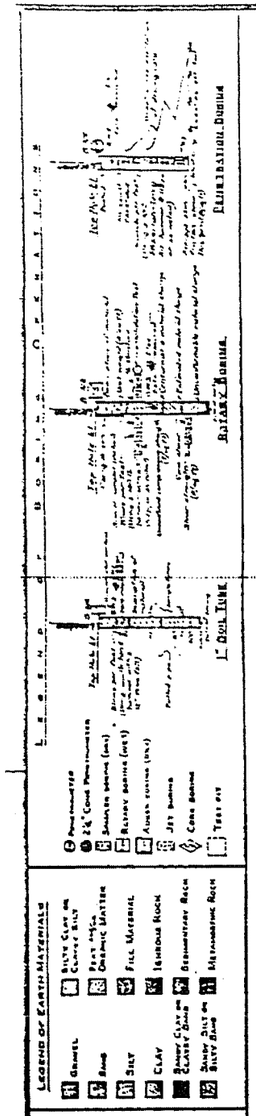
DIST	COUNTY	ROUTE	POST MILES – TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	11.1/21.2	477	491

N 822 234 735
E 506, 640. 385

BENCH MARK

B.M. 491-068 Elev. 206.61

Set in N. curb Crowther Ave. @ B.C.R. 10' W. corner S. of Placentia Ave. 292' W. of E. Fwy. 32' N. of ℄ Crowther Ave.


LEGEND
Proposed Retaining Wall
24" Cast Pile
Abandon Bore (Ora)
Remove Bore (Ora)
Abandon Bore (Riv)
Jet Boring
Core Boring
Test Pit
Existing Retaining Wall
Existing Bridge
Existing Culvert
Existing Drainage Inlet
Existing Pipe
Existing Fence
Existing Overhead Utility
Existing Underground Utility
Existing Tree
Existing Shrub
Existing Sign
Existing Mailbox
Existing Telephone Booth
Existing Power Pole
Existing Light Standard
Existing Traffic Signal
Existing Fire Hydrant
Existing Water Valve
Existing Water Meter
Existing Gas Valve
Existing Gas Meter
Existing Monument
Existing Benchmark
Existing Survey Control
Existing Building
Existing Concrete Pavement
Existing Asphalt Pavement
Existing Dirt Road
Existing Curb
Existing Gutter
Existing Sidewalk
Existing Driveway
Existing Median
Existing Guardrail
Existing Chain Link Fence
Existing Wood Fence
Existing Block Wall
Existing Brick Wall
Existing Concrete Wall
Existing Stone Wall
Existing Metal Fence
Existing Wire Fence
Existing Hedge
Existing Tree Line
Existing Shrub Line
Existing Sign Post
Existing Mailbox Post
Existing Telephone Pole

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	490	491

Kul Bhushan 12/28/89
GEOTECHNICAL PROFESSIONAL
10-29-90
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — KUL BHUSHAN — No. GE 000144 — Exp. 12/31/1989 — GEOTECHNICAL — STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — LIND C. CHEANG — NO. GE 2345 — EXP. 9/30/89 — GEOTECHNICAL — STATE OF CALIFORNIA

RETAINING WALL NO. 492

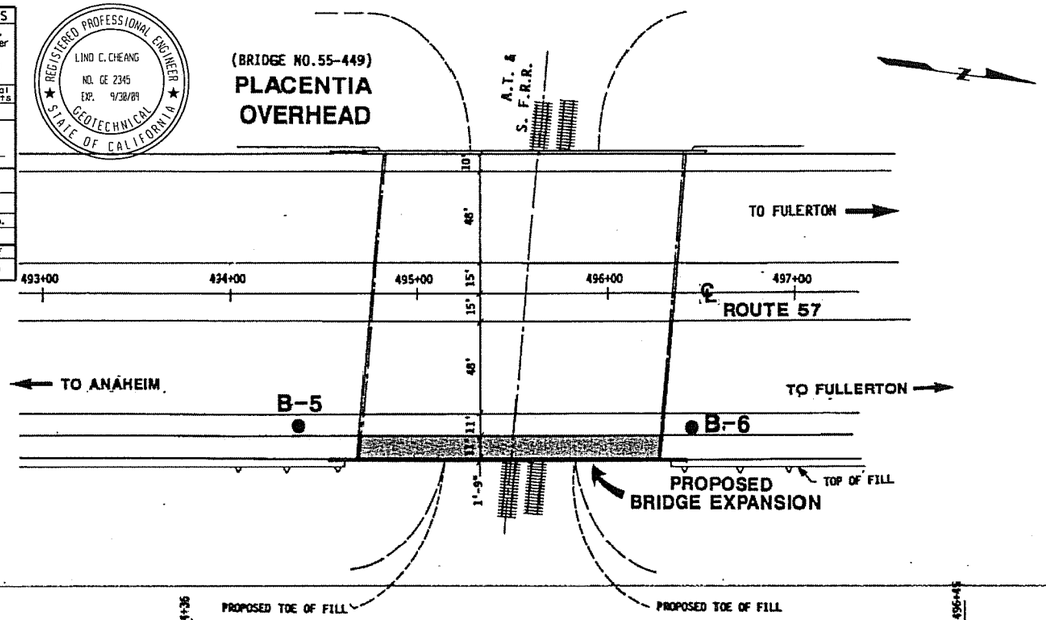
LOG OF TEST BORINGS NO. 8

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

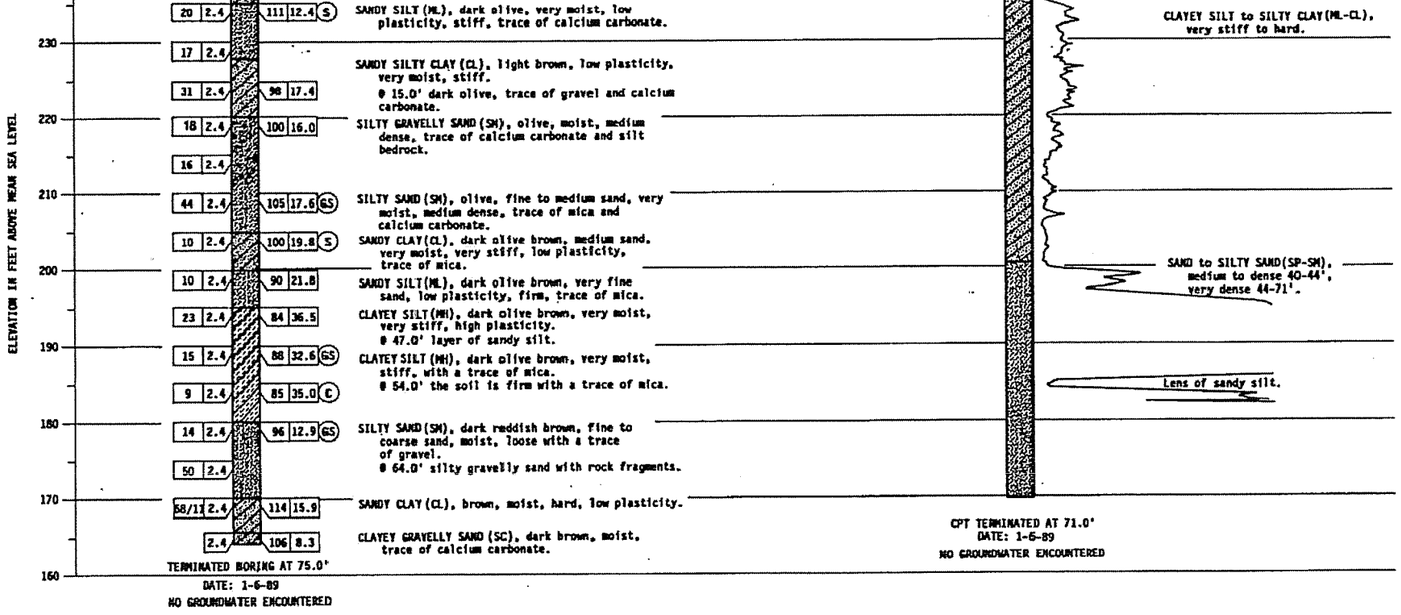
BRIDGE No.	
55E0089	
Sheet	of
35	36

(BRIDGE NO.55-449)
PLACENTIA OVERHEAD



PLAN
SCALE: 1"=40'

PROFILE
VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'

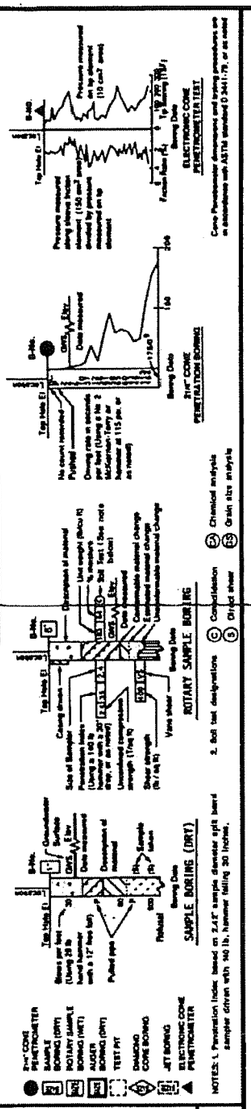


AS BUILT
NO AS BUILT CHANGES

CORRECTIONS BY J. PAINEIRO
CONTRACT NO. 12-020184
DATE 11-23-92

BM 535-D-70 — ELEVATION 257.37

FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60 AND 105 FEET NORTHERLY OF THE CENTERLINE OF RUTWOOD AVE..



DESIGN OVERSIGHT — SIGN OFF DATE 8-22-90
DRAWN BY B. BASMADJIAN
CHECKED BY H. ABDALLAH
S. MOHAMAD — FIELD INVESTIGATOR — DATE 12-28-89

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Victor Lee — PROJECT ENGINEER

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12208
EA 020181

BRIDGE NO.	PLACENTIA OVERHEAD (WIDEN)
55-449	
POST MILE 16.9	LOG OF TEST BORINGS

DISREGARD PRINTS BEARING EARLIER REVISION DATES → REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 13 OF 14

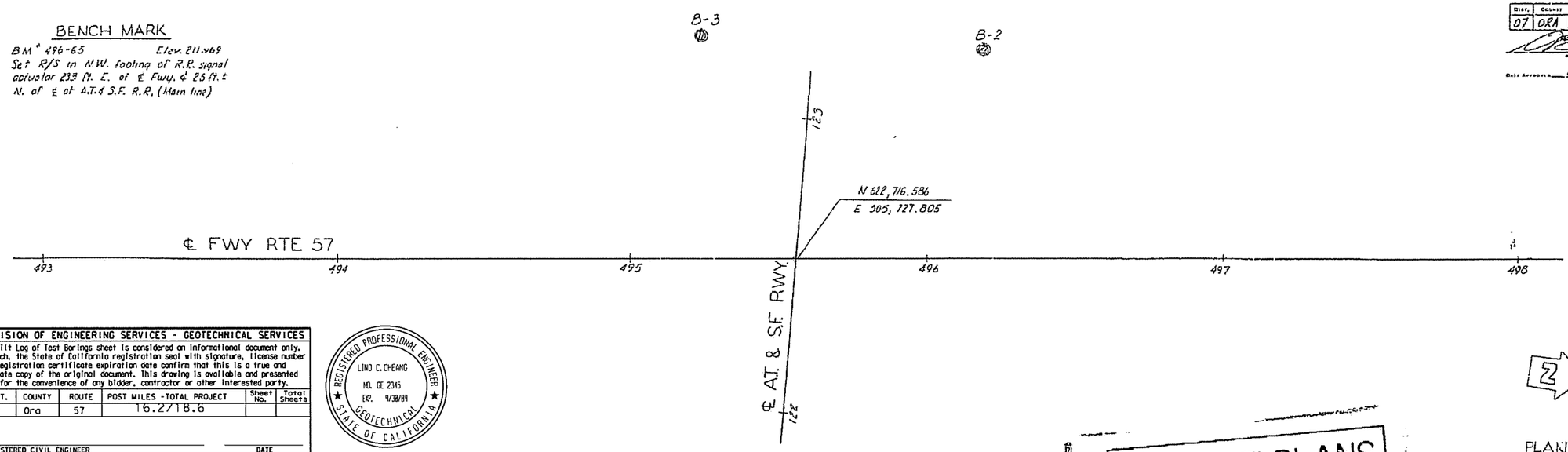
DIV. NO.			
7	CALIF.		

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	15G/21R	147	197

Date Accepted August 28, 1967

BENCH MARK

BM " 496-65 Elev. 211.469
Set R/S in N.W. footing of R.R. signal actuator 233 ft. E. of ℄ Fwy. & 25 ft.± N. of ℄ of A.T.& S.F. R.R. (Main line)

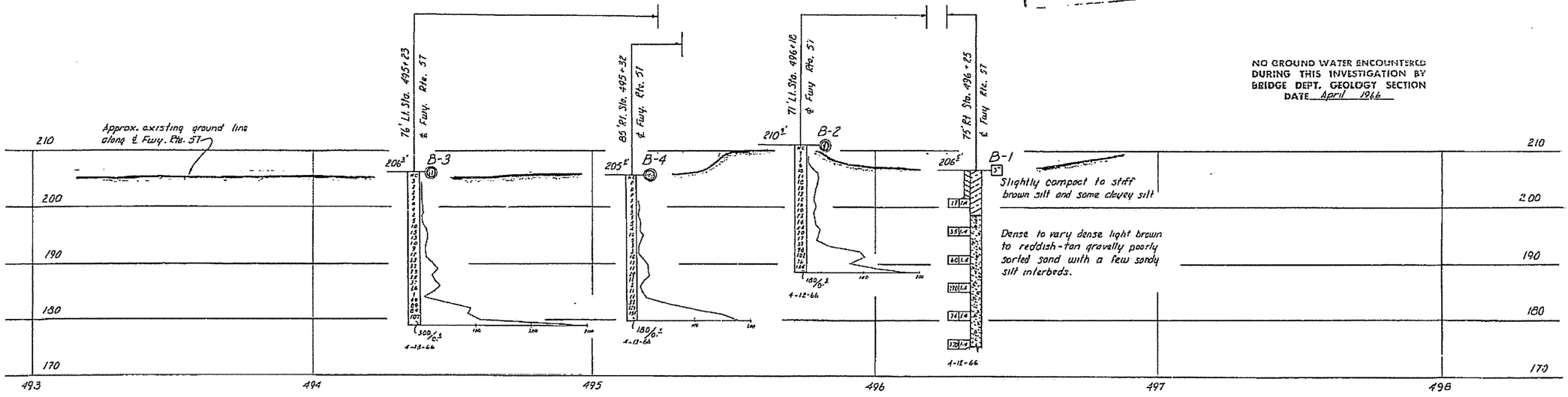


PLAN
Scale 1" = 20'

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		
REGISTERED CIVIL ENGINEER			DATE		
RETAINING WALL NO. 492					
LOG OF TEST BORINGS NO. 9					
NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA		CU: 12 EA: 0F0311		BRIDGE No. 55E0082	
				Sheet 36	of 36

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/69
GEOTECHNICAL
STATE OF CALIFORNIA

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668



PROFILE
Scale Vert. 1" = 10'
Horiz. 1" = 20'

AS BUILT
CORRECTIONS BY HIXSON 7-23-69
CONTRACT NO. 07-032124
DATE 5-11-69

SHEET	OF
13	13

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PLACENTIA OVERHEAD

LOG OF TEST BORINGS

SCALE As Noted	BRIDGE 55-449 ½	FILE	DRAWING 55449-16

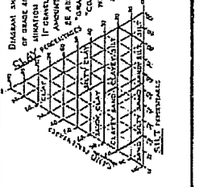
LEGEND OF BORINGS OPERATIONS

- Penetrometer
- 2½" Core Penetrometer
- Sampler Boring (Dry)
- Rotary Boring (Wet)
- Auger Boring (Dry)
- Jet Boring
- Core Boring
- Test Pit

LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Sandy Clay or Clayey Sand
- Sandy Silt or Silty Sand
- Silty Clay or Clayey Silt
- Peat and Organic Matter
- Fill Material
- Igneous Rock
- Sedimentary Rock
- Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS



NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

CHECKED W. E. Blair 5-6-68
Approved for Structures Design

Charge 07208
W.A. 032121

Disregard prints bearing earlier numbers

PREL. DRAWING No. PR- 67

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

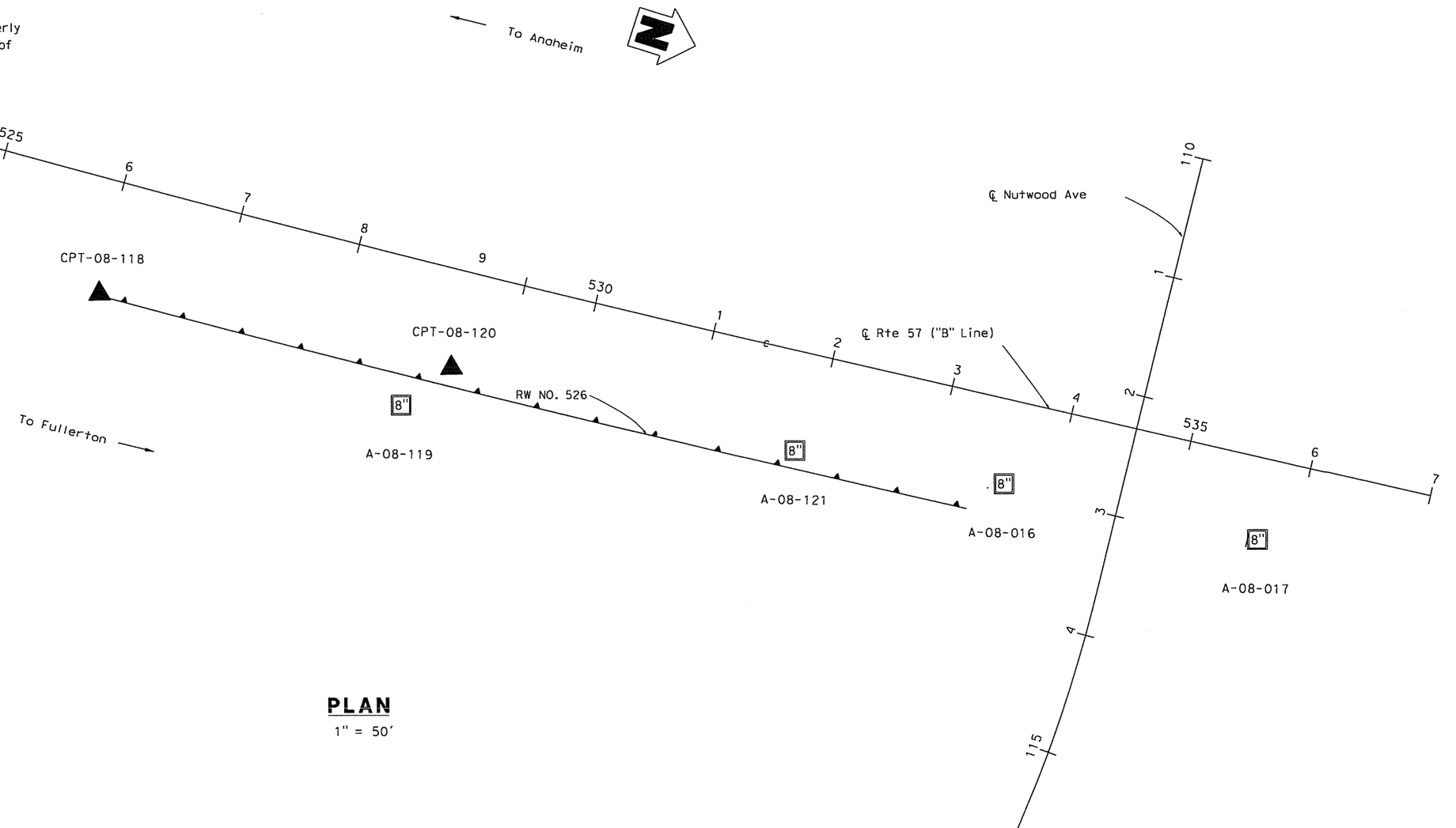
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN
1" = 50'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER	BRIDGE NO. 55E0084 / POST MILES 16.2/18.6

RETAINING WALL NO. 526
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

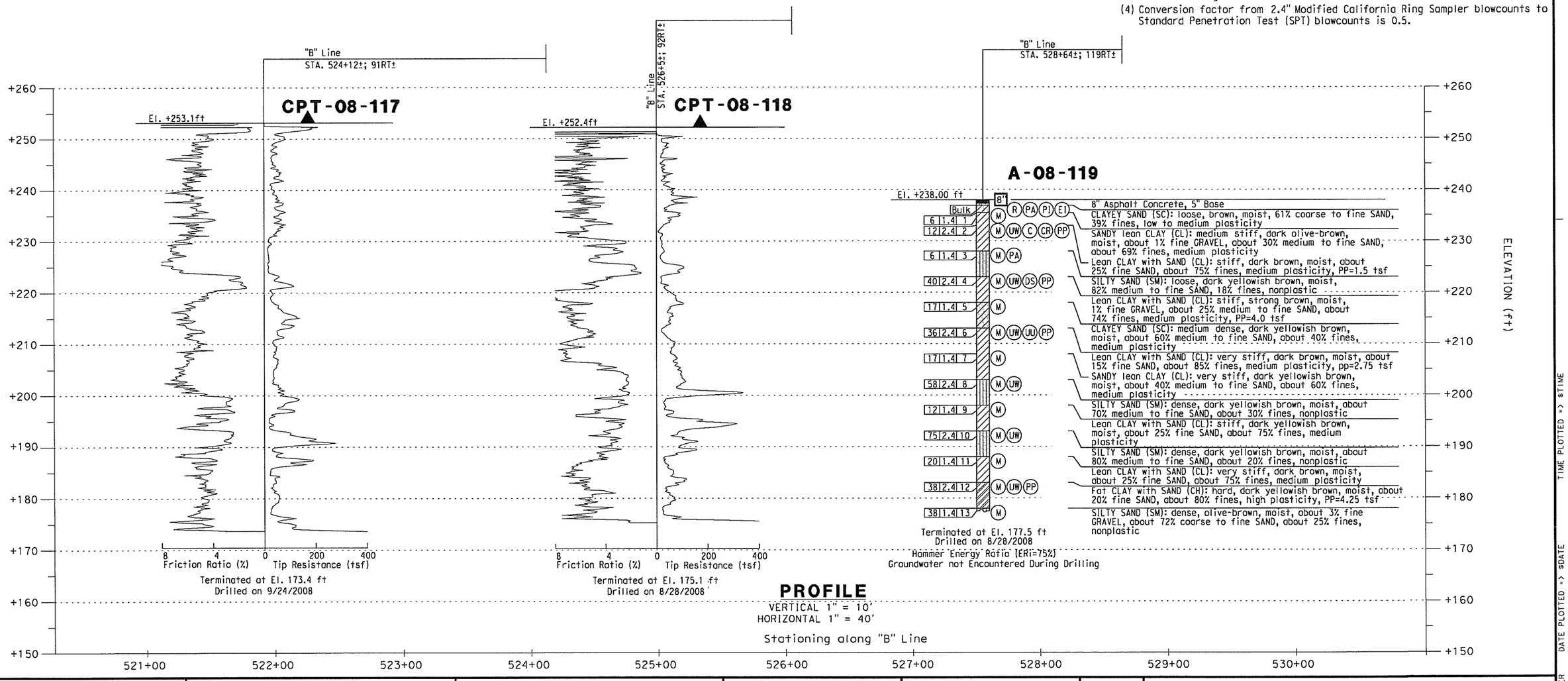
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 526, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

Stationing along "B" Line

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO. 55E0084
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6

RETAINING WALL NO. 526
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 42 OF 46

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
USERNAME => $USER

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

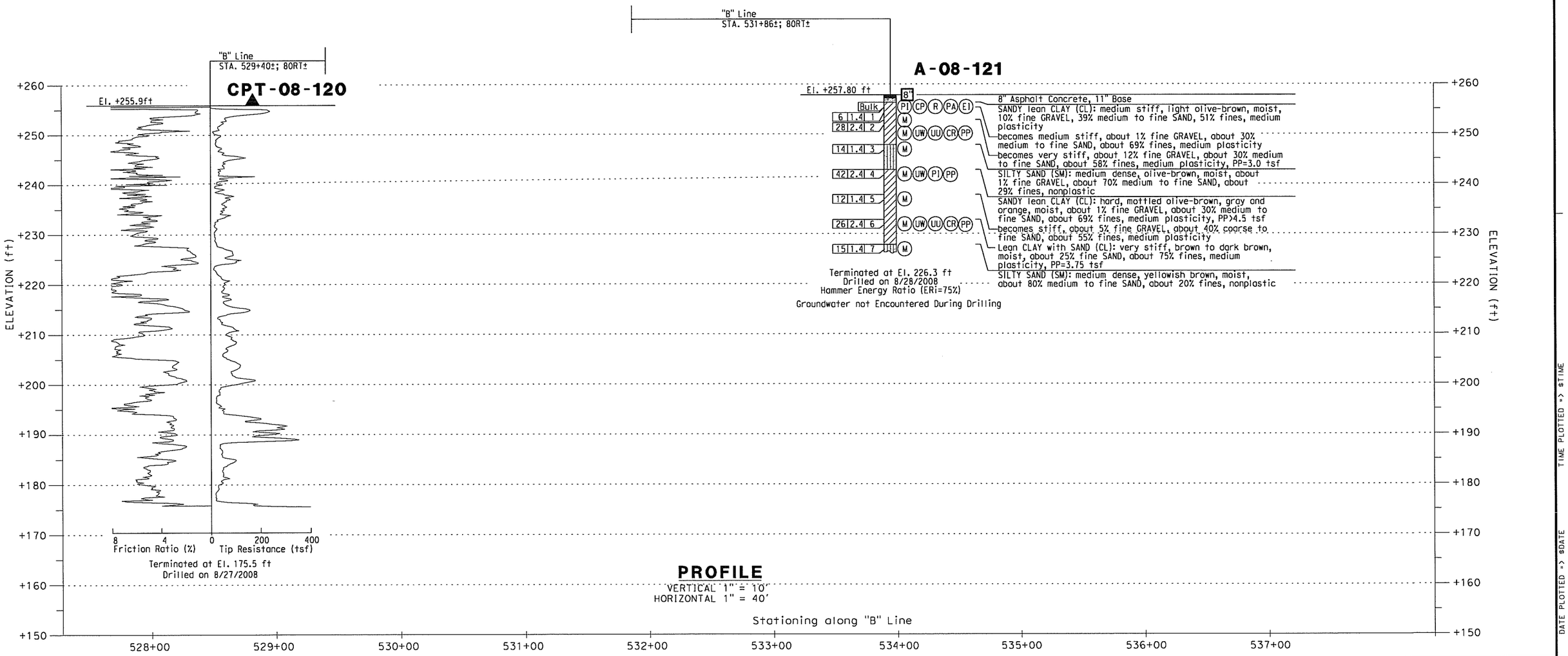
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.

FOR PLAN VIEW SEE "RETAINING WALL NO. 526, LOG OF TEST BORINGS NO. 1"



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0084	RETAINING WALL NO. 526
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 44 OF 46

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

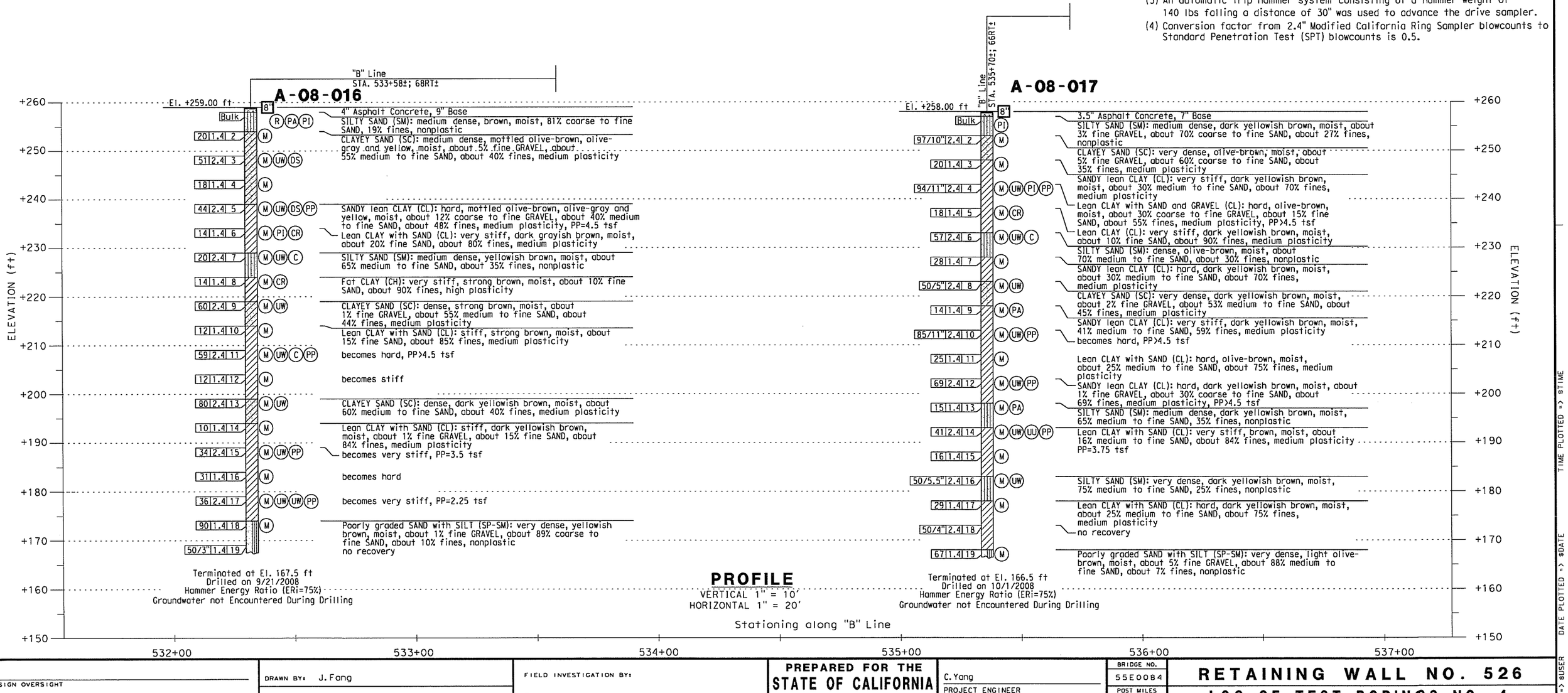
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 526, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0084 / POST MILES 16.2/18.6

RETAINING WALL NO. 526
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 43 OF 46

USERNAME => $USER
DATE PLOTTED => $DATE
TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

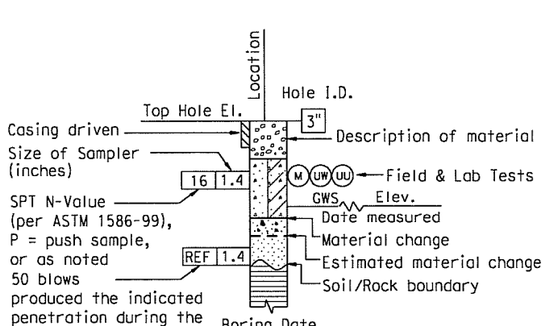
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

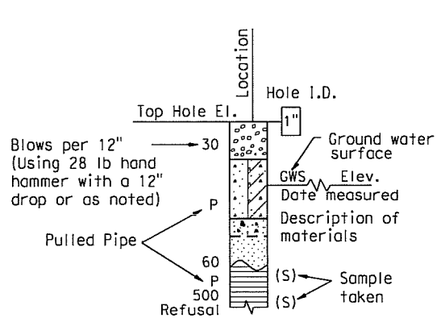
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

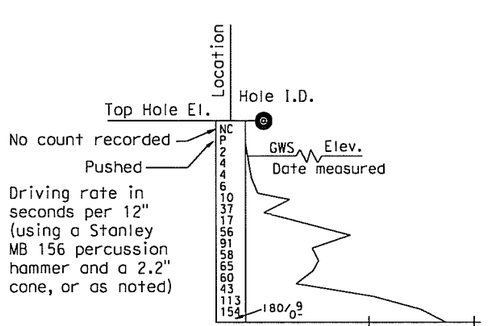
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



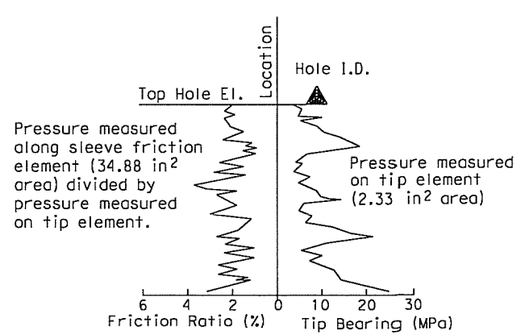
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0084 POST MILES 16.2/18.6

RETAINING WALL NO. 526
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
USERNAME => $USER

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yong — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0084
POST MILES 16.2/18.6

RETAINING WALL NO. 526
LOG OF TEST BORINGS NO. 6

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

USERNAME => $USER
DATE PLOTTED => $DATE
TIME PLOTTED => $TIME

FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	15.4/18.6	197	197

DIST. APPROVED: August 28, 1967

BENCH MARK

BM "519R-65 Elev 2.?39
Set B/S in N. curb of Chapman Ave.
@ E.C.R. from Placentia Ave 48'W. of
Placentia & 31'N. of ℄ Chapman

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER _____ DATE _____

RETAINING WALL NO. 526

LOG OF TEST BORINGS NO. 7

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12	BRIDGE No.
EA: 0F0311	55E0084

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER
LIND C. CHEANG
NO. GE 2345
EXP. 9/30/69
GEOTECHNICAL
STATE OF CALIFORNIA

LEGEND OF PENETRATION BORINGS

- Penetrometer
- 2½" Core Penetrometer
- Sampler Boring (Dry)
- Rotary Boring (Wet)
- Auger Boring (Dry)
- Jet Boring
- Core Boring
- Test Pit
- Penetration Boring
- Rotary Boring
- 1" Soil Tube

LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Silty Clay or Clayey Silt
- Peat and/or Organic Matter
- Fill Material
- Igneous Rock
- Sandy Clay or Clayey Sand
- Silty Silt or Silty Sand
- Sedimentary Rock
- Metamorphic Rock

CLASSIFICATION OF MATERIALS BASED ON STANDARD GRADE SIZE LIMITS

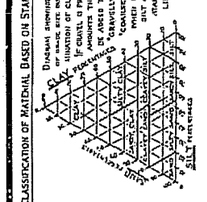
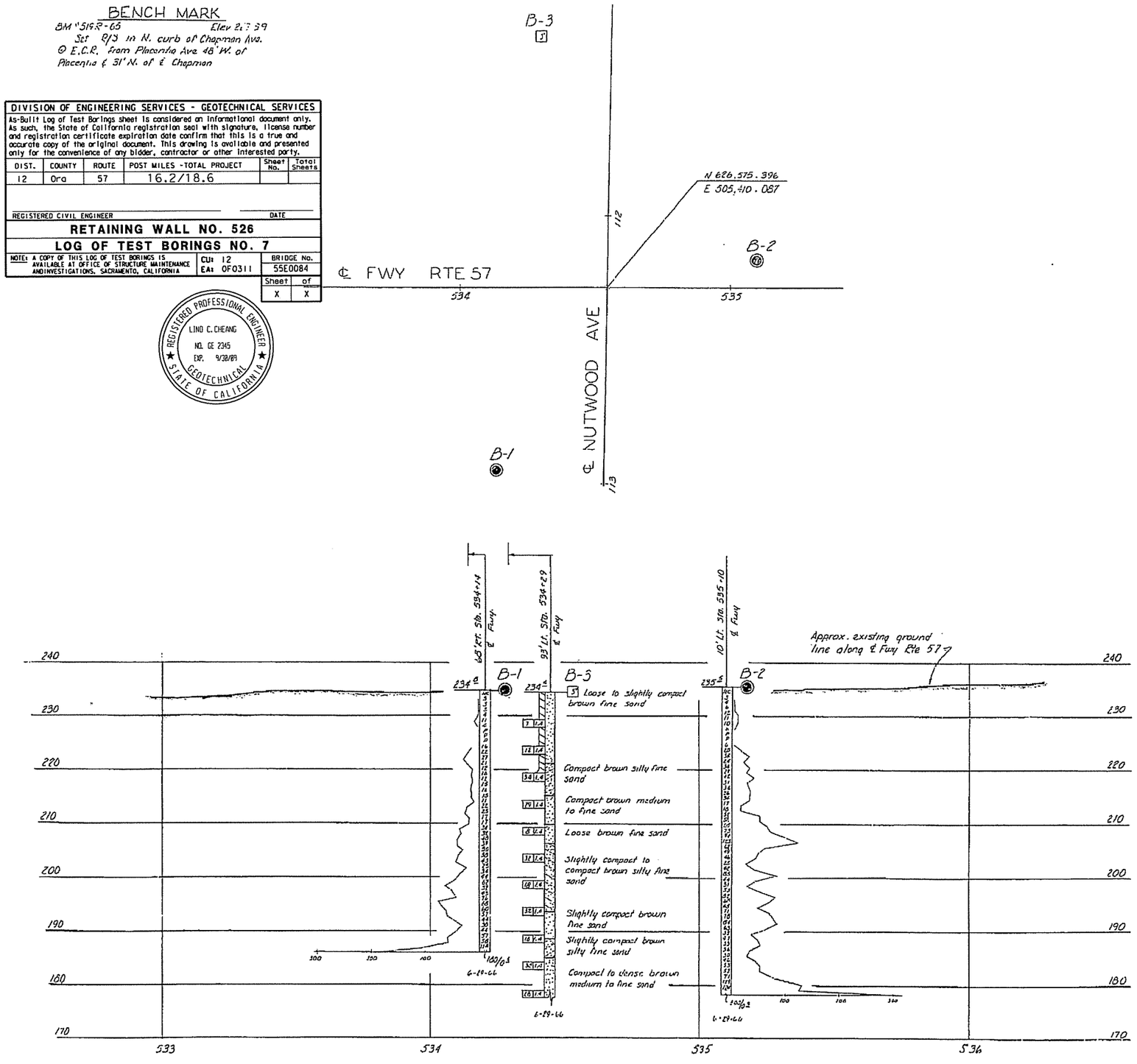


Diagram showing the basis for estimates of mixtures used in materials classification. If gravel is present in appreciable amounts the terms "gravelly" may be added to the class name, viz: "gravelly sand". The terms "silty" or "clayey" may be used to describe sand, silt and gravel. Refer to standard grade size limits.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.



PLAN
Scale 1"=20'

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE June 1966

AS BUILT
CORRECTIONS BY HAXTON 7-29-69
CONTRACT NO. 07-032124
DATE 9-30-69

PROFILE
Scale Vert. 1"=10'
Horiz. 1"=20'

AS BUILT PLANS
Contract No. 07-032124
Date Completed _____
Document No. 70000668

SHEET	OF
12	12

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

NUTWOOD AVENUE UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted	BRIDGE 55-464	FILE	DRAWING 55464-12

	BY	DATE
FIELD STUDY	K. CONSTABLE	6-29-66
DRAWN	M. HASSEP	7-26-66
CHECKED	R. Edwards	7-26-66
APPROVED	Charles E. Welch	

Assistant Supervising Engineer (Engineering Geologist)

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

197

Charge 07208
W. A. 032131

Disregard prints bearing earlier numbers →

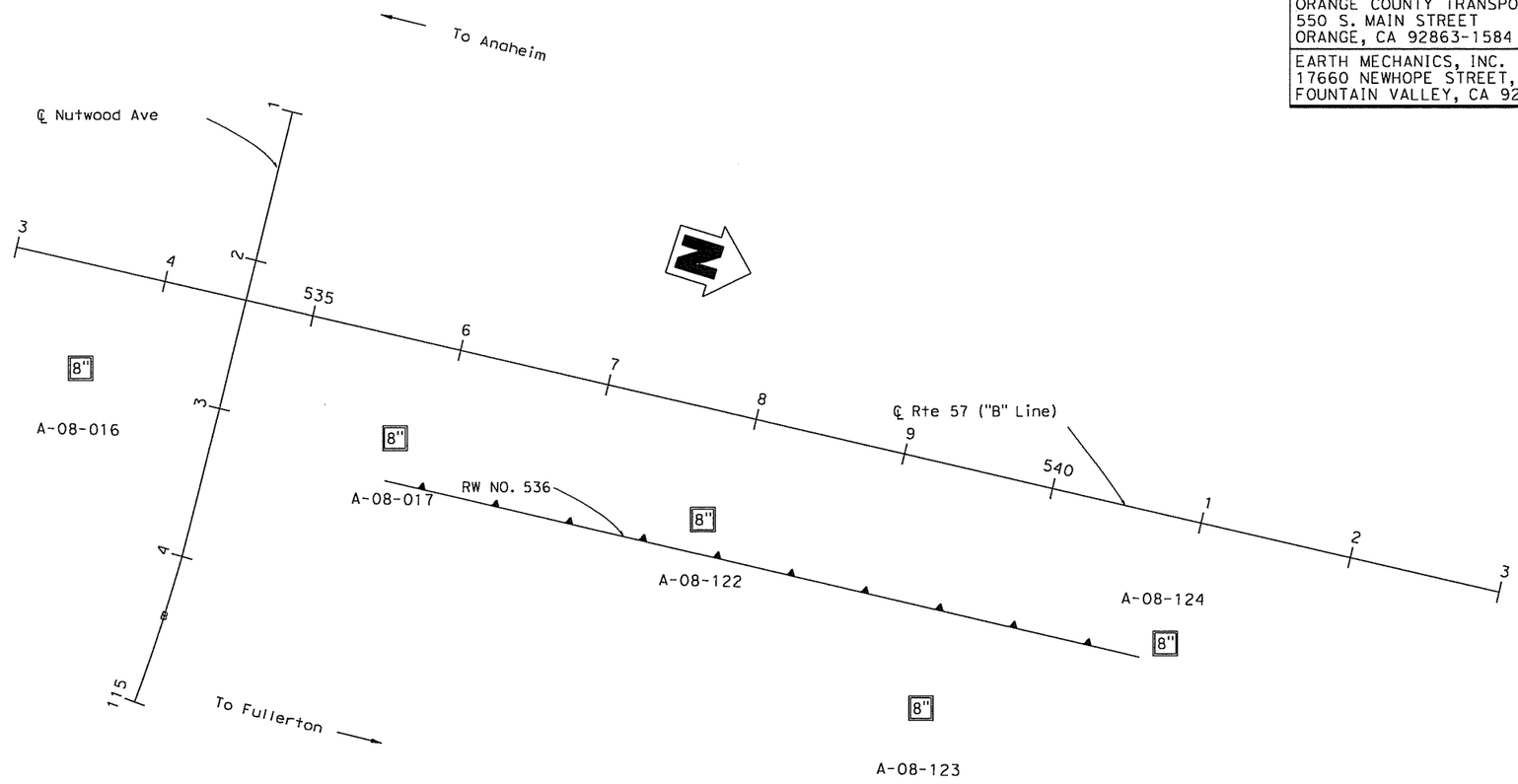
PREL. DRAWING NO. PR-	11/67							

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J.Fang
CHECKED BY: L.Cheang

FIELD INVESTIGATION BY:
R.Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0085
POST MILES 16.2/18.6

RETAINING WALL NO. 536
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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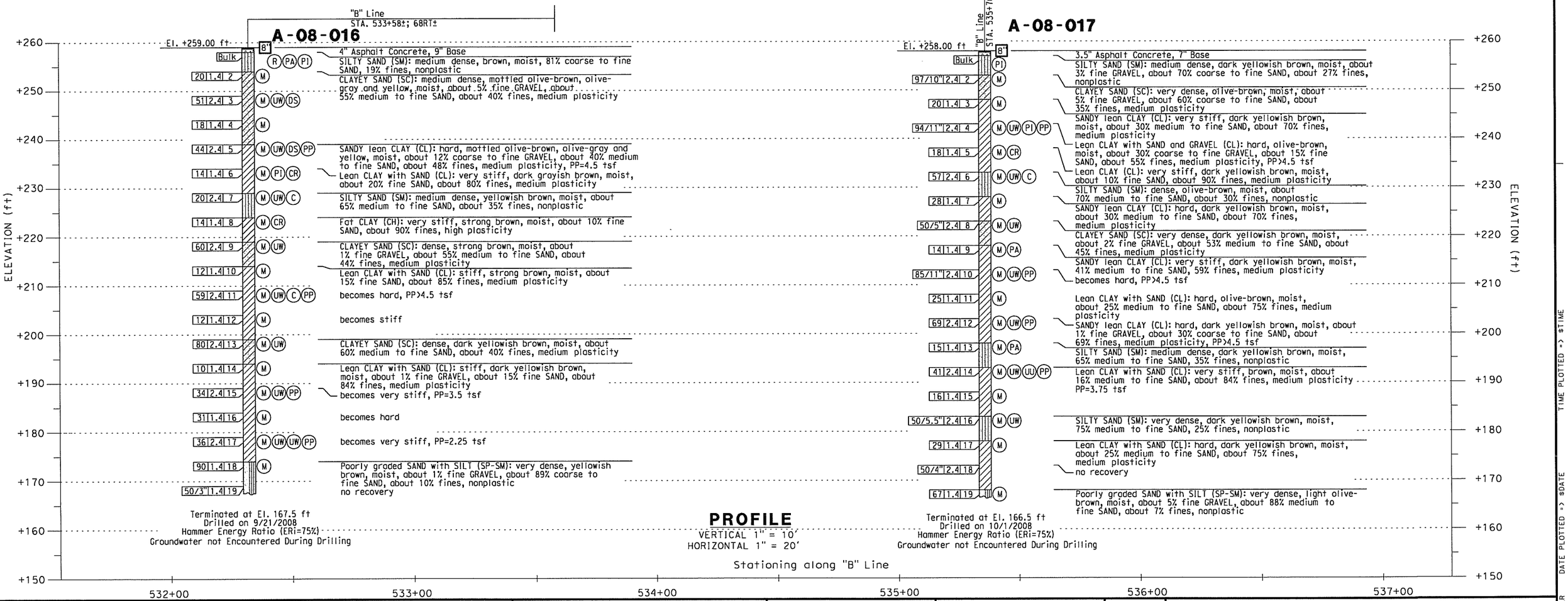
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 536, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER	BRIDGE NO. 55E0085 / POST MILES 16.2/18.6

RETAINING WALL NO. 536
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 43 OF 46

USERNAME -> $USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 536, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
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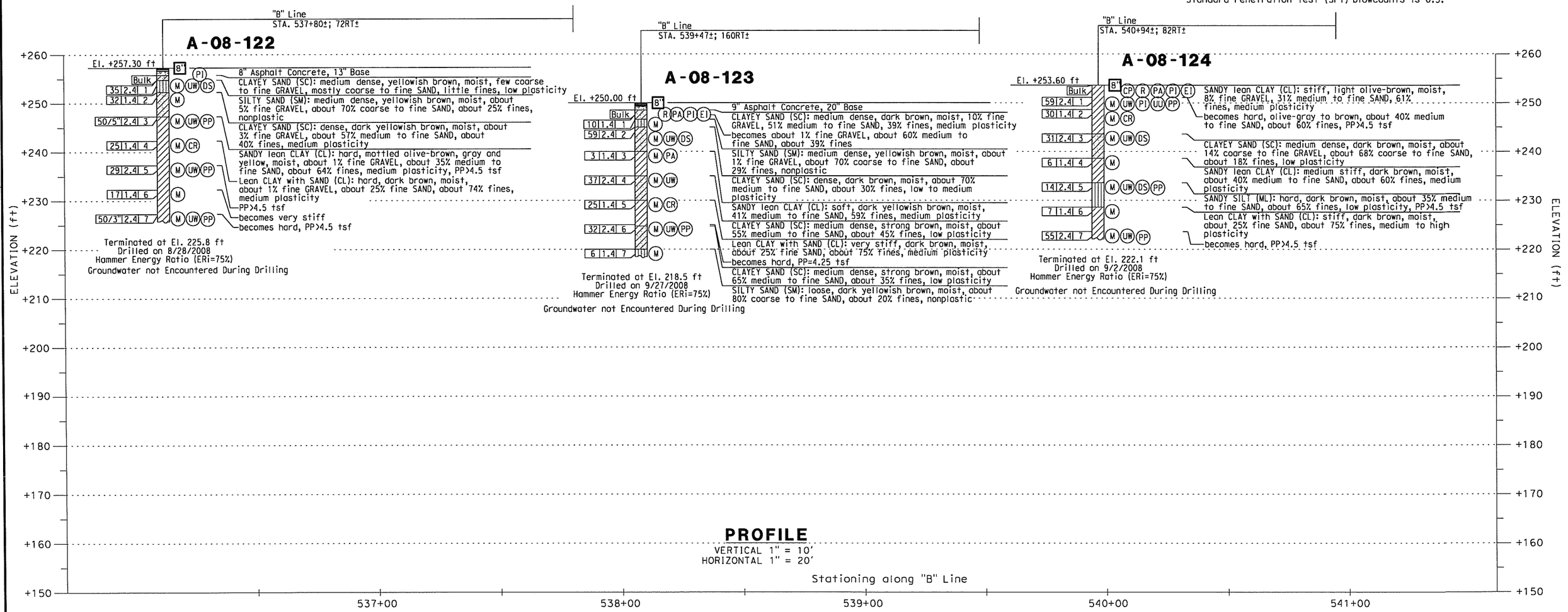

PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO. 55E0085	RETAINING WALL NO. 536	
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 3	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 45 OF 46

USERNAME => $USER
DATE PLOTTED => $DATE
TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

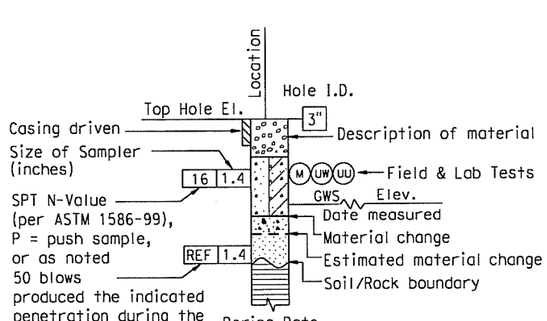
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

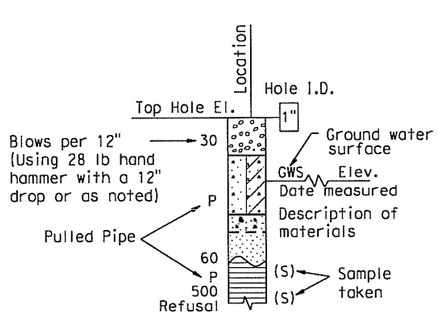
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

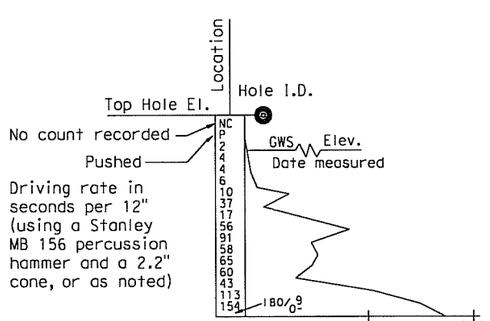
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



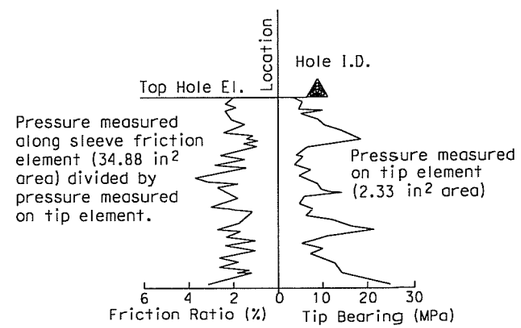
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0085 / POST MILES 16.2/18.6
SIGN OFF DATE	CHECKED BY: L. Cheang				RETAINING WALL NO. 536 LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Chien-Tai Yang
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0085
POST MILES 16.2/18.6

RETAINING WALL NO. 536
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

USERNAME => $USER
DATE PLOTTED => $DATE
TIME PLOTTED => $TIME

FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	16.2/18.6	197	197

Date Approved: August 28, 1967

BENCH MARK

BM "516R-65 Elev 2.7 59
Set B/3 in N. curb of Chapman Ave.
@ E.C.R. from Placentia Ave 48' W. of
Placentia & 31' N. of ℄ Chapman

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER _____ DATE _____

RETAINING WALL NO. 536

LOG OF TEST BORINGS NO. 6

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

Cu: 12 Ea: 0F0311

BRIDGE No. 55E0085

Sheet X of X

REGISTERED PROFESSIONAL ENGINEER
LIND C. CHEANG
NO. GE 2345
EXP. 9/30/69
GEOTECHNICAL
STATE OF CALIFORNIA

B-3 (7)

N 626,575.396
E 505,410.087

B-2 (6)

℄ FWY RTE 57

534 535

℄ NUTWOOD AVE

112

113

B-1 (5)

PLAN
Scale 1"=20'

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668

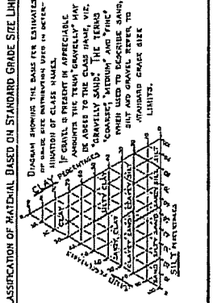
LEGEND OF BORING OPERATIONS

- Penetrometer
- 2½" Cone Penetrometer
- Sampler Boring (Cal)
- Rotary Boring (Wet)
- Auger Boring (Dry)
- Jet Boring
- Core Boring
- Test Pit

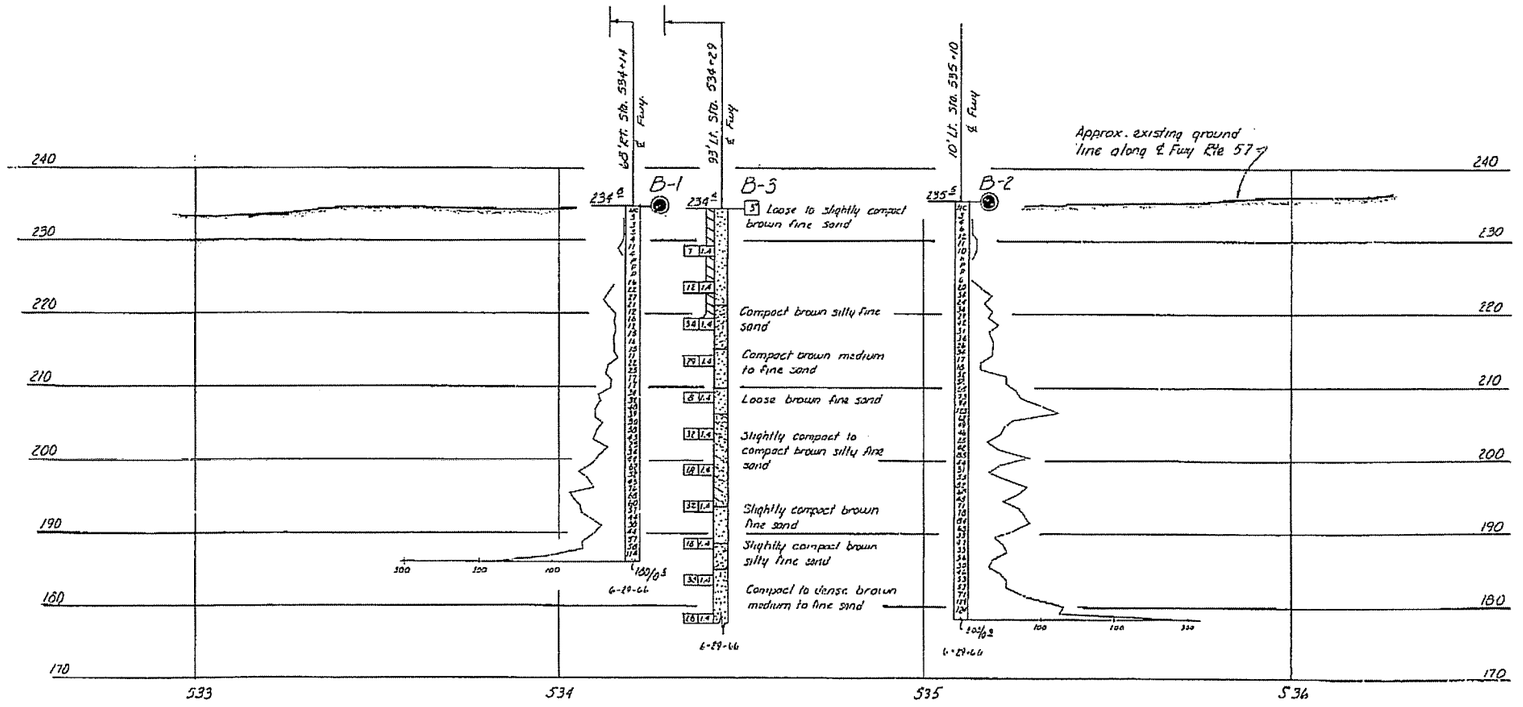
LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Sandy Clay or Clayey Sand
- Sandy Silt or Clayey Silt
- Silty Clay or Clayey Silt
- Peat and/or Organic Matter
- Fill Material
- Igneous Rock
- Sedimentary Rock
- Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS



NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.



NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE June 1966

AS BUILT
CORRECTIONS BY: Alexander Plan 7-29-67
CONTRACT NO. 07-032124
DATE 9-30-67

PROFILE
Scale Vert. 1"=10'
Horiz. 1"=20'

SHEET	OF
12	12

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

NUTWOOD AVENUE UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted	BRIDGE 55-464	FILE	DRAWING 55464-12

FIELD STUDY	By K. CORBALEY 6-29-66
DRAWN	By M. REESED 7-21-66
CHECKED	By C. Ebenil Reyes
SUPERVISED	By Charles F. Hoch

Structural Engineer

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

197

Charge 07208
W. A. 032131

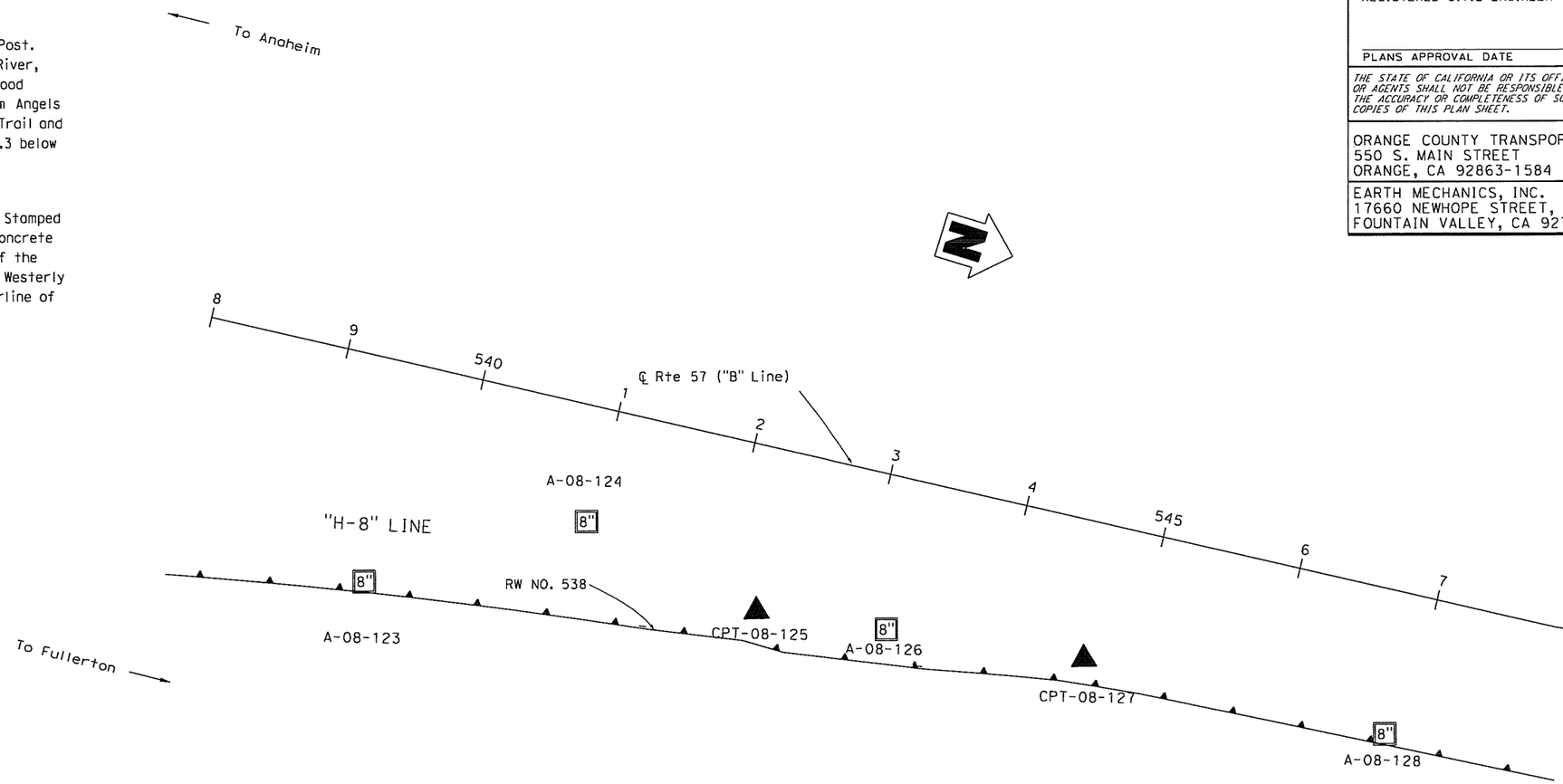
Disregard prints bearing earlier numbers → PREL. DRAWING NO. PR- 11/67

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0086
POST MILES 16.2/18.6

RETAINING WALL NO. 538
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
USERNAME => $USER

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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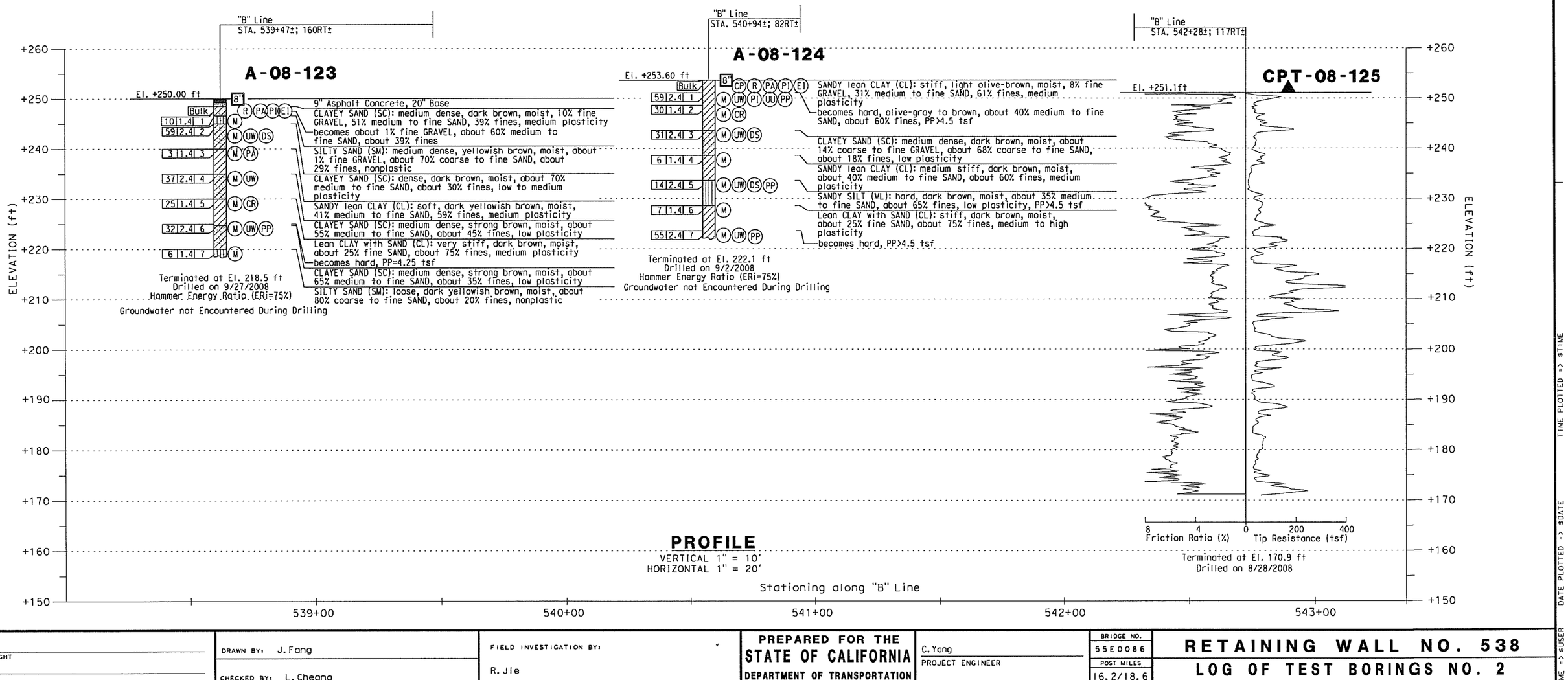
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 538, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0086 / POST MILES 16.2/18.6
SIGN OFF DATE	CHECKED BY: L. Cheang				

RETAINING WALL NO. 538
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 45 OF 46

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 538, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
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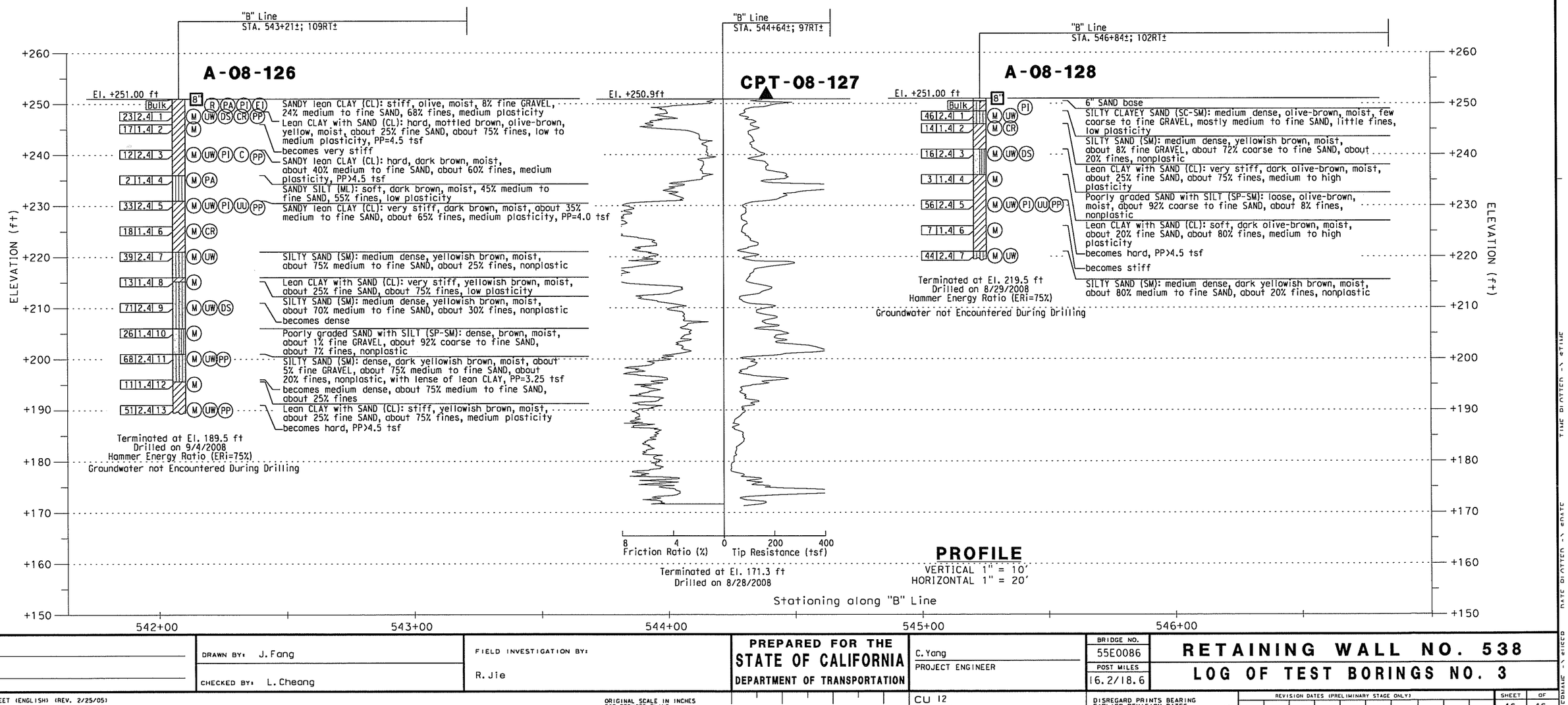

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0086 POST MILES 16.2/18.6

RETAINING WALL NO. 538
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 46 OF 46

DATE PLOTTED = 5-JUNE-09
DATE SAVED = 5-JUNE-09

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

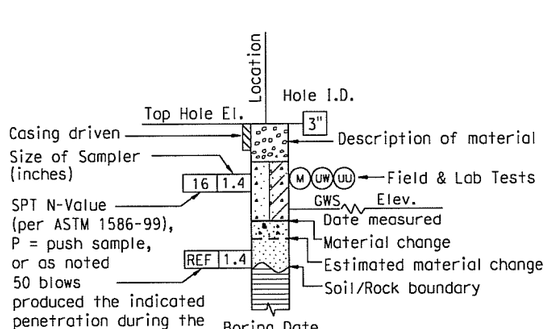
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

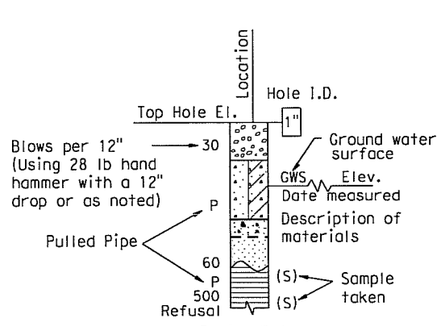
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

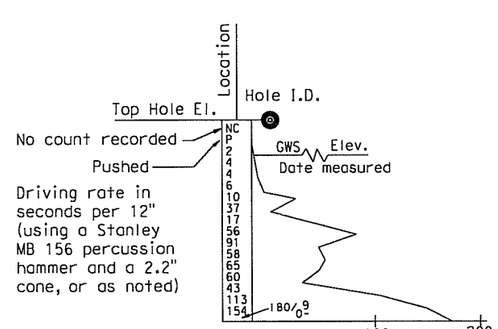
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



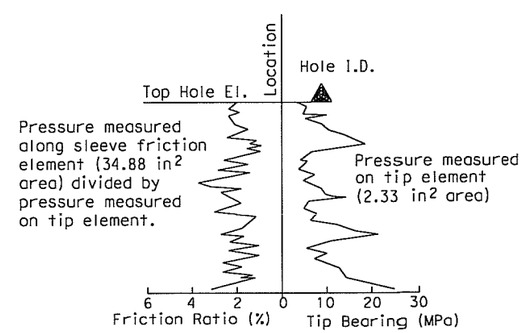
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0086 / POST MILES 16.2/18.6
SIGN OFF DATE	CHECKED BY: L. Cheang				RETAINING WALL NO. 538 LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

USERNAME => $USER
DATE PLOTTED => $DATE
TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0086
POST MILES 16.2/18.6

RETAINING WALL NO. 538
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

APPENDIX A3

EXPLORATORY BORING LOGS FOR MSE WALLS

RW 476 and RW 496

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Chien-Tai Yang
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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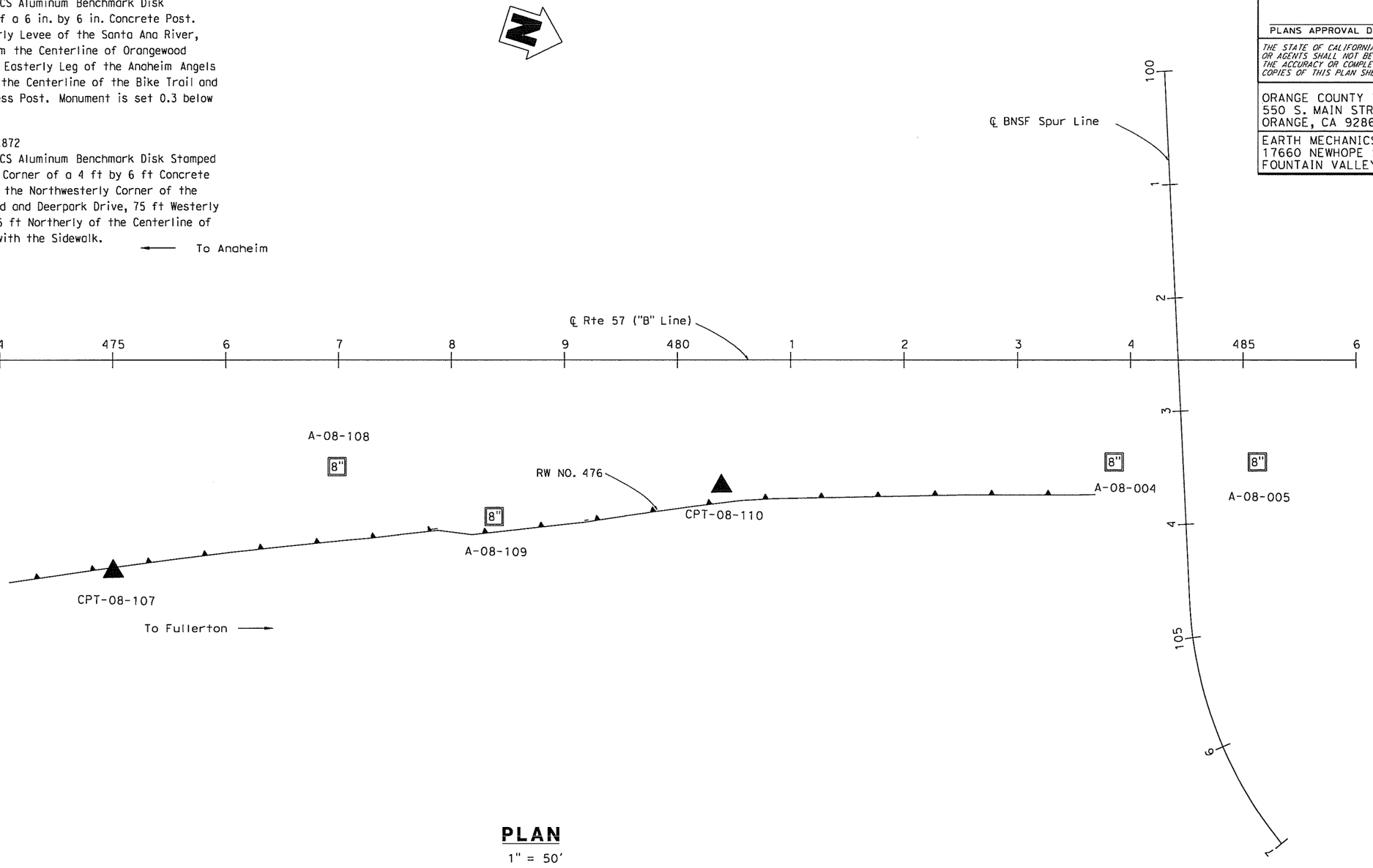
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN
1" = 50'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0081 POST MILES 16.2/18.6

RETAINING WALL NO. 476
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
USERNAME => $USER

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — EXP. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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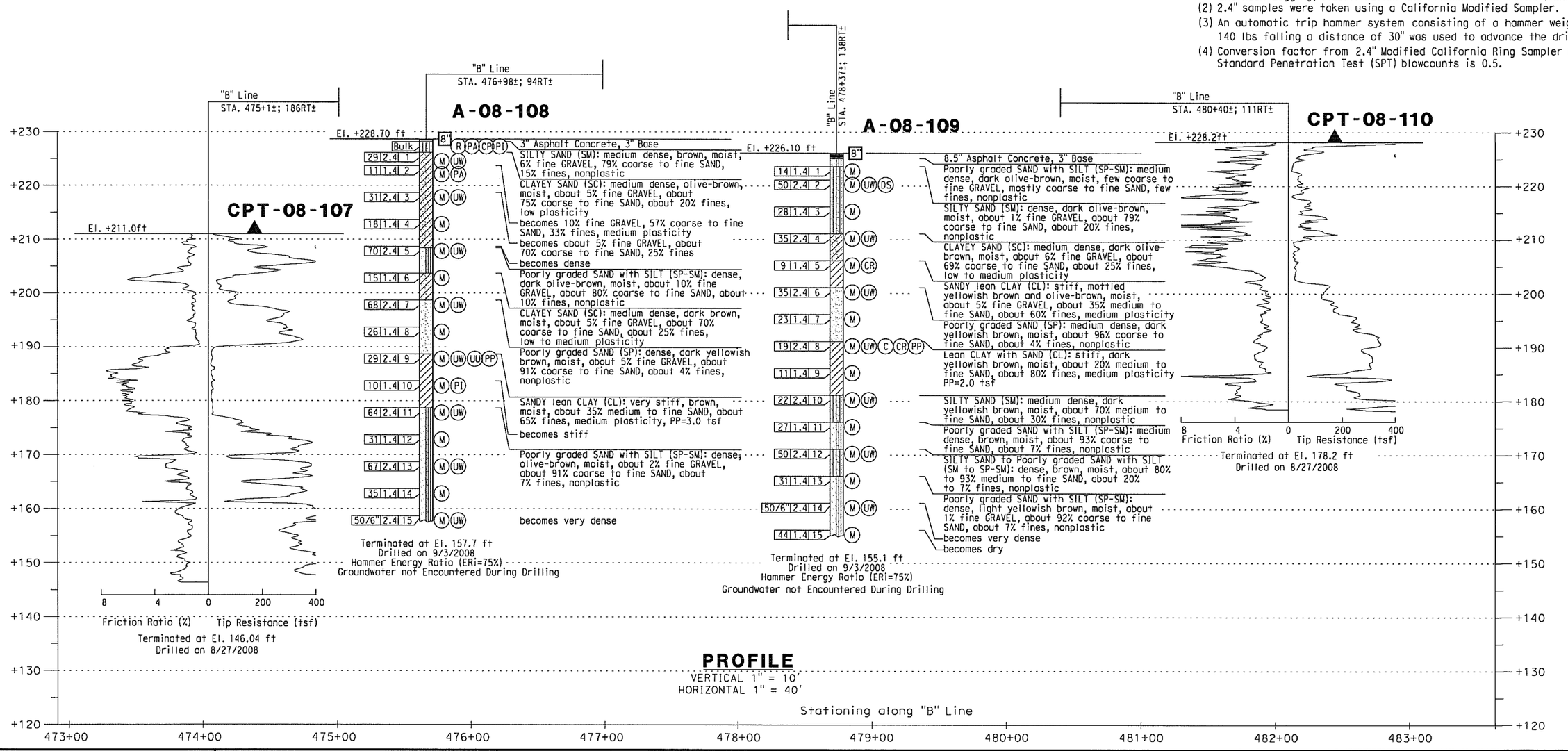
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 476, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO. 55E0081	RETAINING WALL NO. 476	
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 2	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

CU 12
EA 0F031J

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)
4/30/09

SHEET 16 OF 17

DATE PLOTTED => 8/31/09
TIME PLOTTED => 07:17

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 476, LOG OF TEST BORINGS NO. 1"

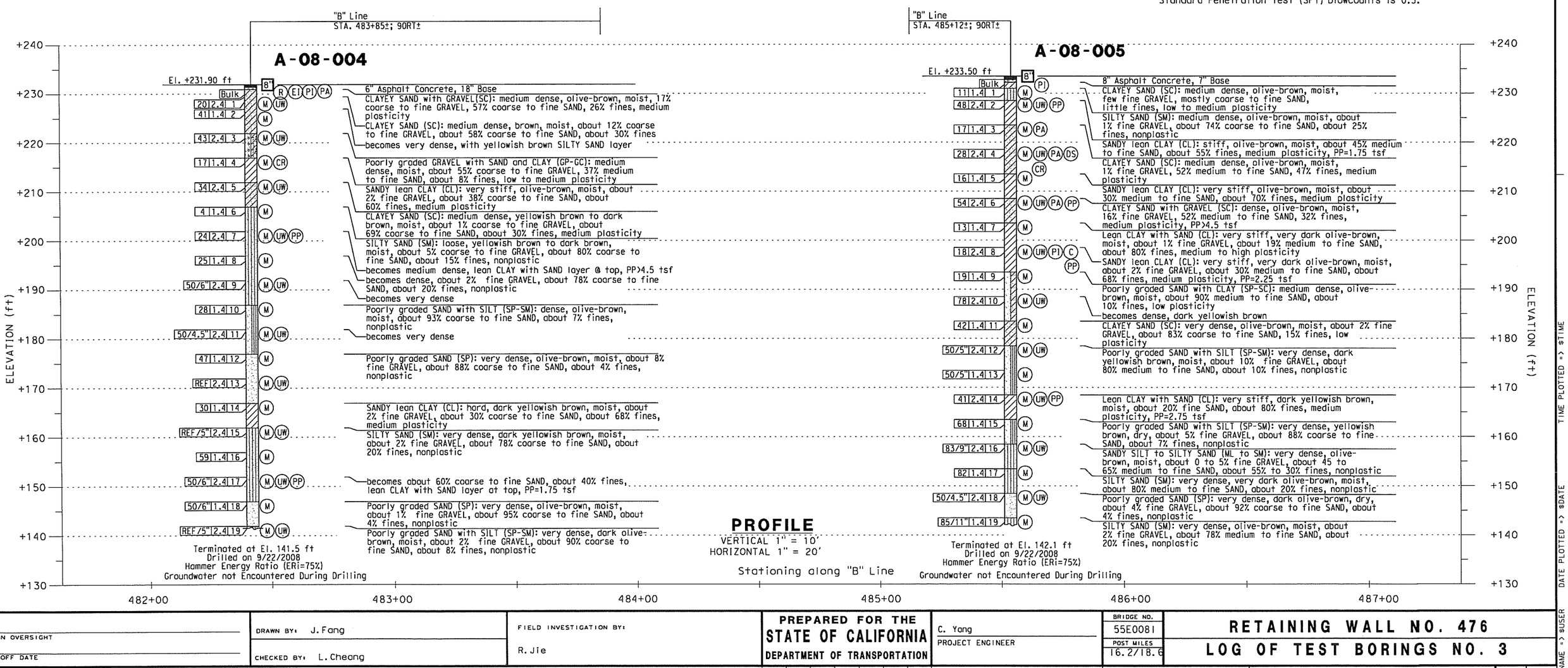
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO. 55E0081
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6

RETAINING WALL NO. 476
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

DATE PLOTTED => 6DATE
TIME PLOTTED => $TIME
USERNAME => $USER

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

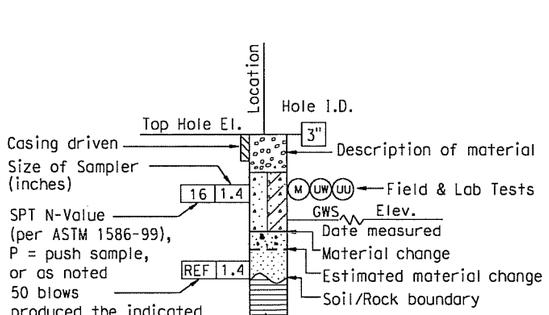
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

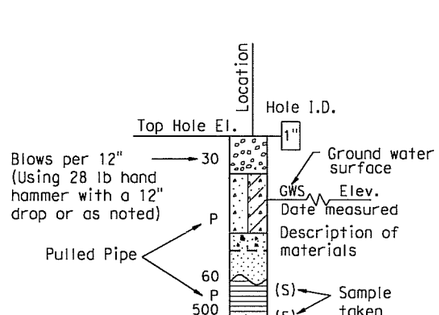
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

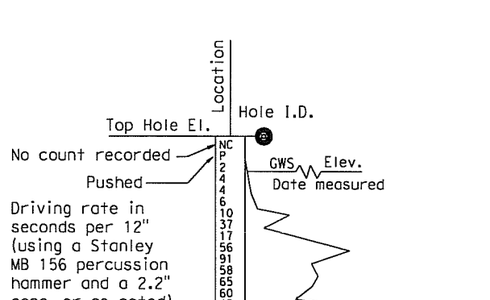
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



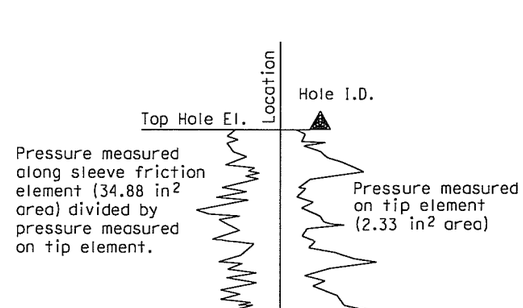
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0081 POST MILES 16.2/18.6

RETAINING WALL NO. 476

LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
E.A. 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 14 OF 17

USERNAME -> $USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0081
POST MILES 16.2/18.6

RETAINING WALL NO. 476
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 15 OF 17

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		
REGISTERED CIVIL ENGINEER			DATE		
RETAINING WALL NO. 476					
LOG OF TEST BORINGS NO. 6					
NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA		CU: 12 EA: 0F0311		BRIDGE No. 55E0081	
				Sheet X	of X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/89
GEOTECHNICAL
STATE OF CALIFORNIA

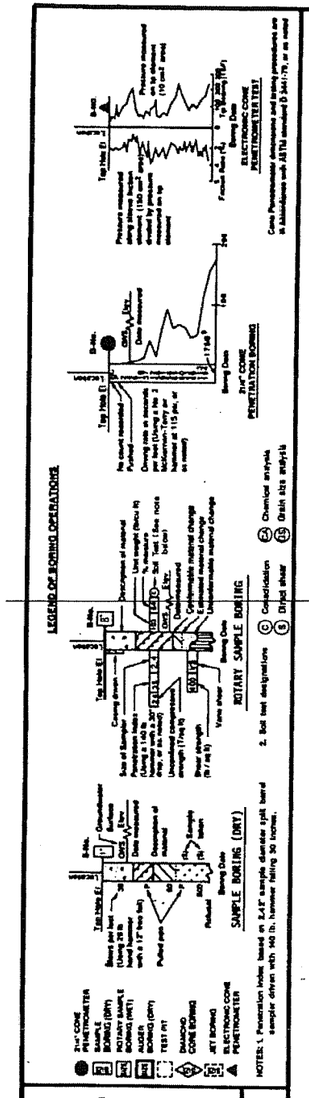
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	467	491

Kul Bhushan 12/20/89
GEOTECHNICAL PROFESSIONAL

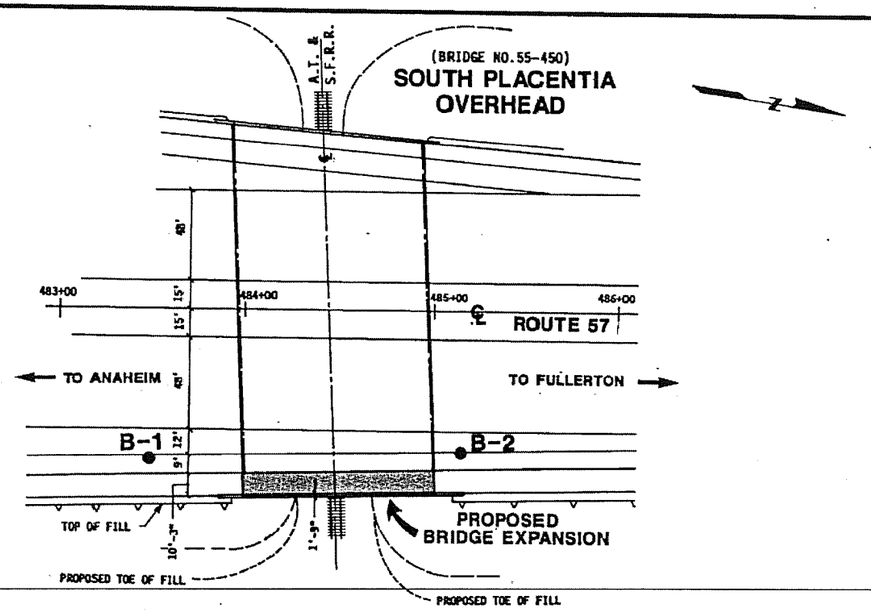
10-29-90
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
KUL BHUSHAN
No. GE 000144
Exp. 12/31/1989
GEOTECHNICAL
STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351



NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

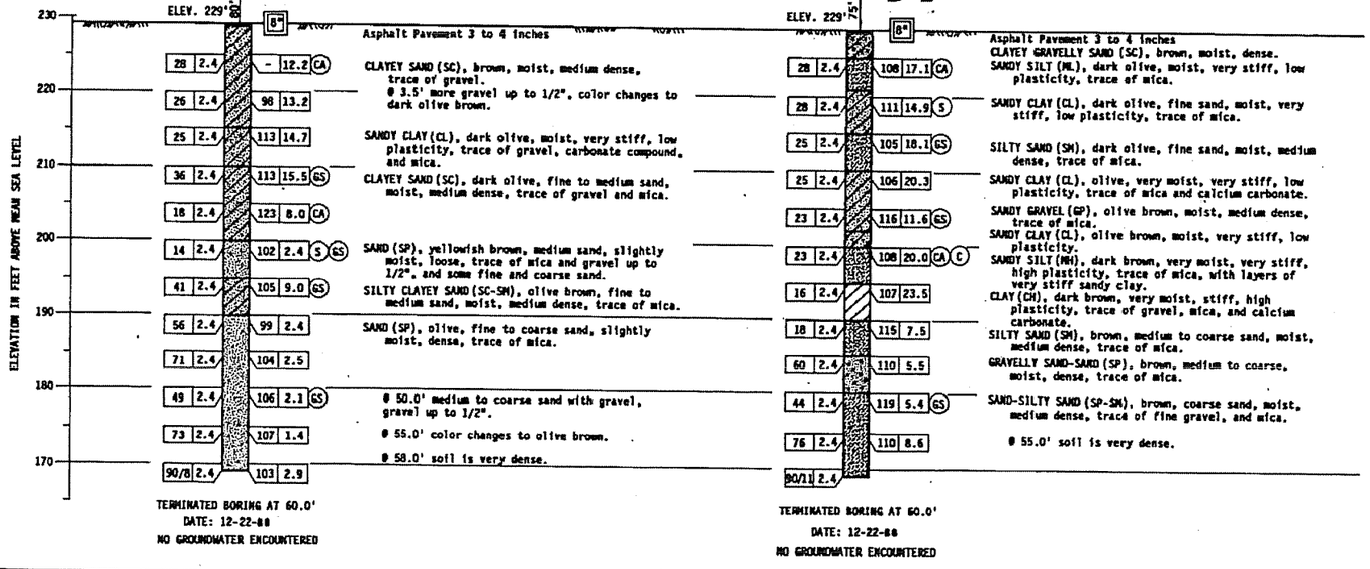


PLAN

SCALE: 1"=40'

PROFILE

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'



AS BUILT NO AS BUILT CHANGES
J. PALHEIRO
CORRECTIONS BY I. PANGLE
CONTRACT NO. 12-020184
DATE 11-24-92

BM 535-D-70 ELEVATION 257.37

FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60 AND 105 FEET NORTHERLY OF THE CENTERLINE OF NUTWOOD AVE..

DESIGN OVERSIGHT 8-22-90 SIGN OFF DATE
DRAWN BY B. BASMADJIAN
CHECKED BY H. ABDALLAH
S. MOHAMAD FIELD INVESTIGATOR
DATE 12-28-89
PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
PROJECT ENGINEER
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3
CU 12208
EA 020180
BRIDGE NO. 55-450
POST MILE 16.7
SOUTH PLACENTIA OVERHEAD (WIDEN)
LOG OF TEST BORINGS
DISREGARD PRINTS BEARING EARLIER REVISION DATES →
REVISION DATES (PRELIMINARY STAGE ONLY)
SHEET 9 OF 10

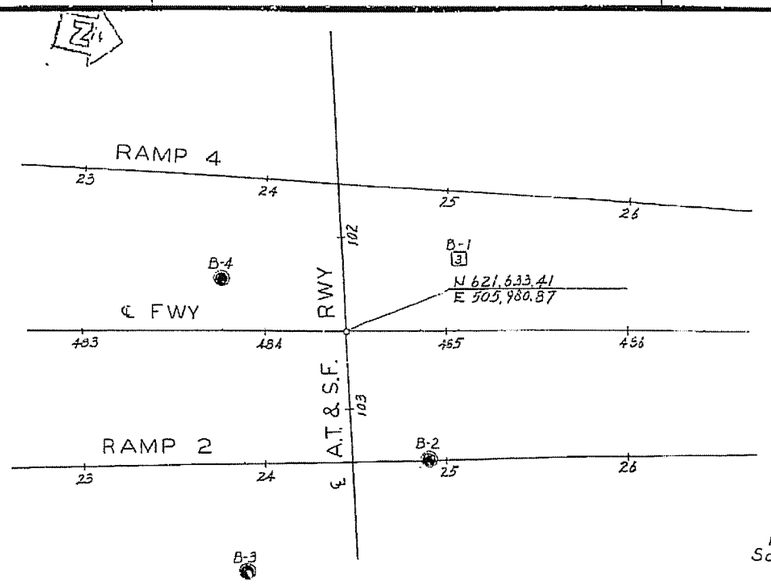
FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	15G/21G	122	197

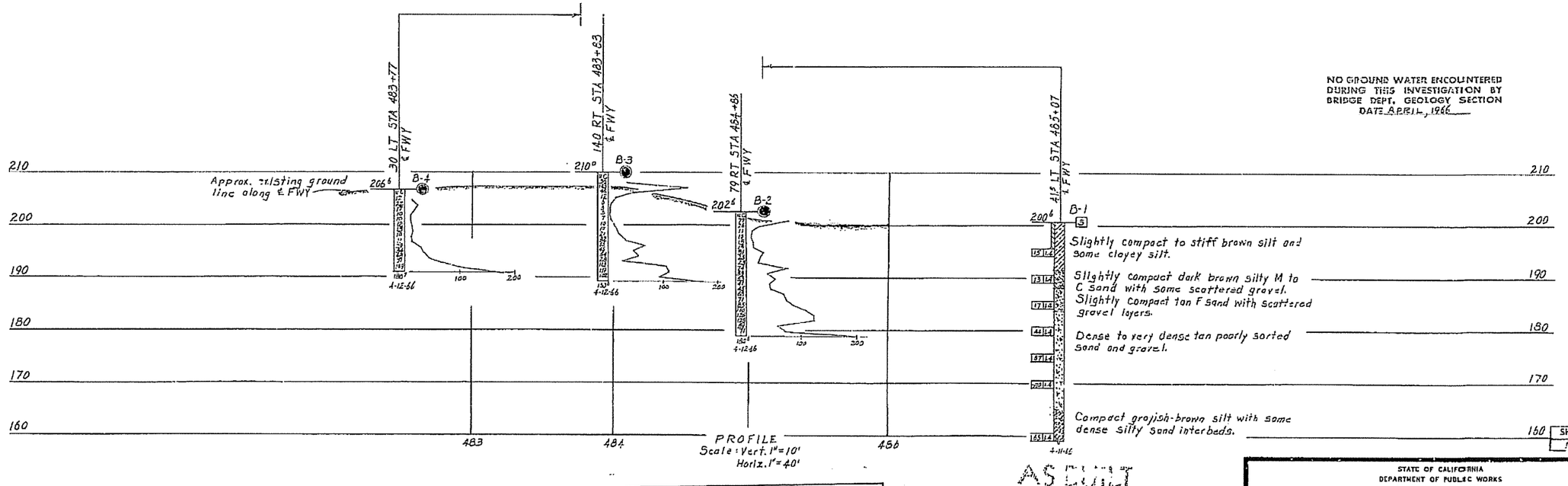
Date approved August 28, 1967

BENCH MARK

B.M. 464-65 Elev. 205.336
Set R.R. spk. in N. side of P.P. # 102608 E. 135 Ft. W. of ℄ intersection Frwy. ℄ A.T. & S.F. R.R. spurline 26 Ft. S. of ℄ Tracks 15 Ft. above O/G.



PLAN
Scale: 1" = 40'



PROFILE
Scale: Vert. 1" = 10'
Horiz. 1" = 40'

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER ____ DATE ____

RETAINING WALL NO. 476

LOG OF TEST BORINGS NO. 7

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

Cu: 12
Ea: 0F0311

BRIDGE No. 55E0081

Sheet X of X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/69
GEOTECHNICAL
STATE OF CALIFORNIA

FIELD STUDY	by D.L. Conrad 4-15-66
DRAWN	by M.C. Clark 4-26-66
CHECKED	by M.C. Clark 4-26-66

Approved: Lino C. Cheang
Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

LEGEND OF EARTH MATERIALS

Gravel; Sand; Silt; Clay; Silty Clay or Clayey Silt; Peat or Organic Matter; Fill Material; Igneous Rock; Sandy Clay or Clayey Sand; Sandy Silt or Silty Sand; Sedimentary Rock; Metamorphic Rock

Penetrometer; 2½" Cone Penetrometer; Sampler Sounding (Only); Rotary Boring (Incl); Auger Boring (Only); Jet Boring; Core Boring; Test Pit

CLASSIFICATION OF MATERIAL BASED ON STANDARD SOIL LIMITS

Diagram showing the basis for symbols of above test borings where we determine if cohesive material is present to differentiate between the terms "gravelly" clay and "sandy" clay. Also used to differentiate between "cohesive" silt and "fine" silty sand. Also used to decide sandy, silty sand or silty gravel where sieve analysis data is not available.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

AS BUILT PLANS
Contract No. 07-032124
Date Completed ____
Document No. 70000668

AS BUILT
CORRECTIONS BY Hazel 7-28-69
CONTRACT NO. 07-032124
DATE 4-3-70

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SOUTH PLACENTIA OVERHEAD

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-450 R/L | FILL | DRAWING 55450-13

SHEET 13 OF 18

Charge: 07206
W.A. 032121

Disregard prints bearing earlier numbers

PREL. DRAWING No. PR- 67

122

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

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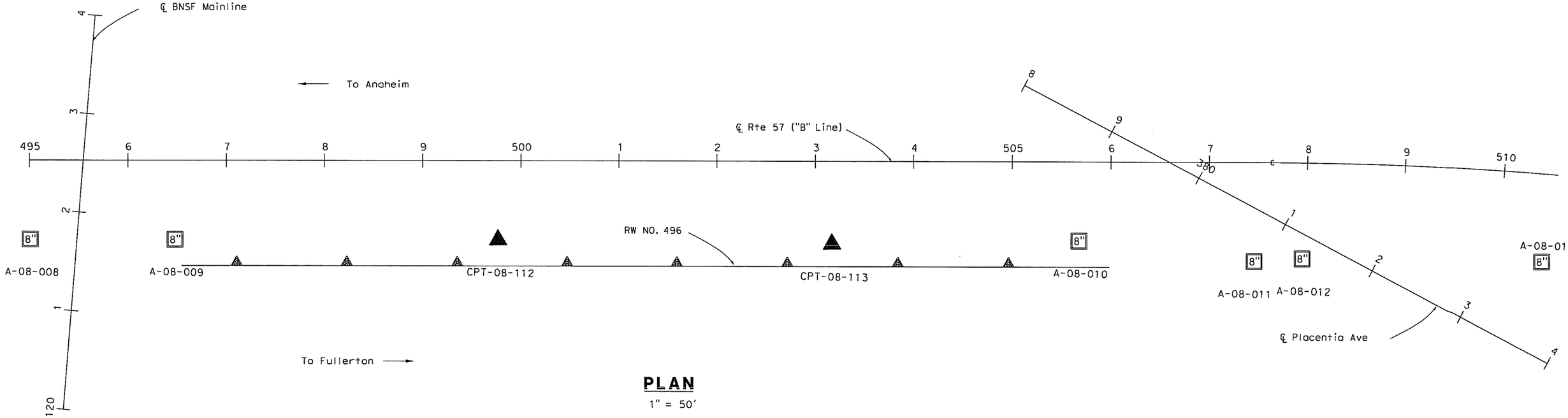
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN
1" = 50'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO. 55E0083	RETAINING WALL NO. 496
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 1
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3		CU 12 EA 0F031I	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09	SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED ENGINEER DATE

PLANS APPROVAL DATE

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REGISTERED PROFESSIONAL ENGINEER
L. CHEANG
NO. GE 2345
EXP. 9-30-09
GEOTECHNICAL
STATE OF CALIFORNIA

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 496, LOG OF TEST BORINGS NO. 1"

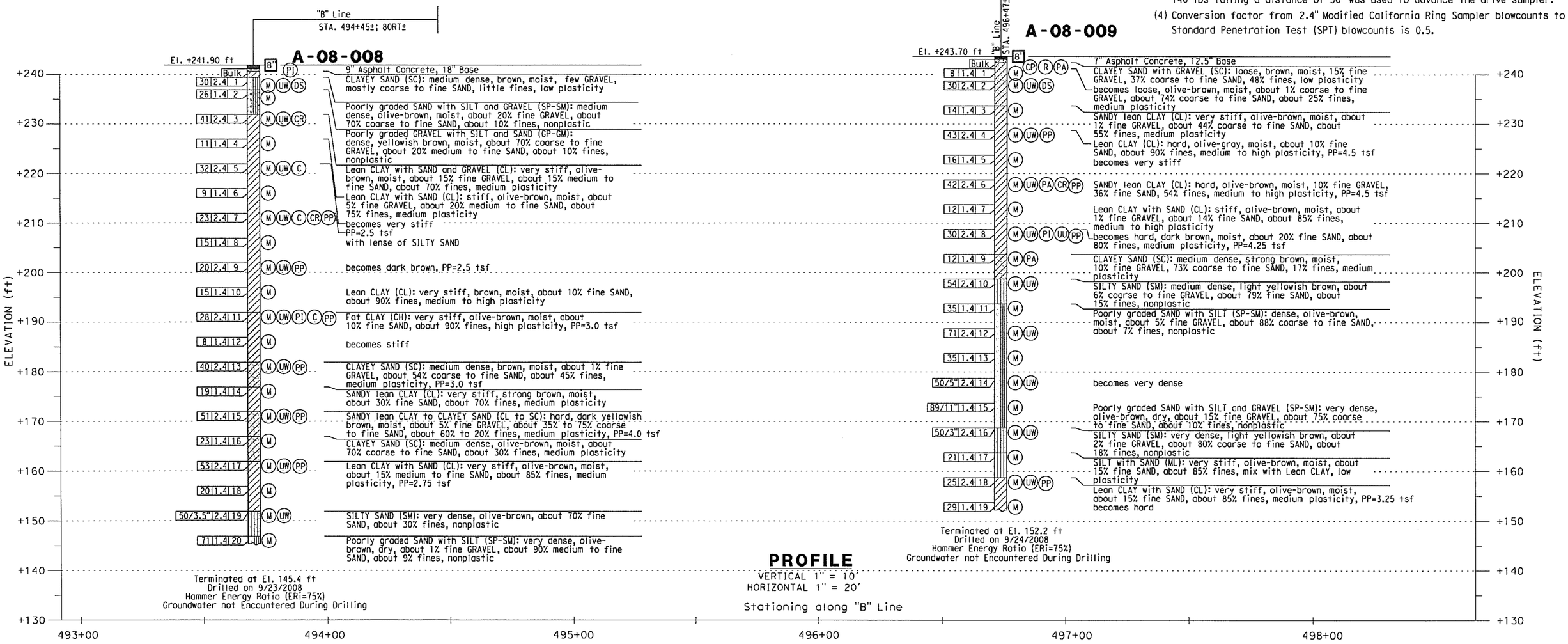
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO. 55E0083
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6

RETAINING WALL NO. 496
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

USERNAME -> $USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.

FOR PLAN VIEW SEE "RETAINING WALL NO. 496, LOG OF TEST BORINGS NO. 1"

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED ENGINEER _____ DATE _____

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE _____

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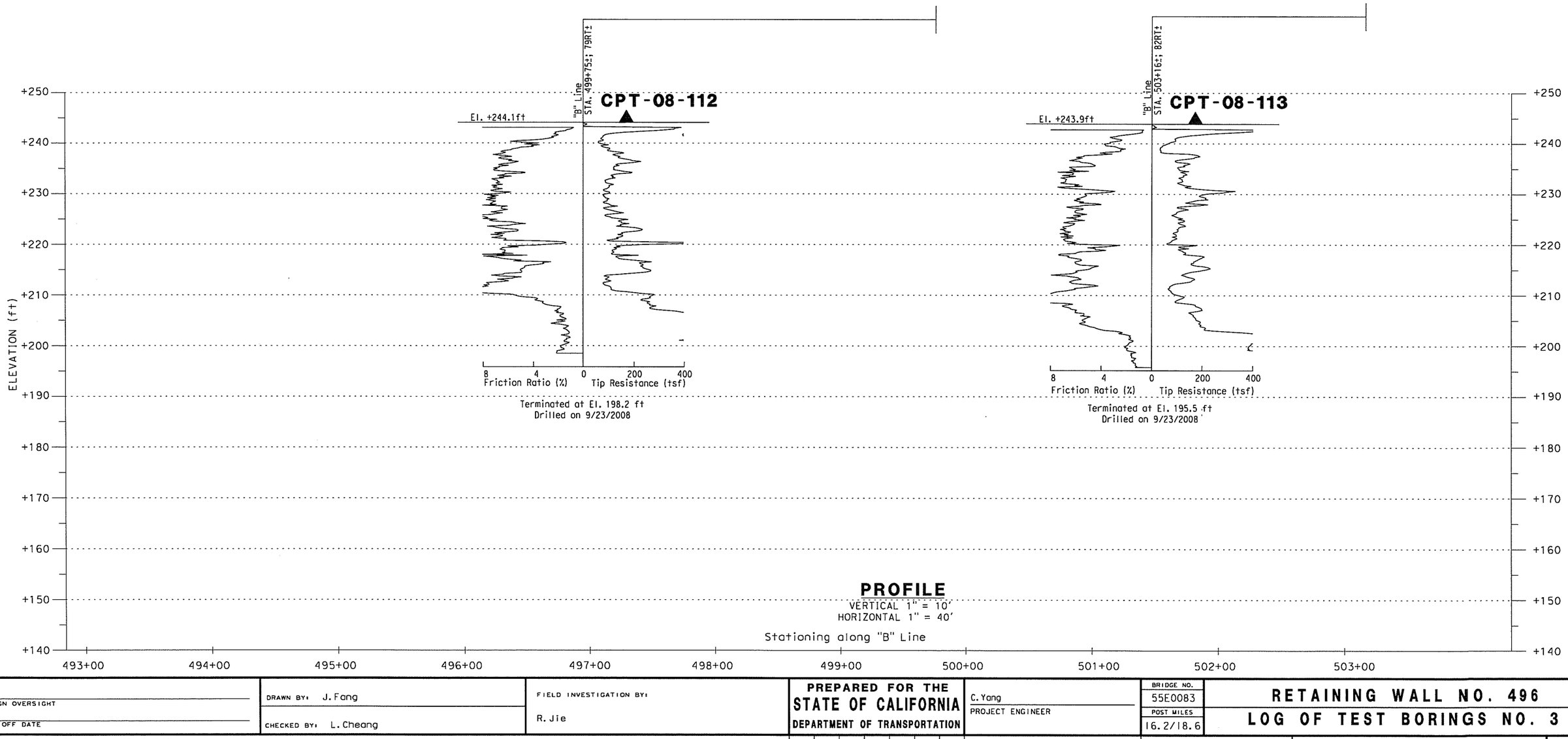
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

PLAN

1" = 50'



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

Stationing along "B" Line

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0083 POST MILES 16.2/18.6	RETAINING WALL NO. 496 LOG OF TEST BORINGS NO. 3
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)		ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3		CU 12 EA 0F0311	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09 — SHEET X OF X

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

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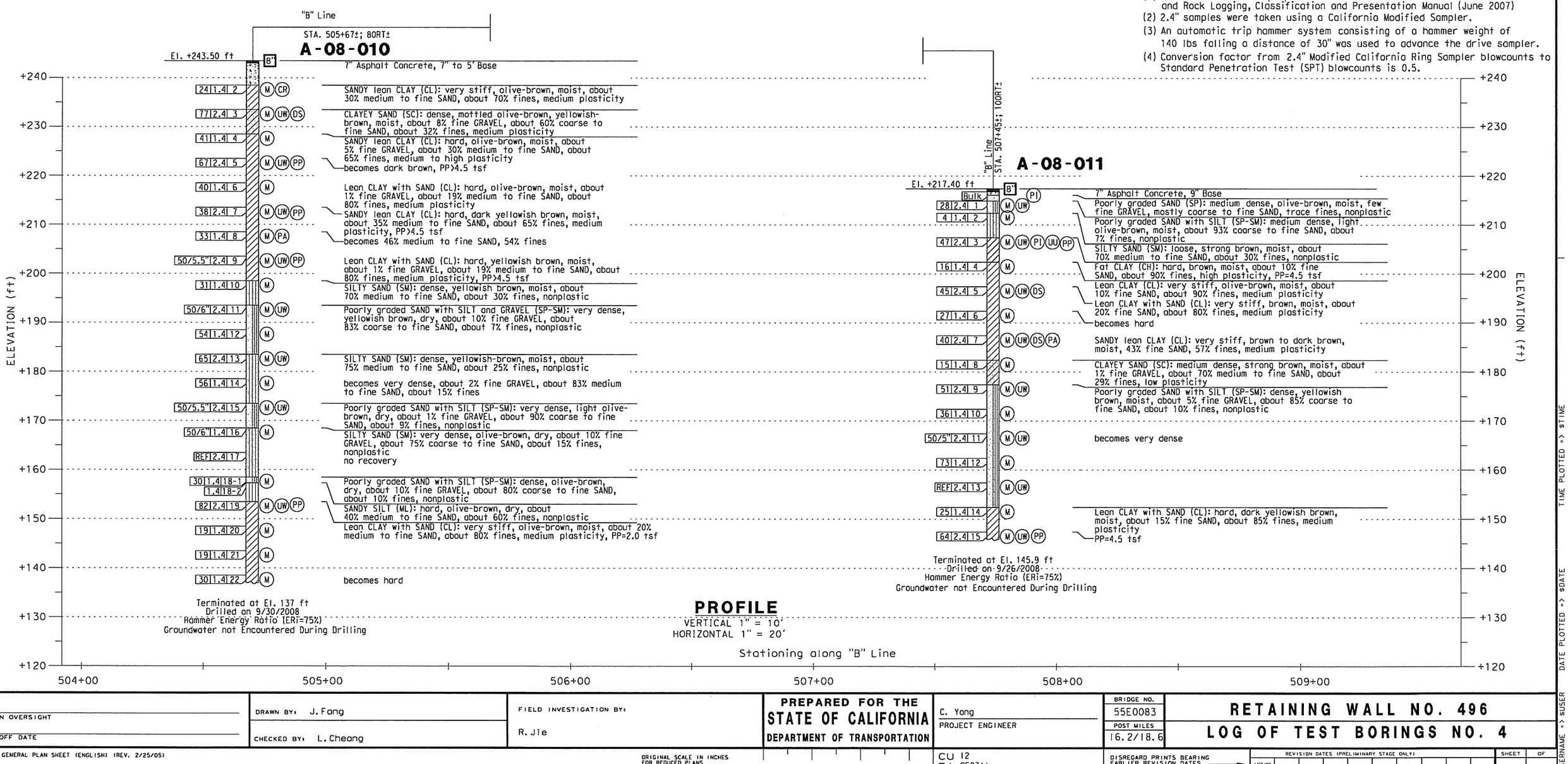
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 496, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0083 POST MILES 16.2/18.6

RETAINING WALL NO. 496
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
USERNAME => $USER

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

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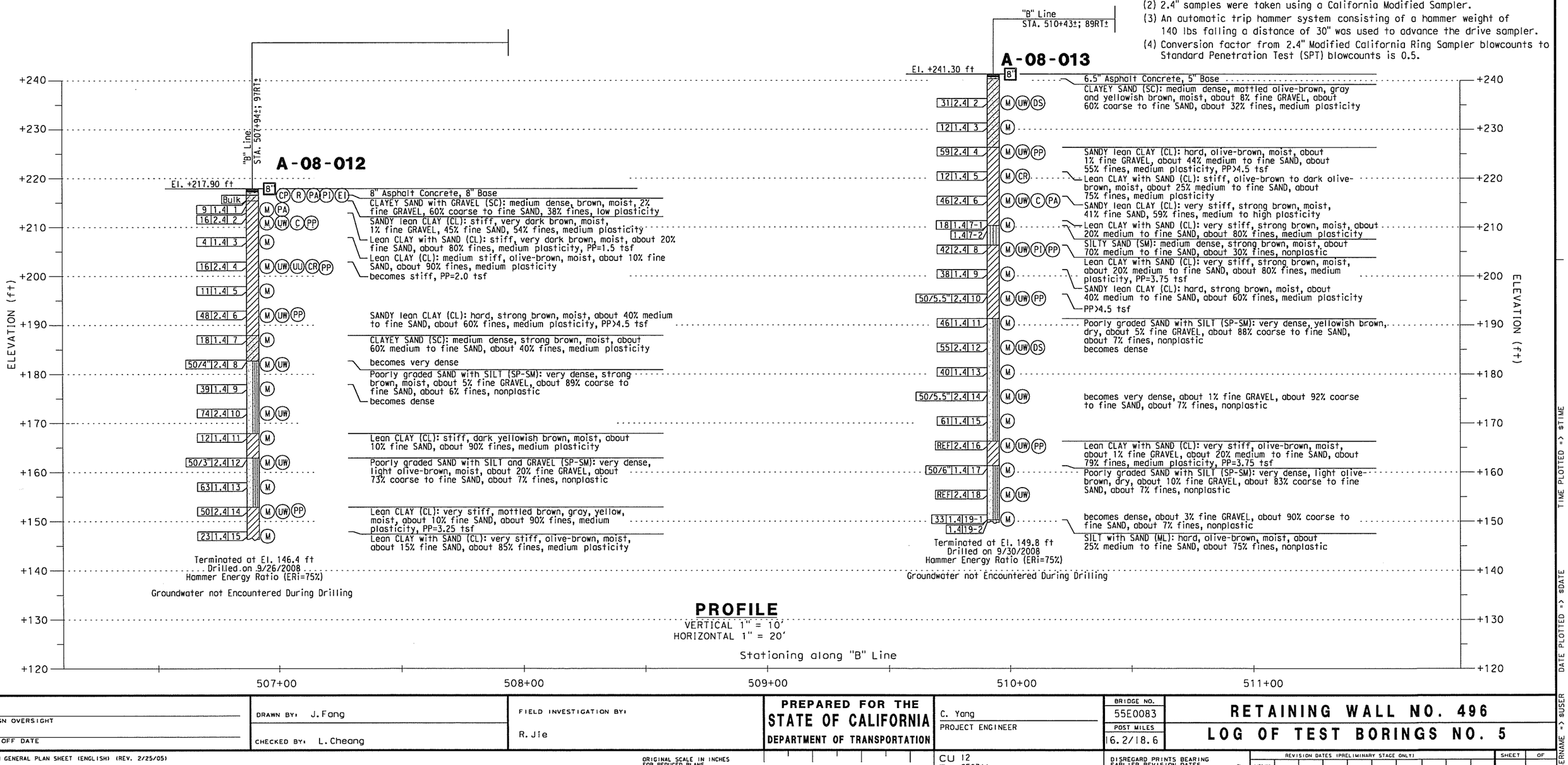
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 496, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J.Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO. 55E0083	RETAINING WALL NO. 496
SIGN OFF DATE	CHECKED BY: L.Cheang	R.Jie		PROJECT ENGINEER	POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET OF

DATE PLOTTED -> $DATE
TIME PLOTTED -> $TIME
USERNAME -> $USER

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL STATE OF CALIFORNIA — REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

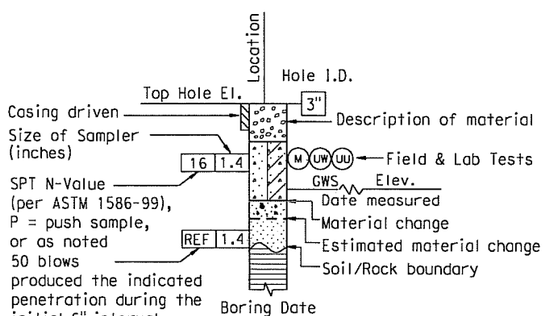
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

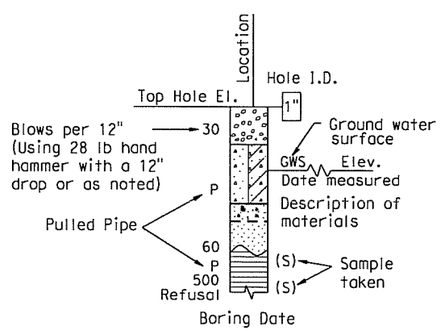
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

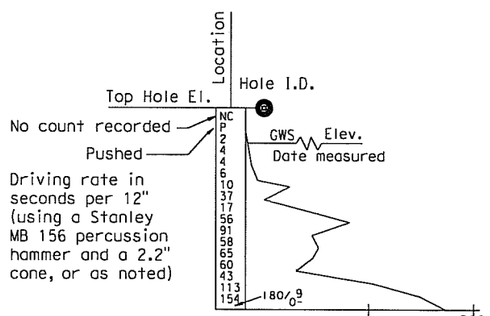
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



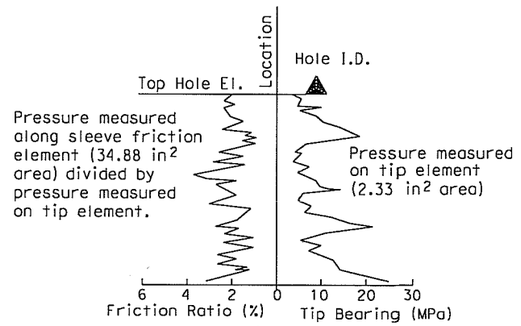
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J.Fang CHECKED BY: L.Cheang	FIELD INVESTIGATION BY: R.Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0083 POST MILES 16.2/18.6

RETAINING WALL NO. 496
LOG OF TEST BORINGS NO. 6

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME -> $USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0083
POST MILES 16.2/18.6

RETAINING WALL NO. 496
LOG OF TEST BORINGS NO. 7

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

RETAINING WALL NO. 496

LOG OF TEST BORINGS NO. 8

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No. 55E0083

Sheet X of X

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

REGISTERED PROFESSIONAL ENGINEER — LINO C. CHEANG — NO. GE 2345 — EXP. 9/30/89 — GEOTECHNICAL — STATE OF CALIFORNIA

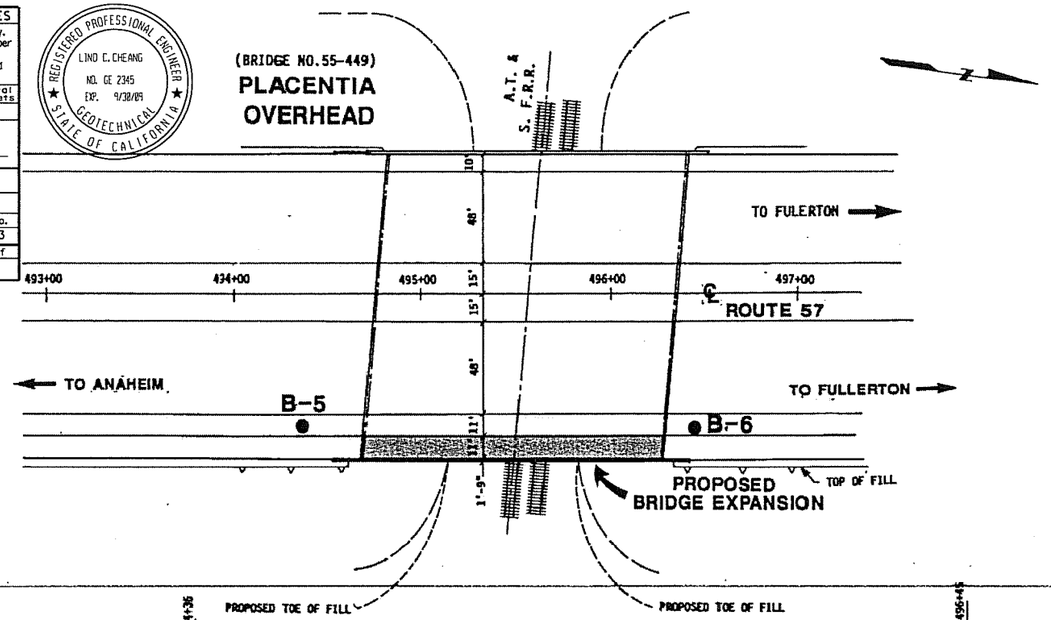
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	490	491

Kul Bhushan 12/28/89
GEOTECHNICAL PROFESSIONAL
10-29-90
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — KUL BHUSHAN — No. GE 000144 — Exp. 12/31/1989 — GEOTECHNICAL — STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351

(BRIDGE NO.55-449)
PLACENTIA OVERHEAD

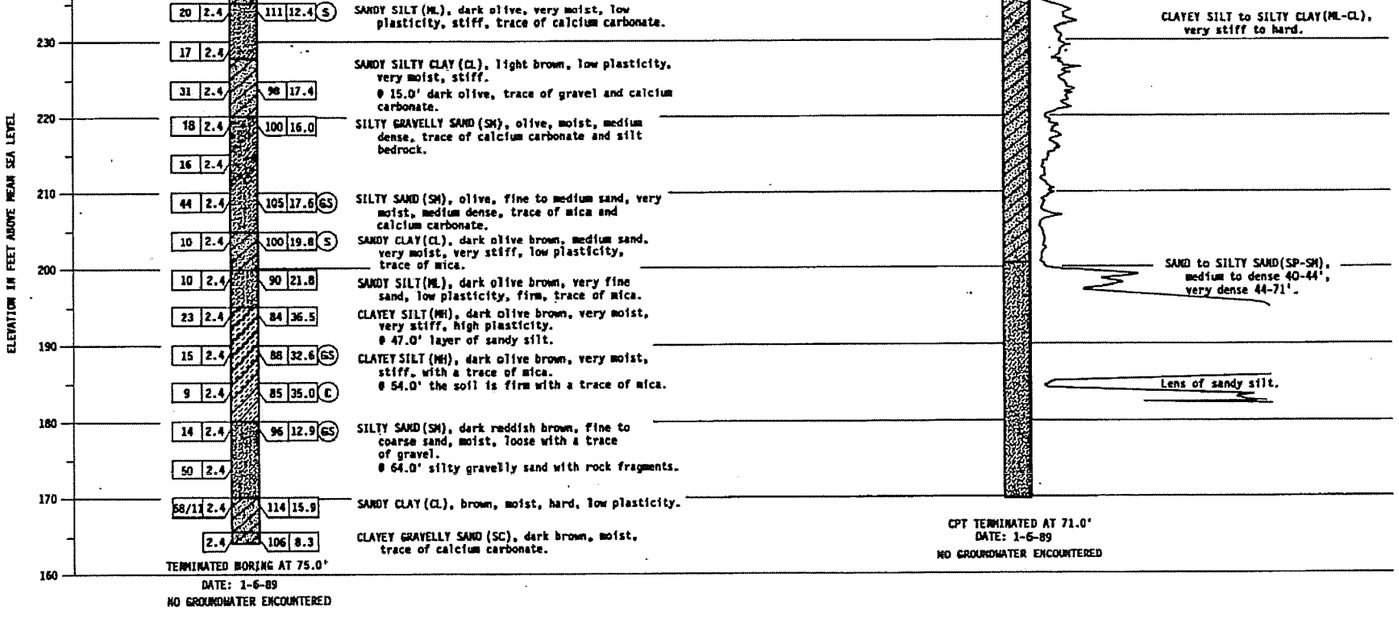


PLAN

SCALE: 1"=40'

PROFILE

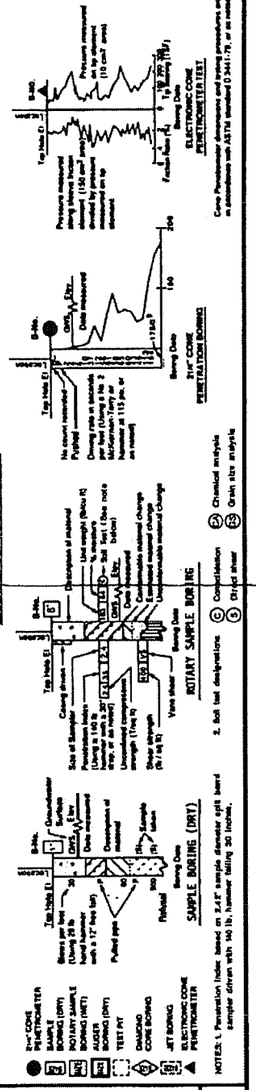
VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'

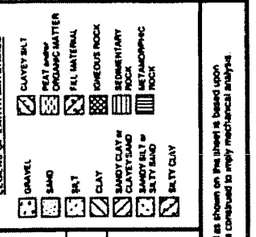


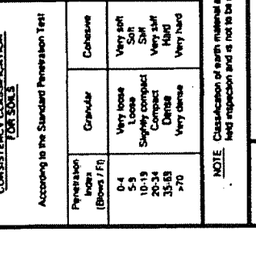
AS BUILT — NO AS BUILT CHANGES
CORRECTIONS BY J. PRINEIRO
CONTRACT NO. 12-020184
DATE 11-23-92

BM 535-D-70 — ELEVATION 257.37

FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+50 AND 105 FEET NORTHERLY OF THE CENTERLINE OF NUTWOOD AVE..







NOTE Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

DESIGN OVERSIGHT — SIGN OFF DATE 8-22-90

DRAWN BY B. BASMADJIAN
CHECKED BY H. ABDALLAH

S. MoHAMAD
FIELD INVESTIGATOR
DATE 12-28-89

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Victor Lee
PROJECT ENGINEER

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12208
EA 020181

BRIDGE NO. 55-449
POST MILE 16.9

PLACENTIA OVERHEAD (WIDEN)

LOG OF TEST BORINGS

DISREGARD PRINTS BEARING EARLIER REVISION DATES → REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 13 OF 14

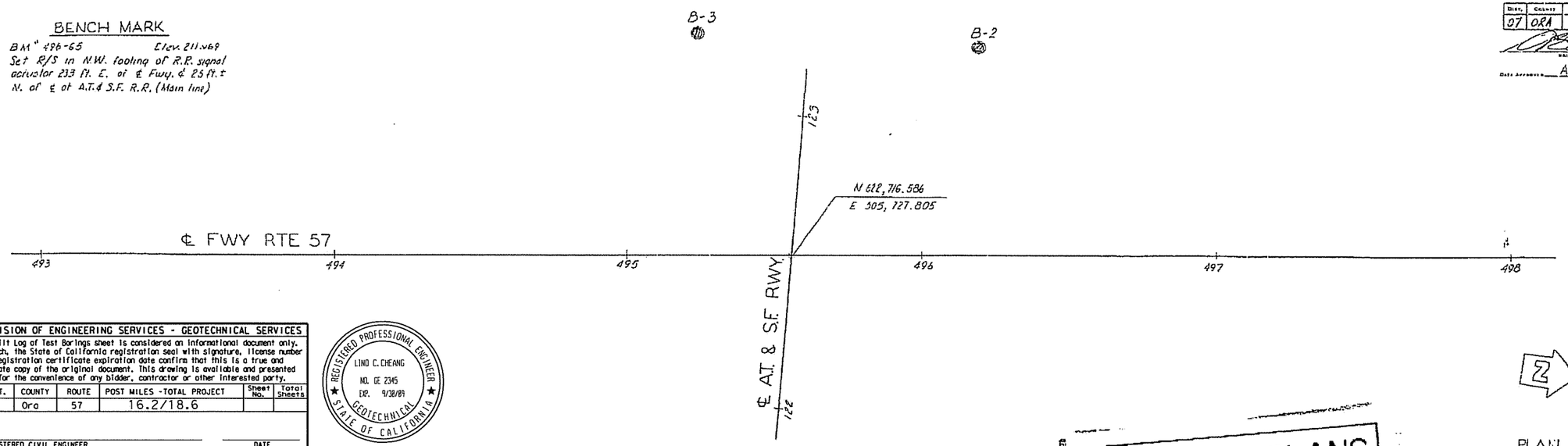
DIV. NO.				No.	SHT.
7	CALIF.				

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	16.6/21.8	147	197

Date Approved August 28, 1967

BENCH MARK

BM " 496-65 Elev. 211.469
Set R/S in N.W. footing of R.R. signal across/or 233 ft. E. of ℄ Fwy. & 25 ft.± N. of ℄ of A.T.& S.F. R.R. (Main line)



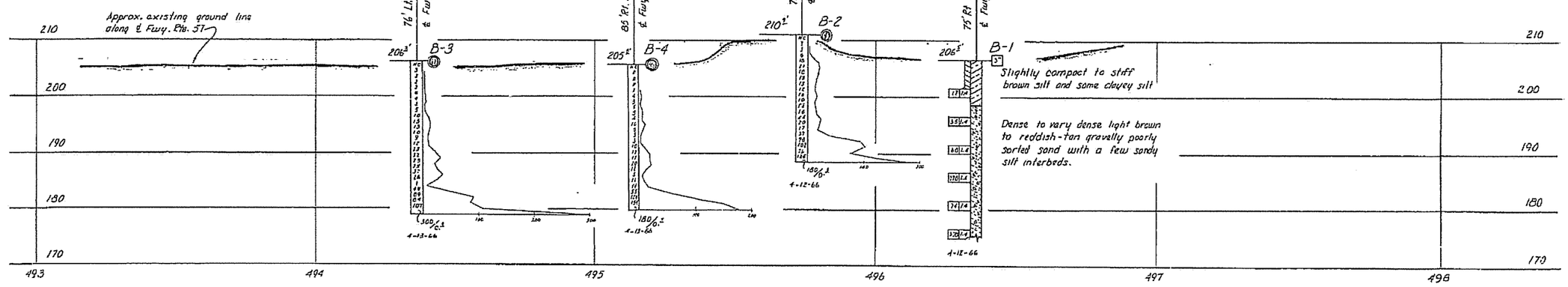
PLAN
Scale 1" = 20'

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		
REGISTERED CIVIL ENGINEER			DATE		
RETAINING WALL NO. 496					
LOG OF TEST BORINGS NO. 9					
NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA		CU: 12 EA: 0F0311		BRIDGE No. 55E0083	
				Sheet: X	of: X

REGISTERED PROFESSIONAL ENGINEER
LIND C. CHEANG
NO. GE 2345
EXP. 9/30/69
GEOTECHNICAL
STATE OF CALIFORNIA

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE April 1966



PROFILE
Scale Vert. 1" = 10'
Horiz. 1" = 20'

AS BUILT
CORRECTIONS BY [illegible] 7-28-69
CONTRACT NO. 07-032124
DATE 5-11-69

SHEET	OF
13	13

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PLACENTIA OVERHEAD

LOG OF TEST BORINGS

SCALE As Noted	BRIDGE 55-449 ½	FILE	DRAWING 55449-16

PREL. DRAWING No. PR- 46/67

Disregard prelim boaring order numbers →

Charge 07208
W.A. 032121

LEGEND OF BORING OPERATIONS

- Penetrometer
- 2½" Cone Penetrometer
- Sampler boring (dry)
- Sampler boring (wet)
- Rotary boring (dry)
- Rotary boring (wet)
- Auger boring (dry)
- Auger boring
- Jet boring
- Core boring
- Test pit

Penetration Borings
Rotary Boring
1" Soil Tube

LEGEND OF EARTH MATERIALS

- Gravel
- Silty Clay or Clayey Silt
- Sand
- Peat and/or Organic Matter
- Silt
- Fill Material
- Clay
- Igneous Rock
- Sandy Clay or Clayey Sand
- Sedimentary Rock
- Silty Sand or Silty Sand
- Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

Diagram showing the basis for estimates of grade size distribution used in determination of class names.
(If gravel is present in appreciable quantities, the term "gravelly" should be added to the class name, viz. "gravelly sand". The terms "coarse", "medium" and "fine" when used to describe sand, refer to the grade size ranges of the standard grade size limits.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

7	CALIF.				

DIST.	COUNTY	ROUTE	POST MILES	SHEET NO.	TOTAL SHEETS
07	ORA	57	15.6/18.8	173	197

APPROVED: August 28, 1967

BENCH MARK

B.M. " 505R-65 Elev. 202.22
Set bolt spk. in E. side of P.P. " 961587 203 ft. E. of ℄ Sta. 379+25 Placentia & 150 ft. S. of ℄ Santa Fe Ave. 1ft above o/g

B-1 B-2 B-3 B-4 B-5 B-6 B-7

℄ CONST. RTE 57

℄ EXISTING PLACENTIA AVE.

N 623,791.956
E 505,476.569

503 504 505 506 379 507 508 509 510 380 381

N

PLAN
Scale 1"=30'

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER _____ DATE _____

RETAINING WALL NO. 496

LOG OF TEST BORINGS NO. 10

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 EA: 0F0311

BRIDGE No. 55E0083

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER
LIND C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE April 1966

AS BUILT
CORRECTIONS BY Hixson dtd 7-29-69
CONTRACT NO. 07-032124
DATE 5-11-69

LEGEND OF BURIED OPERATIONS

- Penetrometer
- 2½" Cone Penetrometer
- Sampler boring (SAV)
- Rotary boring (rvc)
- Auger boring (CAV)
- Boring
- Jet boring
- Core boring
- Test pit
- Rotary Boring
- 1st Soil Tube

LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Silty clay or clayey silt
- Peat and/or organic matter
- Fill material
- Igneous rock
- Sandy clay or clayey sand
- Sandy silt or silty sand
- Sedimentary rock
- Metamorphic rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

Diagram showing the sand fraction limits for estimated percentages of gravel, sand and silt. Text: "If gravel is present in appreciable quantities the following class name may be added to the class name, viz. 'gravelly sand.' The terms 'coarse,' 'medium' and 'fine' may be added to the class name of sand, silt and gravel, refer to standard grade size limits."

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

PROFILE
Scale Vert. 1"= 10'
Horiz. 1"= 30'

B-1: 46' Lt. Sta. 503+60 ℄ Const. Rte. 57; 214.5'; Compact, light brown interbedded sandy silt and silty very fine to medium sand; Dense, yellow-brown to buff, micaceous, very fine to medium sand; Very dense, buff, gravelly, very fine to very coarse sand. 11-15-65

B-2: 35' Lt. Sta. 504+45 ℄ Const. Rte. 57; 214.5'; 160/0.2 11-15-65

B-7: 106' Rt. Sta. 505+00 ℄ Const. Rte. 57; 217.5'; 160/0.2 4-14-66

B-6: 47' Lt. Sta. 506+08 ℄ Const. Rte. 57; 213.5'; 160/0.2 4-14-66

B-5: 70' Lt. Sta. 507+35 ℄ Const. Rte. 57; 211.5'; Approx. existing ground line along ℄ Const. Rte. 57; Loose to slightly compact brown silt, sandy silt and silty fine sand; Slightly compact dark brown sandy silt with some clay binder; Compact buff silty very fine to fine sand; Very dense buff gravelly poorly sorted sand; Compact brown sandy silt. 4-18-66

B-4: 80' Rt. Sta. 507+35 ℄ Const. Rte. 57; 215.5'; 160/0.2 4-13-66

B-3: 10' Rt. Sta. 508+20 ℄ Const. Rte. 57; 215.5'; 130/0.2 4-13-66

220 210 200 190 180 170

503 504 505 506 507 508 509 510

SHEET	OF
26	26

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PLACENTIA AVENUE UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted	BRIDGE 55-460	FILE	DRAWING 55460-2

DRAWN	M. ALLRED 4-26-68
CHECKED	W. CAIN 5-20-68

Approved for Recommended by _____ Engineer in Charge

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

Charge 07208

Disregard prints bearing earlier numbers

PREL. DRAWING No. PR-

173

APPENDIX A4

EXPLORATORY BORING LOGS FOR PAVEMENT DESIGN

Grade Elevation	27.3 FT ±				
Boring Depth	25 FT	Driller	2R DRILLING		SHEET 1 OF 1
Borehole Diameter	8 INCHES	Type of Rig	HOLLOW STEM	Comments	
Date Drilled	12/18/97	Drive Wt.	140-LB		
Logged By	P. F. CHAN	Drop	30 INCHES		

Depth (ft)	Sample Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Weight (lb/ft³)	Tests/ Results
0	B	1			SILTY SAND (SM): DARK GREY-BROWN, MOIST, FINE TO MEDIUM			R, CP
5	D	2	20		SAND (SP): LIGHT OLIVE-GREY, MOIST, FINE TO COARSE, SLIGHTLY COMPACT, LOOSE WHEN HANDLED	14	106	DS
	S	3	20		SAND WITH SILT AND GRAVEL (SP-SM): LIGHT OLIVE-GREY, MOIST, FINE TO COARSE, COMPACT, GRAVEL WITH DIA. UP TO 1/2 INCH	35	-	PA
10								
15	D	4	40			24	108	

1. 'Sample Type' – Graphical representation of sample type as shown below.
   S: Split Spoon – Standard Penetration Test Sample (SPT)
   D: Drive Sample – California Drive Sampler
   B: Bulk Sample – Obtained by collecting cuttings in a plastic bag
   T: Tube Sample – Thin-walled Tube Sample
   P: Thin-walled Pitcher Core Sample

2. 'Sample' – Sample Number

3. 'Blows/foot' – Number of blows required to advance sampler one foot (unless a distance is specified). Samplers in general were driven into the soil at the bottom of the hole with a 140-lb automatic trip hammer falling a standard 30 inches (as specified in header).

   'REC/RQD' – Sample Core Recovery (REC) in percent (%) and Rock Quality Designation (RQD) in percent (%). RQD is defined as the percentage of core in each run in which the spacing between natural fractures is greater than 4 inches. Mechanical breaks of the core are not considered.

4. 'Graphic Log' – Standard symbols for soil and rock types, as shown in Note B opposite

5. ▼ Groundwater elevation while drilling.

6. 'Geotechnical Description' (See also Note A, opposite).
   Soil – Soil classifications are in general accordance with the American Society for Testing and Materials (ASTM) D2488.84. Designations include consistency, moisture, and color. Field description have been modified to reflect results of laboratory analyses where deemed appropriate.

   Rock – Rock classifications generally include a rock type, color, moisture, mineral constituents, degree of weathering, alteration and the mechanical properties of the rock.

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SR-57 Northbound Improvement Project

EMI Project No.: 08-115 | Date: 12-18-08

LEGEND FOR LETTER-SIZE GEOTECHNICAL BORING LOGS (SHEET 1 OF 2)

7. 'Moisture Content' and 'Total Unit Weight' determined by laboratory testing.

8. 'Tests/Results' – Identify types of laboratory tests performed on samples collected from the field investigation. Abbreviations of tests are provided below:

C	Consolidation (ASTM D 2435)	P	Permeability (CTM 220)	SG	Specific Gravity (AASHTO T 100)
CL	Collapse Potential (ASTM D 5333)	PA	Particle Size Analysis (ASTM D 422)	SL	Shrinkage Limit (ASTM D 427)
CP	Compaction Curve (CTM 216)	PI	Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)	SW	Swell Potential (ASTM D 4546)
CR	Corrosivity Testing (CTM 643, CTM 422, CTM 417)	PL	Point Load Index (ASTM D 5731)	TV	Pocket Torvane
CU	Consolidated Undrained Triaxial (ASTM D 4767)	PM	Pressure Meter	UC	Unconfined Compression–Soil (ASTM D 2166)
DS	Direct Shear (ASTM D 3080)	PP	Pocket Penetrometer		Unconfined Compression–Rock (ASTM D 2938)
EI	Expansion Index (ASTM D 4829)	R	R–Value (CTM 301)	UU	Unconsolidated Undrained Triaxial (ASTM D 2850)
M	Moisture Content (ASTM D 2216)	SE	Sand Equivalent (CTM 217)	UW	Unit Weight (ASTM D 4767)
OC	Organic Content–% (ASTM D 2974)			VS	Vane Shear (AASHTO T 223)

Criteria for Describing Moisture Condition

Description	Criteria (After ASTM D 2488)
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

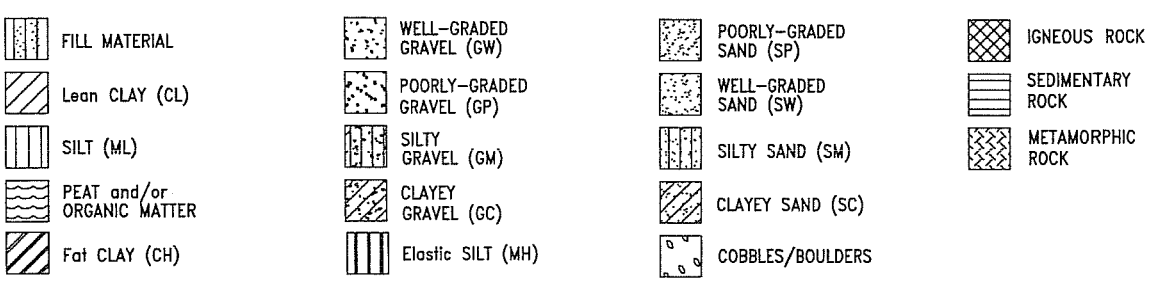
Relative Density of Coarse–Grained Soil

Blows/foot	Relative Density	Field Test (After Sowers, 1979)
0 – 4	Very Loose	Easily penetrated 12" with 0.5–inch steel rod pushed by hand
5 – 10	Loose	Easily penetrated with 0.5–inch steel rod pushed by hand
11 – 30	Medium Dense	Easily penetrated with 0.5–inch steel rod driven by 5–lb hammer
31 – 50	Dense	Penetrated a foot with 0.5–inch steel rod driven by 5–lb hammer
> 50	Very Dense	Penetrated a few inches with 0.5–inch steel rod driven by 5–lb hammer

Consistency of Cohesive Soils

Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

Legend of Earth Materials



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SR–57 Northbound Improvement Project

EMI Project No.: 08–115 | Date: 12–18–08

LEGEND FOR LETTER–SIZE GEOTECHNICAL BORING LOGS (SHEET 2 OF 2)

LOG OF BORING NO. A-08-129

Grade Elevation:	255.8 feet				
Boring Depth:	11.5 feet	Driller:	2R Drilling	SHEET 1 OF 1	
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler	
Date Drilled:	9-02-08	Drive Wt. (lbs):	140		
Logged By:	R.J.	Drop (inches):	30		

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			SITY CLAYEY SAND with GRAVEL (SC-SM): medium dense, dark brown, moist, 27% coarse to fine GRAVEL, 48% coarse to fine SAND, 25% fines, low plasticity			R,CP,PA,PI
2.5	S	1	17		CLAYEY SAND (SC): medium dense, dark yellowish brown, moist, about 3% fine GRAVEL, about 67% coarse to fine SAND, about 30% fines, medium plasticity	11	-	
5	D	2	31		SANDY lean CLAY (CL): hard, very dark yellowish brown, moist, about 40% fine SAND, about 60% fines, medium plasticity	14	137	PP>4.5 tsf
10	S	3	9		SILTY SAND (SM): medium dense, dark yellowish brown, moist, about 70% medium to fine SAND, about 30% fines, nonplastic	7	-	
12.5					Terminated Boring at 11.5 feet depth. No groundwater encountered.			
15								
17.5								

LOG OF BORING NO. A-08-130

Grade Elevation:	260.0 feet			
Boring Depth:	3.5 feet	Driller:	2R Drilling	SHEET 1 OF 1
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler
Date Drilled:	8-29-08	Drive Wt. (lbs):	140	
Logged By:	R.J.	Drop (inches):	30	

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			SILTY CLAYEY SAND (SC-SM): medium dense, yellowish brown, moist, few coarse to fine GRAVEL, mostly coarse to fine SAND, little fines, low plasticity			PI
2.5	D	1	24		SANDY lean CLAY (CL): hard, dark yellowish brown, moist, about 40% fine SAND, about 60% fines, medium plasticity	9	127	PP>4.5 tsf
					Terminated Boring at 3.5 feet depth. No groundwater encountered.			
5								
7.5								
10								
12.5								
15								
17.5								

LOG OF BORING NO. A-08-132

Grade Elevation:	264.5 feet			
Boring Depth:	11.5 feet	Driller:	2R Drilling	SHEET 1 OF 1
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler
Date Drilled:	9-04-08	Drive Wt. (lbs):	140	
Logged By:	R.J.	Drop (inches):	30	

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			SANDY lean CLAY (CL): stiff, dark yellowish brown, moist, little coarse to fine SAND, mostly fines, trace fine GRAVEL, low plasticity			PI
2.5	D	1	14		SILTY SAND with GRAVEL (SM): loose , dark yellowish brown, moist, 19% fine GRAVEL, 66% medium to fine SAND , 15% fines, nonplastic	25	124	PA,DS
					Lean CLAY with SAND (CL): medium stiff, olive-gray, moist, about 20% fine SAND, about 80% fines, medium plasticity			
5	S	2	11		SANDY lean CLAY (CL): stiff, dark yellowish brown, moist, about 45% fine SAND, about 55% fines, medium plasticity	14	-	
7.5								
10	D	3	18		SILTY SAND (SM): loose, dark yellowish brown, moist, about 70% medium to fine SAND, about 30% fines, nonplastic	14	124	CR
					Terminated Boring at 11.5 feet depth. No groundwater encountered.			
12.5								
15								
17.5								

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SR-57 Northbound Improvement Project

Project No. 08-115 Date: 12-18-08

LOG OF BORING NO. A-08-133

Grade Elevation:	266.5 feet			
Boring Depth:	11.5 feet	Driller:	2R Drilling	SHEET 1 OF 1
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler
Date Drilled:	9-04-08	Drive Wt. (lbs):	140	
Logged By:	R.J.	Drop (inches):	30	

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			CLAYEY SAND to SANDY lean CLAY (SC/CL): medium dense, dark brown, moist, 6% coarse to fine GRAVEL, 44% coarse to fine SAND, 50% fines, low plasticity			R,CP,PA,PI
2.5	S	1	13		CLAYEY SAND (SC): medium dense, dark yellowish brown, moist, about 65% coarse to fine SAND, about 35% fines, medium plasticity	13	-	
5	D	2	34			12	136	
7.5								
10	S	3	2		SANDY lean CLAY (CL): soft, very dark yellowish brown, moist, about 40% fine SAND, about 60% fines, medium plasticity	20	-	
12.5					Terminated Boring at 11.5 feet depth. No groundwater encountered.			
15								
17.5								

LOG OF BORING NO. A-08-134

Grade Elevation:	269.4 feet			
Boring Depth:	11.5 feet	Driller:	2R Drilling	SHEET 1 OF 1
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler
Date Drilled:	9-03-08	Drive Wt. (lbs):	140	
Logged By:	R.J.	Drop (inches):	30	

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			SANDY lean CLAY (CL): stiff, dark brown, moist, little coarse to fine SAND, mostly fines, trace coarse to fine GRAVEL, low plasticity			PI
2.5	D	1	16		CLAYEY SAND (SC): loose, dark yellowish brown, moist, about 2% fine GRAVEL, about 73% coarse to fine SAND, about 25% fines, medium plasticity	13	130	DS
5	S	2	8			14	-	
7.5								
10	D	3	14		SILTY CLAYEY SAND (SC-SM): loose, dark yellowish brown, moist, 51% medium to fine SAND, about 49% fines, low plasticity	14	122	PA
12.5					Terminated Boring at 11.5 feet depth. No groundwater encountered.			
15								
17.5								

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SR-57 Northbound Improvement Project

Project No. 08-115 Date: 12-18-08

LOG OF BORING NO. A-08-135

Grade Elevation:	274.9 feet				
Boring Depth:	2 feet	Driller:	2R Drilling	SHEET 1 OF 1	
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler	
Date Drilled:	9-04-08	Drive Wt. (lbs):	140		
Logged By:	R.J.	Drop (inches):	30		

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			SANDY lean CLAY (CL): stiff, dark brown, moist, little coarse to fine SAND, mostly fines, trace coarse to fine GRAVEL, low plasticity			PI
2.5					Terminated Boring at 2 feet depth. No groundwater encountered.			
5								
7.5								
10								
12.5								
15								
17.5								

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SR-57 Northbound Improvement Project

Project No. 08-115 Date: 12-18-08

LOG OF BORING NO. A-08-136

Grade Elevation:	288.0 feet			
Boring Depth:	10.9 feet	Driller:	2R Drilling	SHEET 1 OF 1
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler
Date Drilled:	9-04-08	Drive Wt. (lbs):	140	
Logged By:	R.J.	Drop (inches):	30	

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			CLAYEY SAND (SC): medium dense, dark brown, moist, 9% fine GRAVEL, 50% coarse to fine SAND, 41% fines, low plasticity			R, PA, PI
2.5	D	1	69		SILTY SAND (SM): dense, yellowish brown, moist, about 12% fine GRAVEL, about 68% coarse to fine SAND, about 20% fines, nonplastic	7	130	DS
5	S	2	32			9	-	
7.5								
10	D	3	50/5"		No Recovery			
					Terminated Boring at 10.9 feet depth. No groundwater encountered.			
12.5								
15								
17.5								

LOG OF BORING NO. A-08-139

Grade Elevation:	283.4 feet			
Boring Depth:	3 feet	Driller:	2R Drilling	SHEET 1 OF 1
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler
Date Drilled:	9-05-08	Drive Wt. (lbs):	140	
Logged By:	R.J.	Drop (inches):	30	

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			SILTY SAND (SM): medium dense, yellowish brown, moist, few coarse to fine GRAVEL, mostly coarse to fine SAND, little fines, nonplastic			PI
2.5					Terminated Boring at 3 feet depth. No groundwater encountered.			
5								
7.5								
10								
12.5								
15								
17.5								

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SR-57 Northbound Improvement Project

Project No. 08-115 Date: 12-18-08

LOG OF BORING NO. A-08-140

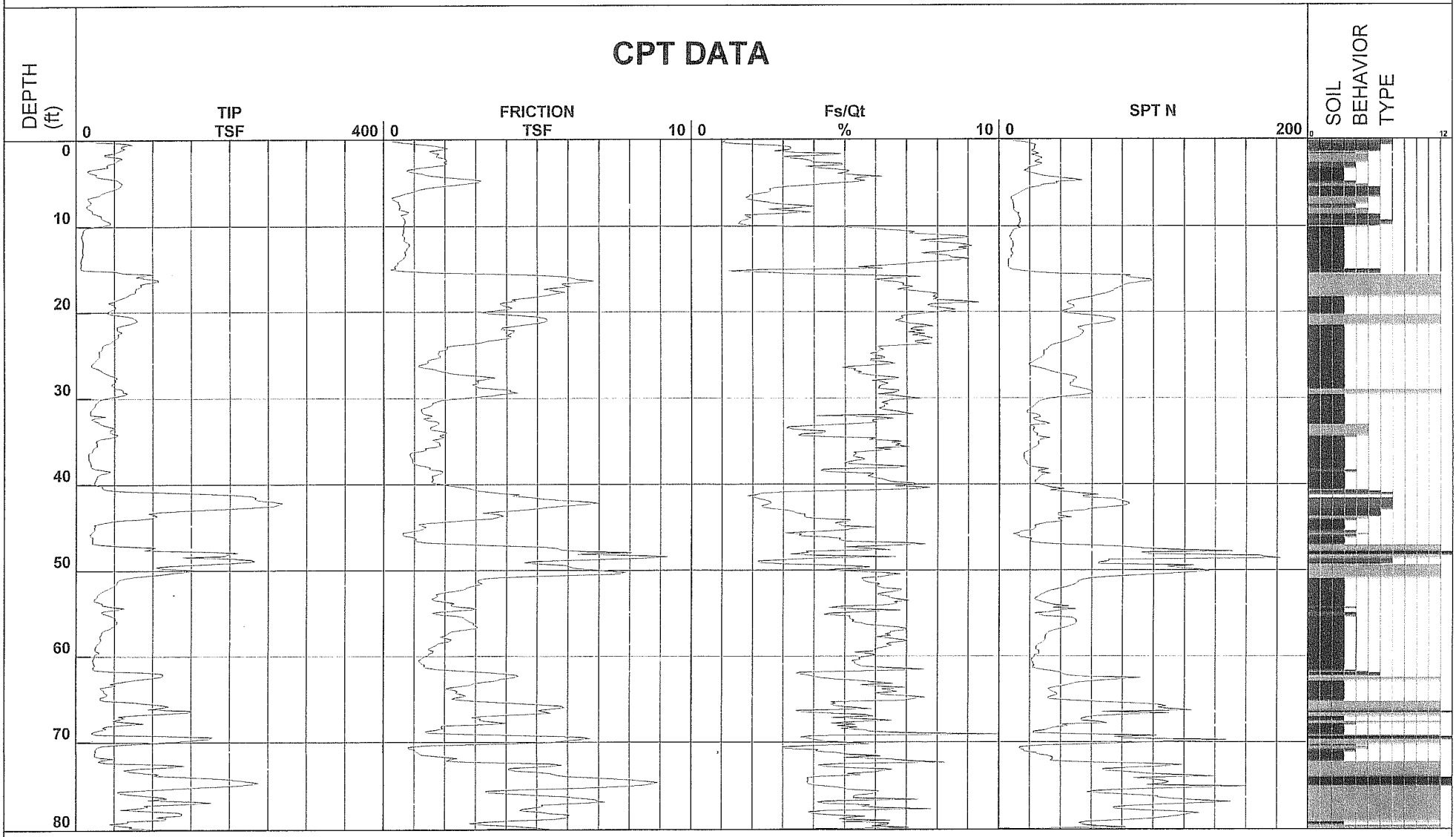
Grade Elevation:	285.6 feet			
Boring Depth:	2 feet	Driller:	2R Drilling	SHEET 1 OF 1
Borehole Diameter:	8 inches	Type of Rig:	Hollow-stem auger	Comments: 1. CME 75 with automatic hammer 2. 3.25" O.D. ring sampler
Date Drilled:	9-05-08	Drive Wt. (lbs):	140	
Logged By:	R.J.	Drop (inches):	30	

Depth (feet)	Sampler Type	Sample	Blows/foot	Graphic Log	GEOTECHNICAL DESCRIPTION	Moisture (%)	Total Unit Wt. (pcf)	Tests/ Results
0	B	0			SANDY lean CLAY (CL): stiff, dark brown, moist, 37% coarse to fine SAND, 63% fines, low plasticity			R,CP,PA,PI EI
2.5					Terminated Boring at 2 feet depth. No groundwater encountered.			
5								
7.5								
10								
12.5								
15								
17.5								

Earth Mechanics

Location	57 Freeway Expansion	Operator	VO/ML	Filename	SDF(183).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-131	Date and Time	8/29/2008 12:45:19 PM	Maximum Depth	80.22 ft
Water Table Depth	80.00 ft				

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

APPENDIX B

LABORATORY SOIL TEST RESULTS

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-001	D-2	5	SC	13.6	133.7									
A-08-001	S-3	10	SC	8.7							2000	8.6	450	153
A-08-001	D-4	15	SC	12.9	138.1									
A-08-001	S-5	20	SM/SC	13.9										
A-08-001	D-6	25	SP	2.7	106.8									
A-08-001	S-7	30	SP	3.4										
A-08-001	D-8	35	SP	3.0	123.8									
A-08-001	S-9	40	SP	2.7										
A-08-001	D-10	45	SP	3.6	115.2									
A-08-001	S-11	50	SP	6.3										
A-08-001	D-12	55	SP-SM	5.1	125.4									
A-08-001	S-13	66	SP	5.5										
A-08-001	D-14	65	SP	3.6	108.7									
A-08-001	S-15	70	SP-SM	3.6										
A-08-001	D-16	75	SP	2.9	112.9									
A-08-001	S-17	80	SP	3.2										
A-08-001	D-18	85	SP	3.8	107.1									
A-08-001	S-19	90	SP	2.9										
A-08-002	S-1-1	2.5	SM	8.6										
A-08-002	S-1-2	3.5	CL	16.5										
A-08-002	D-2	5	SM	14.5	122.9									
A-08-002	S-3	10	SP	3.3										
A-08-002	D-4	15	SW-SM	2.6	121.0									
A-08-002	S-5	20	SP-SM	3.3										
A-08-002	D-6	25	SP-SM	2.9	111.7									
A-08-002	S-7	30	SP	2.6										
A-08-002	D-8	35	SP-SM	2.2	110.1									
A-08-002	S-9	40	SP-SM	2.9										
A-08-002	D-10	45	SP	3.4	110.7									
A-08-002	S-11	50	SP-SM	4.3										
A-08-002	D-12	55	SP-SM	2.0	115.8									
A-08-002	S-13	60	SP-SM	3.4										
A-08-002	D-14	65	SP-SM	2.7	108.8									
A-08-002	S-15	70	SP-SM	2.8										
A-08-003	D-2	5	SC	8.5	141.2									
A-08-003	S-3	10	CL	16.8							1100	8.4	300	216
A-08-003	D-4	15	SC	6.9	140.9			11:67:22						
A-08-003	S-5	20	SC	15.2										
A-08-003	D-6	25	SC	16.9	124.3			1:57:42						
A-08-003	S-7	30	SP	2.7										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-003	D-8	35	SP-SM	2.7	115.1									
A-08-003	S-9	40	SP-SM	2.9										
A-08-003	D-10	45	SP-SM	2.9	112.8									
A-08-003	S-11	50	SP	3.2										
A-08-003	D-12	55	SP-SM	3.7	107.1									
A-08-003	S-13	60	SP-SM	7.1										
A-08-003	D-14	65	SP-SM	3.5	109.6									
A-08-003	S-15	70	SP-SM	3.6										
A-08-003	D-16	75	SP	2.0	106.3									
A-08-003	S-17	80	SP	3.4										
A-08-003	D-18	85	SP	2.3	111.8									
A-08-003	S-19	90	SP	2.6										
A-08-004	D-1	2.5	SC	9.4	134.3									
A-08-004	S-2	5	SC	14.4										
A-08-004	D-3	10	GP-GC	11.6	132.3									
A-08-004	S-4	15	CL	13.1							750	7.5	700	185
A-08-004	D-5	20	SC	8.6	136.5									
A-08-004	S-6	25	SM	5.6										
A-08-004	D-7	30	CL to SM	17.3	128.2	>4.5								
A-08-004	S-8	35	SM	6.6										
A-08-004	D-9	40	SM	6.4	127.2									
A-08-004	S-10	45	SP-SM	4.2										
A-08-004	D-11	50	SP-SM	3.7	112.2									
A-08-004	S-12	55	SP	2.8										
A-08-004	D-13	60	SP	2.7	122.0									
A-08-004	S-14	65	CL	14.7										
A-08-004	D-15	70	SM	8.9	117.7									
A-08-004	S-16	75	SM	11.2										
A-08-004	D-17	80	CL to SM	18.4	124.3	1.75								
A-08-004	S-18	85	SP	3.3										
A-08-004	D-19	90	SP-SM	5.4	112.9									
A-08-005	S-1	2.5	SM	7.1										
A-08-005	D-2	5	CL	10.8	104.1	1.75								
A-08-005	S-3	10	SC	13.0				1:52:47						
A-08-005	D-4	15	SC	13.5	117.9			1:51:48			2000	8.4	120	173
A-08-005	S-5	20	CL	18.6										
A-08-005	D-6	25	SC	12.5	132.2	>4.5		16:52:32						
A-08-005	S-7	30	CL	23.8										
A-08-005	D-8	35	CL	15.0	134.3	2.25				29/16/13				
A-08-005	S-9	40	SP-SC	7.6										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-005	D-10	45	SP-SC	8.4	115.7									
A-08-005	S-11	50	SC	8.1										
A-08-005	D-12	55	SP-SM	7.4	120.4									
A-08-005	S-13	60	SP-SM	3.3										
A-08-005	D-14	65	CL	17.3	132.2	2.75								
A-08-005	S-15	70	SP-SM	2.7										
A-08-005	D-16	75	ML to SM	7.7	124.8									
A-08-005	S-17	80	SM	6.2										
A-08-005	D-18	85	SP	2.0	104.3									
A-08-005	S-19	90	SM	5.3										
A-08-006	S-2	5	SC	13.3										
A-08-006	D-3	10	CL	25.3	127.8	>4.5								
A-08-006	S-4	15	CL	16.5							1800	8.1	100	168
A-08-006	D-5	20	CL to SM	15.7	129.2	2.75								
A-08-006	S-6	25	CL	20.6						38/18/20				
A-08-006	D-7	30	SC	18.0	129.5	4.5								
A-08-006	S-8	35	SP-SM	2.8										
A-08-006	D-9	40	SP-SM	2.2	111.9									
A-08-006	S-10	45	SM	6.1										
A-08-006	D-11	50	SP-SM	1.7	121.0									
A-08-006	S-12	55	ML	20.5										
A-08-006	D-13	60	CL to SM	20.7	126.8	1.5								
A-08-006	S-14	65	SP	1.4										
A-08-006	D-15	70	SP-SM	2.2	122.8									
A-08-006	S-16	75	SC	13.5				0:51:49						
A-08-006	D-17	80	SM	7.8	126.3									
A-08-006	S-18	85	SP-SM	3.0										
A-08-006	D-19	90	SP-SM	2.8										
A-08-007	D-2	5	SC	9.6										
A-08-007	S-3	10	SC	12.4				18:46:36						
A-08-007	D-4	15	CL	16.8	122.1	3.75					740	7.7	500	162
A-08-007	S-5	20	CL	19.1										
A-08-007	D-6	25	SC	12.8	127.2					32/19/13				
A-08-007	S-7	30	CL	18.7				4:39:57						
A-08-007	D-8	35	CL	12.1	132.6	4.5								
A-08-007	S-9	40	CL	10.9										
A-08-007	D-10	45	CL	16.3	122.9	2.5								
A-08-007	S-11	50	CL	17.0										
A-08-007	D-12	55	SM	18.6	112.9									
A-08-007	S-13	60	ML	23.7										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-007	D-14	65	SP	1.3	113.8									
A-08-007	S-15	70	SP-SM	4.5										
A-08-007	D-16	75	CL	30.4	121.2	3								
A-08-007	S-17	80	CL	15.7										
A-08-007	D-18	85	ML	14.5	131.6	4.5								
A-08-007	S-19	90	ML to SC	9.8										
A-08-008	D-1	2.5	SP-SM	7.0	123.6									
A-08-008	S-2	5	GP-GM	2.7										
A-08-008	D-3	10	CL	17.9	126.7						810	7.7	450	213
A-08-008	S-4	15	CL	17.1										
A-08-008	D-5	20	CL	16.0	131.8									
A-08-008	S-6	25	CL	18.4										
A-08-008	D-7	30	CL	20.8	122.5	2.5					510	7.4	750	208
A-08-008	S-8	35	CL	20.1										
A-08-008	D-9	40	CL	18.4	122.3	2.5								
A-08-008	S-10	45	CL	33.6										
A-08-008	D-11	50	CH	32.5	118.3	3.0				58/19/39				
A-08-008	S-12	55	CL	38.4										
A-08-008	D-13	60	CL to SC	14.2	138.7	3.0								
A-08-008	S-14	65	CL	17.2										
A-08-008	D-15	70	CL to SC	11.9	141.2	4.0								
A-08-008	S-16	75	SC	14.5										
A-08-008	D-17	80	CL	20.5	131.2	2.75								
A-08-008	S-18	85	CL	18.3										
A-08-008	D-19	90	SM	16.3	134.3									
A-08-008	S-20	95	SP-SM	2.8										
A-08-009	S-1	2.5	SC	9.8										
A-08-009	D-2	5	SC	12.9	113.7									
A-08-009	S-3	10	CL	12.6										
A-08-009	D-4	15	CL	17.3	109.4	>4.5								
A-08-009	S-5	20	CL	17.8										
A-08-009	D-6	25	CL	15.6	119.7	4.5		10:36:54			850	7.7	300	142
A-08-009	S-7	30	CL	17.6										
A-08-009	D-8	35	CL	16.6	124.7	4.25				42/17/25				
A-08-009	S-9	40	SC	5.3				10:73:17						
A-08-009	D-10	45	SM	1.6	102.7									
A-08-009	S-11	50	SP-SM	2.3										
A-08-009	D-12	55	SP-SM	4.8	109.7									
A-08-009	S-13	60	SP-SM	2.4										
A-08-009	D-14	65	SP-SM	2.0	101.5									

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-009	S-15	70	SP-SM	1.8										
A-08-009	D-16	75	SM	8.3	104.1									
A-08-009	S-17	80	ML	31.6										
A-08-009	D-18	85	CL	21.5	129.5	3.5								
A-08-009	S-19	90	CL	22.1										
A-08-010	S-2	5	CL	10.5							1300	8.0	100	123
A-08-010	D-3	10	SC	9.6	133.2									
A-08-010	S-4	15	CL	11.3										
A-08-010	D-5	20	CL	11.3	134.6	>4.5								
A-08-010	S-6	25	CL	10.9										
A-08-010	D-7	30	CL	8.2	121.8	>4.5								
A-08-010	S-8	35	CL	7.2				0:46:54						
A-08-010	D-9	40	CL	9.2	127.4	>4.5								
A-08-010	S-10	45	SM	3.1										
A-08-010	D-11	50	SP-SM	0.9	128.8									
A-08-010	S-12	55	SP-SM	1.1										
A-08-010	D-13	60	SM	5.6	119.3									
A-08-010	S-14	65	SM	1.7										
A-08-010	D-15	70	SP-SM	0.9	118.6									
A-08-010	S-16	75	SM	1.3										
A-08-010	S-18	85	SP-SM	2.9										
A-08-010	D-19	90	CL	16.4	132.7	2.0								
A-08-010	S-20	95	CL	24.1										
A-08-010	S-21	100	CL	22.7										
A-08-010	S-22	105	CL	17.7										
A-08-011	D-1	2.5	SP-SM	4.2	117.9									
A-08-011	S-2	5	SM	11.1										
A-08-011	D-3	10	CH	27.1	116.6	4.5				66/28/38				
A-08-011	S-4	15	CL	30.8										
A-08-011	D-5	20	CL	19.5	122.3									
A-08-011	S-6	25	CL	12.7										
A-08-011	D-7	30	CL	12.5	135.5			0:43:57						
A-08-011	S-8	35	SC	6.9										
A-08-011	D-9	40	SP-SM	3.6	122.7									
A-08-011	S-10	45	SP-SM	6.6										
A-08-011	D-11	50	SP-SM	6.2	121.8									
A-08-011	S-12	55	SP-SM	4.5										
A-08-011	D-13	60	SP-SM	5.0	121.7									
A-08-011	S-14	65	CL	18.0										
A-08-011	D-15	70	CL	18.4	131.2	4.5								

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-012	S-1	2.5	CL	15.4				1:45:54						
A-08-012	D-2	5	CL	22.4	124.8	1.5								
A-08-012	S-3	10	CL	30.4										
A-08-012	D-4	15	CL	36.7	112.8	2.0					850	7.4	50	245
A-08-012	S-5	20	CL	34.4										
A-08-012	D-6	25	CL	14.0	134.5	>4.5								
A-08-012	S-7	30	SC	14.9										
A-08-012	D-8	35	SP-SM	5.6	119.2									
A-08-012	S-9	40	SP-SM	9.9										
A-08-012	D-10	45	SP-SM	4.7	116.1									
A-08-012	S-11	50	CL	26.4										
A-08-012	D-12	55	SP-SM	2.1	128.7									
A-08-012	S-13	60	SP-SM	5.4										
A-08-012	D-14	65	CL	34.5	115.3	3.25								
A-08-012	S-15	70	CL	19.7										
A-08-013	D-2	5	SC	16.4	125.9									
A-08-013	S-3	10	SC	14.2										
A-08-013	D-4	15	CL	16.4	129.6	>4.5								
A-08-013	S-5	20	CL	16.2							1050	7.8	200	238
A-08-013	D-6	25	CL	15.3	133.4			0:41:59						
A-08-013	S-7	30	CL	22.0										
A-08-013	D-8	35	CL	22.1	121.2	3.75				38/22/16				
A-08-013	S-9	40	CL	14.8										
A-08-013	D-10	45	CL to SC	9.4	137.0	>4.5								
A-08-013	S-11	50	SP-SM	2.0										
A-08-013	D-12	55	SP-SM	1.3	113.6									
A-08-013	S-13	60	SP-SM	8.0										
A-08-013	D-14	65	SP-SM	2.0	104.9									
A-08-013	S-15	70	SP-SM	1.8										
A-08-013	D-16	75	CL	24.7	116.8	3.75								
A-08-013	S-17	80	SP-SM	2.2										
A-08-013	D-18	85	SP-SM	2.9										
A-08-013	S-19-1	90	SP-SM	2.3										
A-08-013	S-19-2	91	ML	23.6										
A-08-014	S-2	5	CL	18.7				4:42:54						
A-08-014	D-3	10	CL	17.5	137.0	3.0					600	7.7	450	158
A-08-014	S-4	15	CL	18.8										
A-08-014	D-5	20	SC	16.1	124.2									
A-08-014	S-6	25	CL	19.0										
A-08-014	D-7	30	CH	28.2	120.6	2.25				65/28/37				

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-014	S-8-1	35	CL	15.2										
A-08-014	S-8-2	35.8	SM	15.0										
A-08-014	D-9	40	CL	26.2	122.9	>4.5								
A-08-014	S-10	45	CL	19.8										
A-08-014	D-11	50	SM	10.3	130.6									
A-08-014	S-12	55	CL	19.1										
A-08-014	D-13	60	CL	20.7	127.3	3.75								
A-08-014	S-14	65	CL	25.8										
A-08-014	D-15	70	SM	8.3	138.1									
A-08-014	S-16	75	SP-SM	1.8										
A-08-014	D-17	80	SP-SM	1.7	115.6									
A-08-014	S-18	85	SP-SM	2.5										
A-08-014	D-19	90	SP-SM	1.8	107.6									
A-08-015	S-1	2.5	SC	12.6										
A-08-015	D-2	5	CL	14.6	121.0	>4.5								
A-08-015	S-3	10	SC	14.0										
A-08-015	D-4	15	CL	18.8	115.0	>4.5								
A-08-015	S-5	20	SC	17.5				6:50:44			840	7.6	350	182
A-08-015	D-6	25	CL	18.0	106.1	4.25								
A-08-015	S-7	30	SM	17.1										
A-08-015	D-8	35	CL	16.2	131.0	4.5				37/15/22				
A-08-015	S-9	40	CL	16.0										
A-08-015	D-10	45	SM	7.6	81.3			0:66:34						
A-08-015	S-11	50	CL	15.2										
A-08-015	D-12	55	CL	12.0	121.5	>4.5								
A-08-015	S-13	60	SC	11.1										
A-08-015	D-14	65	CL	17.0	119.1	4.5								
A-08-015	S-15	70	CL	25.8										
A-08-015	D-16	75	SM	9.0	121.4									
A-08-015	S-17	80	SP-SM	1.8										
A-08-015	D-18	85	SP	1.0	106.8									
A-08-015	S-19	90	SP-SM	2.0										
A-08-016	S-2	5	SC	13.9										
A-08-016	D-3	10	SC	15.5	126.8									
A-08-016	S-4	15	SC	17.2										
A-08-016	D-5	20	SC	20.2	130.3	4.5								
A-08-016	S-6	25	CL	19.8						35/17/18	1040	7.7	150	312
A-08-016	D-7	30	SM	9.7	124.2									
A-08-016	S-8	35	CH	17.5							530	7.5	120	364
A-08-016	D-9	40	SC	11.3	137.7									

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-016	S-10	45	CL	23.7										
A-08-016	D-11	50	CL	15.1	133.9	>4.5								
A-08-016	S-12	55	CL	19.0										
A-08-016	D-13	60	SC	13.1	138.2									
A-08-016	S-14	65	CL	26.2										
A-08-016	D-15	70	CL	18.2	125.1	3.5								
A-08-016	S-16	75	CL	16.2										
A-08-016	D-17	80	CL	20.2	126.7	2.25								
A-08-016	S-18	85	SP-SM	4.3										
A-08-138	D-7	30	SM	2.1	108.8									
A-08-017	D-2	5	SC	10.4										
A-08-017	S-3	10	CL	12.3										
A-08-017	D-4	15	CL	12.8	92.0	>4.5				30/20/10				
A-08-017	S-5	20	CL	19.9							490	7.3	250	362
A-08-017	D-6	25	SM	4.7	123.4									
A-08-017	S-7	30	CL	14.1										
A-08-017	D-8	35	SC	9.1	124.9									
A-08-017	S-9	40	CL	10.2				0:41:59						
A-08-017	D-10	45	CL	12.5	129.5	>4.5								
A-08-017	S-11	50	CL	13.8										
A-08-017	D-12	55	CL	17.4	129.9	>4.5								
A-08-017	S-13	60	SM	7.7				0:65:35						
A-08-017	D-14	65	CL	29.4	124.3	3.75								
A-08-017	S-15	70	CL	17.5										
A-08-017	D-16	75	SM	6.1	106.2									
A-08-017	S-17	80	CL	22.2										
A-08-017	S-19	90	SP-SM	1.0										
A-08-018	S-1	2.5	CL	28.7										
A-08-018	D-2	5	CL	24.4	120.2	1.25					760	8.4	250	223
A-08-018	S-3	10	CL	19.4										
A-08-018	D-4	15	CL	25.0	125.4					43/21/22				
A-08-018	S-5	20	CL	18.2										
A-08-018	D-6	25	CL	16.4	126.2									
A-08-018	S-7	30	SM	12.5										
A-08-018	D-8	35	SM	13.6	116.8									
A-08-018	S-9	40	CL	15.5							900	7.9	80	296
A-08-018	D-10	45	CL	14.9	133.4	>4.5								
A-08-018	S-11	50	SM	15.7										
A-08-018	D-12	55	SP-SM	2.0	106.4									
A-08-018	S-13-1	60	SM	3.8										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-018	S-13-2	60.5	CL	23.1										
A-08-019	D-1	2.5	CL	23.6	122.5	3.25								
A-08-019	S-2	5	CL	28.5										
A-08-019	D-3	10	CL	22.8	119.3	3.25					750	8.5	280	181
A-08-019	S-4	15	CL	23.6										
A-08-019	D-5	20	CL	21.7	120.4	1.5								
A-08-019	S-6	25	SM	3.7										
A-08-019	D-7	30	SM	6.6	118.8									
A-08-019	S-8	35	CL-ML	17.1				0:44:56						
A-08-019	D-9	40	CL	15.8	134.4	>4.5								
A-08-019	S-10	45	SC-SM	12.6										
A-08-019	D-11	50	SM	18.3	128.8									
A-08-019	S-12	55	SM	4.8										
A-08-019	D-13	60	CH	23.0	125.6	>4.5								
A-08-101	S-1	2.5	SC-SM	10.7										
A-08-101	D-2	5	SM	6.3	118.2									
A-08-101	S-3	10	SP-SM	3.7										
A-08-101	D-4	15	SP	2.7	119.8									
A-08-101	S-5	20	SP-SM	4.0										
A-08-101	D-6	25	SP	2.5	114.0									
A-08-101	S-7	30	SP	3.1										
A-08-102	D-1	2.5	SM	4.3	120.1									
A-08-102	S-2	5	SM	4.9										
A-08-102	D-3	10	SP	1.9	111.4									
A-08-102	S-4	15	SP	1.3				3:93:4						
A-08-102	D-5	20	SP	0.9	118.4									
A-08-102	S-6	25	SP-SM	2.6										
A-08-102	D-7	30	SP-SM	3.6	115.2									
A-08-105	S-1	2.5	SP-SM	7.3										
A-08-105	D-2	5	SM	10.2	132.6									
A-08-105	S-3	10	SP-SM	4.4										
A-08-105	D-4	15	SP-SM	5.5	109.7									
A-08-105	S-5	20	SM	7.9										
A-08-105	D-6	25	SP-SM	4.1	109.7									
A-08-105	S-7	30	SP-SM	6.2										
A-08-105	D-8	35	SP-SM	3.2	117.7									
A-08-105	S-9	40	SP-SM	2.7										
A-08-105	D-10	45	SP	3.5	106.1									
A-08-105	S-11	50	SP	2.4										
A-08-105	D-12	55	SP-SM	3.3	117.2									

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-105	S-13	60	SP-SM	2.8										
A-08-105	D-14	65	SP-SM	3.7	111.3									
A-08-105	S-15	70	SP-SM	2.9										
A-08-106	D-1	2.5	SM	3.6	114.5									
A-08-106	S-2	5	SM	5.9										
A-08-106	D-3	10	SP	1.9	104.4									
A-08-106	S-4	15	SP	2.3										
A-08-106	S-6	25	SP-SM	3.6										
A-08-106	D-7	30	SP-SM	4.1	115.0									
A-08-106	S-8	35	SP-SM	3.0										
A-08-106	D-9	40	SP-SM	3.5	117.6									
A-08-106	S-10	45	SP-SM	3.4										
A-08-106	D-11	50	SP-SM	3.1	106.4									
A-08-106	S-12	55	SP-SM	5.0										
A-08-106	D-13	60	SP-SM	4.5	124.3									
A-08-108	D-1	2.5	SC	8.5	131.3									
A-08-108	S-2	5	SC	11.9				10:57:33						
A-08-108	D-3	10	SC	9.6	134.4									
A-08-108	S-4	15	SC	10.5										
A-08-108	D-5	20	SC to SP-SM	3.4	134.2									
A-08-108	S-6	25	SC	15.7										
A-08-108	D-7	30	SP	3.1	115.9									
A-08-108	S-8	35	SP	10.5										
A-08-108	D-9	40	CL	17.0	127.0	3.0								
A-08-108	S-10	45	CL	19.4						33/20/13				
A-08-108	D-11	50	SP-SM	3.3	110.9									
A-08-108	S-12	55	SP-SM	4.2										
A-08-108	D-13	60	SP-SM	3.0	112.6									
A-08-108	S-14	65	SP-SM	2.5										
A-08-108	D-15	70	SP-SM	2.5	111.7									
A-08-109	S-1	2.5	SM	8.8										
A-08-109	D-2	5	SM	4.2	127.5									
A-08-109	S-3	10	SM	8.5										
A-08-109	D-4	15	SC	8.3	132.7									
A-08-109	S-5	20	CL	18.6							700	7.7	1000	221
A-08-109	D-6	25	SP	3.9	105.2									
A-08-109	S-7	30	SP	3.2										
A-08-109	D-8	35	CL	25.9	120.7	2.0					500	7.6	300	270
A-08-109	S-9	40	CL	23.3										
A-08-109	D-10	45	SM	19.6	129.0									

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-109	S-11	50	SP-SM	3.2										
A-08-109	D-12	55	SM to SP-SM	11.5	122.7									
A-08-109	S-13	60	SP-SM	4.1										
A-08-109	D-14	65	SP-SM	3.3	100.0									
A-08-109	S-15	70	SP-SM	2.4										
A-08-116	D-1	2.5	SM	5.3	128.7									
A-08-116	S-2	5	CL	7.5										
A-08-116	D-3	10	CL	11.4	133.8	>4.5								
A-08-116	S-4	15	CL	10.0										
A-08-116	D-5	20	CL	9.1	120.9	>4.5								
A-08-116	S-6	25	CL	12.0							1100	8.3	280	159
A-08-116	D-7	30	CL	9.2	115.9	>4.5								
A-08-116	S-8	35	CL	11.9										
A-08-116	D-9	40	CL	13.3	127.1	>4.5								
A-08-116	S-10	45	SM	1.2										
A-08-116	D-11	50	ML	13.8	121.9	>4.5								
A-08-116	S-12	55	SP-SM	1.2										
A-08-116	D-13	60	SP-SM	1.6	102.9									
A-08-119	S-1	2.5	CL	19.0										
A-08-119	D-2	5	CL	23.1	117.7	1.5					980	7.7	400	221
A-08-119	S-3	10	SM	8.7				0:82:18						
A-08-119	D-4	15	CL	17.6	130.2	4.0								
A-08-119	S-5	20	SC	15.0										
A-08-119	D-6	25	CL	26.4	124.7	2.75								
A-08-119	S-7	30	CL	15.8										
A-08-119	D-8	35	SM	5.6	115.2									
A-08-119	S-9	40	CL	25.7										
A-08-119	D-10	45	SM	5.0	104.0									
A-08-119	S-11	50	CL	18.3										
A-08-119	D-12	55	CH	24.1	125.7	4.25								
A-08-119	S-13	60	SM	12.7										
A-08-121	S-1	2.5	CL	17.5										
A-08-121	D-2	5	CL	18.6	131.0	3.0					1200	8.0	120	184
A-08-121	S-3	10	SM	15.4										
A-08-121	D-4	15	CL	18.4	126.6	>4.5				35/21/14				
A-08-121	S-5	20	CL	19.5										
A-08-121	D-6	25	CL	21.5	129.0	3.75					940	7.7	50	280
A-08-121	S-7	30	SM	5.8										
A-08-122	D-1	2.5	SM	6.7	119.0									
A-08-122	S-2	5	SC	9.8										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

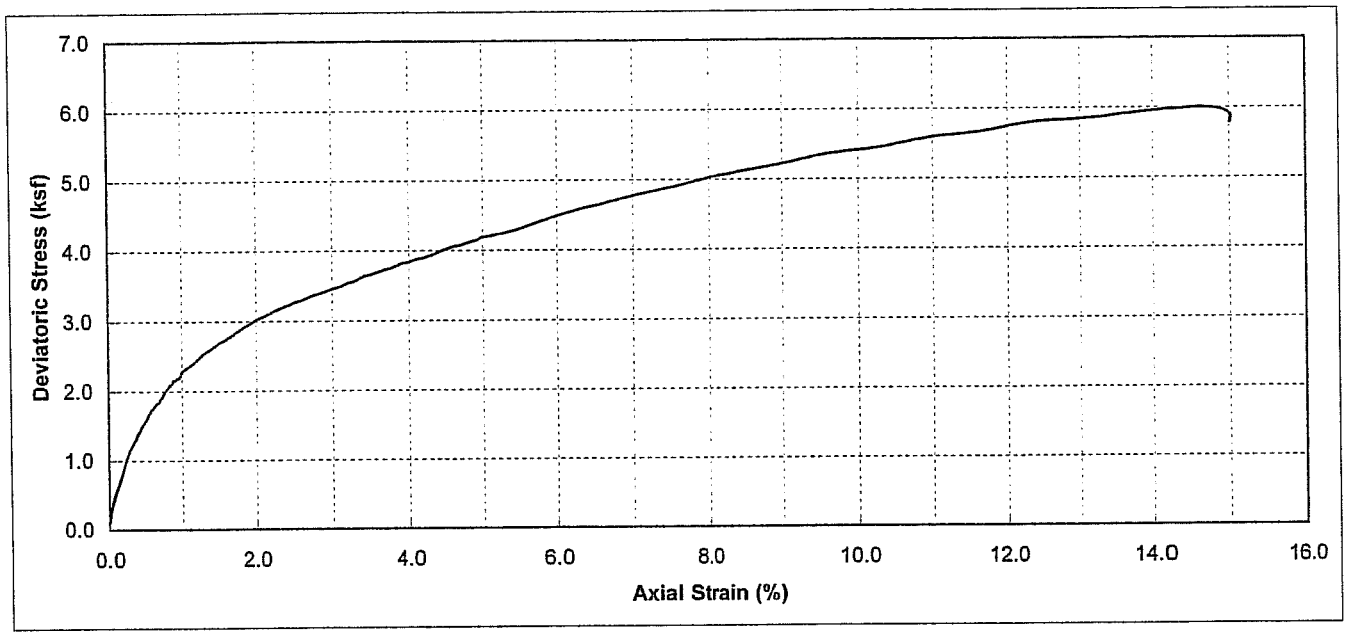
Project No. : 08-115 Project Name : RBF/SR-57 Northbound

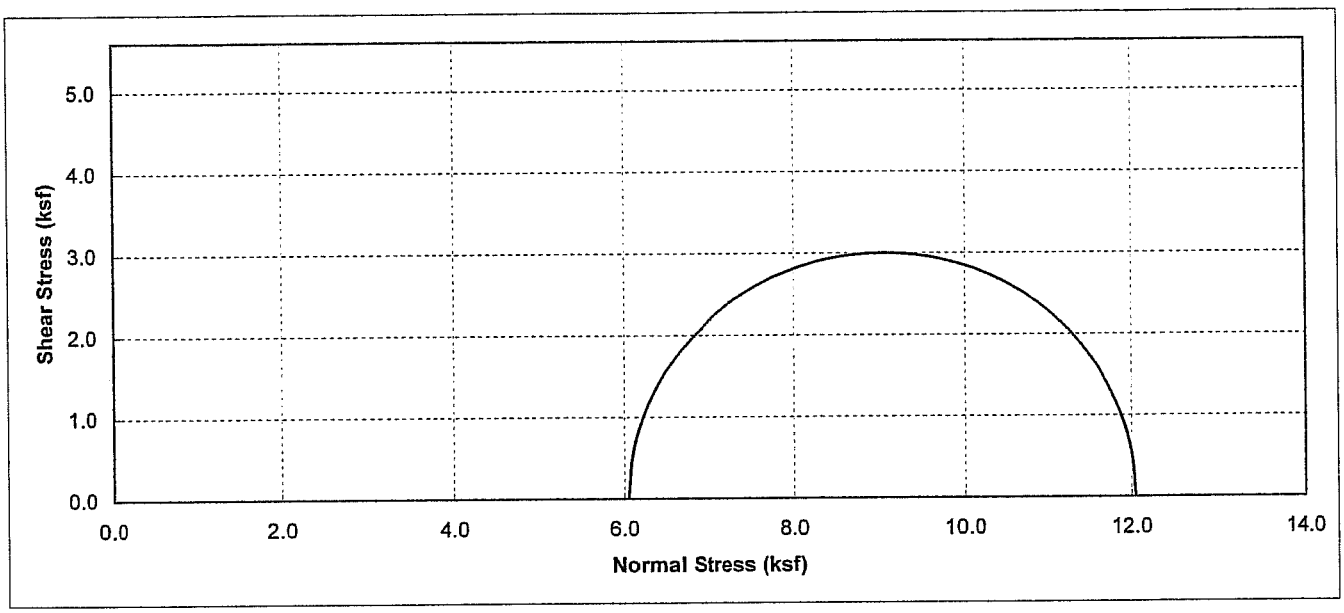
Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-122	S-3	10	CL	9.0	129.3	>4.5								
A-08-122	S-4	15	CL	15.9							520	7.6	150	416
A-08-122	D-5	20	CL	10.3	116.9	>4.5								
A-08-122	S-6	25	CL	11.6										
A-08-122	D-7	30	CL	13.1	133.4	>4.5								
A-08-123	S-1-1	2.5	SC	16.1										
A-08-123	S-1-2	3.4	SM	15.6										
A-08-123	D-2	5	SC	11.1	134.2									
A-08-123	S-3	10	CL	17.7				0:41:59						
A-08-123	D-4	15	SC	10.8	136.0									
A-08-123	S-5	20	CL	20.7							980	7.9	120	315
A-08-123	D-6	25	CL	18.1	128.2	4.25								
A-08-123	S-7	30	SM	8.9										
A-08-124	D-1	2.5	CL	8.6	126.4	>4.5				38/17/21				
A-08-124	S-2	5	CL	10.0							1800	8.3	250	175
A-08-124	D-3	10	SC	13.8	128.2									
A-08-124	S-4	15	CL	16.1										
A-08-124	D-5	20	ML	10.0	121.2	>4.5								
A-08-124	S-6	25	CL	13.0										
A-08-124	D-7	30	CL	16.4	126.3	>4.5								
A-08-126	D-1	2.5	CL	18.3	124.1	4.5					1090	8.4	80	159
A-08-126	S-2	5	CL	18.1										
A-08-126	D-3	10	CL	12.2	127.2	>4.5				34/19/15				
A-08-126	S-4	15	ML	16.5				0:45:55						
A-08-126	D-5	20	CL	17.2	131.3	4.0				39/16/23				
A-08-126	S-6	25	CL	12.3							1100	7.9	120	262
A-08-126	D-7	30	SM	5.1	109.9									
A-08-126	S-8-1	35	CL	22.2										
A-08-126	S-8-2	35.8	SM	11.2										
A-08-126	D-9	40	SM	6.9	112.8									
A-08-126	S-10	45	SP-SM	3.2										
A-08-126	D-11	50	SM	4.5	118.3	3.25								
A-08-126	S-12-1	55	SM	8.0										
A-08-126	S-12-2	55.4	CL	26.9										
A-08-126	D-13	60	CL	15.0	130.9	>4.5								
A-08-128	D-1	2.5	SM	5.8	135.3									
A-08-128	S-2	5	CL	14.8							1500	7.9	50	153
A-08-128	D-3	10	SP-SM	4.7	108.9									
A-08-128	S-4	15	CL	10.5										
A-08-128	D-5	20	CL	18.1	130.4	>4.5				46/19/27				

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-128	S-6	25	CL	27.8										
A-08-128	D-7	30	SM	5.6	109.8									
A-08-129	S-1	2.5	SC	11.0										
A-08-129	D-2	5	CL	13.8	136.8	>4.5								
A-08-129	S-3	10	SM	6.8										
A-08-130	D-1	2.5	CL	8.9	127.0	>4.5								
A-08-132	D-1	2.5	SM	24.6	124.3			19:66:15						
A-08-132	S-2	5	CL	14.4										
A-08-132	D-3	10	CL to SM	13.9	123.9						1500	8.2	50	163
A-08-133	S-1	2.5	SC	13.1										
A-08-133	D-2	5	SC	12.0	135.7									
A-08-133	S-3	10	CL	19.9										
A-08-134	D-1	2.5	SC	13.3	129.8									
A-08-134	S-2	5	SC	13.7										
A-08-134	D-3	10	SC-SM	13.7	121.9			0:51:49						
A-08-136	D-1	2.5	SM	6.7	129.9									
A-08-136	S-2	5	SM	8.5										
A-08-137	S-1	2.5	CL	16.7							1060	8.3	30	168
A-08-137	D-2	5	CL	15.5	126.0	>4.5								
A-08-137	S-3	10	CL	16.4										
A-08-137	D-4	15	SM	5.7	123.9									
A-08-137	S-5	20	SM	4.6										
A-08-137	D-6	25	CL	8.5	137.4	>4.5								
A-08-137	S-7	30	CH	15.1										
A-08-138	D-1	2.5	SM	4.2	134.1									
A-08-138	S-2	5	CL	18.0							1200	8.2	50	171
A-08-138	D-3	10	SC	8.5	115.2									
A-08-138	S-4	15	SC	10.1										
A-08-138	D-5	20	CH	14.6	135.2	>4.5								
A-08-138	S-6	25	SC-SM	8.5										





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-007	D-16	75	Brown, LEAN CLAY With SAND (CL)	95.9	30.43	6.05	6.00	108.5

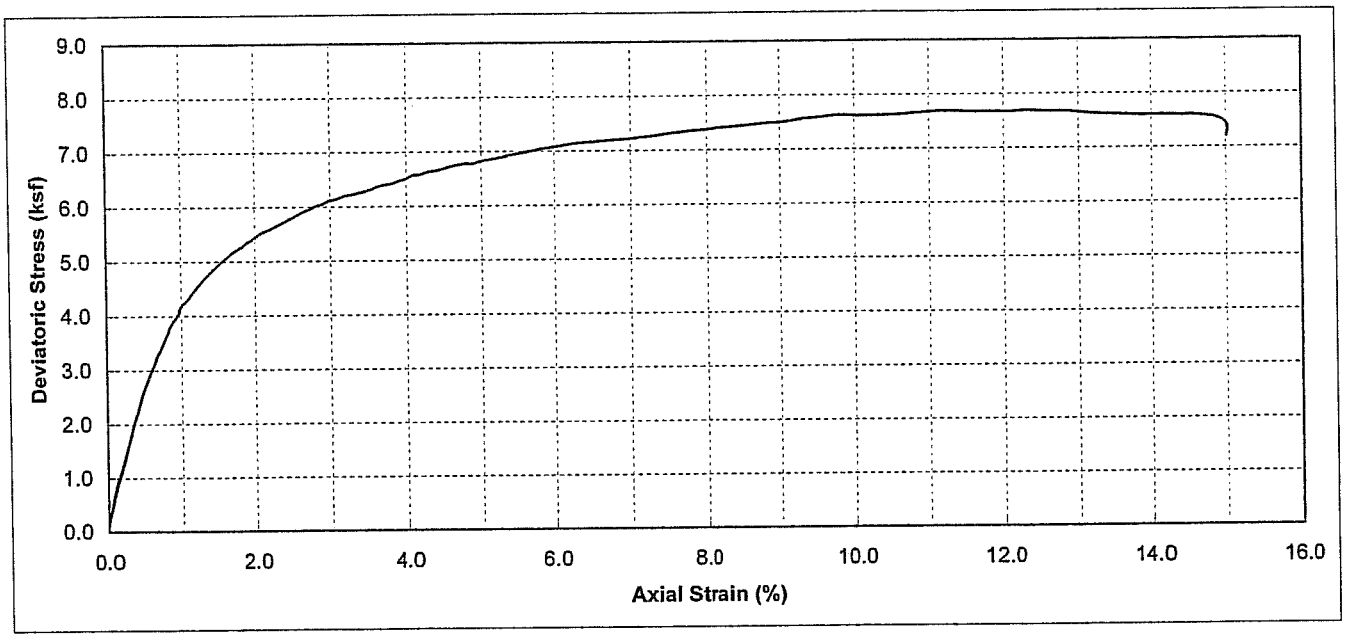
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

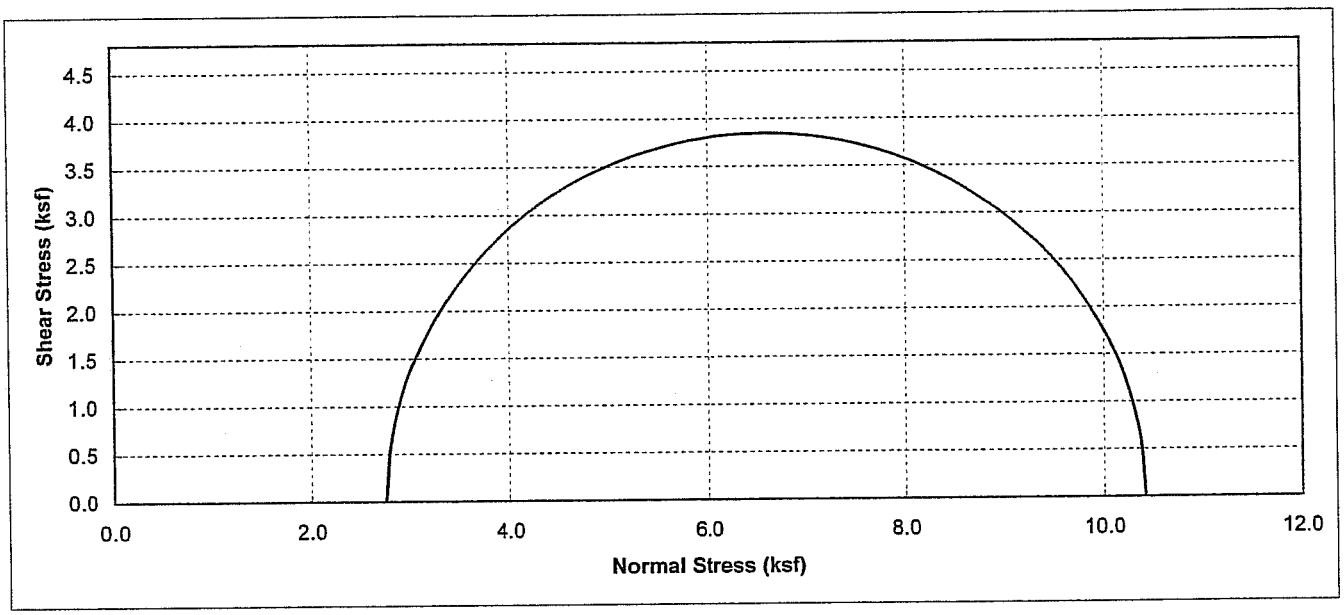
RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115 **Date :** 11/15/08

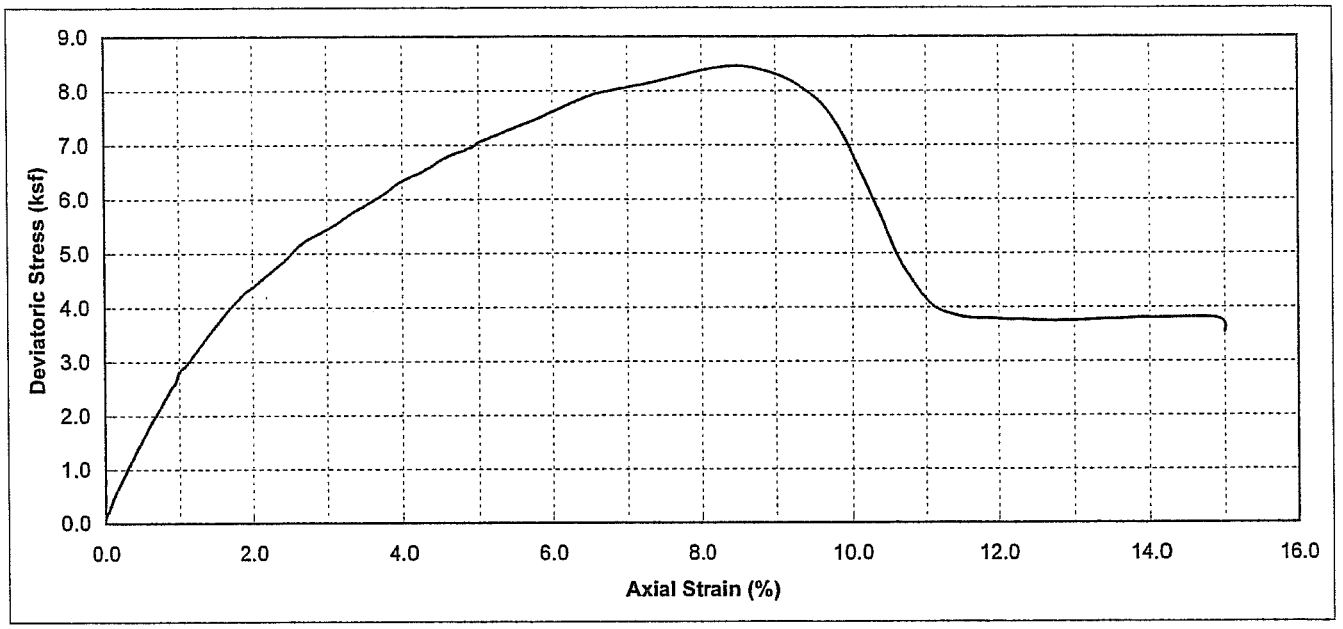
Figure No. :

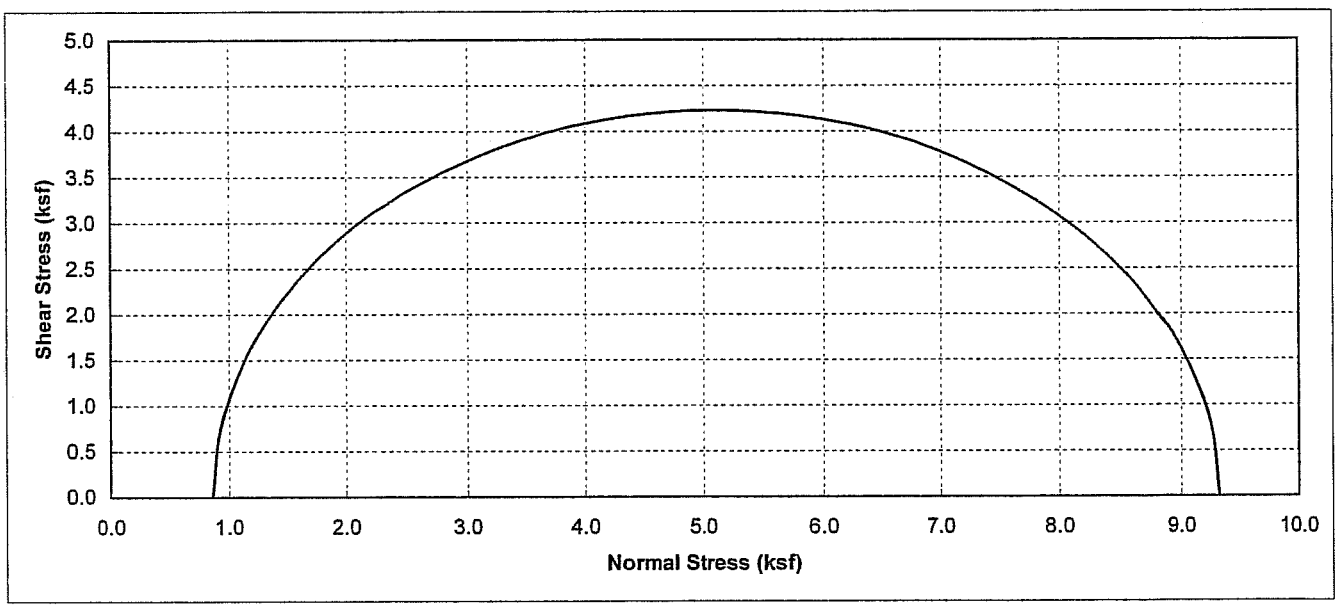




Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-009	D-8	35	Dark Brown,LEAN CLAY With SAND (CL)	105.7	16.60	2.73	7.69	75.4

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound
	UNCONSOLIDATED UNDRAINED TEST (ASTM D2850) Figure No. :
Project No. : 08-115	Date : 11/15/08





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-011	D-3	10	Brown, FAT CLAY (CH)	91.6	27.09	0.86	8.46	87.2

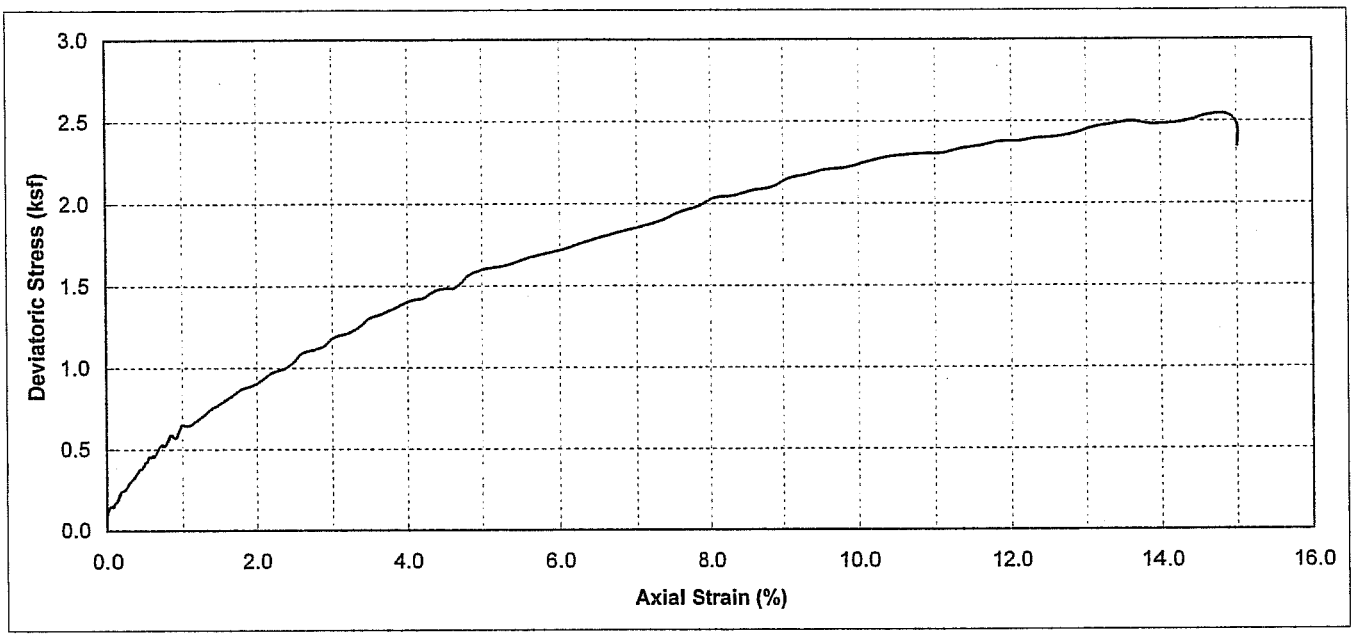
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

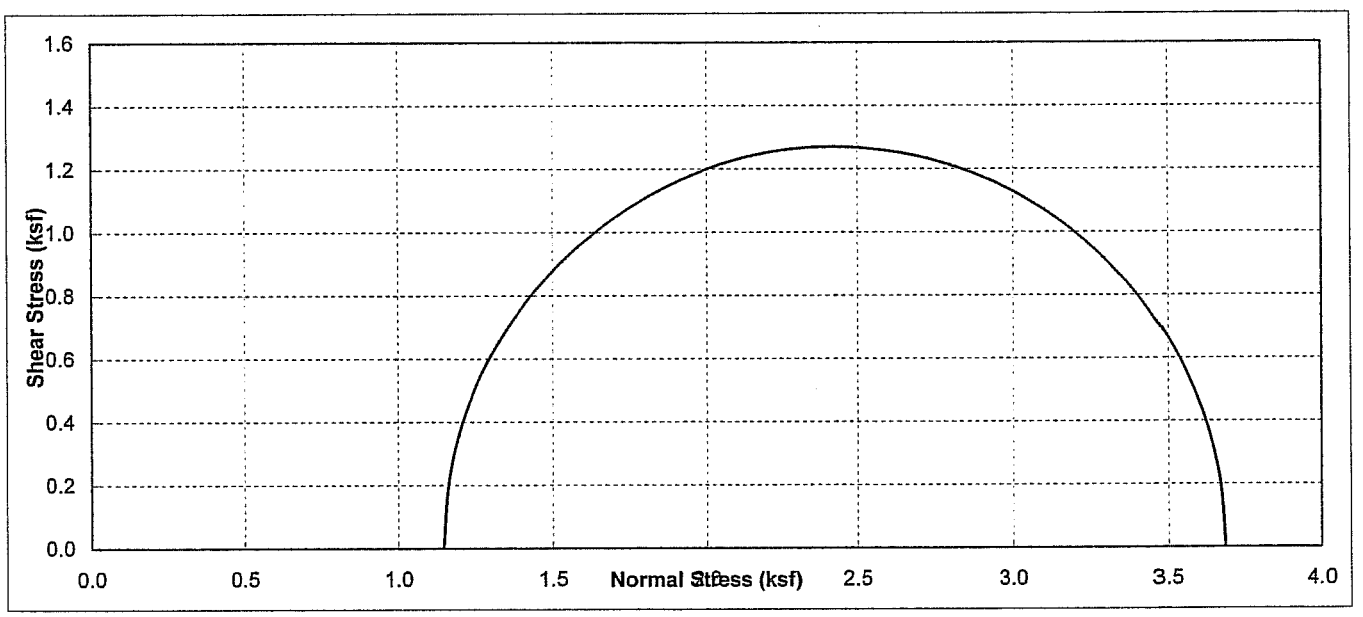
RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115 **Date :** 11/15/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-012	D-4	15	Brown, LEAN CLAY (CL)	82.6	36.67	1.15	2.54	95.2

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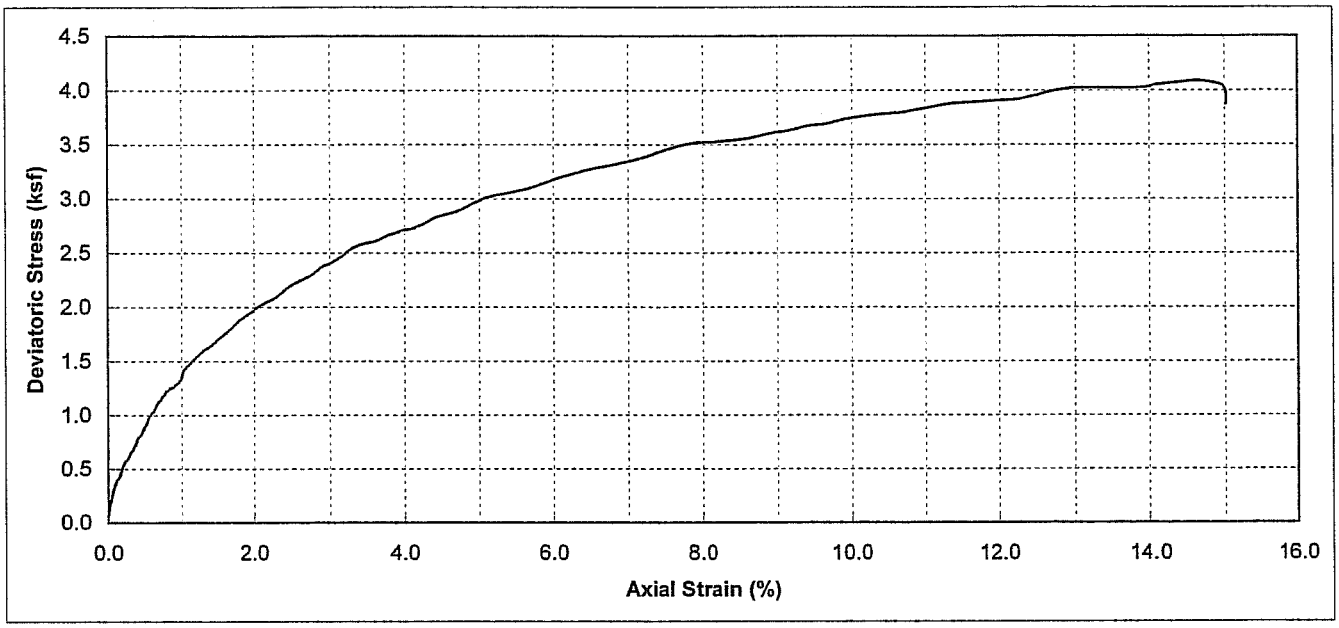
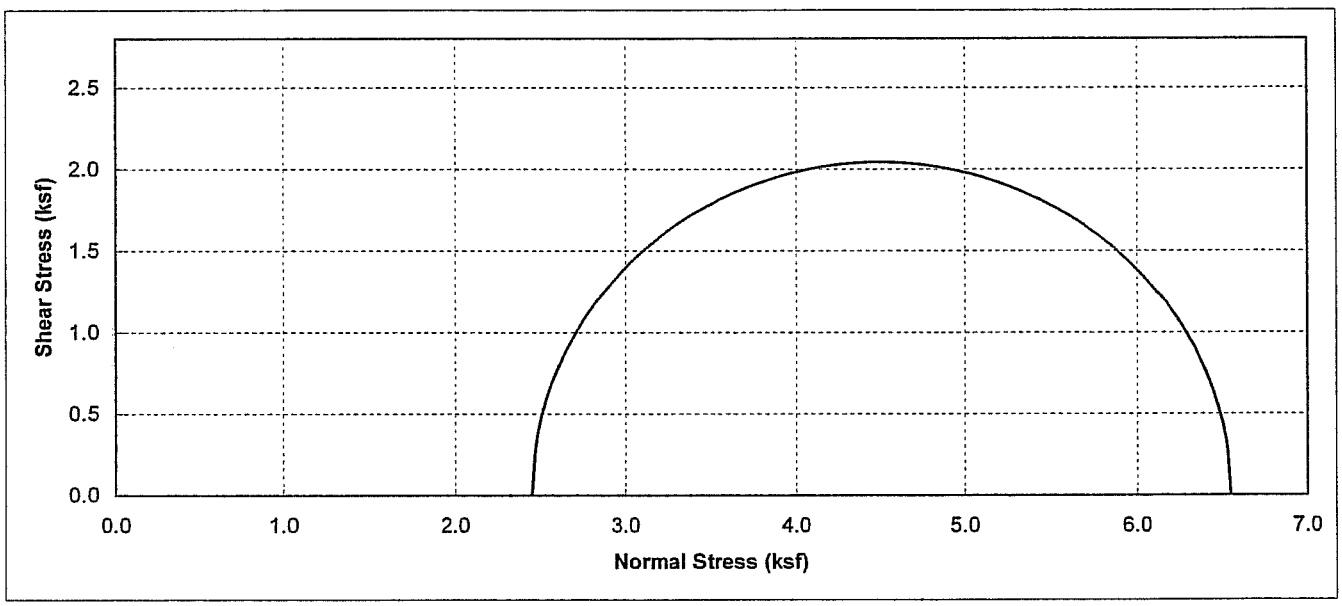
		UNCONSOLIDATED UNDRAINED TEST
Project No. : 08-115	Date : 11/15/08	(ASTM D2850) Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-014	D-7	30	top Brown, FAT CLAY bot Dark Brown SANDY FAT	93.8	28.24	2.45	4.09	95.7

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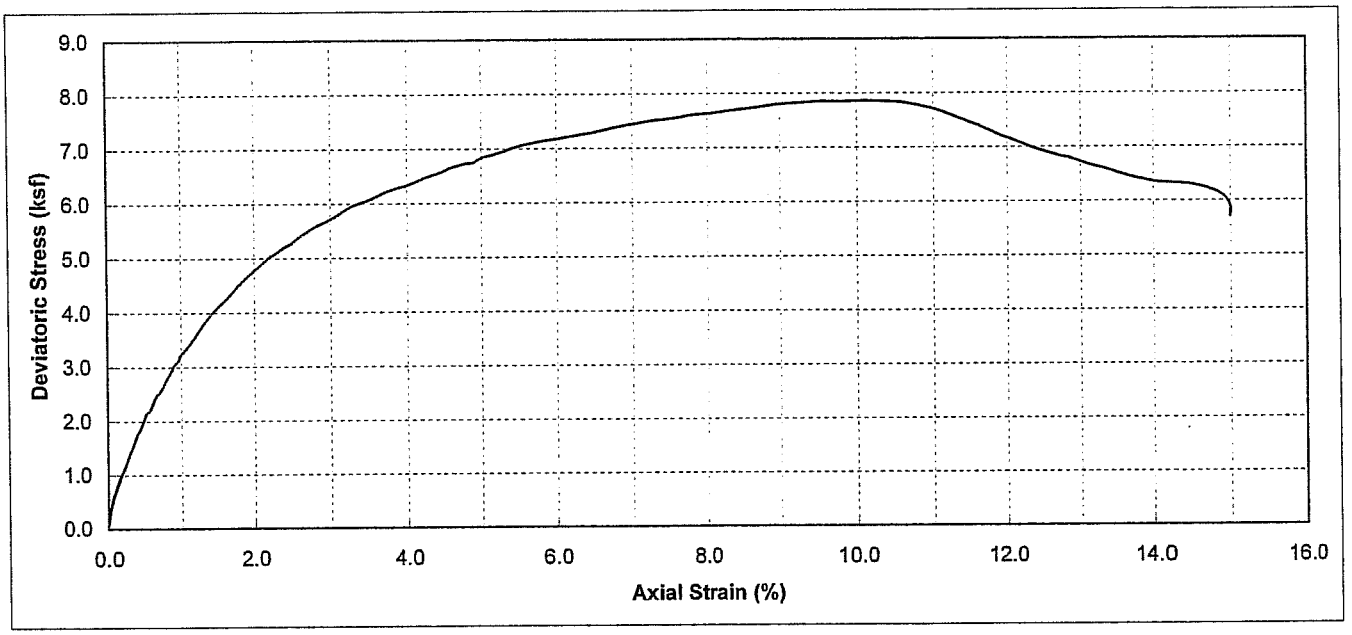
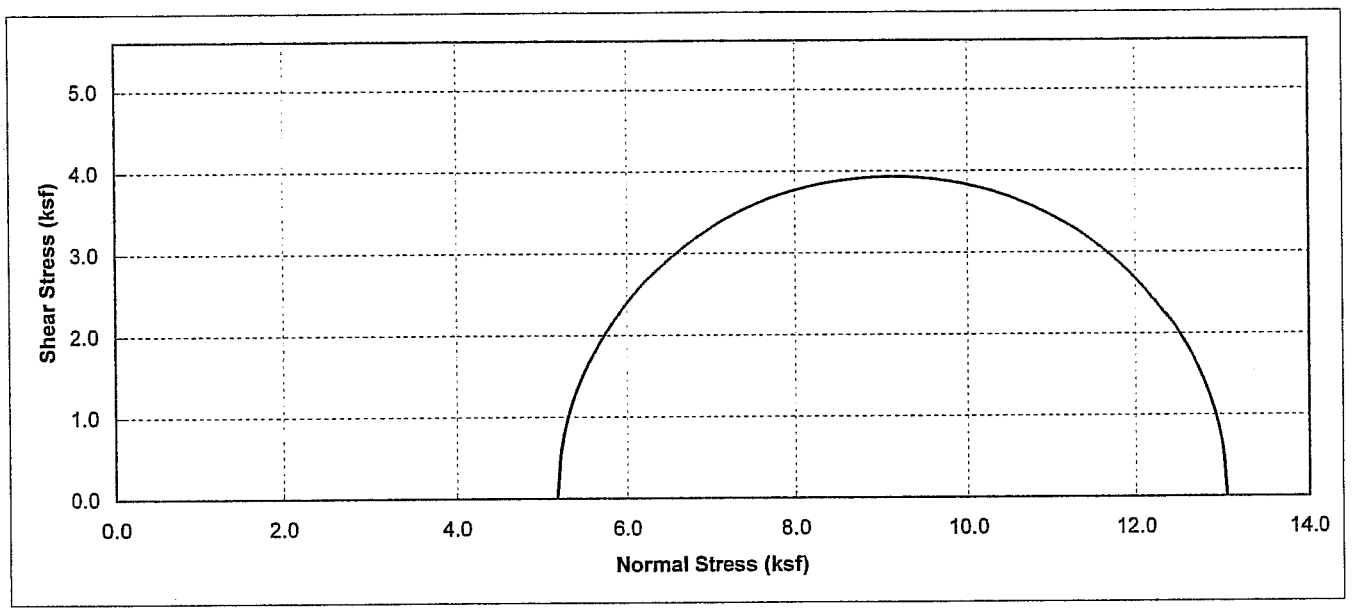
		UNCONSOLIDATED UNDRAINED TEST
Project No. : 08-115	Date : 11/15/08	(ASTM D2850) Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-017	D-14	65	Brown, LEAN CLAY With SAND (CL)	93.3	29.37	5.19	7.86	98.3

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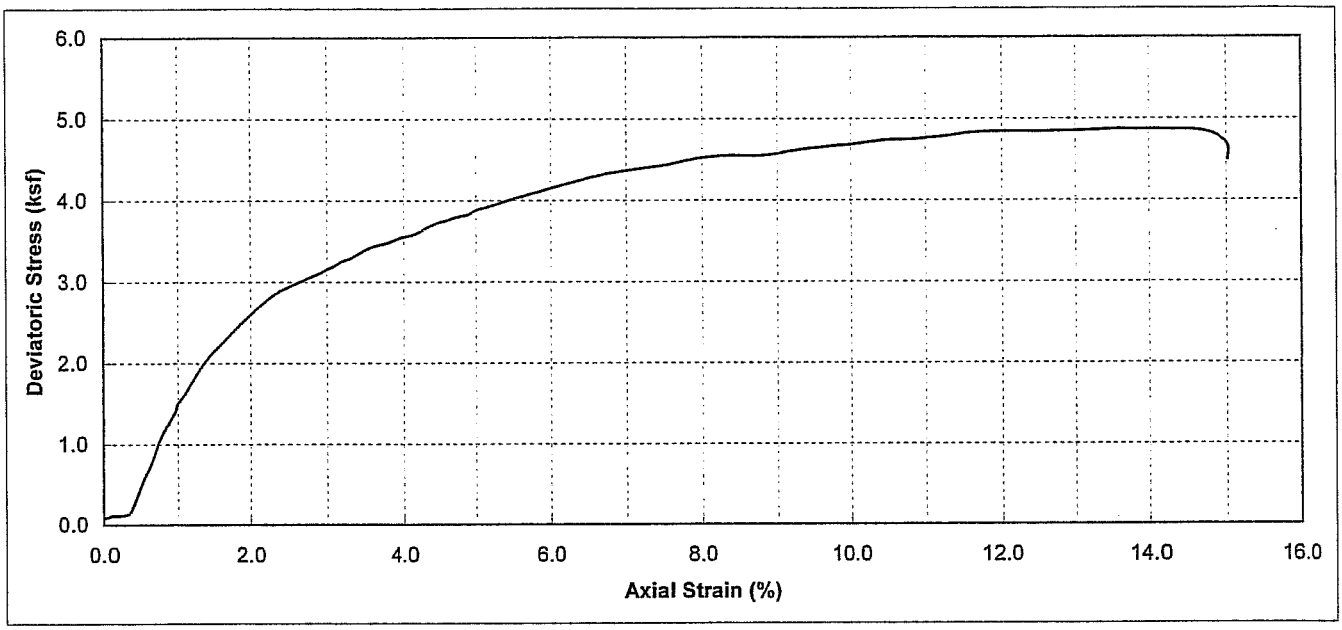
Geotechnical and Earthquake Engineering

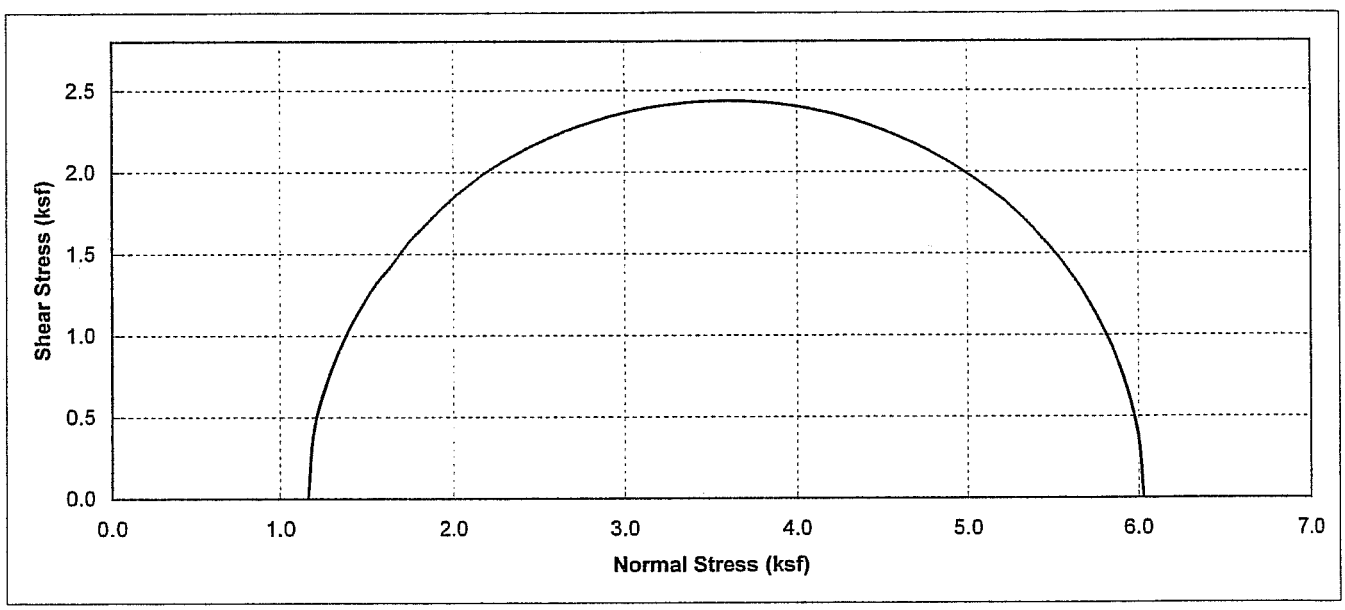
RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115 **Date :** 11/15/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-018	D-4	15	Olive Brown With Olive, SANDY LEAN CLAY (CL)	99.8	24.98	1.16	4.87	98.0

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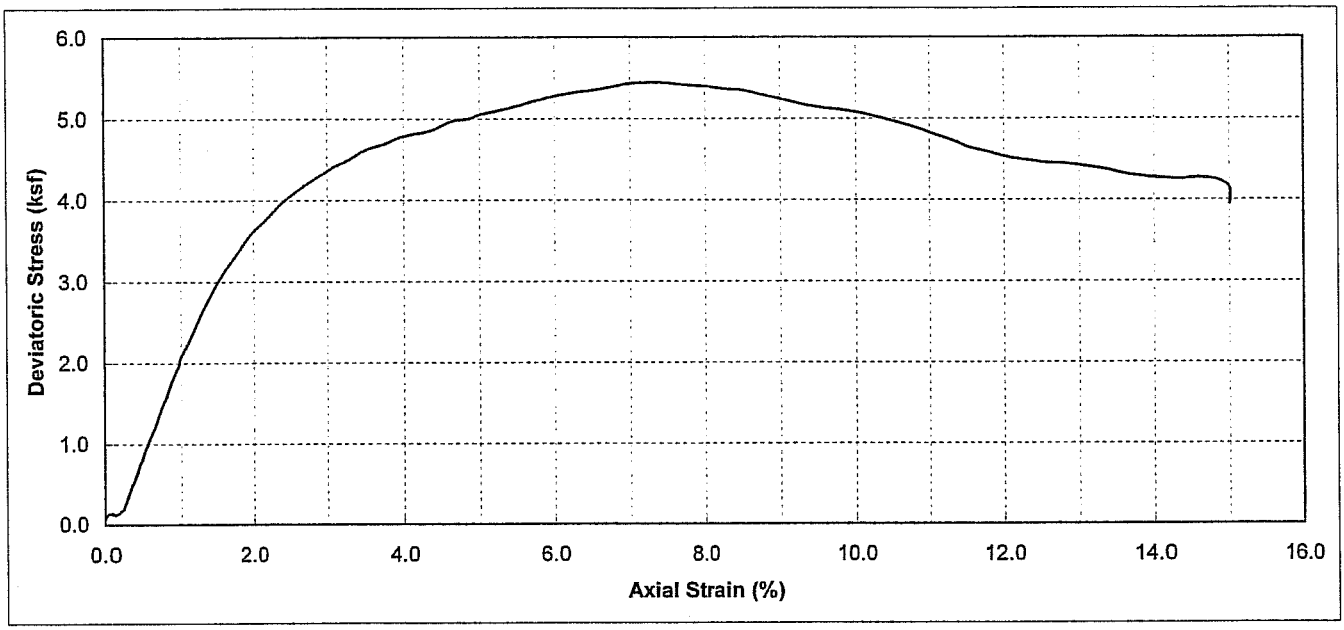
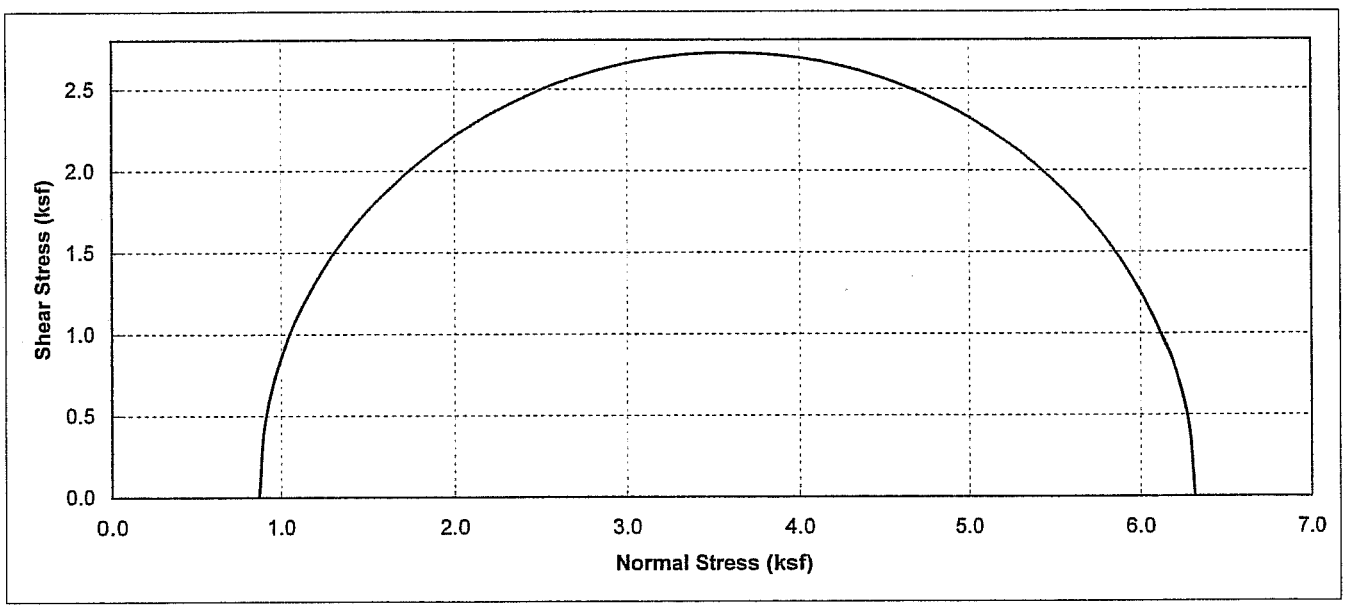
		UNCONSOLIDATED UNDRAINED TEST
Project No. : 08-115	**Date :** 11/15/08	**(ASTM D2850)** Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-019	D-3	10	Olive With Olive Brown, LEAN CLAY With SAND (CL)	97.4	22.77	0.86	5.44	84.2

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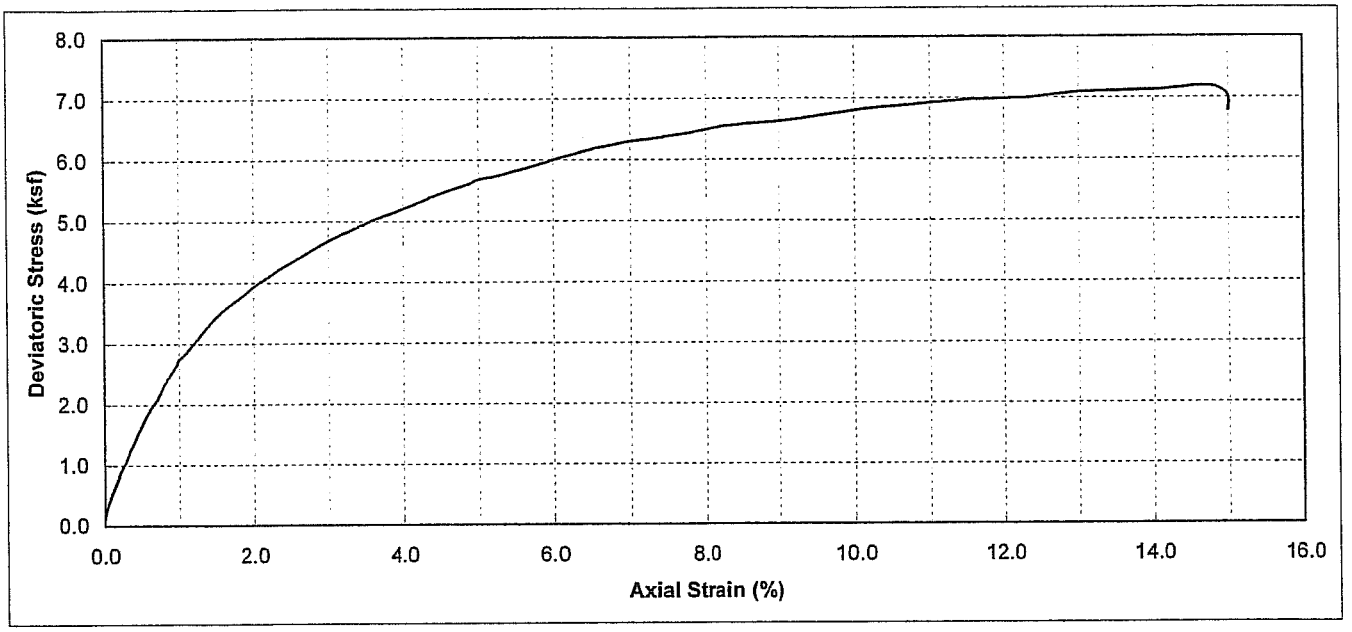
Geotechnical and Earthquake Engineering

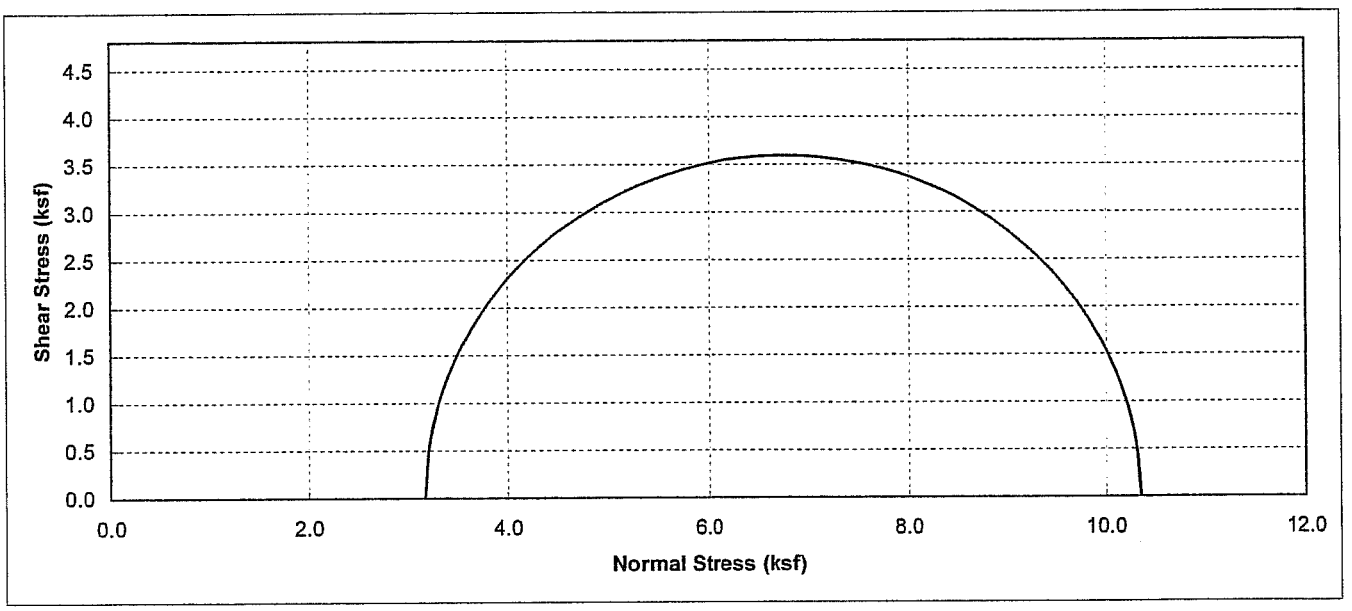
RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115 **Date :** 11/15/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-108	D-9	40	Brown, SANDY LEAN CLAY (CL)	107.5	17.03	3.16	7.19	81.1

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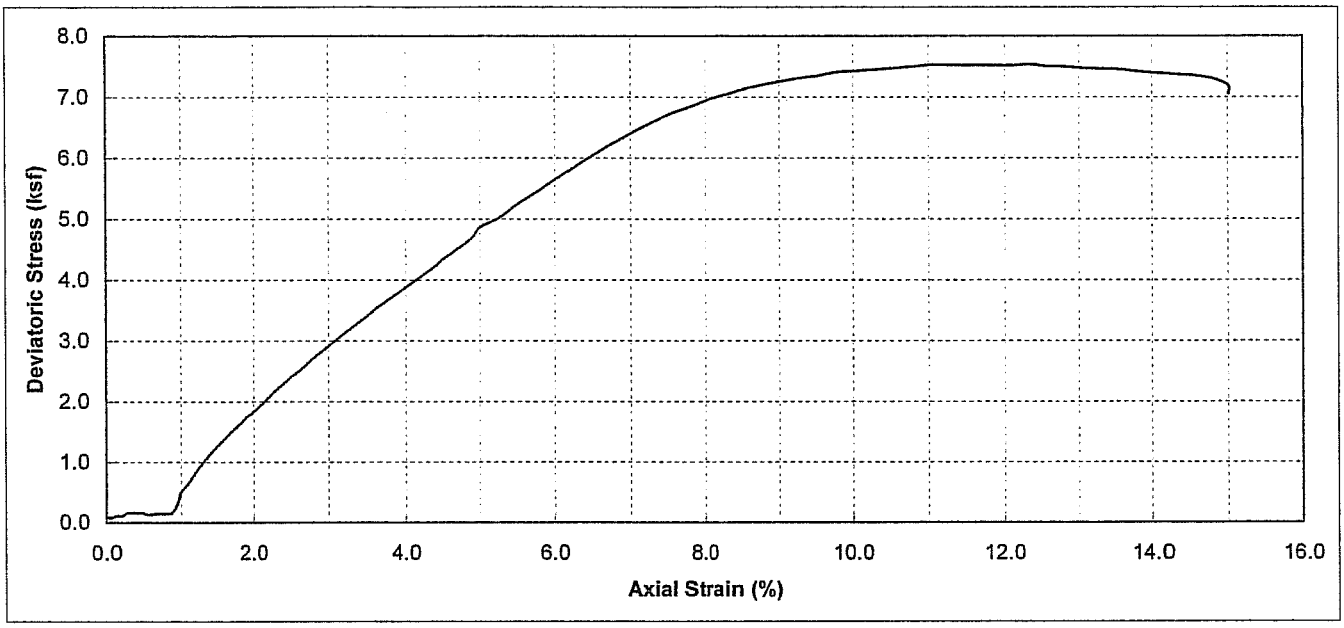
Geotechnical and Earthquake Engineering

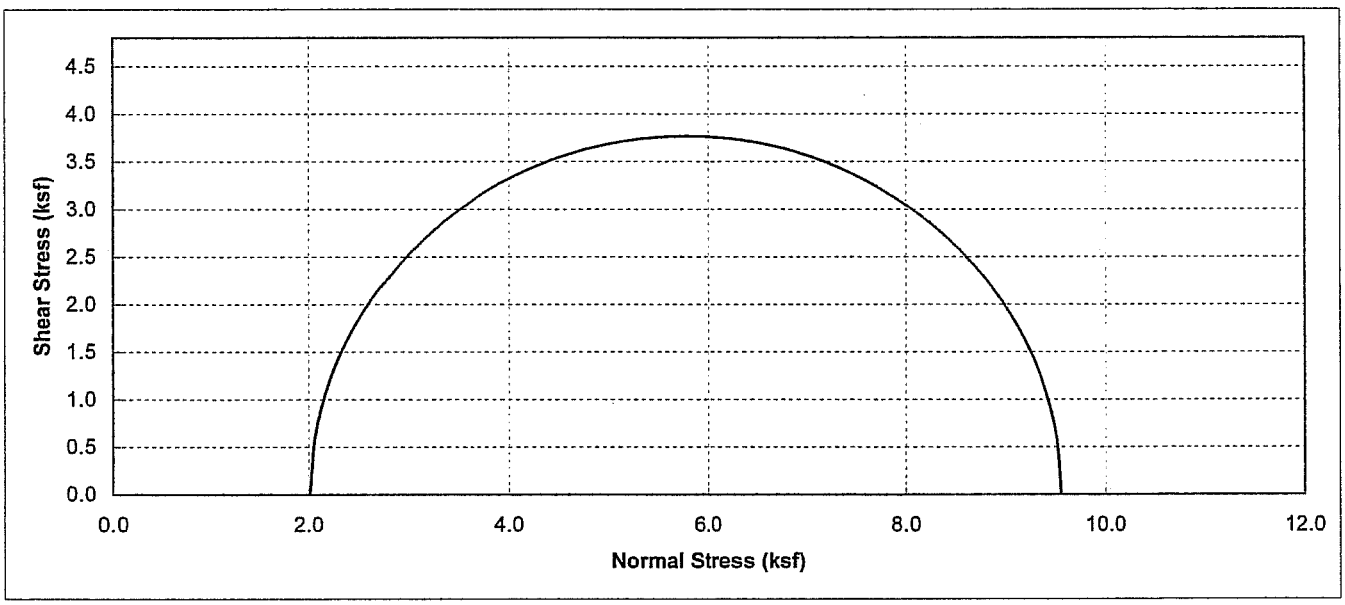
RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115 **Date :** 11/18/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-119	D-6	25	Brown, LEAN CLAY With SAND (CL)	97.7	26.44	2.01	7.54	98.5

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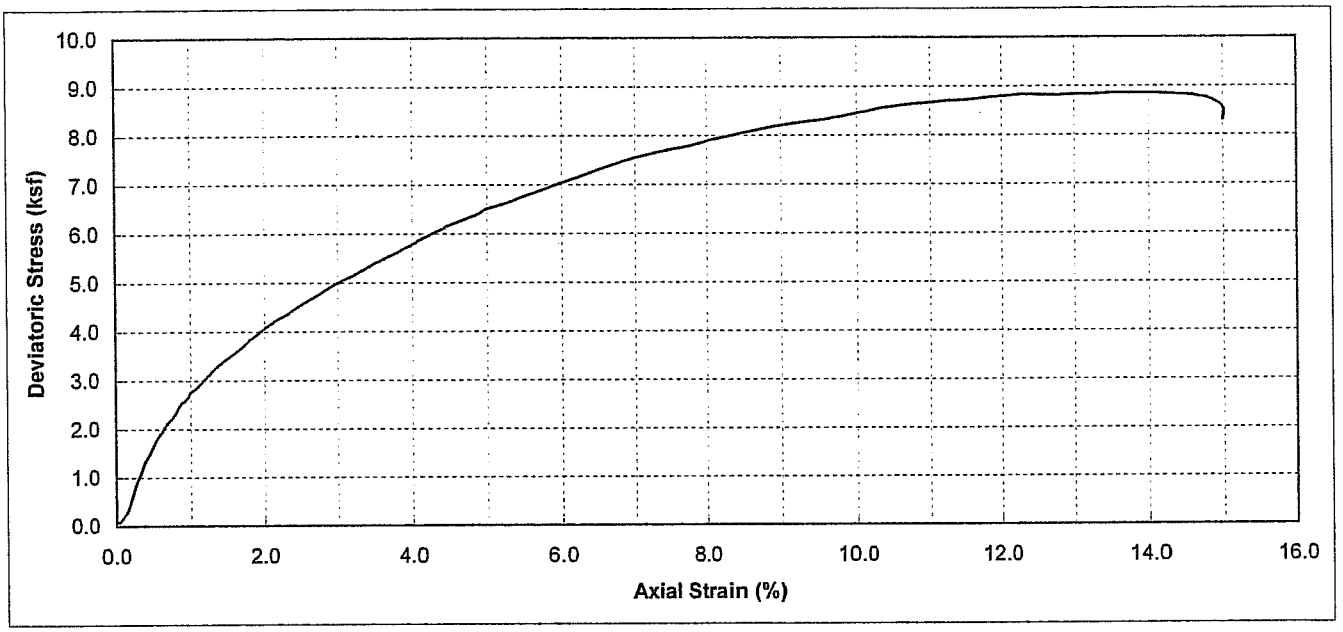
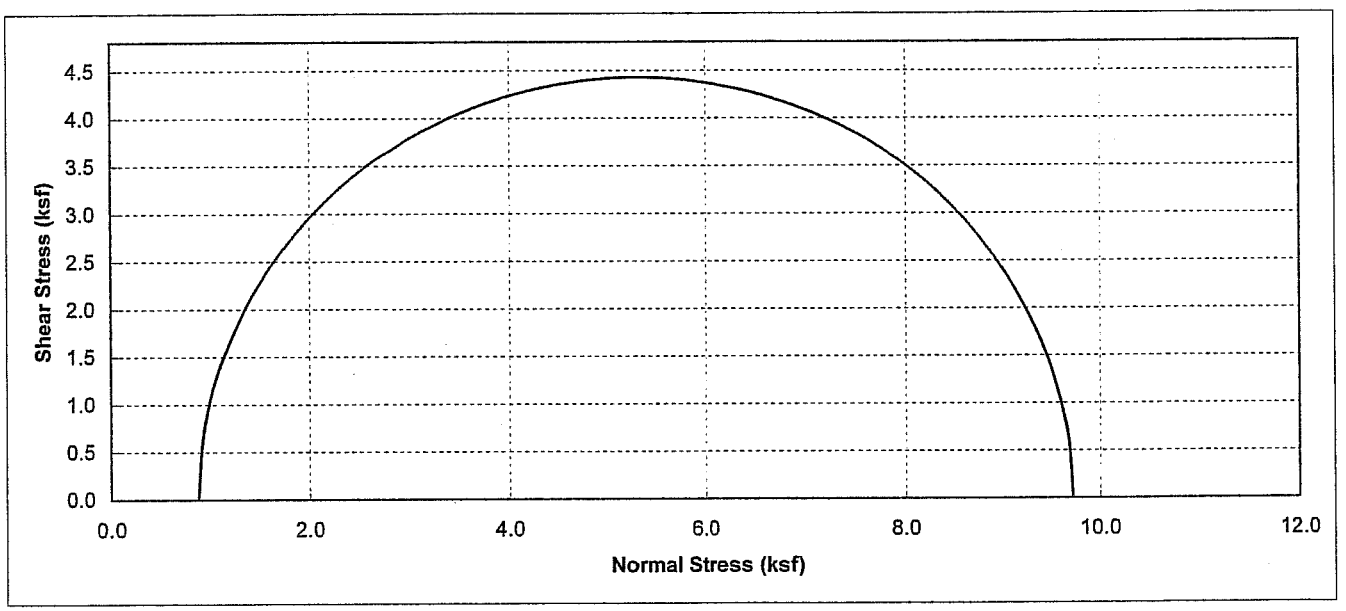
Project No. : 08-115	**Date :** 11/18/08	**(ASTM D2850)** Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-121	D-2	5	Dark Olive Brown, SANDY LEAN CLAY (CL)	110.6	18.64	0.87	8.86	96.2

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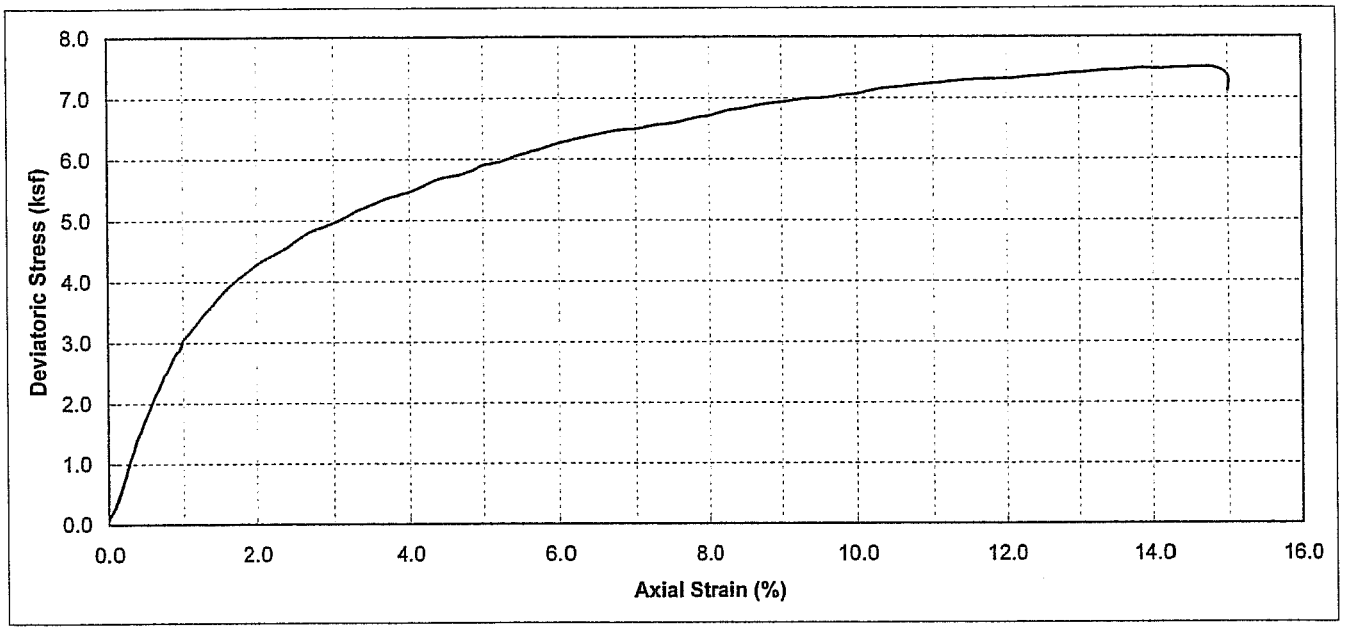
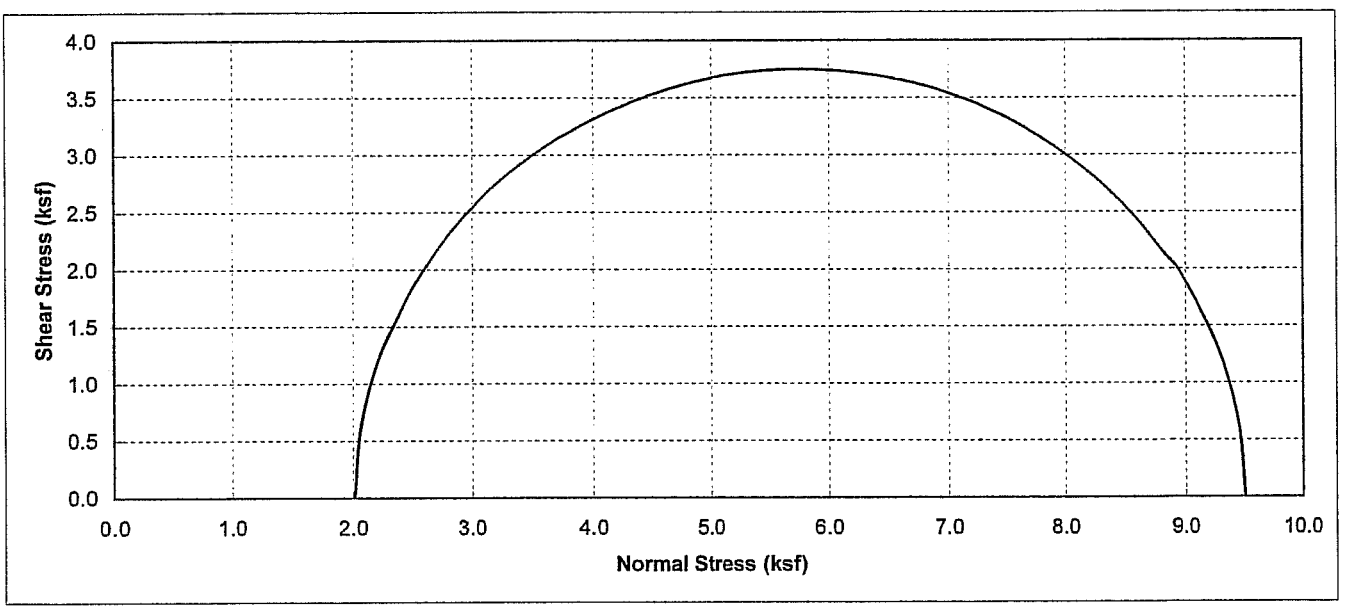
	UNCONSOLIDATED UNDRAINED TEST
Project No. : 08-115 **Date :** 11/18/08	**(ASTM D2850)** Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-121	D-6	25	Brown to Dark Brown, LEAN CLAY With SAND (CL)	105.6	21.47	2.01	7.50	97.4

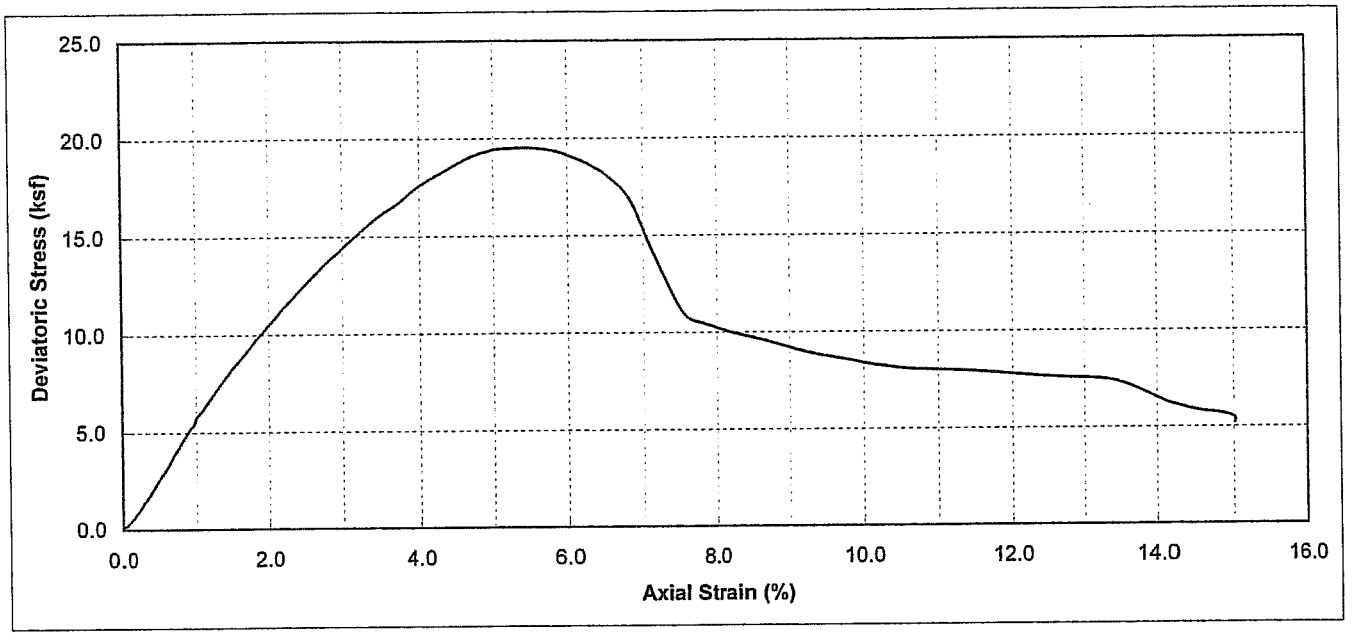
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

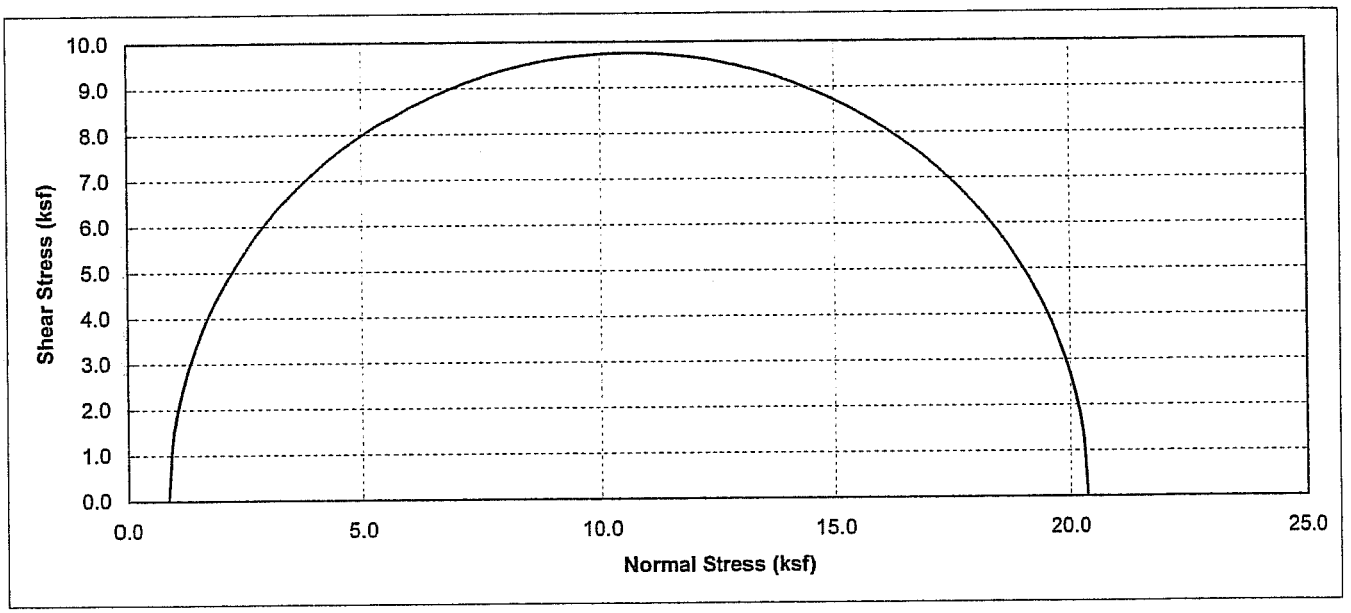
RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115 **Date :** 11/19/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-124	D-1	2.5	Olive Gray to brown, LEAN CLAY to SANDY LEAN CLAY	116.0	8.64	0.87	19.51	51.5

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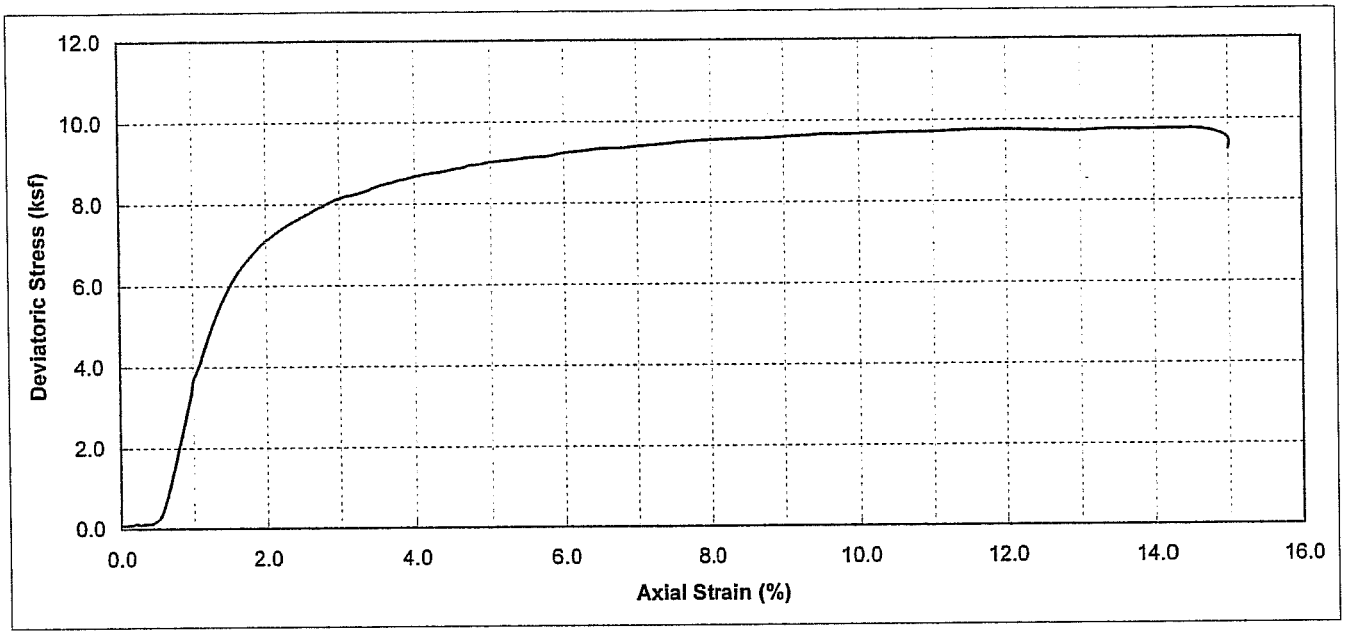
Geotechnical and Earthquake Engineering

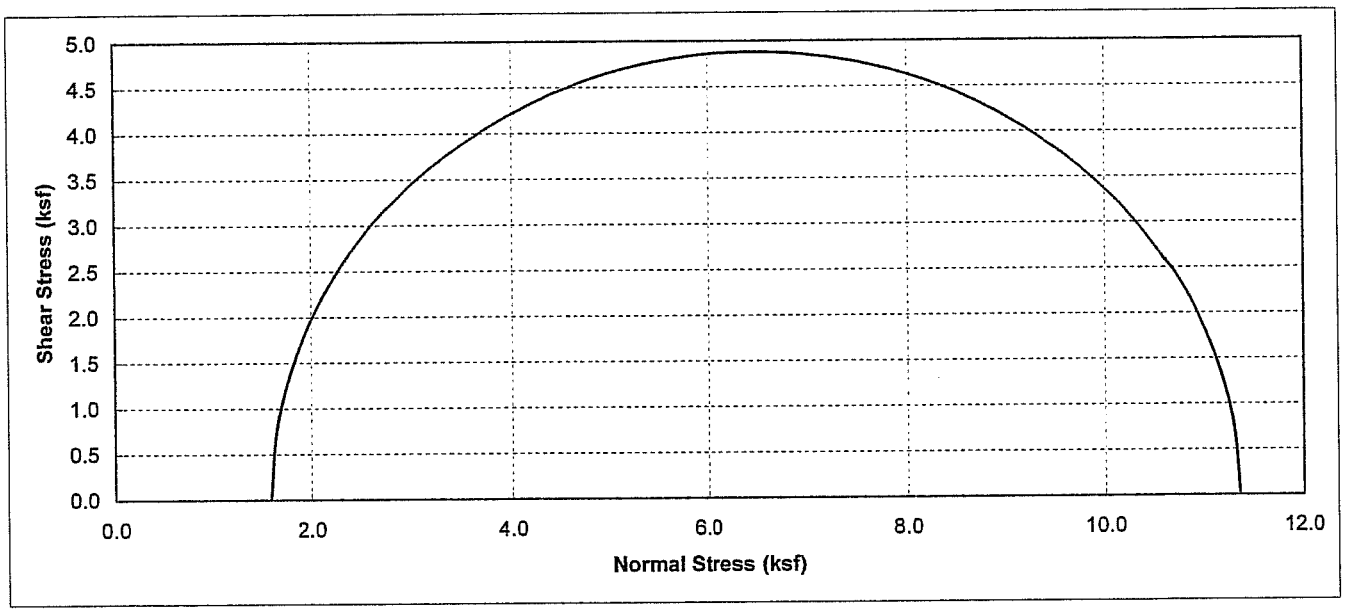
RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Figure No. :

Project No. : 08-115 **Date :** 11/19/08





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-126	D-5	20	Strong Brown, SANDY LEAN CLAY (CL)	112.2	17.15	1.59	9.76	92.4

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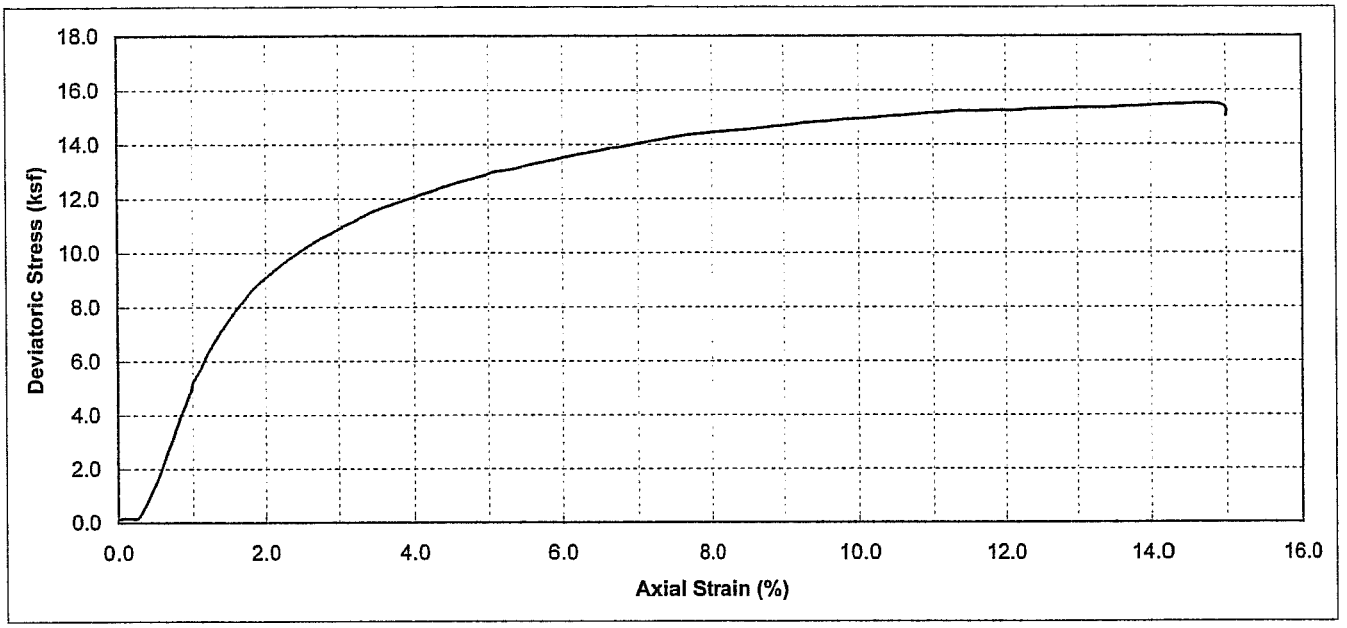
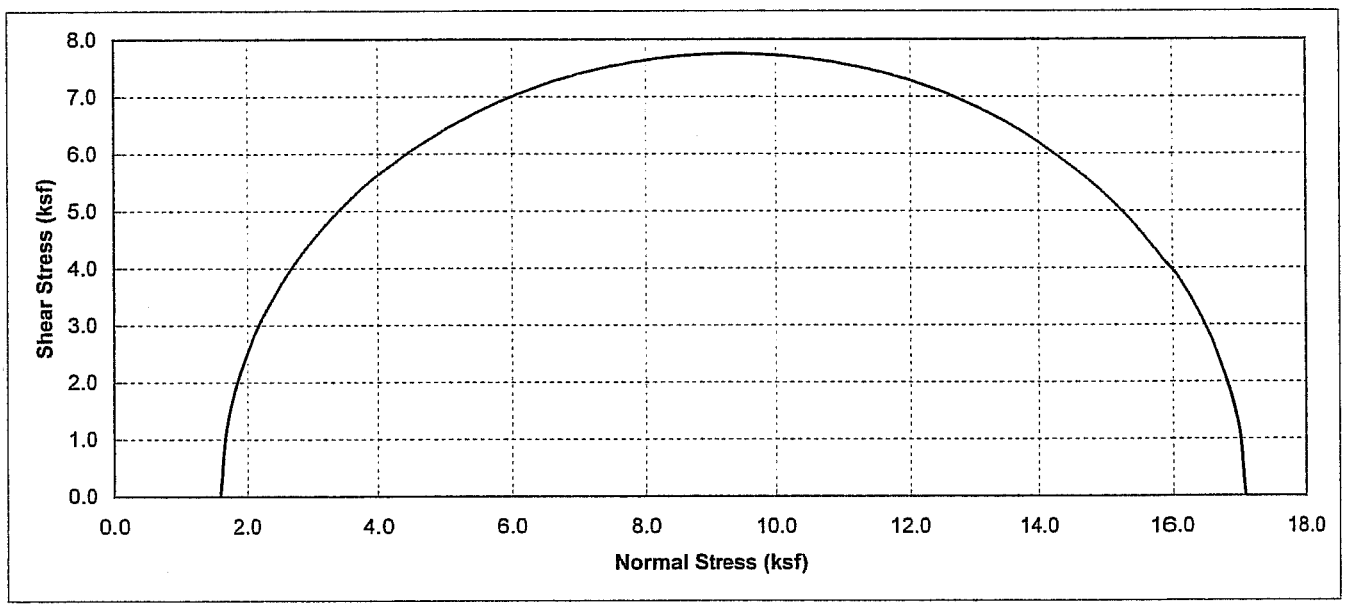
RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115 **Date :** 11/19/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-128	D-5	2	Brown, LEAN CLAY With SAND (CL)	110.9	18.14	1.58	15.51	94.3

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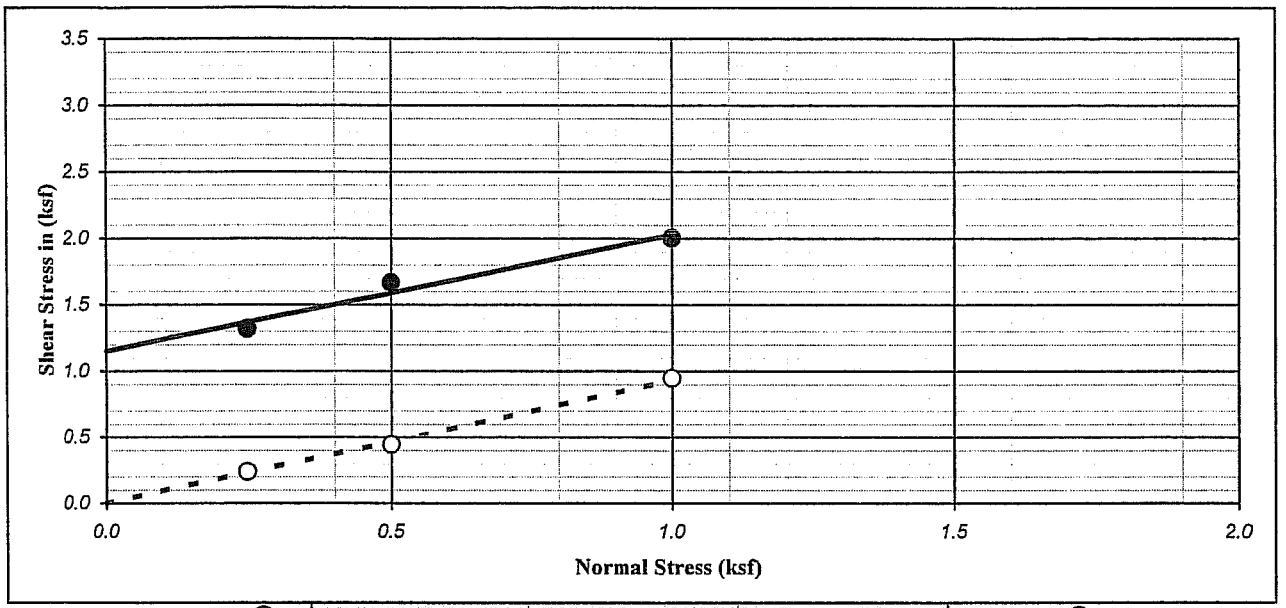
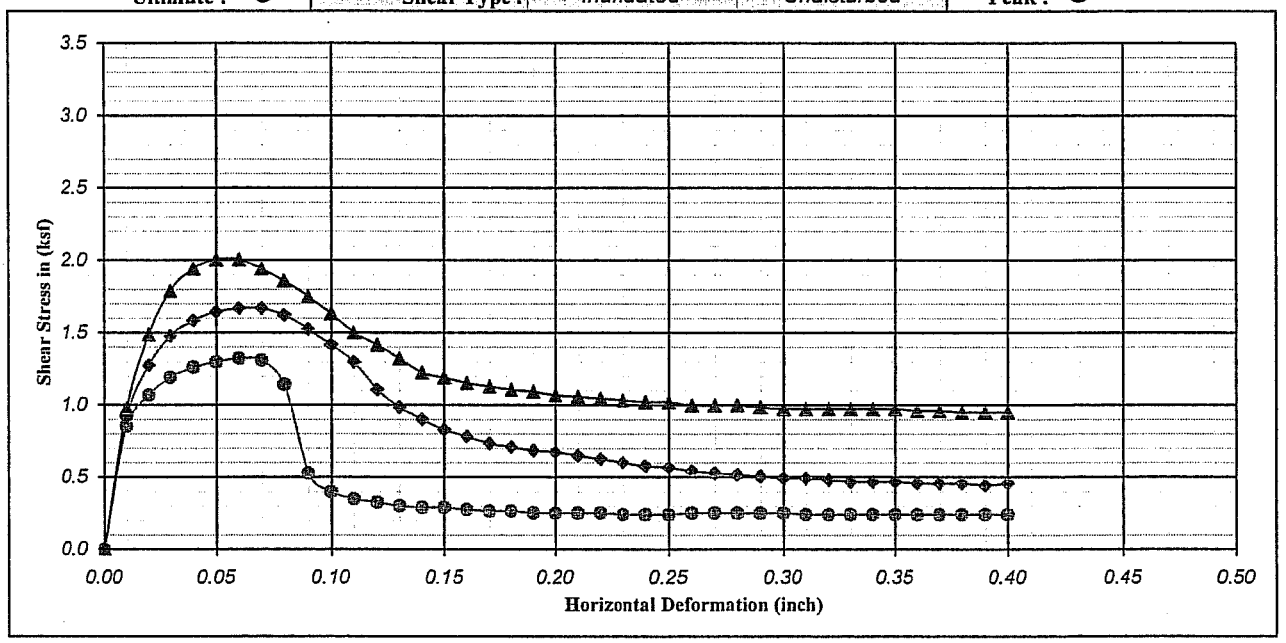
	UNCONSOLIDATED UNDRAINED TEST
Project No. : 08-115 **Date :** 11/19/08	**(ASTM D2850)** Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-001		Strength Intercept (C) :	1.15	(ksf)	Peak	0.00	(ksf)	Ultimate
Sample No. : D-2			55.16	(kPa)		0.00	(kPa)	
Depth (ft/m) : 5.0	0.00	Friction Angle (ϕ) :	41.27	Degree		43.14	Degree	
Description : Brown, CLAYEY SAND (SC)					Shear Rate (inch/minute) :			0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	17.43	116.28	18.30	0.45	0.25	11.97	1.32	63.20	0.24	11.49
◆	18.47	113.44	17.86	0.49	0.50	23.94	1.67	79.86	0.44	21.26
▲	17.65	114.83	18.07	0.47	1.00	47.88	2.00	95.95	0.95	45.39

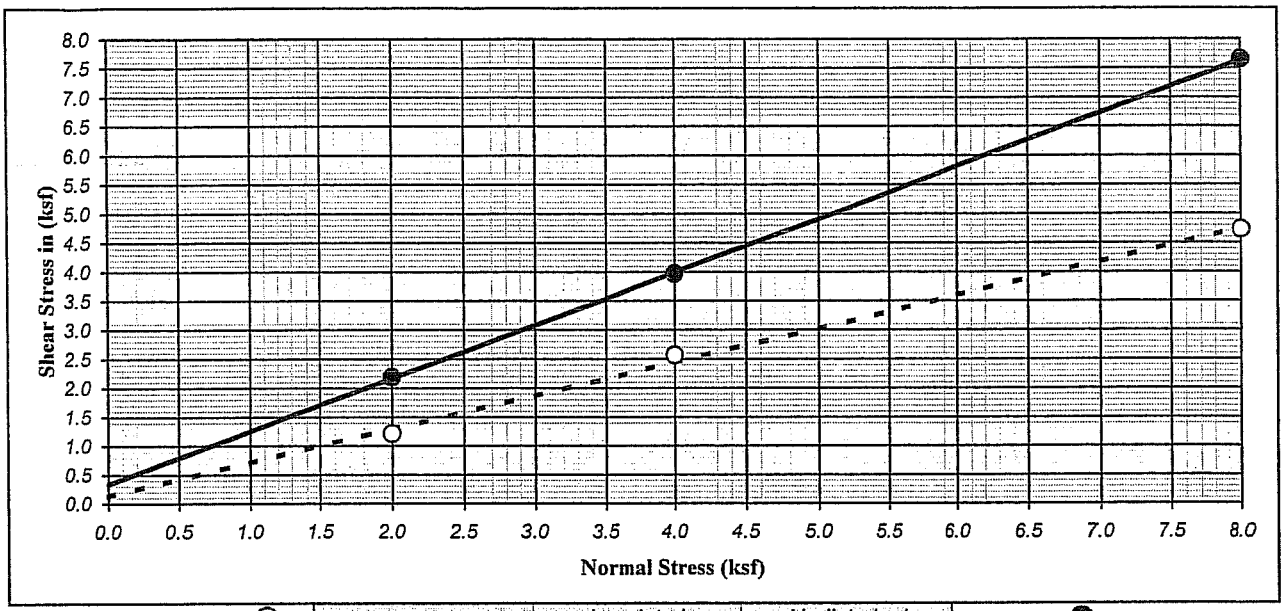
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

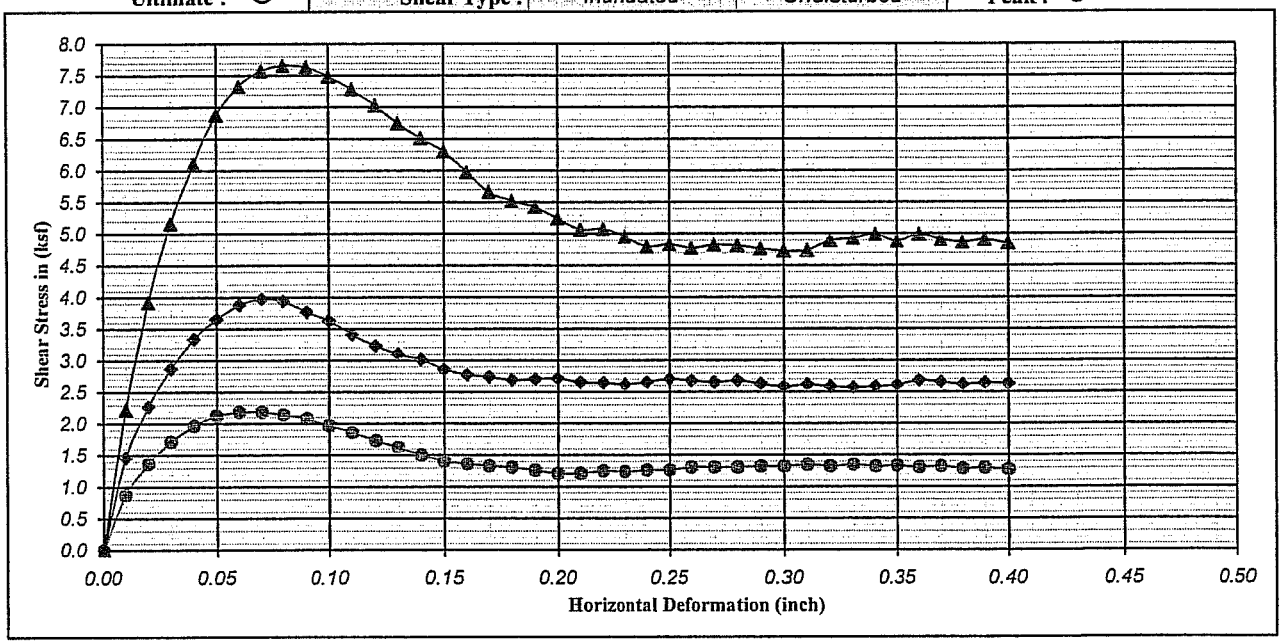
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-001		Strength Intercept (C) :	0.34	(ksf)		0.13	(ksf)		
Sample No. : D-7			16.40	(kPa)	Peak	6.32	(kPa)	Ultimate	
Depth (ft/m) : 35.0	0.00	Friction Angle (ϕ) :	42.40	Degree		30.09	Degree		
Description : Light olive brown, Poorly graded SAND (SP)						Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	16.61	105.01	16.53	0.61	2.00	95.76	2.18	104.57	1.21	58.03
◆	15.39	101.62	16.00	0.66	4.00	191.52	3.97	190.18	2.57	122.96
▲	14.73	104.76	16.49	0.61	8.00	383.04	7.66	366.52	4.73	226.38

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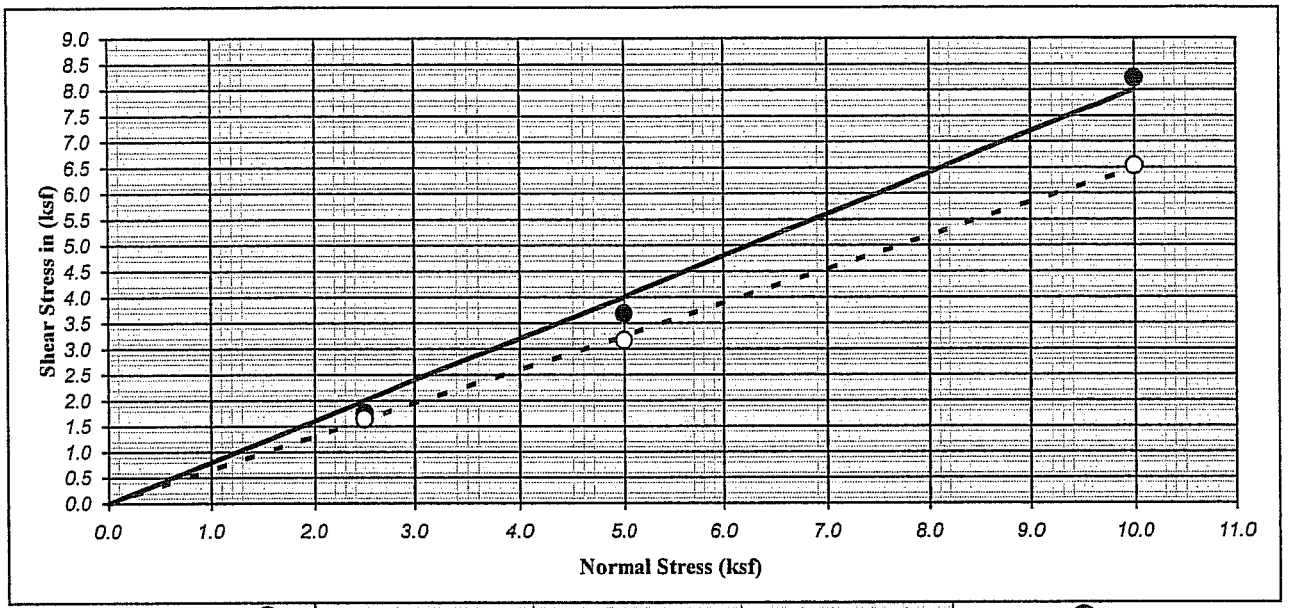
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

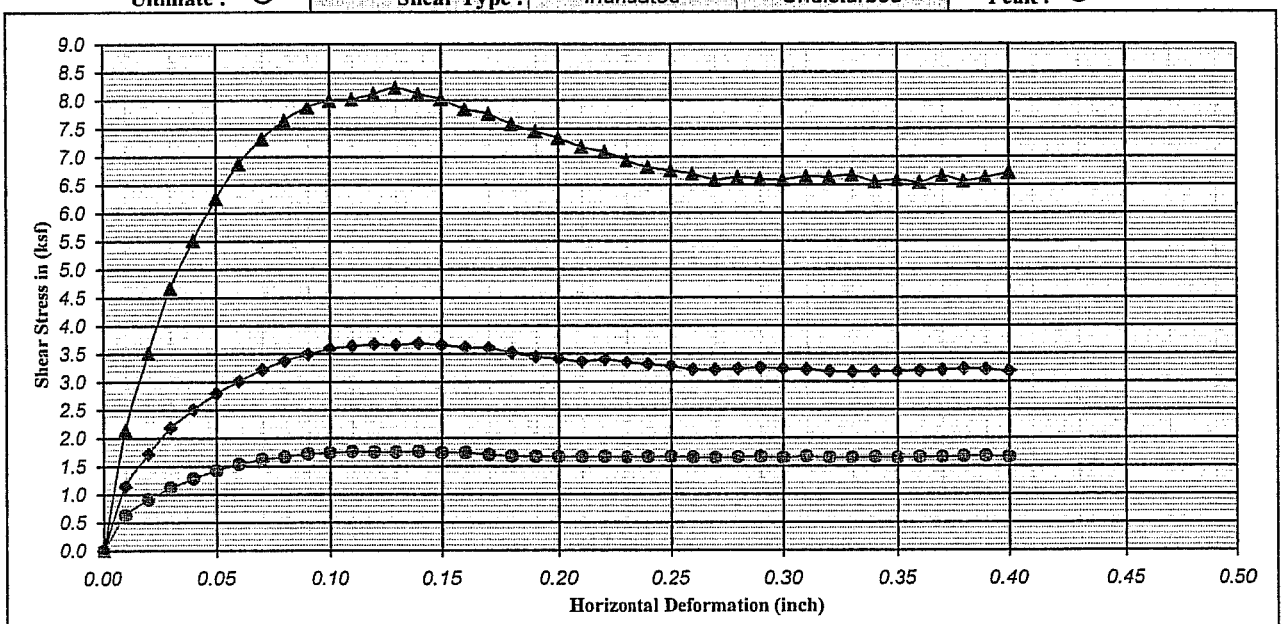
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No.	: A-08-002	Strength Intercept (C) :	0.00	(ksf)	Peak	0.00	(ksf)	Ultimate
Sample No.	: D-10		0.00	(kPa)		0.00	(kPa)	
Depth (ft/m)	: 45.0 | 0.00	Friction Angle (ϕ) :	38.70	Degree		33.03	Degree	
Description	: Olive brown, Poorly graded SAND (SP)						Shear Rate (inch/minute) :	0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	21.34	87.98	13.85	0.92	2.50	119.70	1.76	84.46	1.64	78.71
◆	19.99	91.15	14.35	0.85	5.00	239.40	3.68	176.39	3.17	151.68
▲	18.60	94.70	14.91	0.78	10.00	478.80	8.23	394.10	6.54	313.09

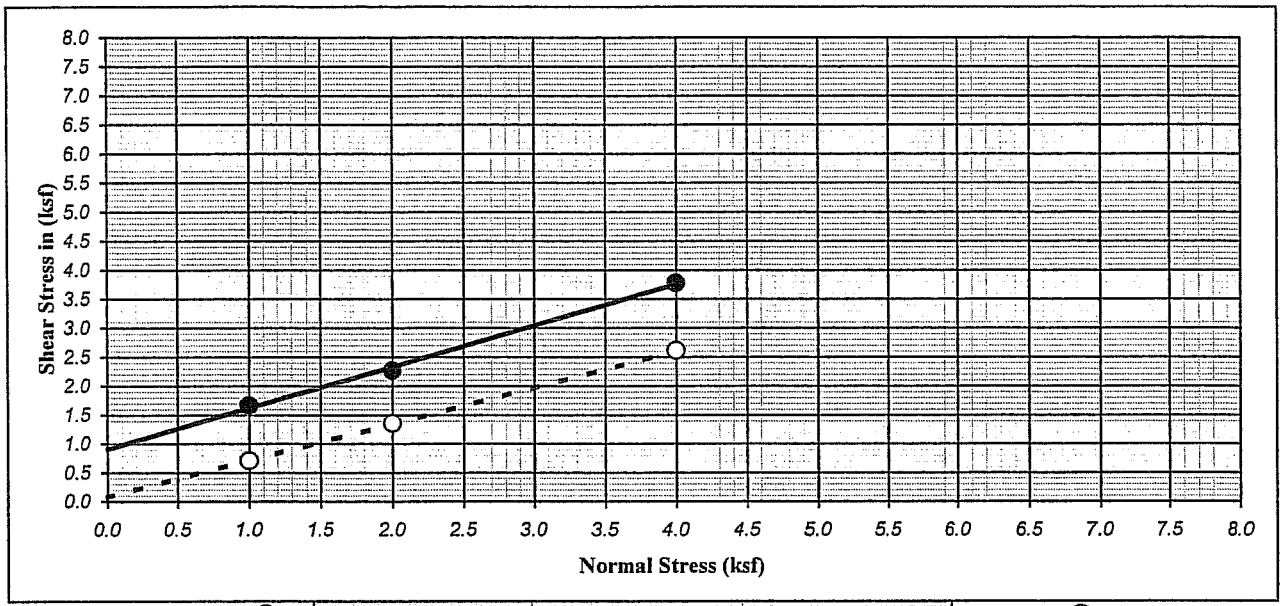
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

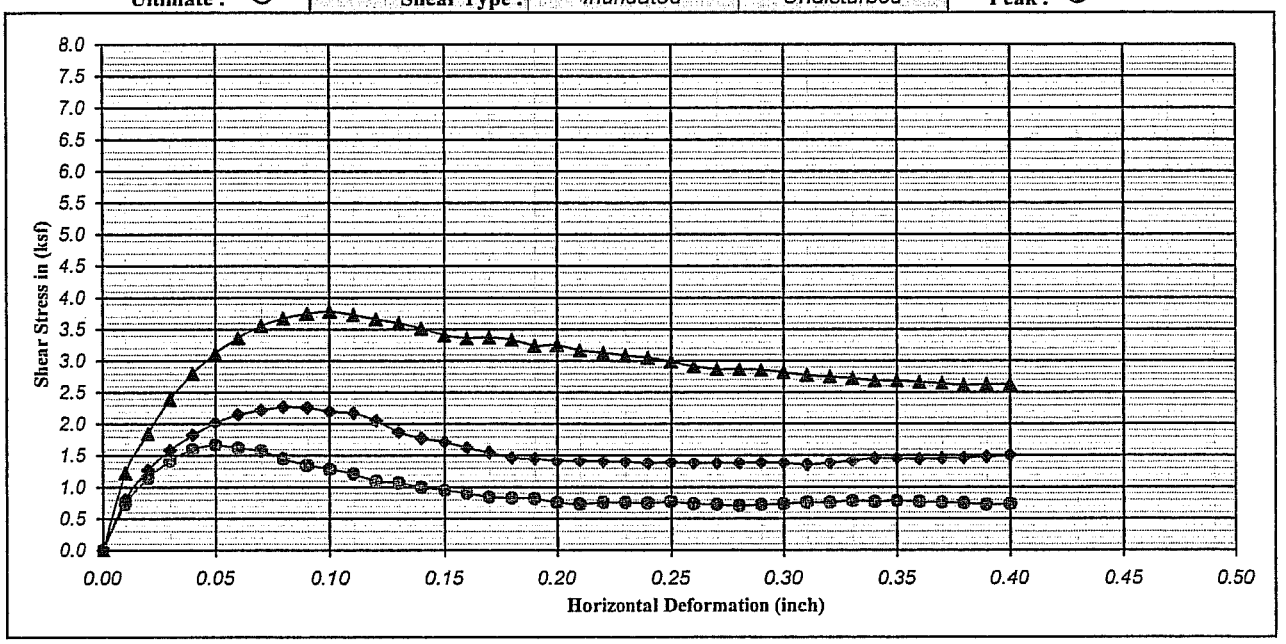
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No.	: A-08-003	Strength Intercept (C) :	0.91	(ksf)	Peak	0.08	(ksf)	Ultimate
Sample No.	: D-4		43.67	(kPa)		3.73	(kPa)	
Depth (ft/m)	: 15.0 | 0.00	Friction Angle (ϕ) :	35.43	Degree		32.42	Degree	
Description	: Brown, CLAYEY SAND (SC)						Shear Rate (inch/minute) :	0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.17	119.87	18.87	0.41	1.00	47.88	1.67	79.86	0.71	33.90
◆	13.80	121.41	19.11	0.39	2.00	95.76	2.27	108.59	1.36	64.93
▲	7.79	128.82	20.28	0.31	4.00	191.52	3.78	180.99	2.62	125.25

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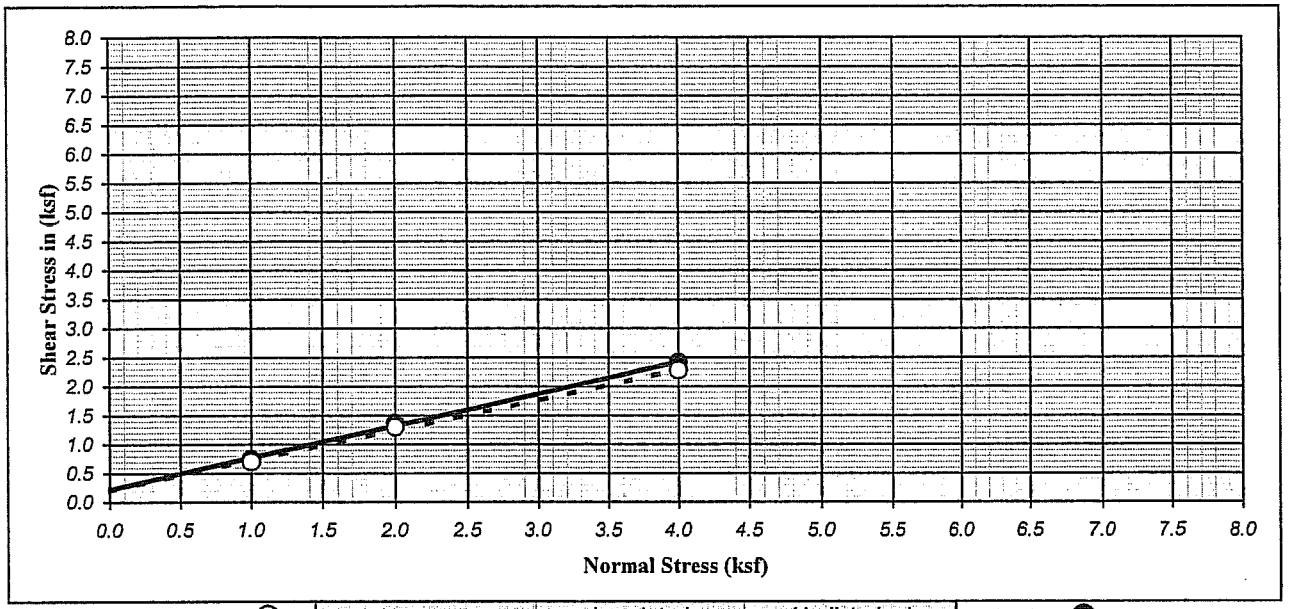
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

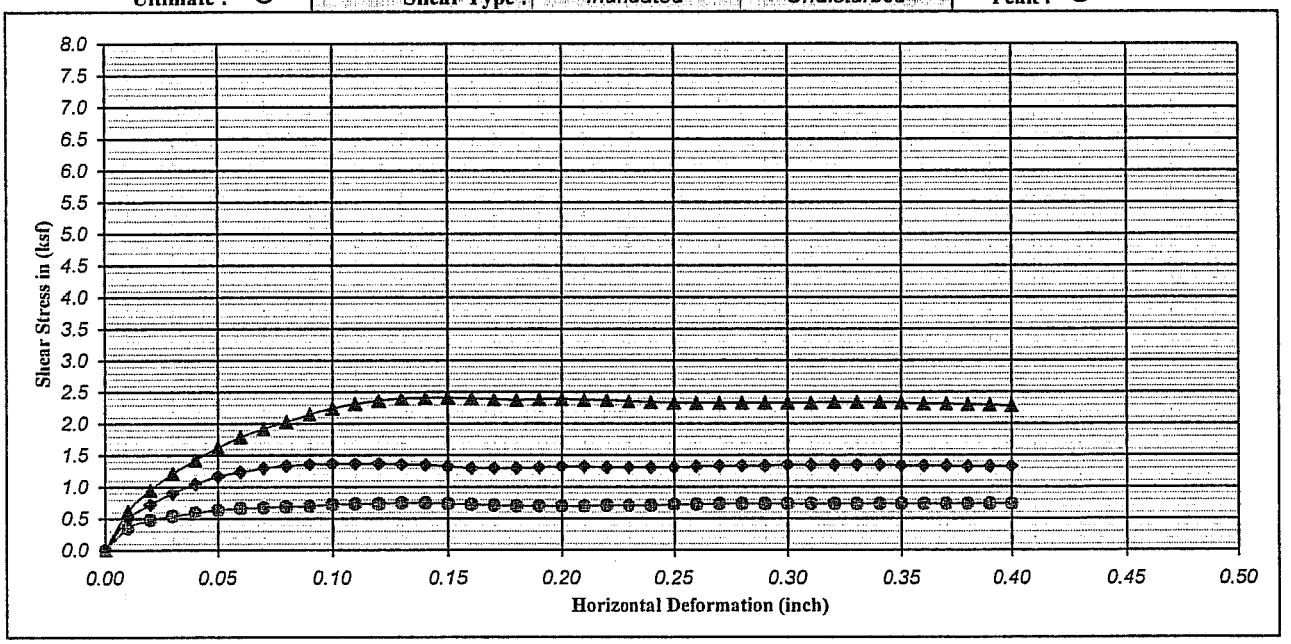
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No.	: A-08-005	Strength Intercept (C) :	0.22	(ksf)	Peak	0.20	(ksf)	Ultimate
Sample No.	: D-4		10.63	(kPa)		9.77	(kPa)	
Depth (ft/m)	: 15.0 | 0.00	Friction Angle (ϕ) :	28.86	Degree		27.60	Degree	
Description	: Olive brown with olive gray, CLAYEY SAND (SC)						Shear Rate (inch/minute) :	0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	25.41	92.12	14.50	0.83	1.00	47.88	0.74	35.62	0.70	33.32
◆	25.89	93.42	14.70	0.80	2.00	95.76	1.37	65.50	1.30	62.05
▲	25.99	92.76	14.60	0.82	4.00	191.52	2.41	115.49	2.28	109.17

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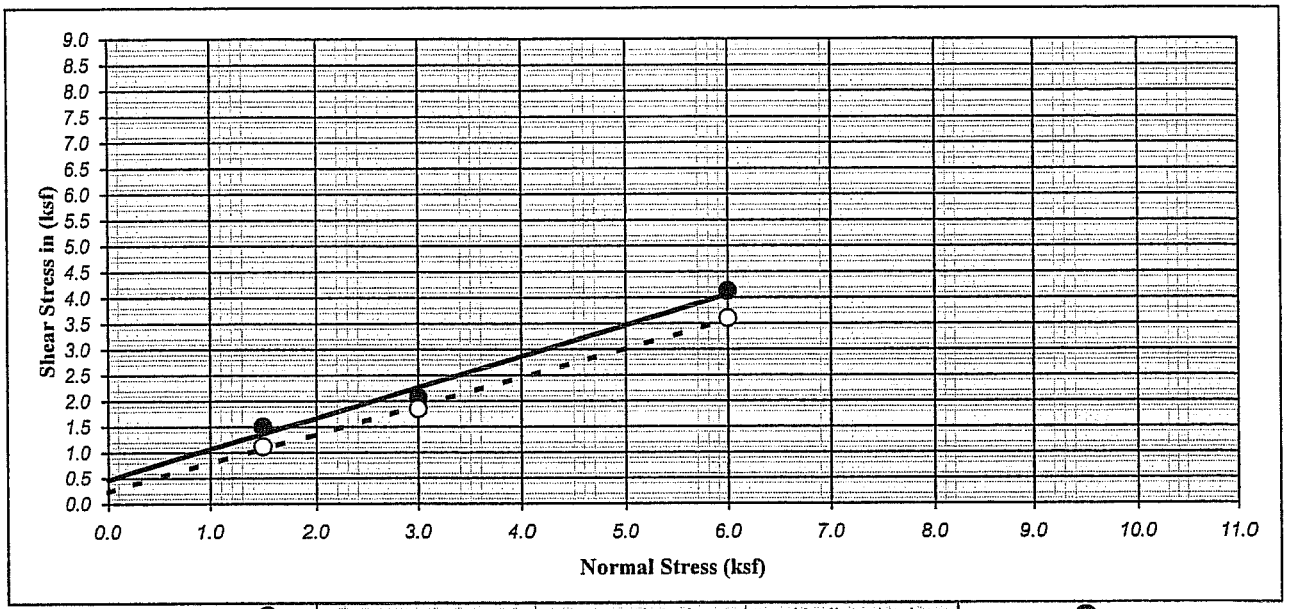
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

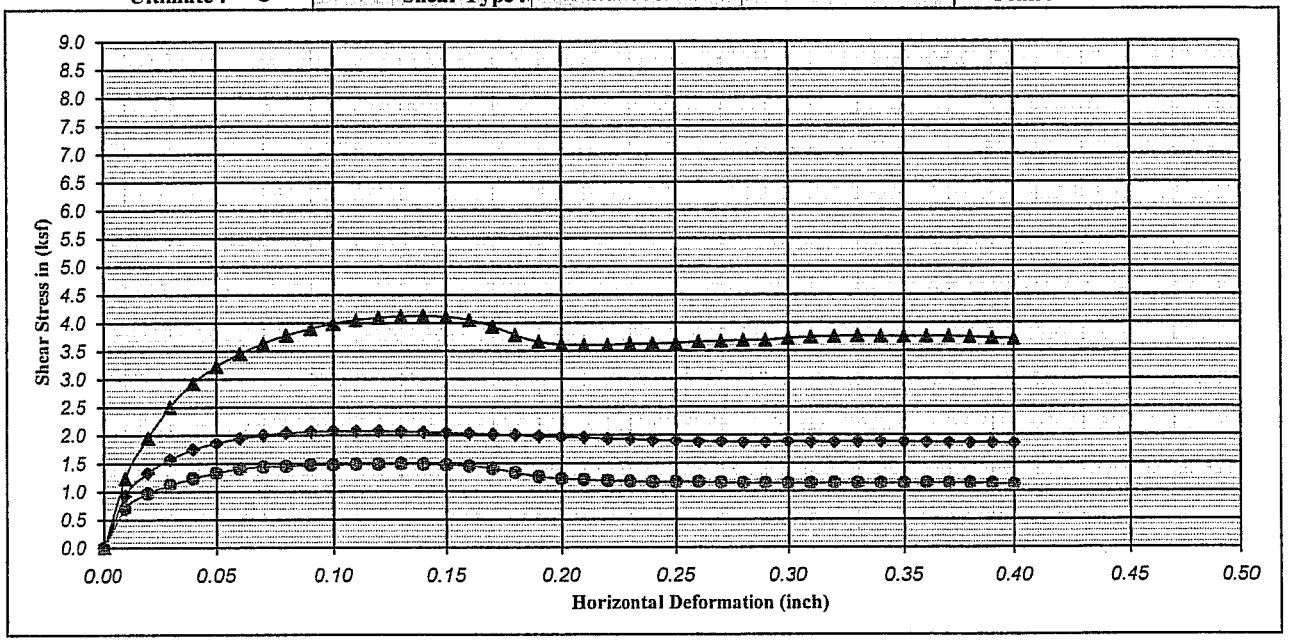
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-006		Strength Intercept (C) :	0.47	(ksf)		0.24	(ksf)		
Sample No. : D-7			22.70	(kPa)	Peak	11.49	(kPa)	Ultimate	
Depth (ft/m) : 10.0	0.00	Friction Angle (ϕ) :	30.89	Degree		29.10	Degree		
Description : Brown, CLAYEY SAND (SC)						Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	50.88	81.26	12.79	1.07	1.50	71.82	1.50	71.82	1.12	53.43
◆	29.72	94.69	14.90	0.78	3.00	143.64	2.08	99.40	1.85	88.48
▲	20.94	99.44	15.65	0.70	6.00	287.28	4.13	197.65	3.60	172.37

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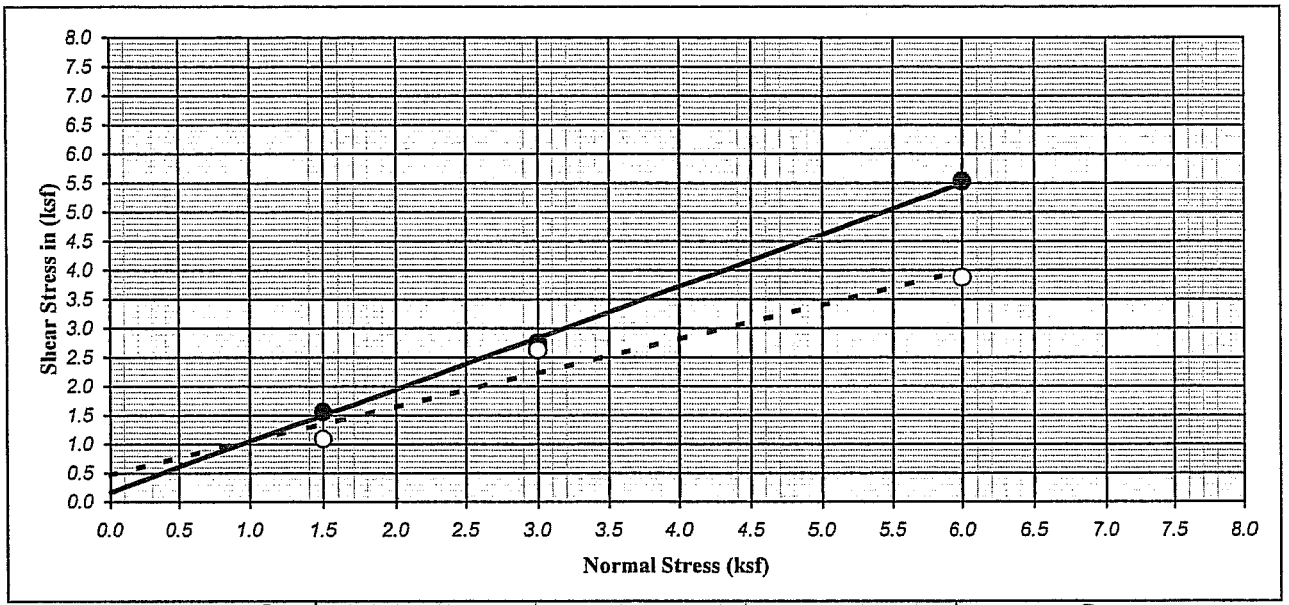
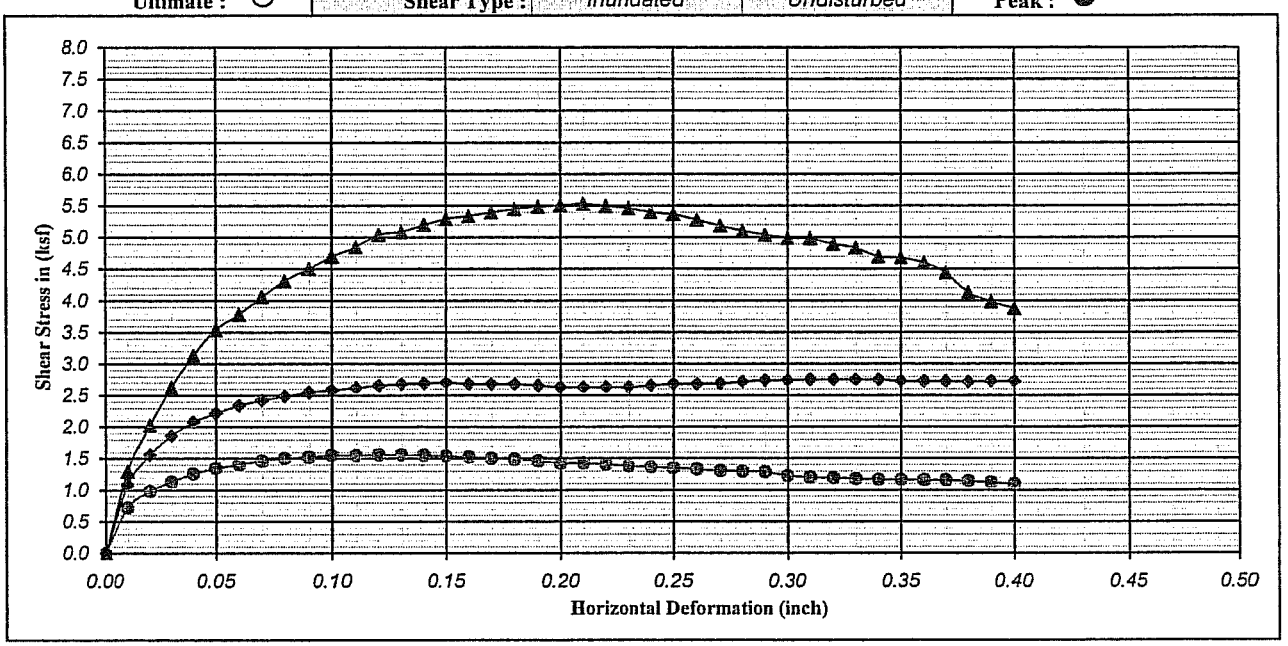
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/13/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-007		Strength Intercept (C) :	0.17	(ksf)	Peak	0.47	(ksf)	Ultimate
Sample No. : D-6			8.07	(kPa)		22.41	(kPa)	
Depth (ft/m) : 25.0	0.00	Friction Angle (ϕ) :	41.63	Degree		30.53	Degree	
Description : Mottled Brown, grayish brown and yellowish brown, CLAYEY SAND with GRAVEL					Shear Rate (inch/minute) :			0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	25.41	100.29	15.79	0.68	1.50	71.82	1.56	74.69	1.09	52.28
◆	20.12	106.34	16.74	0.59	3.00	143.64	2.75	131.57	2.63	125.83
▲	22.72	101.37	15.95	0.66	6.00	287.28	5.53	264.82	3.88	185.58

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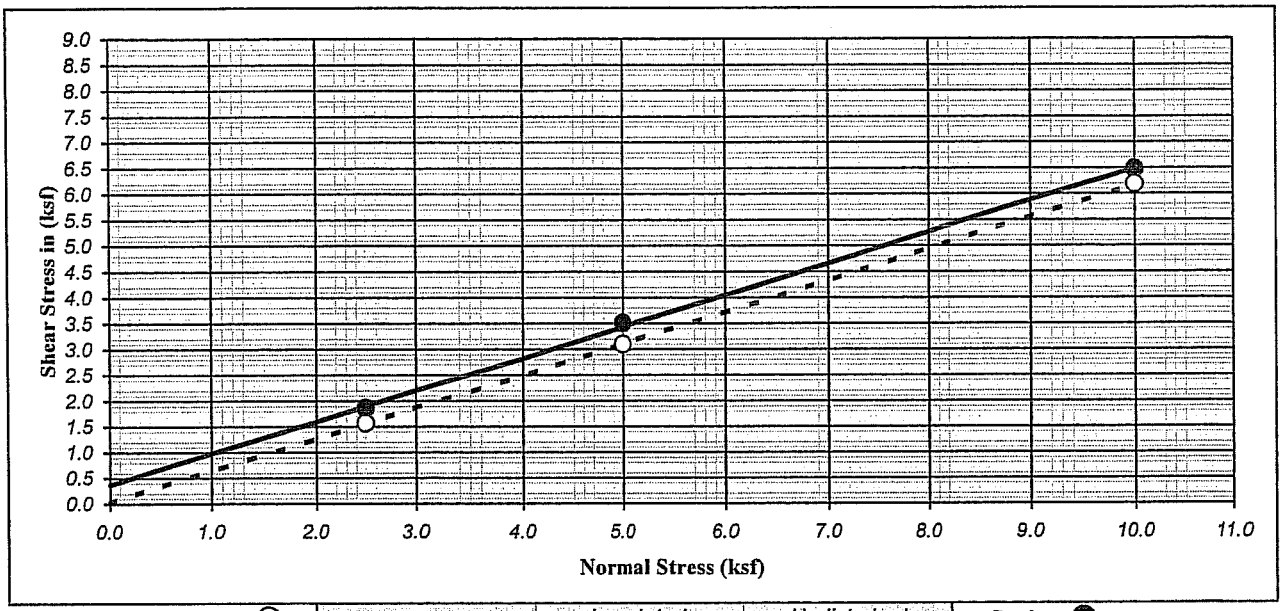
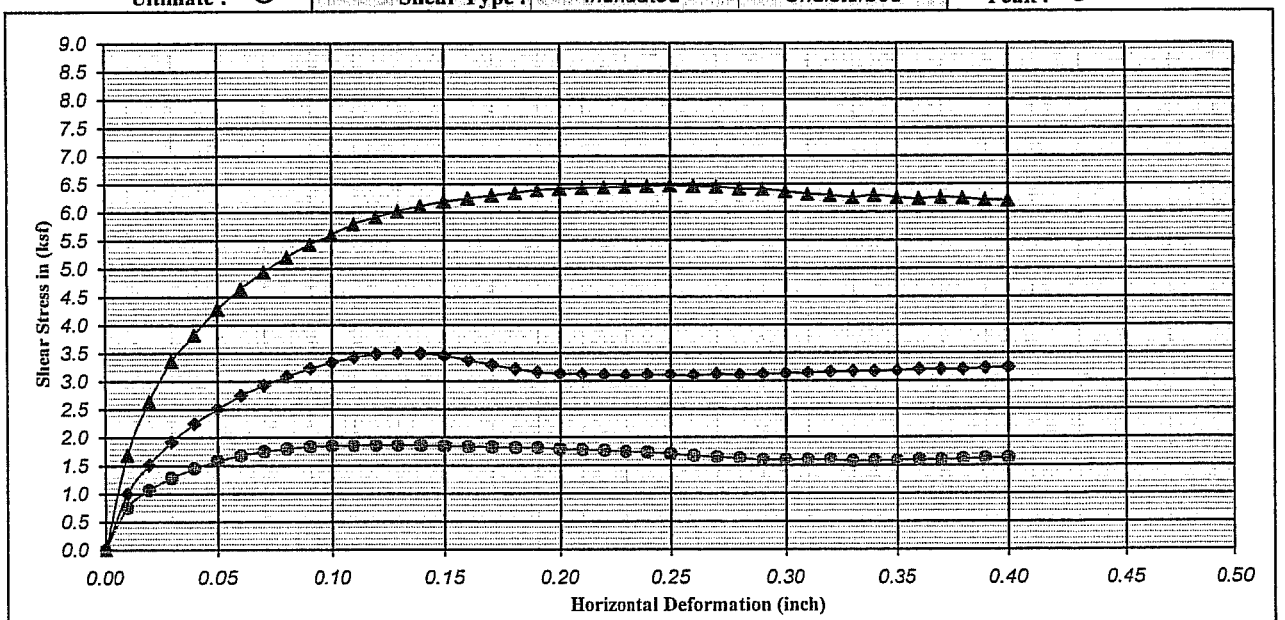
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 **Date :** 11/13/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-007	Strength Intercept (C) :	0.37	(ksf)	Peak	0.02	(ksf)	Ultimate
Sample No. : D-12		17.84	(kPa)		1.17	(kPa)	
Depth (ft/m) : 55.0 | 0.00	Friction Angle (ϕ) :	31.50	Degree		31.65	Degree	

Description : Brown, poorly graded SAND with SILT (SP-SM) — Shear Rate (inch/minute) : 0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	24.90	80.29	12.64	1.10	2.50	119.70	1.86	89.06	1.57	75.27
◆	22.32	89.64	14.11	0.88	5.00	239.40	3.50	167.77	3.10	148.24
▲	24.44	81.19	12.78	1.08	10.00	478.80	6.48	310.21	6.19	296.43

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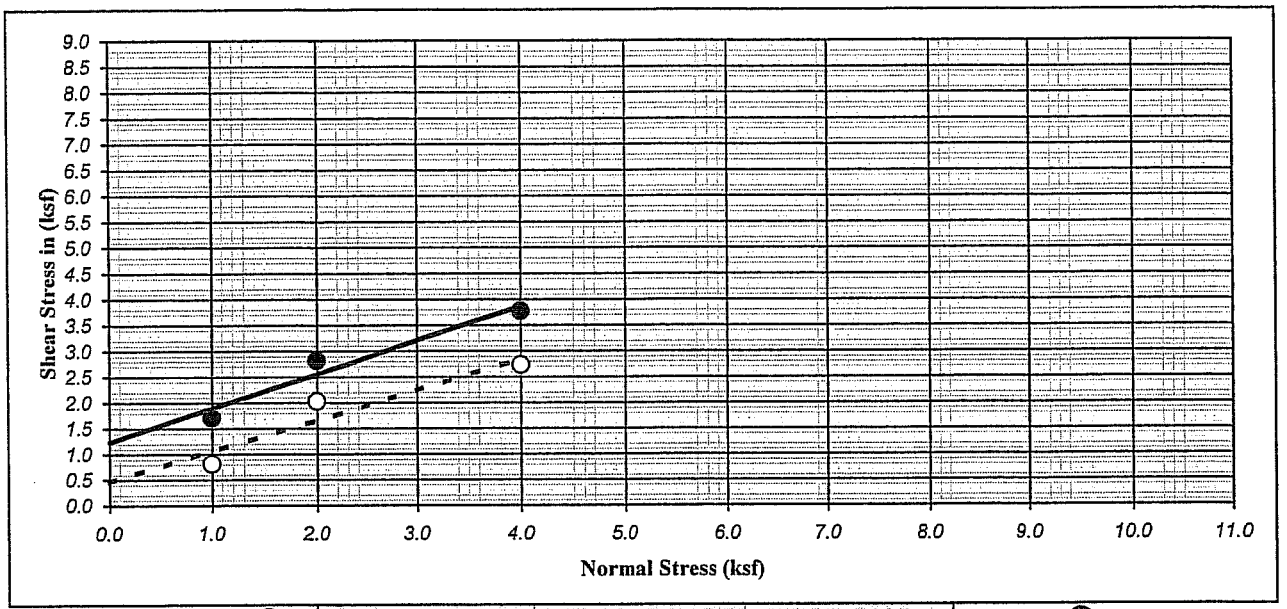
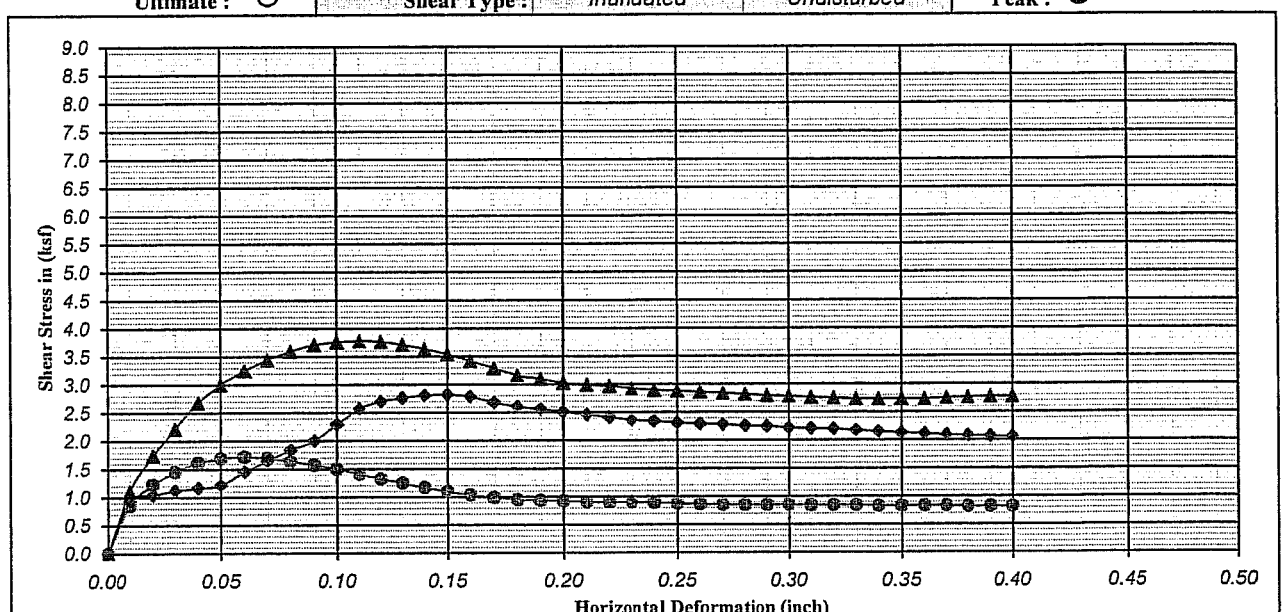
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/14/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No.	: A-08-008	Strength Intercept (C) :	1.24	(ksf)	Peak	0.46	(ksf)	Ultimate		
Sample No.	: D-5		59.18	(kPa)		22.12	(kPa)			
Depth (ft/m)	: 20.0 | 0.00	Friction Angle (ϕ) :	33.36	Degree		30.93	Degree			
Description	: Olive, Lean CLAY with SAND (CL)						Shear Rate (inch/minute) :	0.02		

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	20.33	109.98	17.31	0.53	1.00	47.88	1.72	82.16	0.82	39.07
◆	22.02	105.52	16.61	0.60	2.00	95.76	2.82	135.02	2.03	97.10
▲	18.31	107.45	16.91	0.57	4.00	191.52	3.78	180.99	2.74	131.00

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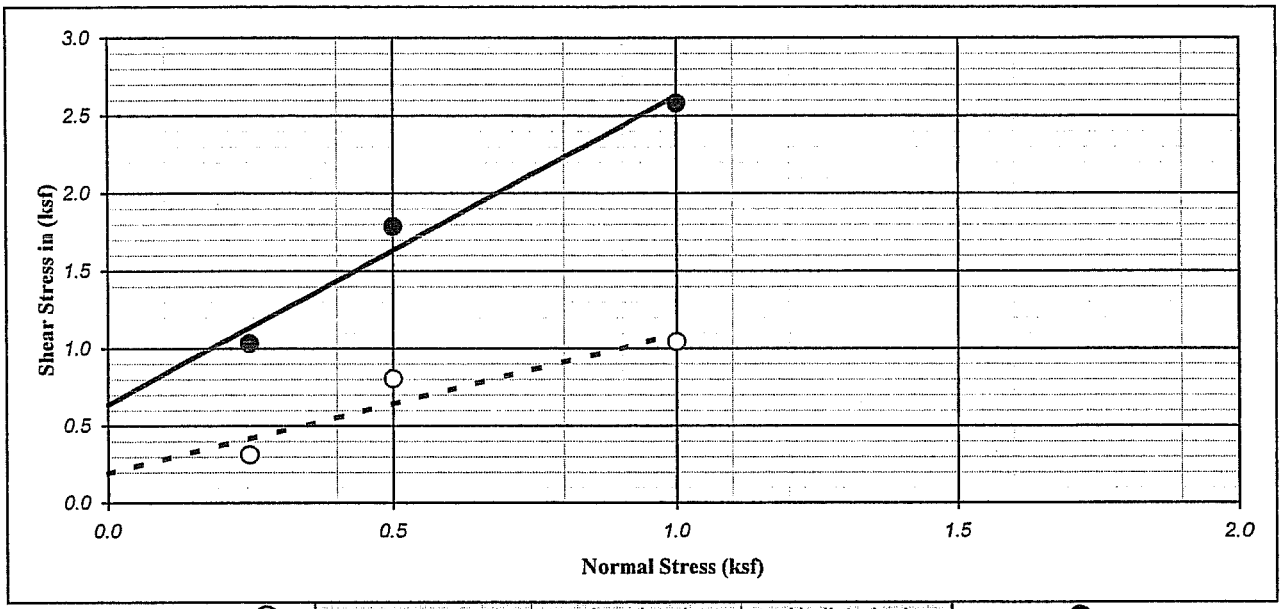
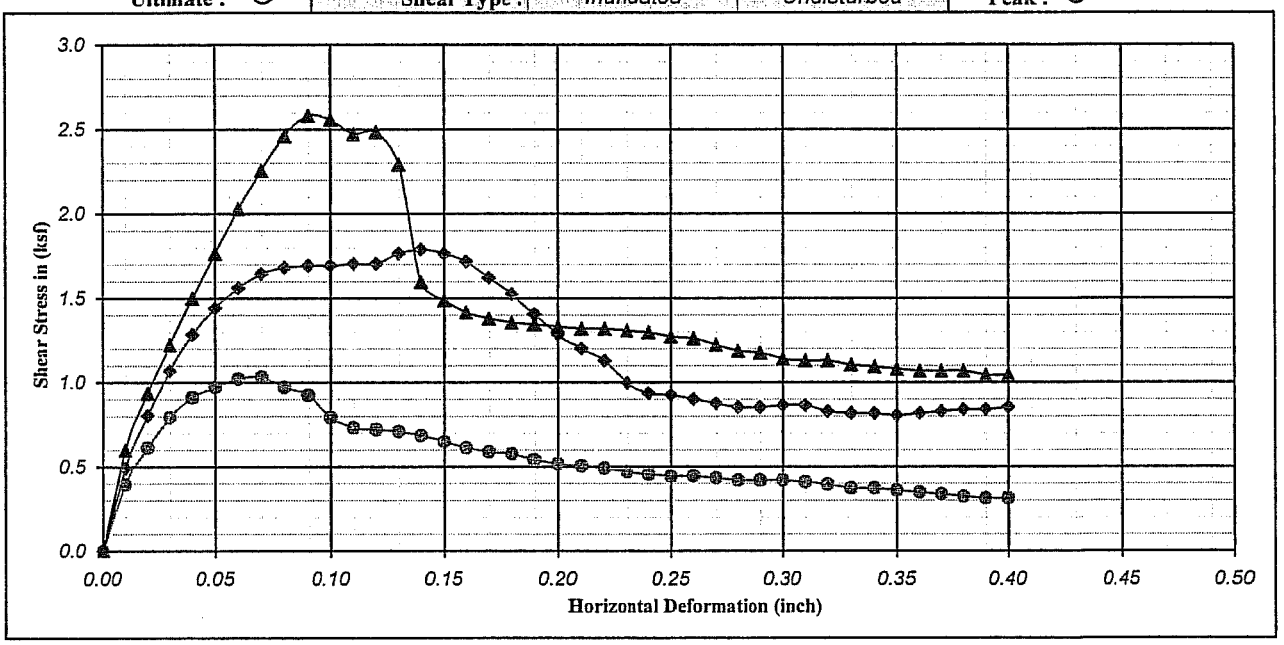
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | **Date :** 11/14/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No.	: A-08-009		Strength Intercept (C) :	0.64	(ksf)		0.19	(ksf)	
Sample No.	: D-2			30.45	(kPa)	Peak	9.19	(kPa)	Ultimate
Depth (ft/m)	: 5.0	0.00	Friction Angle (ϕ) :	63.38	Degree		42.15	Degree	
Description	: Mottled olive brown, yellowish brown, brown, CLAYEY SAND (SC)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	13.01	100.63	15.84	0.68	0.25	11.97	1.03	49.41	0.31	14.94
◆	13.46	102.67	16.16	0.64	0.50	23.94	1.79	85.61	0.80	38.50
▲	13.35	104.37	16.43	0.61	1.00	47.88	2.58	123.53	1.04	49.99

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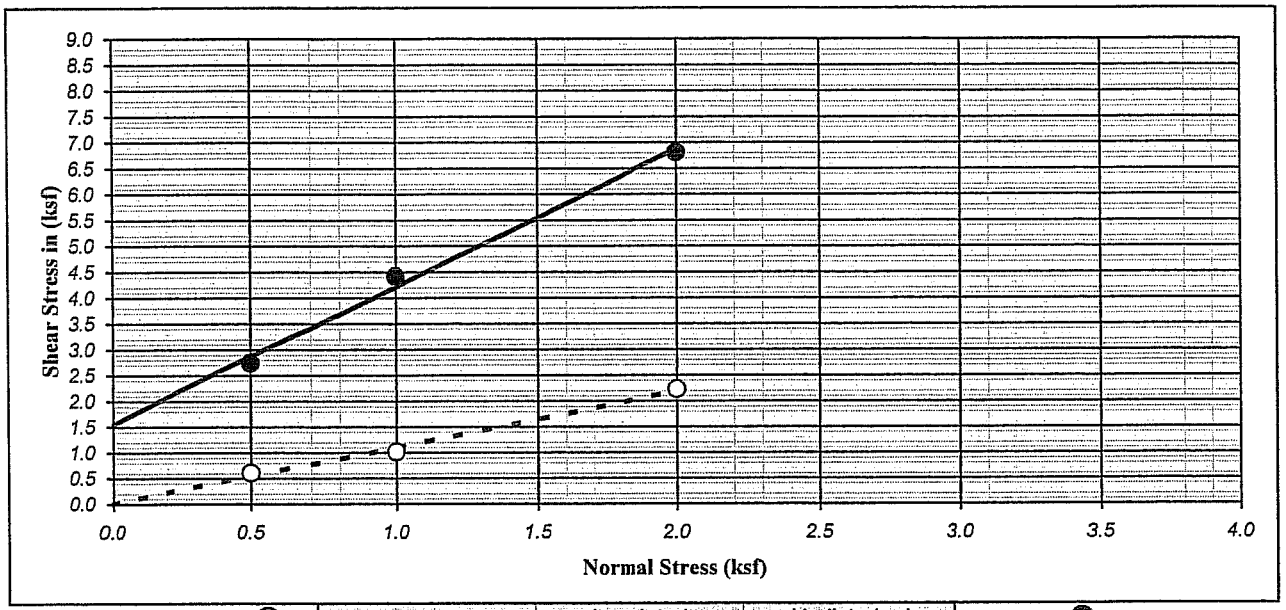
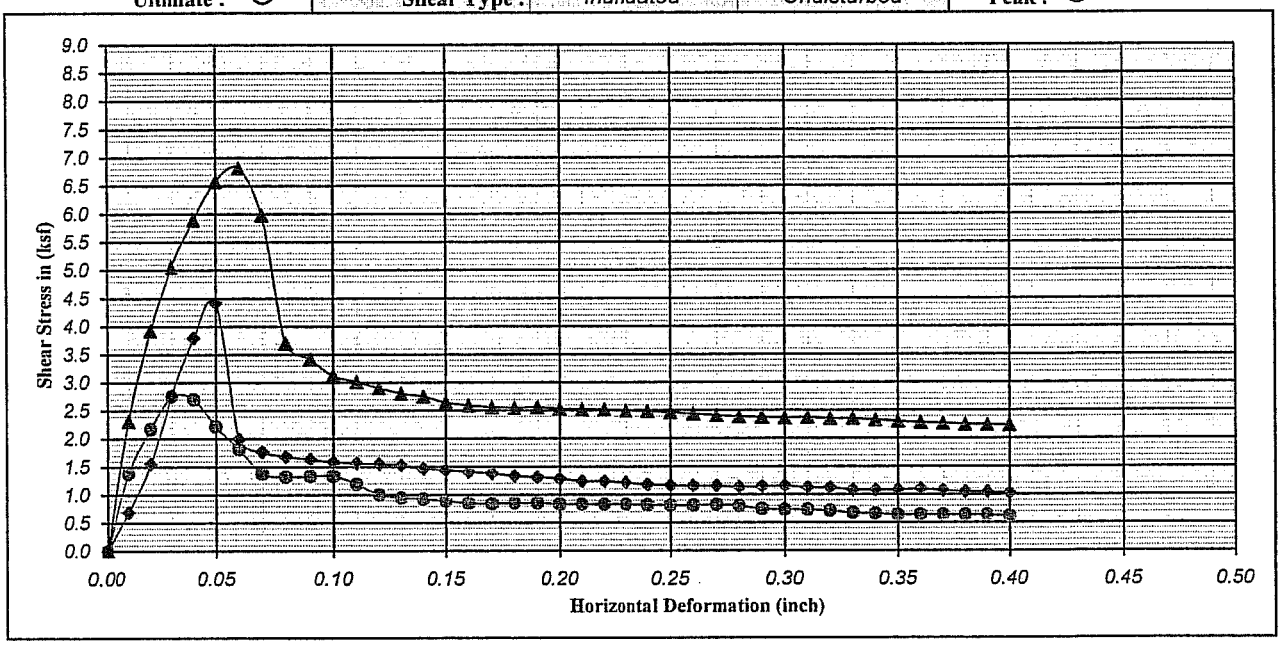
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/21/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No.	: *A-08-010*	**Strength Intercept (C) :**	*1.55*	(ksf)	**Peak**	*0.01*	(ksf)	**Ultimate**
Sample No.	: *D-3*		*74.14*	(kPa)		*0.29*	(kPa)	
Depth (ft/m)	: *10.0* | *0.00*	**Friction Angle (ϕ) :**	*69.44*	Degree		*47.70*	Degree	
Description	: *Mottled olive brown, yellowish brown, brown, CLAYEY SAND (SC)*					**Shear Rate** (inch/minute) :		*0.02*

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	*10.14*	*126.22*	*19.87*	*0.34*	*0.50*	*23.94*	*2.75*	*131.57*	*0.61*	*29.30*
◆	*10.34*	*123.00*	*19.36*	*0.37*	*1.00*	*47.88*	*4.42*	*211.44*	*1.02*	*48.84*
▲	*10.58*	*123.26*	*19.40*	*0.37*	*2.00*	*95.76*	*6.82*	*326.30*	*2.23*	*106.87*

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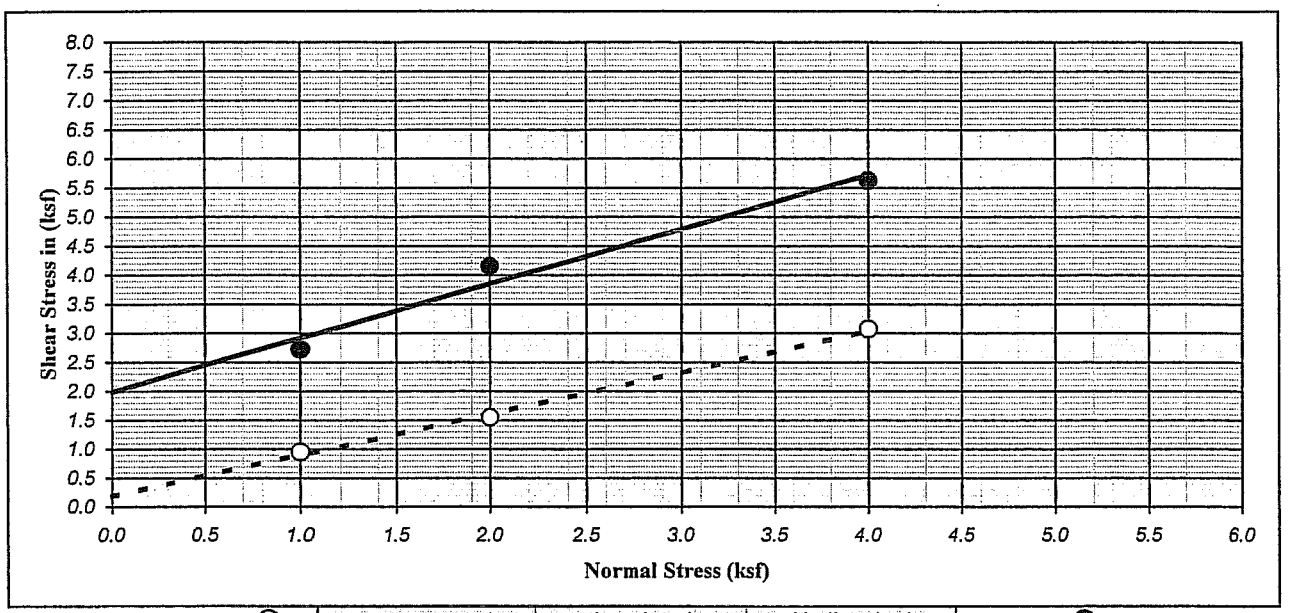
RBF/SR-57 Northbound

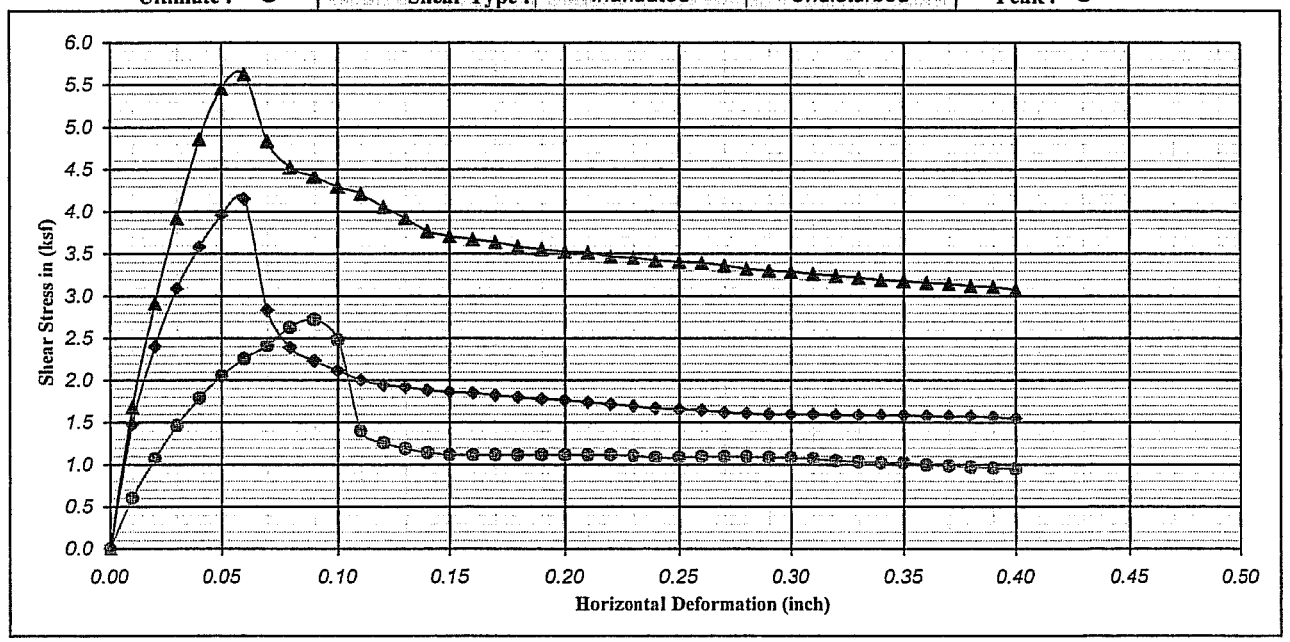
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : *08-115* | **Date :** *11/23/08*

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-011		Strength Intercept (C) :	1.99	(ksf)		0.19	(ksf)		
Sample No. : D-5			95.11	(kPa)	Peak	8.91	(kPa)	Ultimate	
Depth (ft/m) : 20.0	0.00	Friction Angle (ϕ) :	43.07	Degree		35.59	Degree		
Description : Brown, Lean CLAY with SAND (CL)						Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.35	102.70	16.17	0.64	1.00	47.88	2.72	130.43	0.95	45.39
◆	18.92	106.02	16.69	0.59	2.00	95.76	4.15	198.80	1.55	74.12
▲	16.19	111.34	17.52	0.51	4.00	191.52	5.63	269.42	3.07	147.09

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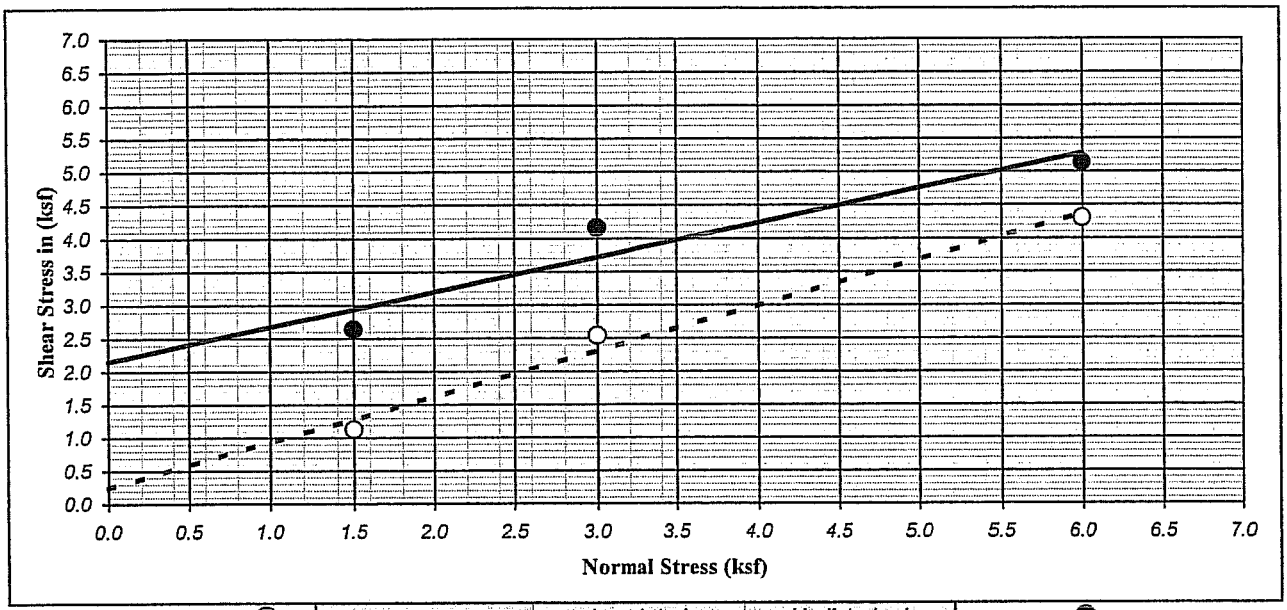
RBF/SR-57 Northbound

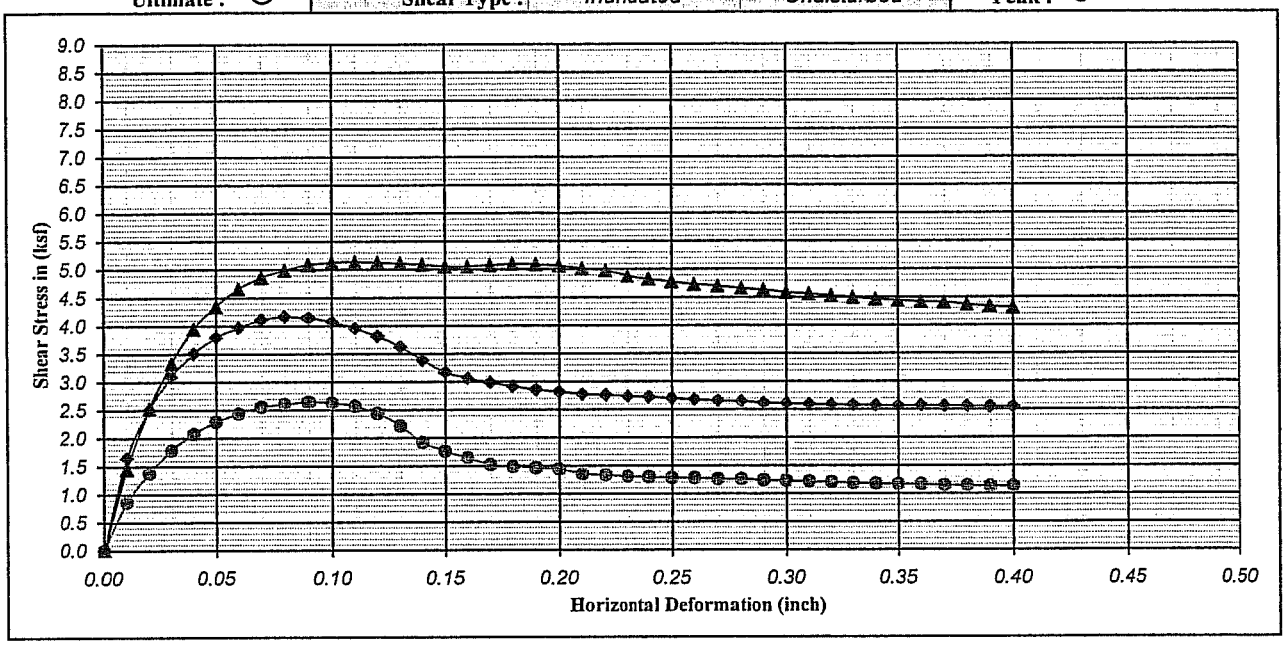
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : *Inundated* | *Undisturbed* | Peak : ●



Boring No. : *A-08-011*	Strength Intercept (C) :	*2.15*	(ksf)		*0.25*	(ksf)	
Sample No. : *D-7*		*103.13*	(kPa)	Peak	*11.78*	(kPa)	Ultimate
Depth (ft/m) : *30.0* *0.00*	Friction Angle (ϕ) :	*27.55*	Degree		*34.59*	Degree	
Description : *Brown to dark brown, SANDY LEAN CLAY (CL)*					Shear Rate (inch/minute) :		*0.02*

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	*16.08*	*116.72*	*18.37*	*0.44*	*1.50*	*71.82*	*2.64*	*126.40*	*1.13*	*54.01*
◆	*15.82*	*119.90*	*18.87*	*0.41*	*3.00*	*143.64*	*4.16*	*199.37*	*2.54*	*121.81*
▲	*16.81*	*117.88*	*18.55*	*0.43*	*6.00*	*287.28*	*5.14*	*245.91*	*4.31*	*206.27*

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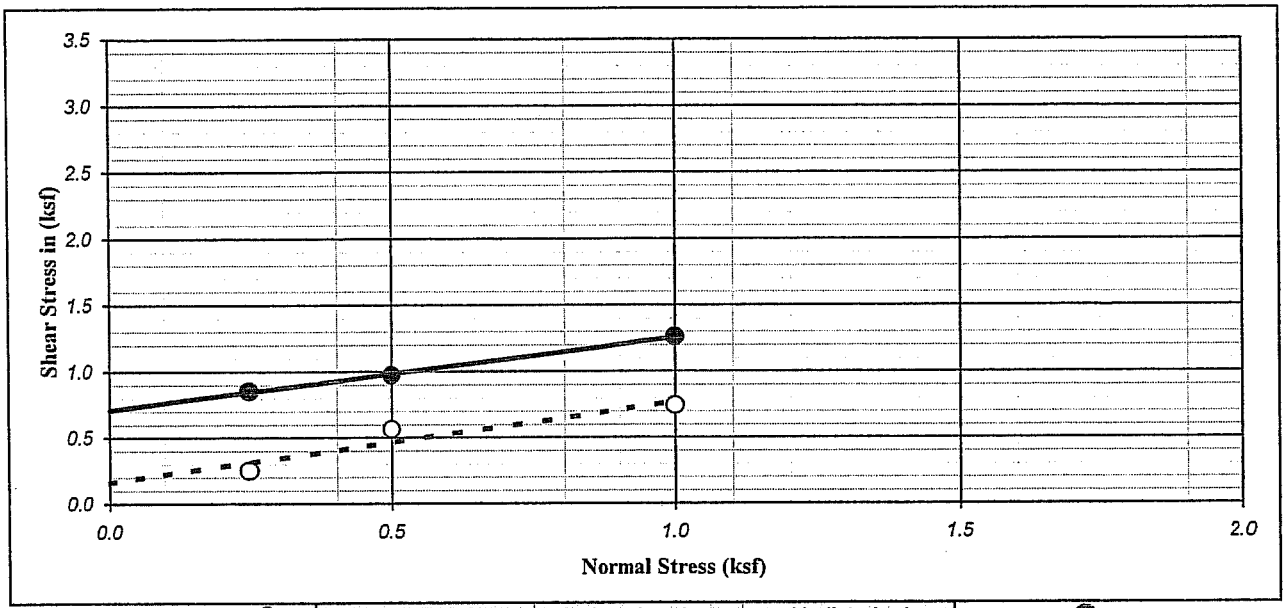
RBF/SR-57 Northbound

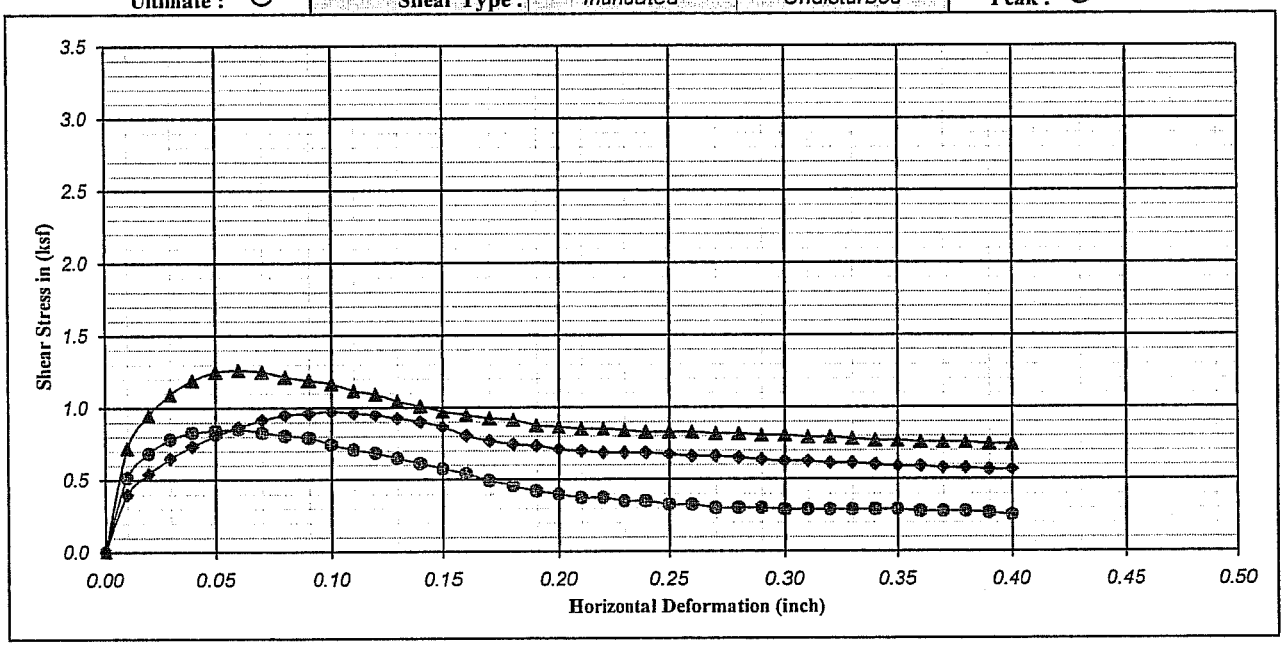
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : *08-115* | Date : *11/23/08*

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-013		Strength Intercept (C) :	0.71	(ksf)		0.16	(ksf)		
Sample No. : D-2			33.90	(kPa)	Peak	7.76	(kPa)	Ultimate	
Depth (ft/m) : 5.0	0.00	Friction Angle (ϕ) :	28.75	Degree		31.54	Degree		
Description : Mottled olive brown, yellowish brown, CLAYEY SAND (SC)						Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	24.16	102.19	16.08	0.65	0.25	11.97	0.85	40.79	0.25	12.07
◆	23.10	101.16	15.92	0.67	0.50	23.94	0.97	46.54	0.56	27.00
▲	20.94	101.47	15.97	0.66	1.00	47.88	1.26	60.33	0.74	35.62

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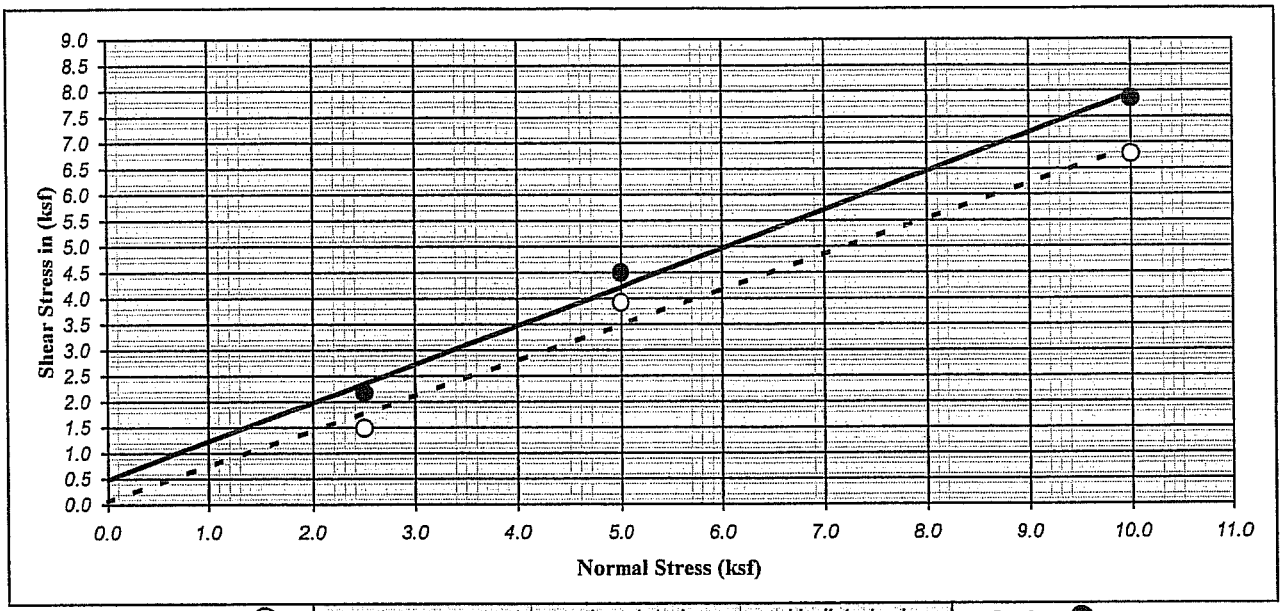
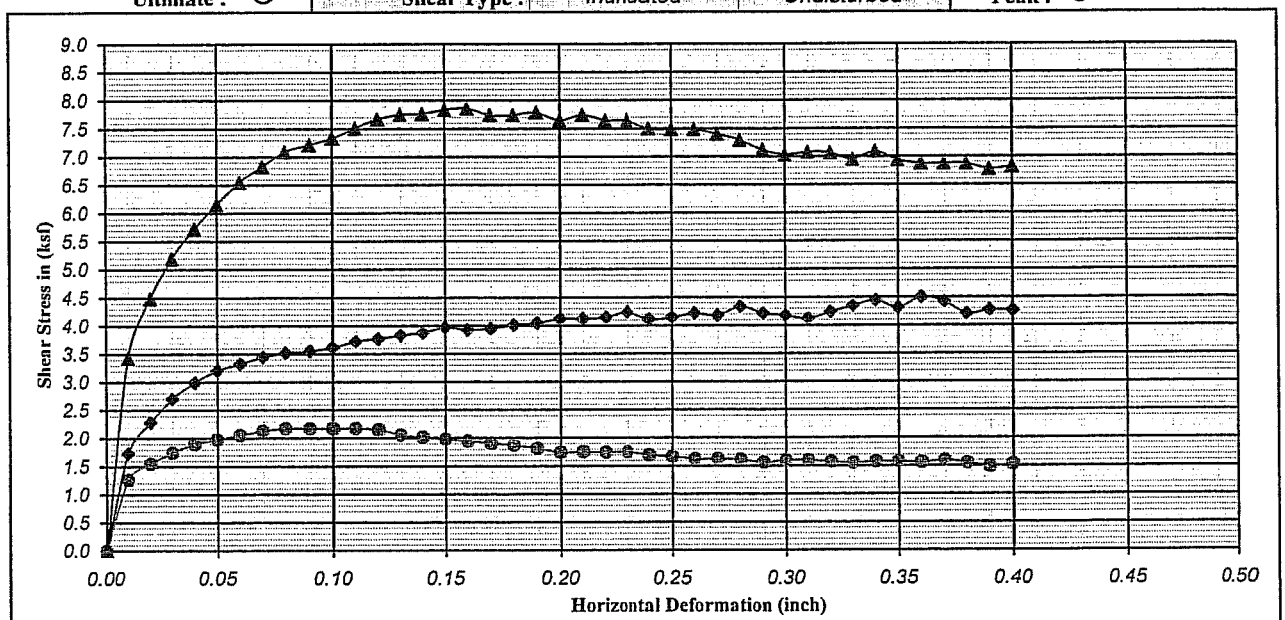
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08 | Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-013		Strength Intercept (C) :	0.49	(ksf)	Peak	0.06	(ksf)	Ultimate
Sample No. : D-12			23.58	(kPa)		2.90	(kPa)	
Depth (ft/m) : 55.0	0.00	Friction Angle (ϕ) :	36.72	Degree		34.46	Degree	
Description : Yellowish brown, Poorly-graded SAND with SILT (SP-SM)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	17.57	103.83	16.34	0.62	2.50	119.70	2.17	104.00	1.49	71.25
◆	16.58	102.89	16.19	0.64	5.00	239.40	4.50	215.46	3.92	187.88
▲	15.95	107.70	16.95	0.57	10.00	478.80	7.86	376.29	6.78	324.58

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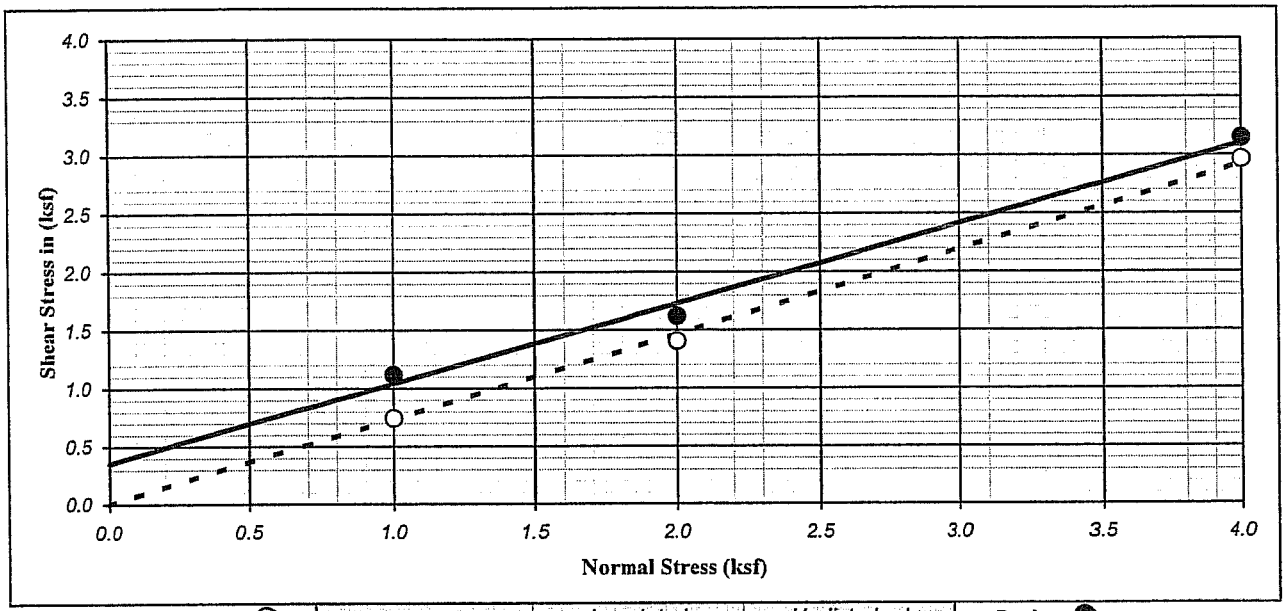
Geotechnical and Earthquake Engineering

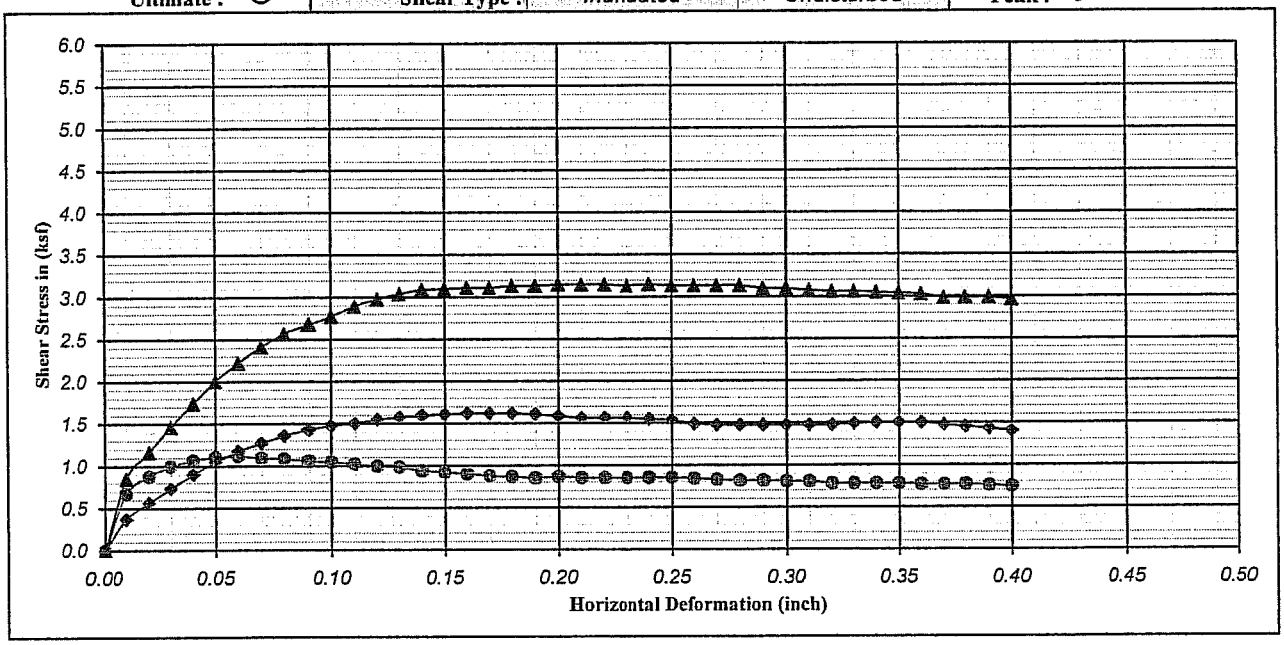
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115	Date : 11/23/08	Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-014		Strength Intercept (C) :	0.35	(ksf)	Peak	0.00	(ksf)	Ultimate
Sample No. : D-5			16.95	(kPa)		0.00	(kPa)	
Depth (ft/m) : 20.0	0.00	Friction Angle (ϕ) :	34.54	Degree		36.27	Degree	

Description : *Mottled olive gray, yellowish brown, yellow, CLAYEY SAND(SC)* — Shear Rate (inch/minute) : 0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	26.35	97.26	15.31	0.73	1.00	47.88	1.12	53.43	0.74	35.62
◆	24.96	92.99	14.64	0.81	2.00	95.76	1.62	77.57	1.40	67.22
▲	24.60	98.14	15.45	0.72	4.00	191.52	3.14	150.53	2.96	141.92

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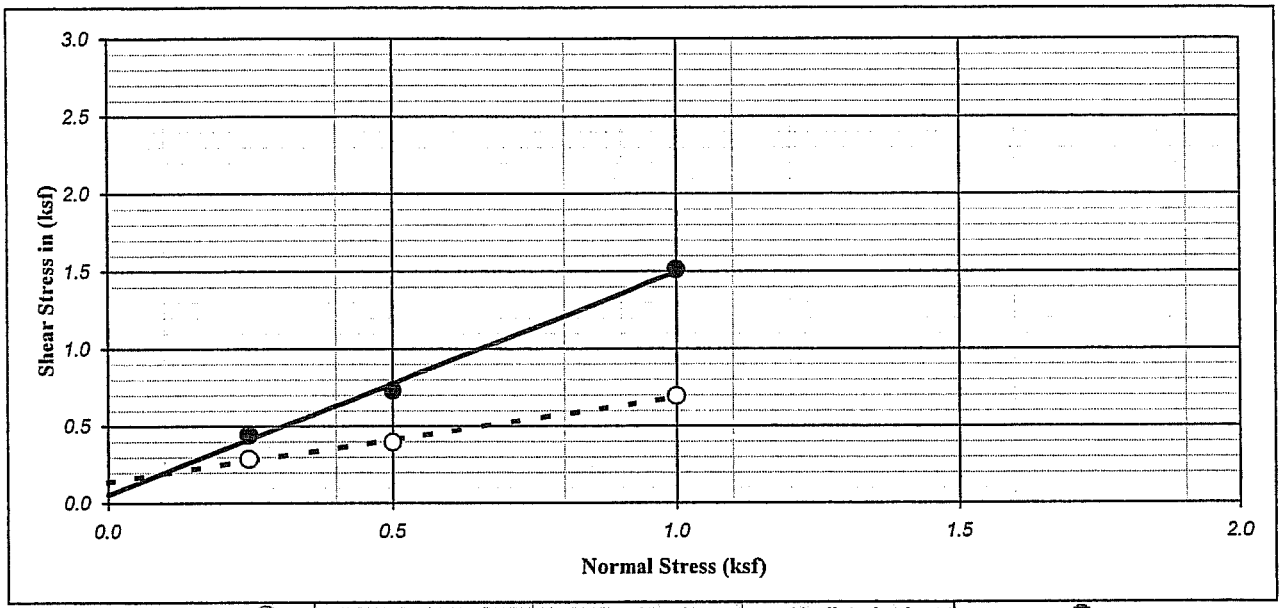
RBF/SR-57 Northbound

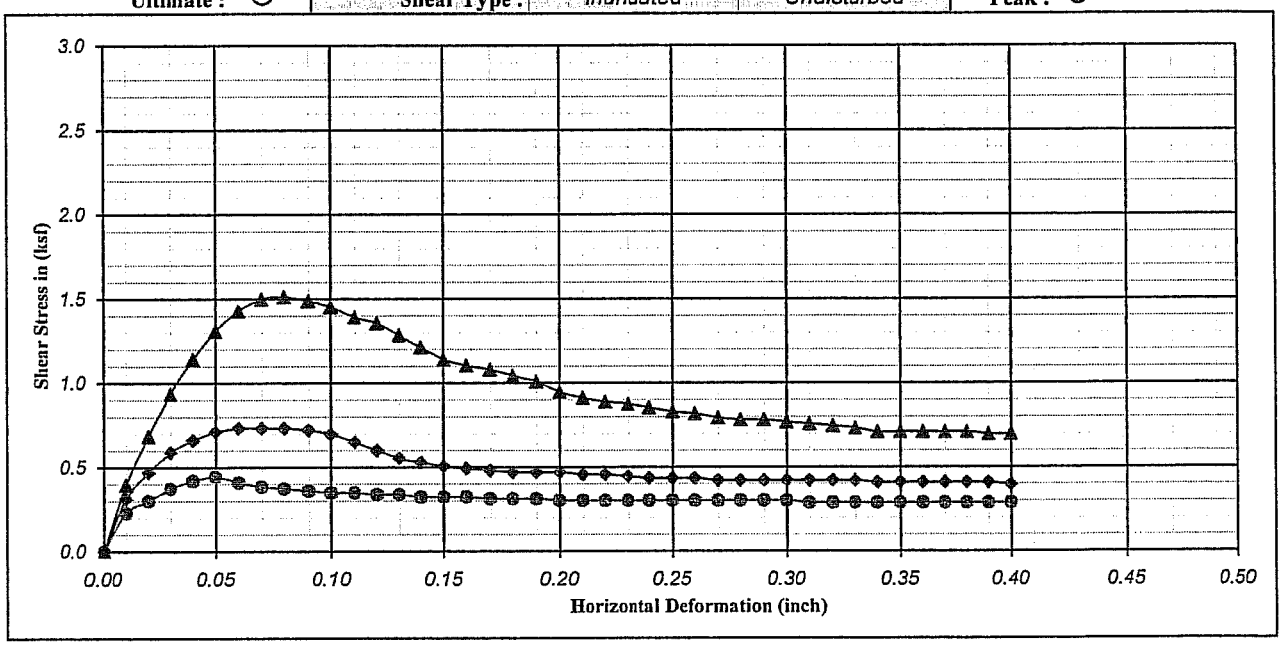
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-015		Strength Intercept (C) :	0.05	(ksf)		0.14	(ksf)		
Sample No. : D-2			2.59	(kPa)	Peak	6.61	(kPa)	Ultimate	
Depth (ft/m) : 5.0	0.00	Friction Angle (ϕ) :	55.29	Degree		28.90	Degree		
Description : Olive brown with yellow, SANDY Lean CLAY (CL)							Shear Rate (inch/minute) :	0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	29.30	90.50	14.24	0.86	0.25	11.97	0.44	21.26	0.29	13.79
◆	24.81	96.13	15.13	0.75	0.50	23.94	0.73	35.05	0.40	18.96
▲	28.23	95.13	14.97	0.77	1.00	47.88	1.51	72.39	0.70	33.32

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Geotechnical and Earthquake Engineering

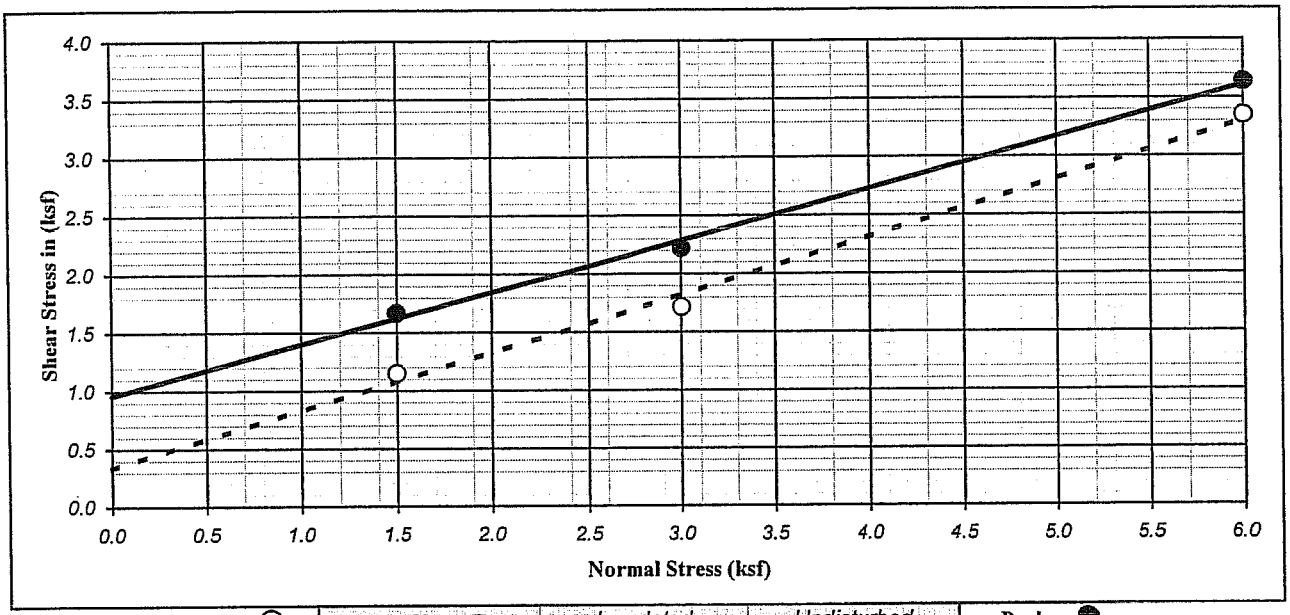
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

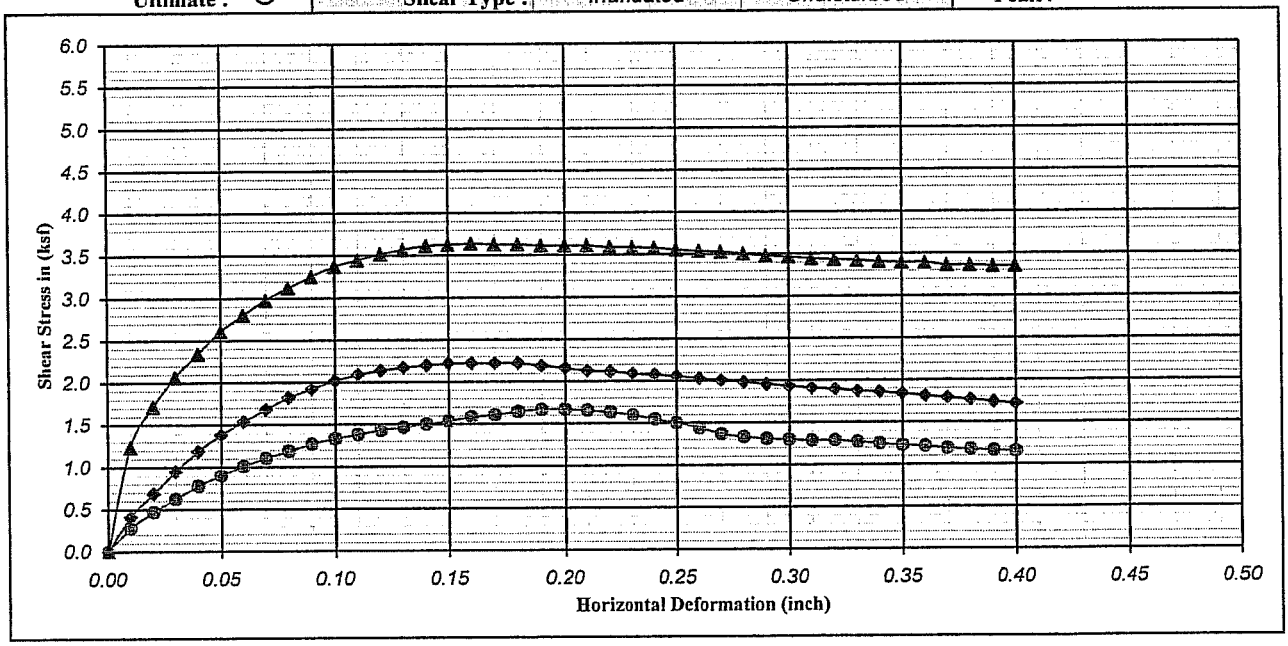
Project No. : 08-115

Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-015		Strength Intercept (C) :	0.96	(ksf)	Peak	0.34	(ksf)	Ultimate	
Sample No. : D-6			45.96	(kPa)		16.09	(kPa)		
Depth (ft/m) : 25.0	0.00	Friction Angle (ϕ) :	23.86	Degree		26.38	Degree		
Description : Very dark olive brown, Lean CLAY with SAND (CL)						Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	28.45	86.81	13.66	0.94	1.50	71.82	1.67	79.86	1.15	55.16
◆	28.71	89.17	14.04	0.89	3.00	143.64	2.22	106.29	1.72	82.16
▲	24.37	94.60	14.89	0.78	6.00	287.28	3.64	174.09	3.35	160.30

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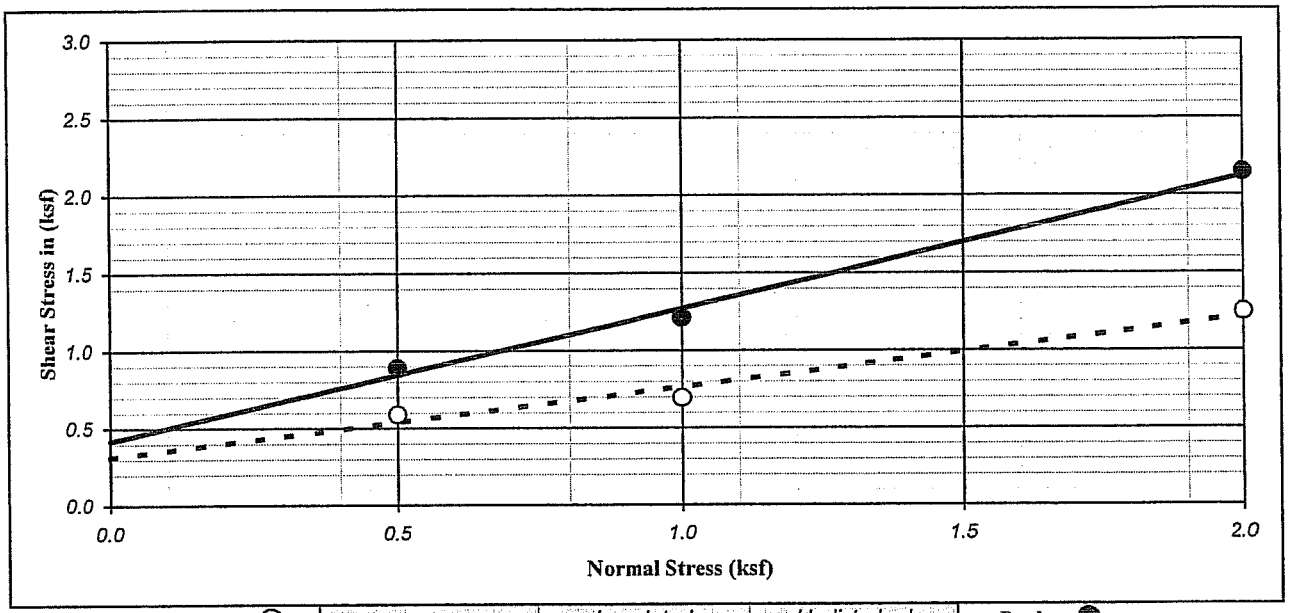
RBF/SR-57 Northbound

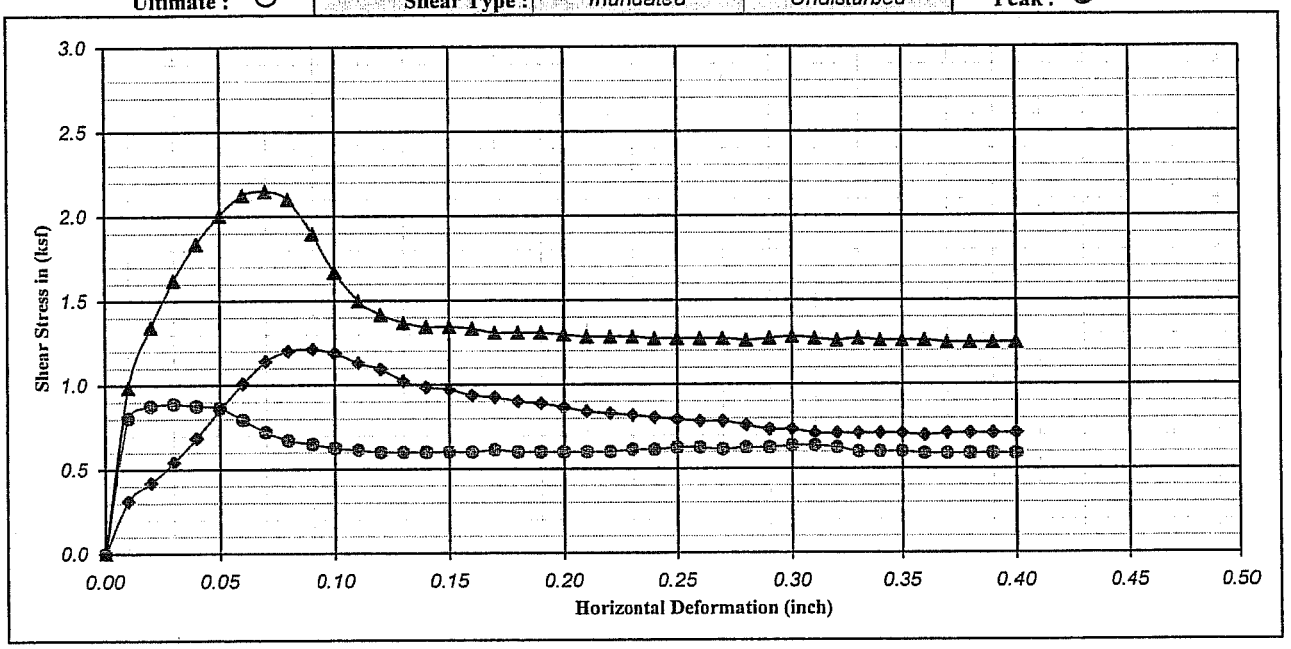
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : *Inundated* | *Undisturbed* | Peak : ●



Boring No.	: *A-08-016*	**Strength Intercept (C) :**	*0.42*	(ksf)	**Peak**	*0.31*	(ksf)	**Ultimate**
Sample No.	: *D-3*		*20.11*	(kPa)		*14.94*	(kPa)	
Depth (ft/m)	: *10.0* *0.00*	**Friction Angle (ϕ) :**	*40.49*	Degree		*24.51*	Degree	
Description	: *Mottled olive gray, olive brown and yellow, CLAYEY SAND (SC)*					**Shear Rate** (inch/minute) :		*0.02*

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	*24.50*	*99.71*	*15.69*	*0.69*	*0.50*	*23.94*	*0.89*	*42.52*	*0.59*	*28.15*
◆	*21.80*	*99.86*	*15.72*	*0.69*	*1.00*	*47.88*	*1.21*	*58.03*	*0.70*	*33.32*
▲	*21.72*	*99.56*	*15.67*	*0.69*	*2.00*	*95.76*	*2.15*	*102.85*	*1.25*	*59.75*

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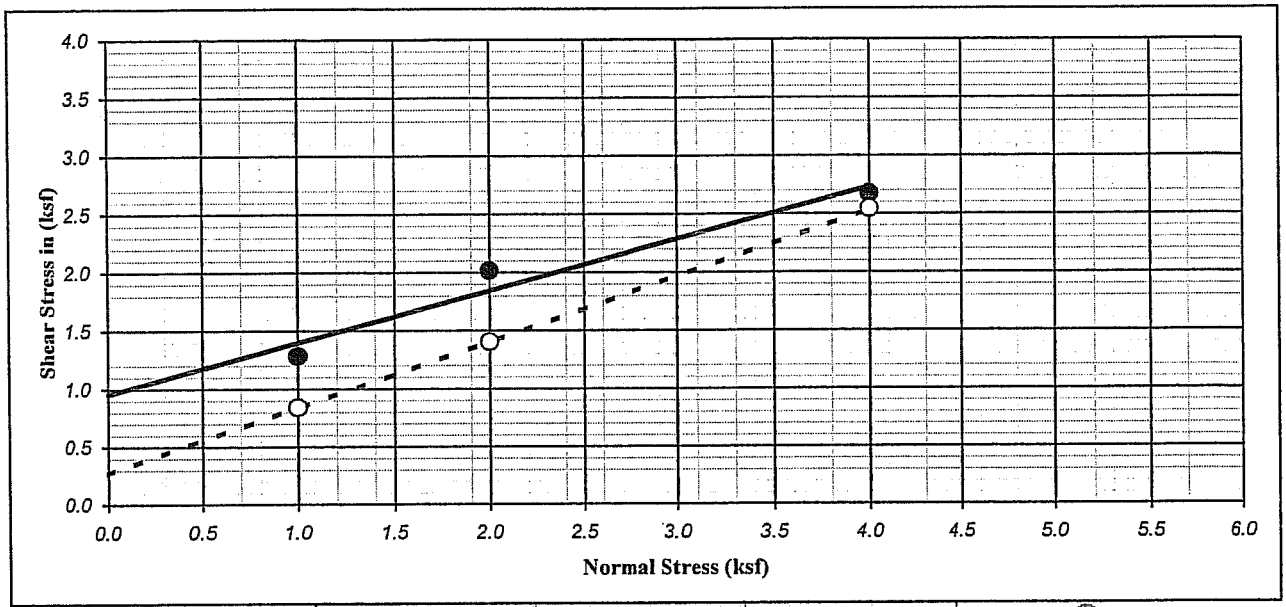
RBF/SR-57 Northbound

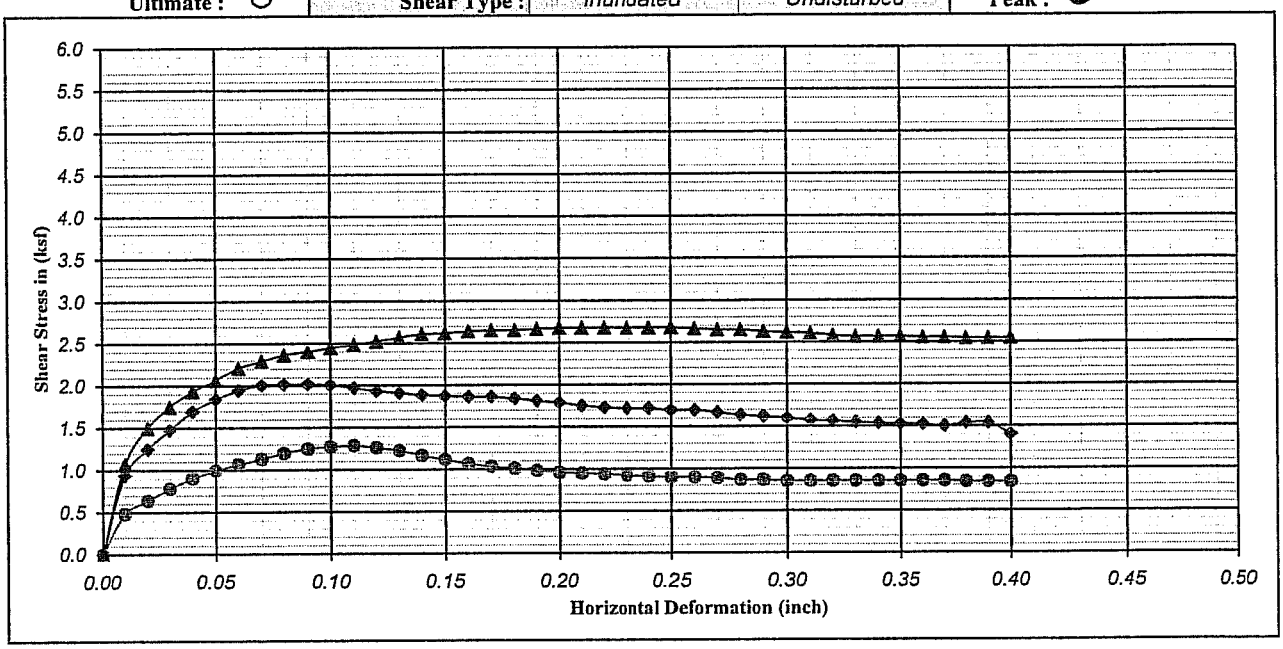
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : *08-115* | **Date :** *11/23/08*

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-016		Strength Intercept (C) :	0.95	(ksf)		0.27	(ksf)	
Sample No. : D-5			45.68	(kPa)	Peak	12.93	(kPa)	Ultimate
Depth (ft/m) : 20.0	0.00	Friction Angle (ϕ) :	23.98	Degree		29.61	Degree	
Description : Mottled olive gray, olive brown and yellow, CLAYEY SAND (SC)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	22.35	104.57	16.46	0.61	1.00	47.88	1.28	61.48	0.84	40.22
◆	23.20	102.74	16.17	0.64	2.00	95.76	2.02	96.53	1.40	67.22
▲	24.59	100.39	15.80	0.68	4.00	191.52	2.68	128.13	2.54	121.81

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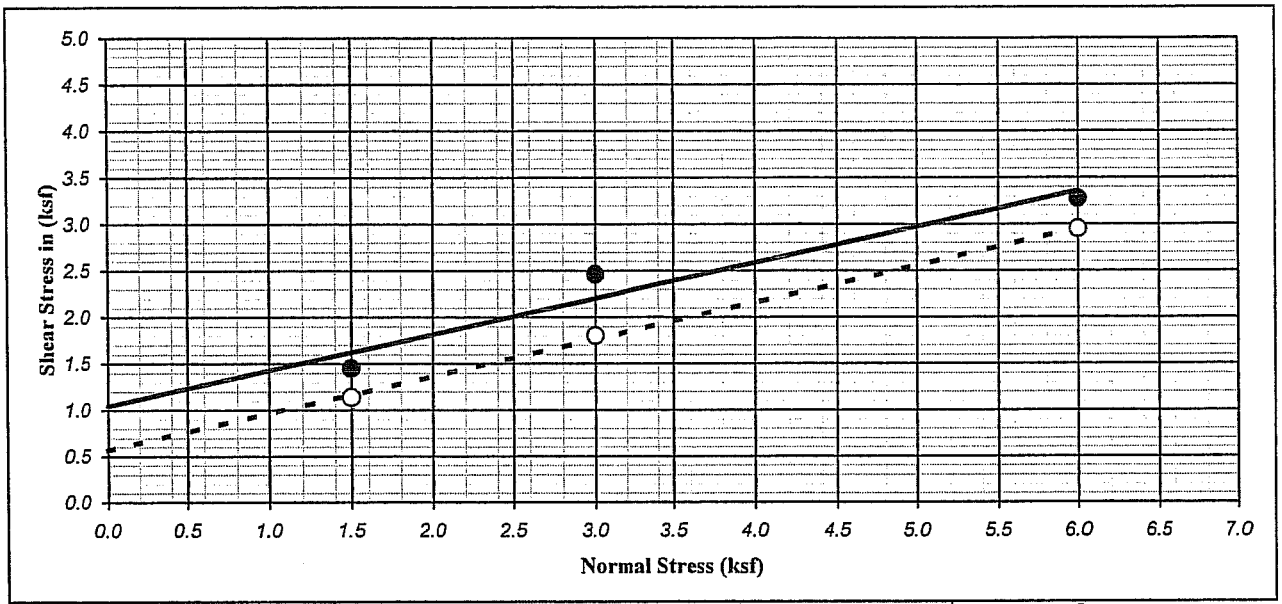
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

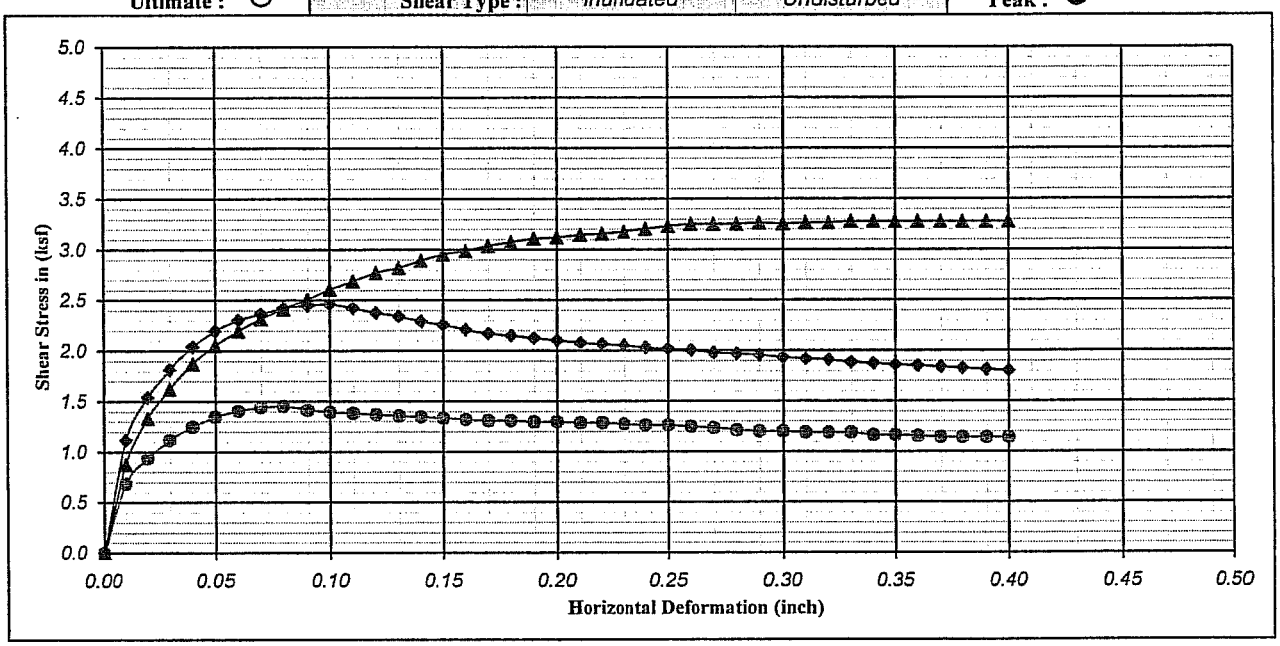
Project No. : 08-115

Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-018		Strength Intercept (C) :	1.04	(ksf)		0.56	(ksf)	
Sample No. : D-6			49.99	(kPa)	Peak	27.00	(kPa)	Ultimate
Depth (ft/m) : 25.0	0.00	Friction Angle (ϕ) :	21.12	Degree		21.80	Degree	
Description : Yellow brown, Lean CLAY with SAND (CL)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	22.82	102.68	16.16	0.64	1.50	71.82	1.45	69.52	1.14	54.58
◆	23.06	101.31	15.95	0.66	3.00	143.64	2.46	117.78	1.80	86.18
▲	21.75	101.79	16.02	0.66	6.00	287.28	3.28	156.85	2.95	141.34

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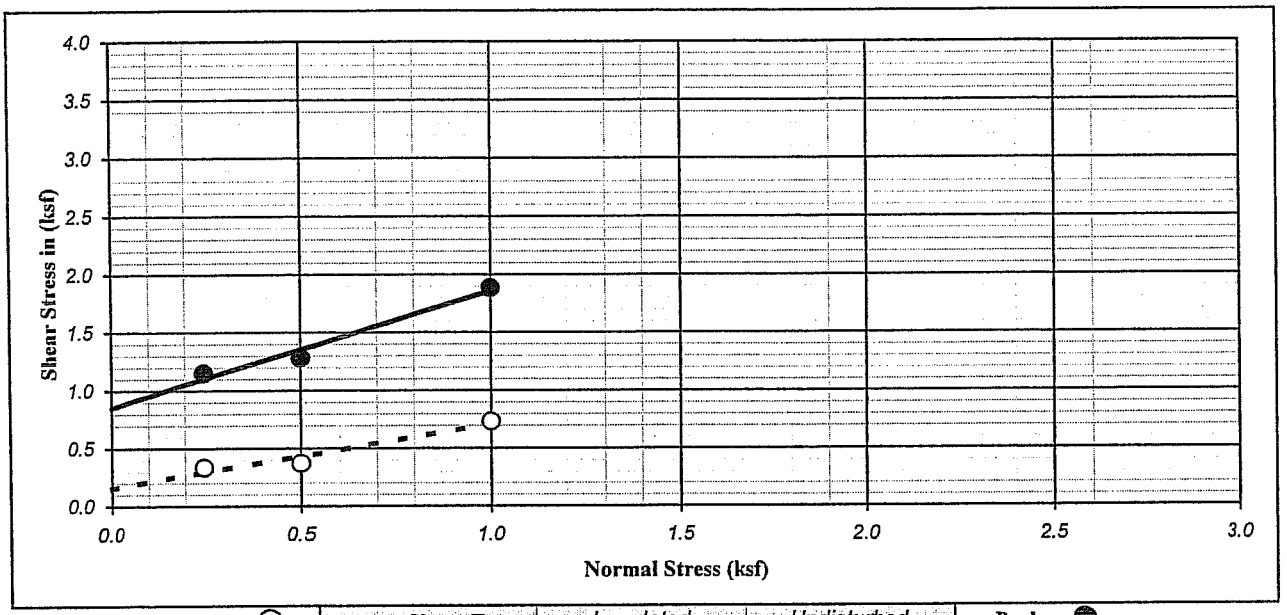
RBF/SR-57 Northbound

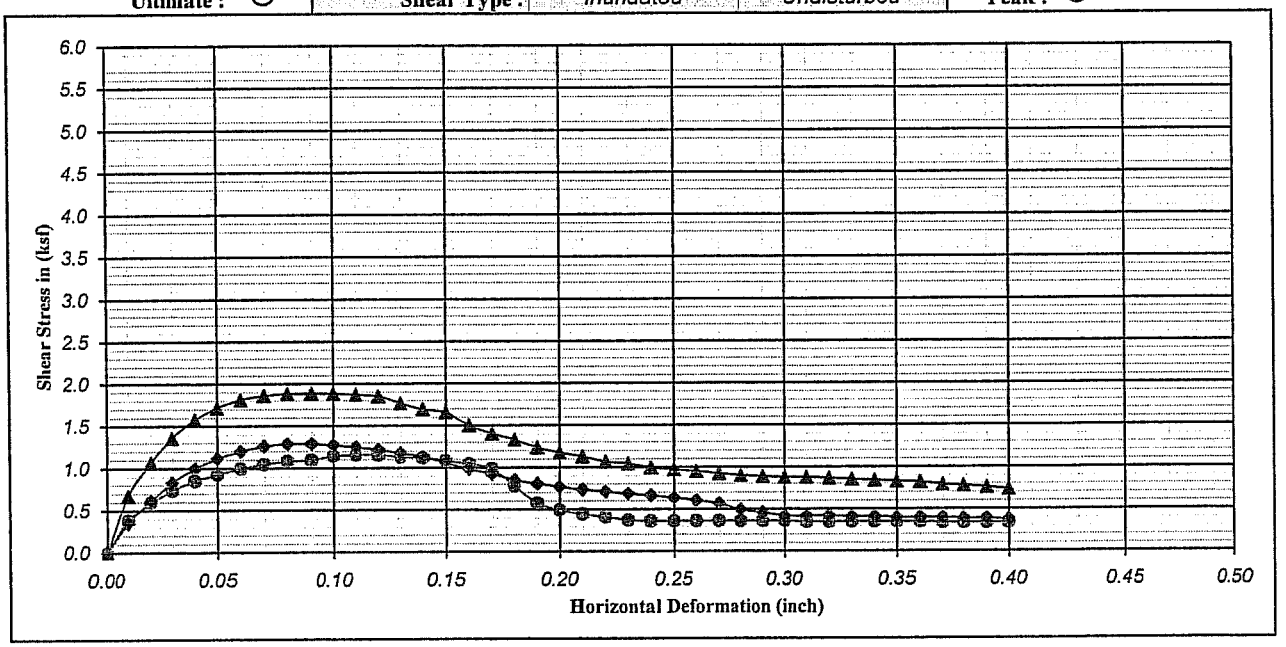
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-019		Strength Intercept (C) :	0.85	(ksf)	Peak	0.16	(ksf)	Ultimate
Sample No. : D-1			40.79	(kPa)		7.47	(kPa)	
Depth (ft/m) : 2.5	0.00	Friction Angle (ϕ) :	45.23	Degree		29.05	Degree	
Description : Olive, Lean CLAY (CL)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	28.15	96.35	15.17	0.75	0.25	11.97	1.15	55.16	0.34	16.09
◆	28.70	93.93	14.78	0.79	0.50	23.94	1.28	61.48	0.37	17.81
▲	27.26	97.26	15.31	0.73	1.00	47.88	1.88	90.21	0.73	35.05

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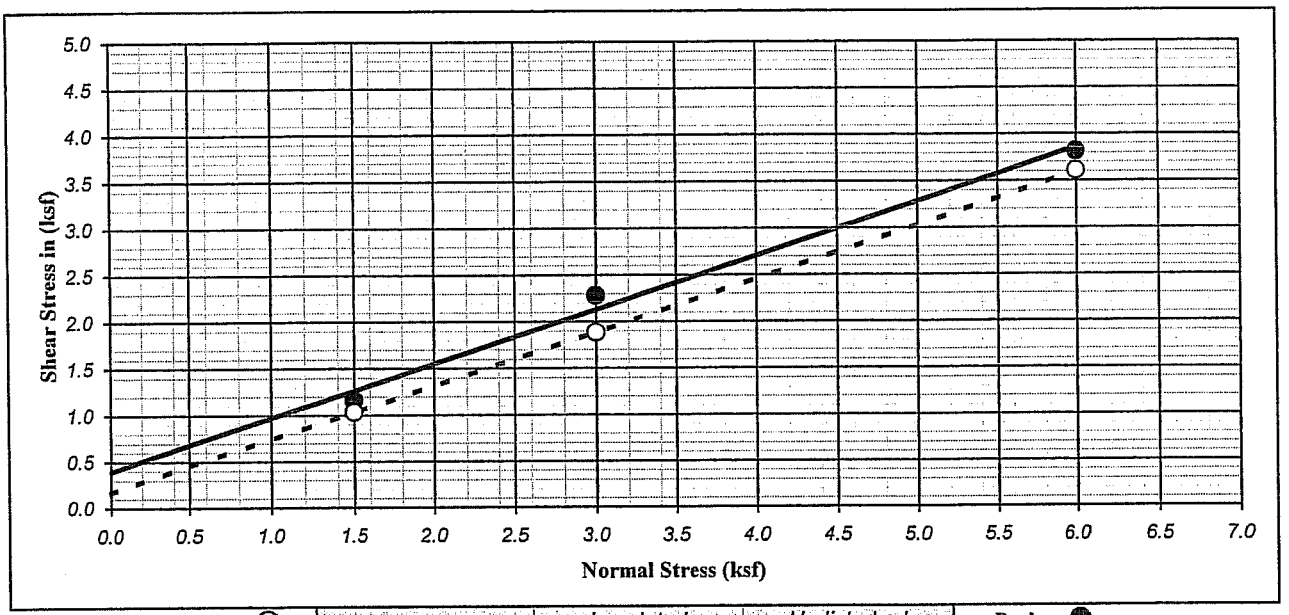
RBF/SR-57 Northbound

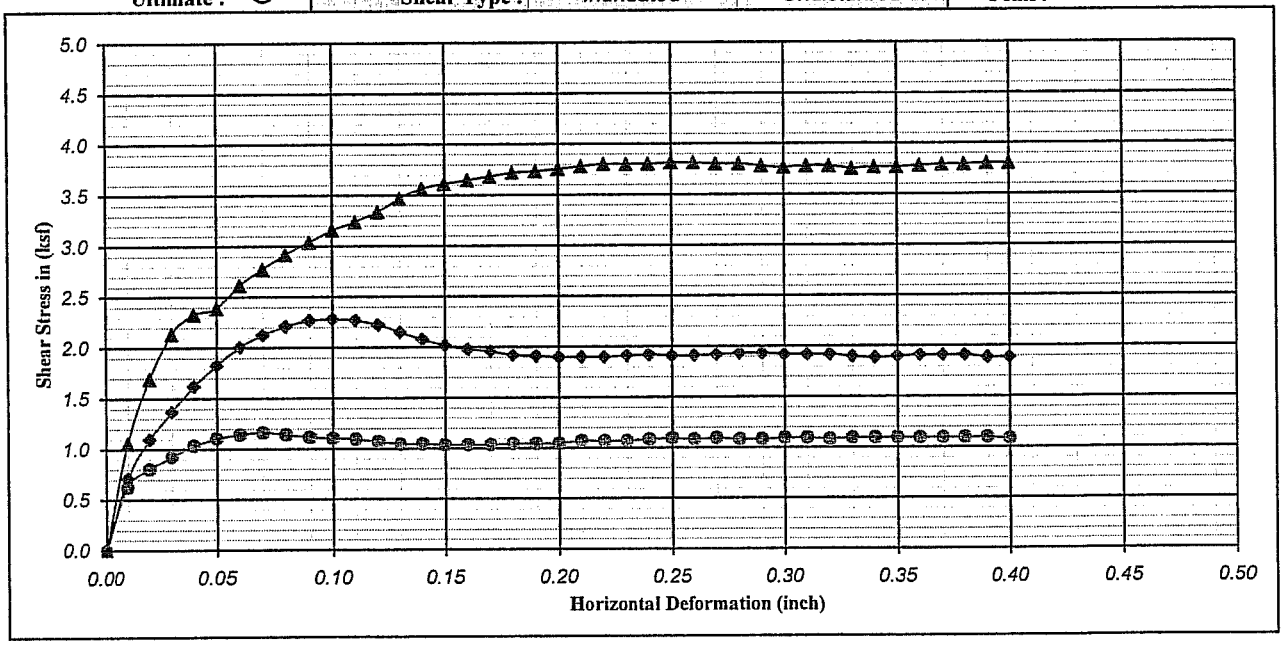
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-019		Strength Intercept (C) :	0.40	(ksf)		0.17	(ksf)		
Sample No. : D-7			18.96	(kPa)	Peak	8.04	(kPa)	Ultimate	
Depth (ft/m) : 30.0	0.00	Friction Angle (ϕ) :	30.04	Degree		29.84	Degree		
Description : Yellow brown, SILTY SAND (SM)						Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	15.82	104.09	16.38	0.62	1.50	71.82	1.16	55.73	1.03	49.41
◆	16.53	100.50	15.82	0.68	3.00	143.64	2.28	109.17	1.88	90.21
▲	16.19	96.58	15.20	0.75	6.00	287.28	3.82	182.71	3.61	172.94

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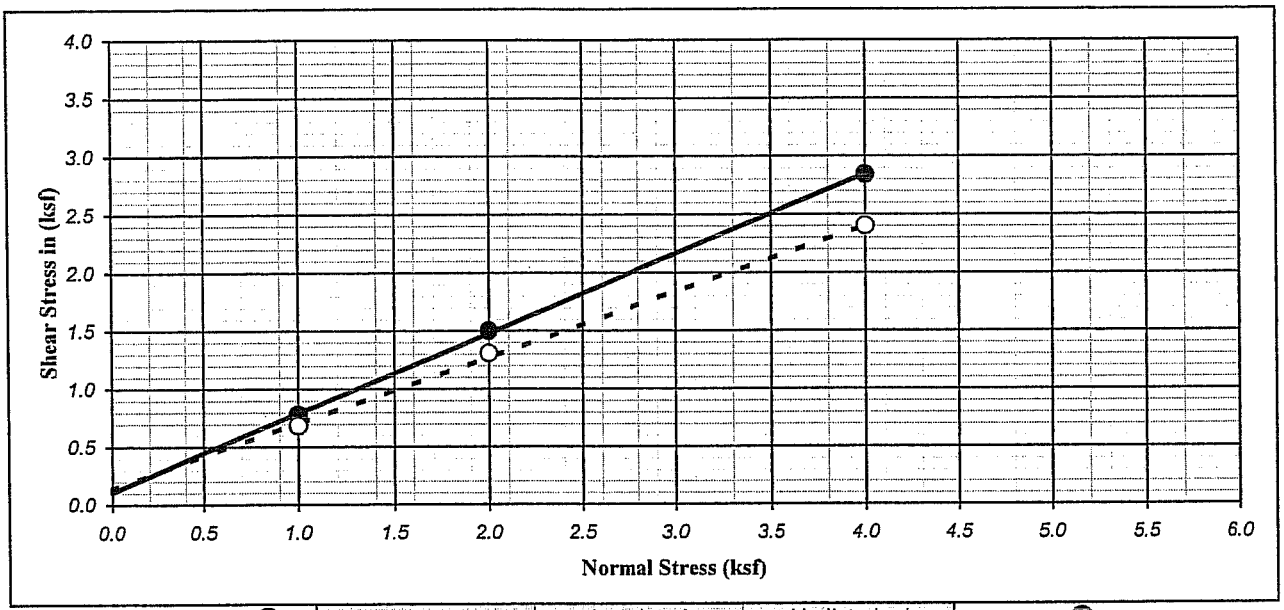
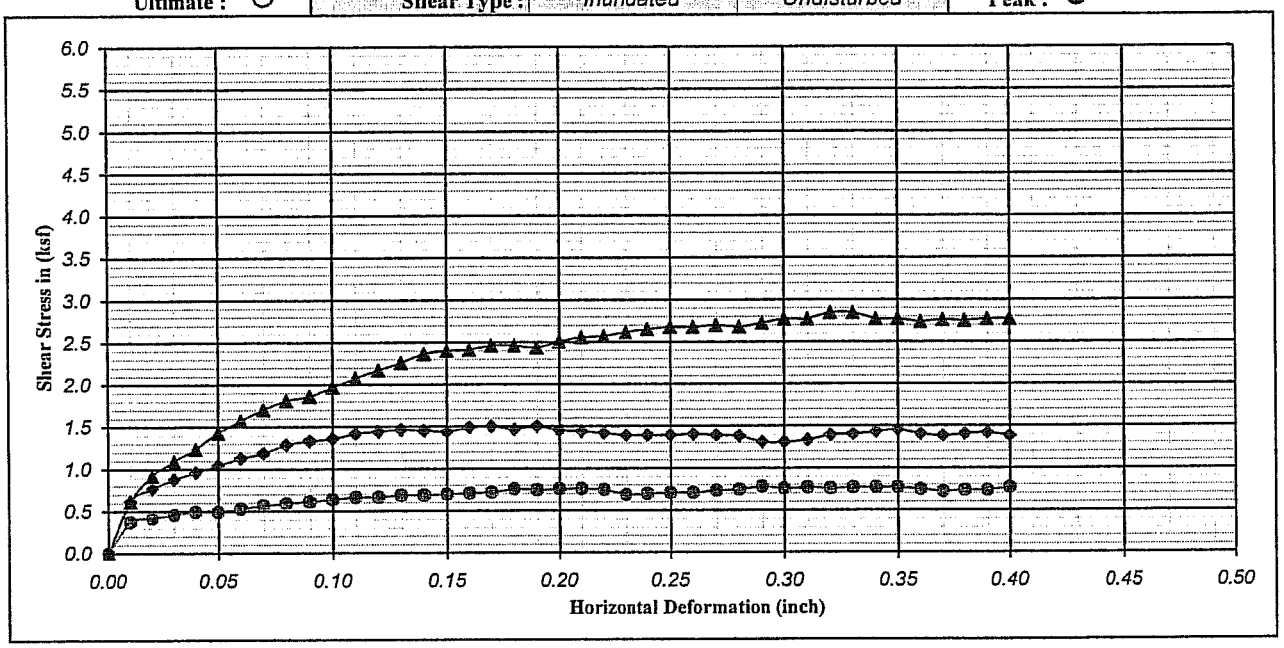
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08 | Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-101		Strength Intercept (C) :	0.11	(ksf)	Peak	0.14	(ksf)	Ultimate
Sample No. : D-4			5.17	(kPa)		6.61	(kPa)	
Depth (ft/m) : 15.0	0.00	Friction Angle (ϕ) :	34.44	Degree		29.61	Degree	
Description : Dark Yellowish Brown, Poorly-graded SAND (SP)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	15.15	99.67	15.69	0.69	1.00	47.88	0.78	37.35	0.68	32.75
◆	14.47	107.35	16.90	0.57	2.00	95.76	1.50	71.82	1.31	62.63
▲	14.30	106.15	16.71	0.59	4.00	191.52	2.84	136.17	2.40	114.91

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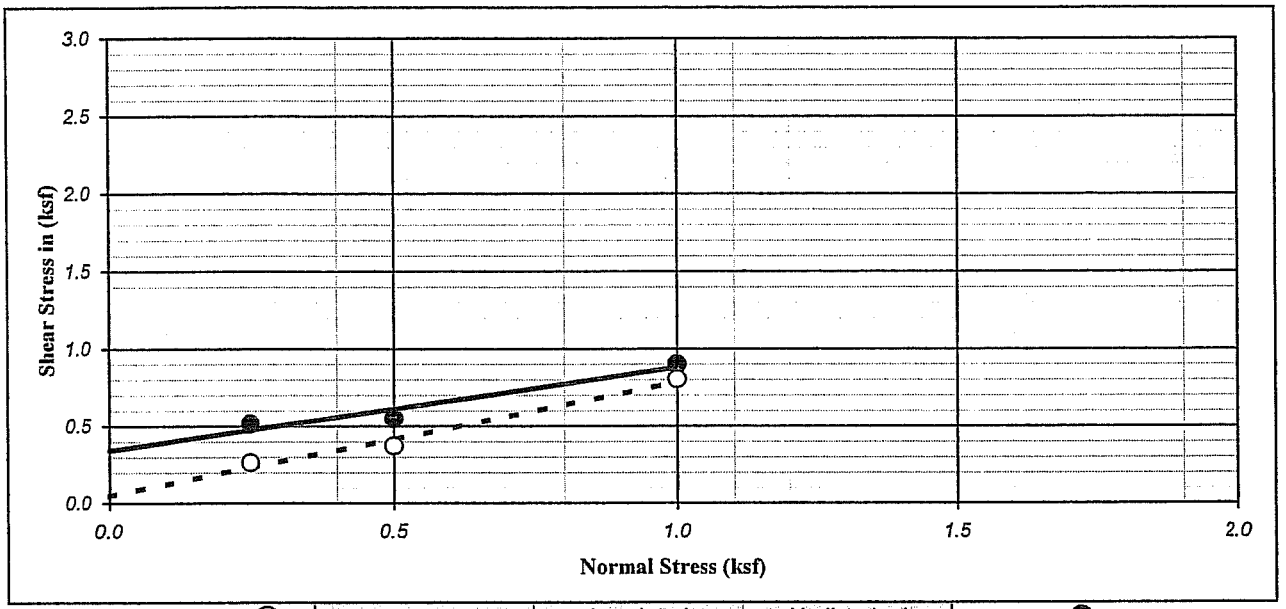
RBF/SR-57 Northbound

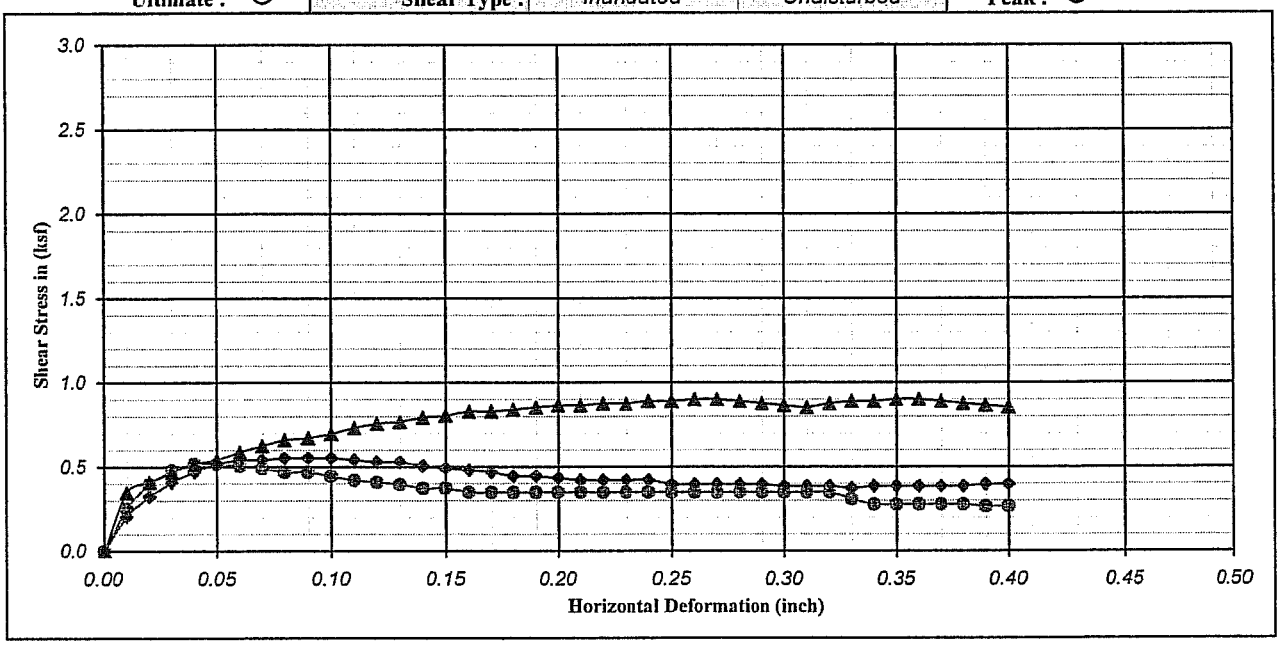
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-102		Strength Intercept (C) :	0.34	(ksf)		0.05	(ksf)		
Sample No. : D-1			16.37	(kPa)	Peak	2.30	(kPa)	Ultimate	
Depth (ft/m) : 2.5	0.00	Friction Angle (ϕ) :	28.29	Degree		36.52	Degree		
Description : Dark yellow brown, SILTY SAND (SM)						Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	15.59	100.65	15.84	0.67	0.25	11.97	0.52	24.71	0.26	12.64
◆	16.37	98.80	15.55	0.71	0.50	23.94	0.55	26.43	0.37	17.81
▲	15.59	98.66	15.53	0.71	1.00	47.88	0.90	43.09	0.80	38.50

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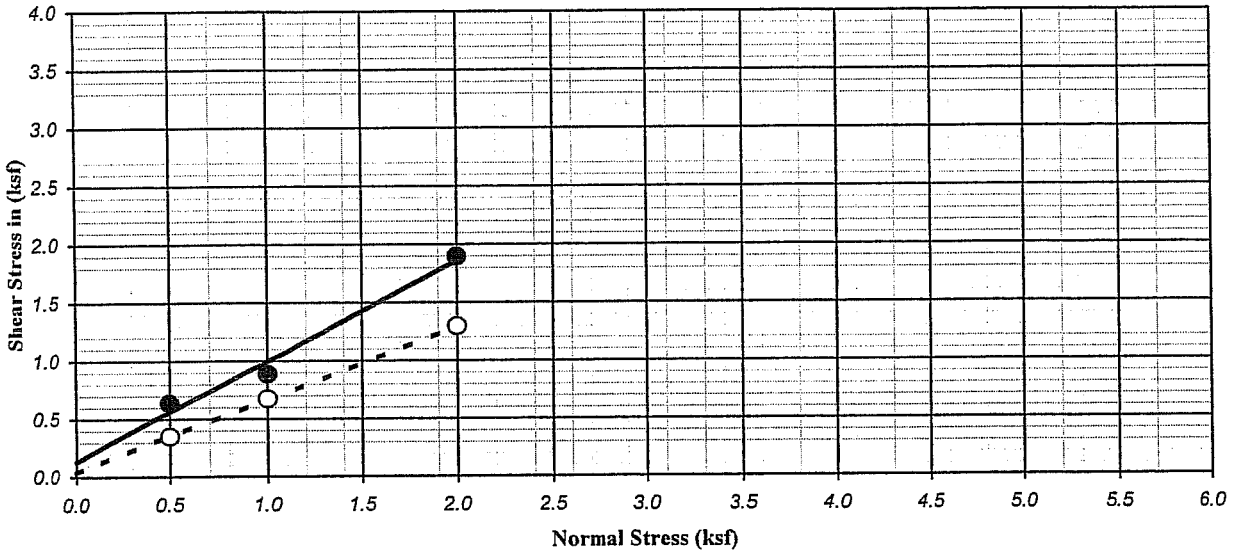
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

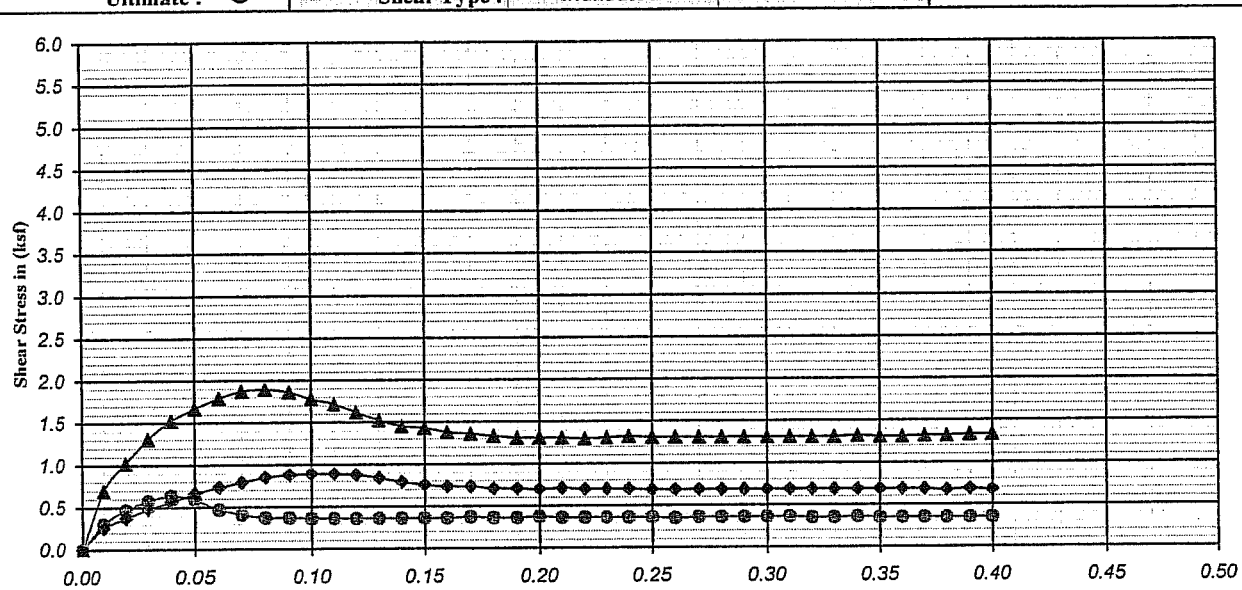
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No.	: A-08-105	Strength Intercept (C) :	0.13	(ksf)	Peak	0.04	(ksf)	Ultimate
Sample No.	: D-4		6.32	(kPa)		1.72	(kPa)	
Depth (ft/m)	: 15.0 | 0.00	Friction Angle (ϕ) :	40.83	Degree		32.25	Degree	
Description	: Light olive brown, Poorly graded SAND with SILT (SP-SM)					Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.62	94.55	14.88	0.78	0.50	23.94	0.64	30.45	0.35	16.66
◆	21.99	88.51	13.93	0.90	1.00	47.88	0.89	42.52	0.67	32.18
▲	23.09	83.98	13.22	1.01	2.00	95.76	1.90	90.78	1.30	62.05

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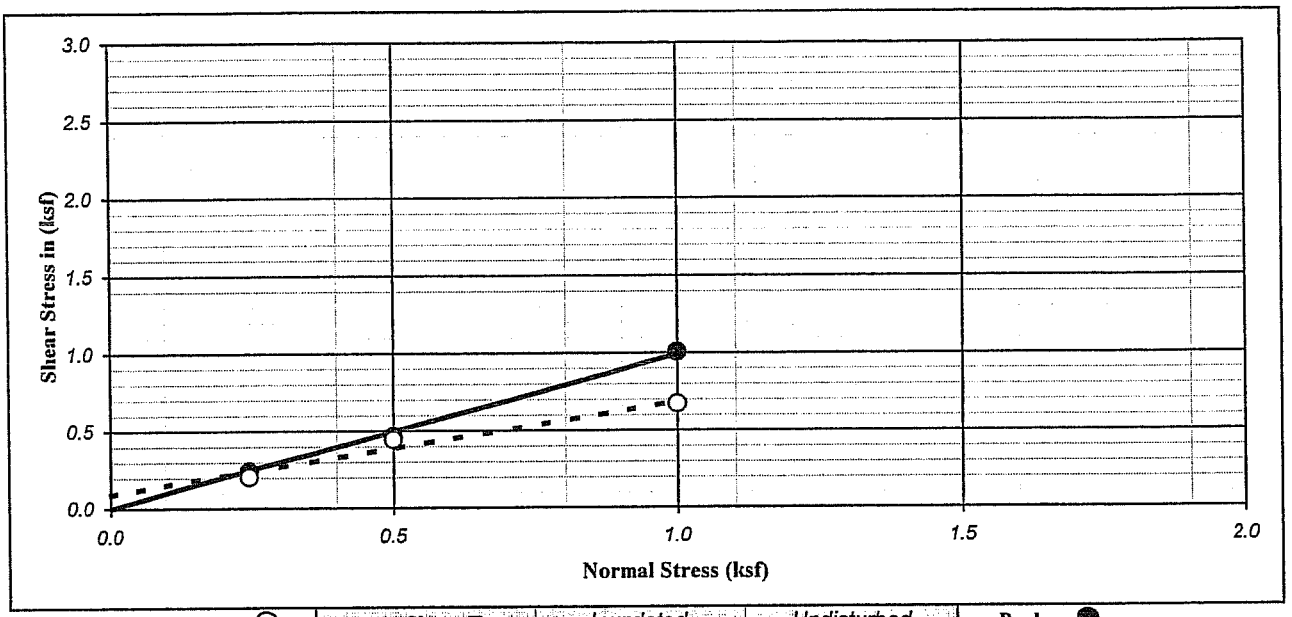
RBF/SR-57 Northbound

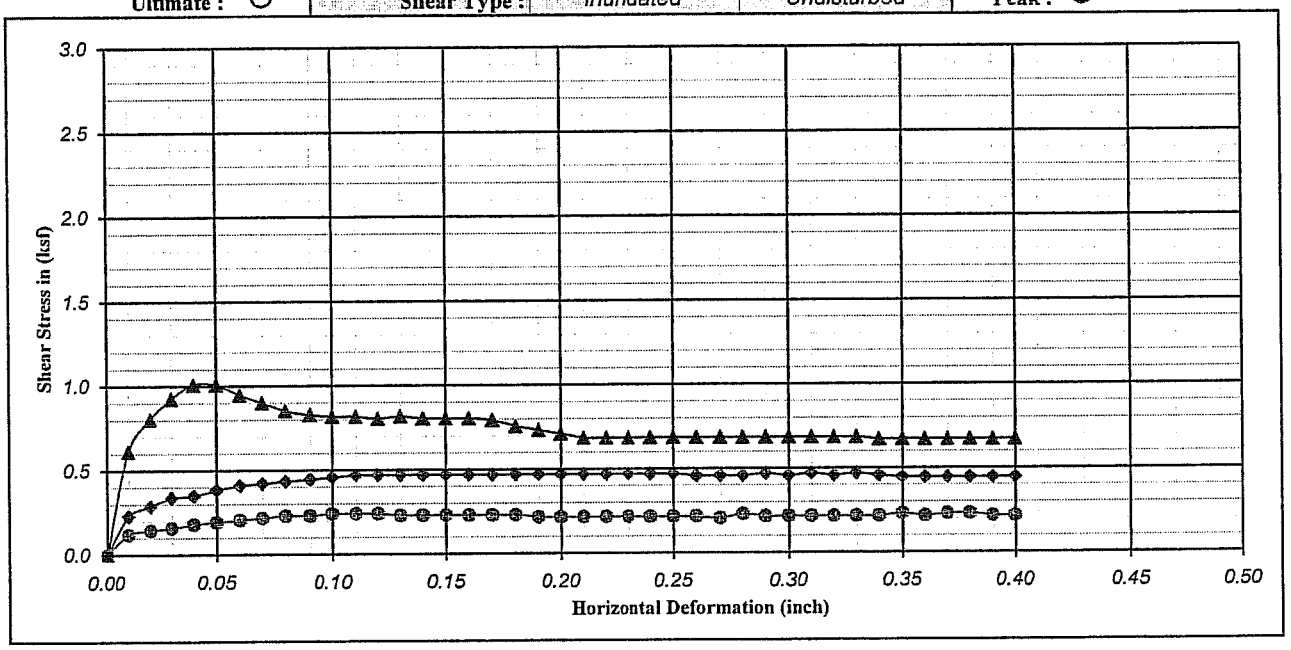
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No.	: A-08-109		Strength Intercept (C) :	0.00	(ksf)	Peak	0.09	(ksf)	Ultimate
Sample No.	: D-2			0.00	(kPa)		4.31	(kPa)	
Depth (ft/m)	: 5.0	0.00	Friction Angle (ϕ) :	44.77	Degree		30.96	Degree	
Description	: Olive brown, SILTY SAND (SM)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	15.42	109.37	17.21	0.54	0.25	11.97	0.24	11.49	0.20	9.77
◆	15.01	105.94	16.68	0.59	0.50	23.94	0.47	22.41	0.44	21.26
▲	15.40	111.01	17.47	0.52	1.00	47.88	1.01	48.26	0.67	32.18

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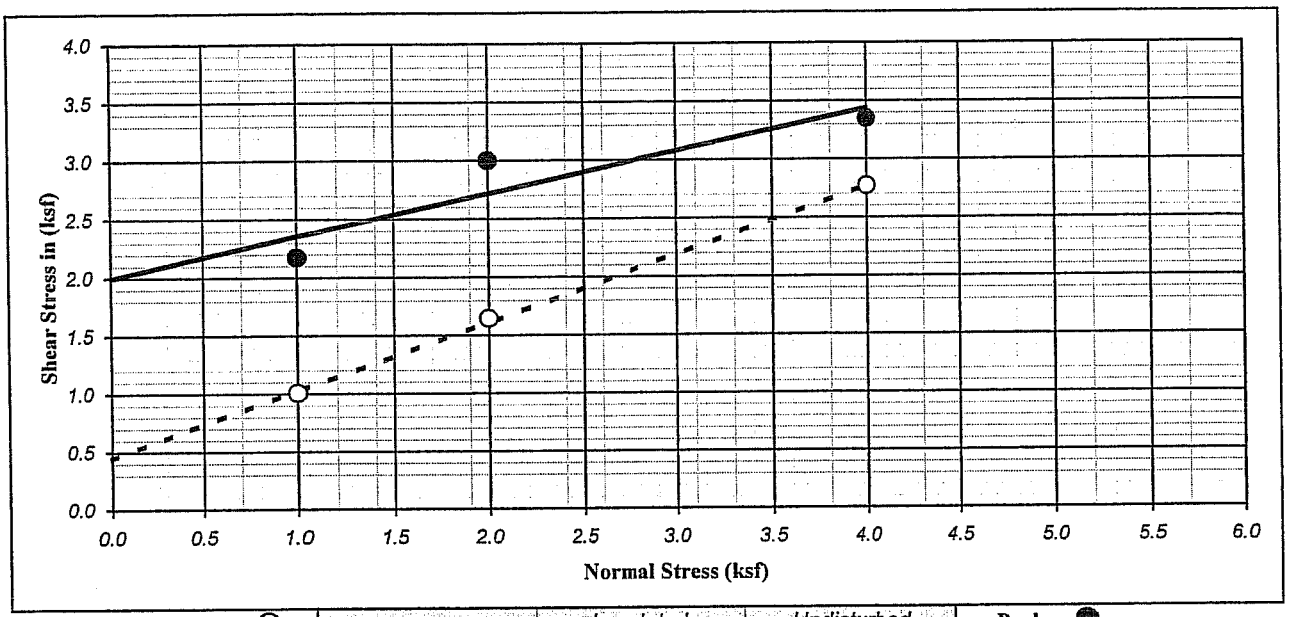
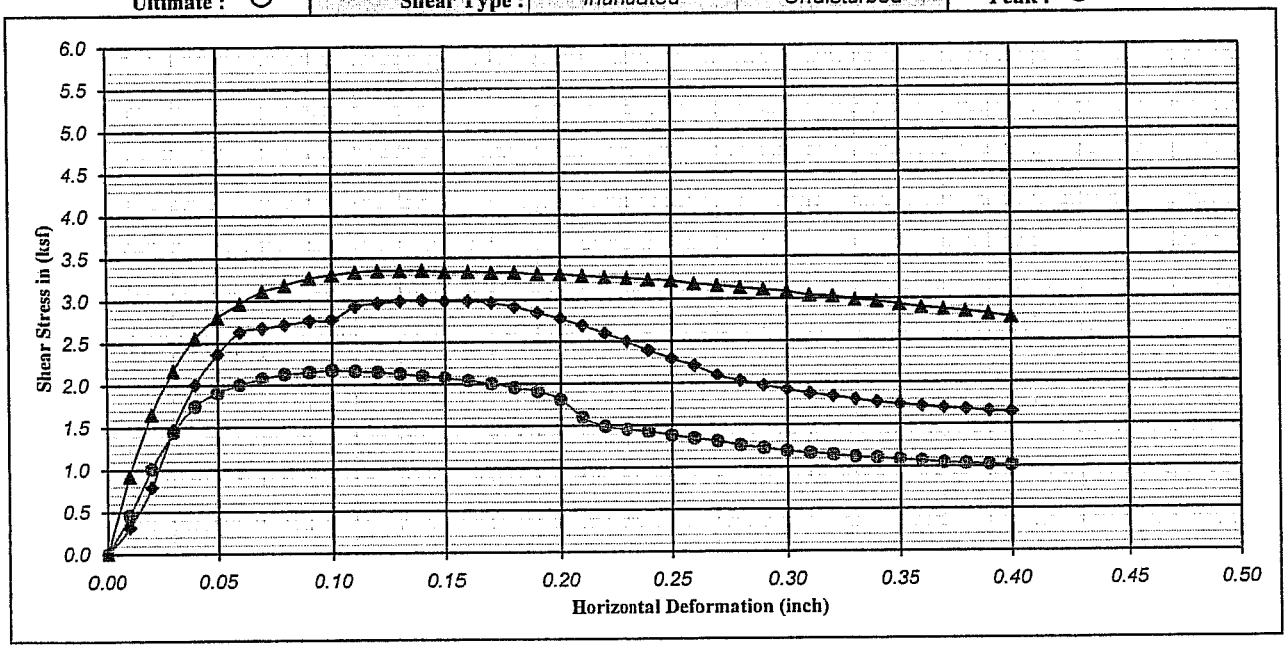
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08 | Figure No. :



Ultimate : ○ | Shear Type : *Inundated* | *Undisturbed* | Peak : ●



Boring No. : *A-08-119*	Strength Intercept (C) :	*2.00*	(ksf)	Peak	*0.44*	(ksf)	Ultimate
Sample No. : *D-4*		*95.66*	(kPa)		*21.26*	(kPa)	
Depth (ft/m) : *15.0* *0.00*	Friction Angle (ϕ) :	*19.84*	Degree		*30.31*	Degree	
Description : *Dark yellowish brown, Lean CLAY with SAND (CL)*					Shear Rate (inch/minute) :		*0.02*

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	*21.70*	*106.12*	*16.70*	*0.59*	*1.00*	*47.88*	*2.17*	*104.00*	*1.01*	*48.26*
◆	*20.98*	*107.63*	*16.94*	*0.57*	*2.00*	*95.76*	*3.00*	*143.64*	*1.64*	*78.71*
▲	*19.71*	*107.86*	*16.98*	*0.56*	*4.00*	*191.52*	*3.35*	*160.30*	*2.77*	*132.72*

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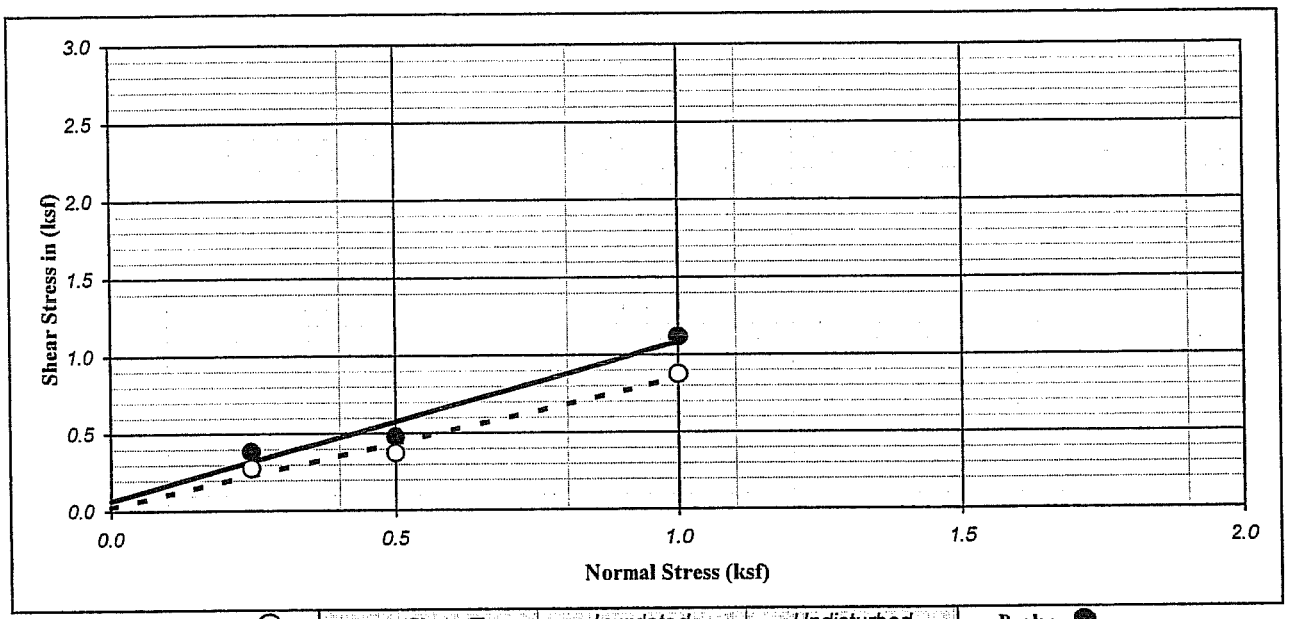
RBF/SR-57 Northbound

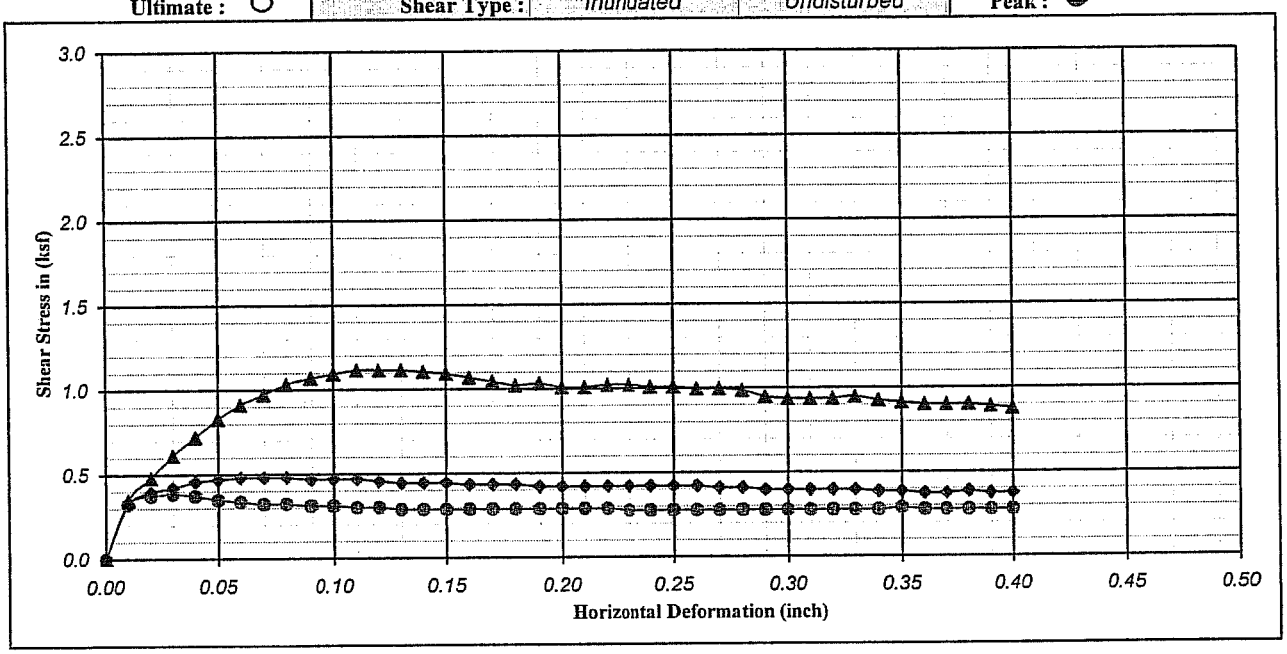
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : *08-115* | **Date :** *11/24/08*

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-122		Strength Intercept (C) :	0.07	(ksf)	Peak	0.02	(ksf)	Ultimate
Sample No. : D-1			3.16	(kPa)		1.15	(kPa)	
Depth (ft/m) : 2.5	0.00	Friction Angle (ϕ) :	45.52	Degree		39.68	Degree	
Description : Yellowish brown, SILTY SAND (SM)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.41	102.95	16.20	0.64	0.25	11.97	0.38	18.39	0.28	13.21
◆	20.99	98.22	15.46	0.72	0.50	23.94	0.48	22.98	0.37	17.81
▲	19.67	103.90	16.35	0.62	1.00	47.88	1.12	53.43	0.88	41.94

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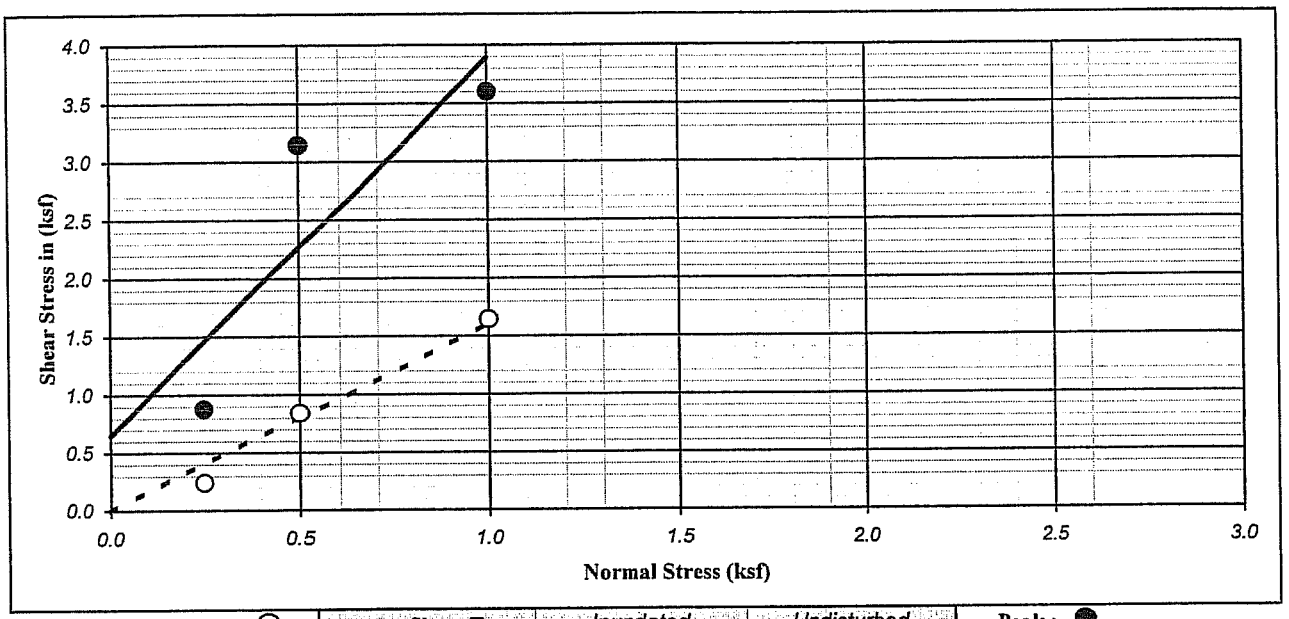
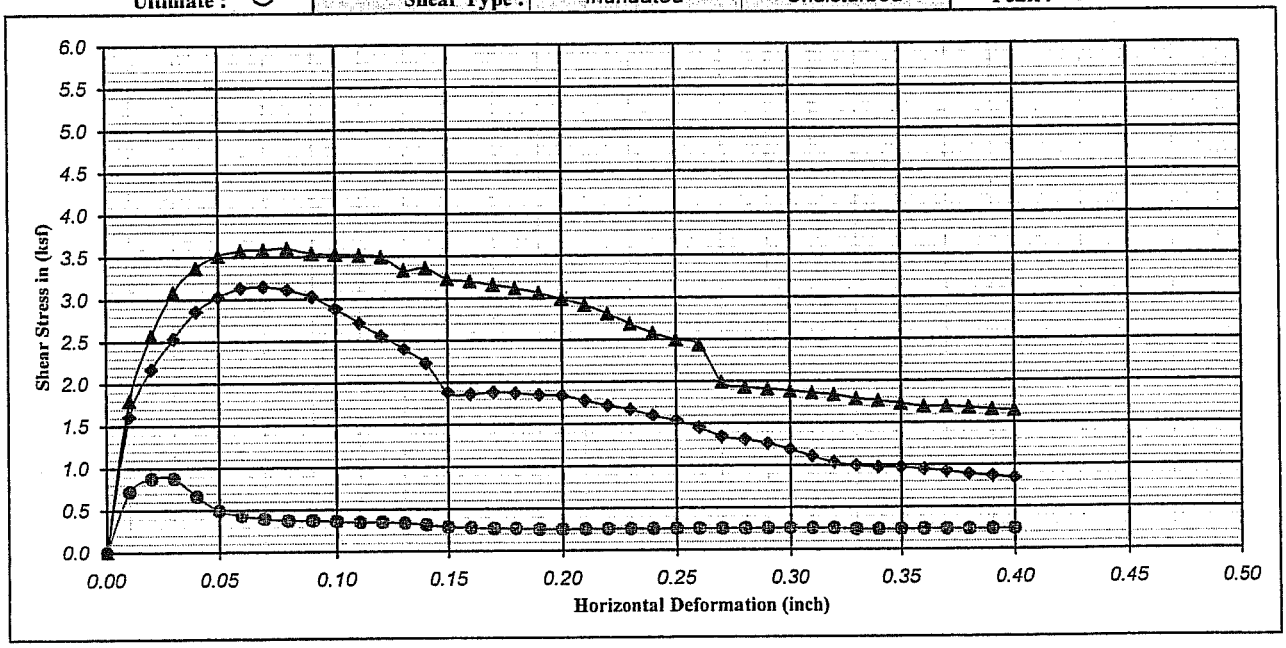
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08 | Figure No. :



Ultimate : ○ | Shear Type : *Inundated* | *Undisturbed* | Peak : ●



Boring No. : *A-08-123*	**Strength Intercept (C) :**	*0.65*	(ksf)	**Peak**	*0.00*	(ksf)	**Ultimate**
Sample No. : *D-2*		*31.03*	(kPa)		*0.00*	(kPa)	
Depth (ft/m) : *5.0* *0.00*	**Friction Angle (ϕ) :**	*72.86*	Degree		*58.29*	Degree	
Description : *Brown to dark brown, CLAYEY SAND (SC)*					**Shear Rate** (inch/minute) :		*0.02*

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	*15.15*	*116.23*	*18.30*	*0.45*	*0.25*	*11.97*	*0.88*	*41.94*	*0.24*	*11.49*
◆	*16.17*	*123.05*	*19.37*	*0.37*	*0.50*	*23.94*	*3.14*	*150.53*	*0.84*	*40.22*
▲	*16.31*	*120.36*	*18.94*	*0.40*	*1.00*	*47.88*	*3.60*	*172.37*	*1.64*	*78.71*

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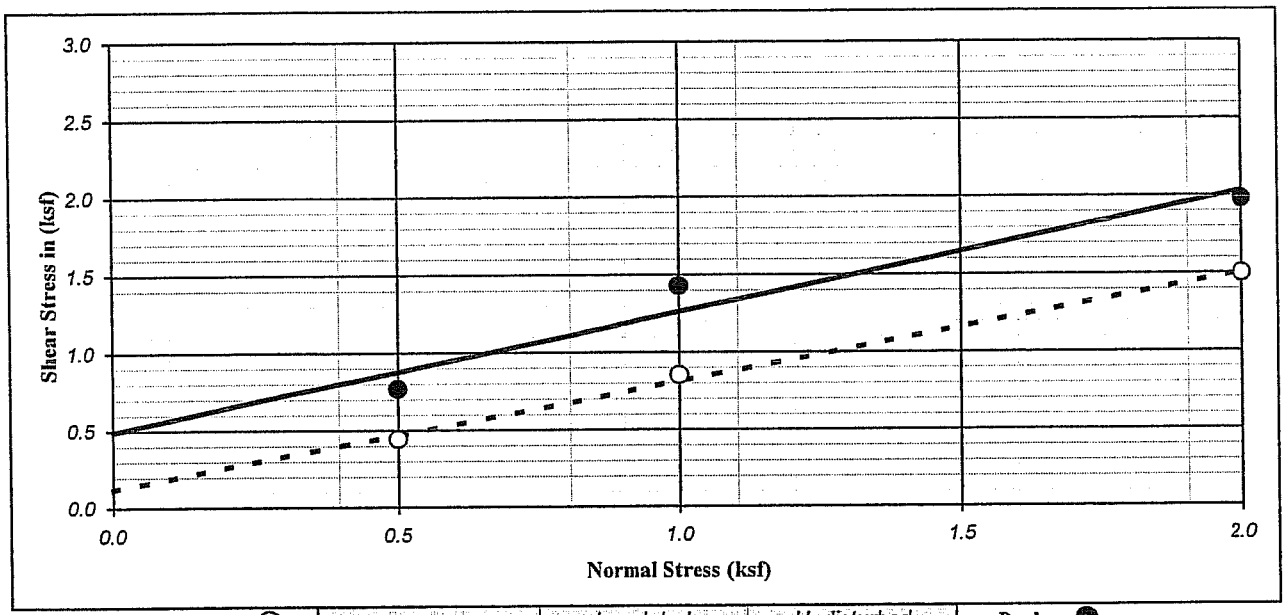
RBF/SR-57 Northbound

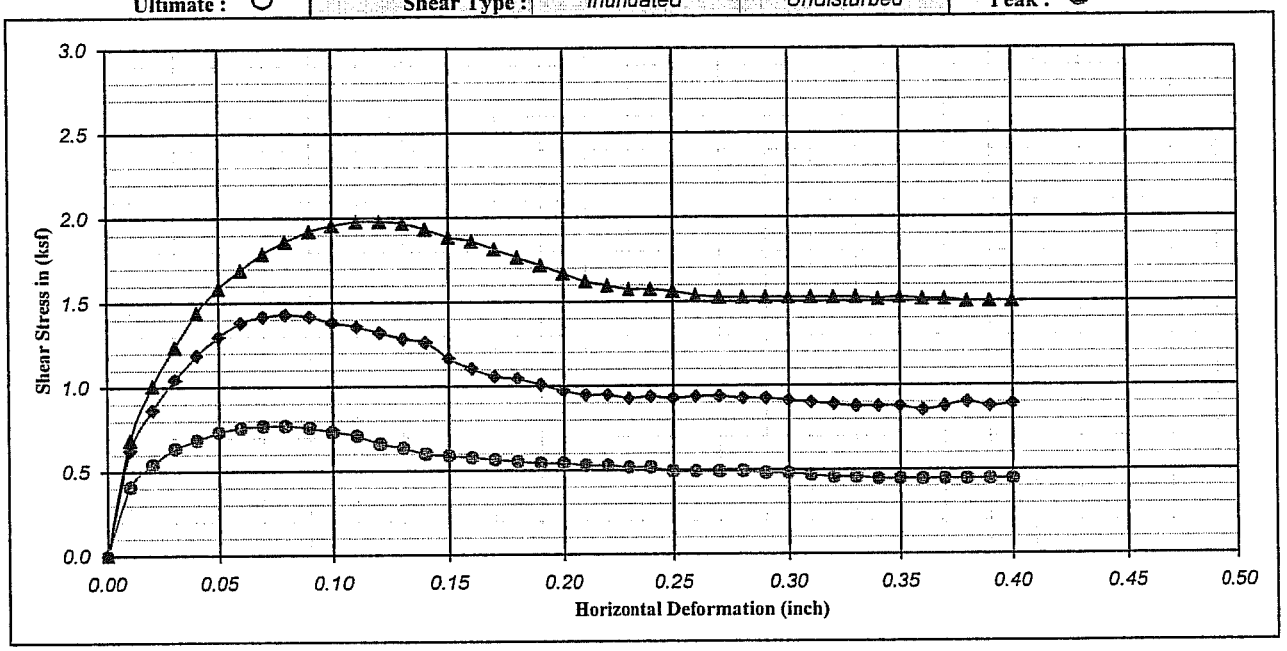
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : *08-115* | **Date :** *11/24/08*

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-124		Strength Intercept (C) :	0.49	(ksf)	Peak	0.12	(ksf)	Ultimate
Sample No. : D-3			23.56	(kPa)		5.75	(kPa)	
Depth (ft/m) : 10.0	0.00	Friction Angle (ϕ) :	37.65	Degree		34.84	Degree	
Description : Brown, CLAYEY SAND (SC)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	26.23	101.94	16.05	0.65	0.50	23.94	0.77	36.77	0.44	21.26
◆	18.98	116.04	18.26	0.45	1.00	47.88	1.43	68.37	0.85	40.79
▲	22.20	108.03	17.00	0.56	2.00	95.76	1.98	94.80	1.50	71.82

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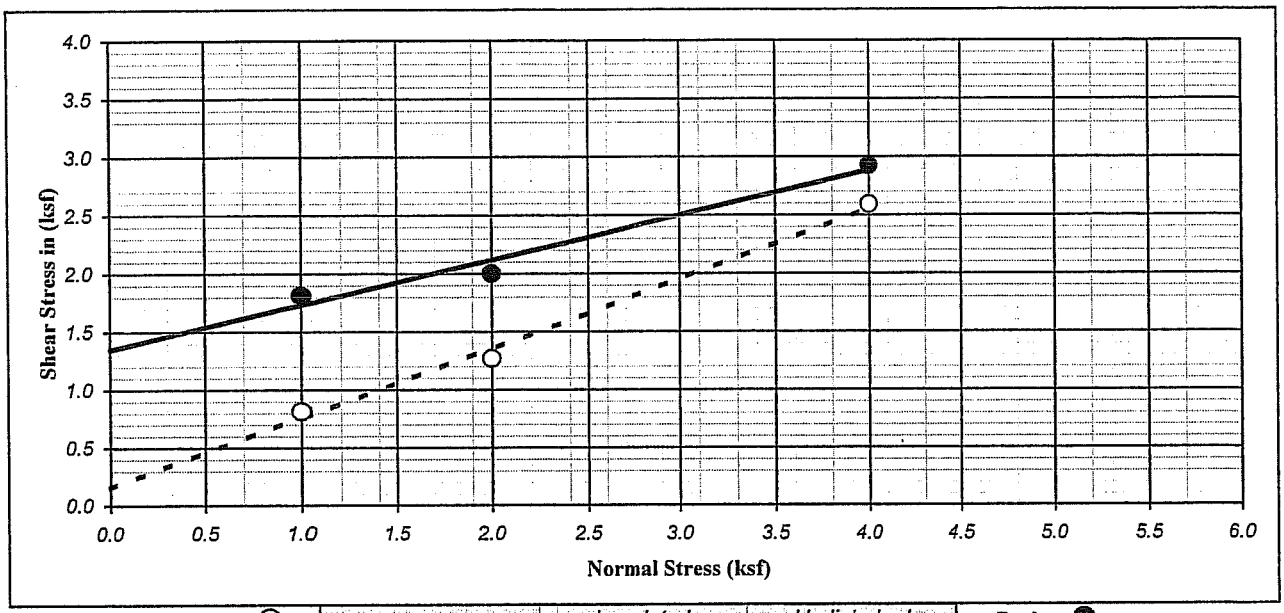
RBF/SR-57 Northbound

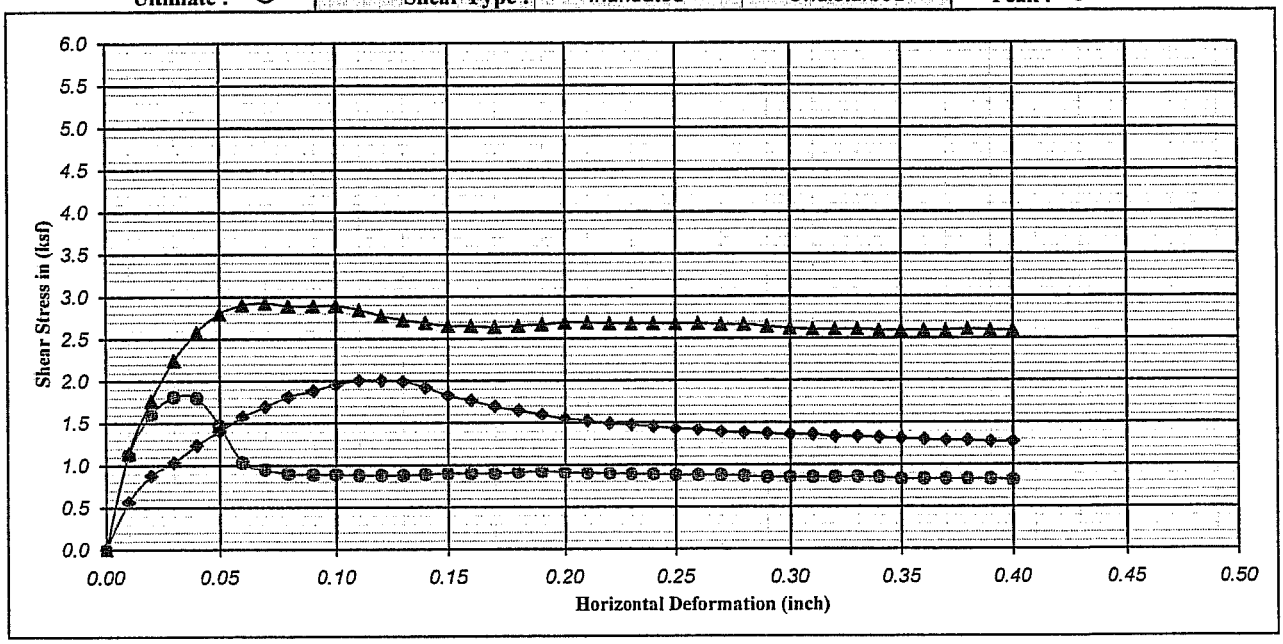
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-124		Strength Intercept (C) :	1.35	(ksf)	Peak	0.16	(ksf)	Ultimate
Sample No. : D-5			64.64	(kPa)		7.47	(kPa)	
Depth (ft/m) : 20.0	0.00	Friction Angle (ϕ) :	21.05	Degree		31.04	Degree	
Description : Brown, SANDY SILT (ML)					Shear Rate (inch/minute) :			0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	22.44	104.10	16.38	0.62	1.00	47.88	1.81	86.76	0.82	39.07
◆	28.81	94.27	14.84	0.79	2.00	95.76	2.00	95.95	1.27	60.90
▲	21.01	101.14	15.92	0.67	4.00	191.52	2.93	140.19	2.59	124.10

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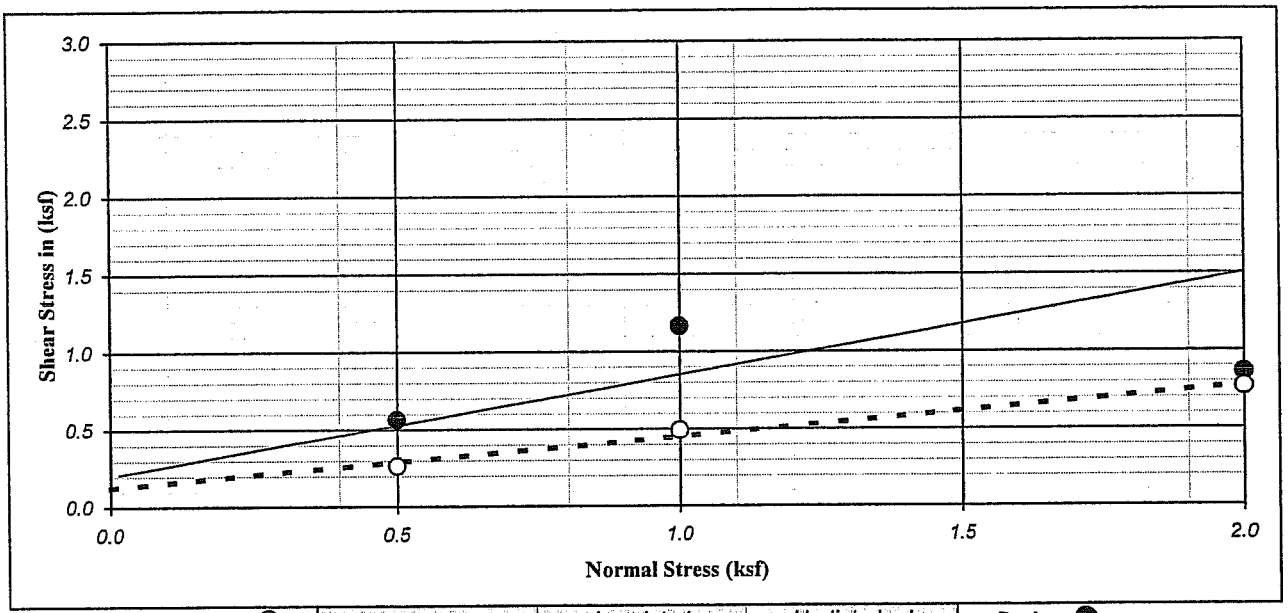
RBF/SR-57 Northbound

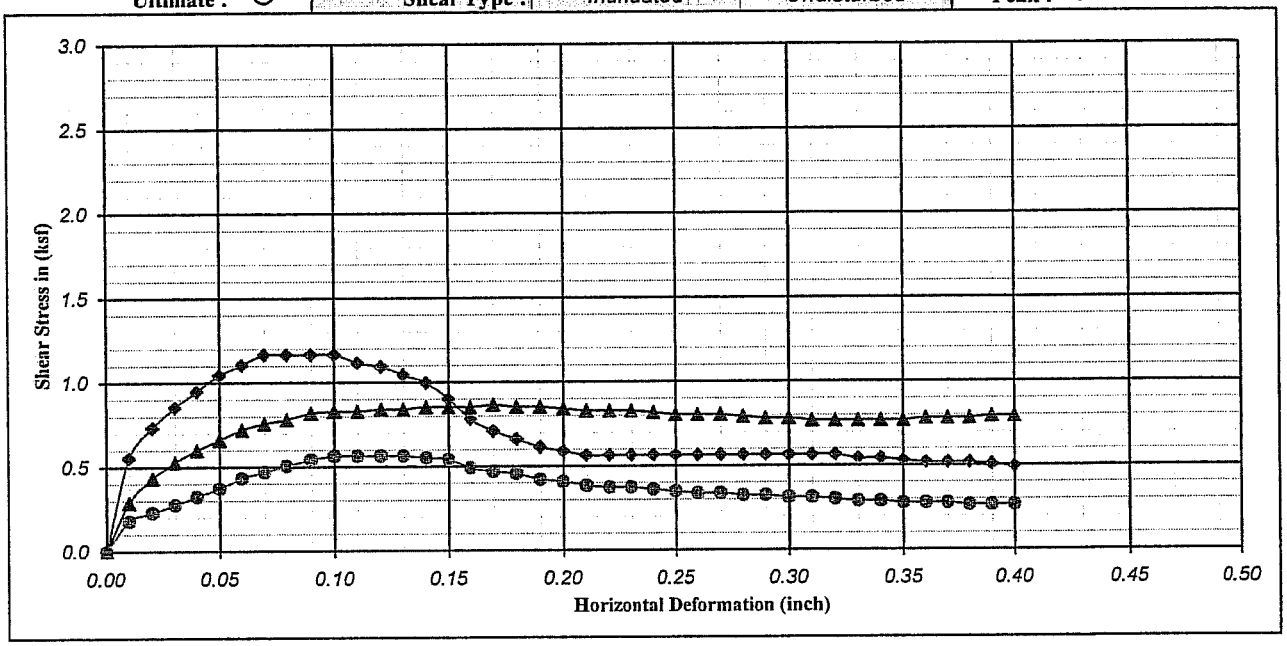
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-126	Strength Intercept (C) :	0.20	(ksf)	Peak	0.13	(ksf)	Ultimate
Sample No. : D-1		9.58	(kPa)		6.03	(kPa)	
Depth (ft/m) : 2.5 / 0.00	Friction Angle (ϕ) :	30.96	Degree		18.13	Degree	

Description : Mottled brown, olive brown, yellowish brown, Lean CLAY with SAND (CL) Shear Rate (inch/minute) : 0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	26.91	98.44	15.49	0.71	0.50	23.94	0.56	27.00	0.26	12.64
◆	25.84	101.95	16.05	0.65	1.00	47.88	1.16	55.73	0.49	23.56
▲	25.23	100.71	15.85	0.67	2.00	95.76	0.86	41.37	0.77	36.77

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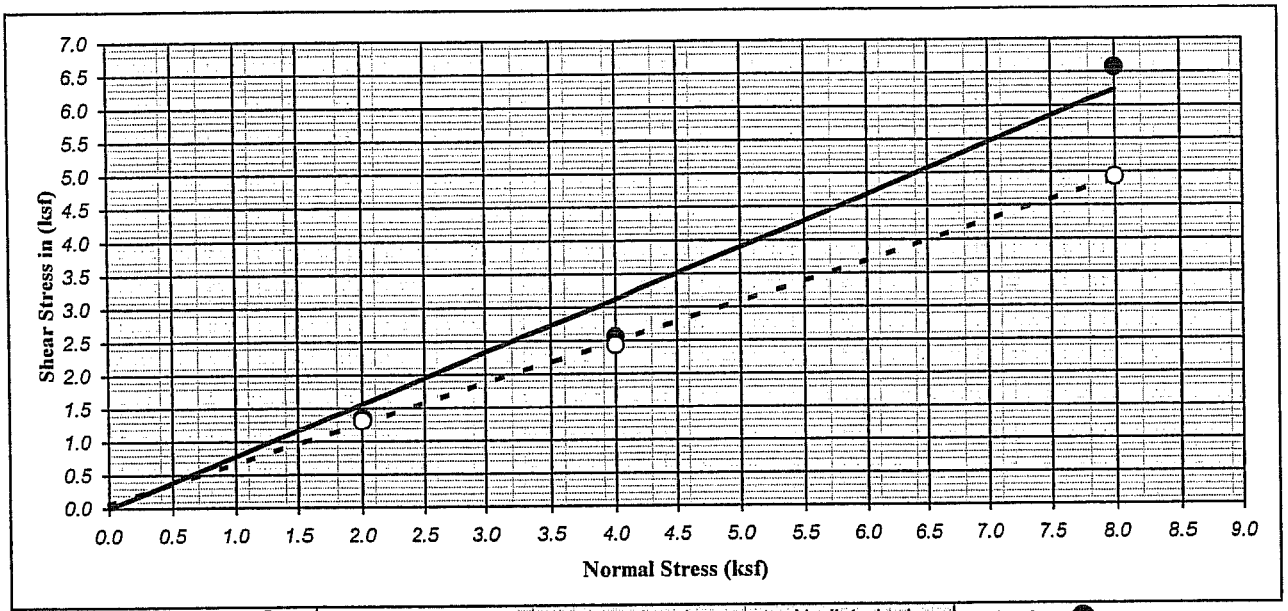
RBF/SR-57 Northbound

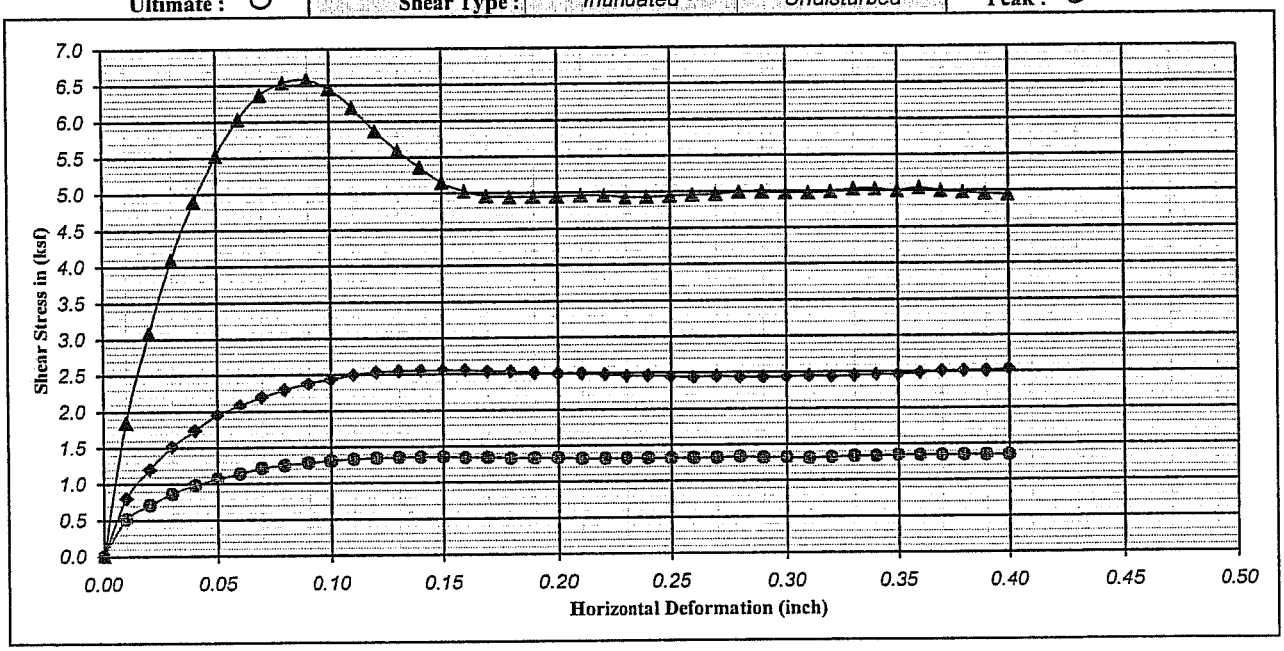
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No.	: A-08-126	Strength Intercept (C) :	0.00	(ksf)	Peak	0.06	(ksf)	Ultimate	
Sample No.	: D-9		0.00	(kPa)		2.87	(kPa)		
Depth (ft/m)	: 40.0 | 0.00	Friction Angle (ϕ) :	37.96	Degree		31.25	Degree		
Description	: Brown, SILTY SAND (SM)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	24.19	90.95	14.32	0.85	2.00	95.76	1.36	64.93	1.31	62.63
◆	24.11	88.93	14.00	0.90	4.00	191.52	2.56	122.38	2.44	116.64
▲	20.35	92.02	14.48	0.83	8.00	383.04	6.58	314.81	4.93	236.14

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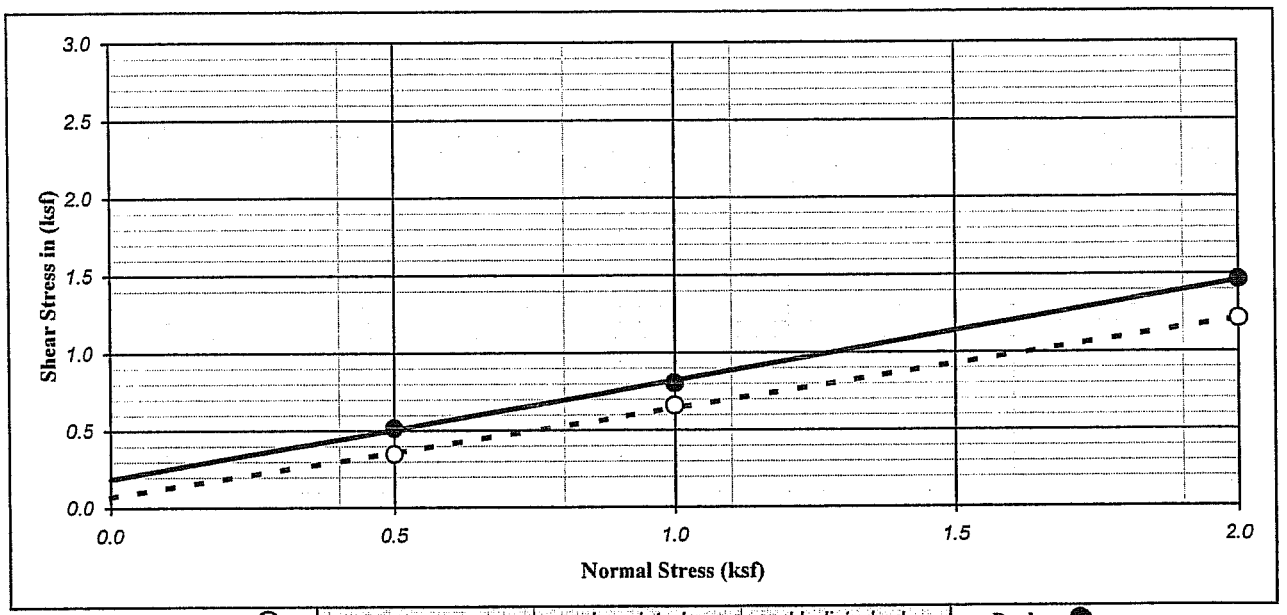
RBF/SR-57 Northbound

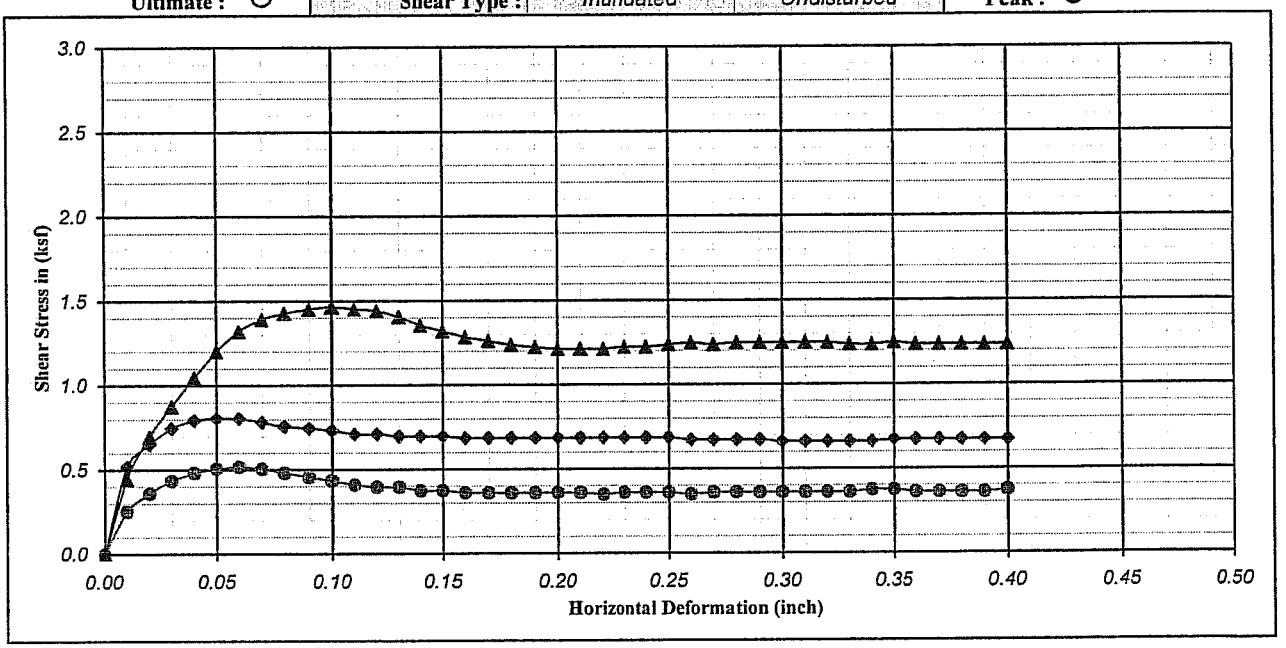
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-128		Strength Intercept (C) :	0.19	(ksf)		0.07	(ksf)	
Sample No. : D-3			8.91	(kPa)	Peak	3.45	(kPa)	Ultimate
Depth (ft/m) : 10.0	0.00	Friction Angle (ϕ) :	32.46	Degree		29.79	Degree	
Description : Yellowish brown, Poorly graded SAND with SILT (SP-SM)					Shear Rate (inch/minute) :			0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.70	89.91	14.15	0.87	0.50	23.94	0.52	24.71	0.35	16.66
◆	20.30	88.42	13.92	0.91	1.00	47.88	0.80	38.50	0.66	31.60
▲	21.96	84.47	13.30	1.00	2.00	95.76	1.46	70.10	1.21	58.03

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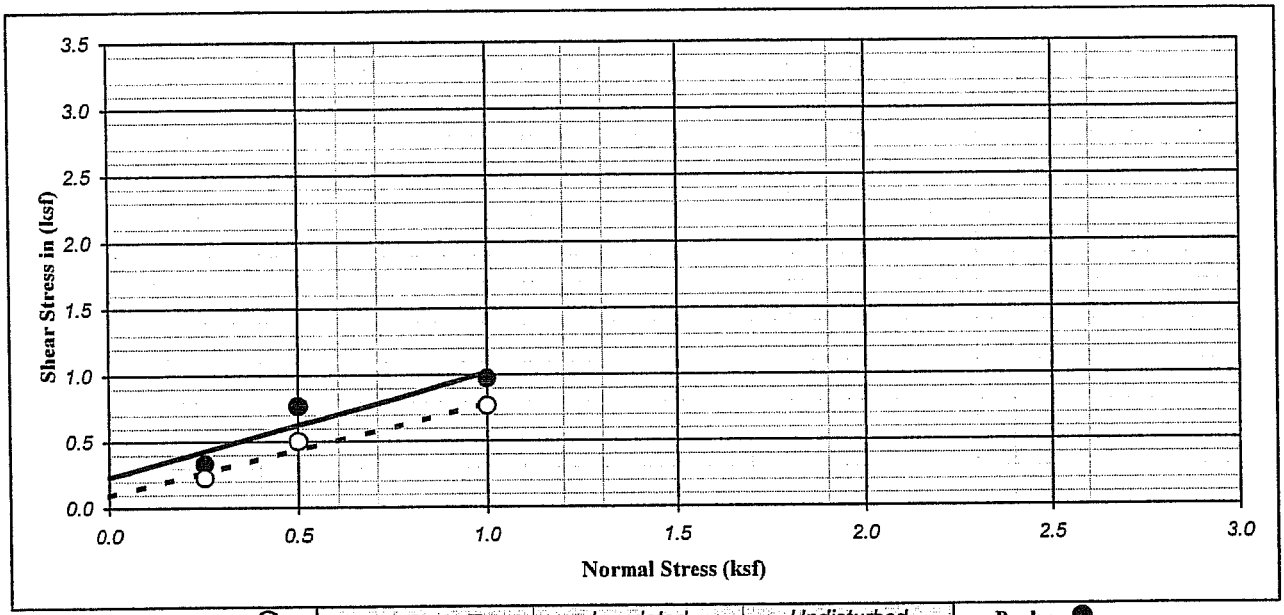
RBF/SR-57 Northbound

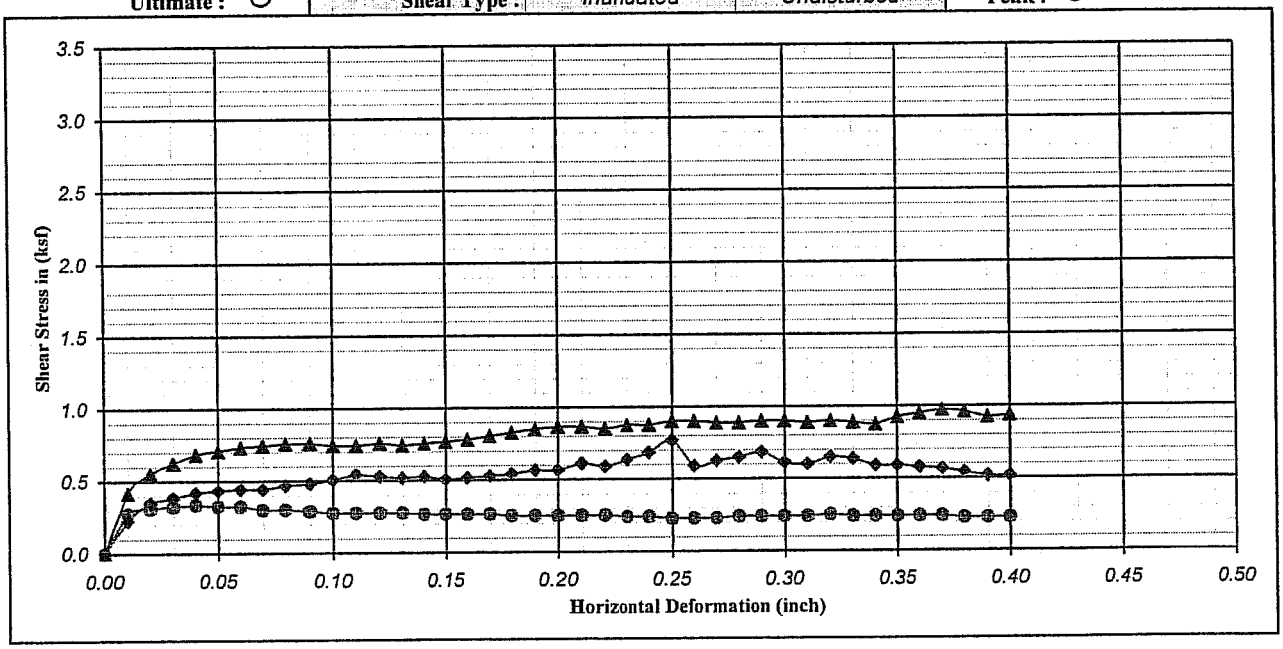
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-132		Strength Intercept (C) :	0.23	(ksf)	Peak	0.10	(ksf)	Ultimate
Sample No. : D-1			11.20	(kPa)		4.60	(kPa)	
Depth (ft/m) : 2.5	0.00	Friction Angle (ϕ) :	38.14	Degree		34.71	Degree	
Description : Dark yellowish brown, SILTY SAND with GRAVEL (SM)					Shear Rate (inch/minute) :			0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	16.35	107.06	16.85	0.57	0.25	11.97	0.34	16.09	0.23	10.92
◆	15.09	105.55	16.61	0.60	0.50	23.94	0.77	36.77	0.50	24.13
▲	15.82	110.34	17.37	0.53	1.00	47.88	0.97	46.54	0.77	36.77

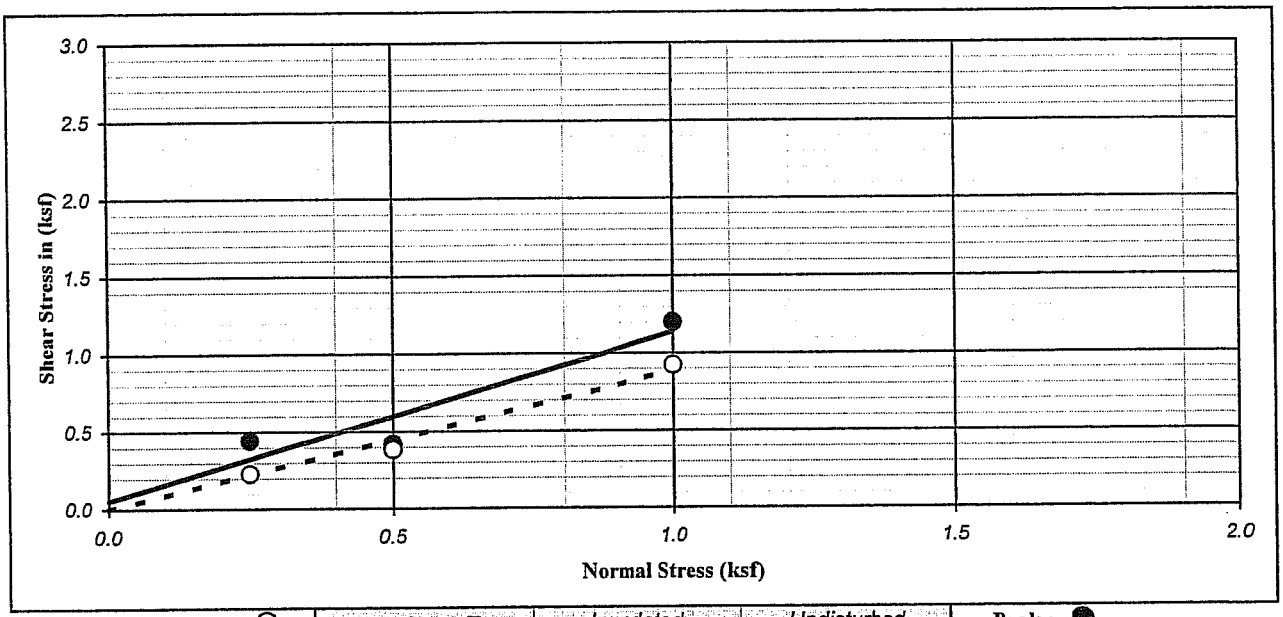
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

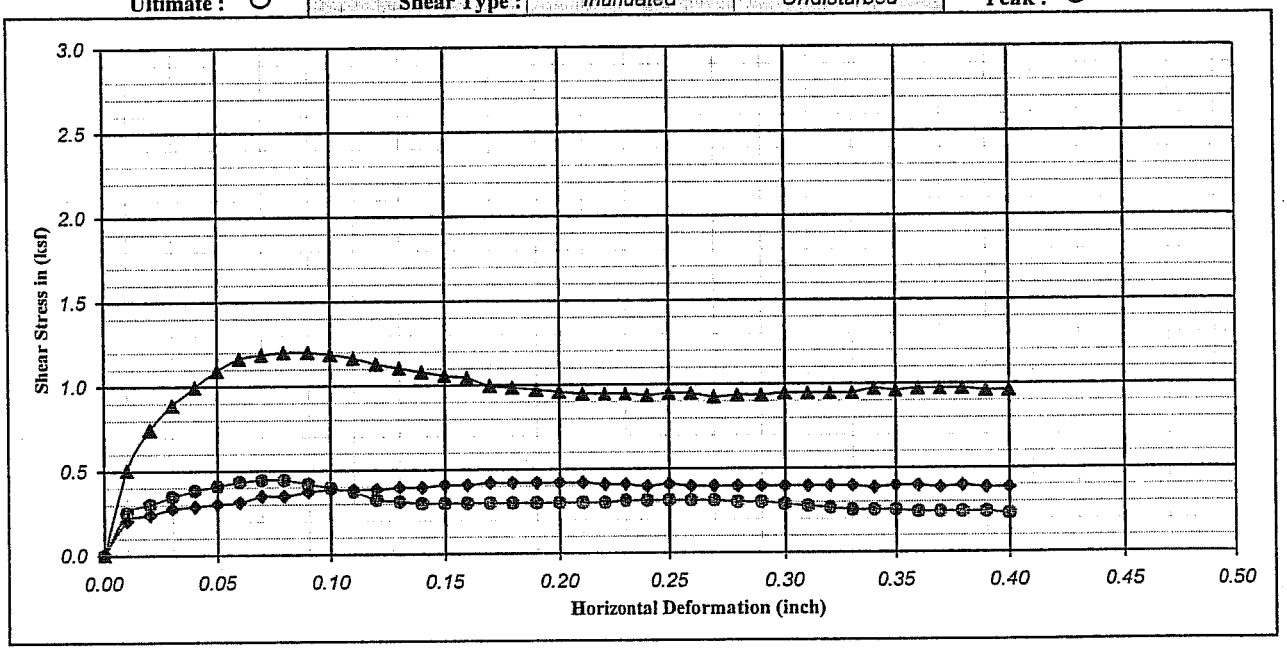
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-134		Strength Intercept (C) :	0.05	(ksf)		0.00	(ksf)	
Sample No. : D-1			2.59	(kPa)	Peak	0.00	(kPa)	Ultimate
Depth (ft/m) : 2.5	0.00	Friction Angle (ϕ) :	47.38	Degree		41.79	Degree	
Description : Dark yellowish brown, CLAYEY SAND (SC)						Shear Rate (inch/minute) :		0.02

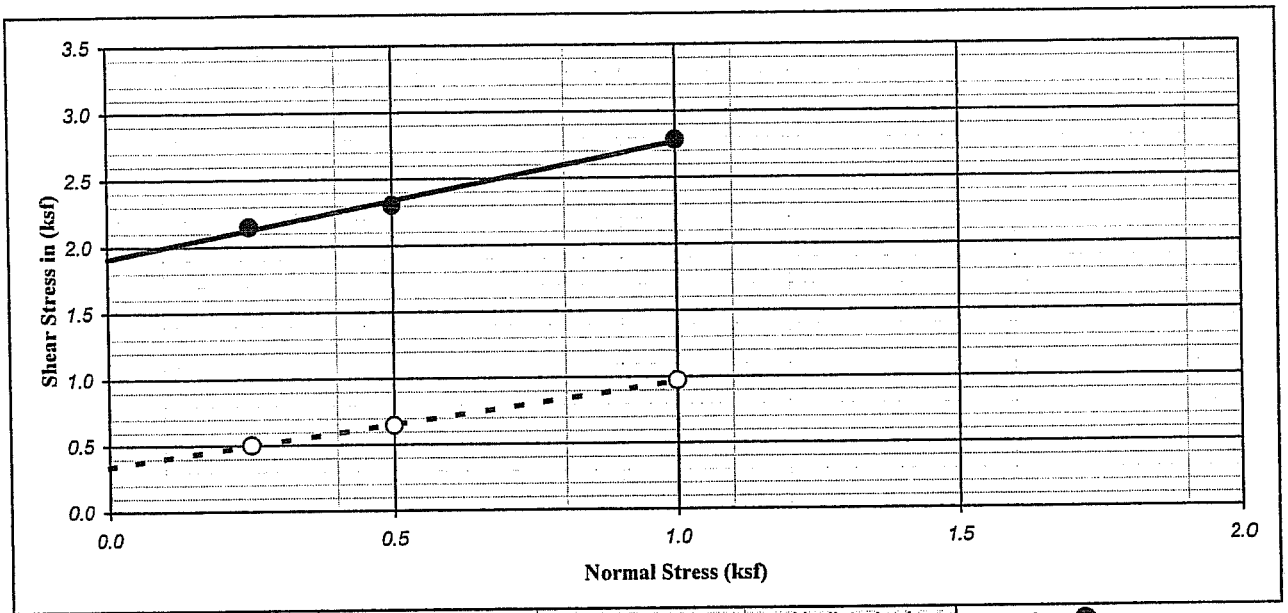
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	20.42	106.41	16.75	0.58	0.25	11.97	0.44	21.26	0.23	10.92
◆	19.49	106.59	16.78	0.58	0.50	23.94	0.42	20.11	0.38	18.39
▲	18.62	109.26	17.20	0.54	1.00	47.88	1.20	57.46	0.92	44.24

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

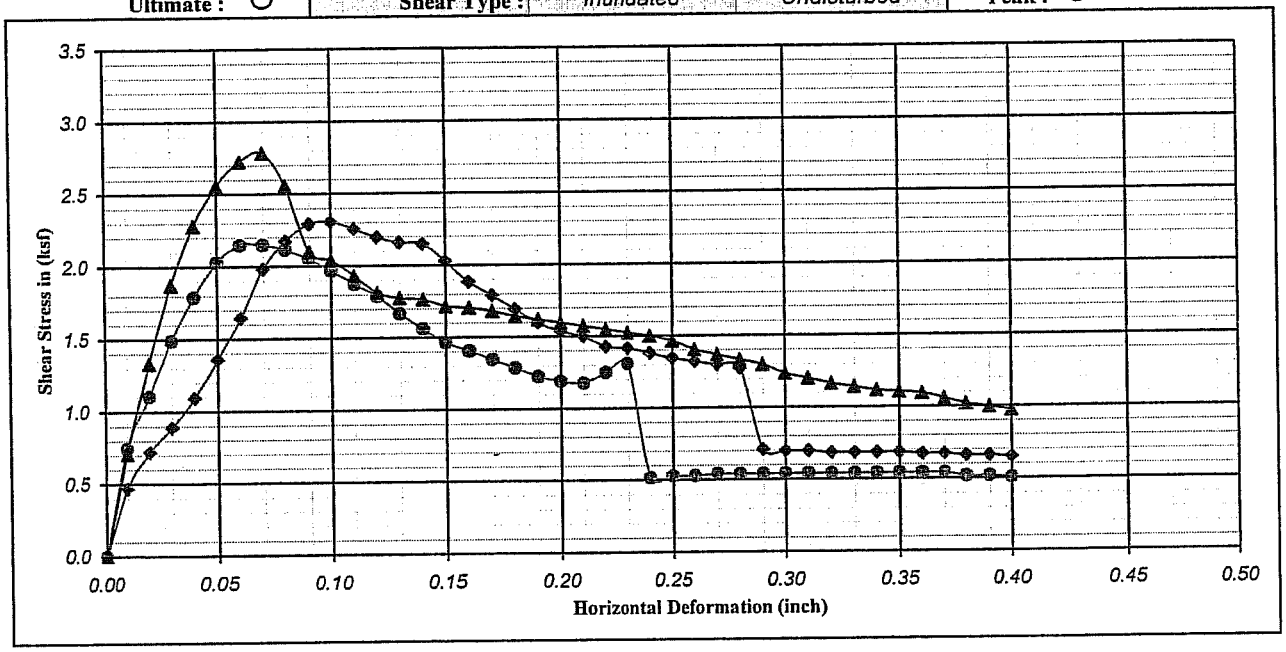
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08 | Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-137		Strength Intercept (C) :	1.91	(ksf)		0.34	(ksf)		
Sample No. : D-2			91.36	(kPa)	Peak	16.37	(kPa)	Ultimate	
Depth (ft/m) : 5.0	0.00	Friction Angle (ϕ) :	40.83	Degree		32.11	Degree		
Description : Mottled olive brown, white, orange, Lean CLAY with SAND (CL)							Shear Rate (inch/minute) :		0.02

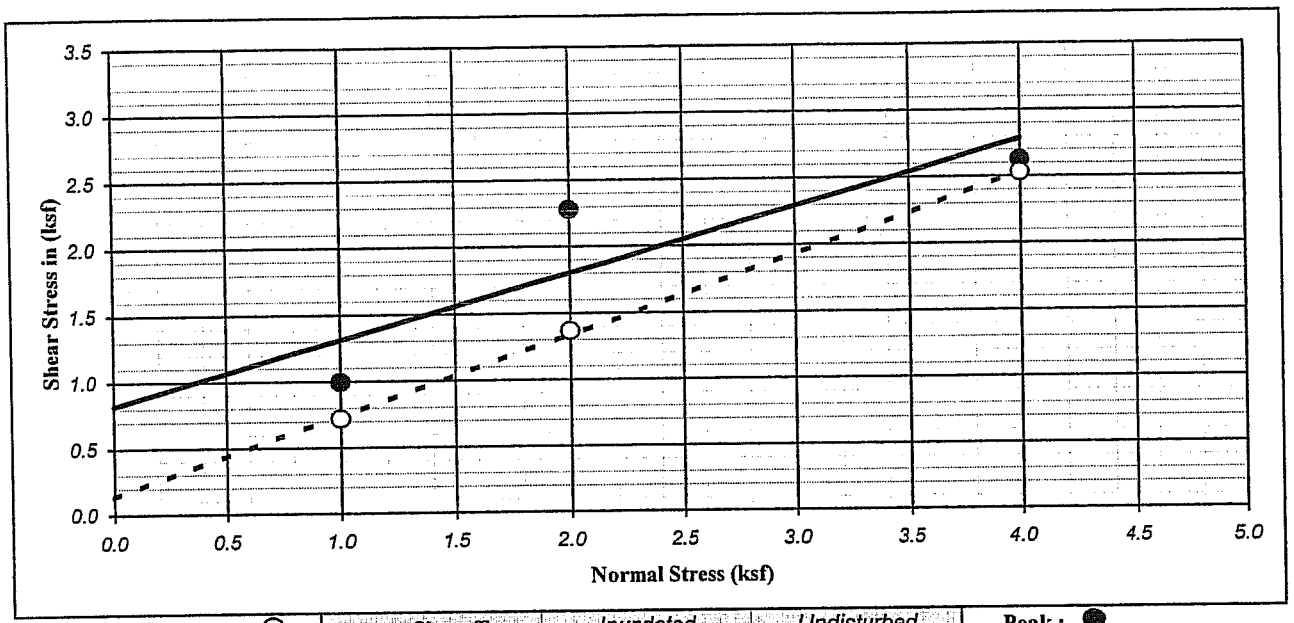
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	41.66	88.58	13.94	0.90	0.25	11.97	2.15	102.85	0.50	24.13
◆	37.73	88.25	13.89	0.91	0.50	23.94	2.30	110.32	0.65	31.03
▲	29.23	93.92	14.78	0.79	1.00	47.88	2.78	133.30	0.97	46.54

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

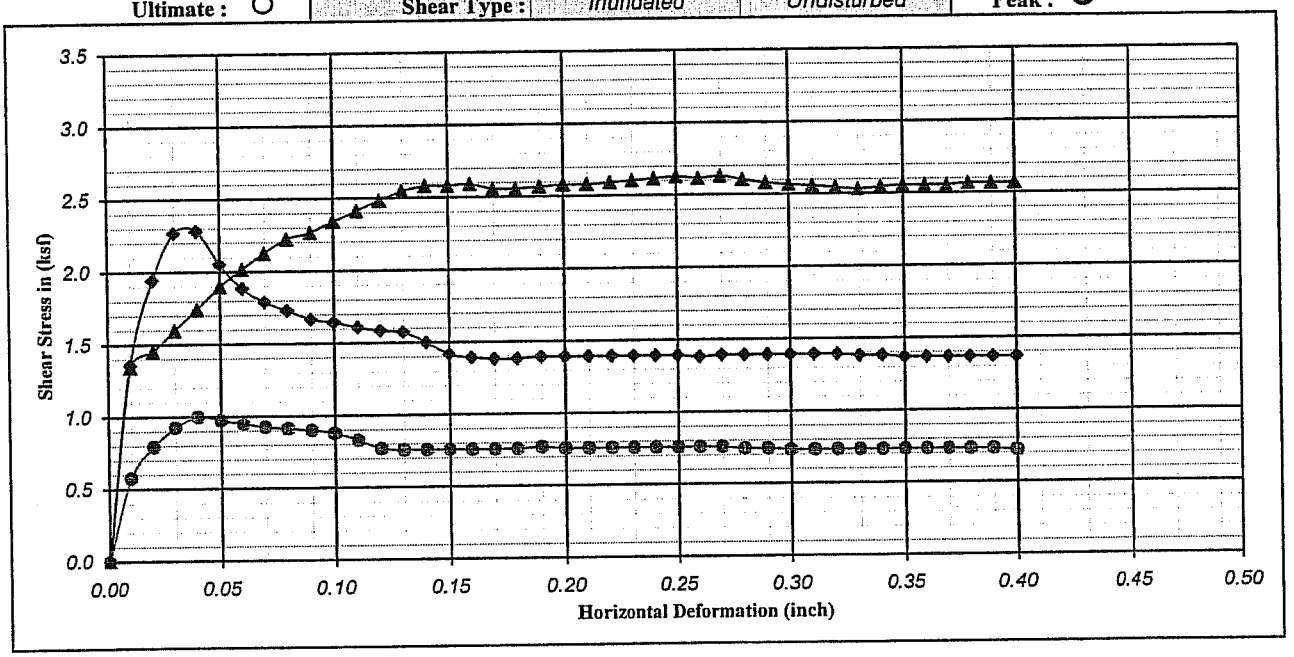
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08 | Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-137		Strength Intercept (C) :	0.82	(ksf)	Peak	0.14	(ksf)	Ultimate
Sample No. : D-4			39.36	(kPa)		6.61	(kPa)	
Depth (ft/m) : 15.0	0.00	Friction Angle (ϕ) :	26.16	Degree		31.00	Degree	
Description : Very dark brown, SILTY SAND (SM)						Shear Rate (inch/minute) :		0.02

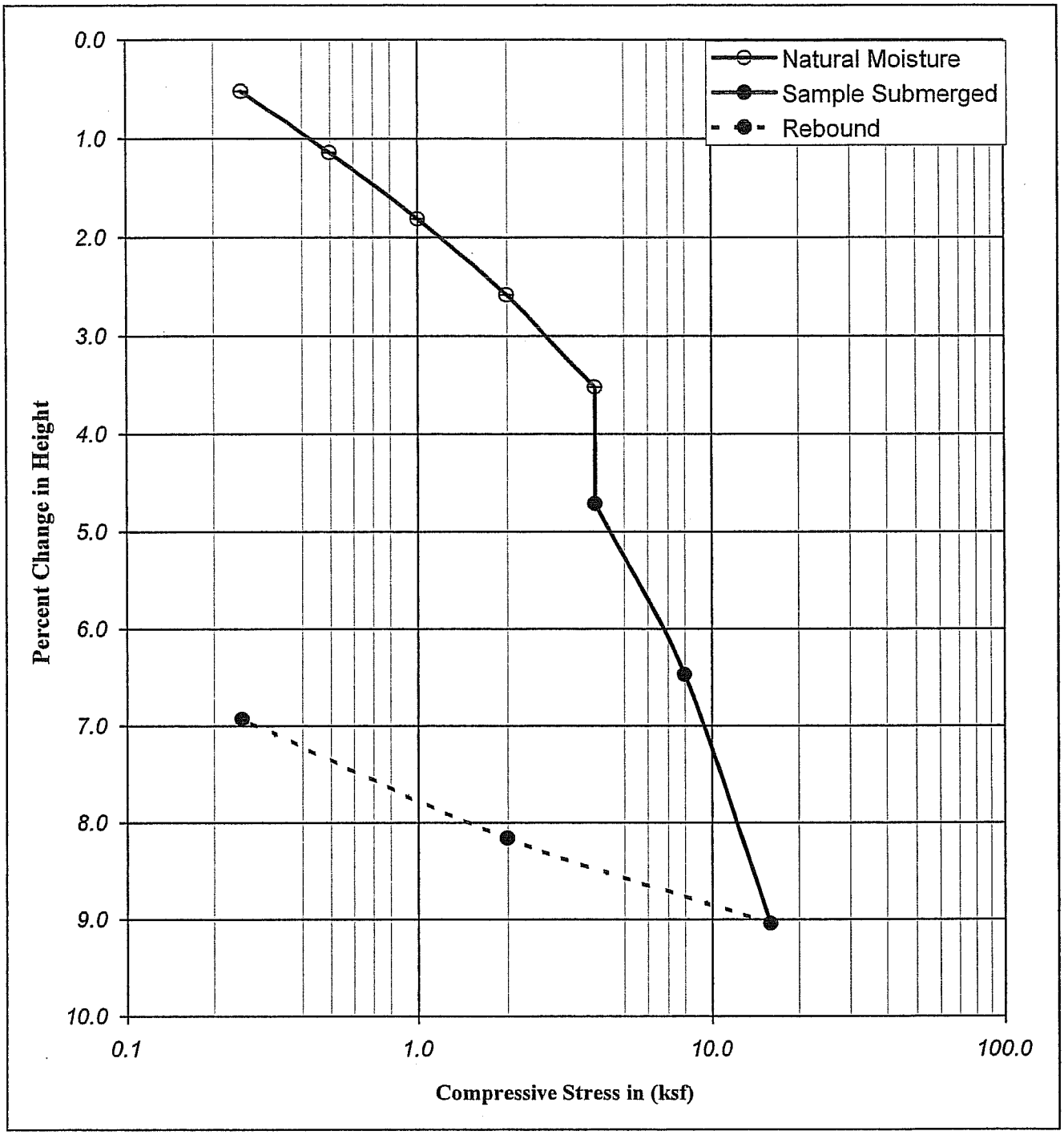
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	17.82	98.71	15.54	0.71	1.00	47.88	1.00	47.69	0.72	34.47
◆	16.17	102.89	16.19	0.64	2.00	95.76	2.28	109.17	1.37	65.50
▲	19.81	98.79	15.55	0.71	4.00	191.52	2.63	125.83	2.53	121.23

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08 | Figure No. :



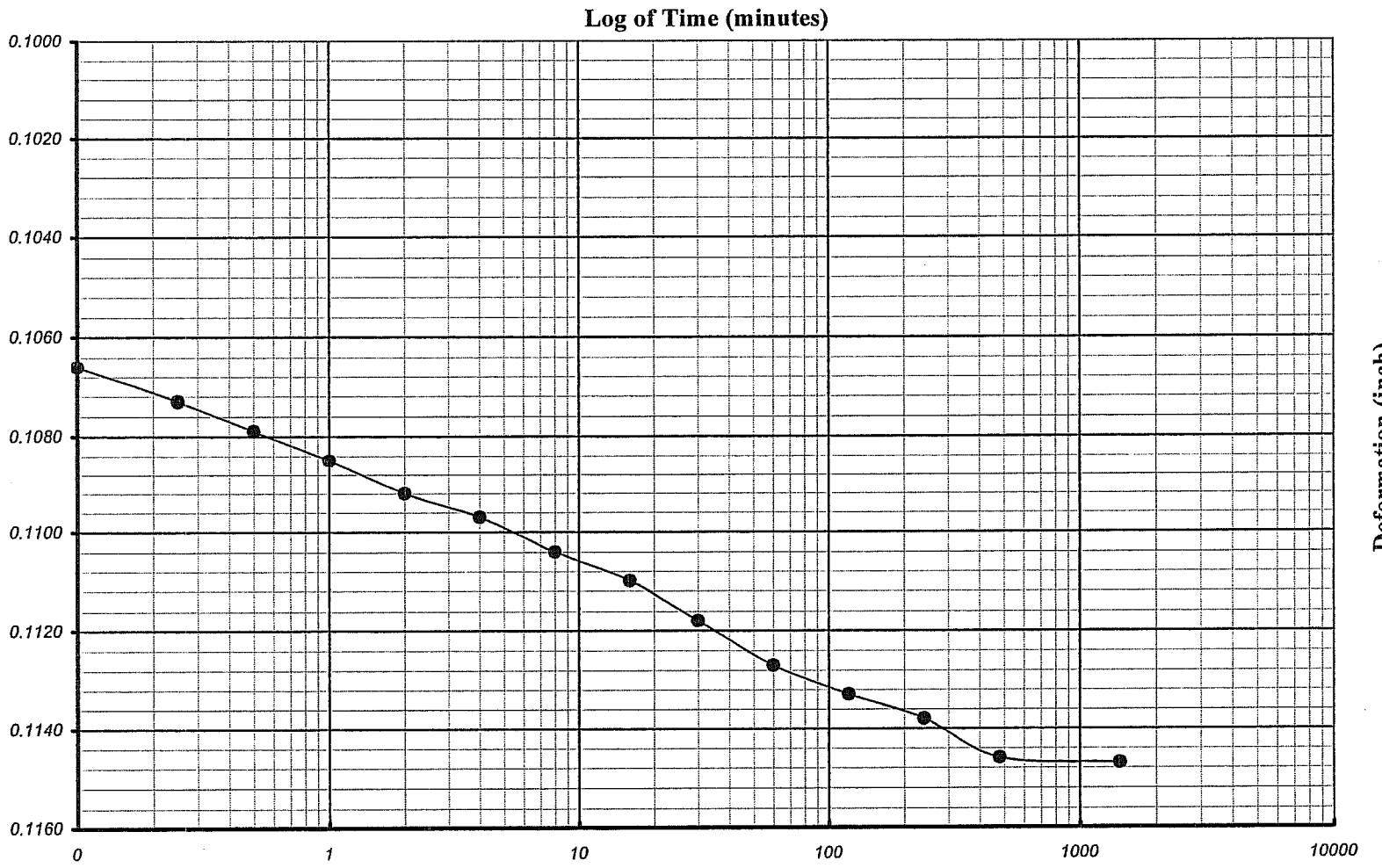
Boring No.	: A-08-005			Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-8			Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft) :	35.0	36.5	Plastic Index :	-	Initial	13.84	115.16	18.13	80.56	0.46
	(m) :	10.68	11.13	Specific Gravity :	2.70	Final	13.47	123.84	19.49	100.71	0.36
Description	: Dark yellowish brown, SANDY lean CLAY (CL)										

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

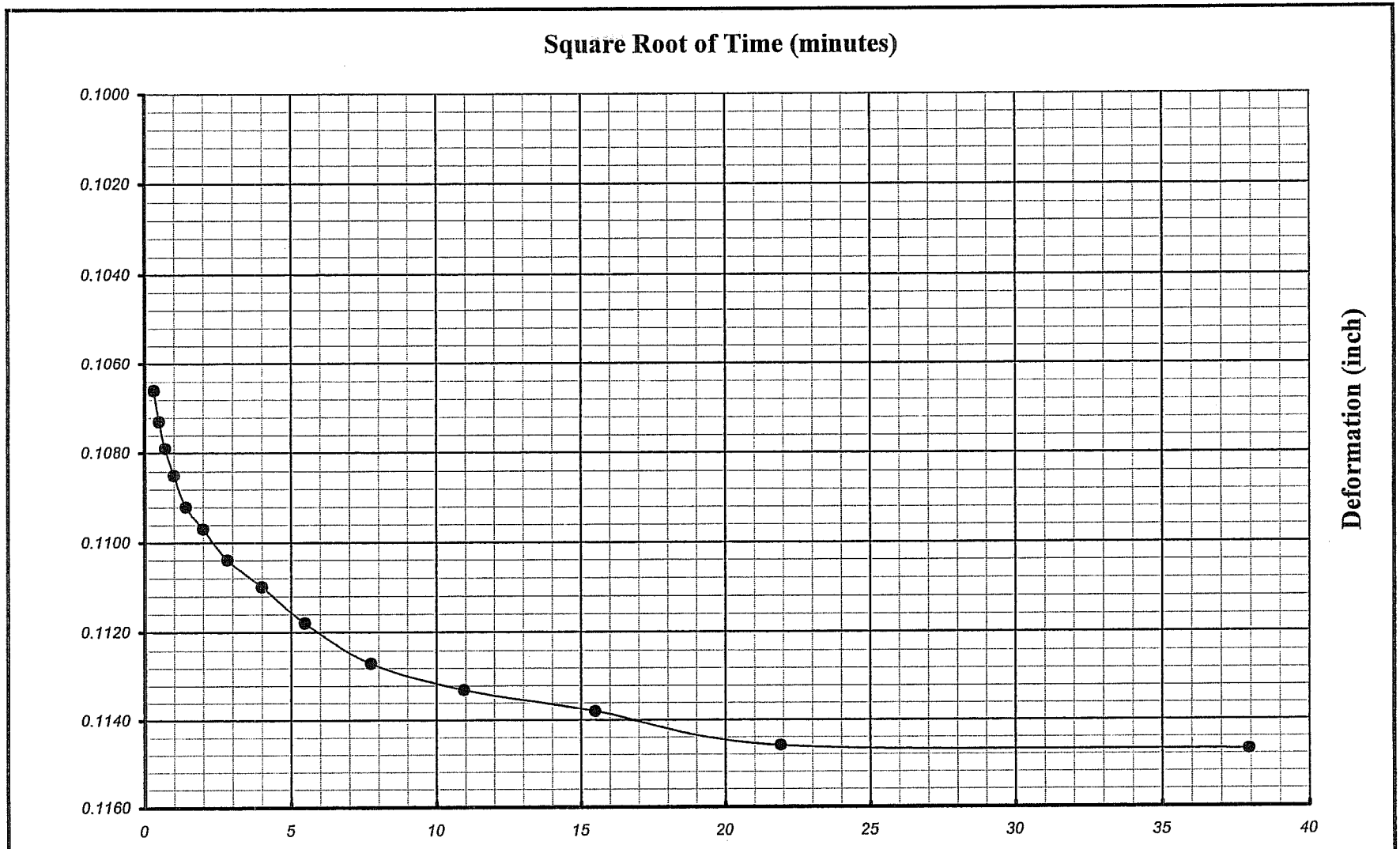
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

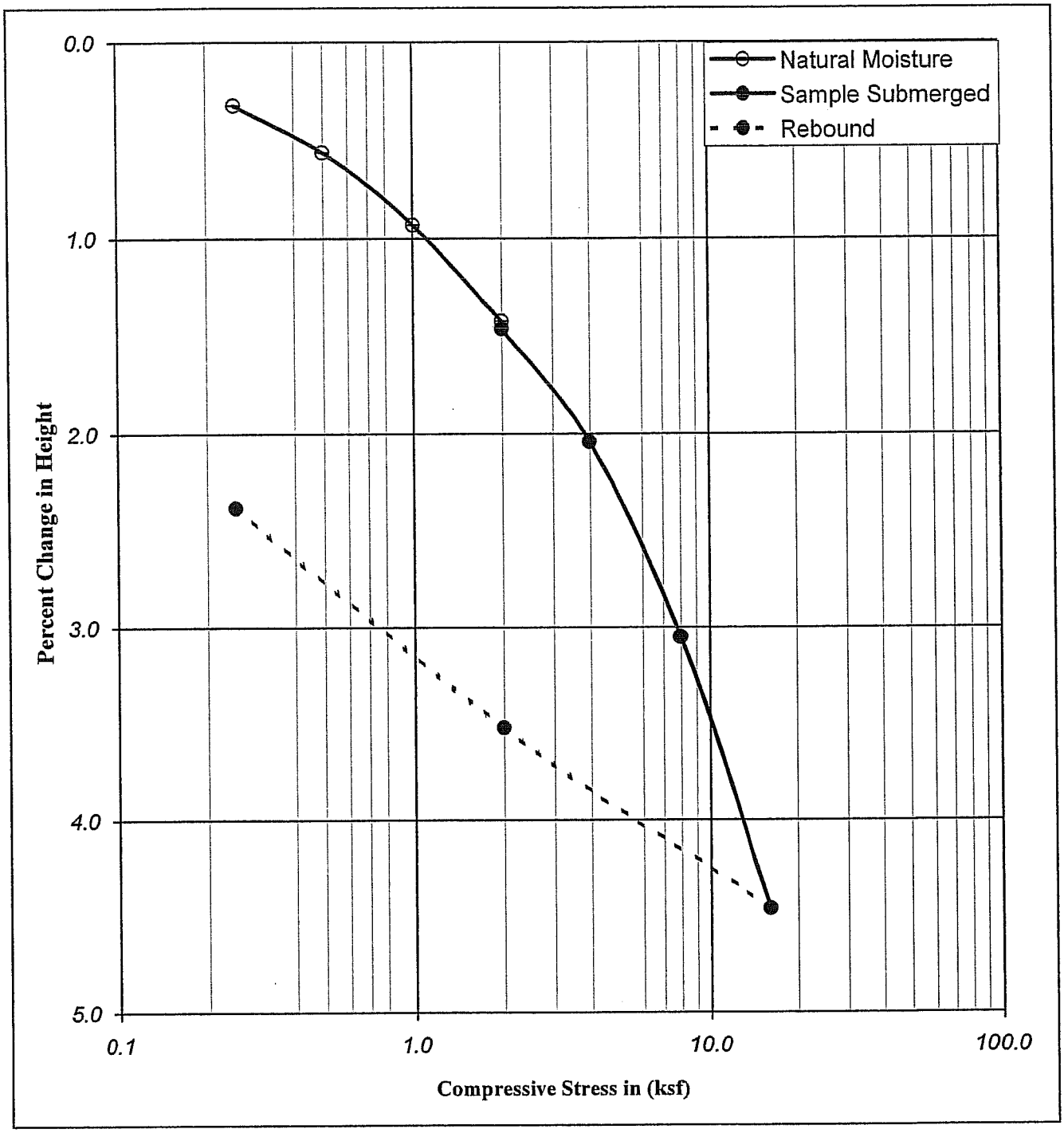
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-005*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-8*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-005*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-8*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



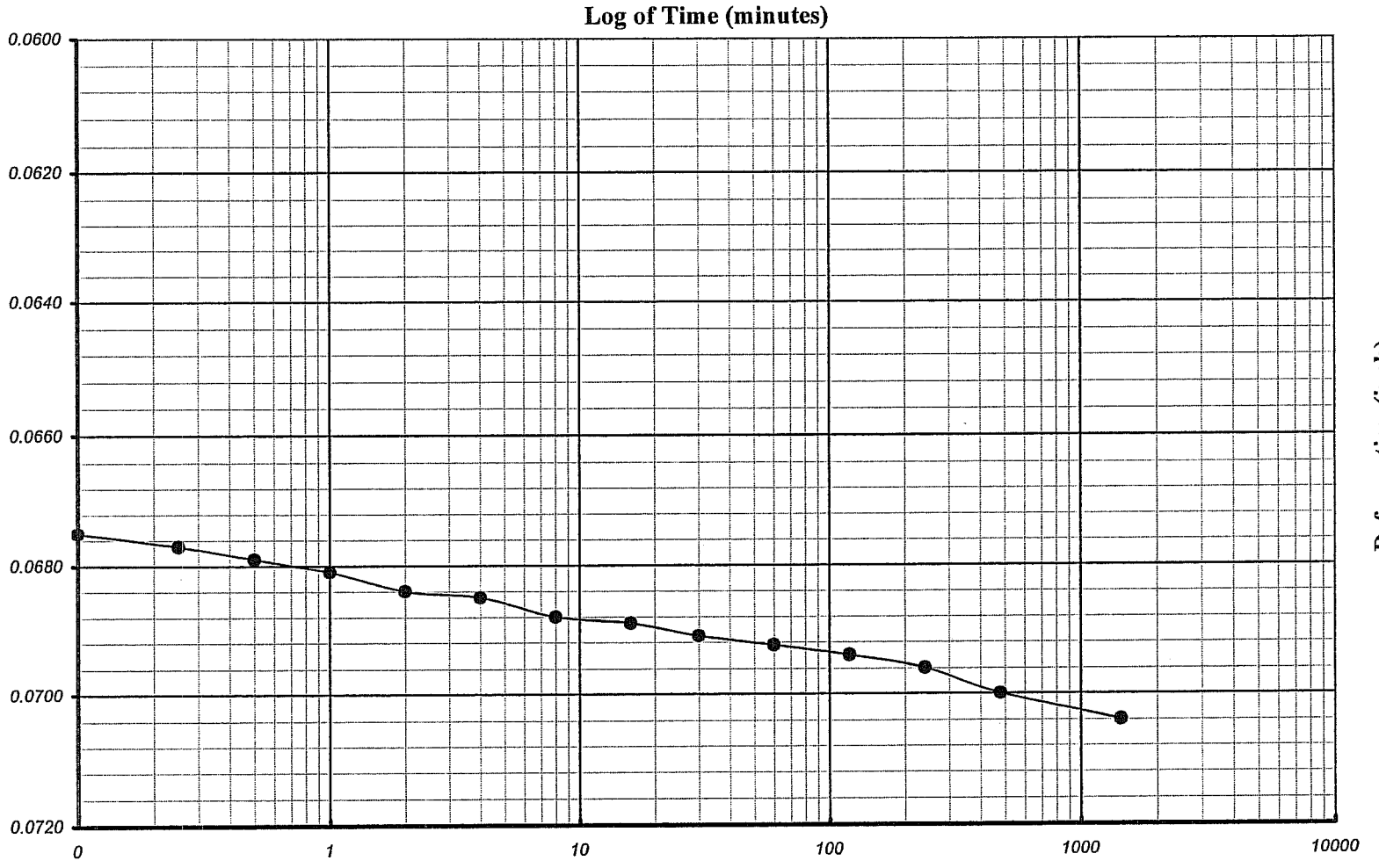
Boring No.	: A-08-006			Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-3			Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft) :	10.0	11.5	Plastic Index :	-	Initial	17.05	109.64	17.26	85.66	0.54
	(m) :	3.05	3.51	Specific Gravity :	2.70	Final	18.30	112.38	17.69	98.86	0.50
Description	: Olive gray with olive brown, SANDY LEAN CLAY (CL)										

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

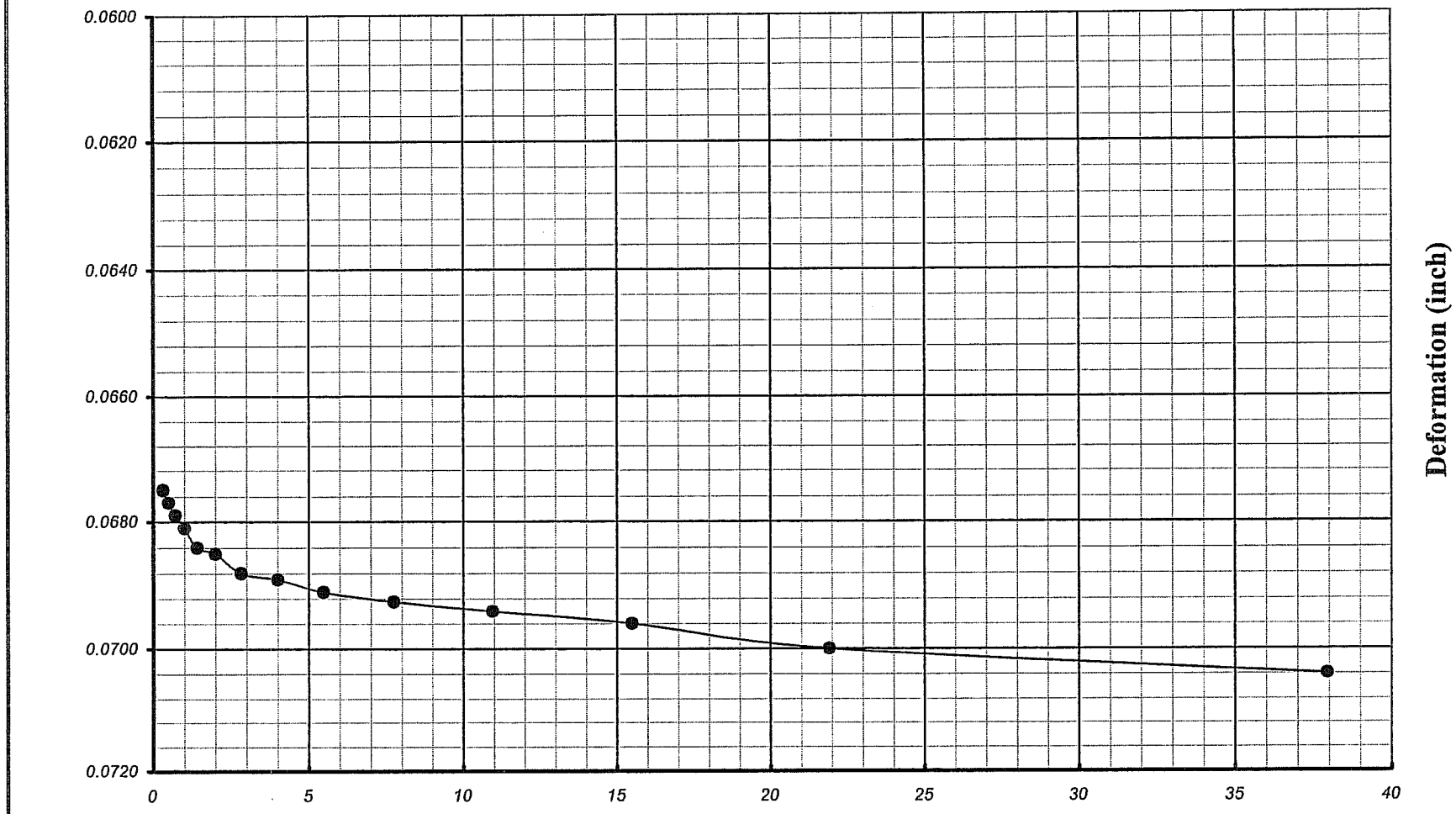
RBF/SR-57 Northbound

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

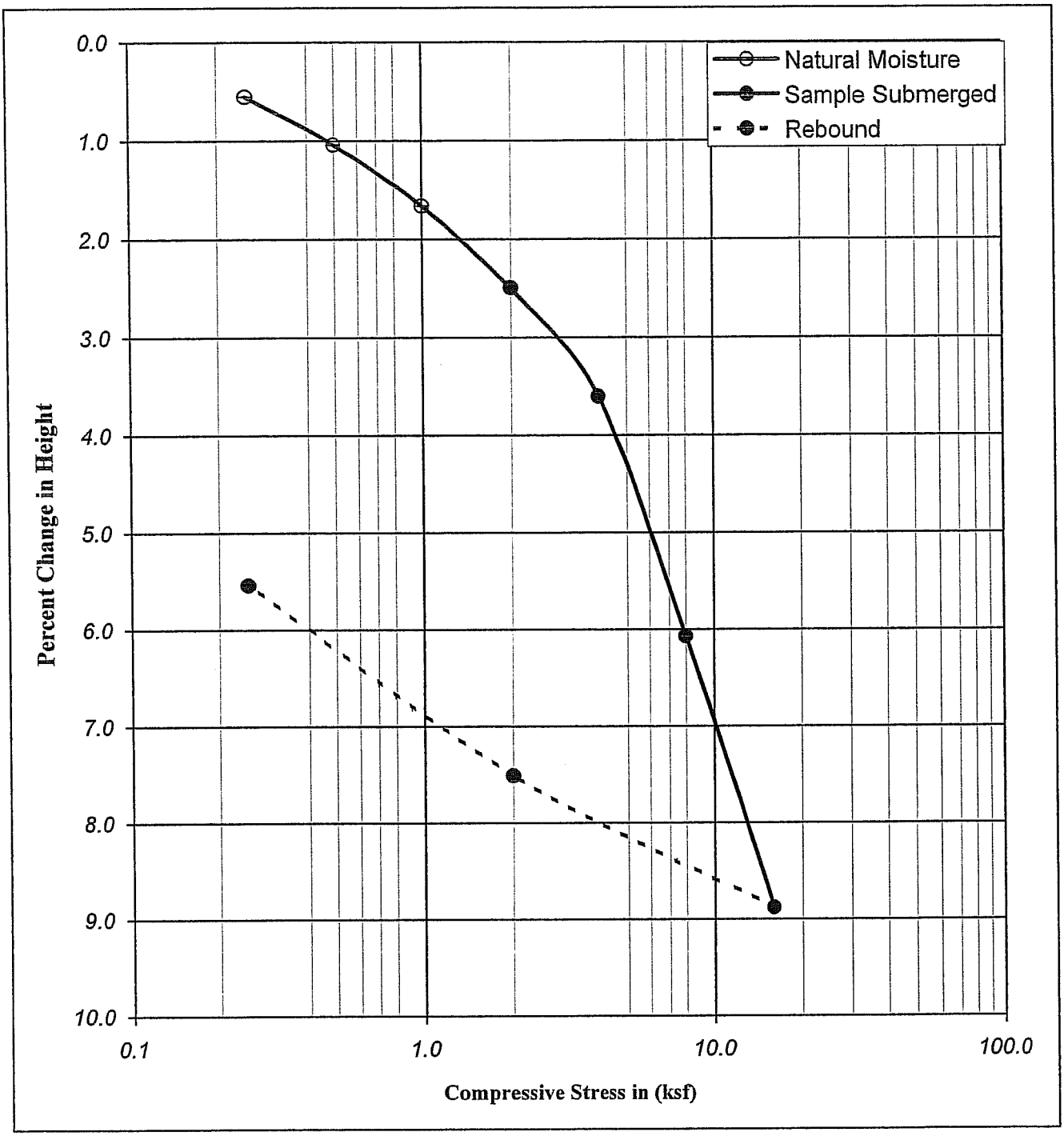
Project No. : 08-115 12/05/08



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound	Boring No. : A-08-006	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : D-3	
EMI Project No. : 08-115		Depth (ft/m) : 10.0 3.1	Veritcal Load (ksf/kpa) : 4.00 191.5



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-006*	**One-Dimensional Consolidation of Soil** Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-3*	
EMI Project No. : *08-115*		Depth (ft/m) : *10.0* *3.1*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



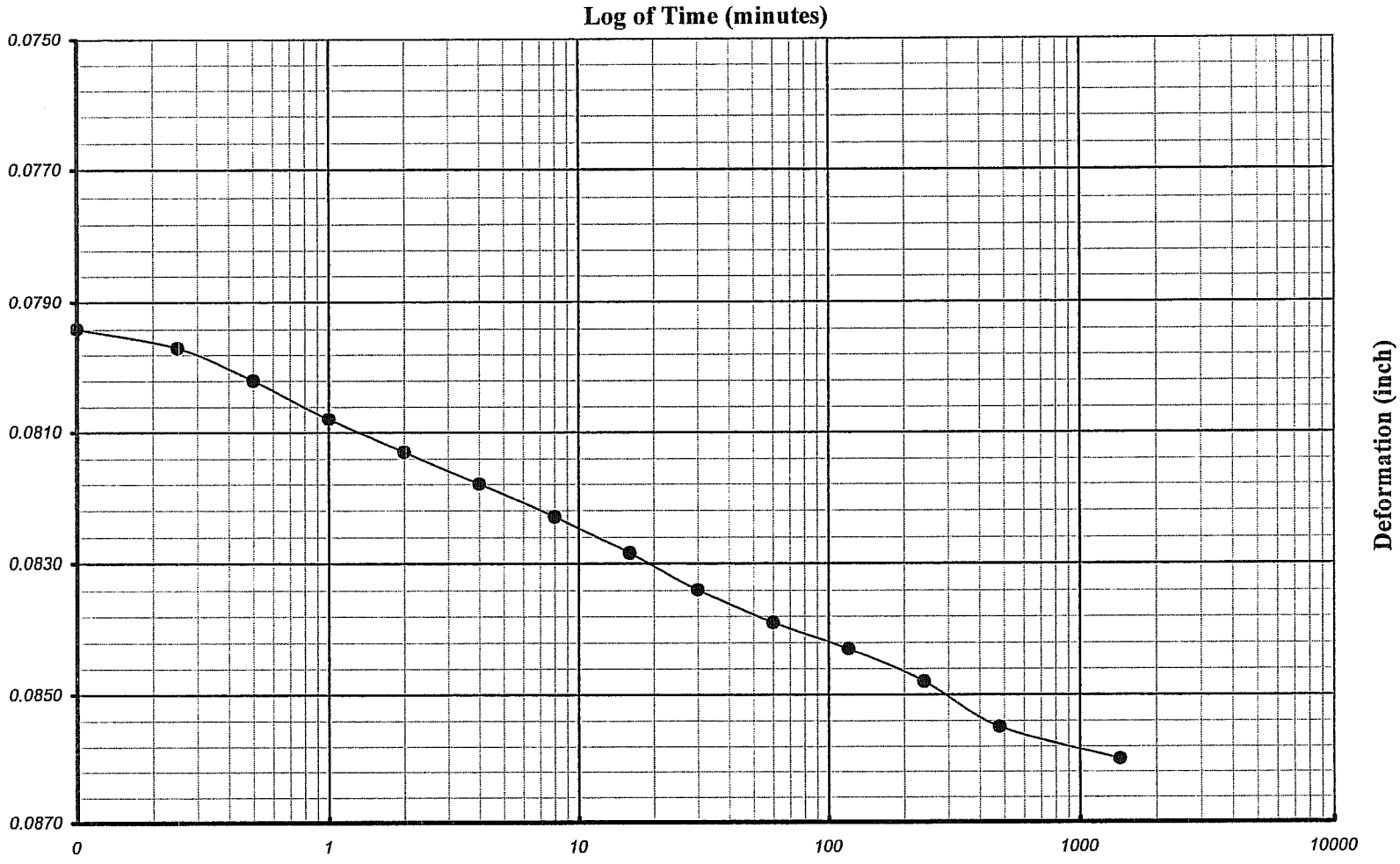
Boring No.		: A-08-007		Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.		: D-4		Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft)	: 15.0	16.5	Plastic Index :	-	Initial	19.30	102.11	16.07	80.09	0.65
	(m)	: 4.58	5.03	Specific Gravity :	2.70	Final	21.16	108.15	17.02	102.28	0.56
Description		: Olive brown, SANDY lean CLAY (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

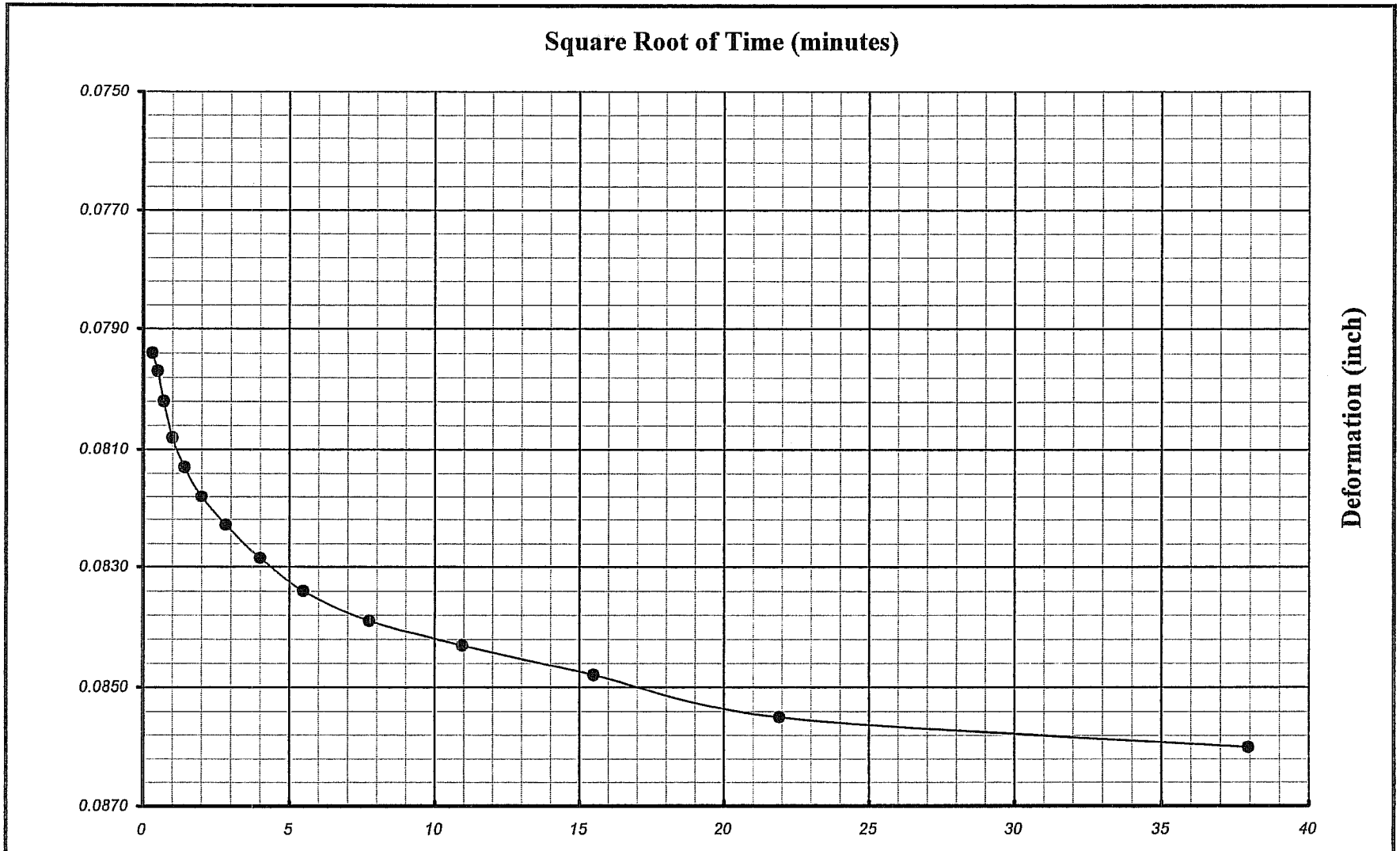
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

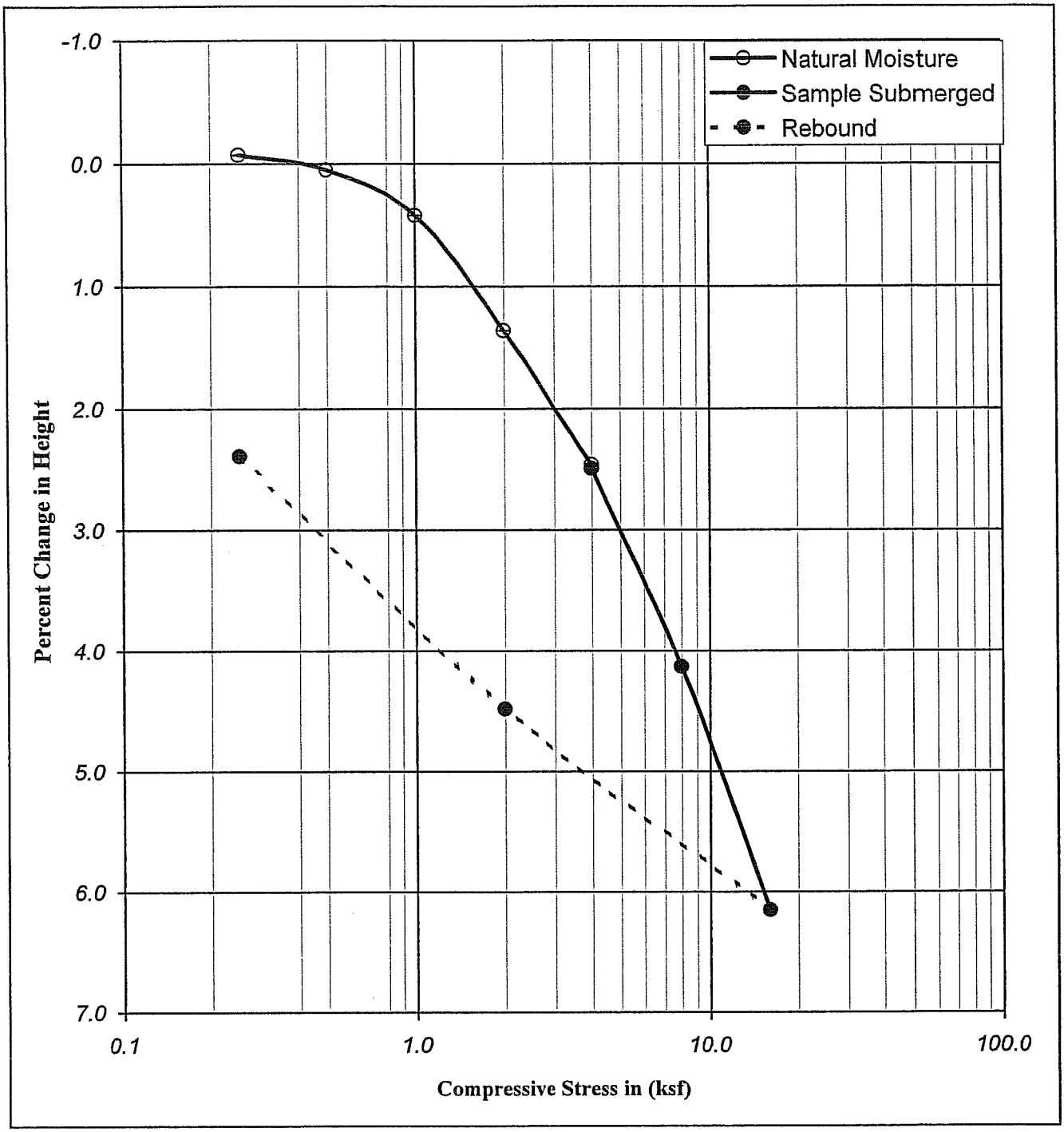
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound	Boring No. : A-08-007	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : D-4	
EMI Project No. : 08-115		Depth (ft/m) : 15.0 4.6	Veritcal Load (ksf/kpa) : 4.00 191.5



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-007*	**One-Dimensional Consolidation of Soil** Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-4*	
EMI Project No. : *08-115*		Depth (ft/m) : *15.0* *4.6*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



Boring No.	: A-08-008		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m^3)	Percent Saturation	Void Ratio
Sample No.	: D-5		Plastic Limit :	-						
Depth (ft)	: 20.0	21.5	Plastic Index :	-	Initial	21.90	102.37	16.11	91.45	0.65
Depth (m)	: 6.10	6.56	Specific Gravity :	2.70	Final	23.11	104.95	16.52	102.93	0.61
Description	: Olive, Lean CLAY With SAND(CL)									

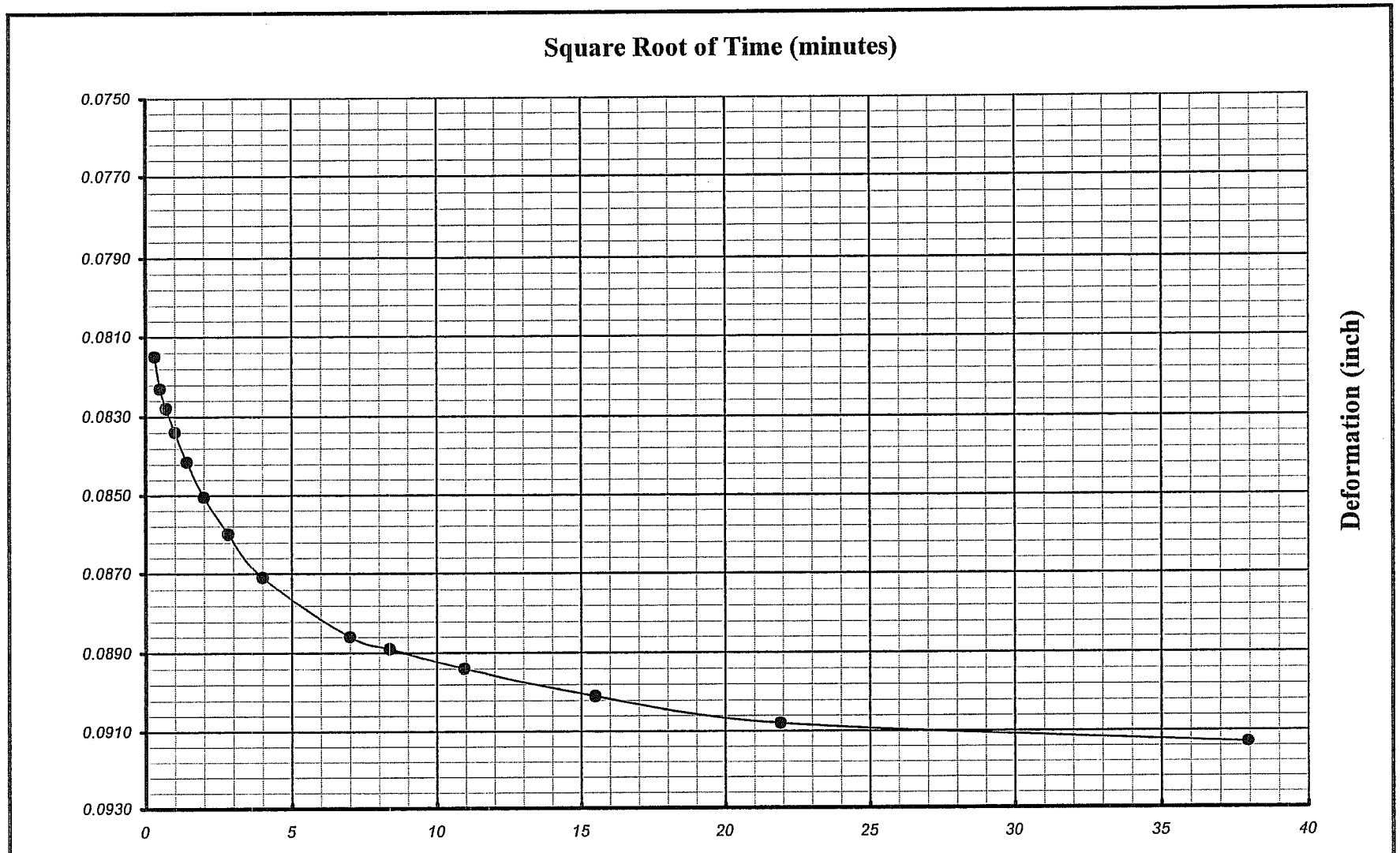
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

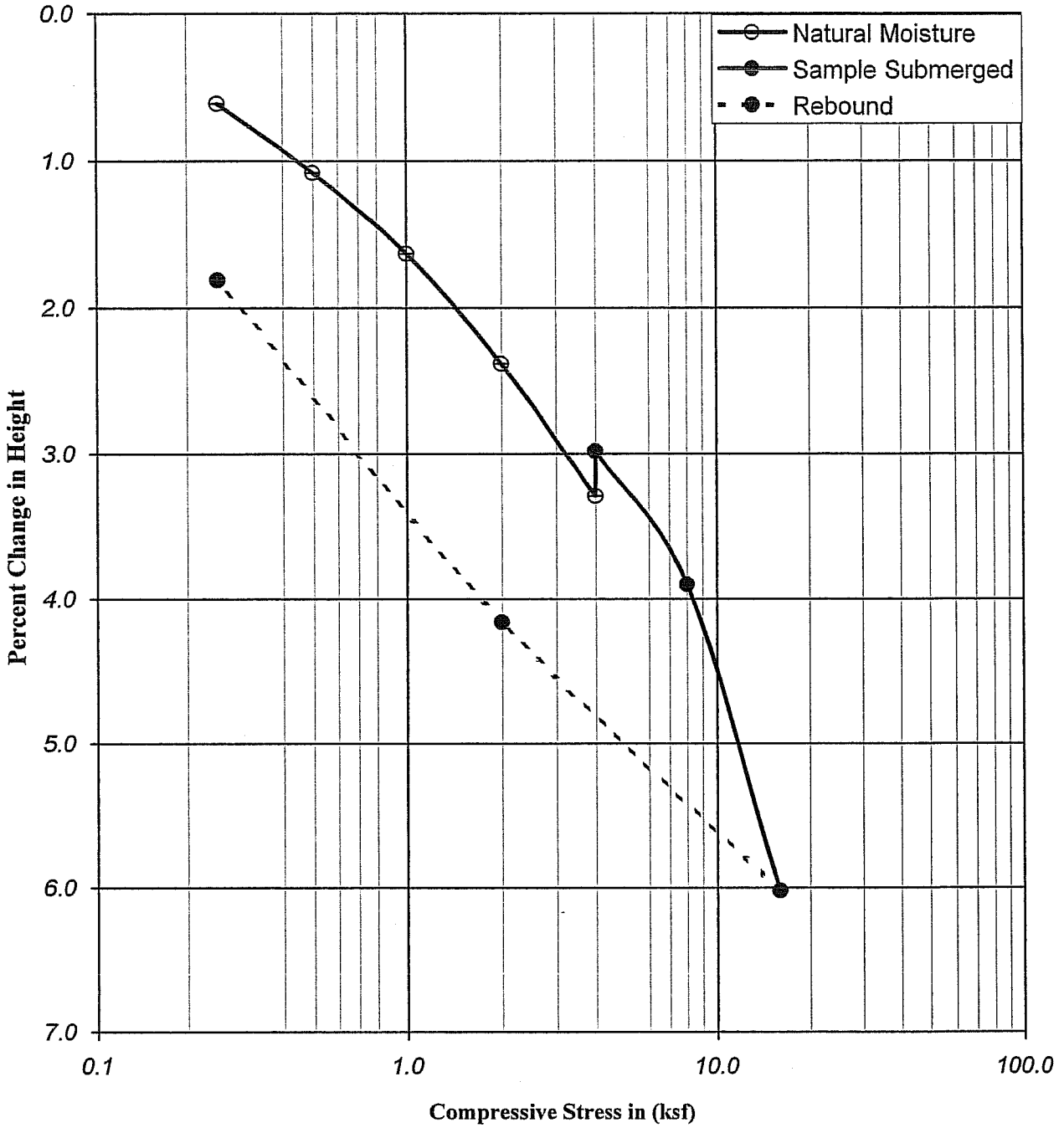
Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-5*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Squre Root of Time Method)
		Sample No. : *D-5*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



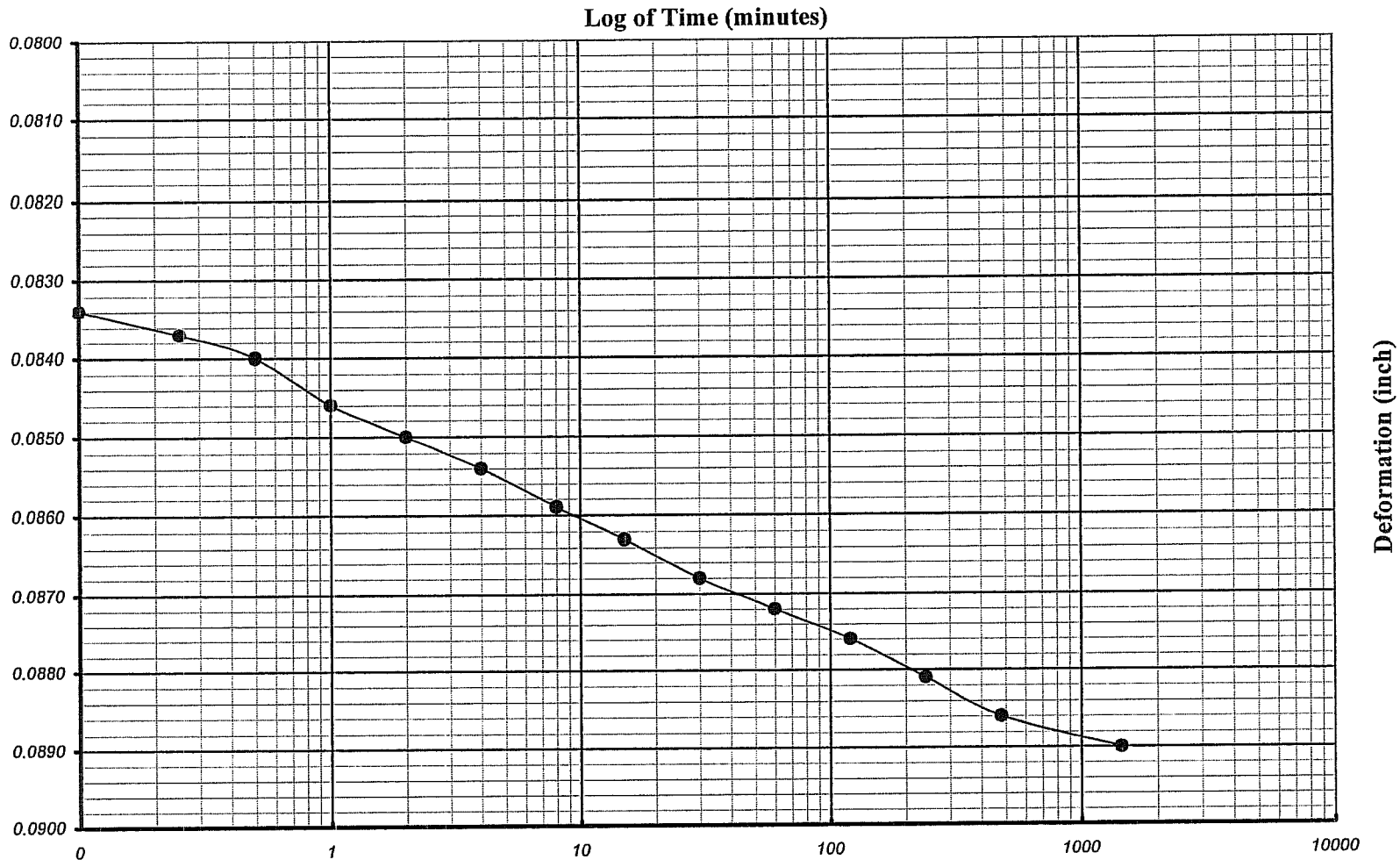
Boring No.	: A-08-008			Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-7			Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft) :	30.0	31.5	Plastic Index :	-	Initial	24.51	99.60	15.68	95.60	0.69
	(m) :	9.15	9.61	Specific Gravity :	2.70	Final	25.56	101.48	15.97	104.41	0.66
Description : Olive gray, lean CLAY (CL)											

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

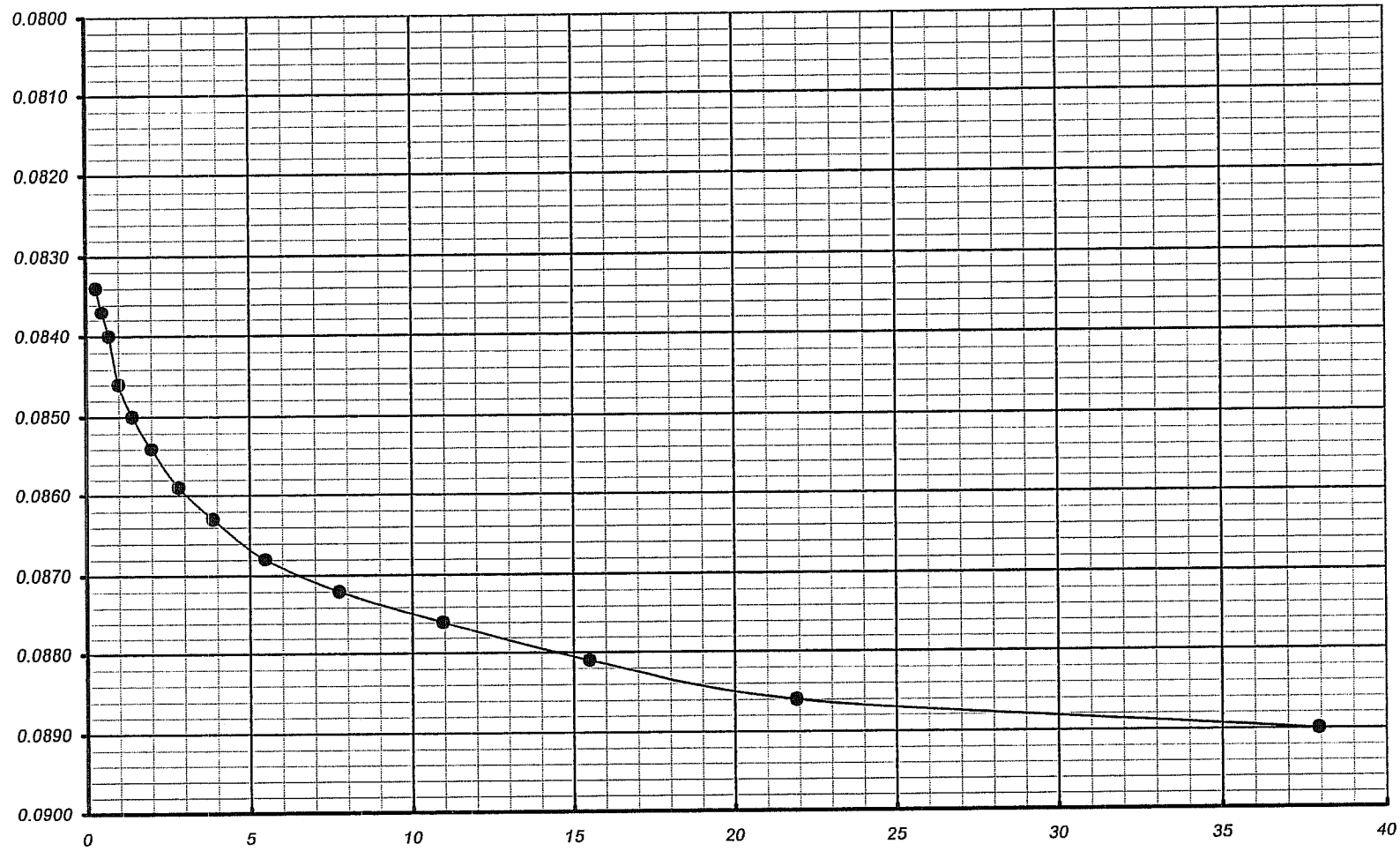
Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

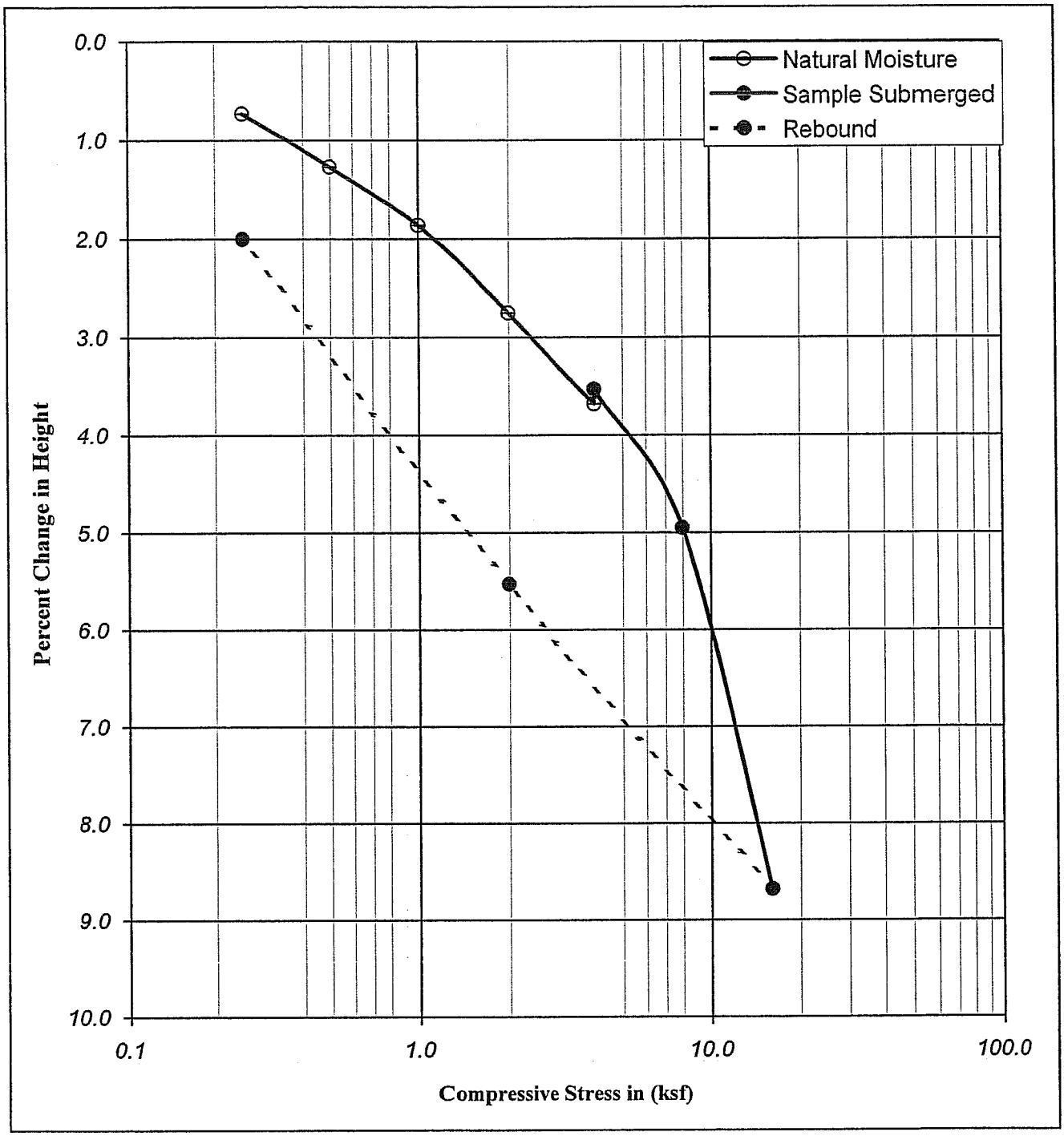


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-7*	
EMI Project No. : *08-115*		Depth (ft/m) : *30.0* *9.2*	Veritcal Load (ksf/kpa) : *8.00* *383.0*

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	**One-Dimensional Consolidation of Soil** Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-7*	
EMI Project No. : *08-115*		Depth (ft/m) : *30.0* *9.2*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



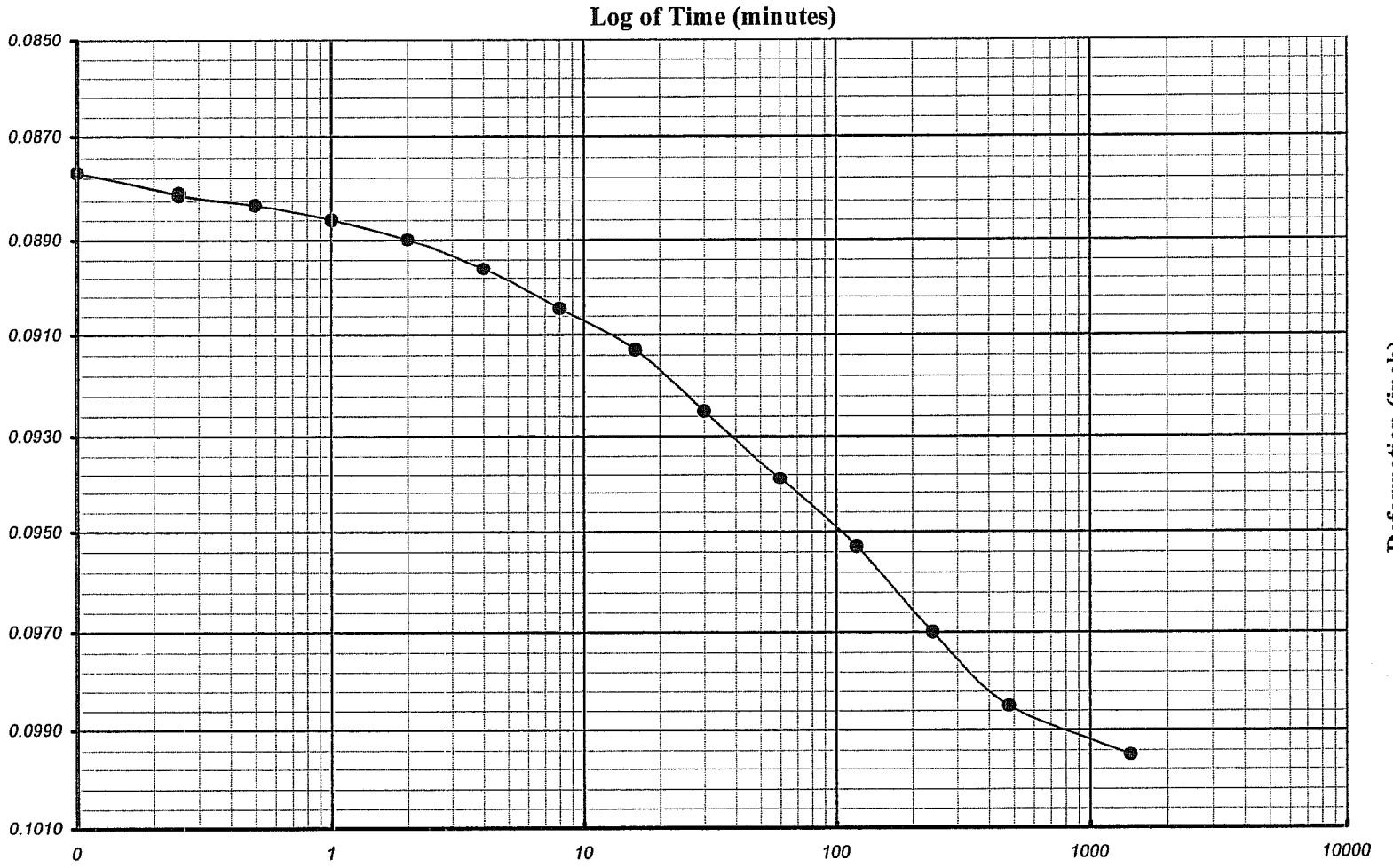
Boring No.	: A-08-008		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-11		Plastic Limit :	-						
Depth (ft)	: 50.0	51.5	Plastic Index :	-	Initial	32.62	88.25	13.89	96.78	0.91
Depth (m)	: 15.25	15.71	Specific Gravity :	2.70	Final	33.01	90.09	14.18	102.31	0.87
Description	: Brown, FAT CLAY (CH)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

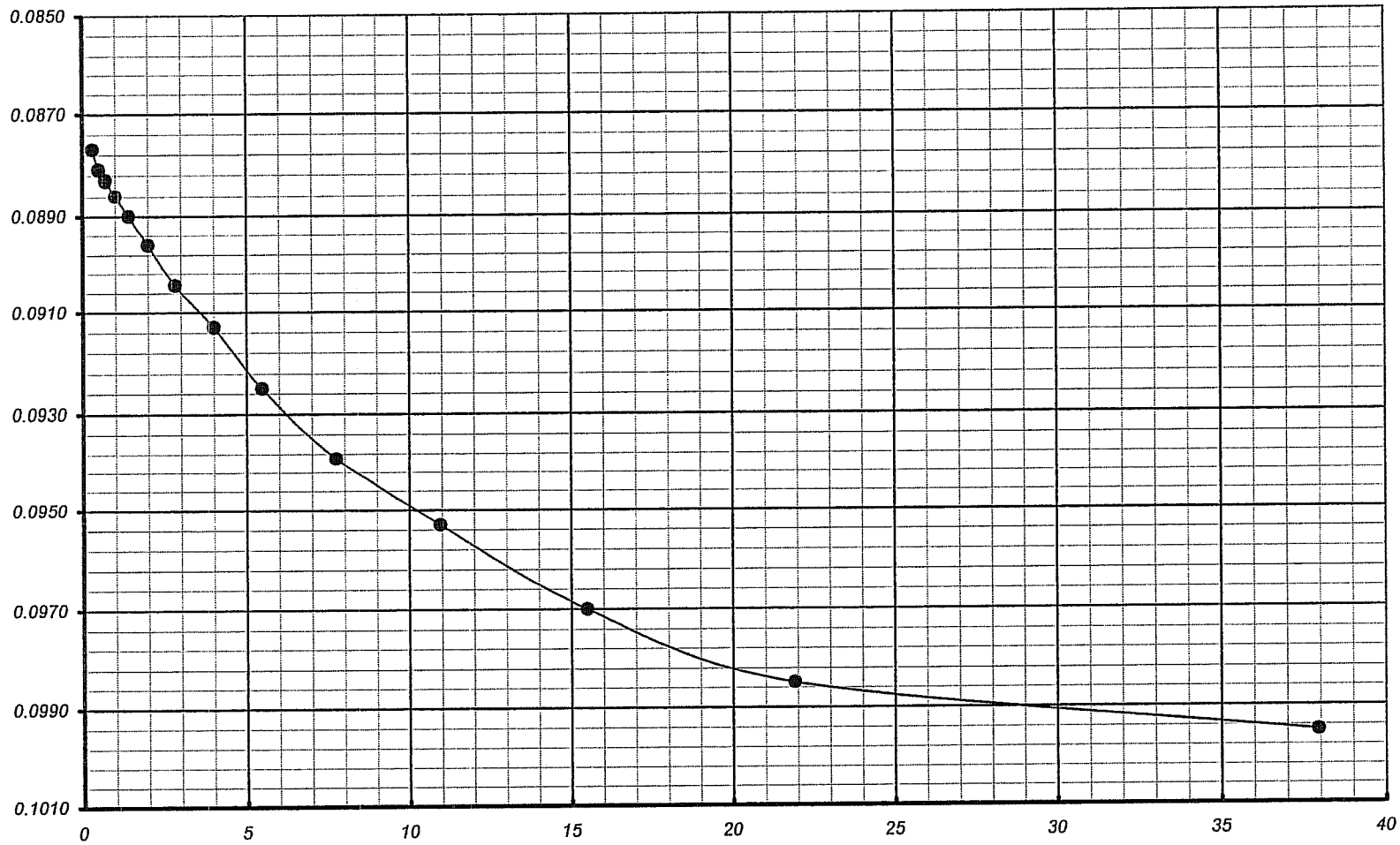
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

Project No. : 08-115 12/05/08

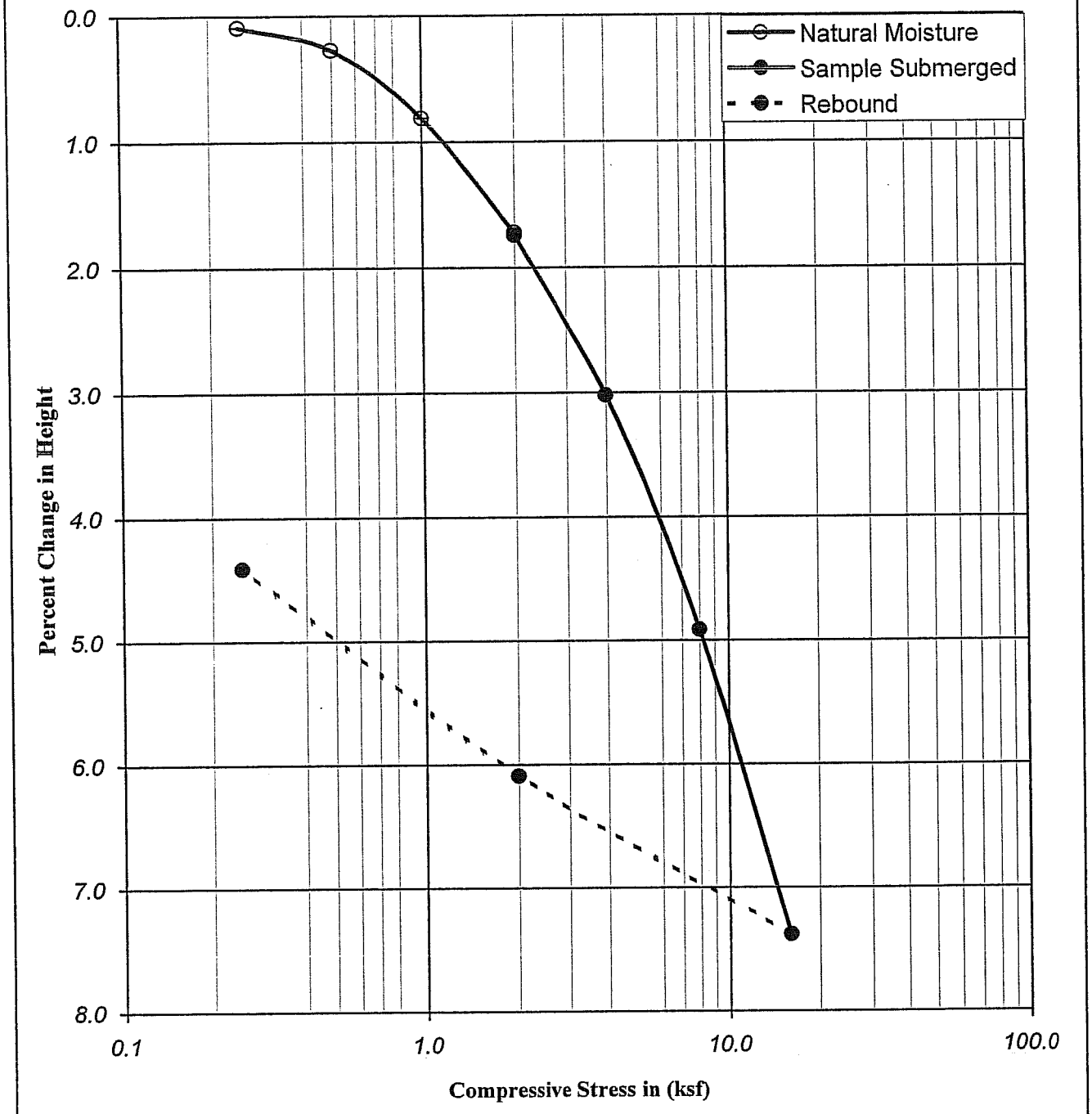


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-11*	
EMI Project No. : *08-115*		Depth (ft/m) : *50.0* *15.3*	Veritcal Load (ksf/kpa) : *8.00* *383.0*

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-11*	
EMI Project No. : *08-115*		Depth (ft/m) : *50.0* *15.3*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



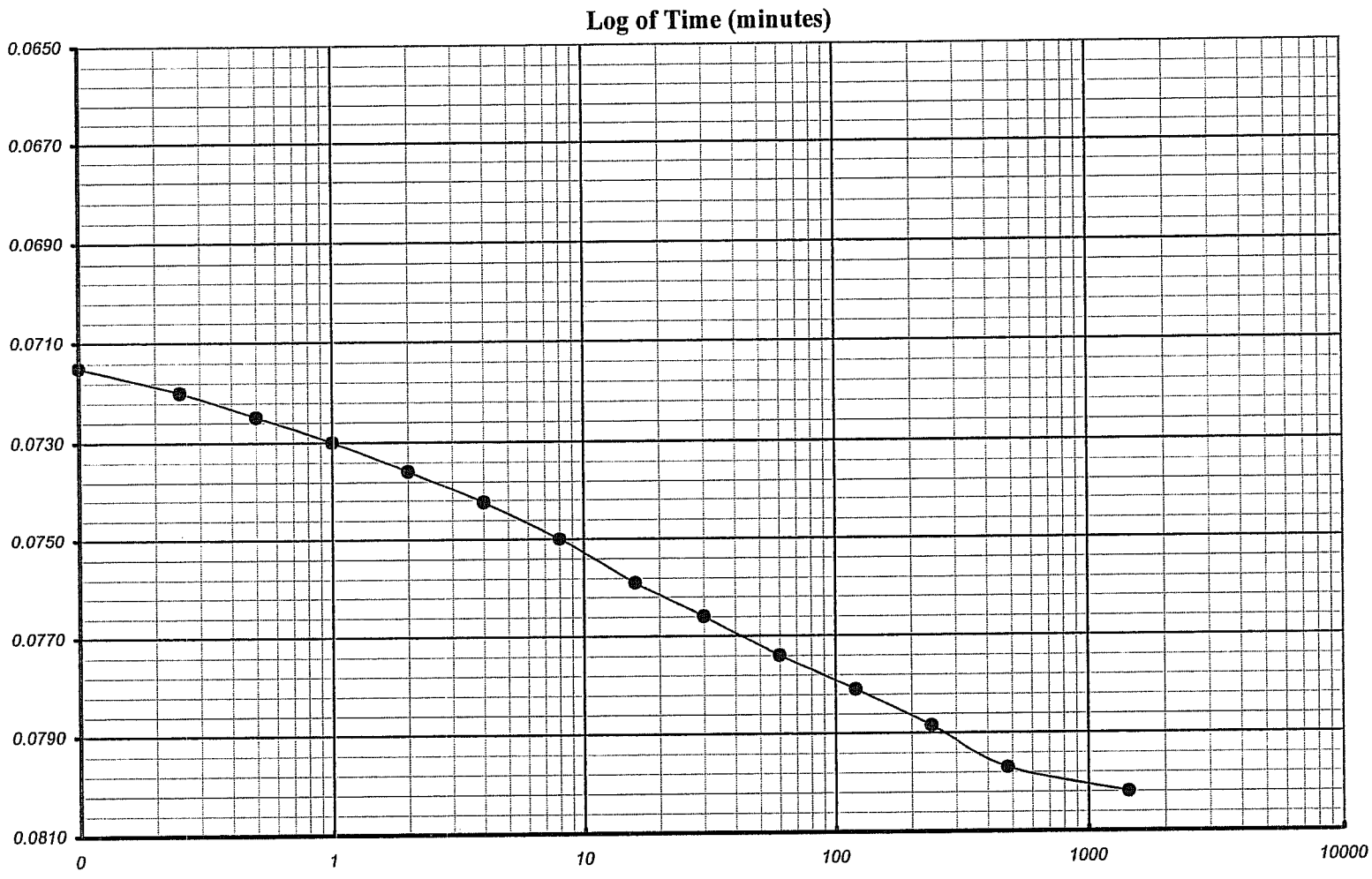
Boring No.	: A-08-012		Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-2		Plastic Limit :	-			(pcf)	(kN/m³)		
Depth (ft)	: 5.0	6.5	Plastic Index :	-	Initial	20.71	105.63	16.63	93.85	0.60
Depth (m)	: 1.53	1.98	Specific Gravity :	2.70	Final	20.02	110.55	17.40	103.00	0.52
Description	: Very dark yellowish brown, lean CLAY with SAND (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

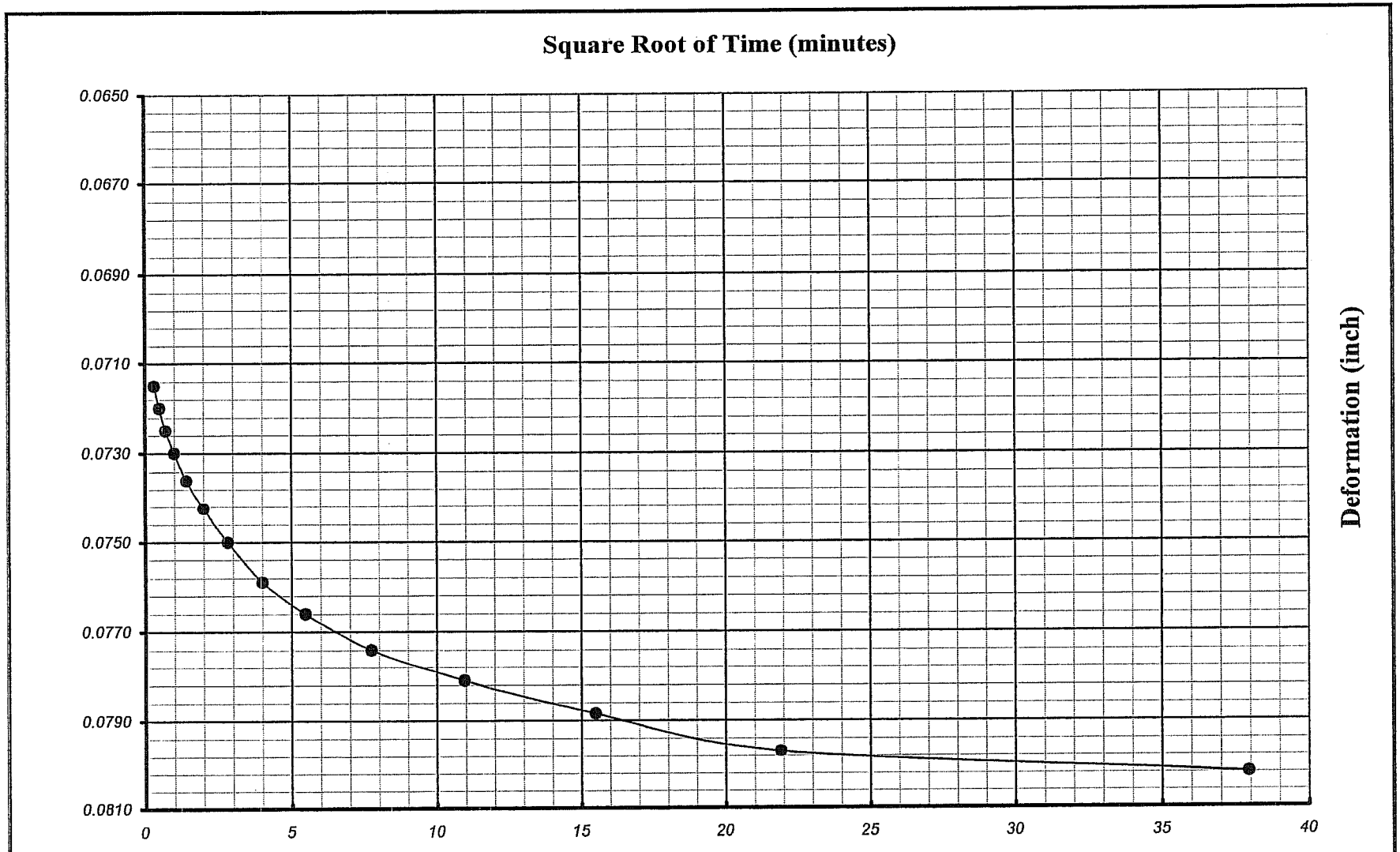
RBF/SR-57 Northbound

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

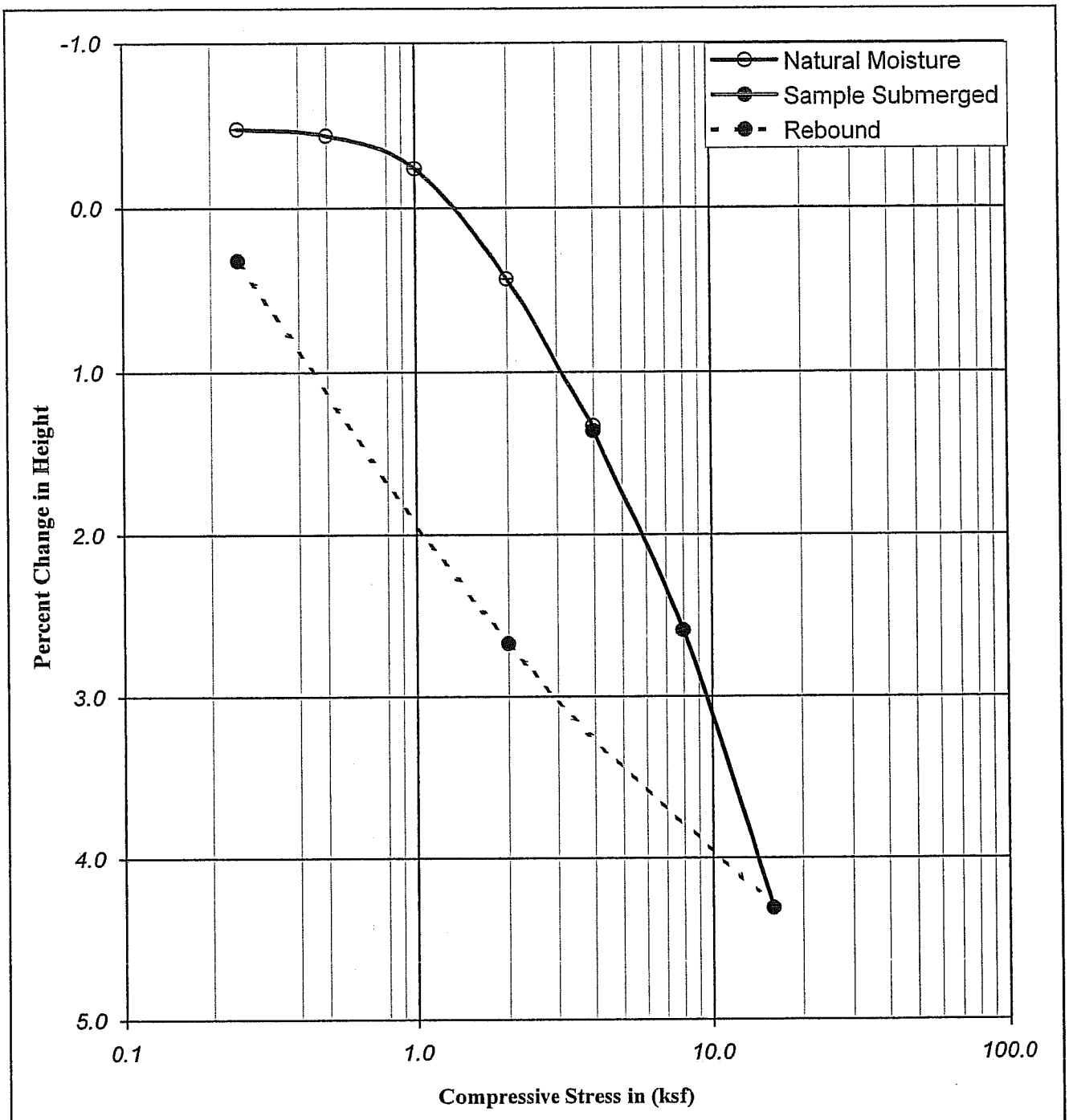
Project No. : *08-115* *12/05/08*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-012*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.00* *191.5*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-012*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



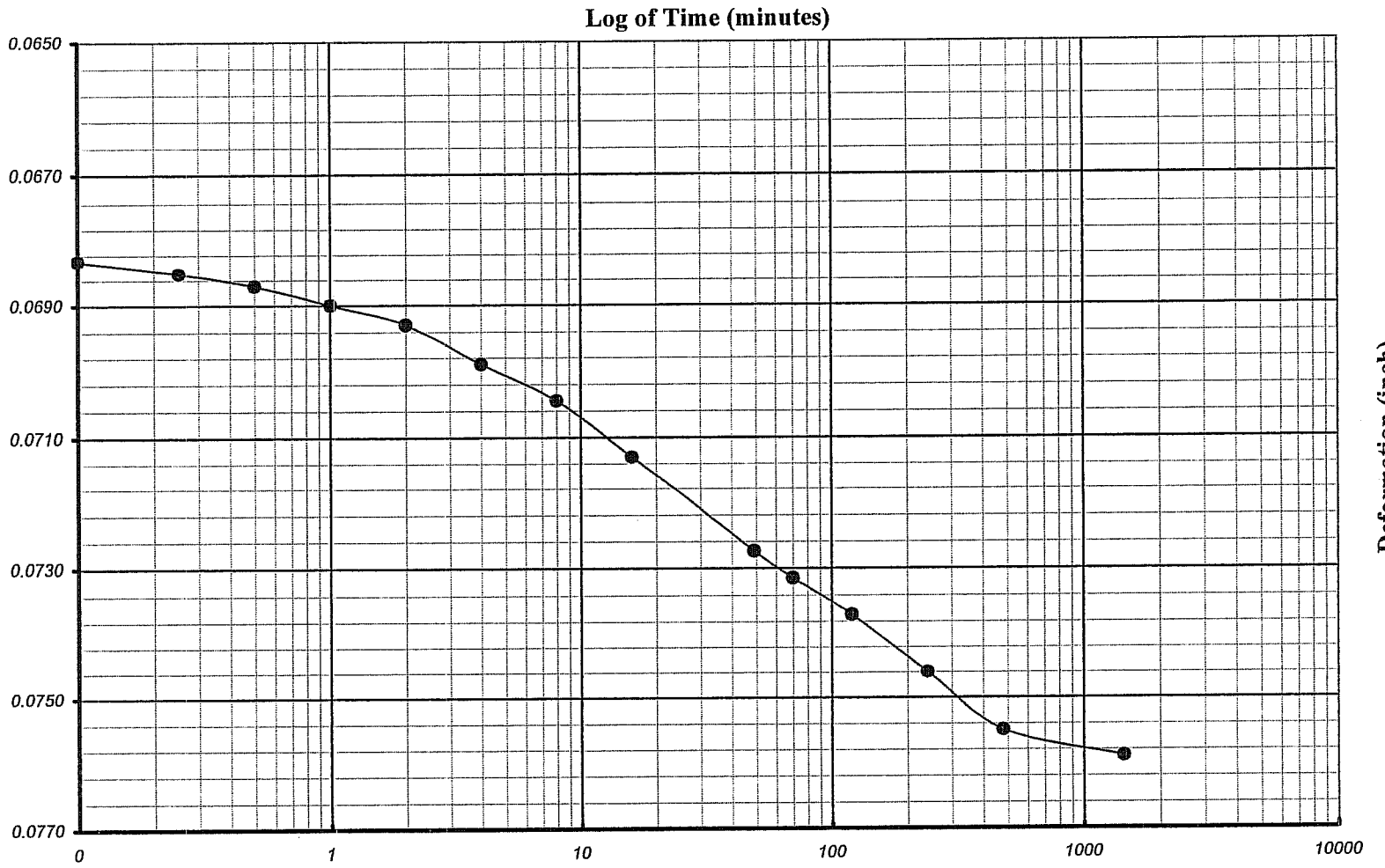
Boring No.	: A-08-013		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m^3)	Percent Saturation	Void Ratio
Sample No.	: D-6		Plastic Limit :	-						
Depth (ft)	: 25.0	26.5	Plastic Index :	-	Initial	16.10	114.51	18.02	92.10	0.47
Depth (m)	: 7.63	8.08	Specific Gravity :	2.70	Final	17.92	115.43	18.17	105.14	0.46
Description	: Strong brown, SANDY lean CLAY (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

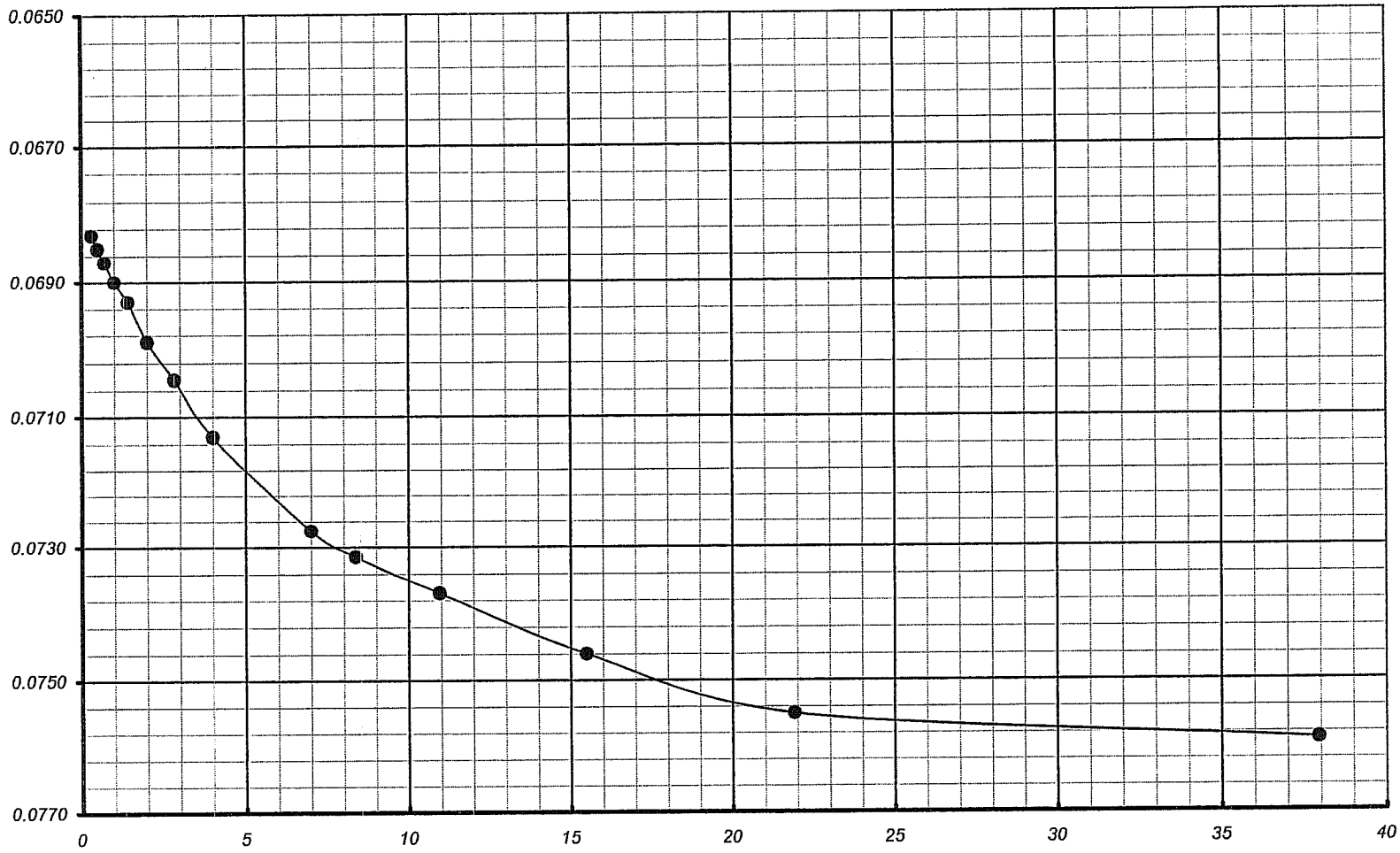
Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

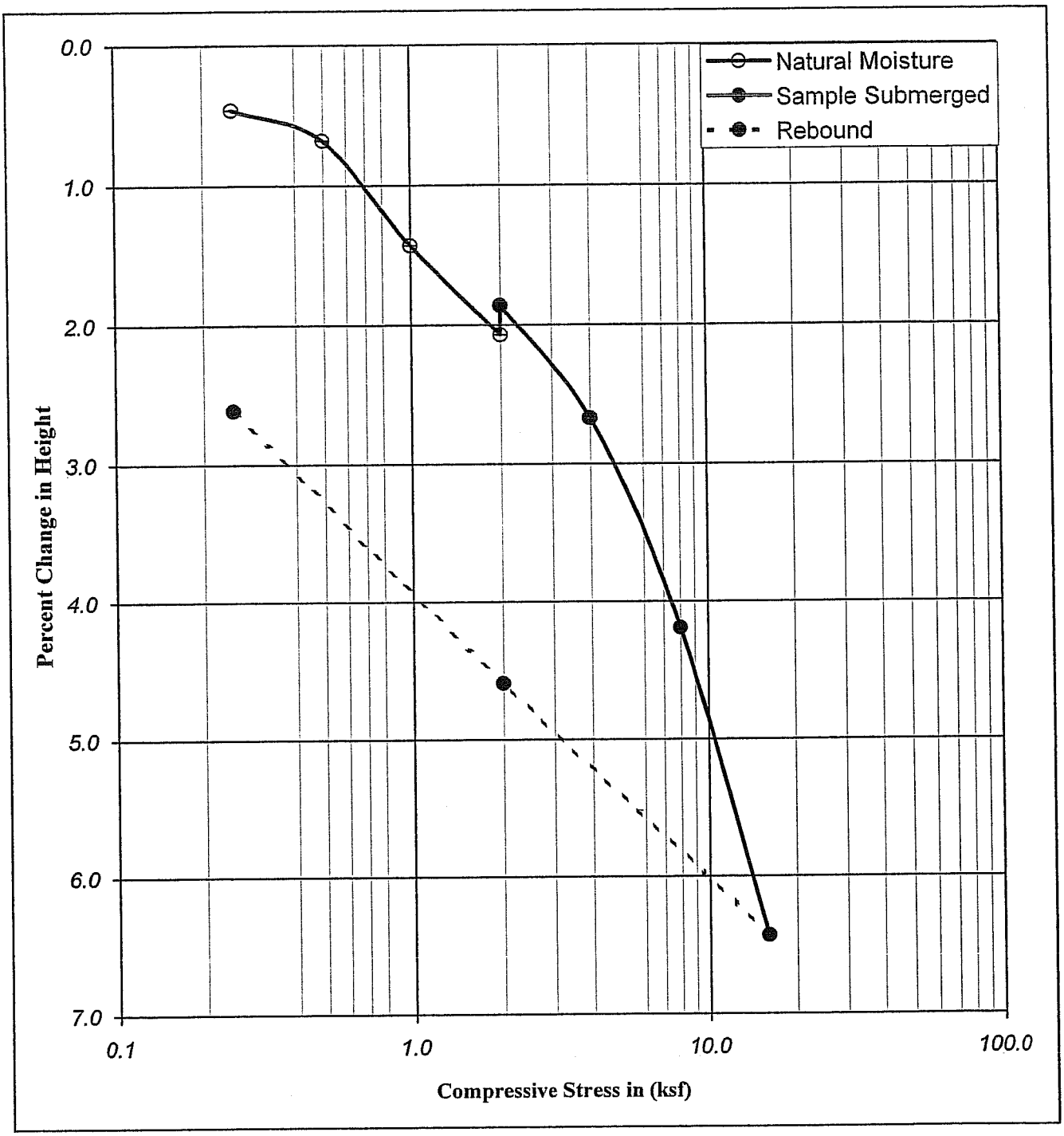


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-013*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-6*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *8.00* *383.0*

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-013*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-6*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



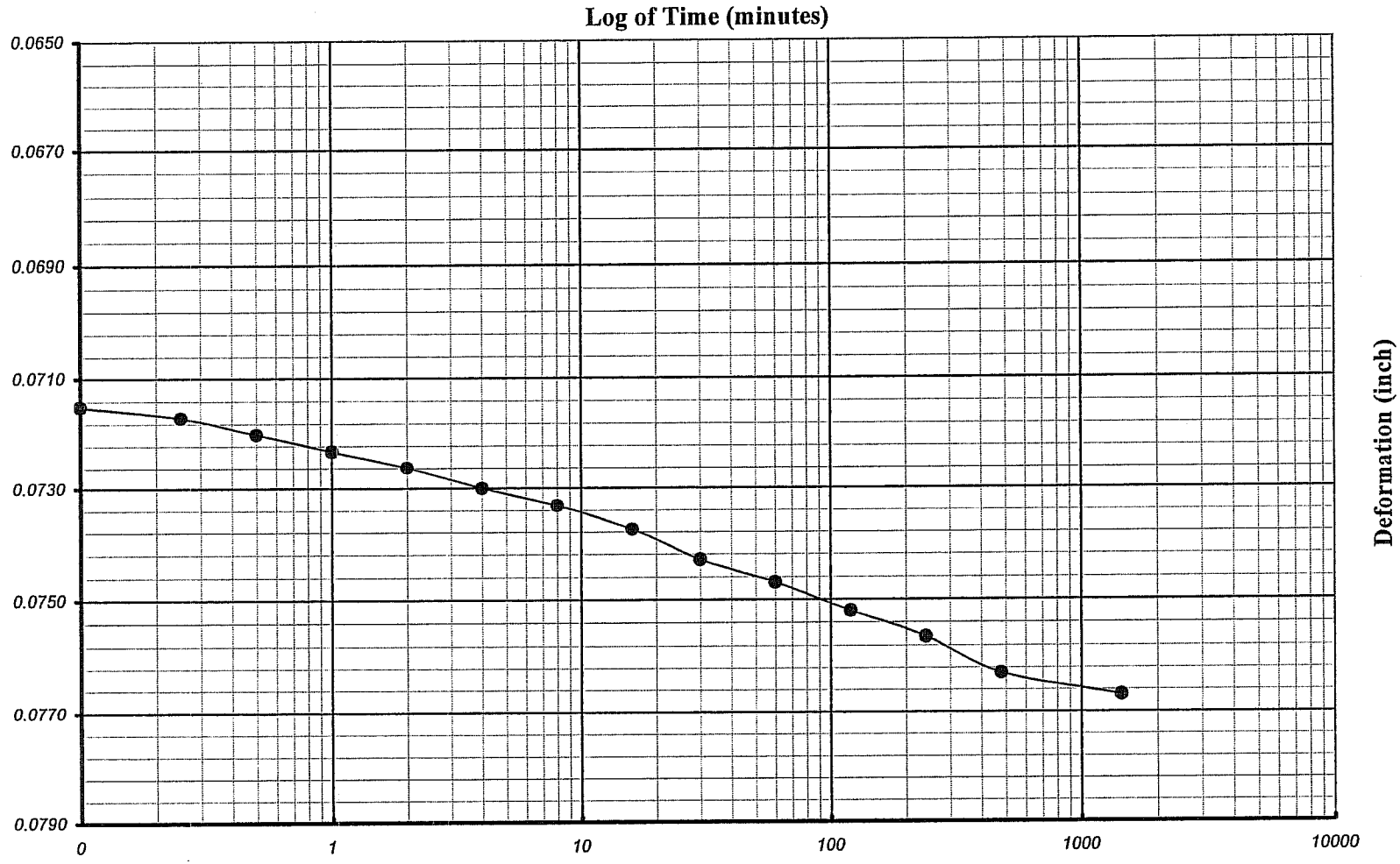
Boring No.	: A-08-014		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-2		Plastic Limit :	-						
Depth (ft)	: 5.0	6.5	Plastic Index :	-	Initial	21.65	106.41	16.75	100.06	0.58
Depth (m)	: 1.53	1.98	Specific Gravity :	2.70	Final	22.30	109.35	17.21	111.20	0.54
Description	: Olive brown mix black, SANDY lean CLAY (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

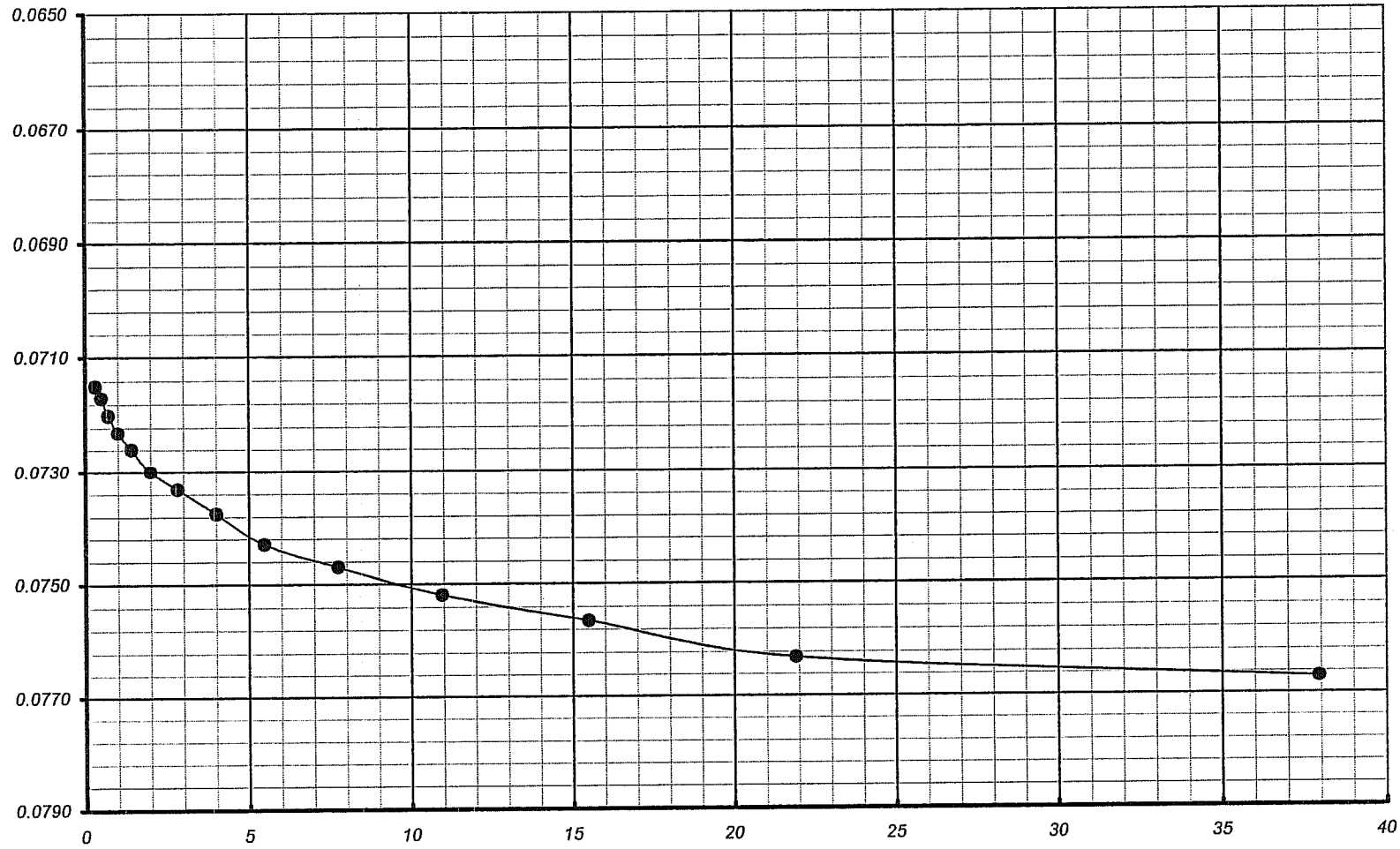
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

Project No. : *08-115* *12/05/08*

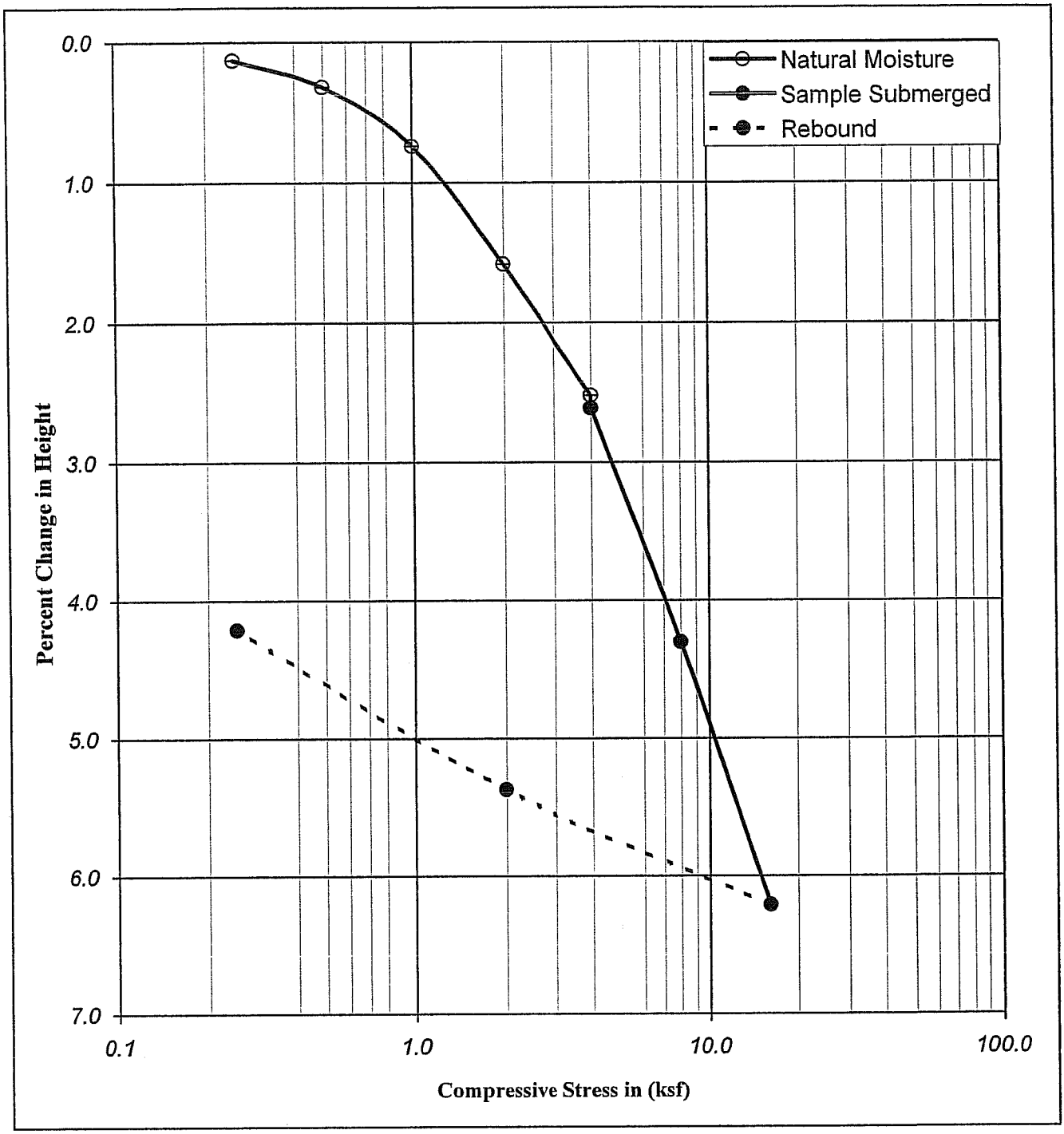


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound	Boring No. : A-08-014	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : D-2	
EMI Project No. : 08-115		Depth (ft/m) : 5.0 1.5	Veritcal Load (ksf/kpa) : 4.00 191.5

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-014*	**One-Dimensional Consolidation of Soil** Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



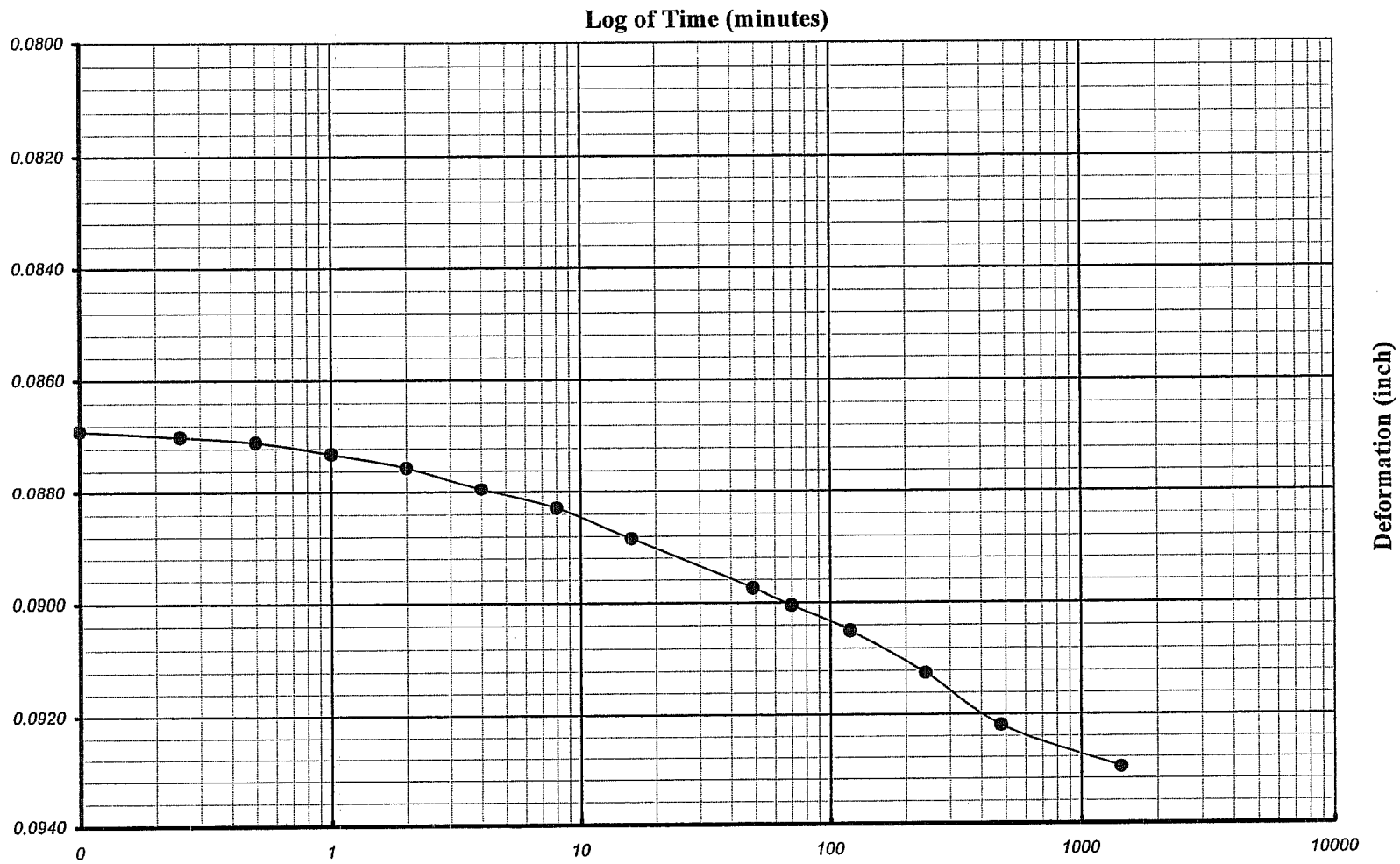
Boring No.	: A-08-015			Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-10			Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft) :	25.0	26.5	Plastic Index :	-	Initial	13.36	96.70	15.22	48.54	0.74
	(m) :	7.63	8.08	Specific Gravity :	2.70	Final	24.67	100.96	15.89	99.46	0.67
Description	: Yellowish brown, SILTY SAND (SM)										

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

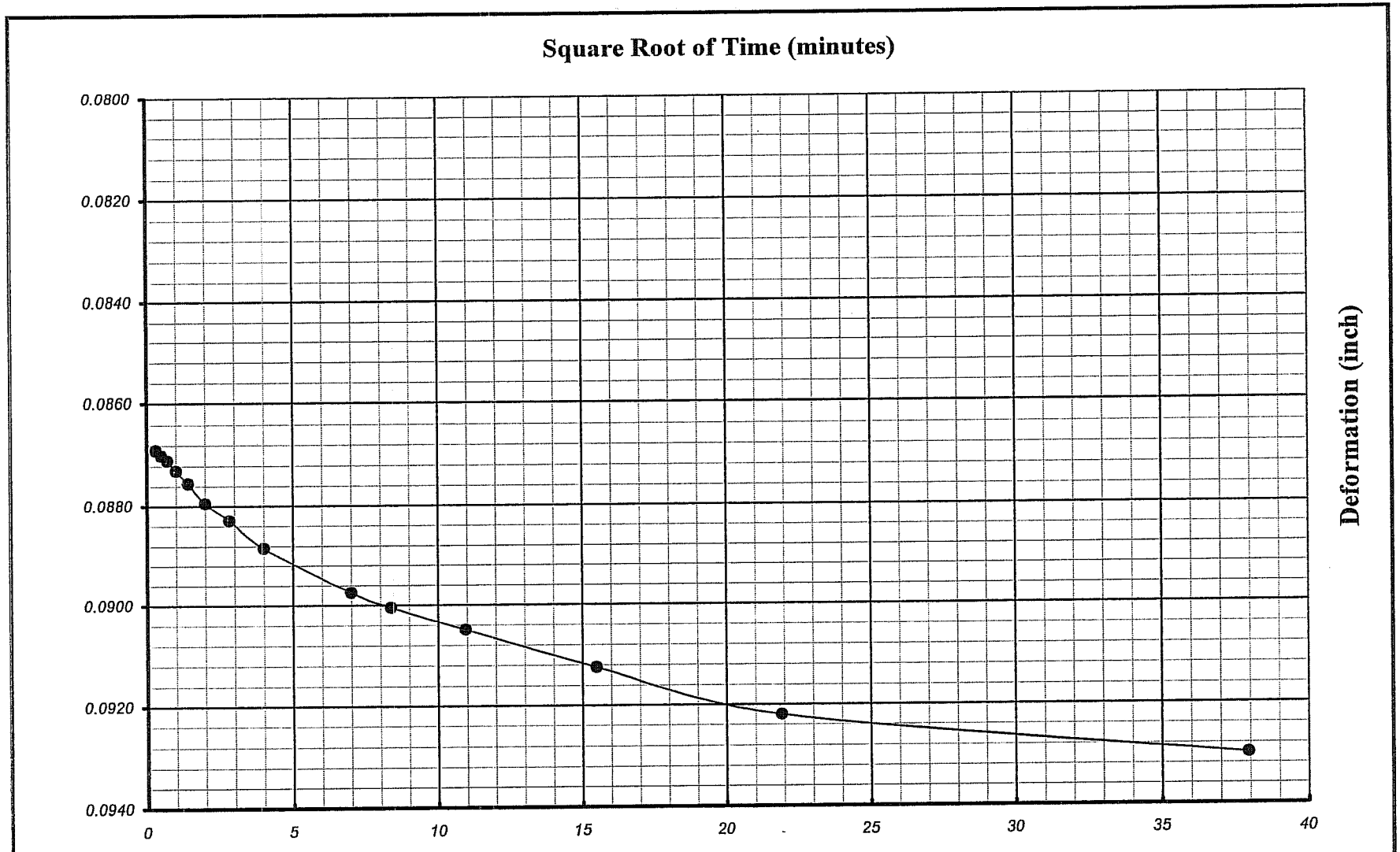
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

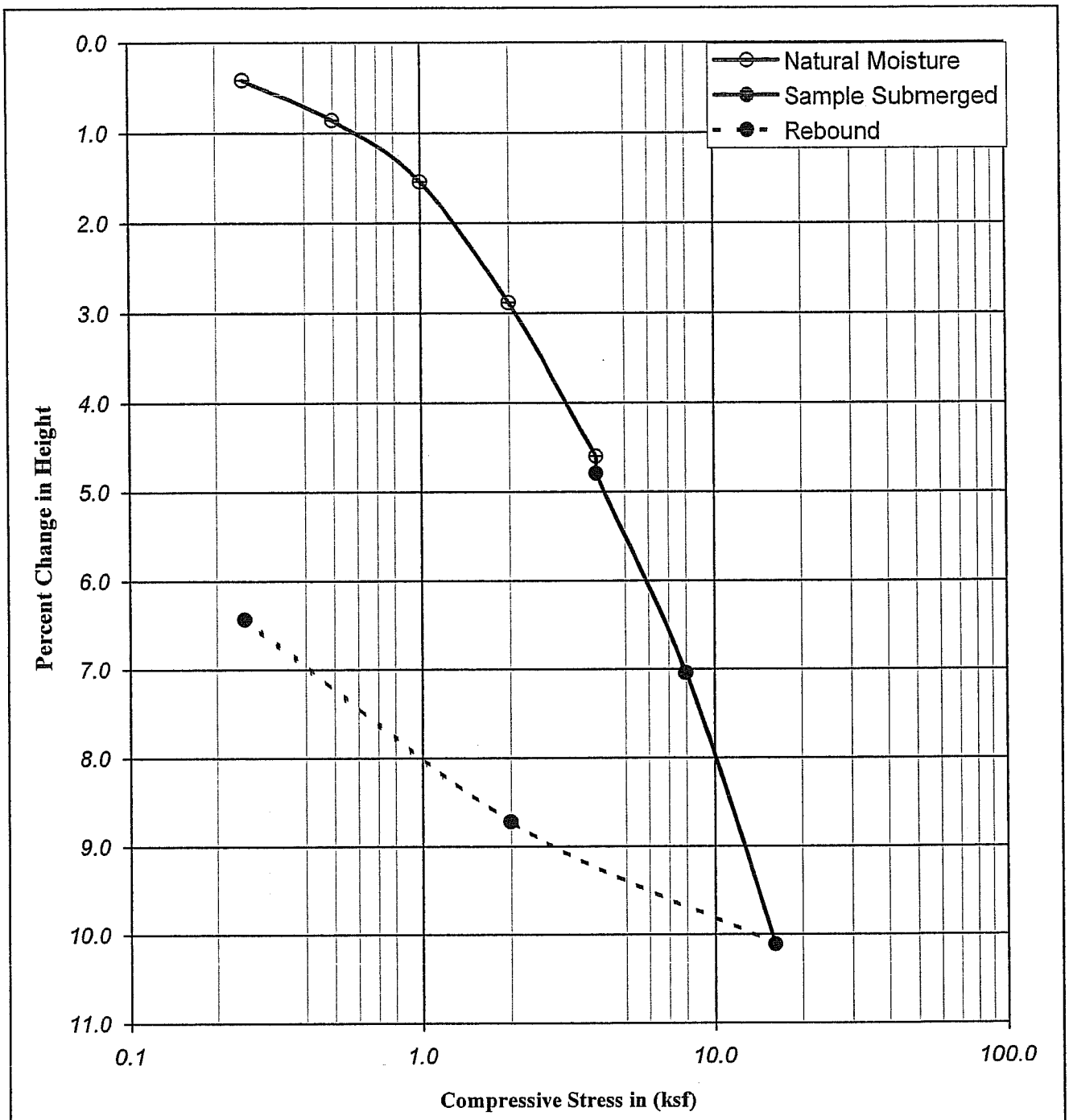
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-015*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-10*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-015*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-10*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



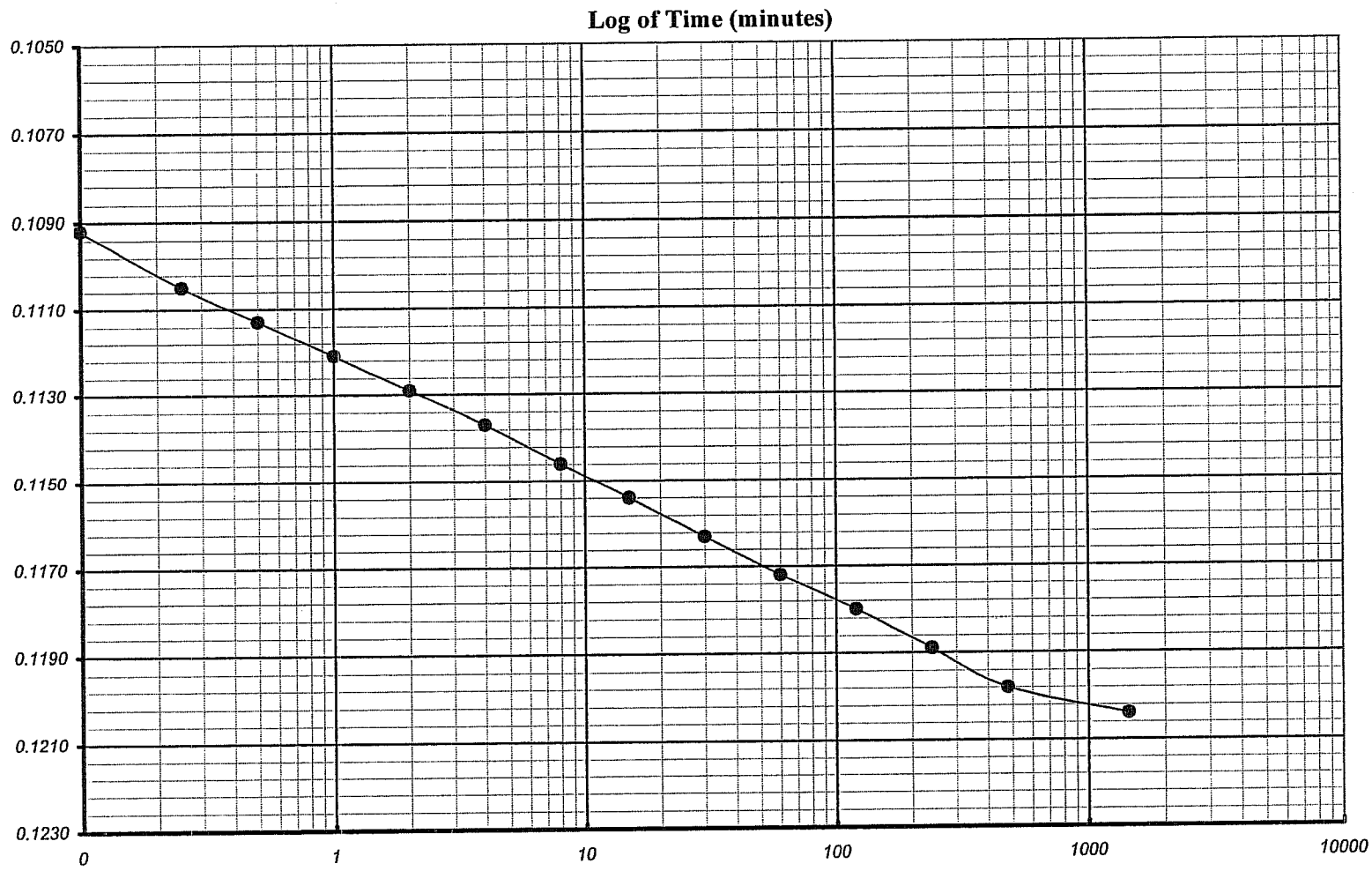
Boring No.	: A-08-016			Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-7			Plastic Limit :	-						
Depth (ft)	: 30.0	31.5		Plastic Index :	-	Initial	18.78	103.85	16.35	81.38	0.62
Depth (m)	: 9.15	9.61		Specific Gravity :	2.70	Final	19.40	111.00	17.47	100.98	0.52
Description	: Dark yellowish brown, lean CLAY with SAND (CL)										

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

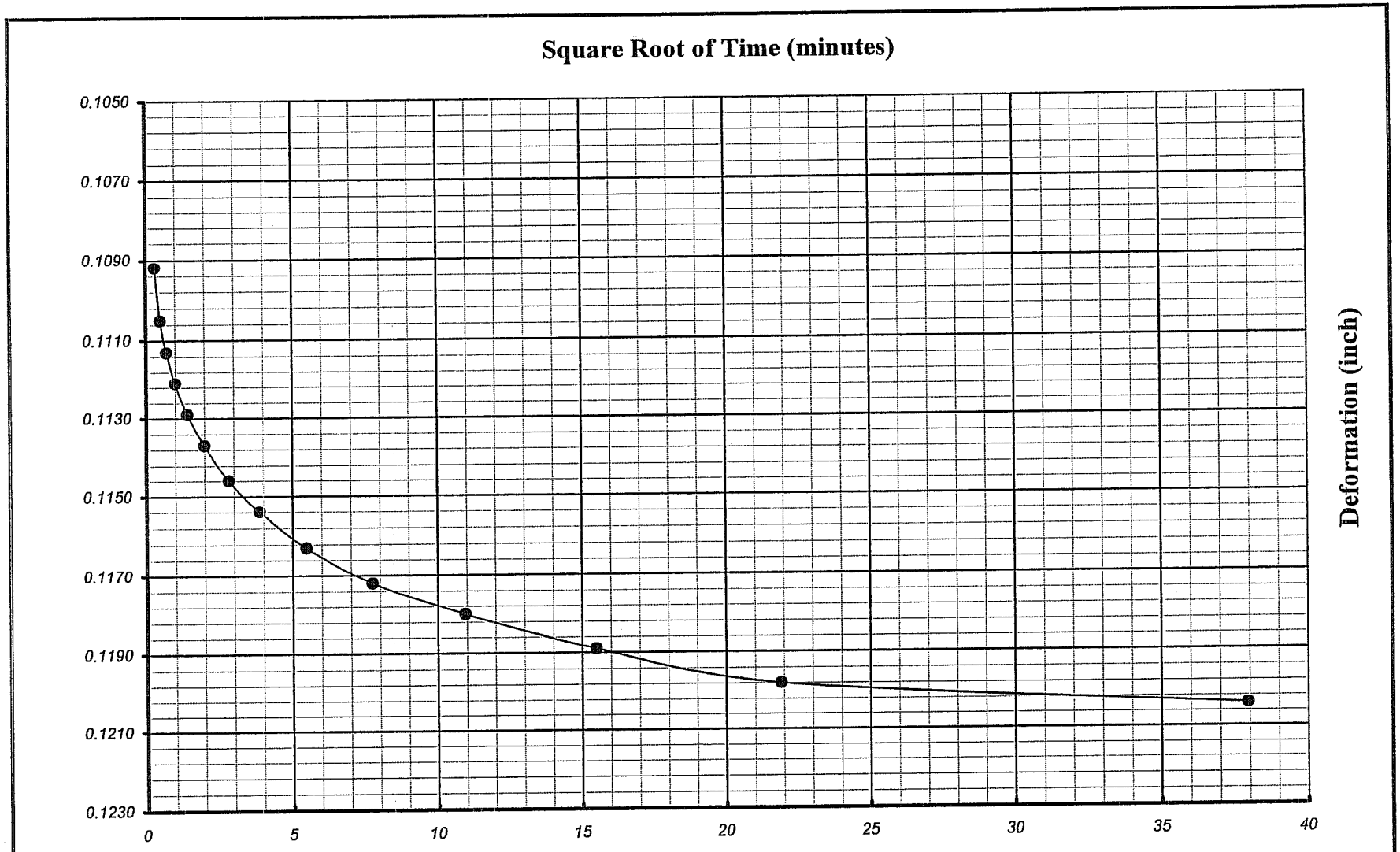
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

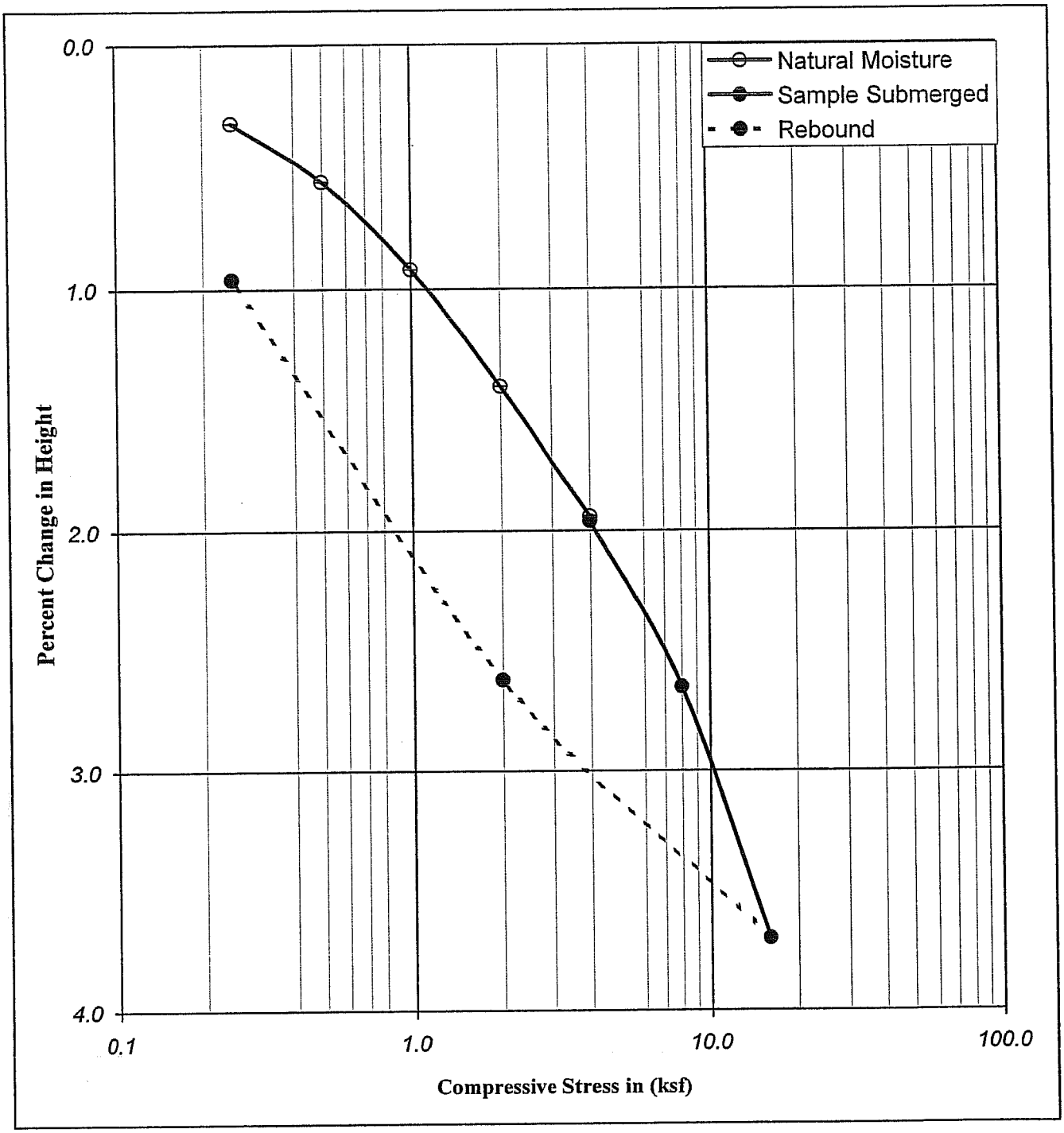
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound	Boring No. : A-08-016	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : D-7	
EMI Project No. : 08-115		Depth (ft/m) : 30.0 9.2	Veritcal Load (ksf/kpa) : 8.00 383.0



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-016*	**One-Dimensional Consolidation of Soil** Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-7*	
EMI Project No. : *08-115*		Depth (ft/m) : *30.0* *9.2*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



Boring No.	: A-08-016		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m^3)	Percent Saturation	Void Ratio
Sample No.	: D-11		Plastic Limit :	-						
Depth (ft)	: 50.0	51.5	Plastic Index :	-	Initial	15.23	113.96	17.94	85.79	0.48
Depth (m)	: 15.25	15.71	Specific Gravity :	2.70	Final	16.92	115.25	18.14	98.75	0.46

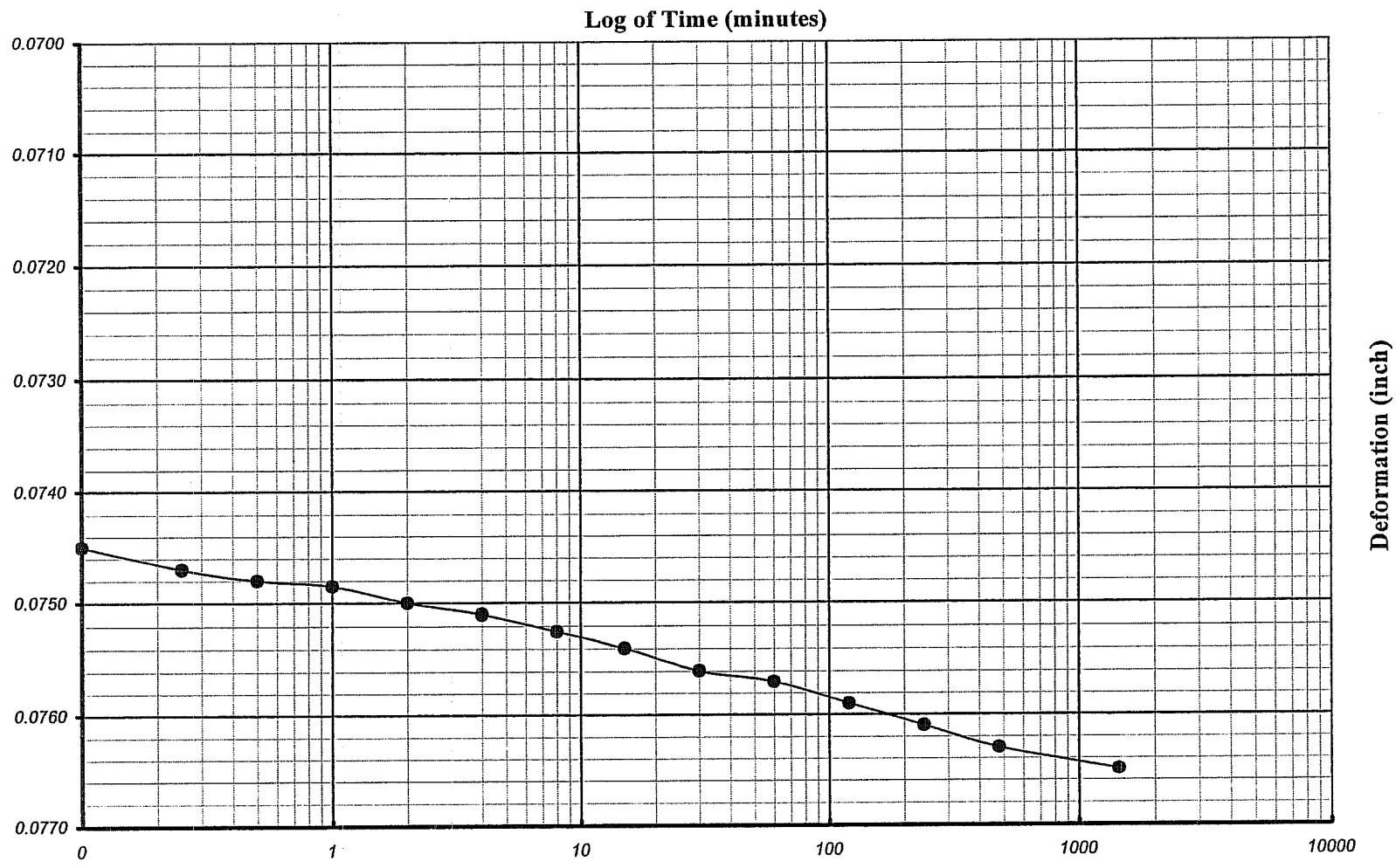
Description : *Dark yellowish brown, Lean CLAY With SAND (CL)*

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

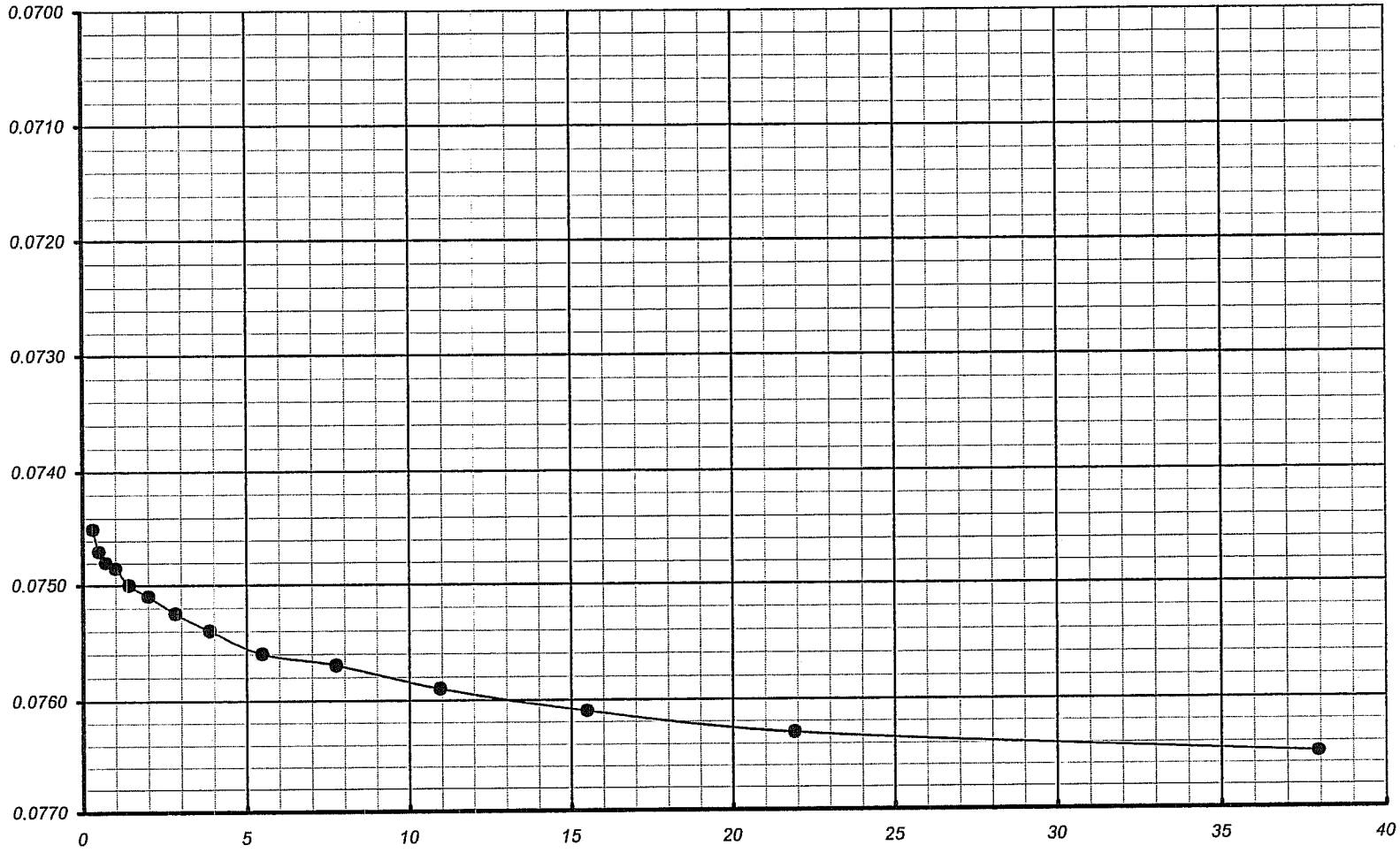
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

Project No. : *08-115* *12/05/08*

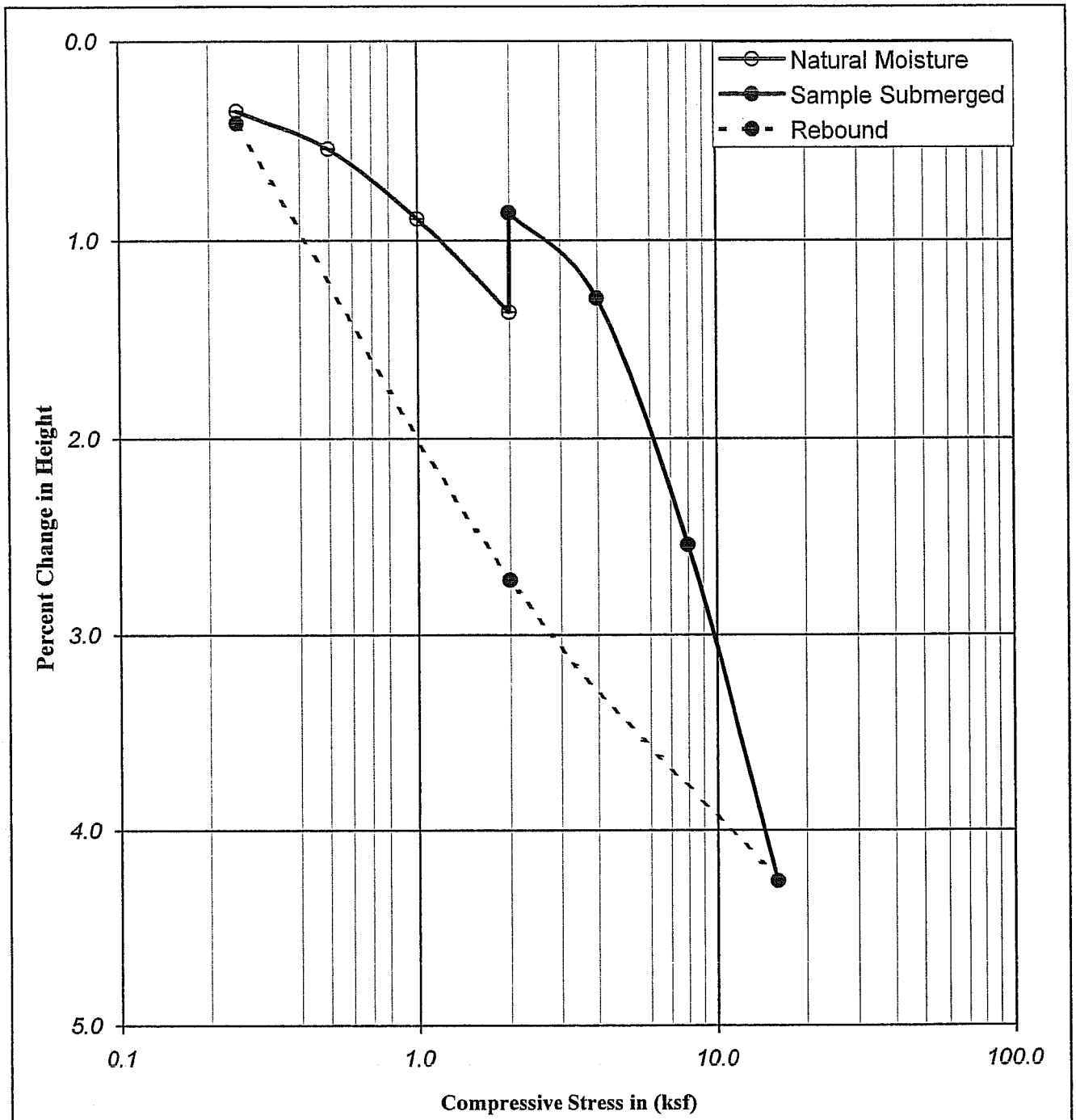


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	***RBF/SR-57 Northbound***	**Boring No. :** *A-08-016*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-11*	
EMI Project No. : *08-115*		**Depth (ft/m) :** *50.0* *15.3*	**Veritcal Load (ksf/kpa) :** *8.00* *383.0*

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-016*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-11*	
EMI Project No. : *08-115*		Depth (ft/m) : *50.0* *15.3*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



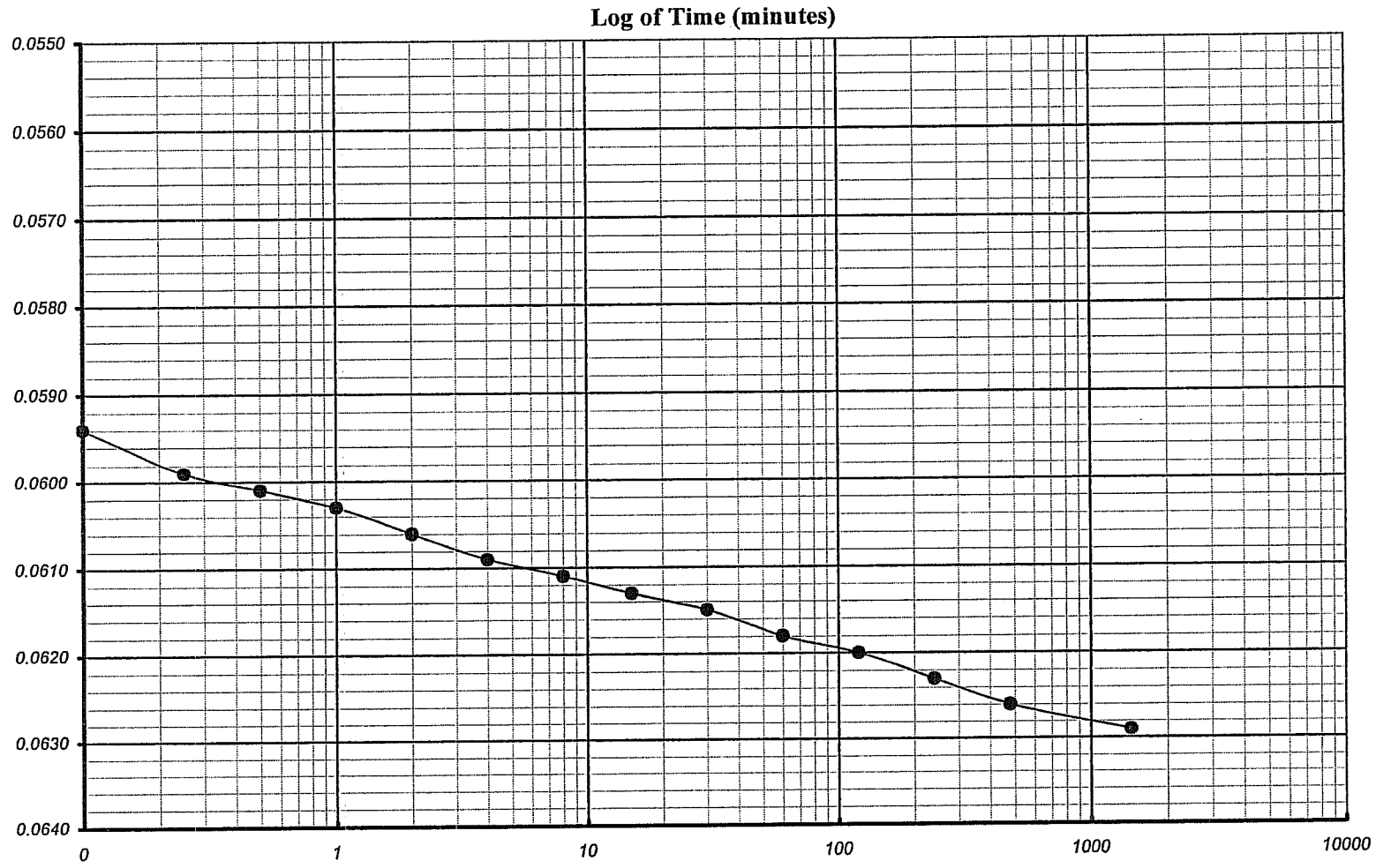
Boring No.		: A-08-017		Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.		: D-6		Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft)	: 25.0	26.5	Plastic Index :	-	Initial	14.38	110.80	17.44	74.49	0.52
	(m)	: 7.63	8.08	Specific Gravity :	2.70	Final	18.30	111.29	17.52	96.01	0.51
Description		: Dark brown, lean CLAY with SAND (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

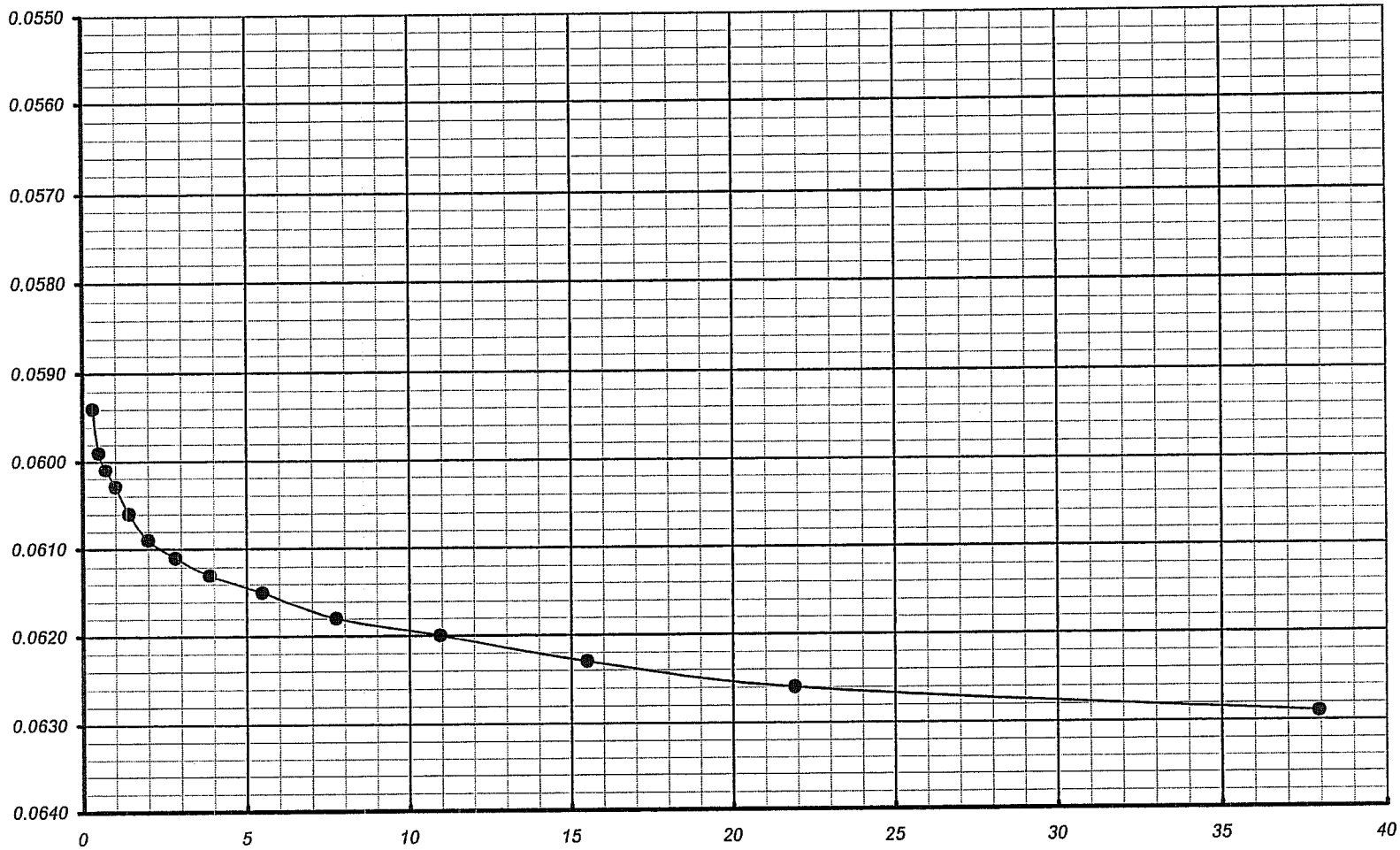
Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

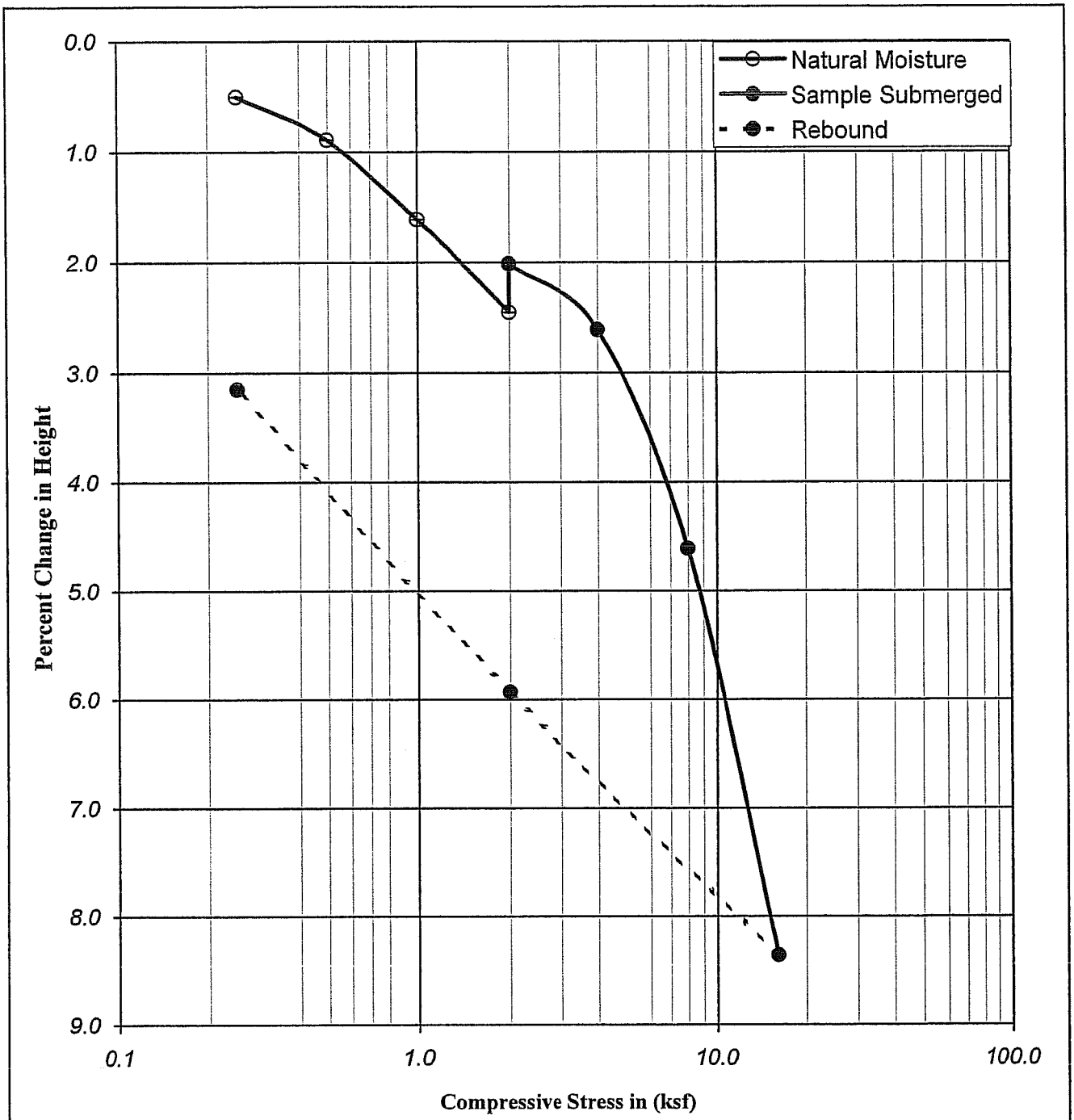


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound	Boring No. : A-08-017	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : D-6	
EMI Project No. : 08-115		Depth (ft/m) : 25.0 7.6	Veritcal Load (ksf/kpa) : 4.00 191.5

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-017*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-6*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



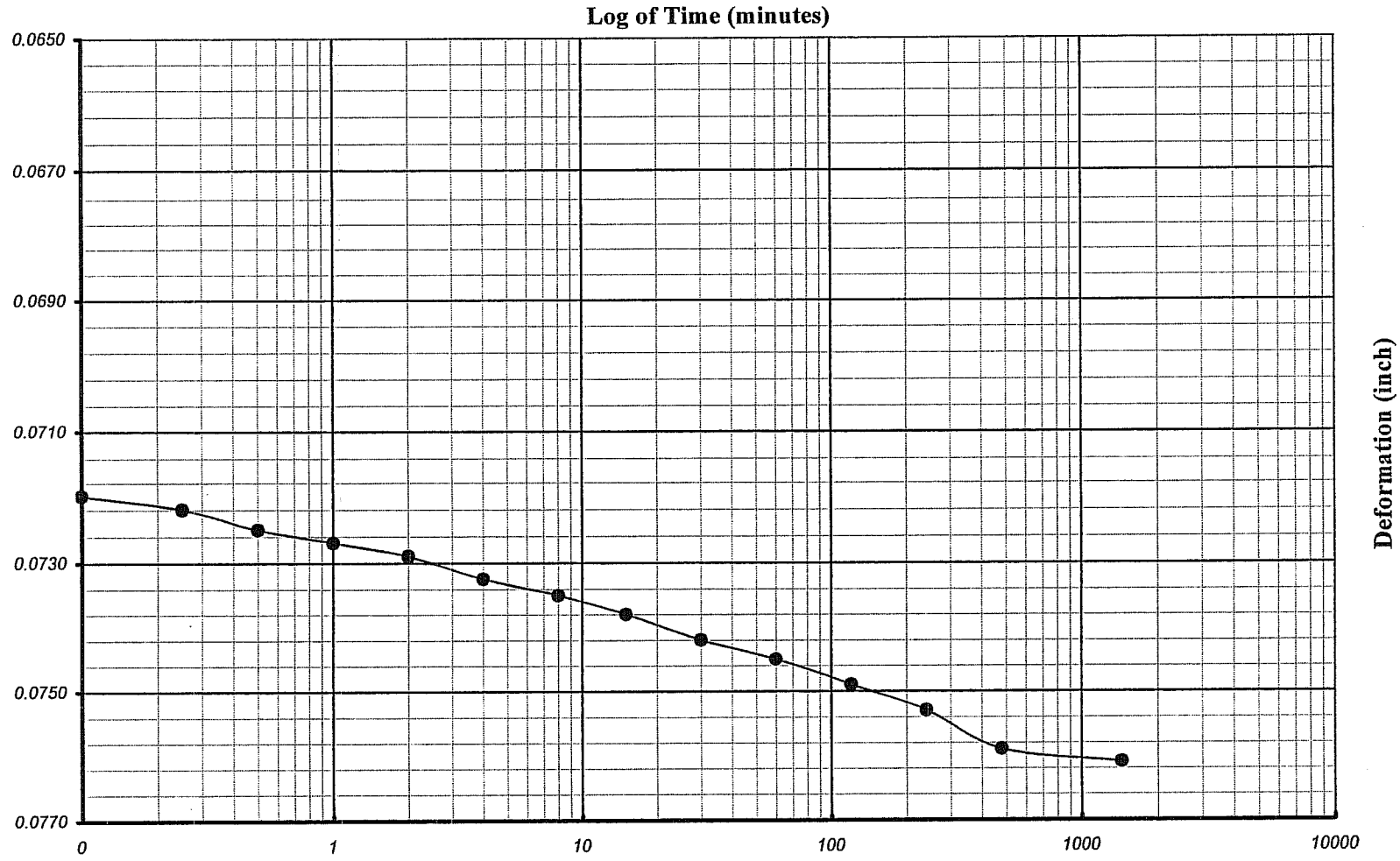
Boring No.	: A-08-018		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-2		Plastic Limit :	-						
Depth (ft)	: 5.0	6.5	Plastic Index :	-	Initial	26.10	96.70	15.22	94.85	0.74
Depth (m)	: 1.53	1.98	Specific Gravity :	2.70	Final	26.84	99.94	15.73	105.55	0.69
Description	: Olive brown, lean CLAY with SAND (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

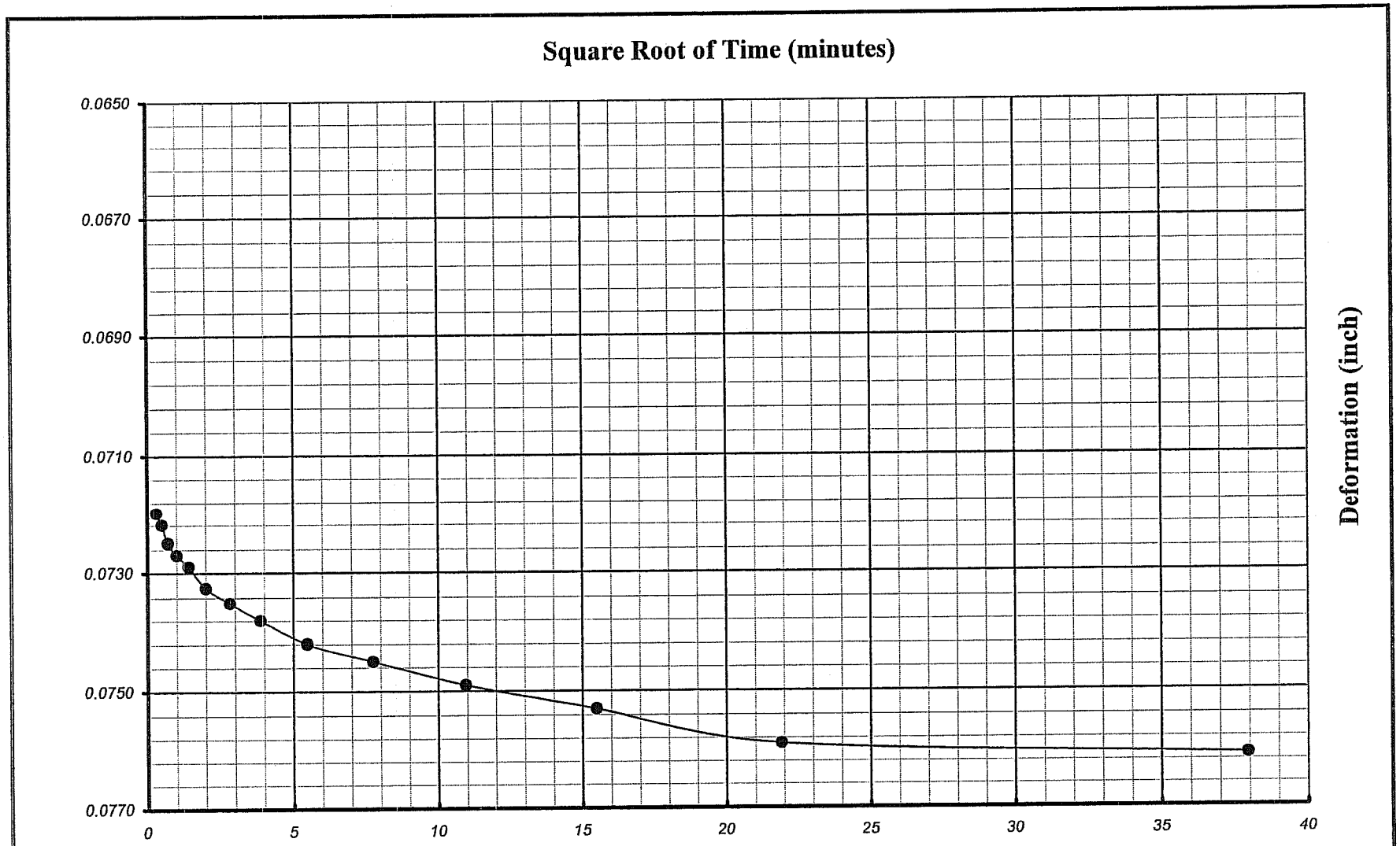
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

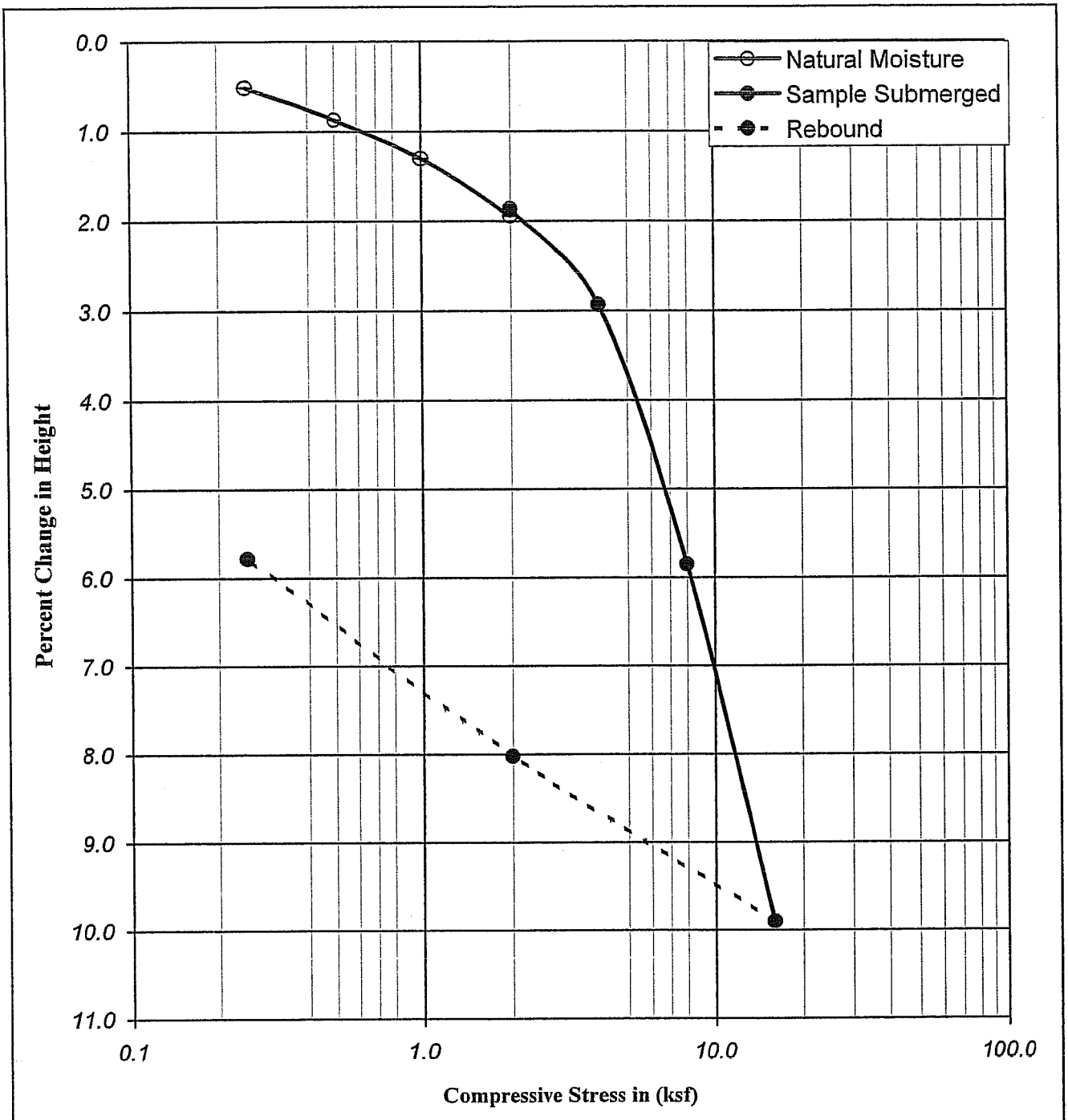
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-018*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.00* *191.5*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-018*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Squnre Root of Time Method)**
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



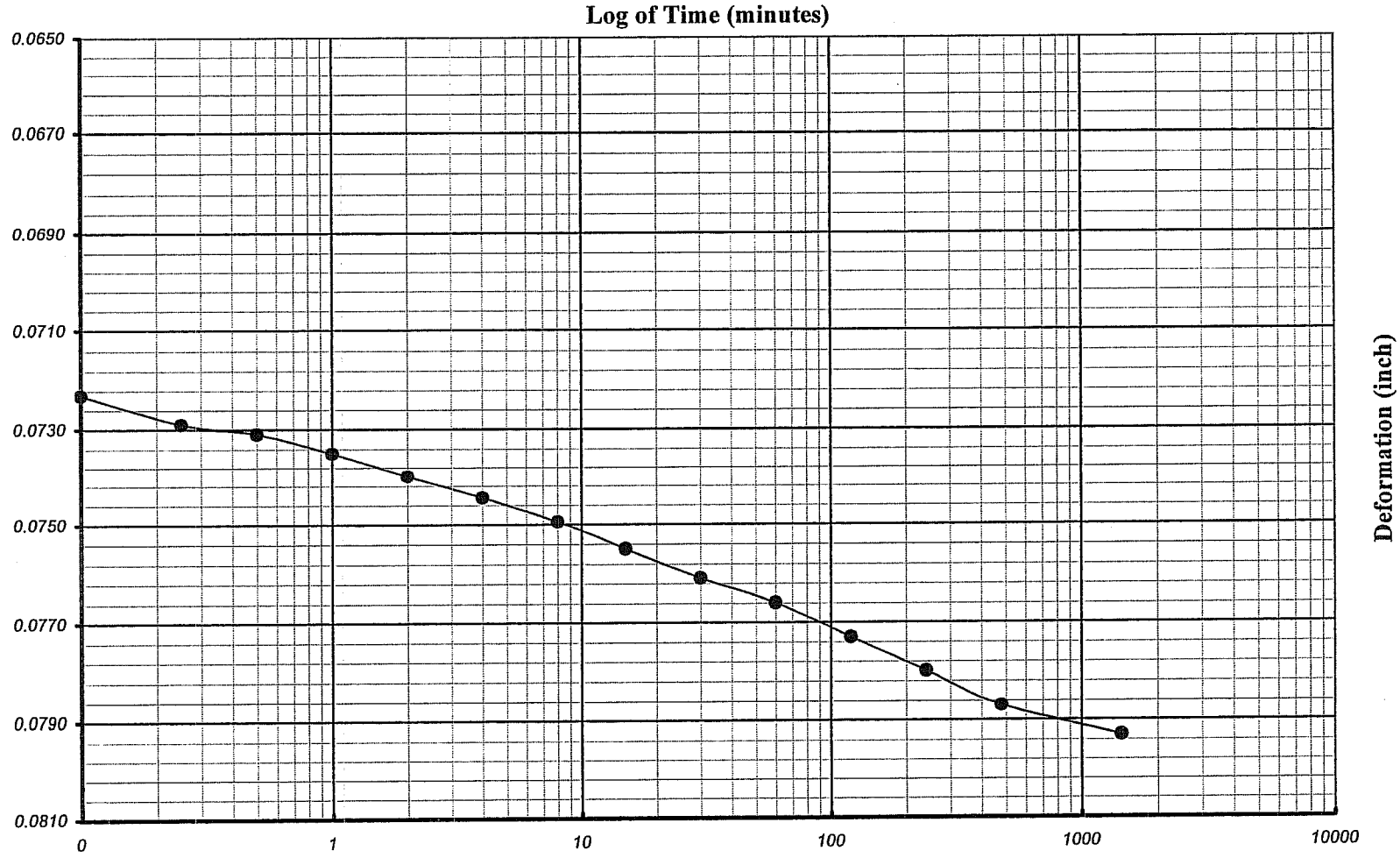
Boring No.	: A-08-019			Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-5			Plastic Limit :	-						
Depth (ft)	: 20.0	21.5		Plastic Index :	-	Initial	26.28	94.14	14.82	89.76	0.79
Depth (m)	: 6.10	6.56		Specific Gravity :	2.70	Final	25.19	100.06	15.75	99.33	0.68
Description	: Mottled olive gray, olive brown and brown, lean CLAY(CL)										

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

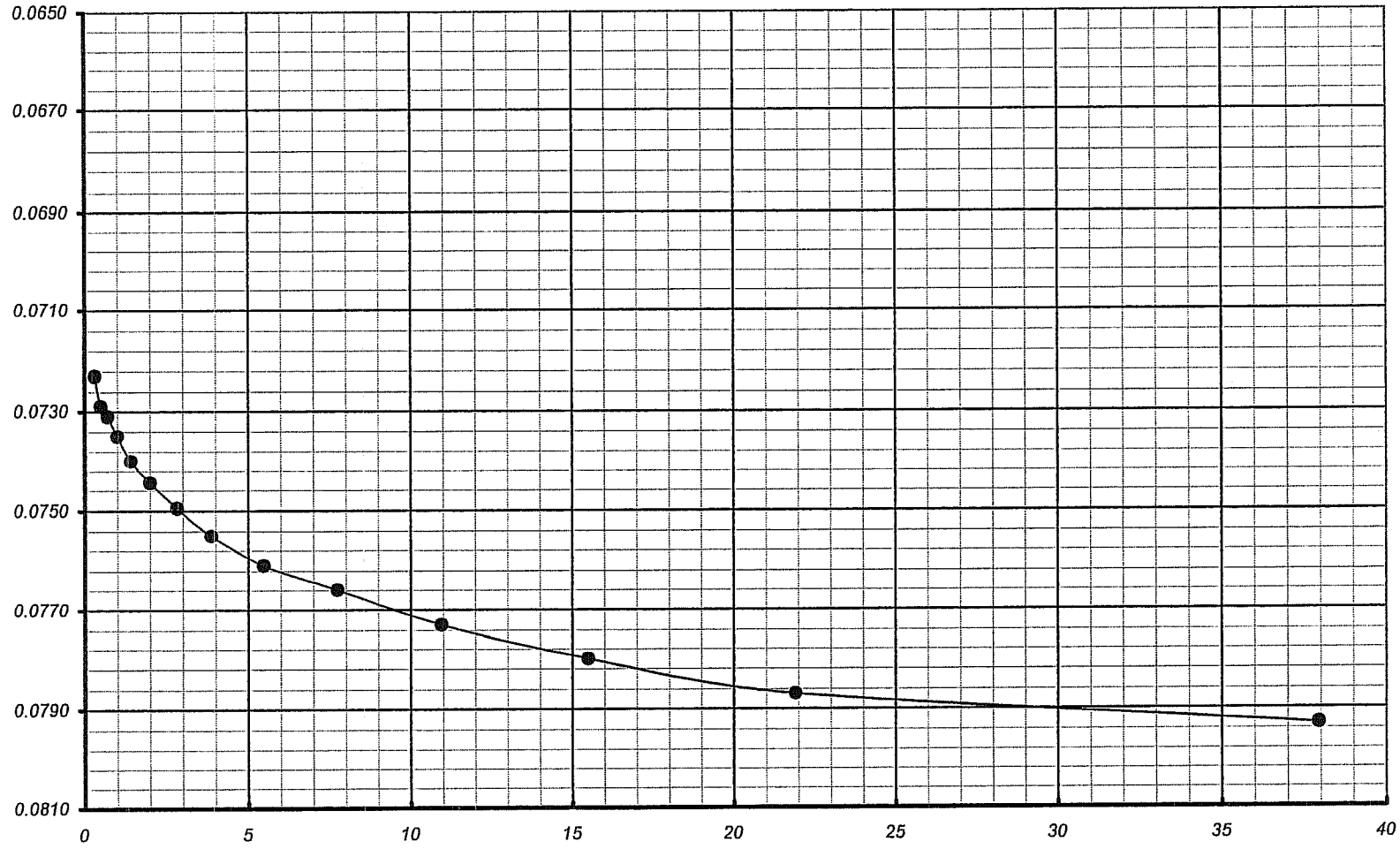
Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

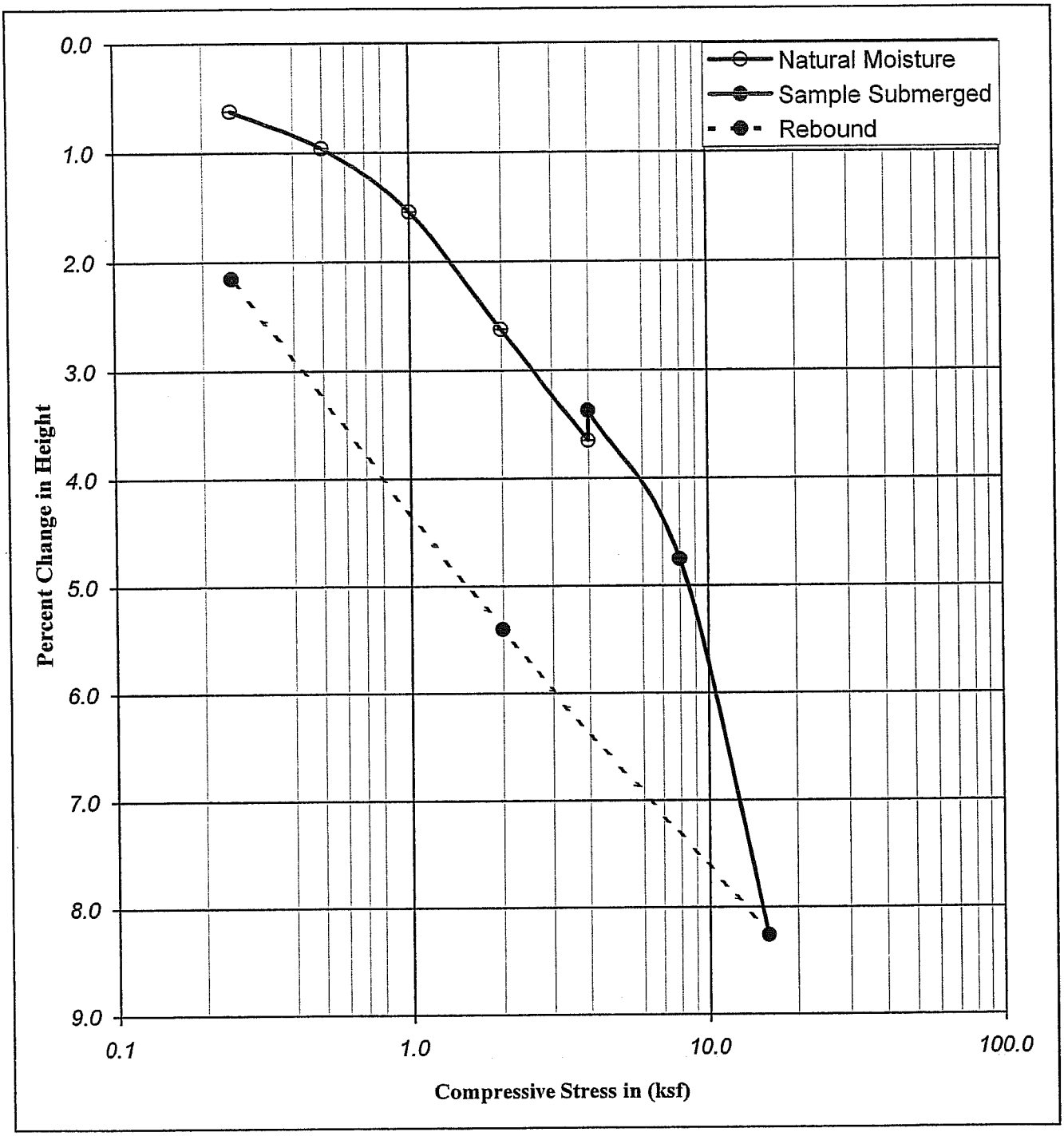


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	***RBF/SR-57 Northbound***	**Boring No. :** *A-08-019*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-5*	
EMI Project No. : *08-115*		**Depth (ft/m) :** *20.0* *6.1*	**Veritcal Load (ksf/kpa) :** *4.00* *191.5*

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-019*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-5*	
EMI Project No. : *08-115*		Depth (ft/m) : *20.0* *6.1*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



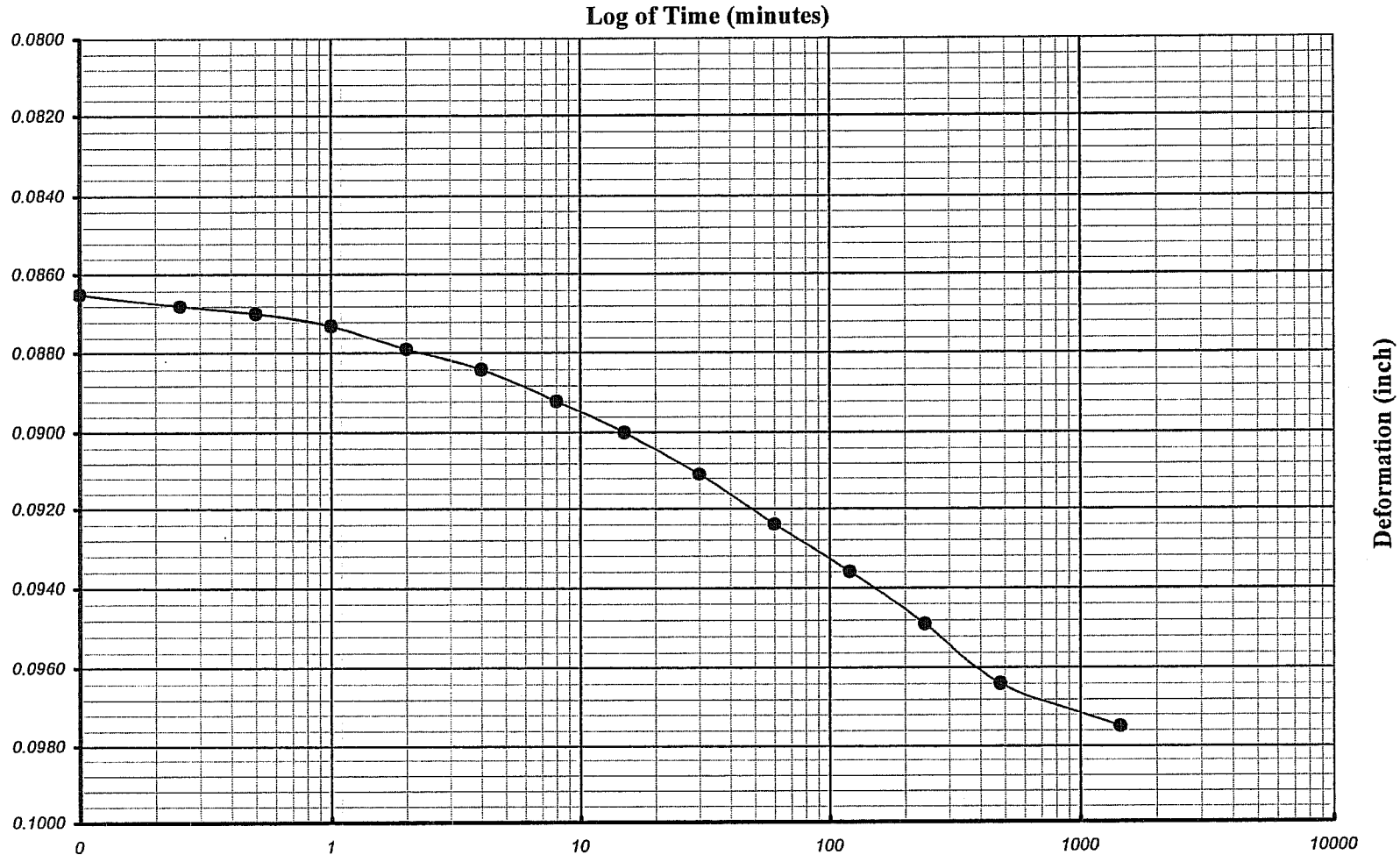
Boring No.	: A-08-109		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-8		Plastic Limit :	-						
Depth (ft)	: 35.0	36.5	Plastic Index :	-	Initial	29.11	93.24	14.68	97.29	0.81
Depth (m)	: 10.68	11.13	Specific Gravity :	2.70	Final	29.27	95.34	15.01	102.89	0.77
Description	: Dark yellowish brown, lean CLAY(CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

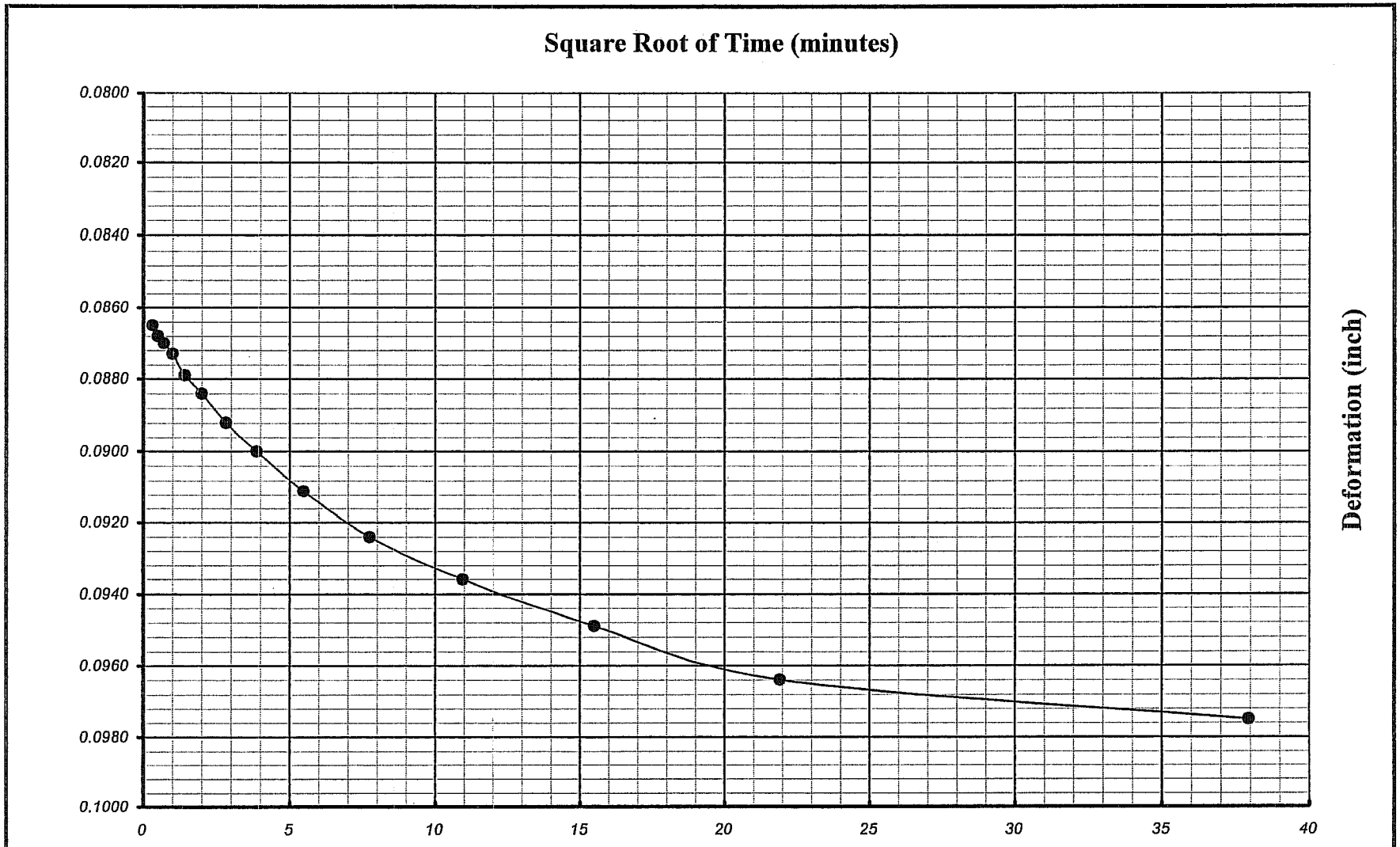
RBF/SR-57 Northbound

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

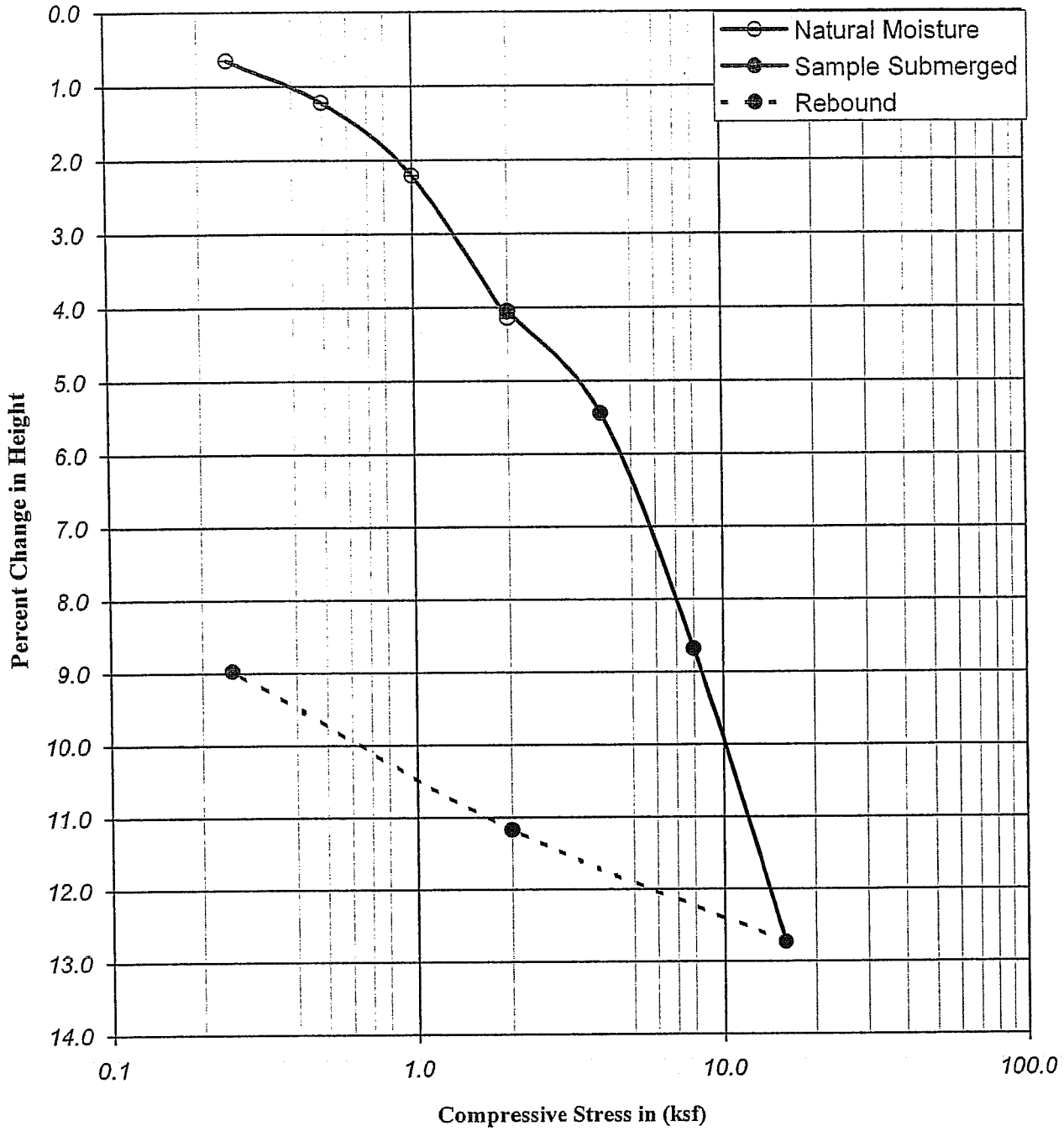
Project No. : 08-115 12/05/08



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-109*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-8*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-109*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-8*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



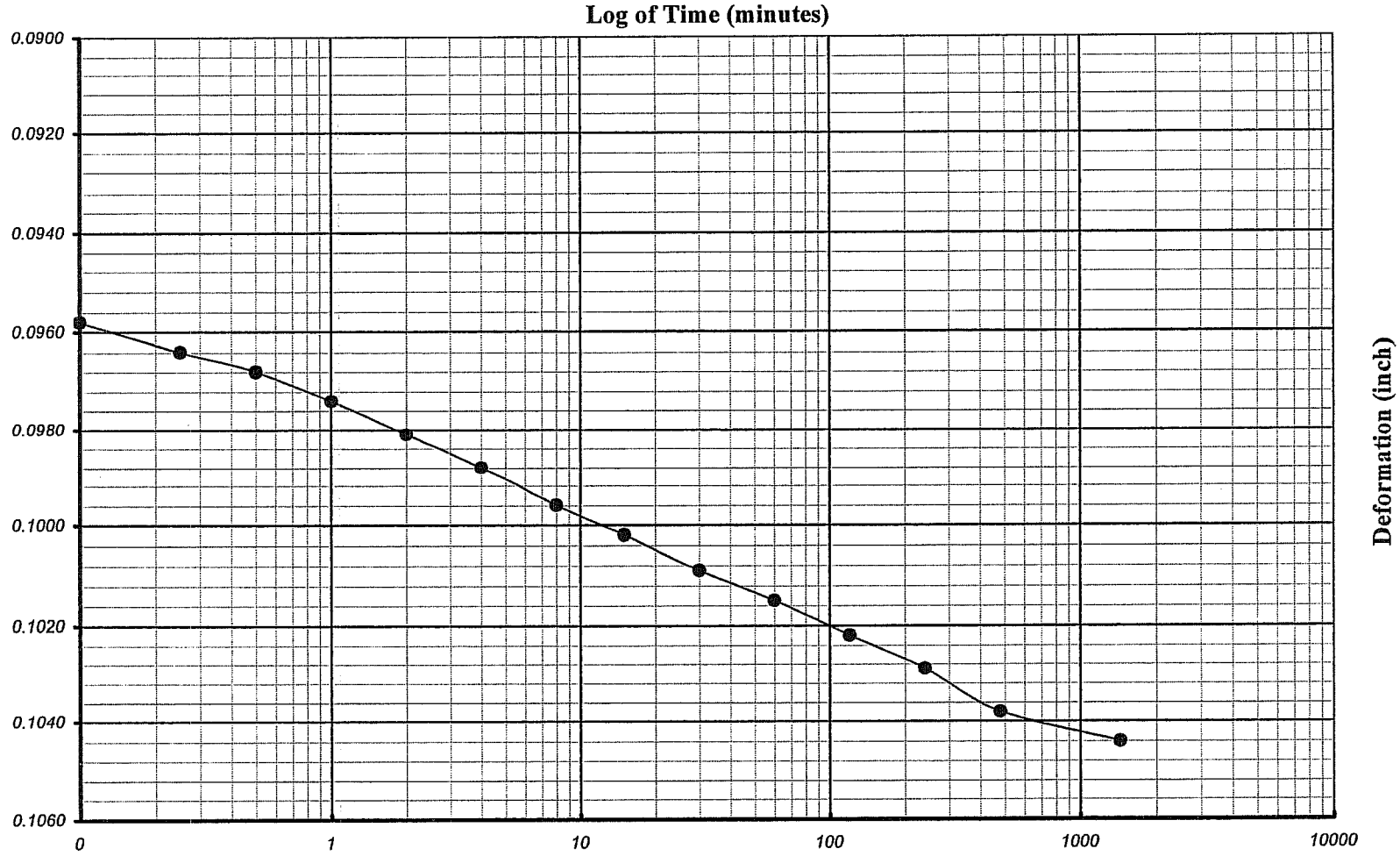
Boring No.	: A-08-119			Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-2			Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft) :	5.0	6.5	Plastic Index :	-	Initial	26.02	92.03	14.49	84.48	0.83
	(m) :	1.53	1.98	Specific Gravity :	2.70	Final	23.61	101.17	15.92	95.67	0.67
Description	: Very dark brown, lean CLAY (CL)										

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

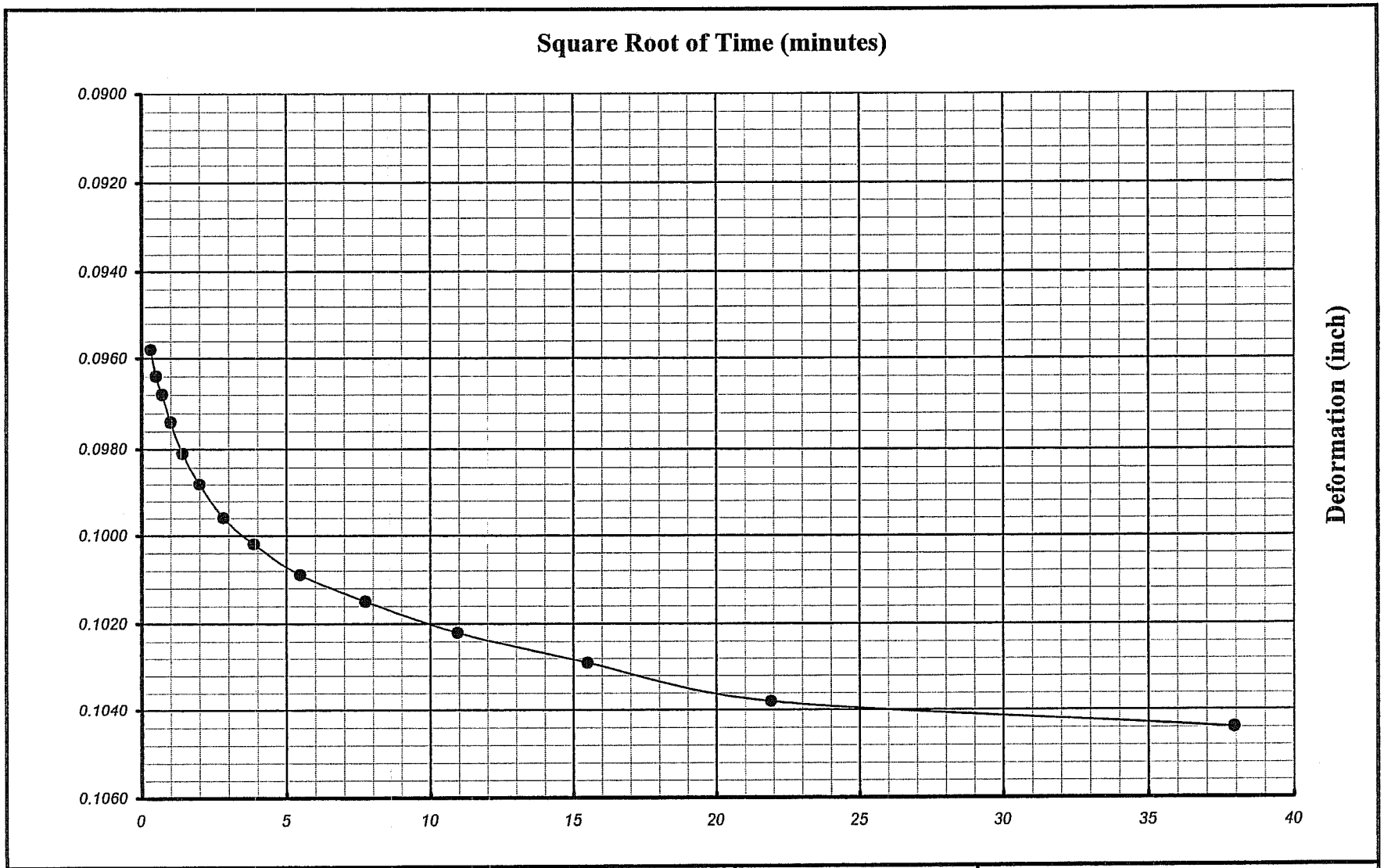
RBF/SR-57 Northbound

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

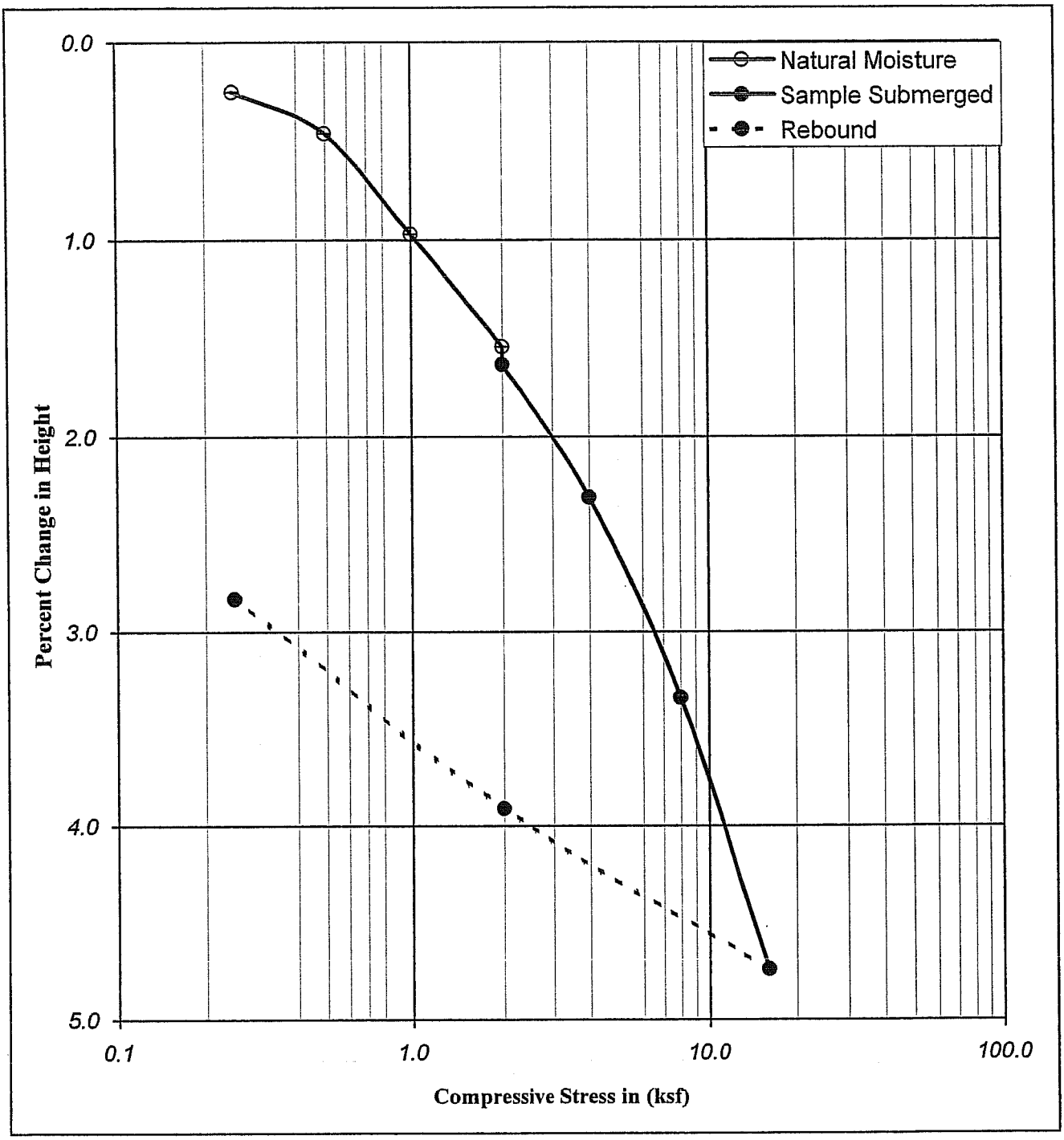
Project No. : *08-115* *12/05/08*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-119*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.00* *191.5*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-119*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



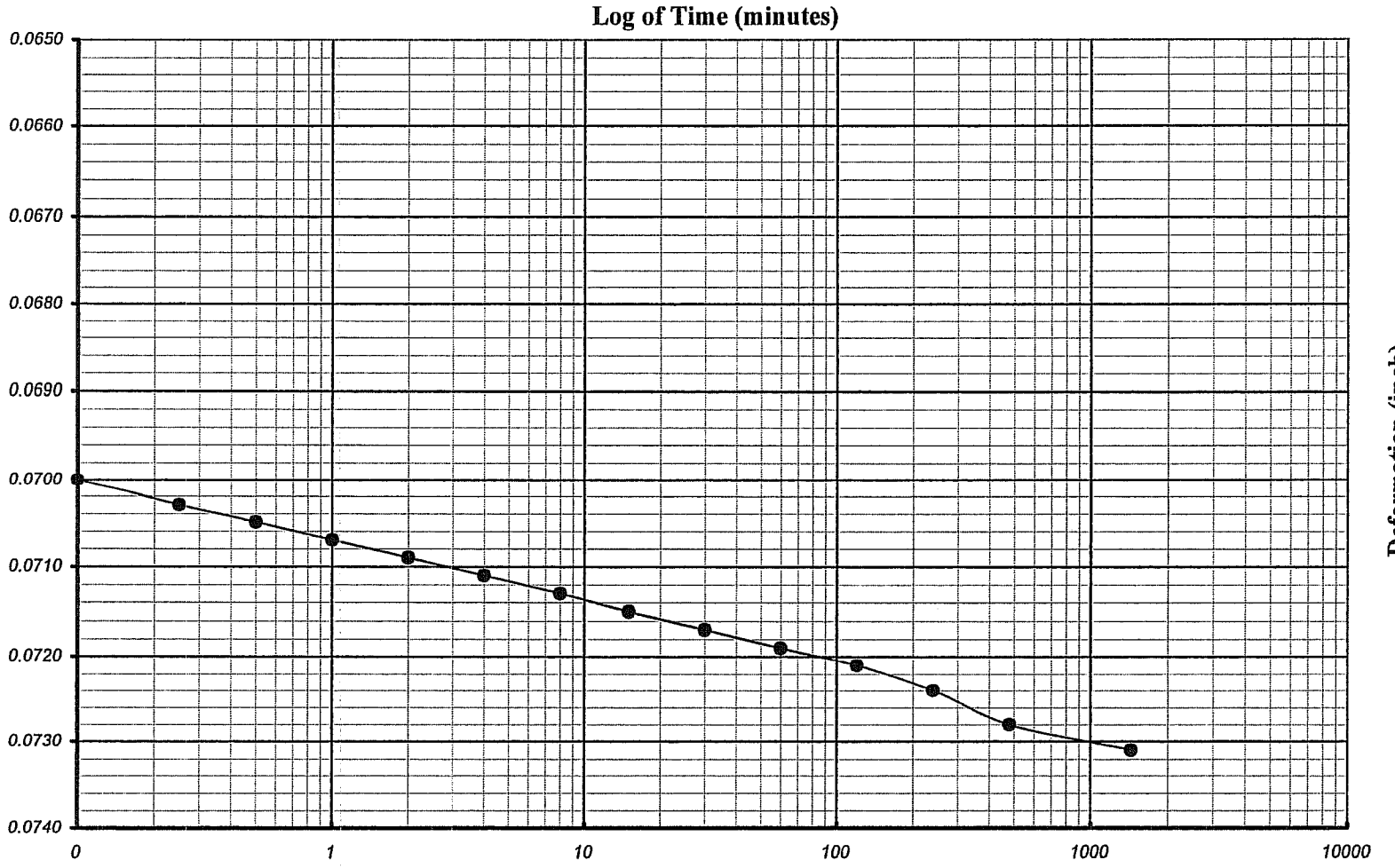
Boring No.	: A-08-126		Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-3		Plastic Limit :	-			(pcf)	(kN/m³)		
Depth (ft)	: 10.0	11.5	Plastic Index :	-	Initial	12.70	110.76	17.43	65.73	0.52
Depth (m)	: 3.05	3.51	Specific Gravity :	2.70	Final	16.26	114.04	17.95	91.86	0.48
Description	: Dark yellowish brown, SANDY lean CLAY(CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

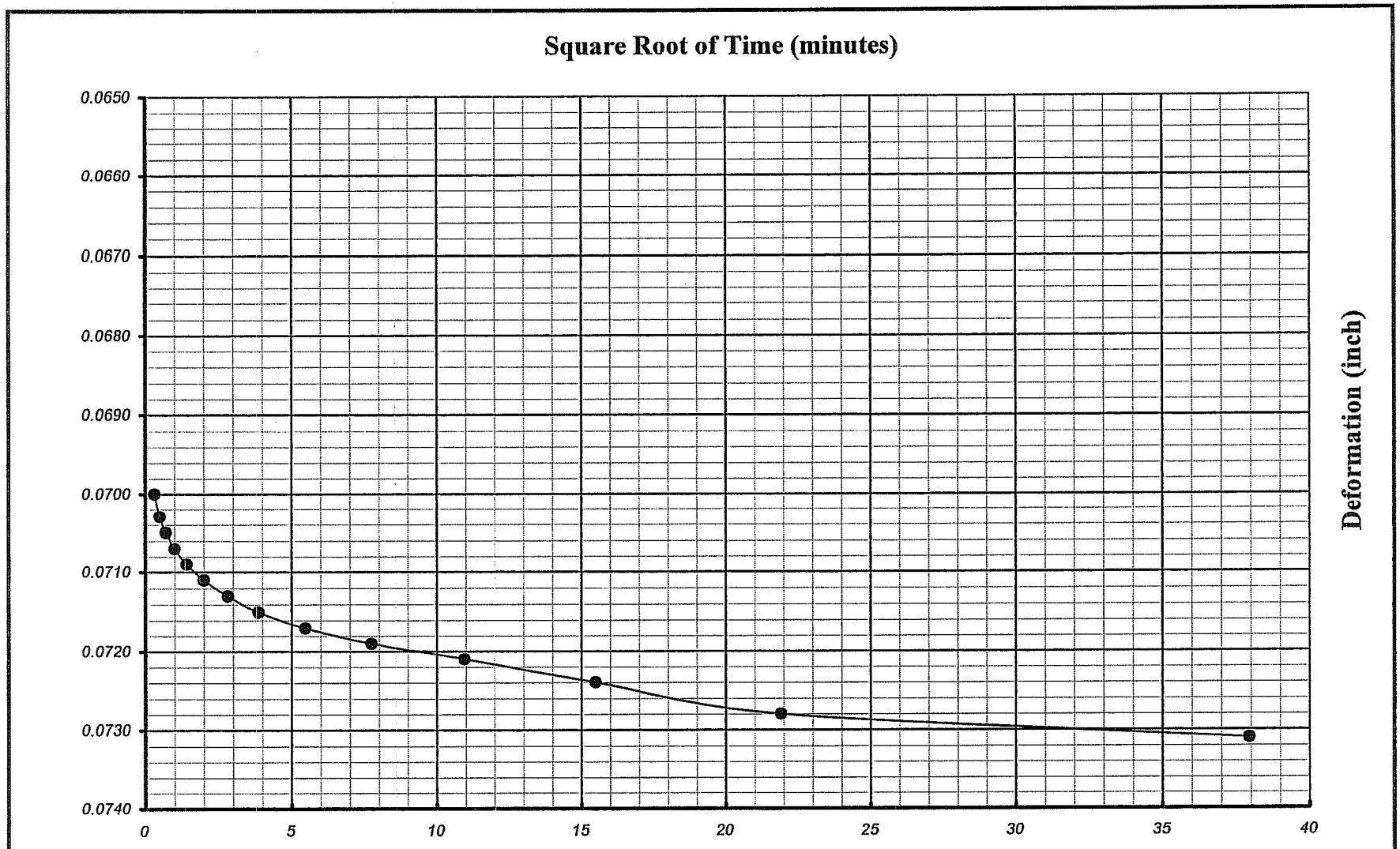
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-126*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-3*	
EMI Project No. : *08-115*		Depth (ft/m) : *10.0* *3.1*	Veritcal Load (ksf/kpa) : *4.00* *191.5*



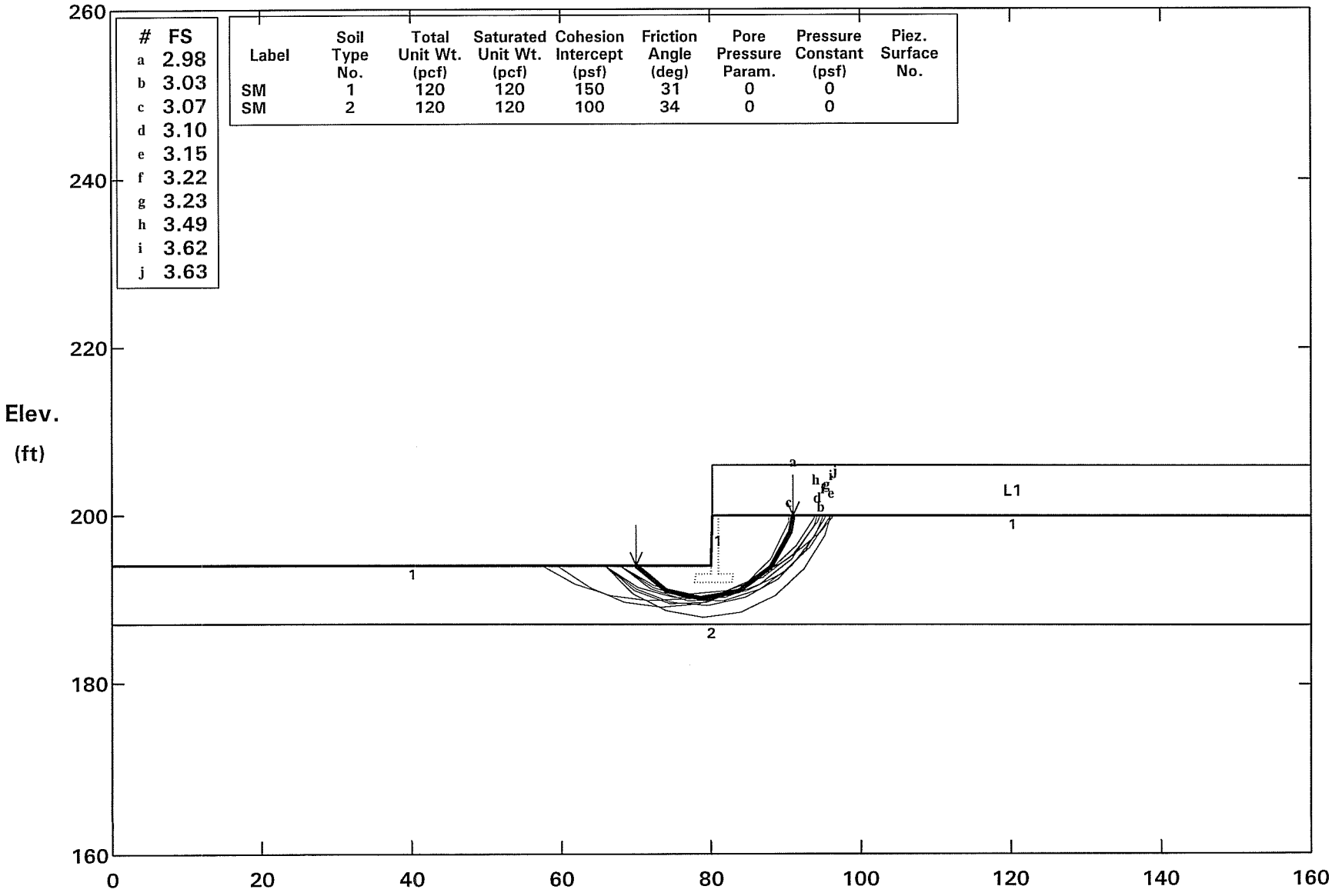
Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-126*	**One-Dimensional Consolidation of Soil** Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-3*	
EMI Project No. : *08-115*		Depth (ft/m) : *10.0* *3.1*	Veritcal Load (ksf/kpa) : *4.0* *191.5*

APPENDIX C

ANALYSES AND CALCULATIONS

RW462 (8'-high type 1 RW) @ Sta 465+00 Static Condition

Ten Most Critical. D:RW462S.PLT 01-24-09 10:43am

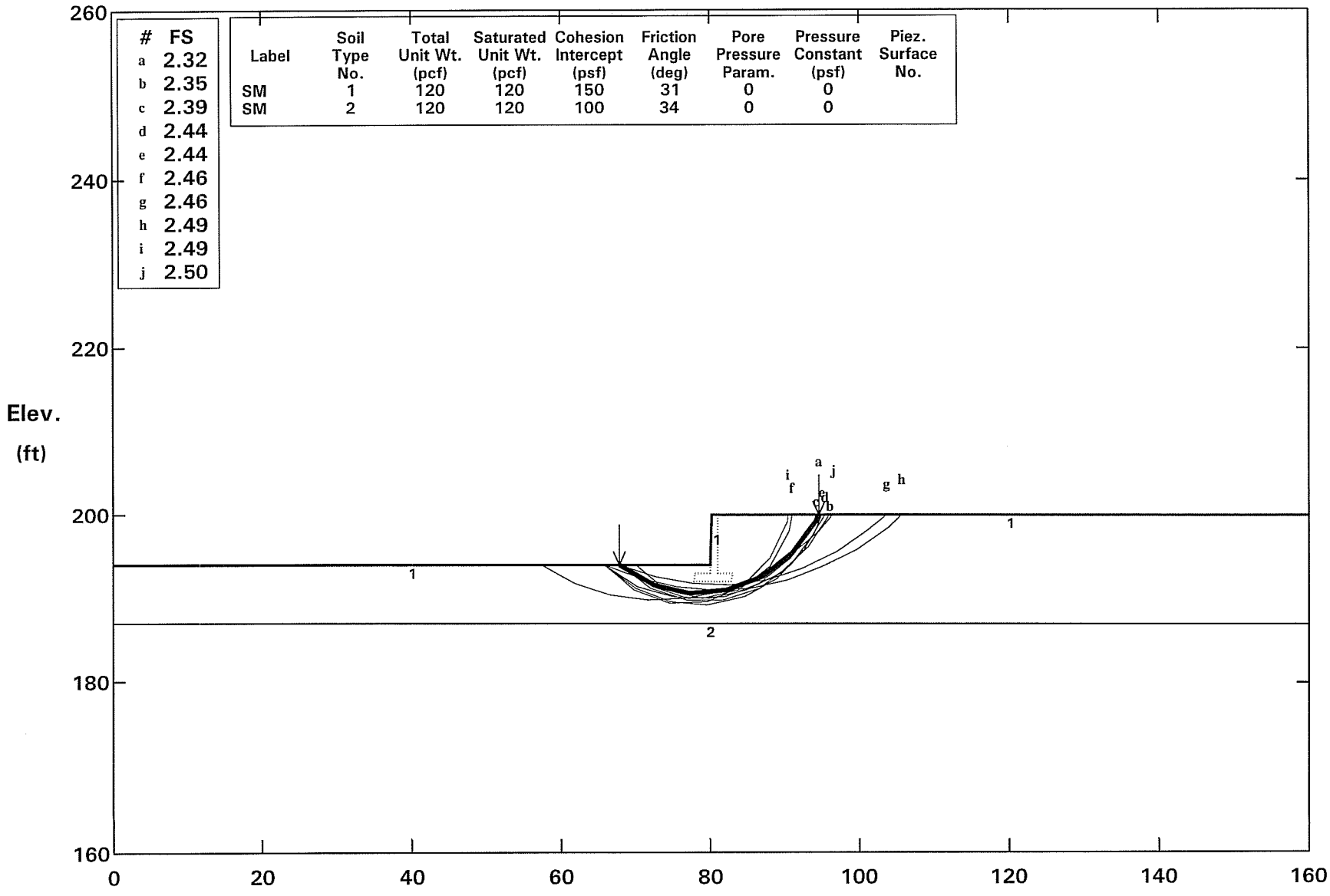


STABL6H FSmin = 2.98 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW462 (8'-high type 1 RW) @ Sta 465+00 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW462D.PLT 01-24-09 10:44am

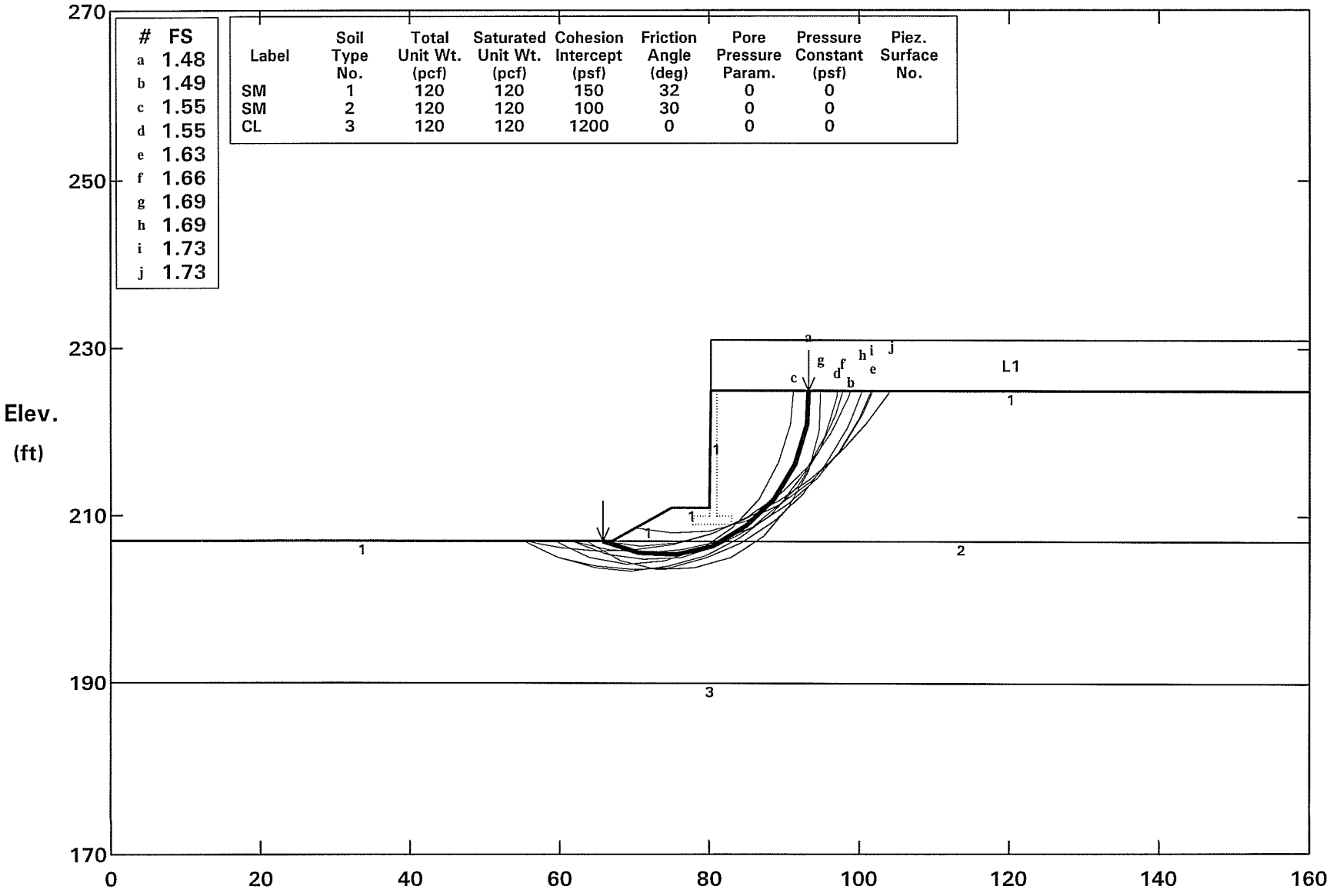


STABL6H FSmin=2.32 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW466 (14'-high Type 1 RW) @ Sta 471+20 Static Condition

Ten Most Critical. D:RW466S.PLT 01-24-09 10:56am

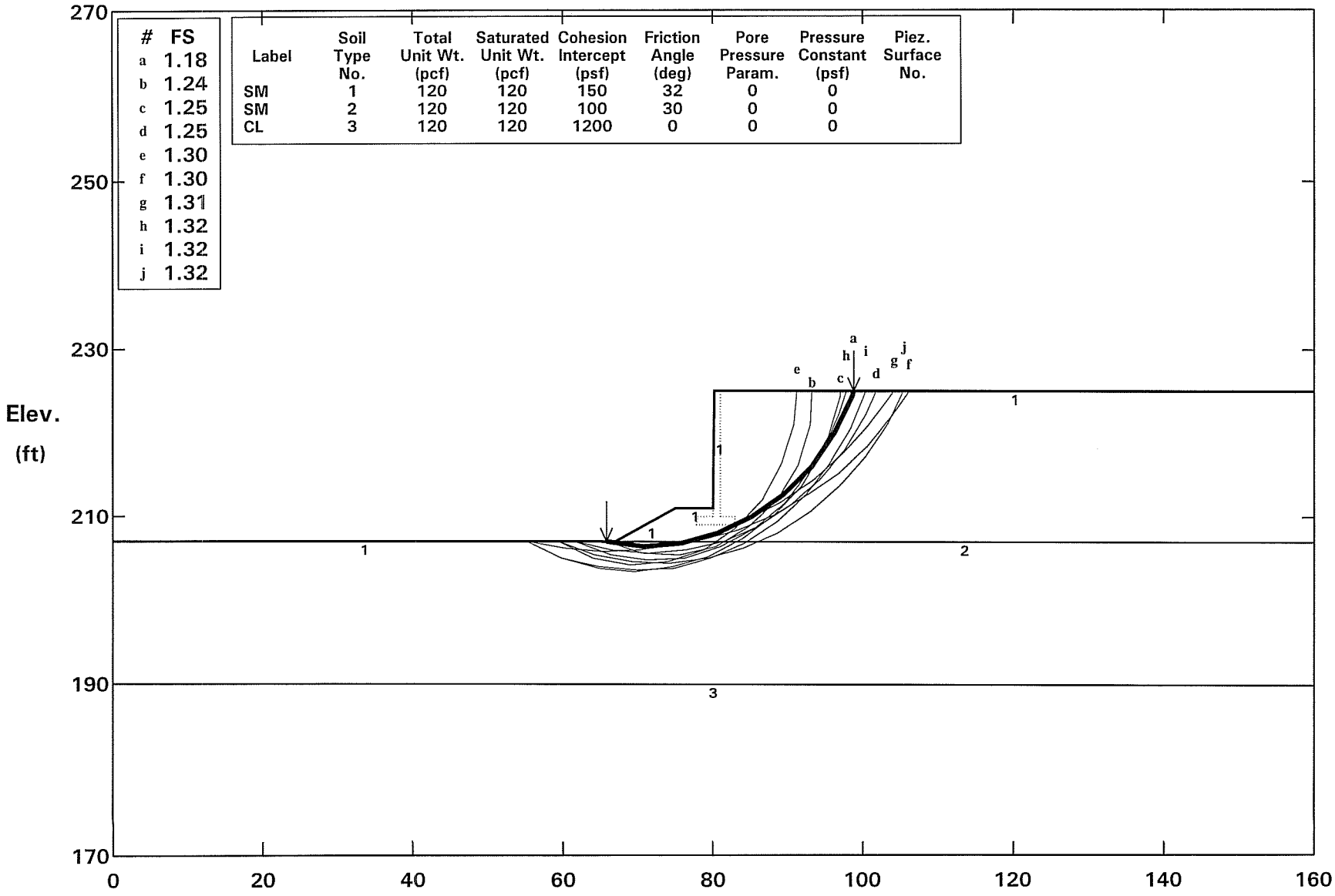


STABL6H FSmin = 1.48 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW466 (14'-high Type 1 RW) @ Sta 471+20 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW466D.PLT 01-24-09 10:56am

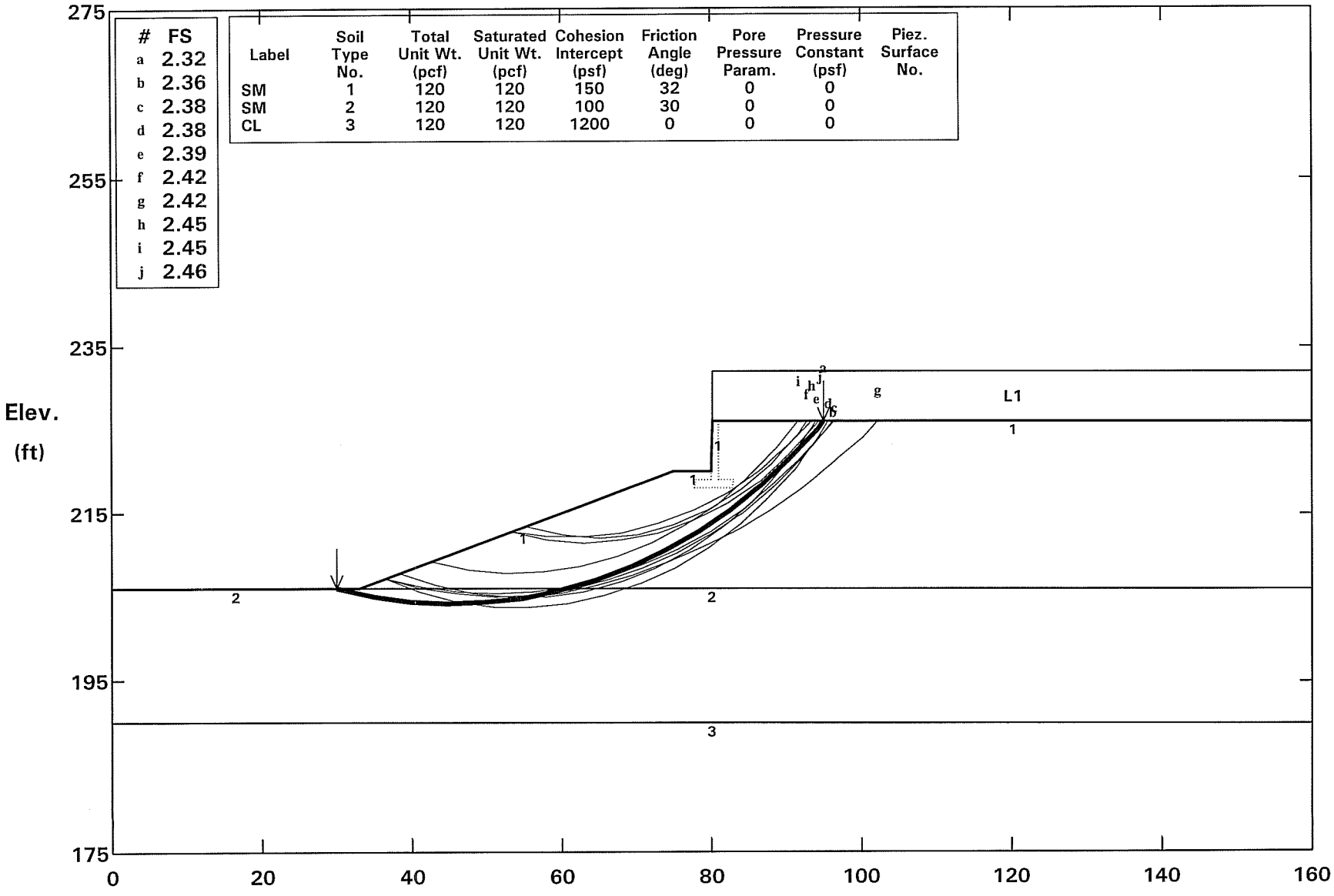


STABL6H FSmin=1.18 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW474 (12'-high SW on 8'-high RW) @ Sta 475+10 Static Condition

Ten Most Critical. D:RW474S.PLT 01-24-09 11:01am

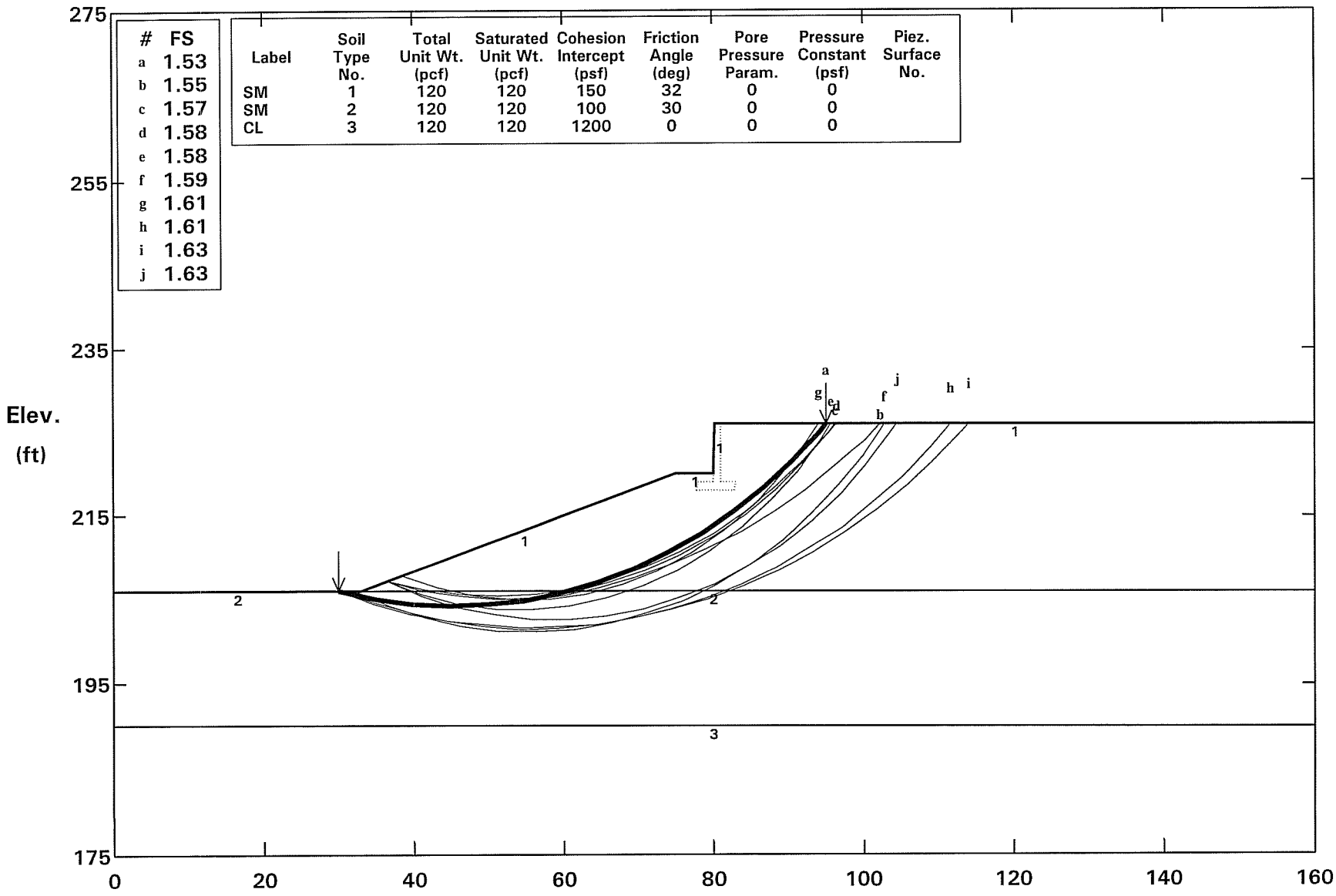


STABL6H FSmin = 2.32 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW474 (12'-high SW on 8'-high RW) @ Sta 475+10 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW474D.PLT 01-24-09 11:01am

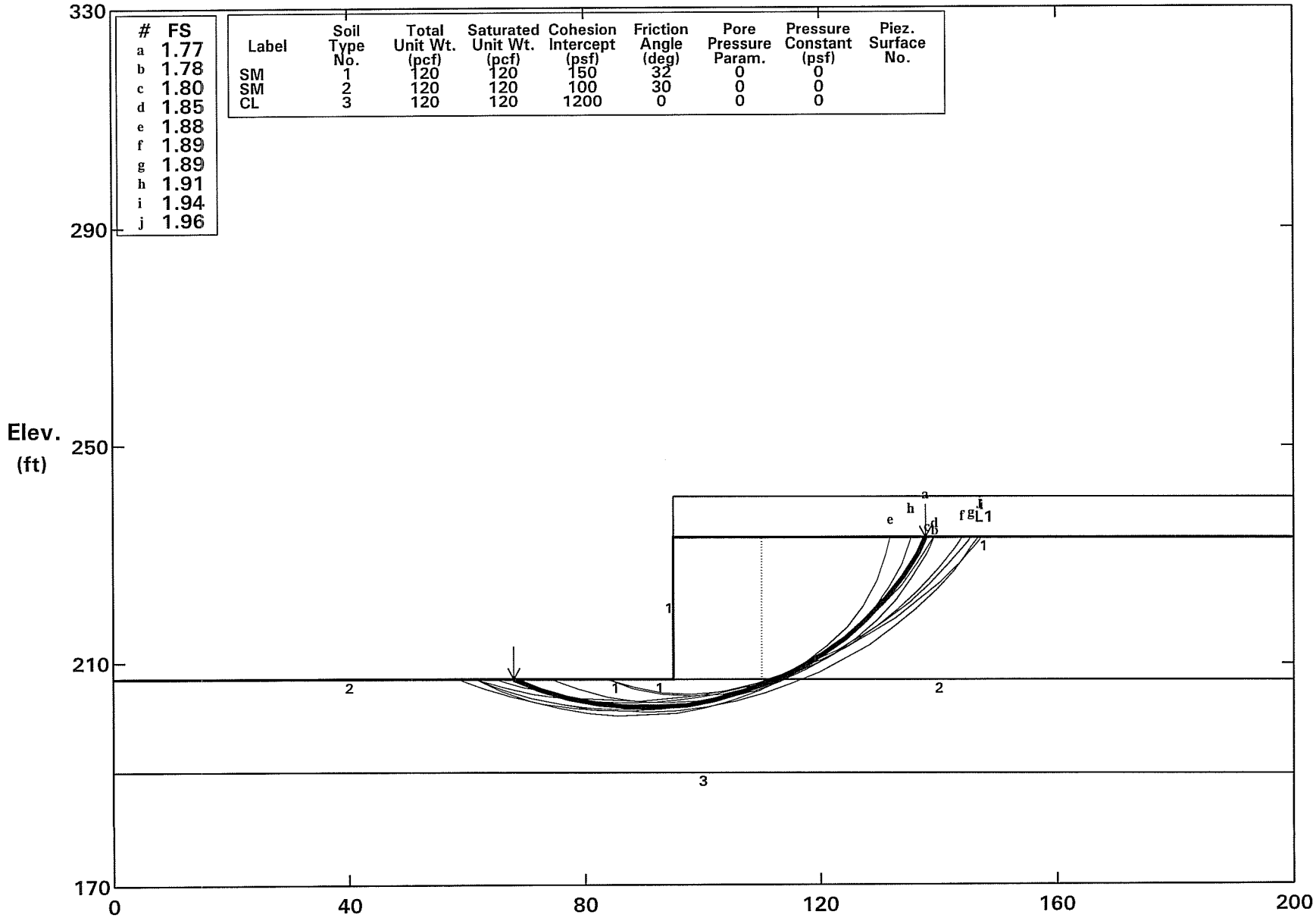


STABL6H FSmin=1.53 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW476 (22'-high MSE wall) @ Sta 478+00 Static Condition

Ten Most Critical. D:RW480S.PLT 01-24-09 11:11am

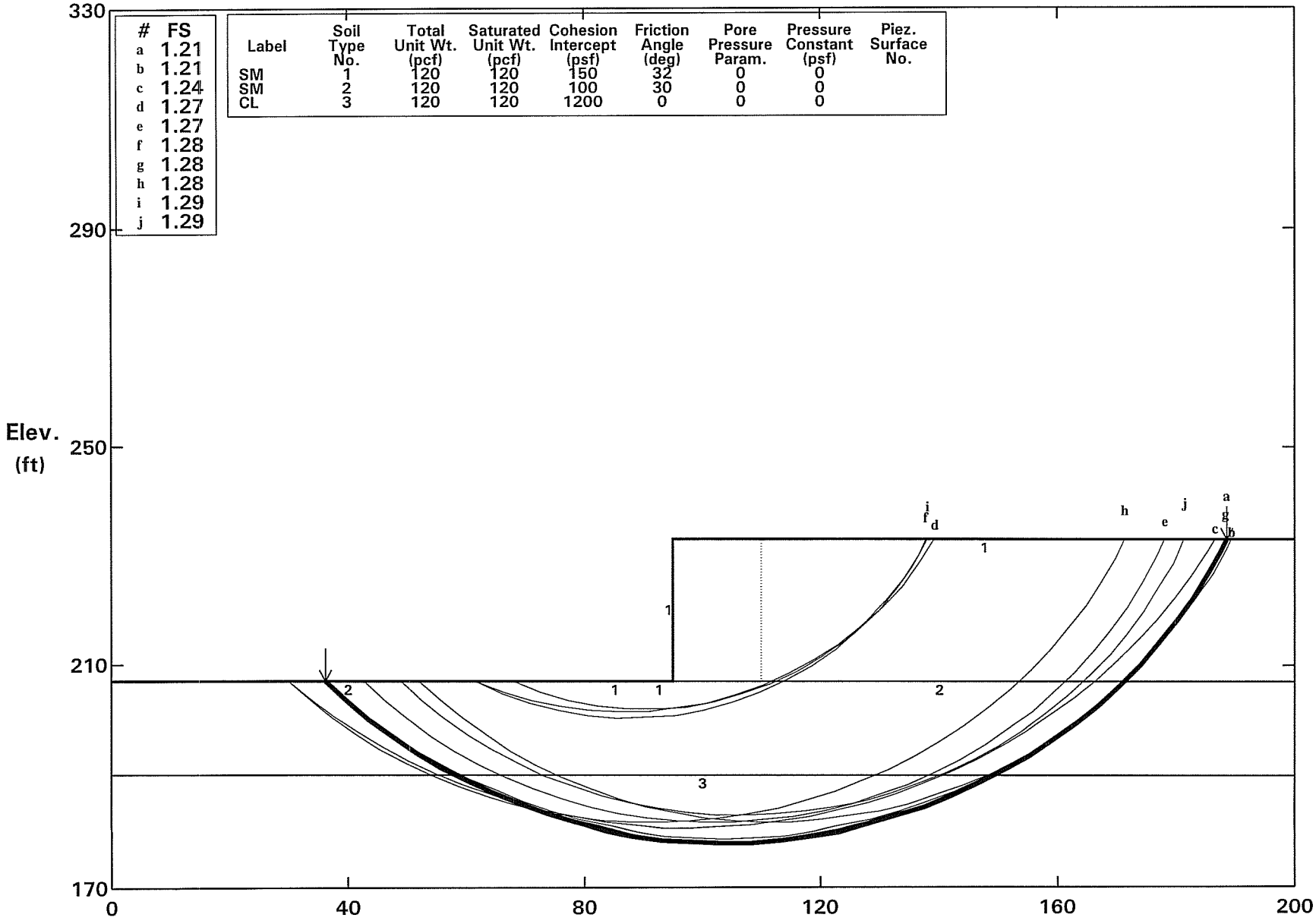


STABL6H FSmin = 1.77 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW476 (22'-high MSE wall) @ Sta 478+00 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW480D.PLT 01-24-09 11:11am

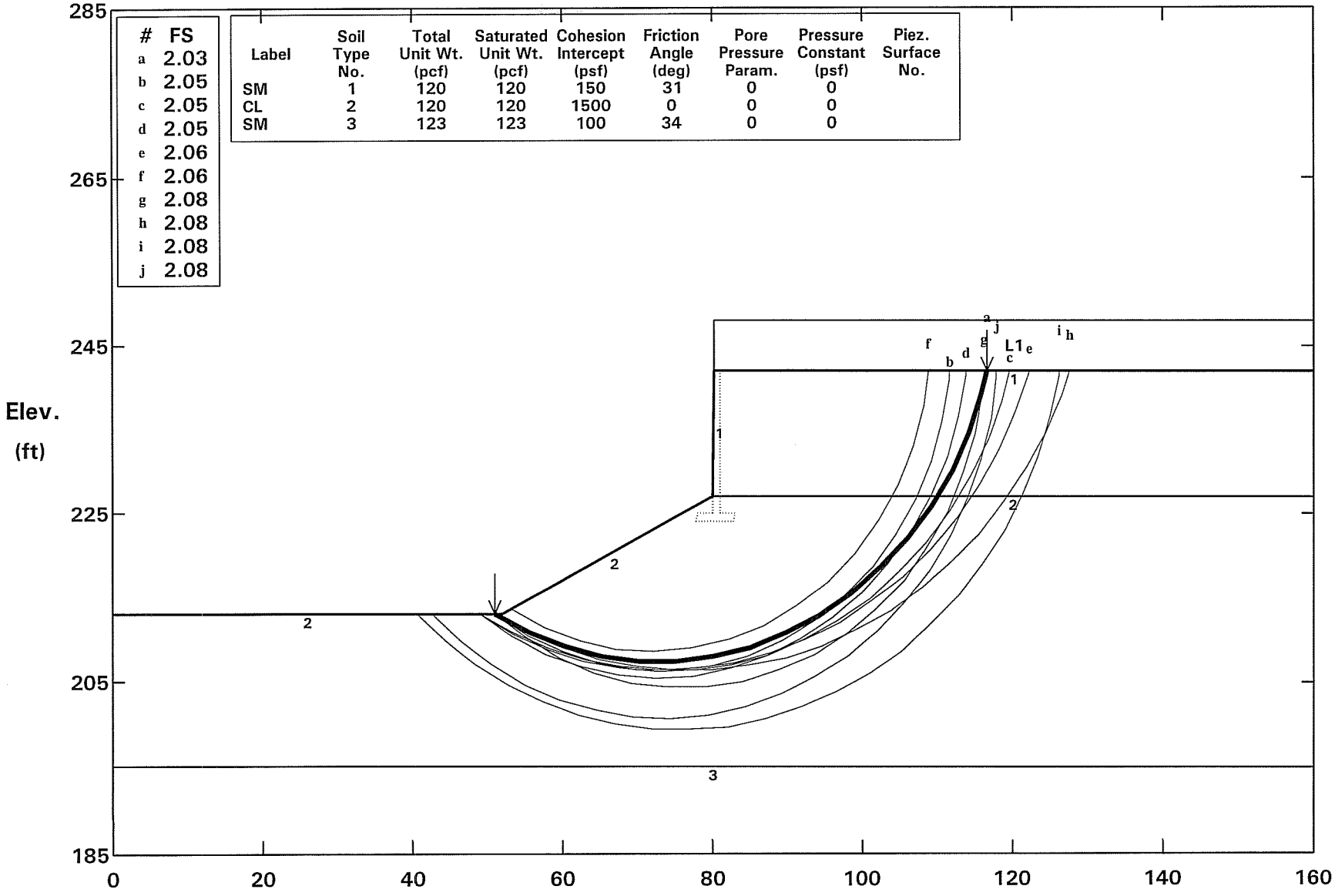


STABL6H FSmin = 1.21 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW486 (14'-high type 1 RW) @ Sta 489+50 Static Condition

Ten Most Critical. D:RW486S.PLT 01-24-09 11:28am

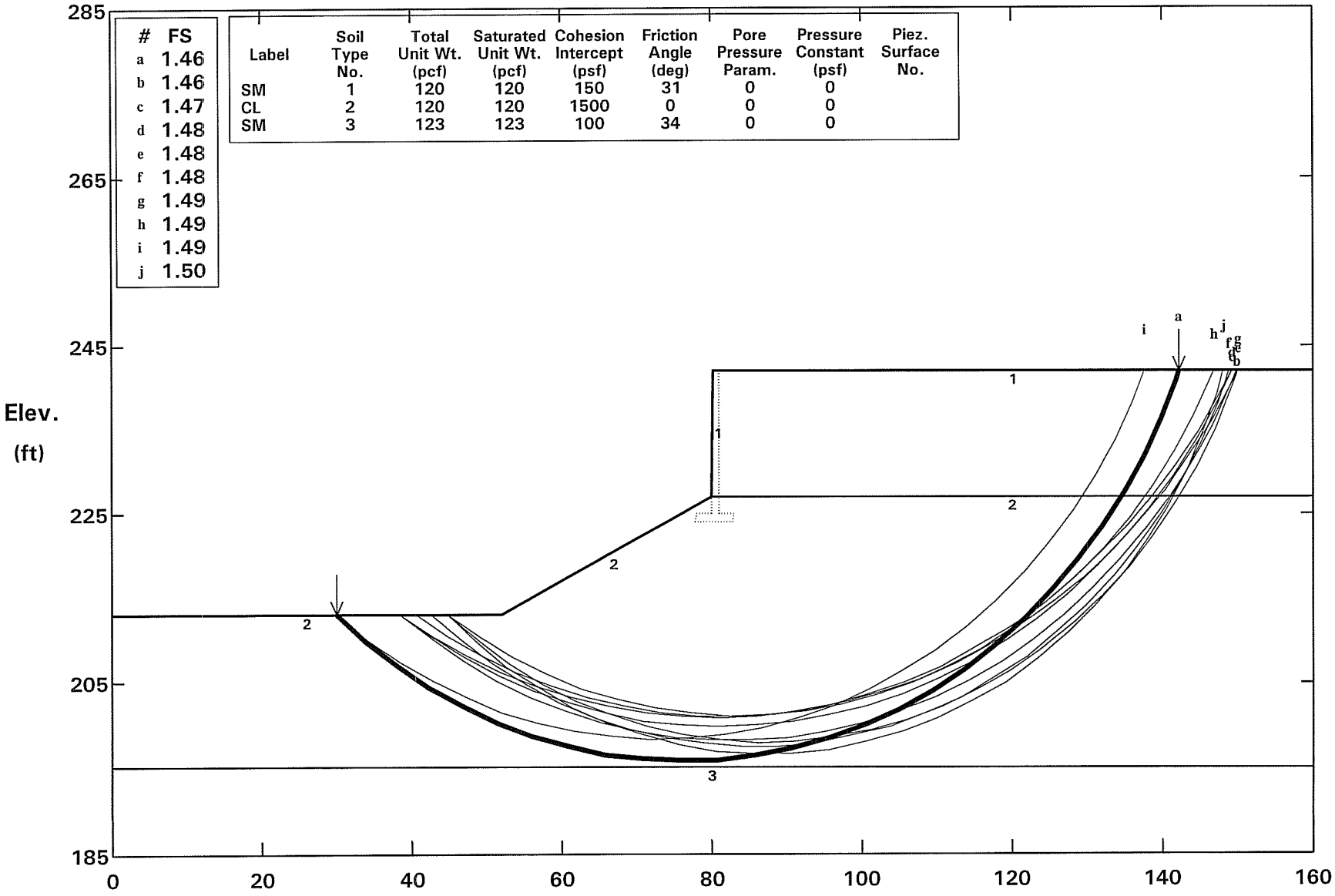


STABL6H FSmin = 2.03 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW486 (14'-high type 1 RW) @ Sta 489+50 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW486D.PLT 01-24-09 11:29am

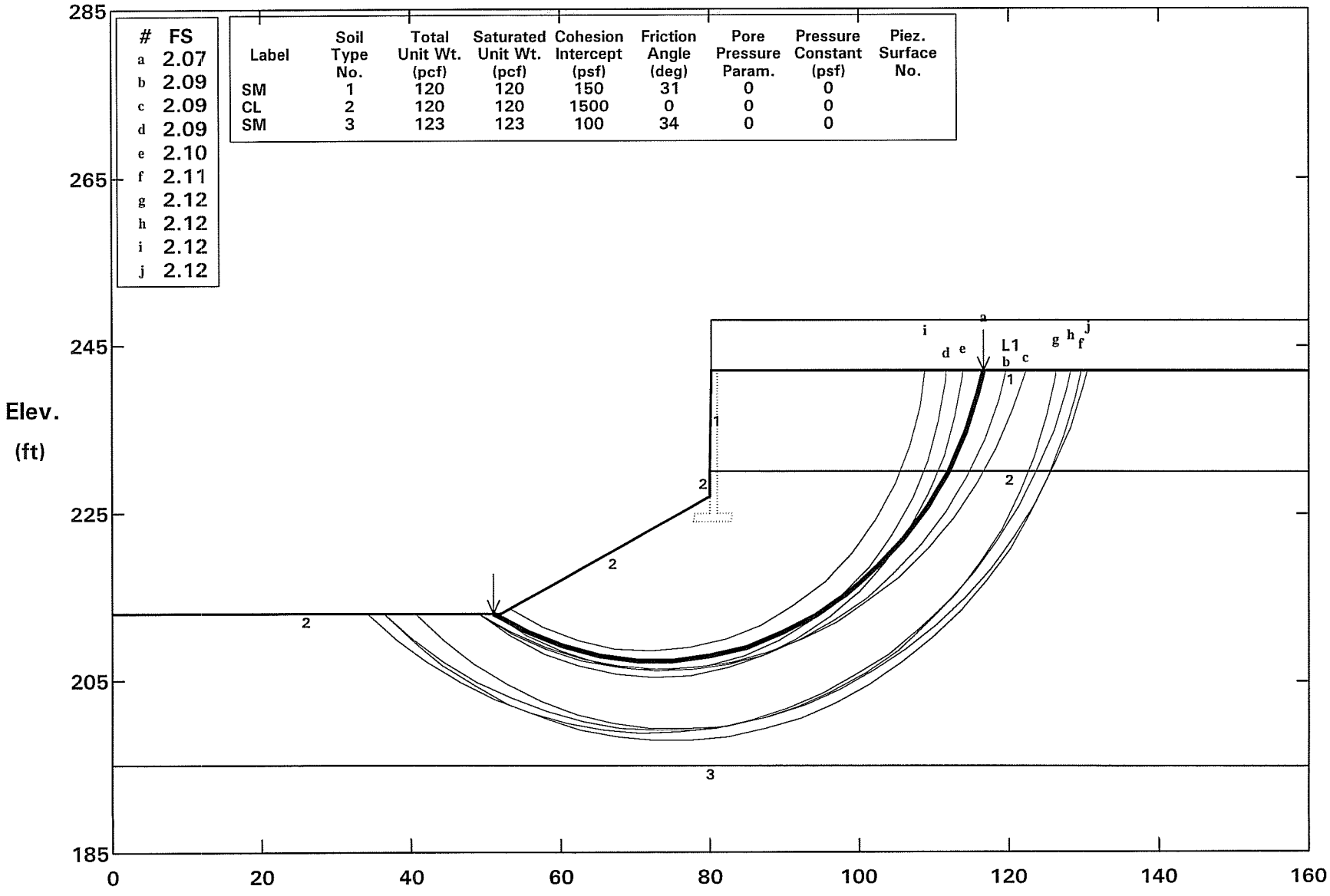


STABL6H FSmin=1.46 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW492 (14'-high type 1 RW) @ Sta 492+00 Static Condition

Ten Most Critical. D:RW492S.PLT 01-24-09 11:30am

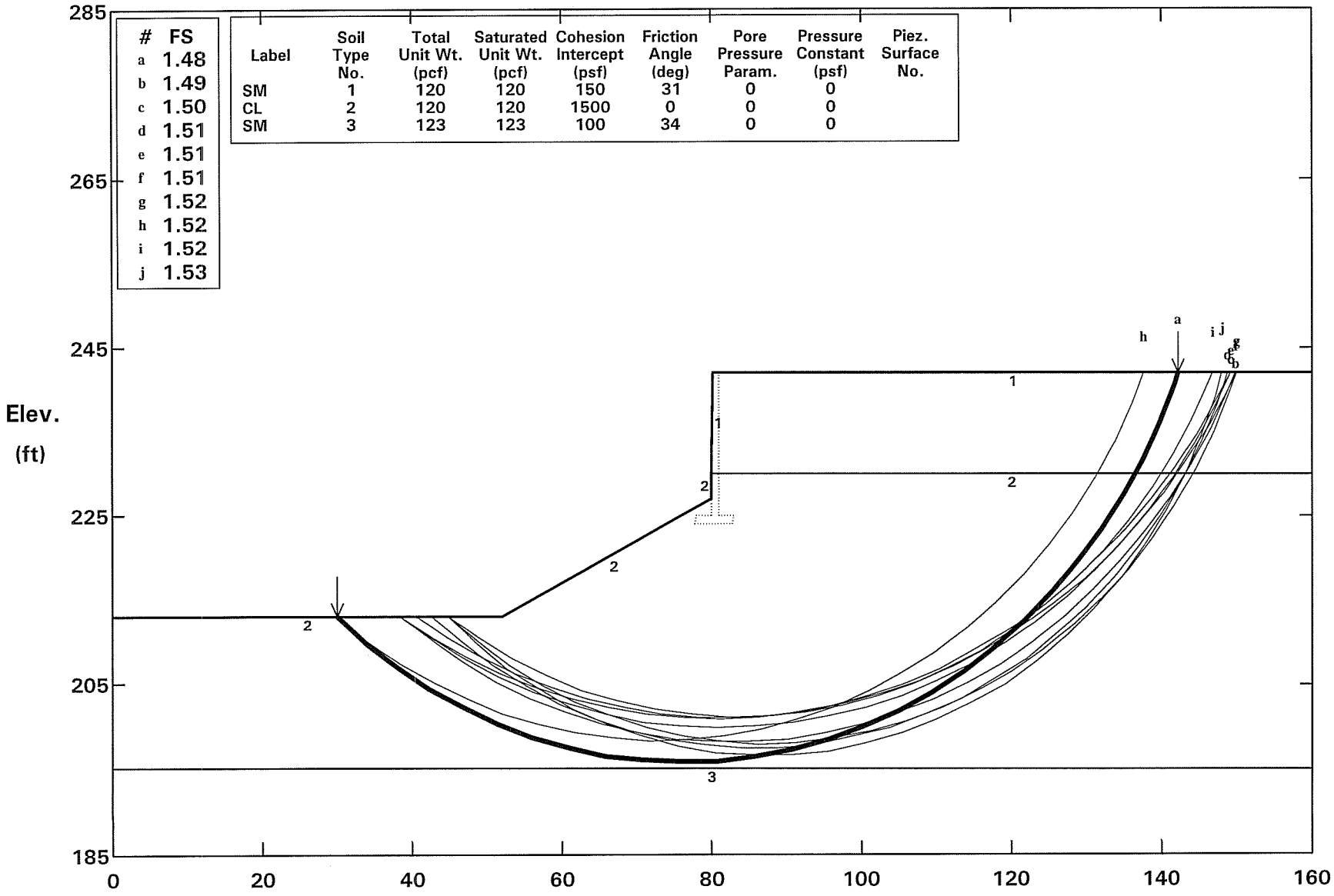


STABL6H FSmin = 2.07 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW492 (14'-high type 1 RW) @ Sta 492+00 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW492D.PLT 01-24-09 11:31am

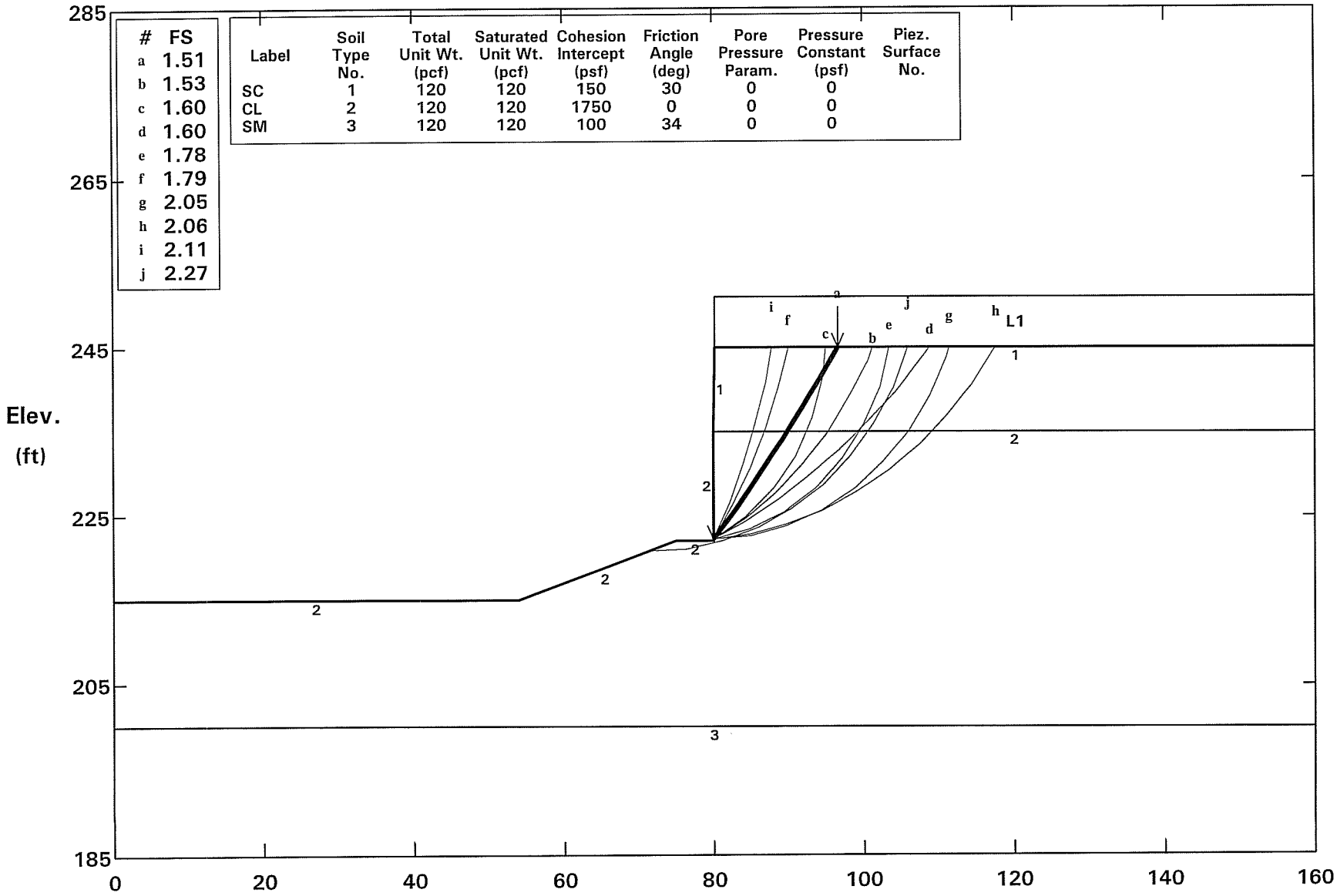


STABL6H FSmin = 1.48 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW496 (22'-high MSE wall) @ Sta 501+00 Static Condition

Ten Most Critical. D:RW496S.PLT 01-26-09 8:35am

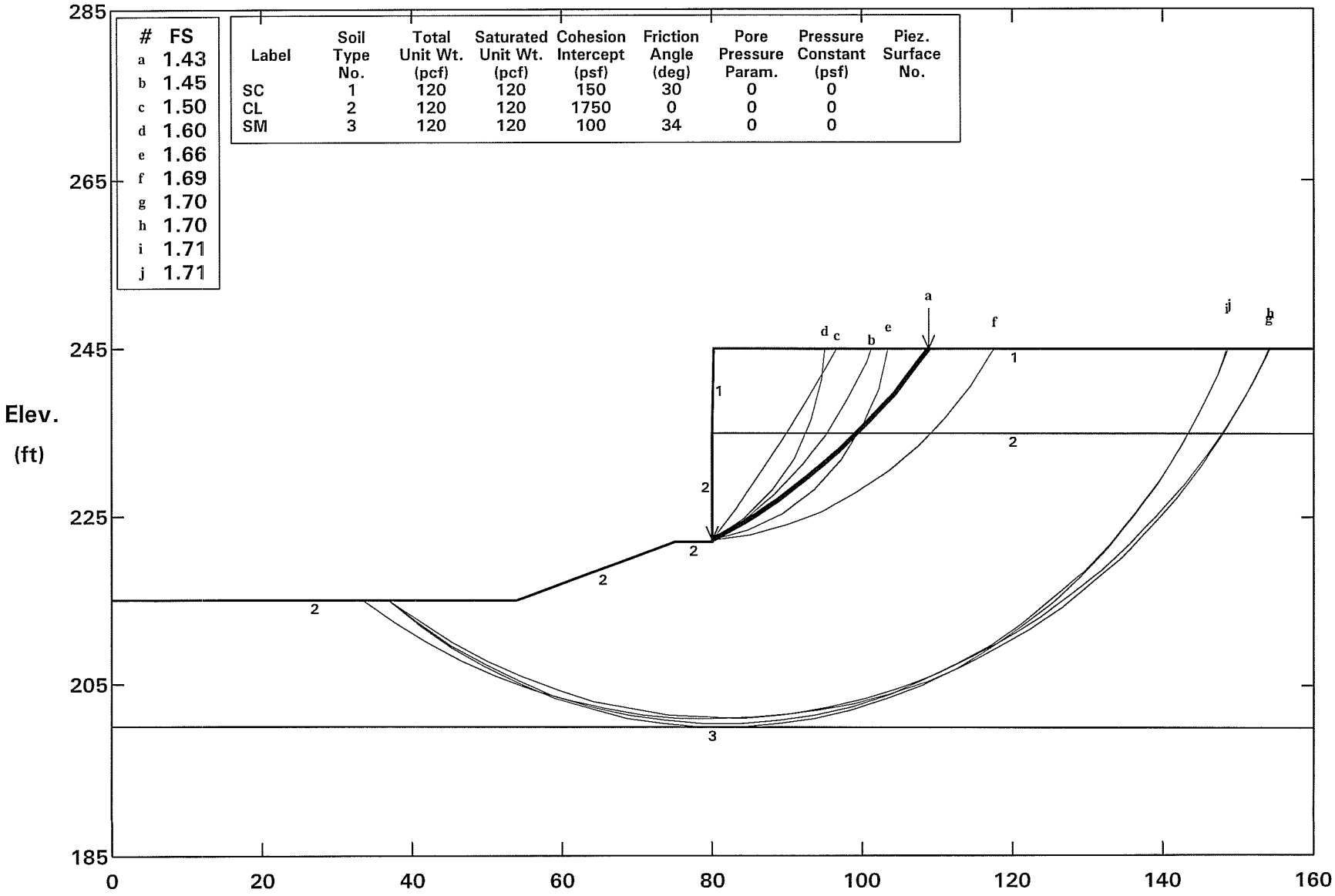


STABL6H FSmin = 1.51 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW496 (22'-high MSE wall) @ Sta 501+00 Pseudosatic Condition (kh=0.2)

Ten Most Critical. D:RW496D.PLT 01-26-09 8:41am

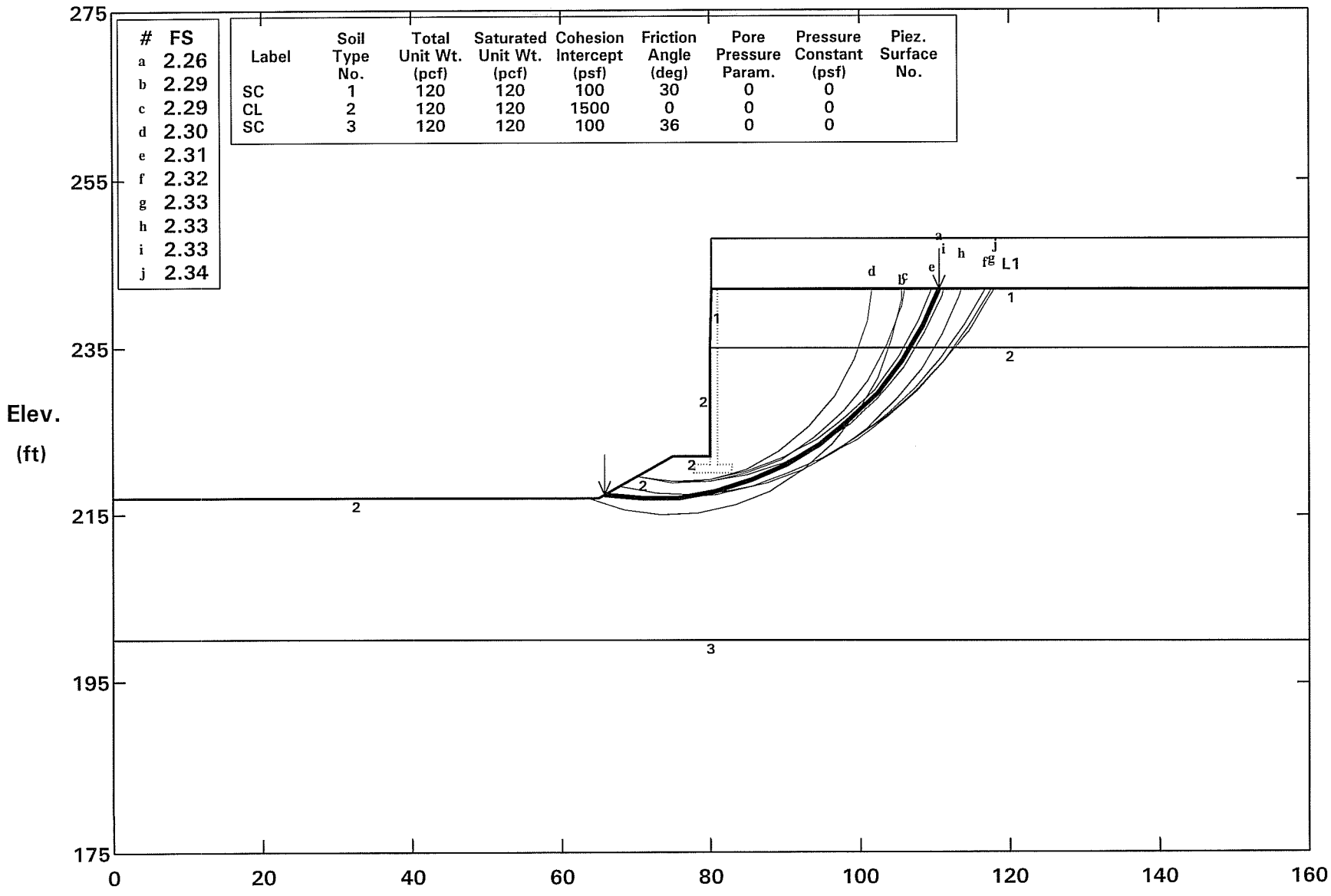


STABL6H FSmin=1.43 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW512 (18'-high type 1 wall) Sta 511+60 Static Condition

Ten Most Critical. D:RW512S.PLT 01-26-09 8:45am

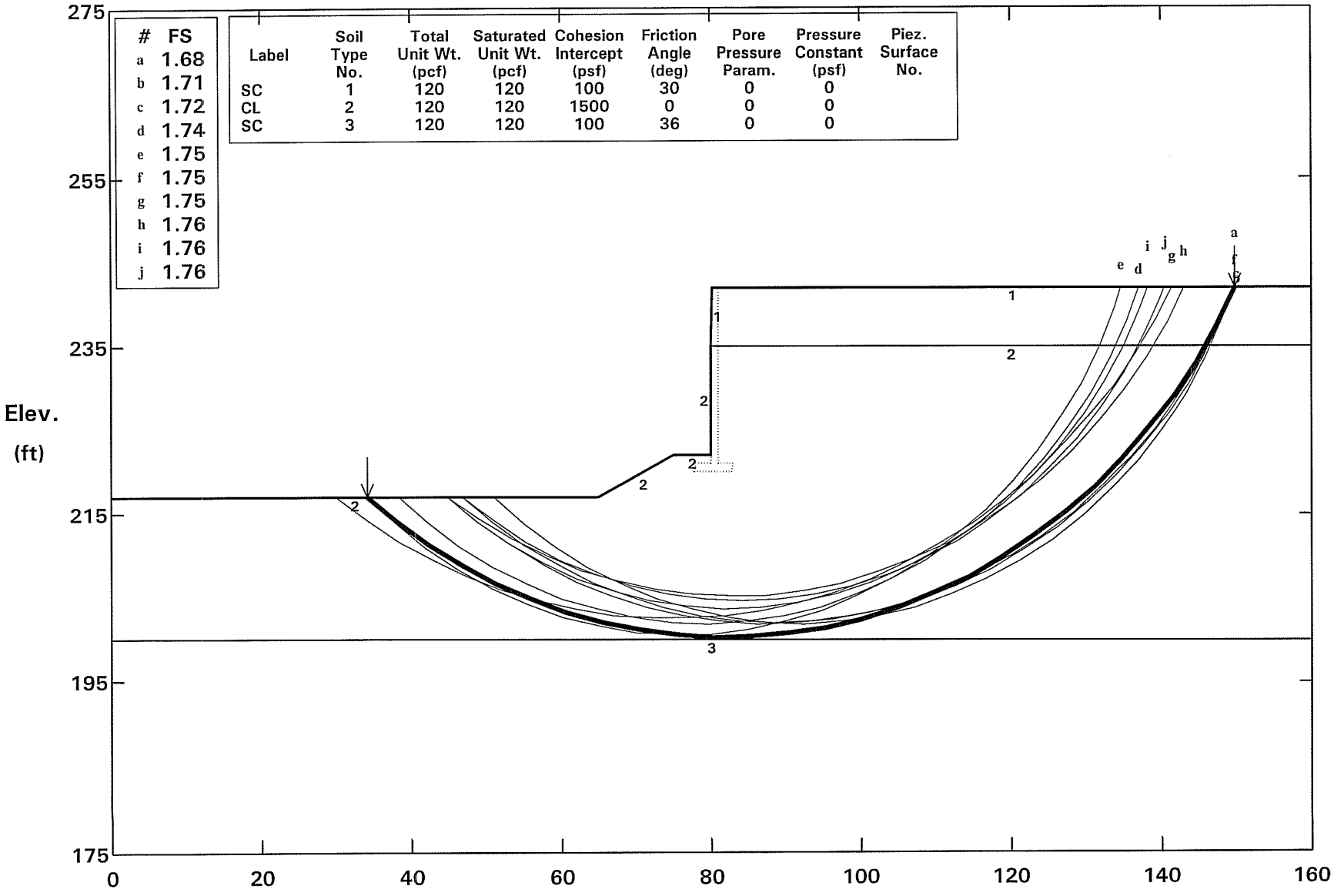


STABL6H FSmin = 2.26 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW512 (18'-high type 1 wall) Sta 511+60 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW512D.PLT 01-26-09 8:46am

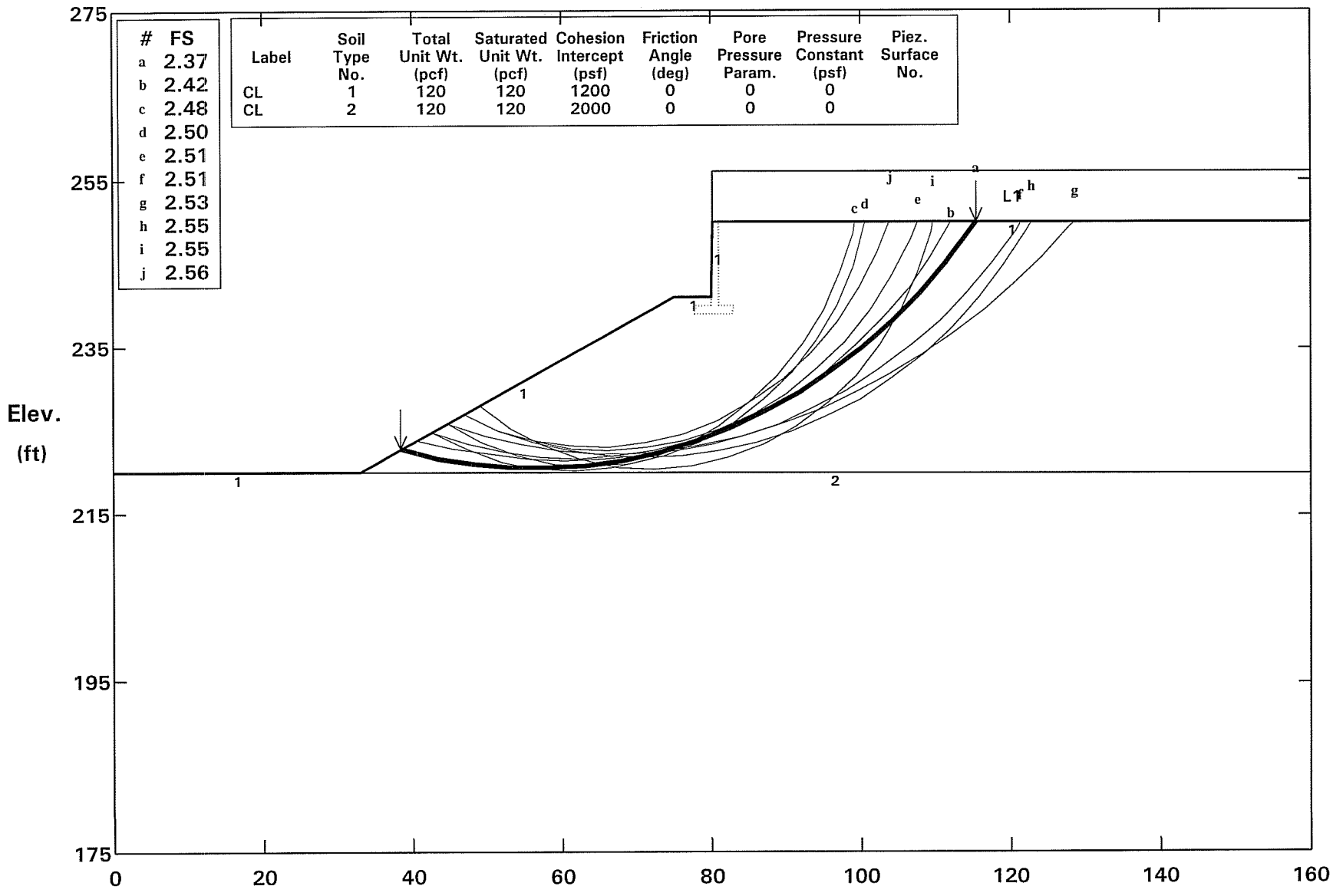


STABL6H FSmin=1.68 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW514 (10'-high Type 1 wall) Sta 517+60 Static Condition

Ten Most Critical. D:RW514S.PLT 01-26-09 8:48am

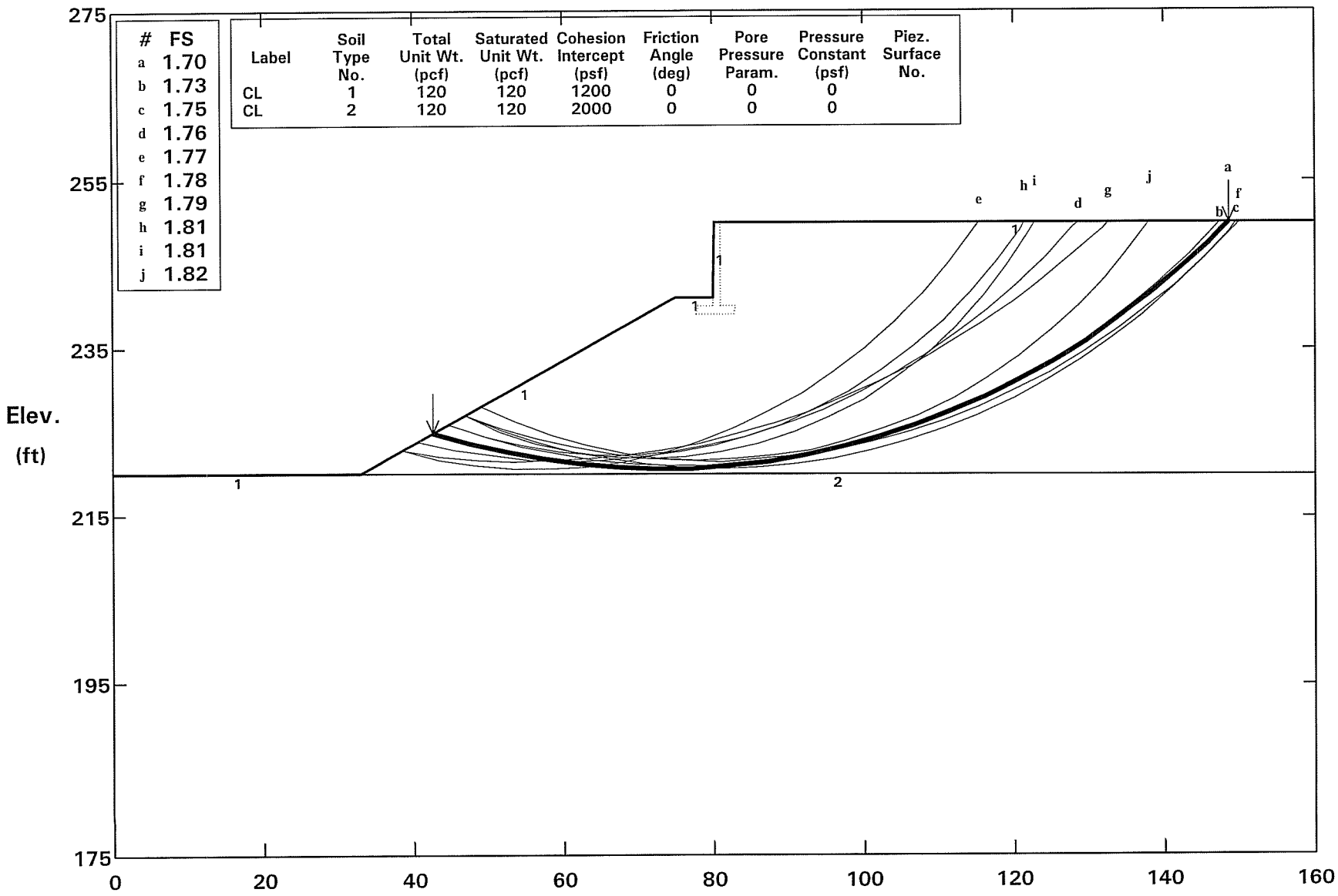


STABL6H FSmin = 2.37 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW514 (10'-high Type 1 wall) Sta 517+60 Static Condition

Ten Most Critical. D:RW514D.PLT 01-26-09 8:49am

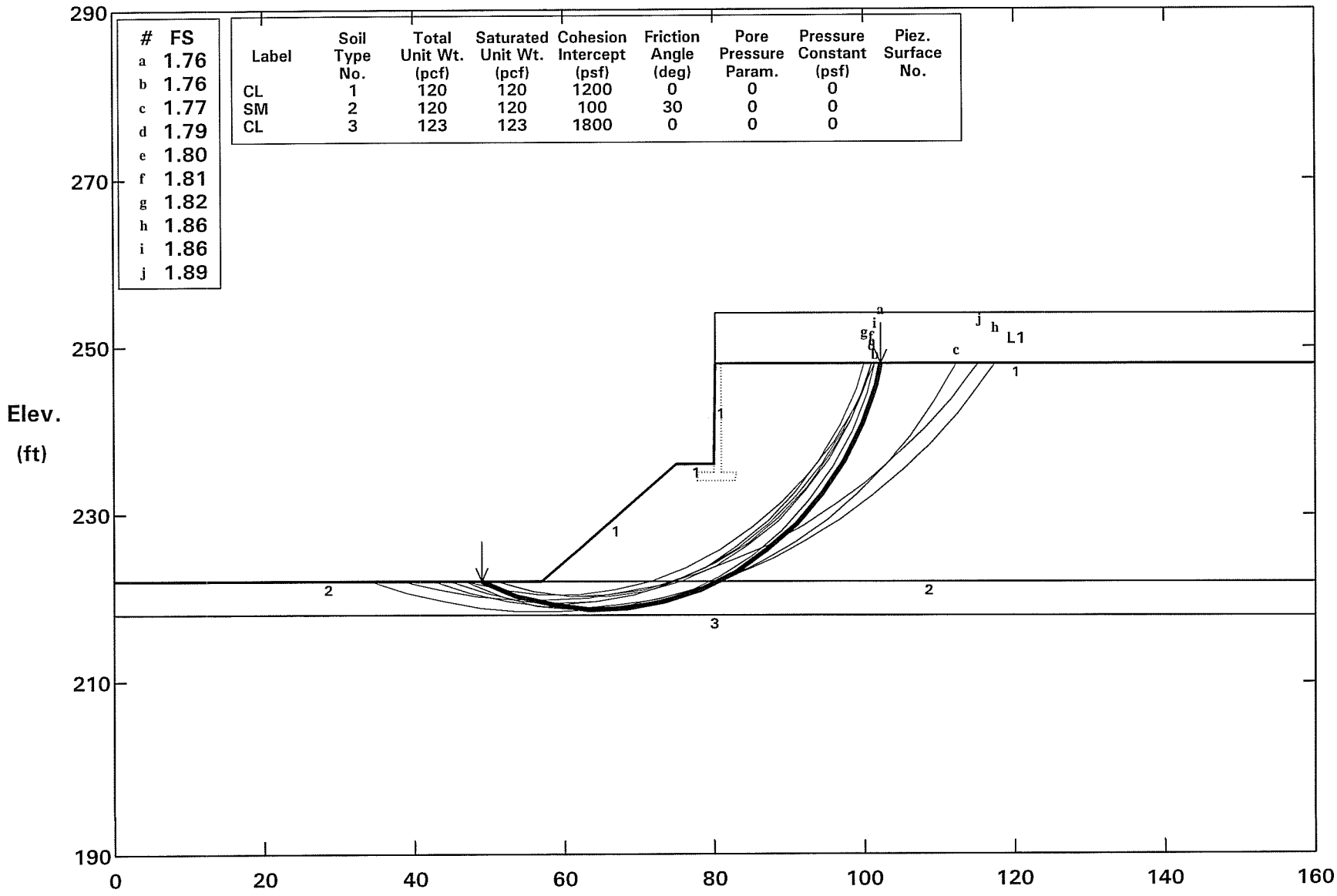


STABL6H FSmin = 1.70 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW522 (14'-high type 1 wall) Sta 527+00 Static Condition

Ten Most Critical. D:RW522S.PLT 01-26-09 8:50am

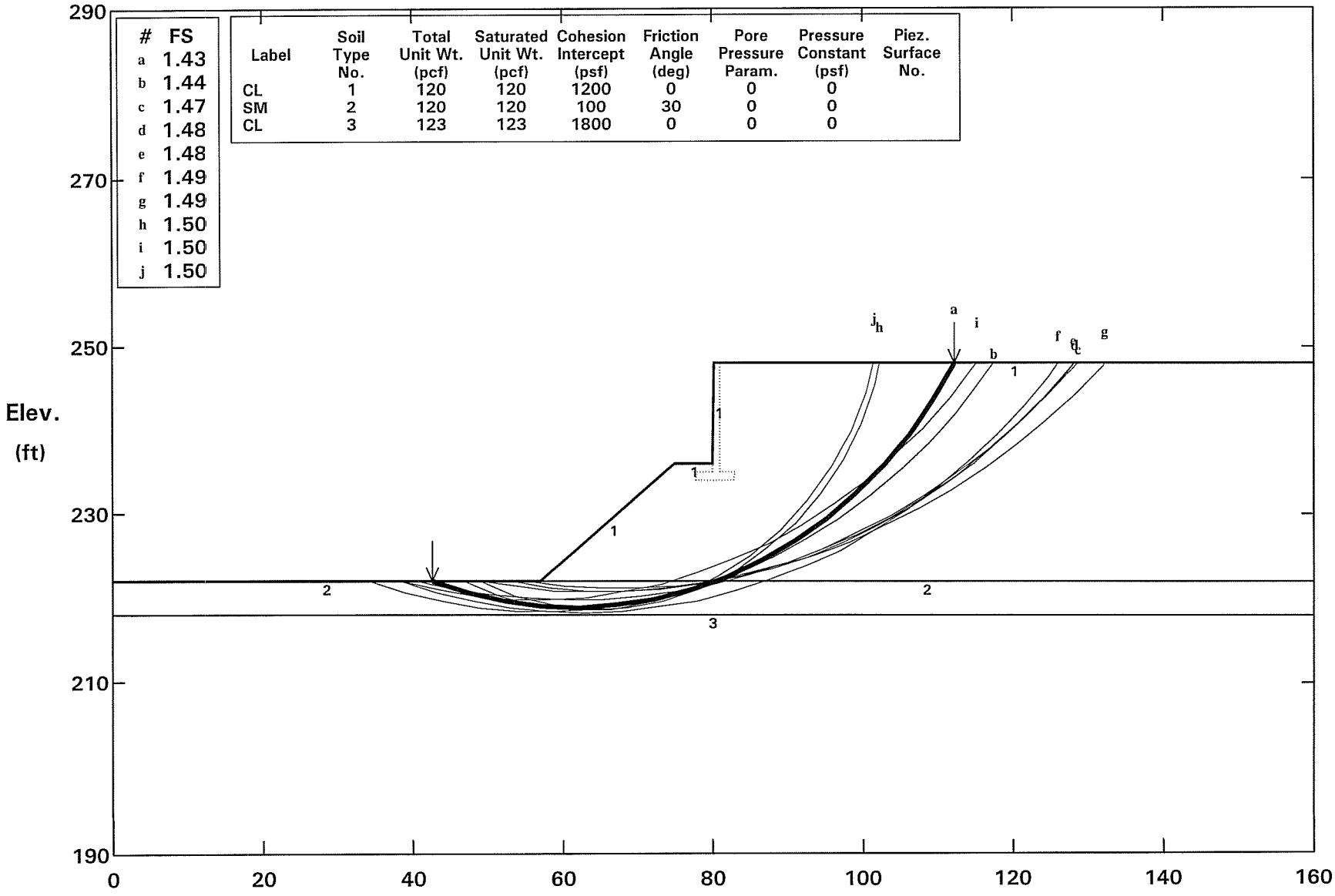


STABL6H FSmin = 1.76 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW522 (14'-high type 1 wall) Sta 527+00 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW522D.PLT 01-26-09 8:50am

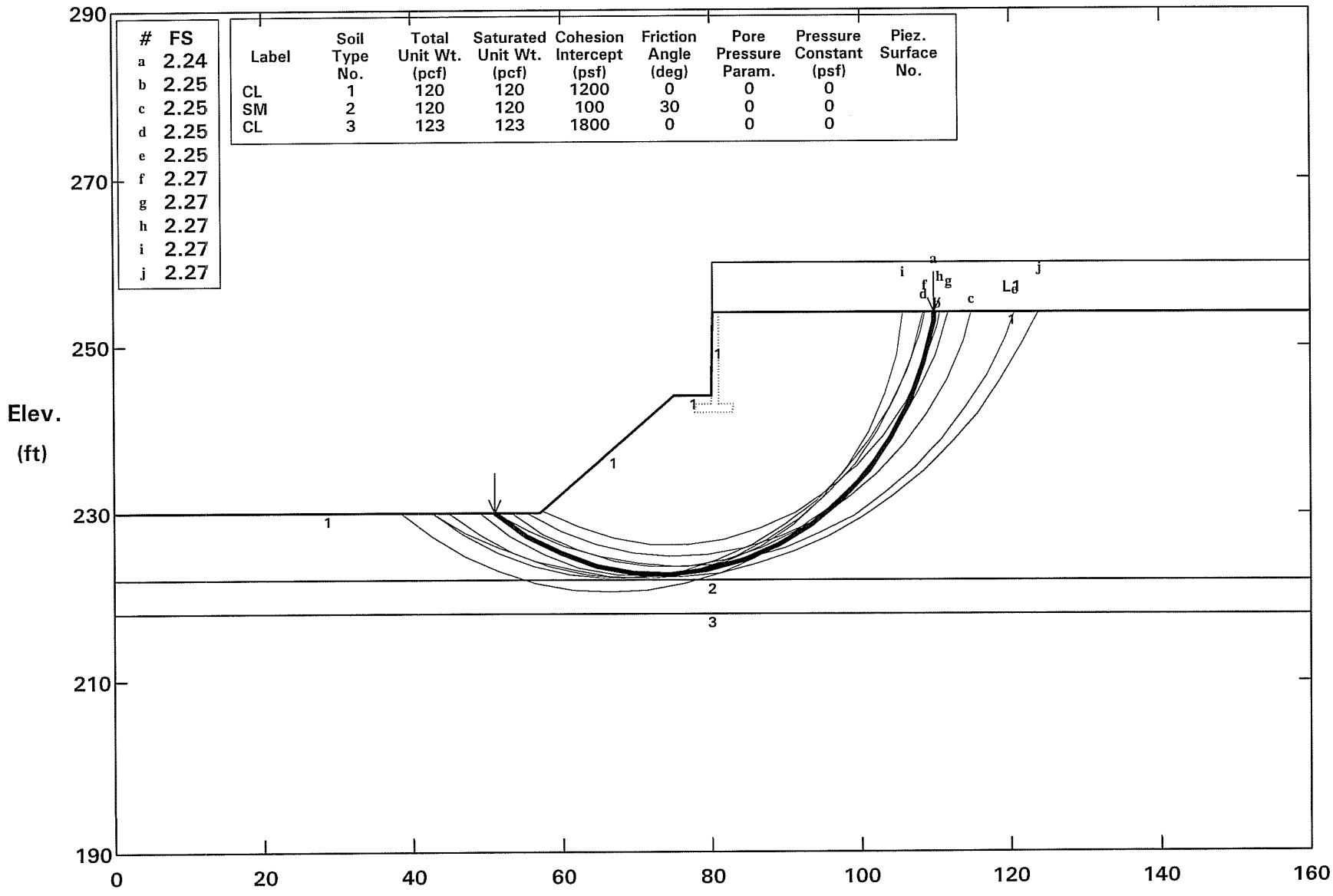


STABL6H FSmin = 1.43 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW526 (14'-4"-high SW on 8'-high RW) @ Sta 529+00 Static Condition

Ten Most Critical. D:RW526S.PLT 01-26-09 8:53am

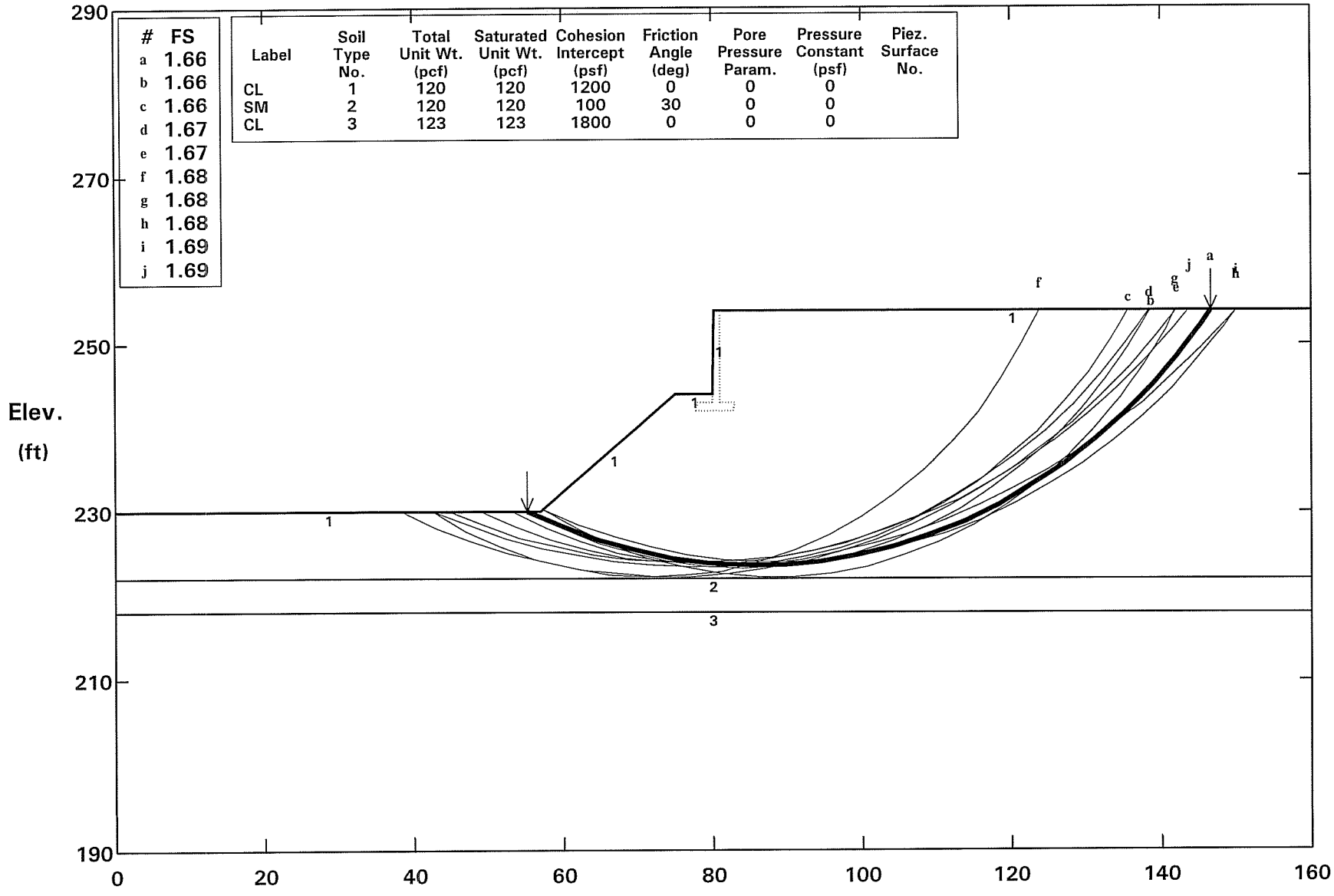


STABL6H FSmin = 2.24 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW526 (14'-4"-high SW on 8'-high RW) @ Sta 529+00 Pseudostatic Cond. (kh=0.2)

Ten Most Critical. D:RW526D.PLT 01-26-09 8:54am



#	FS
a	1.66
b	1.66
c	1.66
d	1.67
e	1.67
f	1.68
g	1.68
h	1.68
i	1.69
j	1.69

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
CL	1	120	120	1200	0	0	0	
SM	2	120	120	100	30	0	0	
CL	3	123	123	1800	0	0	0	

STABL6H FSmin=1.66 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

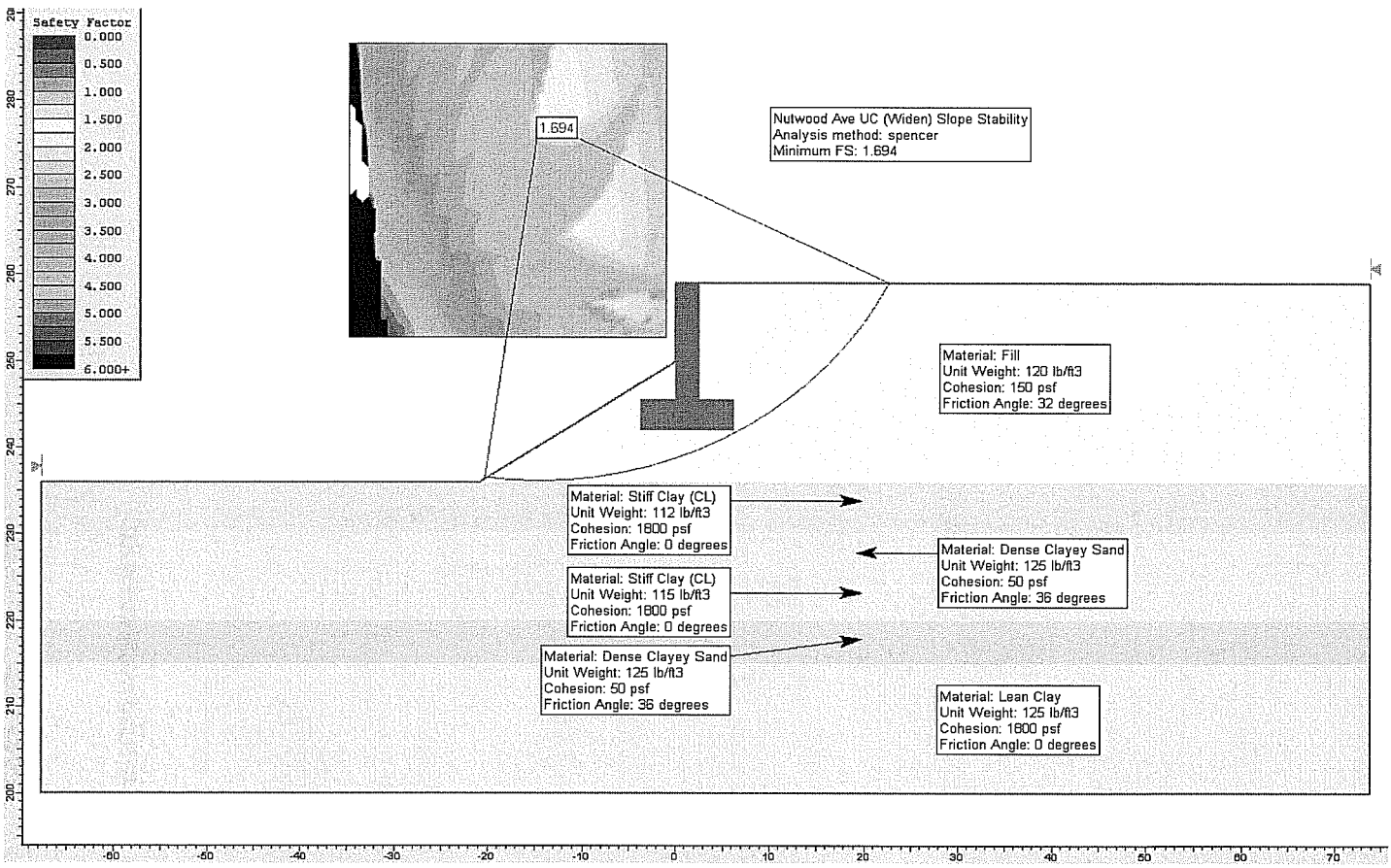
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
phone: (714)751-3826, Fax (714)751-3928

Project: **RW 536** Project No. **08-115**

By AZ Date 01/09/09 Check by Date Sheet

Static Slope Stability



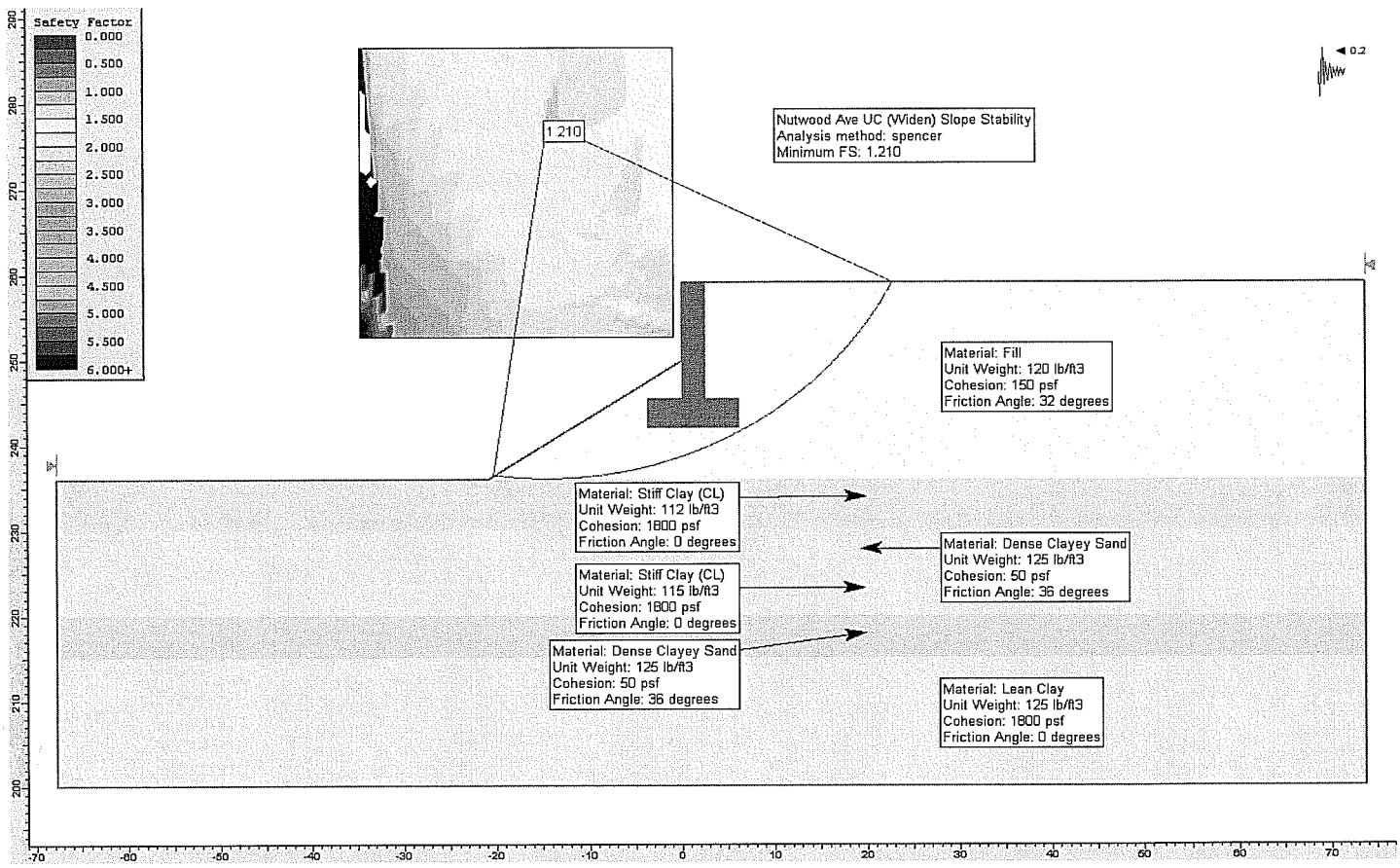
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
phone: (714)751-3826, Fax (714)751-3928

Project: **RW 536** Project No. **08-115**

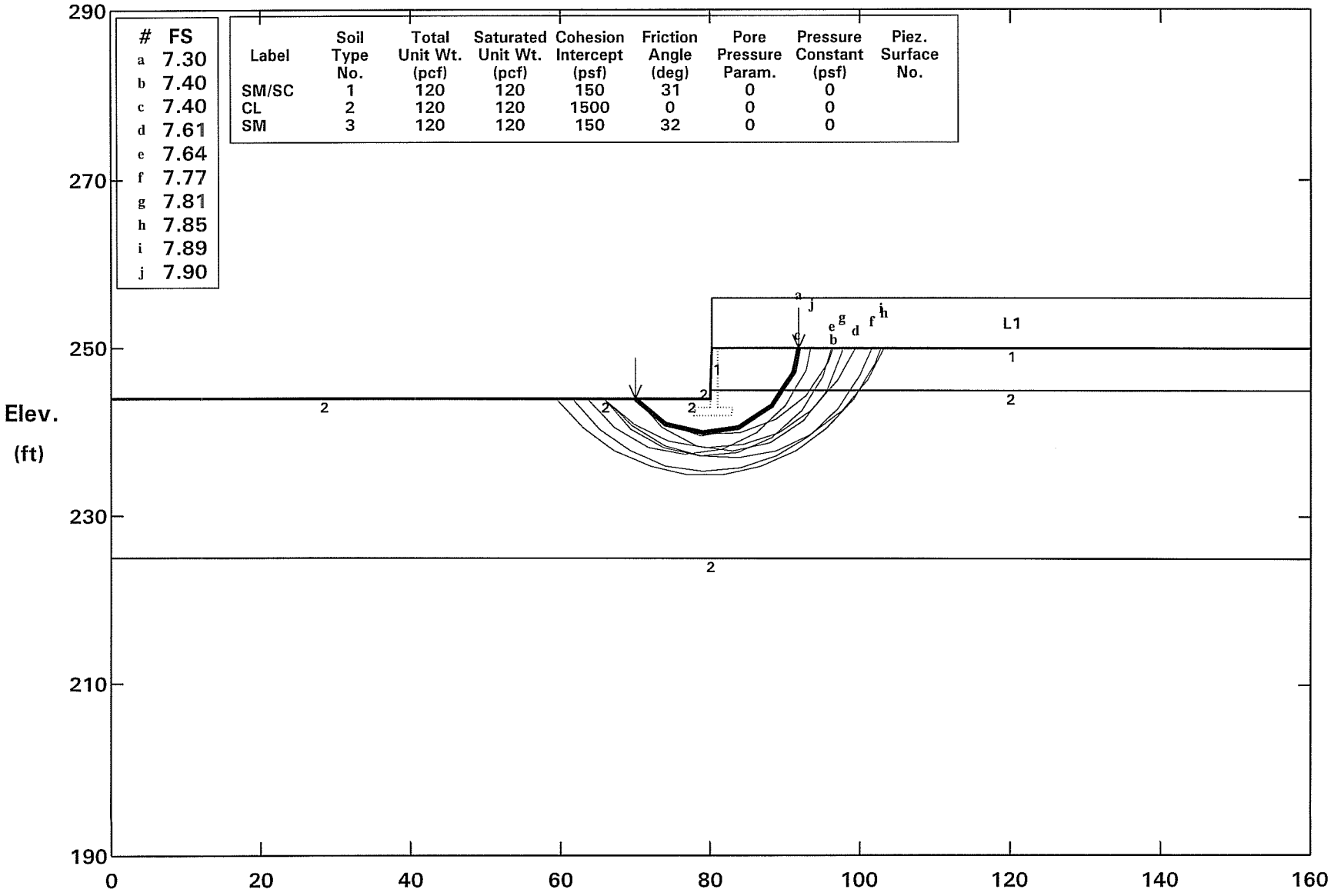
By AZ Date 01/09/09 Check by Date Sheet

Seismic Slope Stability



RW538/542 (12'-high SW on 8'-high RW) @ Sta 541+00 Static Condition

Ten Most Critical. D:RW538S.PLT 01-26-09 9:01am



#	FS
a	7.30
b	7.40
c	7.40
d	7.61
e	7.64
f	7.77
g	7.81
h	7.85
i	7.89
j	7.90

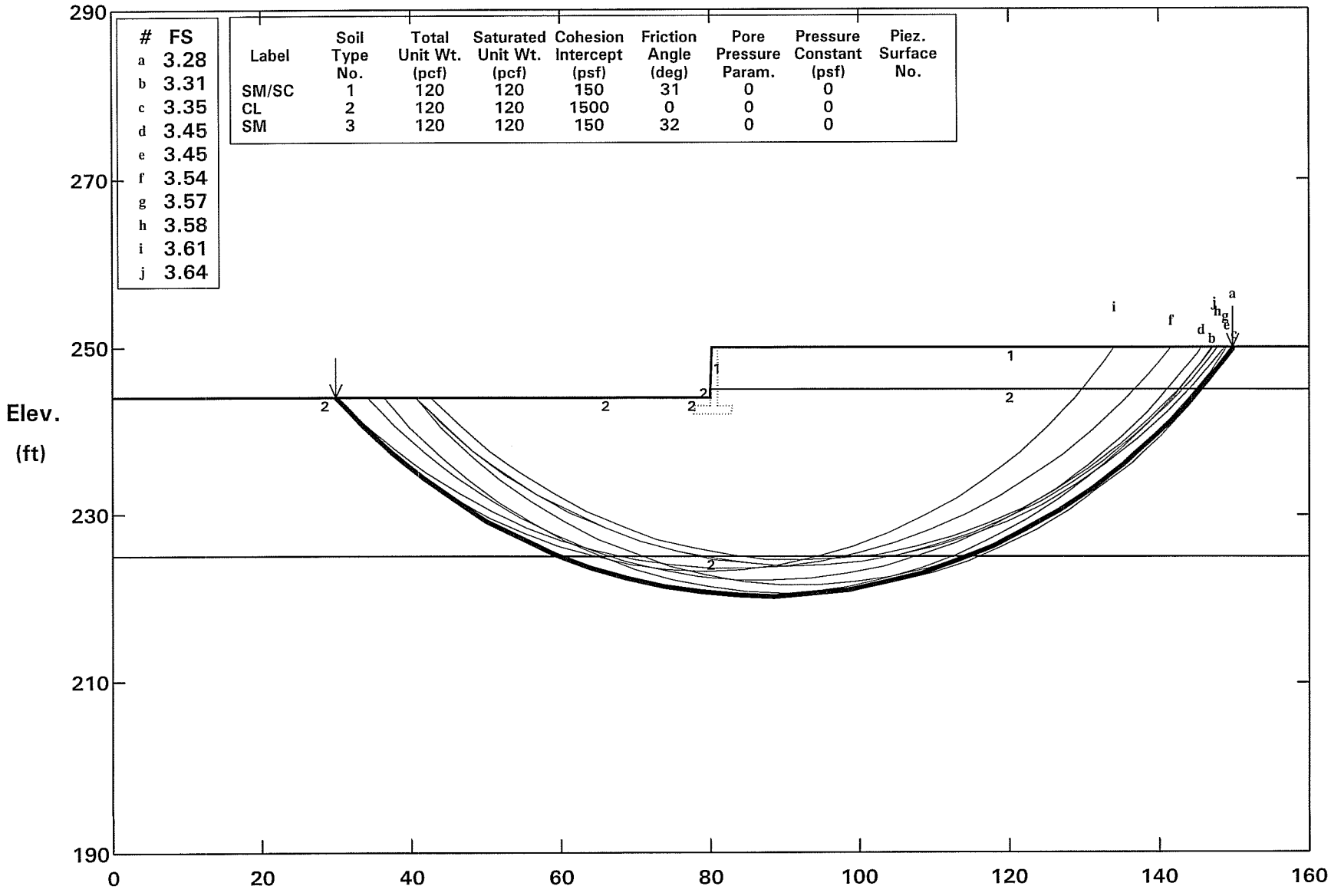
Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SM/SC	1	120	120	150	31	0	0	
CL	2	120	120	1500	0	0	0	
SM	3	120	120	150	32	0	0	

STABL6H FSmin = 7.30 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW538/542 (12'-high SW on 8'-high RW) @ Sta 541+00 Pseudostatic Cond. (kh=0.2)

Ten Most Critical. D:RW538D.PLT 01-26-09 9:02am

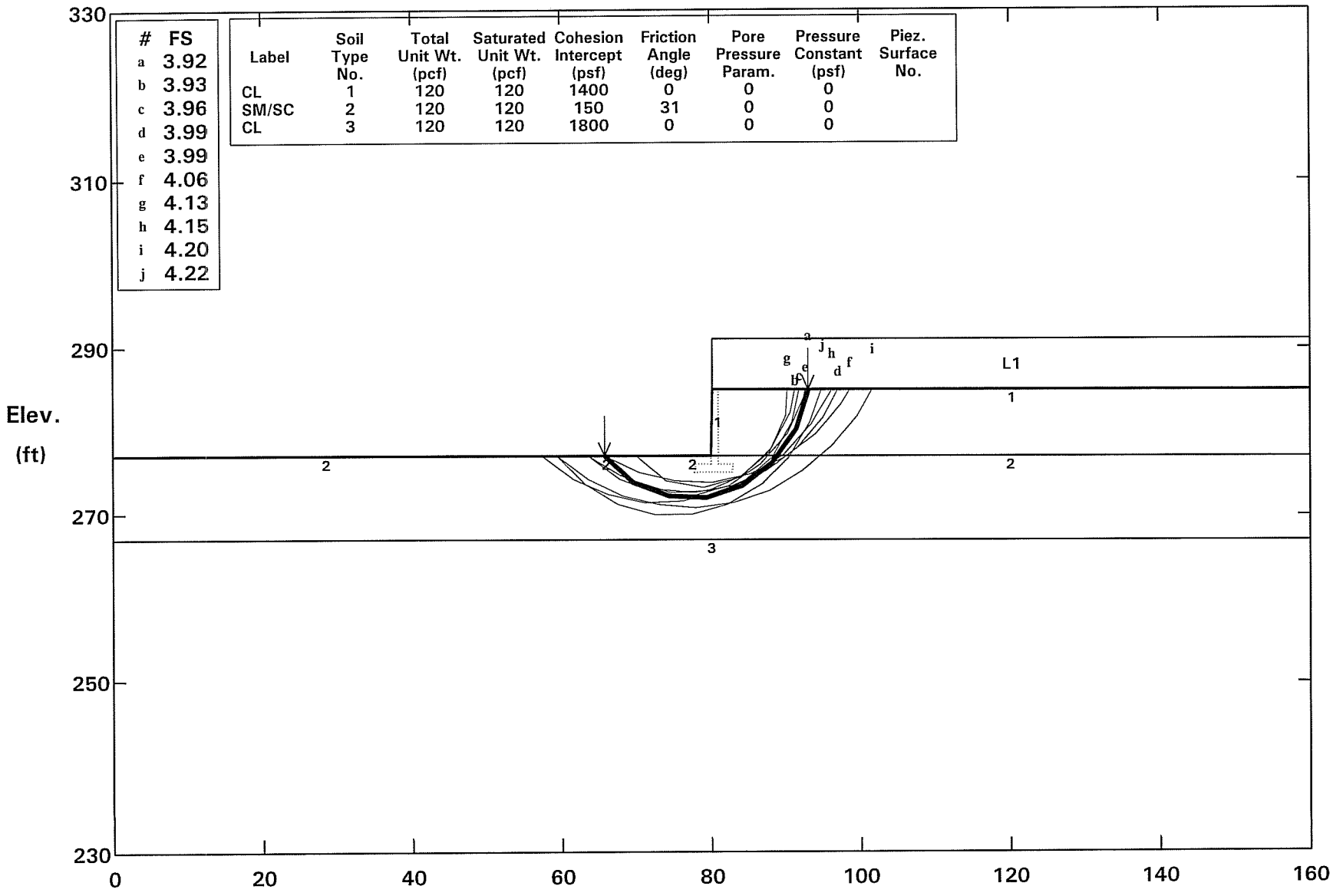


STABL6H FSmin=3.28 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW576 (10'-high type 1 wall) @ 576+00 Static Condition

Ten Most Critical. D:RW576S.PLT 01-26-09 9:05am



#	FS
a	3.92
b	3.93
c	3.96
d	3.99
e	3.99
f	4.06
g	4.13
h	4.15
i	4.20
j	4.22

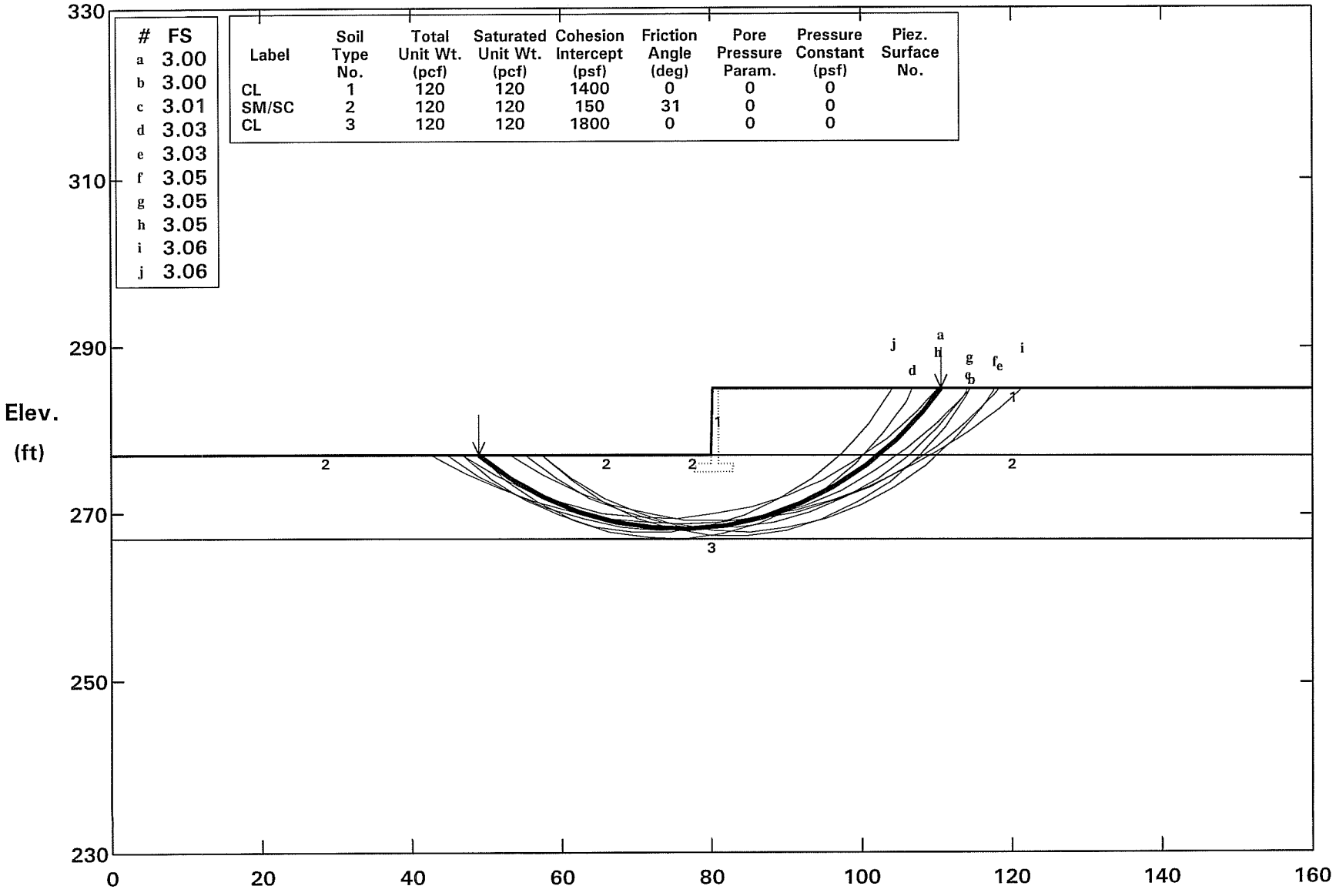
Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
CL	1	120	120	1400	0	0	0	
SM/SC	2	120	120	150	31	0	0	
CL	3	120	120	1800	0	0	0	

STABL6H FSmin = 3.92 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW576 (10'-high type 1 wall) @ 576+00 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW576D.PLT 01-26-09 9:06am



Factors Of Safety Calculated By The Modified Bishop Method

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
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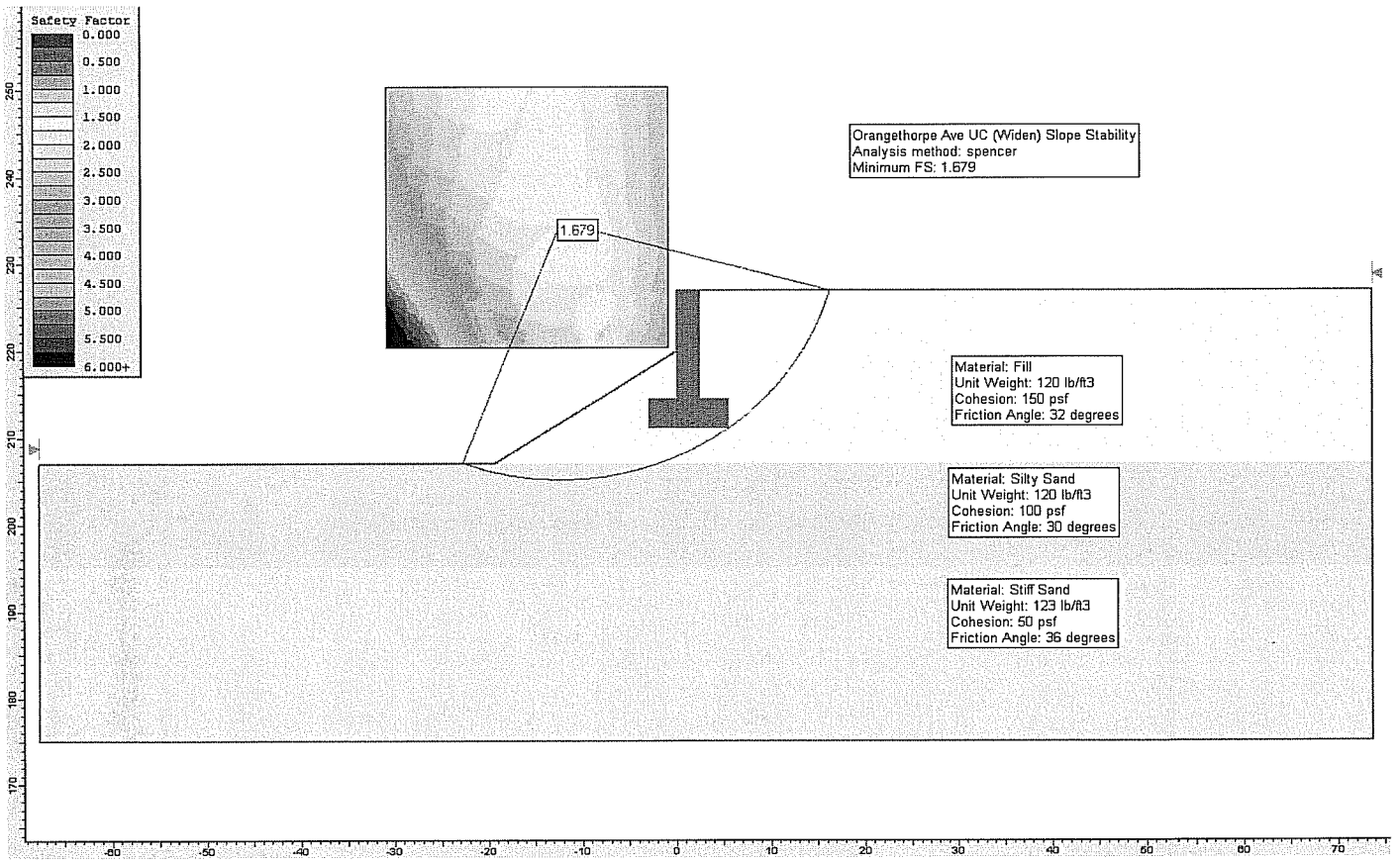
Project: **Orangethorpe Avenue UC (WIDEN)** Project No. **08-115**

By AZ Date 01/08/09 Check by Date Sheet

Static Slope Stability



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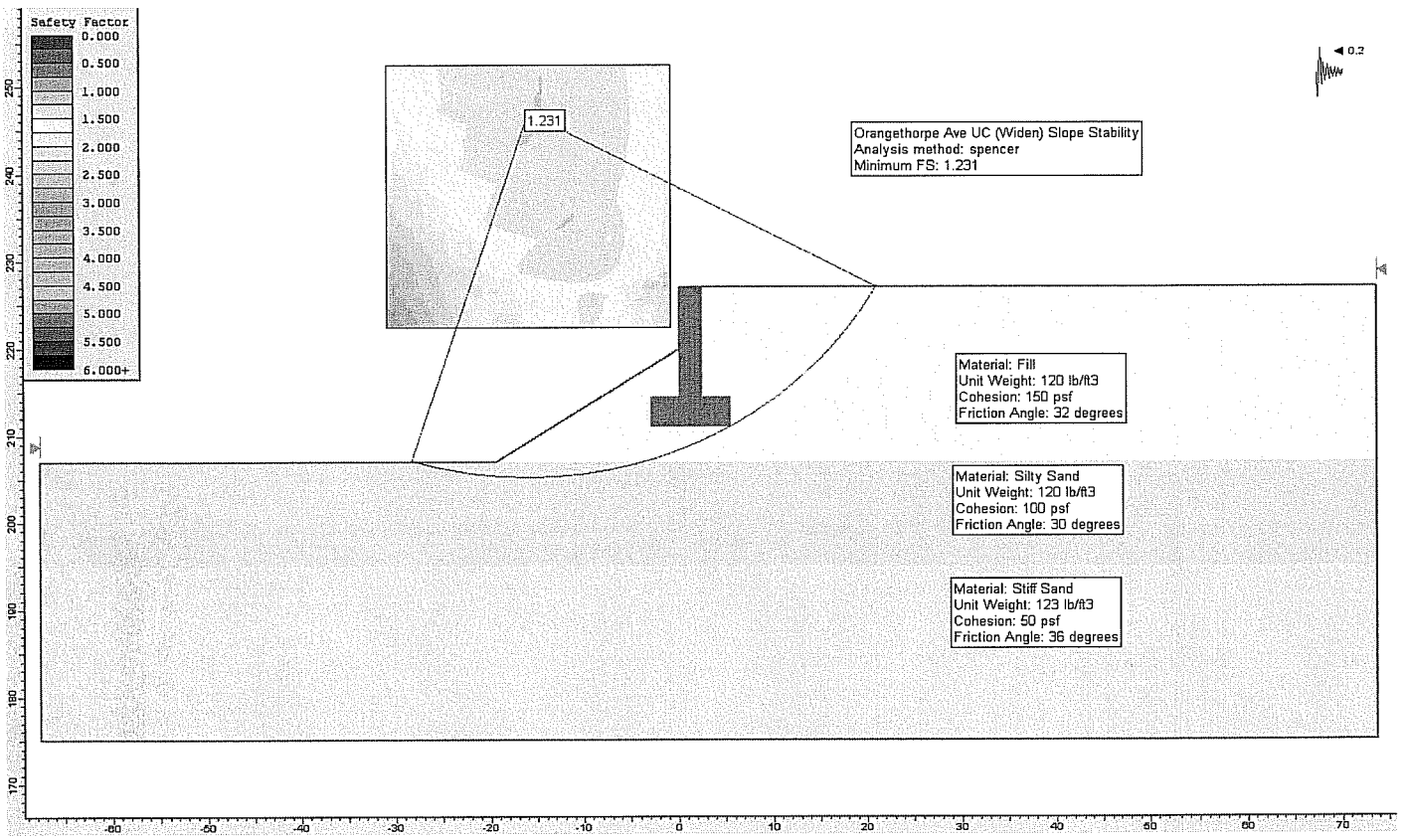
Project: **Orangethorpe Avenue UC (WIDEN)** Project No. **08-115**

By AZ Date 01/08/09 Check by Date Sheet

Seismic Slope Stability



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

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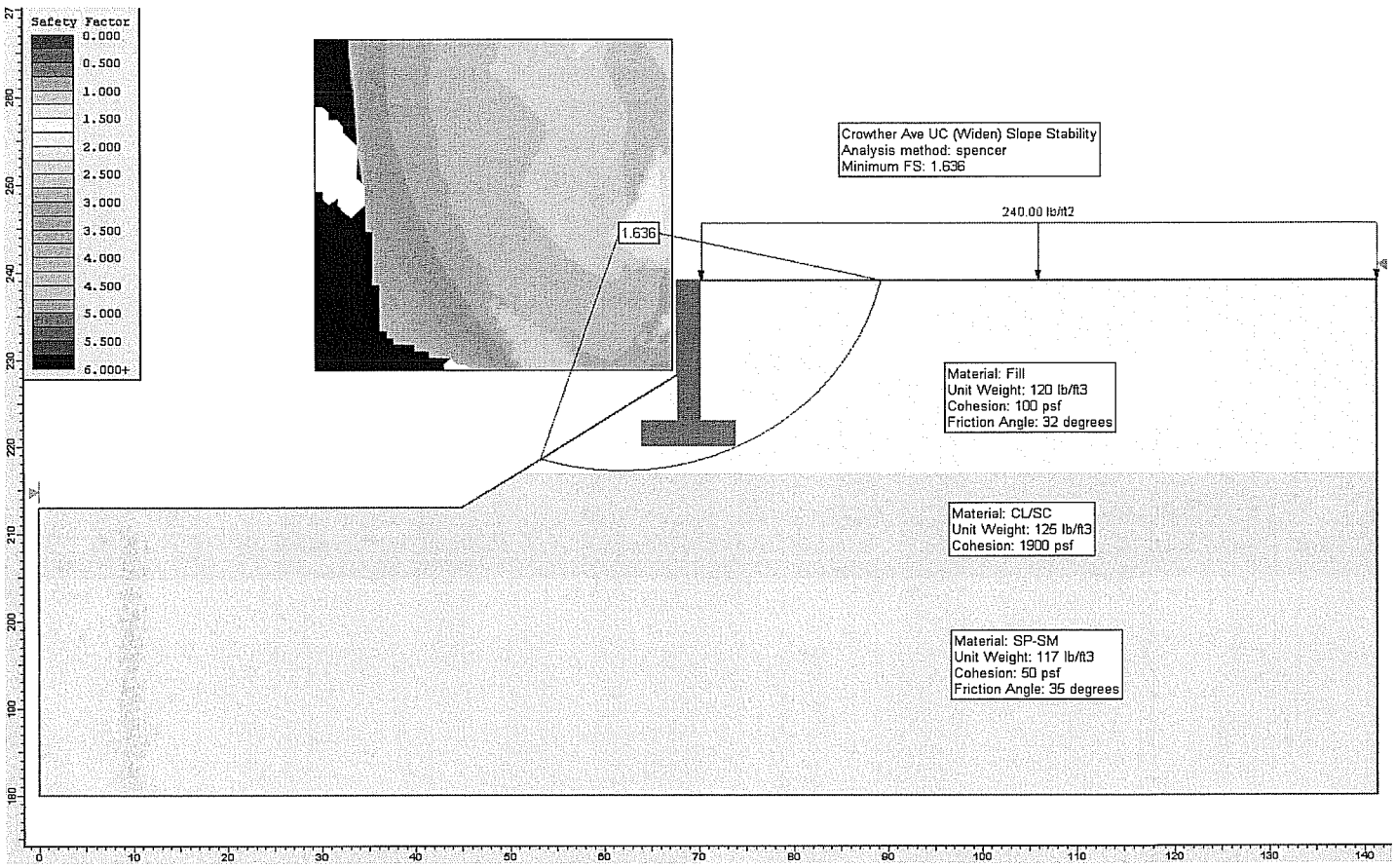
phone: (714)751-3826, Fax (714)751-3928

Project: **Crowther Avenue UC (WIDEN)** Project No. **08-115**

By AZ Date 01/08/09 Check by Date Sheet

Static Slope Stability



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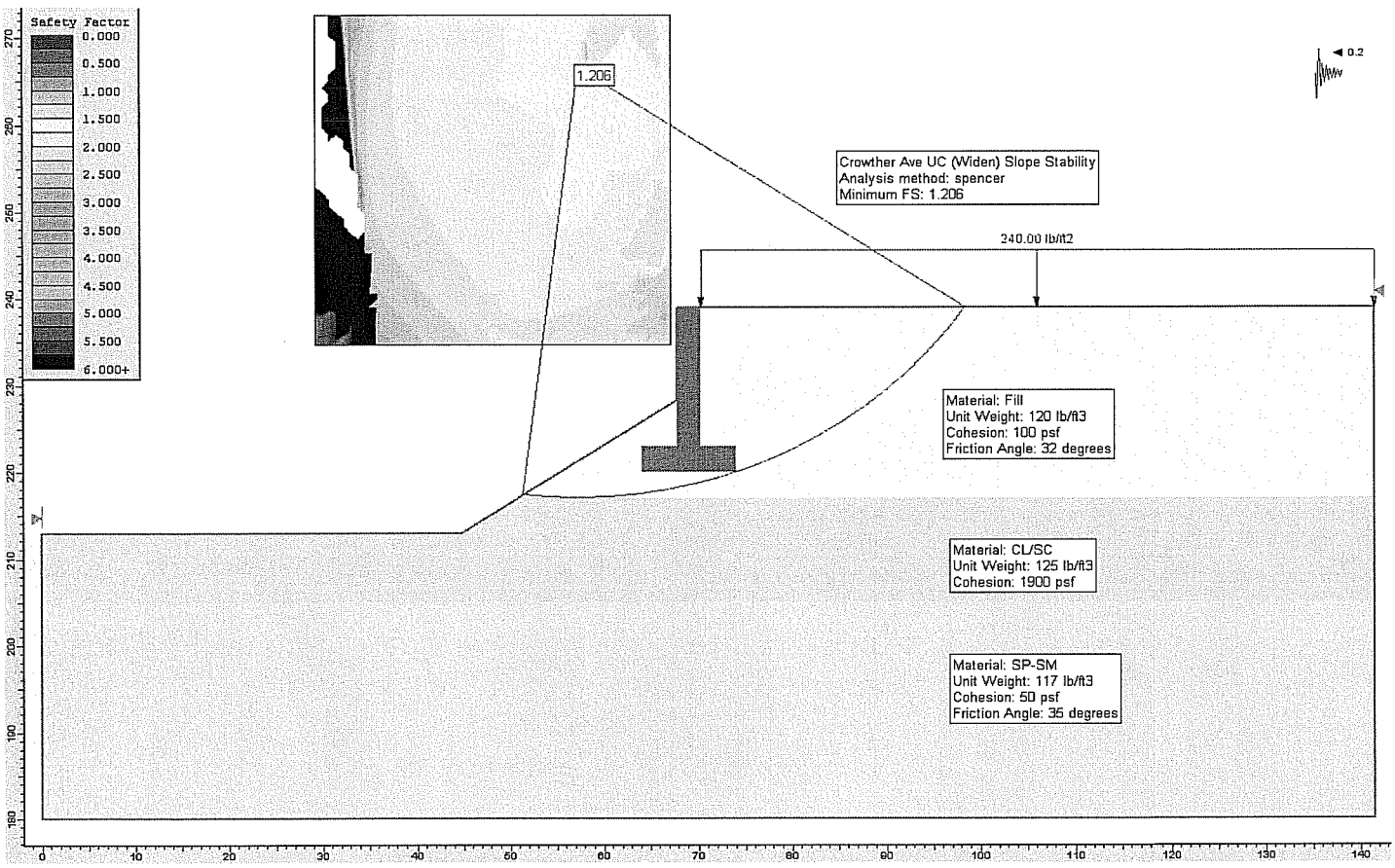
Project: **Crowther Avenue UC (WIDEN)** Project No. **08-115**

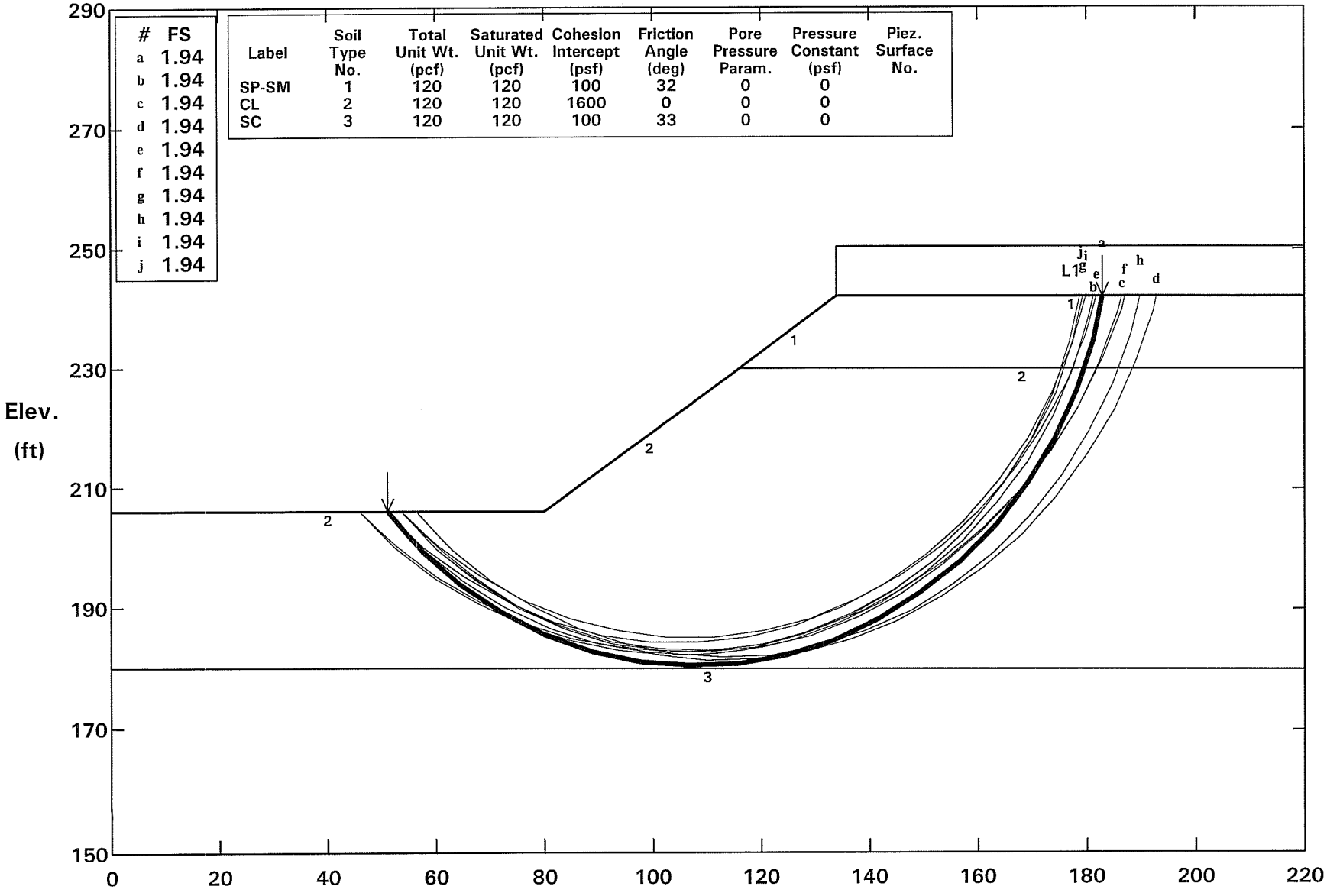
By AZ Date 01/08/09 Check by Date Sheet

Seismic Slope Stability



Placentia Overhead (Widen) Abut 1 Static Condition

Ten Most Critical. D:PLOHA1S.PLT 01-08-09 1:46pm

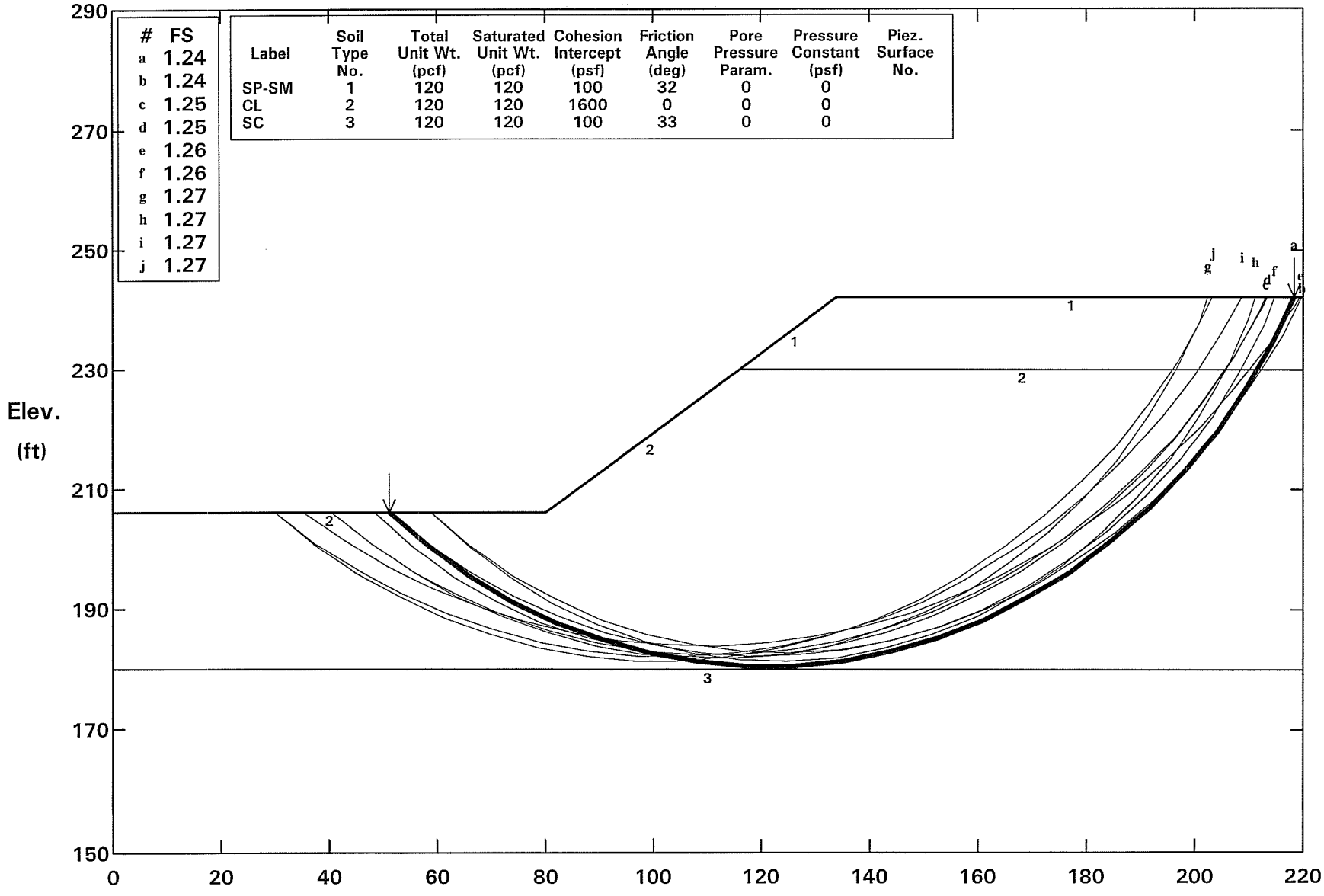


STABL6H FSmin = 1.94 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Placentia Overhead (Widen) Abut 1 Pseudostatic Condition (kh = 0.2)

Ten Most Critical. D:PLOHA1D.PLT 01-08-09 1:48pm



#	FS
a	1.24
b	1.24
c	1.25
d	1.25
e	1.26
f	1.26
g	1.27
h	1.27
i	1.27
j	1.27

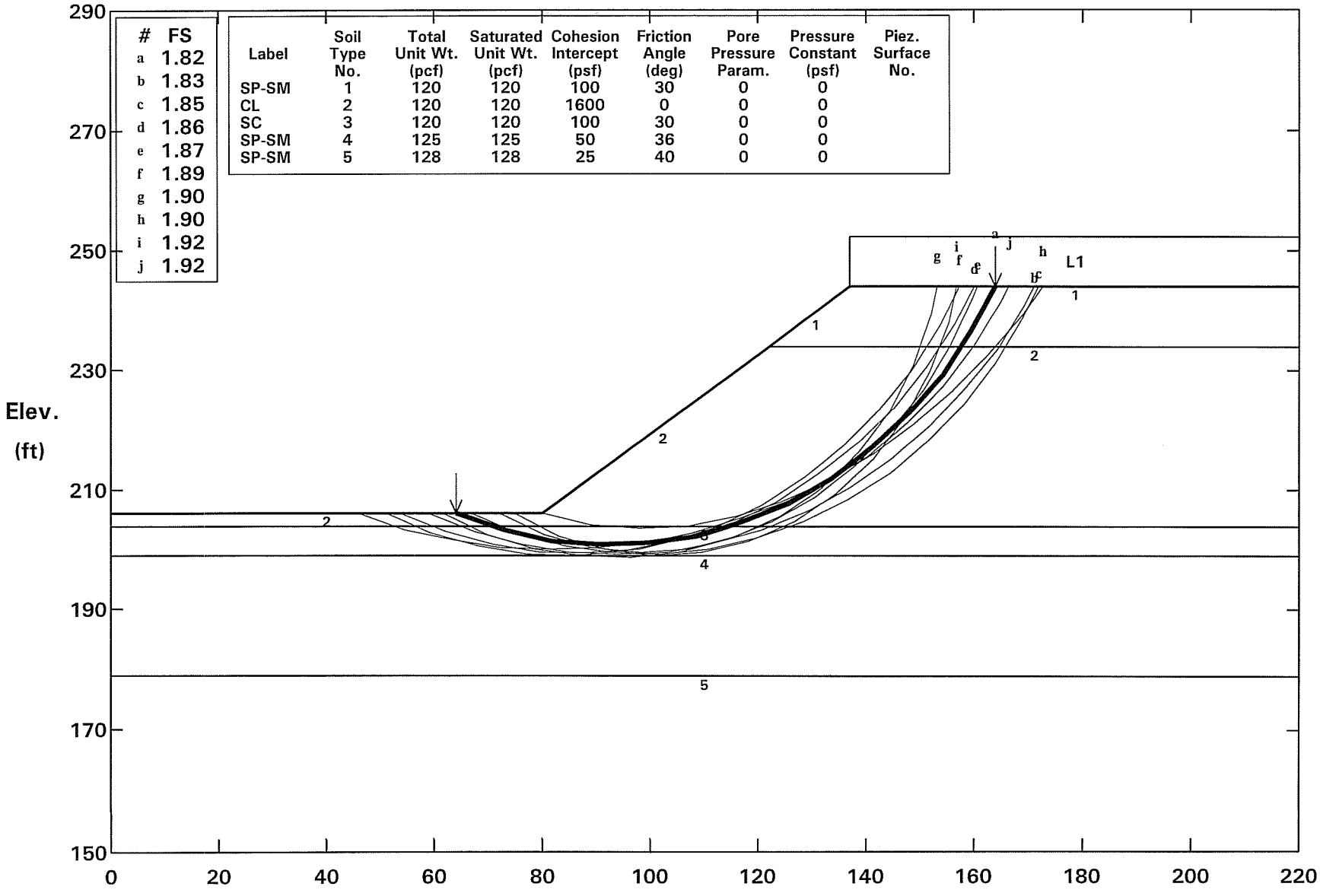
Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SP-SM	1	120	120	100	32	0	0	
CL	2	120	120	1600	0	0	0	
SC	3	120	120	100	33	0	0	

STABL6H FSmin = 1.24 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Placentia Overhead (Widen) Abut 2 Static Condition

Ten Most Critical. D:PLOHA2S.PLT 01-08-09 1:56pm

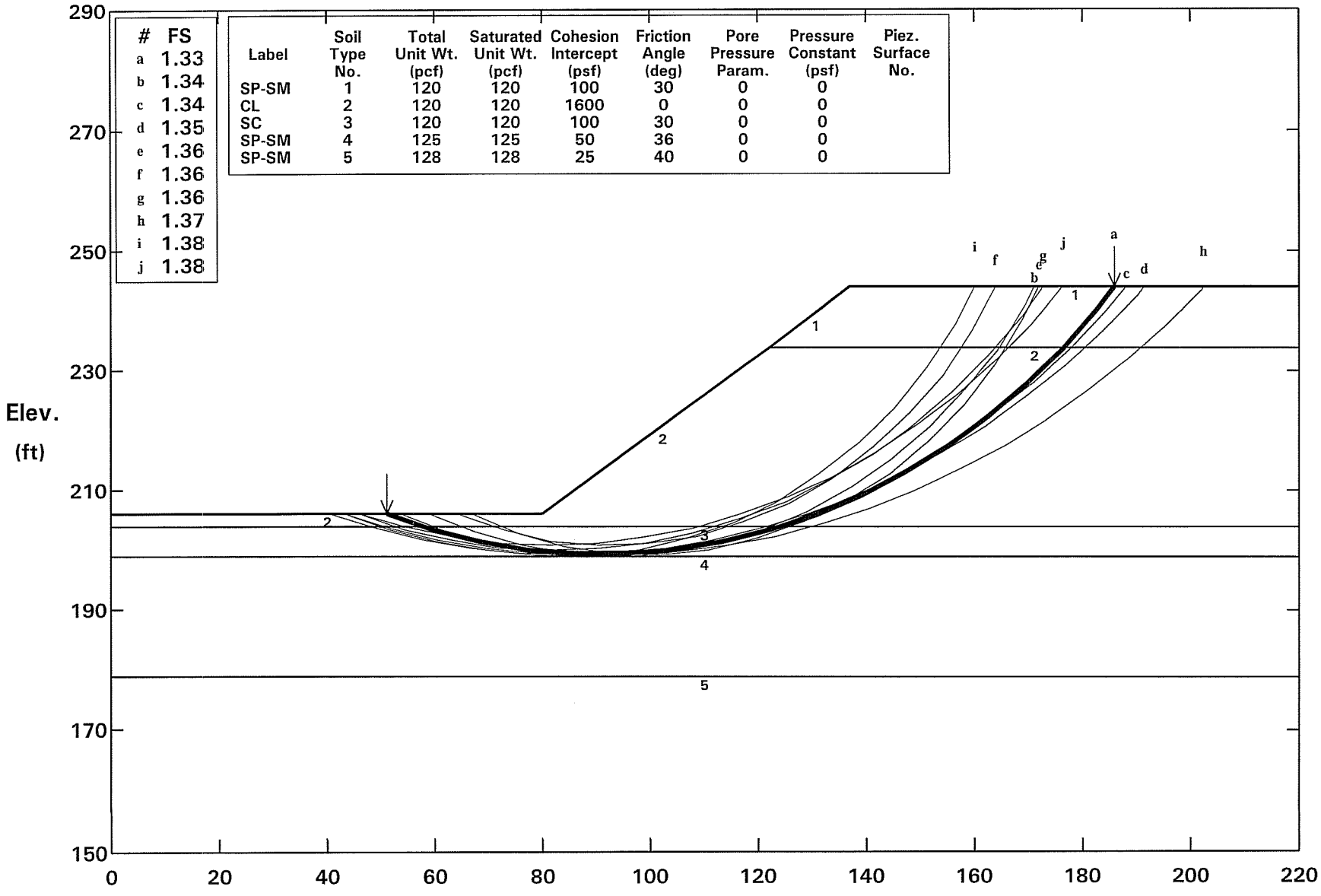


STABL6H FSmin = 1.82 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Placentia Overhead (Widen) Abut 2 Pseudostatic Condition (kh = 0.2)

Ten Most Critical. D:PLOHA2D.PLT 01-08-09 1:56pm

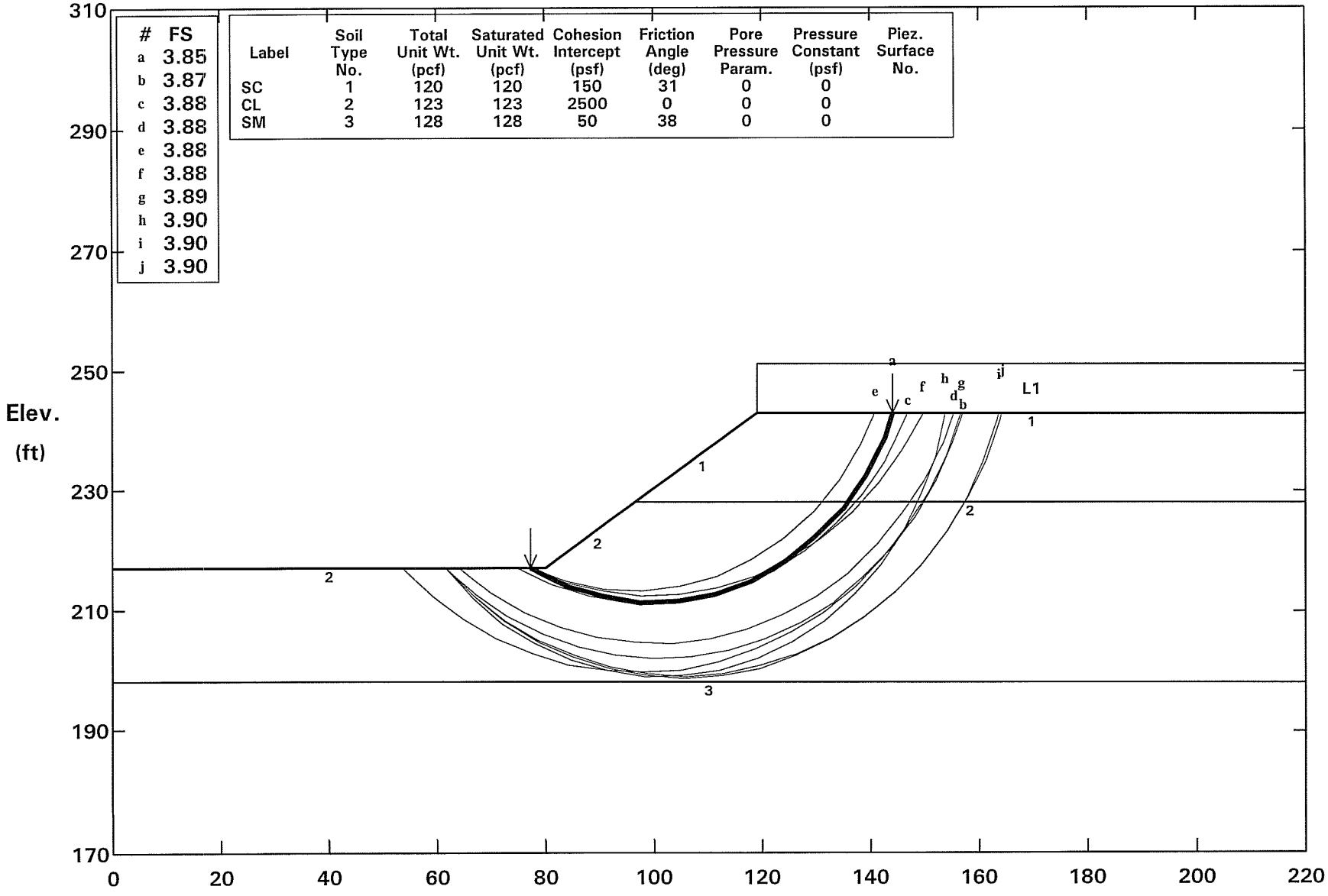


STABL6H FSmin = 1.33 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Placentia Ave UC (Widen) Static Condition

Ten Most Critical. D:PLAVES.PLT 01-21-09 10:39am

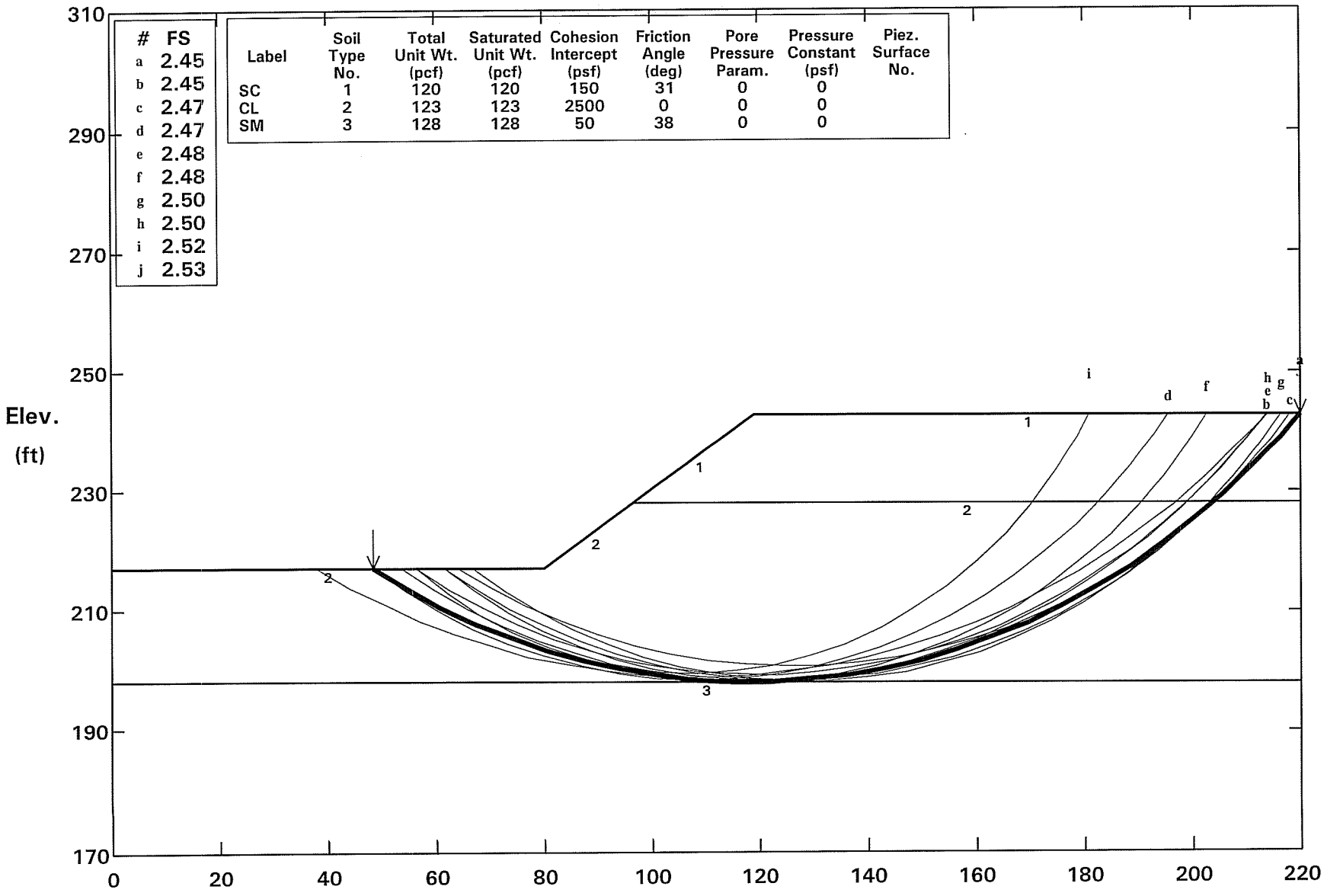


STABL6H FSmin = 3.85 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Placentia Ave UC (Widen) Pseudostatic Condition (kh = 0.2)

Ten Most Critical. D:PLAVED.PLT 01-21-09 10:39am



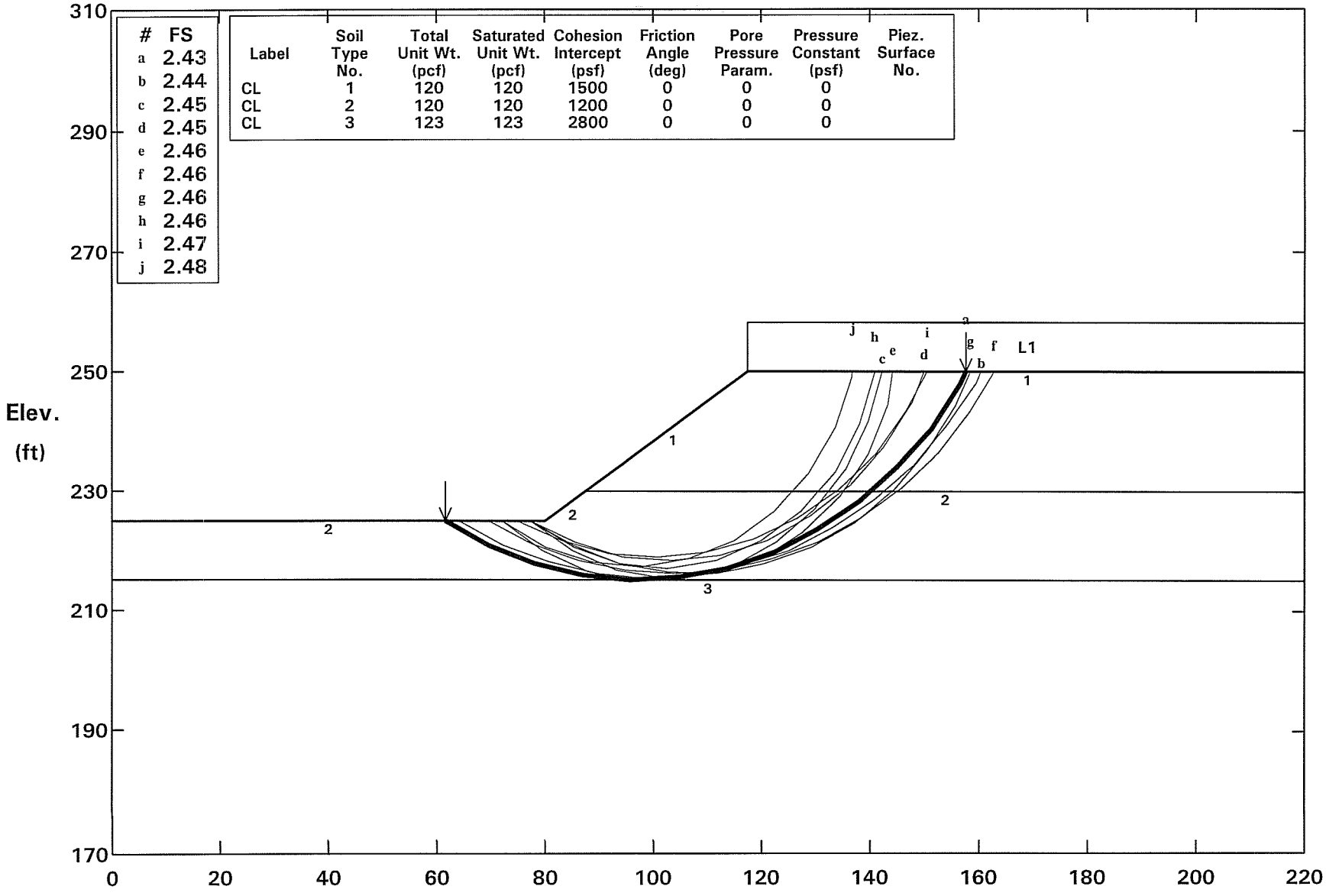
#	FS
a	2.45
b	2.45
c	2.47
d	2.47
e	2.48
f	2.48
g	2.50
h	2.50
i	2.52
j	2.53

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SC	1	120	120	150	31	0	0	
CL	2	123	123	2500	0	0	0	
SM	3	128	128	50	38	0	0	

Factors Of Safety Calculated By The Modified Bishop Method

Chapman Ave UC (Widen) Abut 1 Static Condition

Ten Most Critical. D:CHAPA1S.PLT 01-13-09 2:49pm

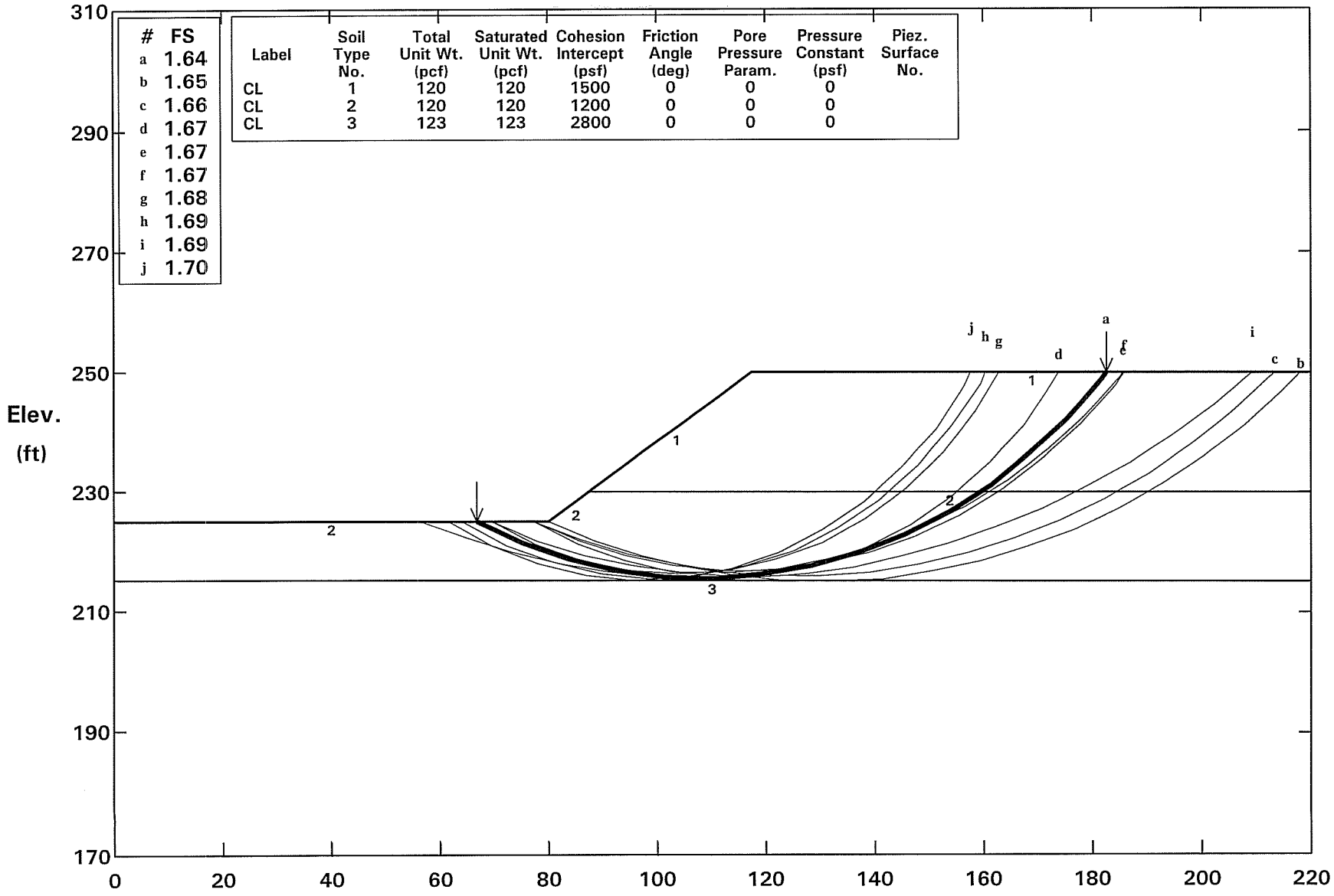


STABL6H FSmin = 2.43 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Chapman Ave UC (Widen) Abut 1 Pseudostatic Condition (kh = 0.2)

Ten Most Critical. D:CHAPA1D.PLT 01-13-09 2:50pm

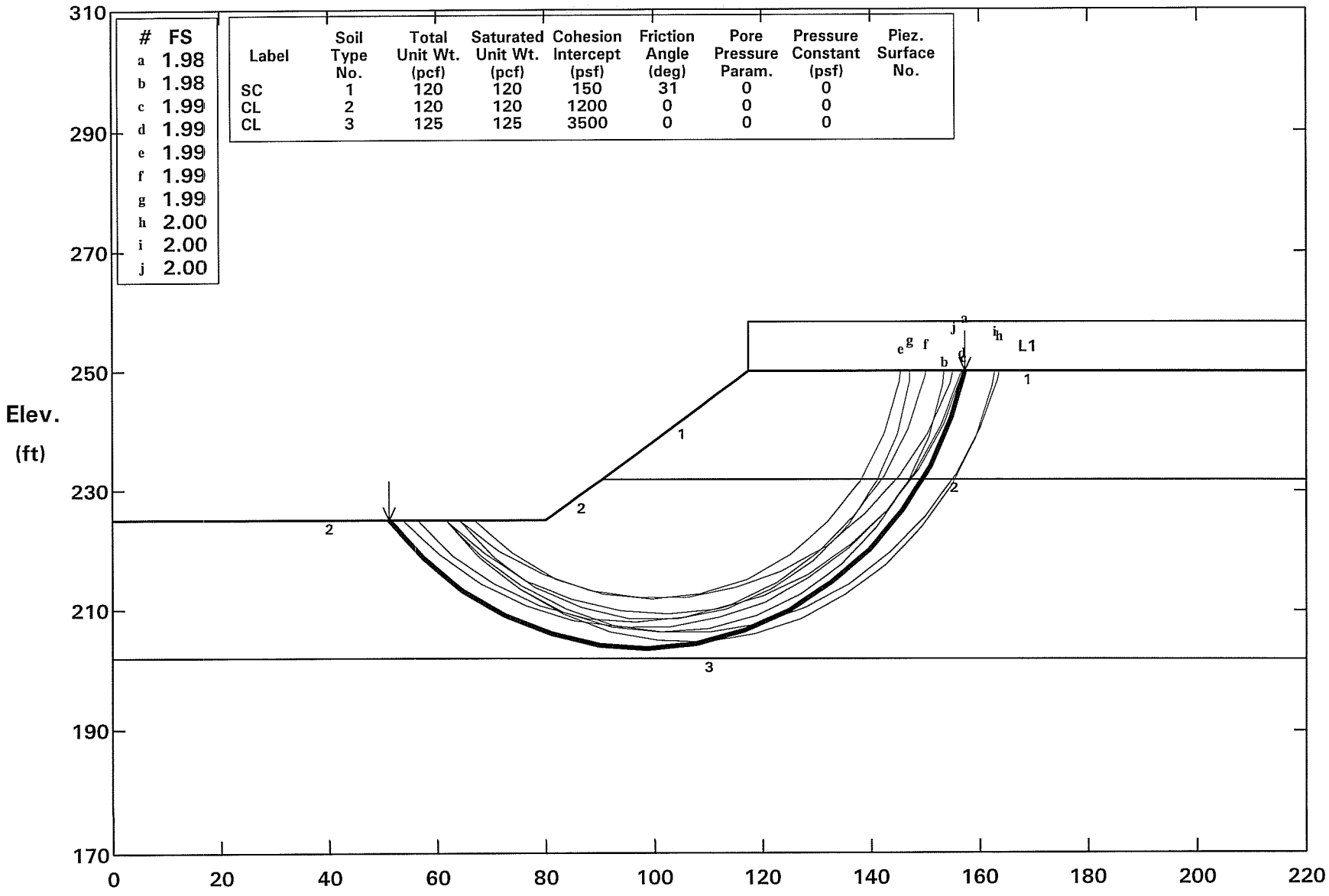


STABL6H FSmin = 1.64 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Chapman Ave UC (Widen) Abut 2 Static Condition

Ten Most Critical. D:CHAPA2S.PLT 01-13-09 2:51pm

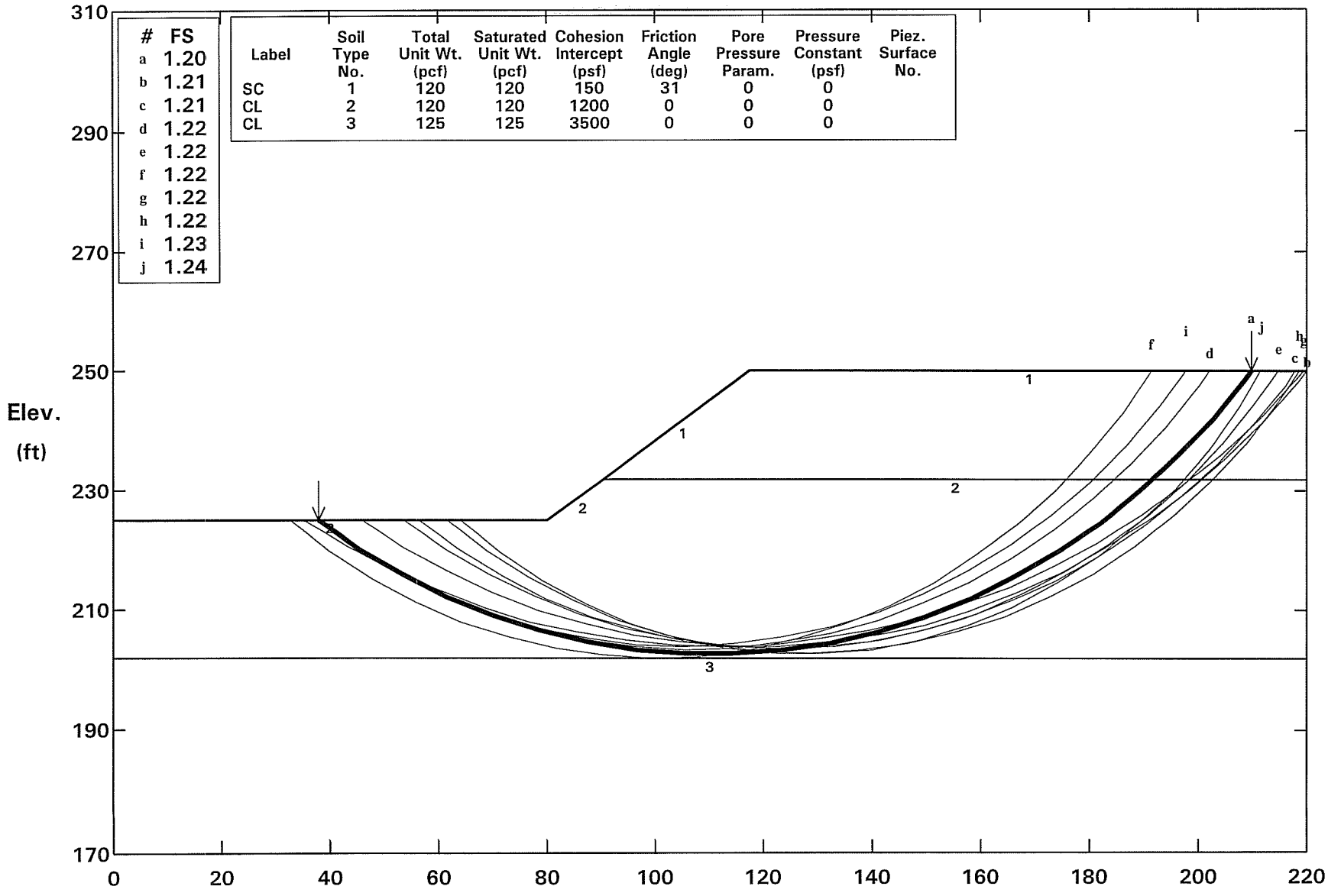


STABL6H FSmin = 1.98 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Chapman Ave UC (Widen) Abut 2 Pseudostatic Condition (kh = 0.2)

Ten Most Critical. D:CHAPA2D.PLT 01-13-09 2:52pm



#	FS
a	1.20
b	1.21
c	1.21
d	1.22
e	1.22
f	1.22
g	1.22
h	1.22
i	1.23
j	1.24

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SC	1	120	120	150	31	0	0	
CL	2	120	120	1200	0	0	0	
CL	3	125	125	3500	0	0	0	

STABL6H FSmin = 1.20 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

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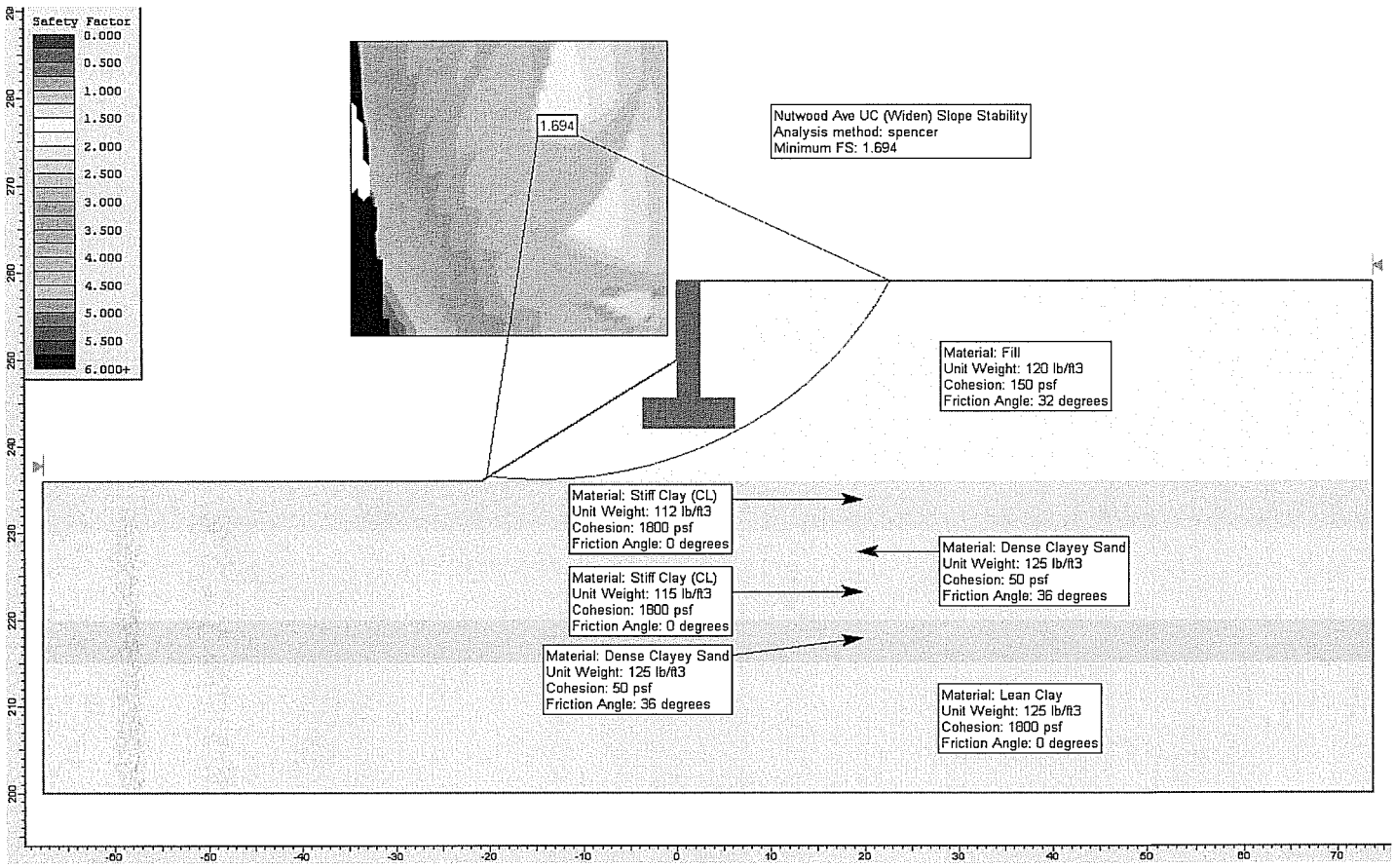
Project: **Nutwood Avenue UC (WIDEN)** Project No. **08-115**

By AZ Date 01/09/09 Check by Date Sheet

Static Slope Stability



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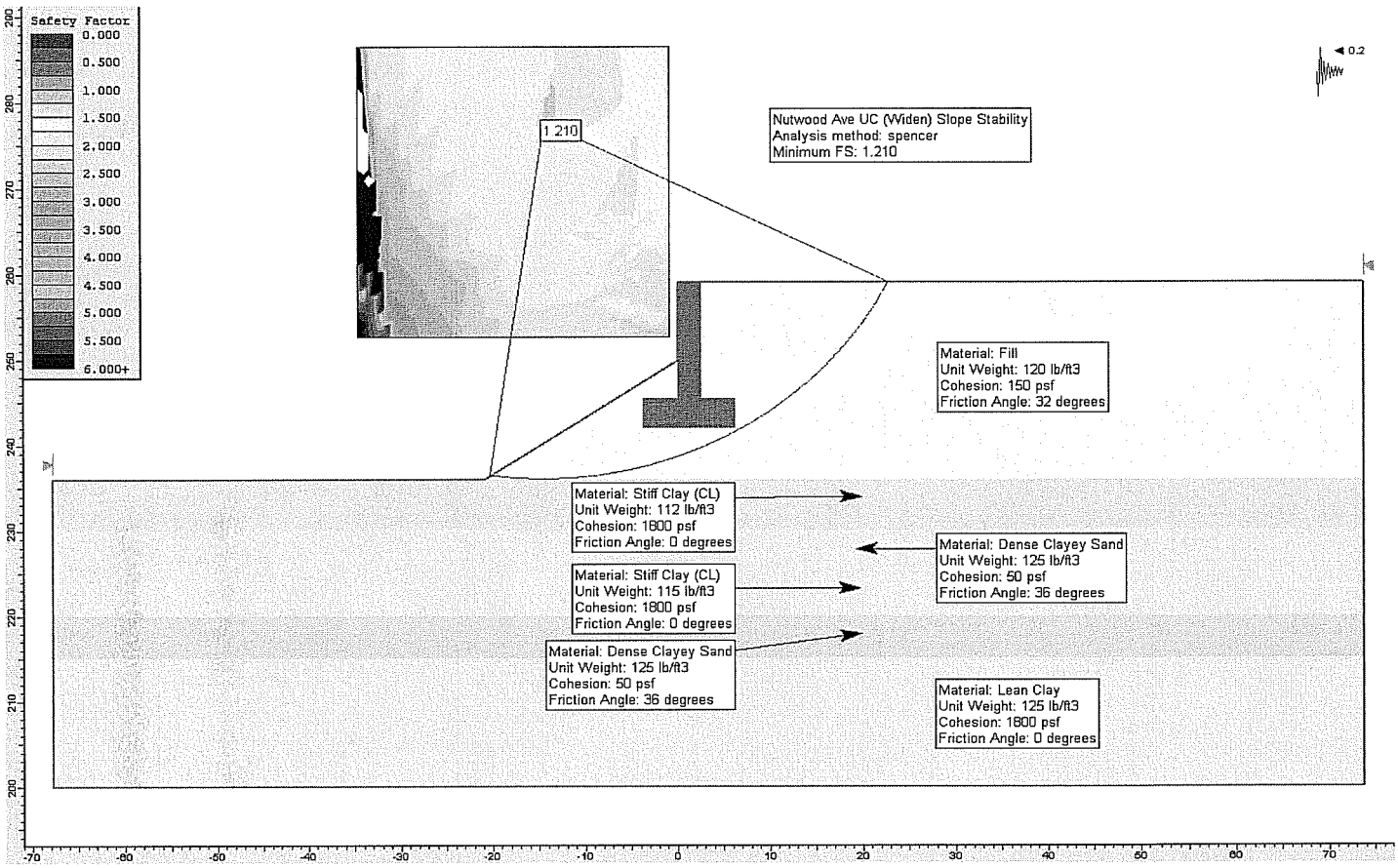
Project: **Nutwood Avenue UC (WIDEN)** Project No. **08-115**

By AZ Date 01/09/09 Check by Date Sheet

Seismic Slope Stability



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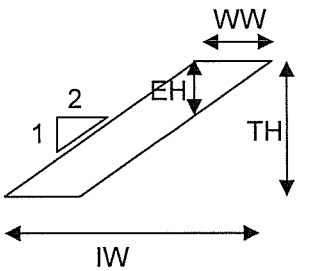
phone: (714)751-3826, Fax (714)751-3928

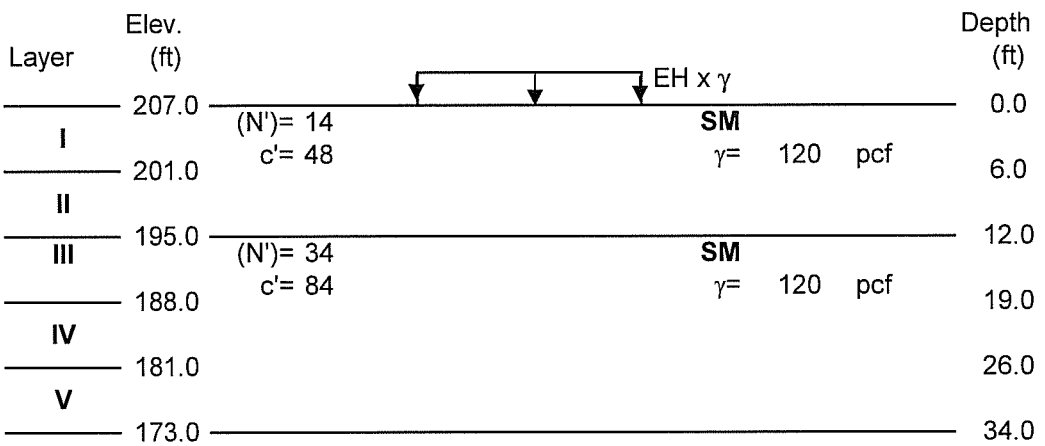
Project: **Orangethrope Avenue UC (Widen)** Project No. **08-115**
By CTY Date 1/19/09 Check by Date Sheet

Settlement Calculation for Sliver Fill

Total Fill Height, TH=	23	ft	Width of Widening, WW=	20	ft
Effective Fill Height, EH=	10	ft			
Loading=	1.2	ksf = EH x unit weight (120 pcf used)			
Influenced Width, IW=	80	ft			



Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-08



Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)
0	6	3	3.0	0.36	0.04	100%	1.20	1.56	48	0.96
II	6	9	9.0	1.08	0.11	98%	1.18	2.26	48	0.48
II	7	15.5	15.5	1.86	0.19	97%	1.16	3.02	84	0.21
III	7	22.5	22.5	2.70	0.28	95%	1.14	3.84	84	0.15
IV	8	30	30.0	3.60	0.38	91%	1.09	4.69	84	0.13
									total=	*1.93*

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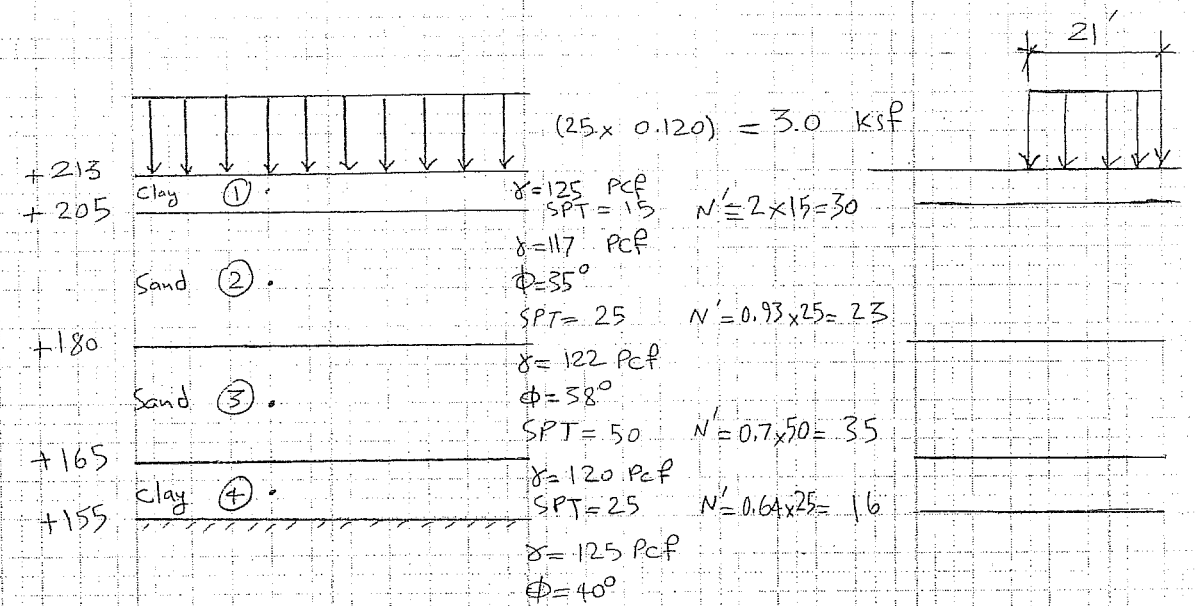
Project Crowther Ave. UC (widen) Project No. 08-115

By AZ Date 1-5-09 Checked By _____ Date _____ Sheet ___ of ___

Settlement

Loading: 25' of silver fill



Stress distribution was calculated from elastic solution.

Point	Depth (Ft)	σ_{vo} (ksf)	$\Delta\sigma$ (ksf)	σ_{vf} (ksf)	c'*	Settlement (in)
1	4.0	0.50	2.95	3.45	45	1.8
2	19.0	2.46	1.78	4.24	65	1.1
3	39	4.84	0.99	5.83	85	0.2
4	51.5	6.36	0.76	7.12	20	0.3

$S_{total} = 3.3$ in.

layer settlement: $S = H \frac{1}{c'} \log \frac{\sigma_{vf}}{\sigma_{vo}}$

* Note: Bearing capacity index (c') for clay layers was estimated from consolidation tests in nearby borings.
For sand layers FHWA (1982) Figure 13 was used.

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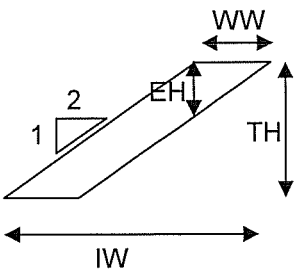
Project: **Placentia Overhead (Widen)** Project No. **08-115**
By CTY Date 1/8/2009 Check by Date Sheet

Settlement Calculation for Sliver Fill

Total Fill Height, TH=	34	ft	Width of Widening, WW=	24	ft
Effective Fill Height, EH=	12	ft			
Loading=	1.44	ksf = EH x unit weight (120 pcf used)			
Influenced Width, IW=	30	ft			



Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-08

Layer	Elev. (ft)			Depth (ft)
	206.0	EH x γ		0.0
I		(N')= 13	CL	
	198.0	c'= 40	γ= 120 pcf	8.0
II				
	190.0			16.0
III				
	180.0			26.0
IV		(N')= 20	SC	
	170.0	c'= 58	γ= 120 pcf	36.0
V		(N')= 23	SC	
	160.0	c'= 63	γ= 120 pcf	46.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)
0	8	4	4.0	0.48	0.13	98%	1.42	1.90	40	1.43
II	8	12	12.0	1.44	0.40	91%	1.31	2.75	40	0.67
II	10	21	21.0	2.52	0.70	71%	1.02	3.54	40	0.44
III	10	31	31.0	3.72	1.03	55%	0.79	4.51	58	0.17
IV	10	41	41.0	4.92	1.37	45%	0.65	5.57	63	0.10
									total=	*2.82*

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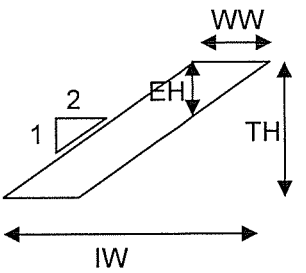
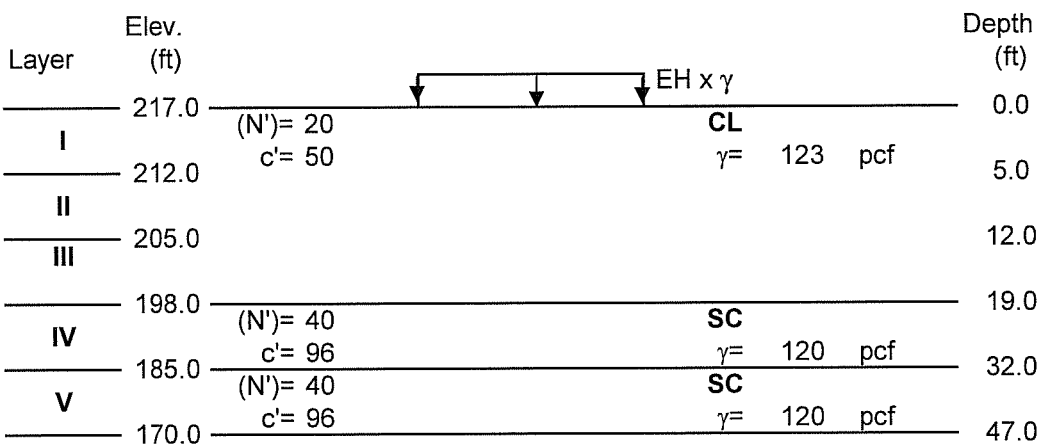
Project: **Placentia Avenue UC (Widen)** Project No. **08-115**
By CTY Date 1/20/09 Check by Date Sheet

Settlement Calculation for Sliver Fill

Total Fill Height, TH=	27	ft	Width of Widening, WW=	22	ft
Effective Fill Height, EH=	11	ft			
Loading=	1.32	ksf = EH x unit weight (120 pcf used)			
Influenced Width, IW=	70	ft			



Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Borings A-08-10 and A-08-13



Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)
0	5	2.5	2.5	0.31	0.04	100%	1.32	1.63	50	0.87
II	7	8.5	8.5	1.04	0.12	98%	1.30	2.33	50	0.59
II	7	15.5	15.5	1.89	0.22	97%	1.28	3.16	50	0.38
III	13	25.5	25.5	3.09	0.36	91%	1.20	4.28	96	0.23
IV	15	39.5	39.5	4.77	0.56	82%	1.08	5.85	96	0.17
									total=	*2.24*

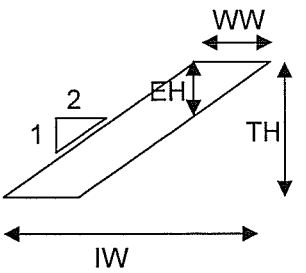
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
phone: (714)751-3826, Fax (714)751-3928

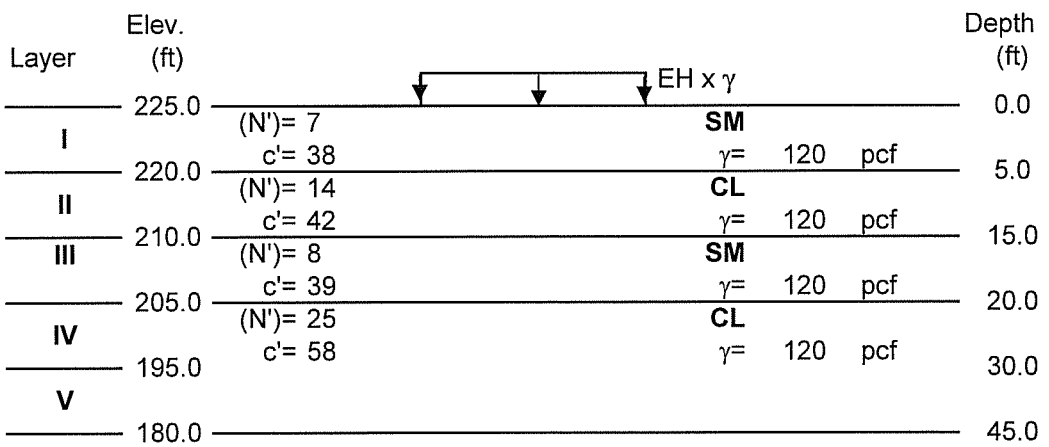
Project: **Chapman Avenue UC (Widen)** Project No. **08-115**
By CTY Date 01/11/09 Check by Date Sheet

Settlement Calculation for Sliver Fill

Total Fill Height, TH=	26	ft	Width of Widening, WW=	20	ft
Effective Fill Height, EH=	10	ft			
Loading=	1.2	ksf = EH x unit weight (120 pcf used)			
Influenced Width, IW=	80	ft			



Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-15



Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)
0	5	2.5	2.5	0.30	0.03	100%	1.20	1.50	38	1.10
II	10	10	10.0	1.20	0.13	98%	1.18	2.38	42	0.85
II	5	17.5	17.5	2.10	0.22	97%	1.16	3.26	39	0.29
III	10	25	25.0	3.00	0.31	95%	1.14	4.14	58	0.29
IV	15	37.5	37.5	4.50	0.47	86%	1.04	5.54	58	0.28
									total=	*2.82*

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

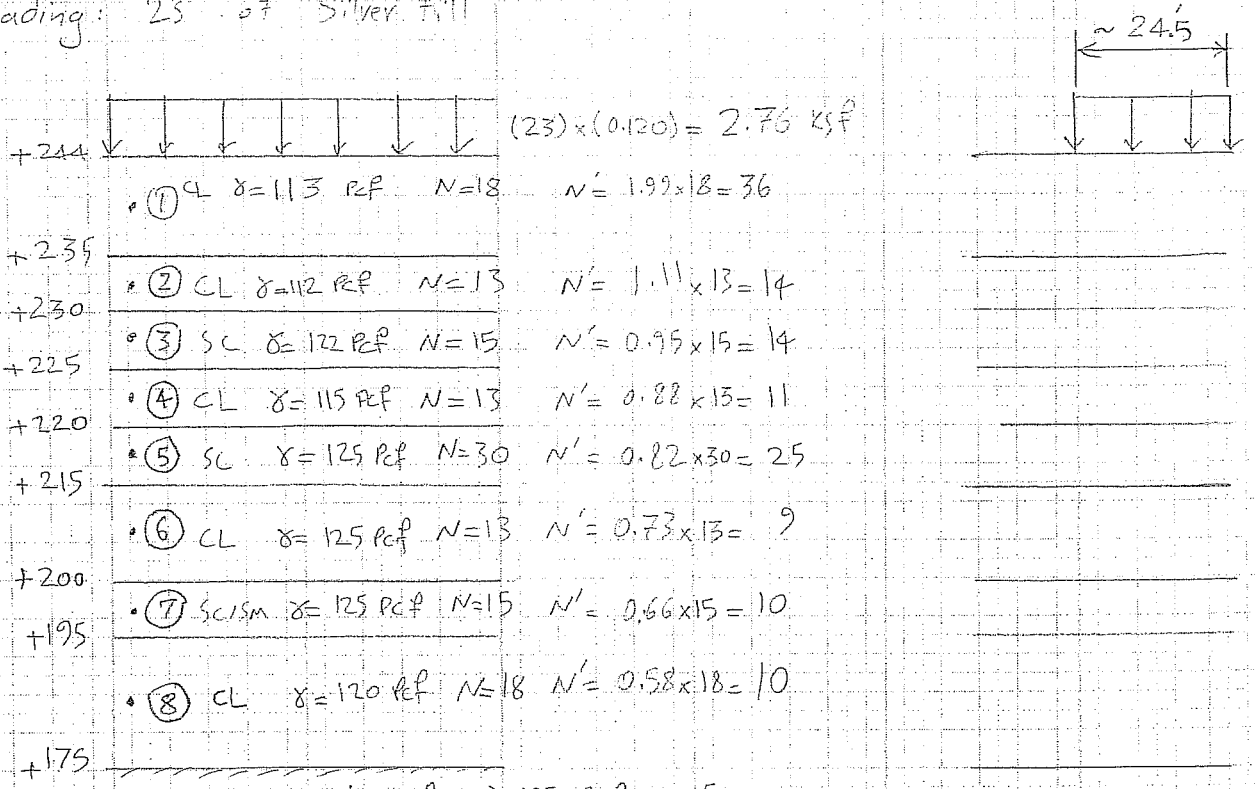
17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project Nutwood Ave. UC (Widen) Project No. 08-115

By AZ Date 01-08-09 Checked By _____ Date _____ Sheet ____ of ____

Settlement:

Loading: 23' of Silver Fill



Stress distribution was calculated from elastic solutions.

Point	Depth (ft)	Layer H (ft)	~ σ_{vo} (ksf)	$\Delta\sigma$ (ksf)	σ_{vf} (ksf)	C'*	Settlement (in)
1	4.5	9	0.509	2.71	3.22	70	1.2
2	11.5	5	1.30	2.31	3.61	45	0.6
3	16.5	5	1.88	1.97	3.85	49	0.4
4	21.5	5	2.47	1.67	4.14	40	0.3
5	26.5	5	3.07	1.43	4.51	67	0.2
6	36.5	15	4.32	1.10	5.43	40	0.4
7	46.5	5	5.57	0.89	6.46	42	0.1
8	59.0	20	7.09	0.71	7.80	40	0.3

Layer Settlement: $S = H \frac{1}{C'} \log \frac{\sigma_{vf}}{\sigma_{vo}}$ $S_{total} = 3.5$ in

* Note: Bering Capacity index (C') for clay layers was estimated from Consolidation tests, for sand layers from Fig. 13 in FHWA (1982).

APPENDIX D

CALTRANS REVIEW COMMENTS AND EMI RESPONSES

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MS. MILI LIM STAMATION
Branch Chief, Design A

Date: May 28, 2009
File: 12-ORA-57-PM 16.2/18.6
12-0F0311

SR-57 Northbound Widening
Southern Segment

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: 2nd Review of the Geotechnical Design Report

On May 22, 2009, we received a response and revised portions of the Geotechnical Design Report for the SR-57 Northbound improvement between 0.2 miles south of Orangethorpe Ave. and 0.2 miles north of Yorba Linda Blvd. The following comments are based on the response partially revised report prepared by Earth Mechanics, Inc., dated May 22, 2009.

- Title block in Log of Test Borings (LOTB) of wall Nos. 486, 512, 522, 576 & untitled sheet No. 13 are still shown on the left margin. Please use appropriate bottom title block similar to other wall LOTBs. EMI: We will comply.
- The CPT-08-131 in LOTB No. 13 belongs to which wall. EMI: CPT-08-131 belongs to pavement
- Bridge as built and recent LOTBs with proper title block and wall No. should be design included separately in each adjacent wall's LOTB package as listed below:
  a. Include LOTBs of Orangethorpe Ave. UC in LOTB of wall Nos. 466 and 474.
  b. Include LOTBs of South Placentia OH in LOTB of wall Nos. 476 and 486*.
  c. Include LOTBs of Crowther Ave. UC in LOTB of wall Nos. 486* and 492*.
  d. Include LOTBs of Placentia Ave. OH in LOTB of wall Nos. 492* and 496*.
  e. Include LOTBs of Placentia Ave. UC in LOTB of wall Nos. 496* and 512.
  f. Include LOTBs of Chapman Ave. UC in LOTB of wall Nos. 514 and 522.
  g. Include LOTBs of Nutwood Ave. UC in LOTB of wall Nos. 526 and 536.

  * These walls connect two bridges, therefore should have both bridge LOTBs.

EMI: We will comply.

Report by:

FARAMARZ GERAMI, P.G., C.E.G.
Engineering Geologist
Office of Geotechnical Design - South 1
Branch C

Reviewed by: Date: 5/28/09

CHI-TSENG TED LIU, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design - South 1
Branch C

REGISTERED PROFESSIONAL ENGINEER
CHI TSENG TED LIU
No. 2629
Exp. 6-30-2010
GEOTECHNICAL
STATE OF CALIFORNIA

c: OGDS1 - LA. File
OGDS1 - Sac. File
GS – Sac. File

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

May 22, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Attention: Mr. Steve Huff

Subject: Response to Caltrans Foundation Review Comments on "Geotechnical Design Report (GDR), SR-57 Northbound Widening"
12-Ora-57, PM 16.2/18.6, EA 12-0F0311

Dear Mr. Huff:

Caltrans issued a Foundation Review sheet dated March 18, 2009 for the subject project. A copy of this review sheet is attached at the end. The following are our responses to those comments. Many of these responses require revisions of the GDR. We have included those revised pages as attachments, and the actual revisions are also identified by a vertical line place on the right side of the text.

5.1 Drilling and Sampling

- Para. 1, 1st sentence: the year 2008 should be changed to 2009.

Response: The drilling was performed in 2008 instead of 2009. Therefore, we will still keep the year 2008.

- Para. 2, 5th sentence: 2.4 inches ID and 3.25 inches ID should be changed to 2.4 inches OD and 3.25 inches OD.

Response: "ID" was changed to "OD" (see attached Page 9).

Table 3

- Stationing and off set of all borings should be referenced to centerline Route 57 "B" line in this table and Log of Test borings (LOTB). The location of those borings that are based on other lines could be kept in parenthesis or as equivalent to centerline 57 stationing; however, boring locations on LOTB should only be referred to centerline Route 57 "B" line.

Response: All boring locations were revised to refer to the centerline Route 57 "B" line. Revised Table 3 (Pages 10 and 11) and LOTB sheets are attached.

Table 5

- It would be prudent to add a column for expansion potential of different soils.

Response: A column for expansion potential was added to Table 5 (see attached Pages 14 thru 16).

8.3.3 Stability

- RW 462, 466 and 536 are shown by sound wall on retaining wall symbol in Figure 17.
- RW 496 is shown by sound wall on MSE wall symbol in Figure 17.

Response: Wall symbols in the attached Figure 17 were revised to present the correct wall type. RW 462, 466 and 536 are a combination of sound walls and sound walls on retaining walls. RW 496 consists of sound walls on retaining walls and MSE walls (see Figure 17 and attached Page 21).

8.4 Culvert Foundations

- What would be RCB extensions supported on and has any field investigation been conducted for characterization of existing soil at the proposed RCB extension invert elevation and below.

Response: Based on our review of the Drainage Plans and our discussions with the civil designers, there is only one RCB (14' by 9') that needs to be extended. This RCB is located near the beginning of the Orangethorpe Avenue NB Off-Ramp (Station 63+50, T-Line). The invert elevation of the RCB is near +192 feet. A soil boring (A-08-102) and a CPT (C-08-103) were performed immediately adjacent to the RCB. At and immediately below the invert elevation of +192 feet, the soil boring and CPT logs show sand and silty sand with SPT blowcounts ranging from 13 to 22 blows per foot. Based on this information, no special foundation treatment is necessary.

12.0 Recommendations and Specifications

- Remediation/over-excavation of expansive soils where encountered at retaining walls, sound walls and/or RCB/RCP locations, should be discussed.

There are overexcavation requirements for spread footing foundations supporting walls (EMI, 2009). The overexcavation depths range from 0.5 to 5 feet below the footing bottom. We also recommended backfilling with Structure Backfill; that is, onsite soils are not allowed to be re-used below the spread footings. Since Structure Backfill is used below the footing, there is no design concern for expansive soils. There is one exception: onsite soils are allowed to be re-used as backfill (compacted to a minimum relative compaction of 95%) below the two MSE walls (Wall Nos. 476 and 496) only because MSE walls can withstand larger ground movements and the soil types below the two MSE walls consist of silty sand, clayey sand, sandy clay and lean

clay with sand with expansion potential ranging from very low to medium. With the significant overburden exerted by the MSE backfill and no highly expansive materials (such as fat clays) are anticipated to be encountered below the MSE wall, we believe there is also no design concerns for expansive soils below the two MSE walls.

Based on our review of the Drainage Plans, new drainage devices and existing drainage devices that need to be extended consist of DIP (Ductile Iron Pipe), RCP and APC; APC can be either CMP or RCP. The diameters of these devices range from 8 to 24 inches and the invert of these devices are generally located about 4 to 6 feet below the ground surface. We reviewed all the soil boring and CPT logs drilled for this project, concentrating on the soil conditions within the upper 10 feet, as well as the results of 22 Expansion Index tests performed on soil samples recovered from the subgrade for R-value testing. Based on our review of these data, there is a clear trend that soils with significant fines content are predominant from about south of Nutwood Avenue to the northern project limit (SR-57 Sta 534+00 to 587+15); soils with high fine contents such as sandy clay, lean clay and fat clay usually have an expansion potential ranging from medium to high. Therefore, to mitigate possible uneven upward movement of the buried drainage devices, we recommend surrounding the bottom of these drainage lines using Sand Bedding. The Sand Bedding cradling the invert of these drainage devices will reduce the uplift forces (if any) acting on the drainage devices, thus minimizing the potential of excessive vertical displacements. Limits and configurations of the Sand Bedding should conform to Caltrans Standard Plan Sheet A62D (2006). Material properties of the Sand Bedding should conform to Caltrans Standard Specifications, Section 19-3.025B (2006).

Figure 17

- Although sound wall symbol is marked in the legend, the plan shows no sound wall.

Response: Wall symbols in the attached Figure 17 were revised to present the correct wall type. For those walls shown in Figure 17 as "sound/retaining wall", they are a combination of sound walls (SW) and sound walls on retaining walls (SW/RW).

Appendix A – Log of Borings

- Boring A-08-132, in first layer when group symbol changes, a new layer should be added (i.e. no SM to CL).

- Boring A-08-133, first layer should probably be described as a fine grained soil since there is 50% fines.

Response: The above Log of Test Borings were revised to follow the above comments and the revised LOTB sheets are included in Attachment 1.

Appendix A - Log of Test Borings (LOTB)

- Title Block for both soil legends and LOTB should be on the bottom of the sheet (not on the left margin of the sheet). Soil legend sheets should have "Soil Legend" in the title and bridge/wall name and number. Soil legend sheets should be the end sheets (after all LOTB sheets).

- Although it would be acceptable to use only one set of soil legend sheets as presented in the Geotechnical Design Report, in contract plans each wall should have its own set of soil legend sheets with LOTB.

- Correction/multiplication factor for conversion of 2.4" sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.

- When ground water was not encountered or measured, a note to that effect should be placed under each boring (i.e. ground water was not encountered or not measured during field investigation).

- Since consistency of fine grained/cohesive soils are based on pocket penetrometer or torvane (Fig 2-8 of Caltrans Soil and Rock Manual), the values should be noted at the end of each cohesive soil layer as pp or tv = ...(measured number).

- Comment under Table 3 in this report should be followed for all LOTB borings.

- The name and directions (in arrow) of nearest cities should be placed on plan view.

- When there is an existing bridge or retaining/sound wall adjacent to or between a proposed retaining/sound wall, the As-Built LOTB of those structures in compliance with Section 5.2.4 of Caltrans Soil and Rock Manual should be included.

- Please refrain from wet method for caving control, since it necessitates additional instrumentation and possibility of creating anomalies in the pile.

Response: The attached LOTB sheets incorporated the following revisions per Caltrans review:

- An appropriate bottom title block was used in the attached LOTB sheets.
- The LOTB legend sheets will be prepared for each wall in contract plans.
- Conversion factor from 2.4" California Modified Ring sampler blowcount to 1.4" Standard Penetration Test sampler blowcount is added to the "Notes"
- "Groundwater Not Encountered During Drilling" is added under each boring.
- Pocket penetrometer test results are added and used for classifying cohesive soils.
- Boring locations were revised to refer to the centerline Route 57 "B" line.
- Directions to the nearest cities are added.
- As-built LOTB sheets will be added in the final GDR.

Sincerely,
EARTH MECHANICS, INC.

Chien-Tai Yang, GE 2827
Project Engineer

Attachments

Attachment 1:
-Revised Report Page 9 for **OD – outside diameter**
-Revised Report Pages 10 and 11 for **Table 3**
-Revised Report Pages 14 thru 16 for **Table 5**
-Revised Report Page 21 for **Section 8.3.3 Stability**
-Revised Report **Figure 17**
-Revised LOTB Sheets

– deleted
(See the revised report)

Attachment 2:
-Caltrans Foundation Review Comment Sheets dated March 18, 2009

Attachment 1

Portions of Revised Reports Related to the Review Comments and Revised LOTB Sheets

deleted
(See the revised report)

Attachment 2

Caltrans Foundation Review Comment Sheets dated March 18, 2009

State of California Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MS. MILI LIM STAMATION
Branch Chief, Design A

Date: March 18, 2009
File: 12-ORA-57-PM 16.2/18.6
12-0F0311

SR-57 Northbound Widening
Southern Segment

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of the Geotechnical Design Report

On February 19, 2009, we received a Geotechnical Design Report for the SR-57 Northbound improvement project which is located between 0.2 miles south of Orangethorpe Ave. and 0.2 miles north of Yorba Linda Blvd. The following comments are based on the subject report prepared by Earth Mechanics, Inc. for RBF Consulting, dated February 17, 2009.

5.1 Drilling and Sampling

- Para. 1, 1st sentence: the year 2008 should be changed to 2009.

- Para. 2, 5th sentence: 2.4 inches ID and 3.25 inches ID should be changed to 2.4 inches OD and 3.25 inches OD.

Table 3

- Stationing and off set of all borings should be referenced to centerline Route 57 "B" line in this table and Log of Test borings (LOTB). The location of those borings that are based on other lines could be kept in parenthesis or as equivalent to centerline 57 stationing; however, boring locations on LOTB should only be referred to centerline Route 57 "B" line.

Table 5

- It would be prudent to add a column for expansion potential of different soils.

8.3.3 Stability

- RW 462, 466 and 536 are shown by sound wall on retaining wall symbol in Figure 17.

- RW 496 is shown by sound wall on MSE wall symbol in Figure 17.

8.4 Culvert Foundations

- What would be RCB extensions supported on and has any field investigation been conducted for characterization of existing soil at the proposed RCB extension invert elevation and below.

12.0 Recommendations and Specifications

- Remediation/over-excavation of expansive soils where encountered at retaining walls, sound walls and/or RCB/RCP locations, should be discussed.

Figure 17

- Although sound wall symbol is marked in the legend, the plan shows no sound wall.

Appendix A – Log of Borings

- Boring A-08-132, in first layer when group symbol changes, a new layer should be added (i.e. no SM to CL).

- Boring A-08-133, first layer should probably be described as a fine grained soil since there is 50% fines.

Appendix A - Log of Test Borings (LOTB)

- Title Block for both soil legends and LOTB should be on the bottom of the sheet (not on the left margin of the sheet). Soil legend sheets should have "Soil Legend" in the title and bridge/wall name and number. Soil legend sheets should be the end sheets (after all LOTB sheets).

- Although it would be acceptable to use only one set of soil legend sheets as presented in the Geotechnical Design Report, in contract plans each wall should have its own set of soil legend sheets with LOTB.

- Correction/multiplication factor for conversion of 2.4" sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.

- When ground water was not encountered or measured, a note to that effect should be placed under each boring (i.e. ground water was not encountered or not measured during field investigation).

- Since consistency of fine grained/cohesive soils are based on pocket penetrometer or torvane (Fig 2-8 of Caltrans Soil and Rock Manual), the values should be noted at the end of each cohesive soil layer as pp or tv = …(measured number).

- Comment under Table 3 in this report should be followed for all LOTB borings.

- The name and directions (in arrow) of nearest cities should be placed on plan view.

- When there is an existing bridge or retaining/sound wall adjacent to or between a proposed retaining/sound wall, the As-Built LOTB of those structures in compliance with Section 5.2.4 of Caltrans Soil and Rock Manual should be included.

Any questions regarding the above comments should be directed to Faramarz Gerami at (213) 620-2149 or Ted Liu at (213) 620-2136.

Report by:

FARAMARZ GERAMI, P.G., C.E.G.
Engineering Geologist
Office of Geotechnical Design - South 1
Branch C

Reviewed by: Date: 3/18/09

CHI-TSENG TED LIU, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design - South 1
Branch C

REGISTERED PROFESSIONAL ENGINEER
CHI-TSENG TED LIU
No. 2669
Exp. 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

c: OGDS1 - LA. File
OGDS1 - Sac. File
GS – Sac. File

FINAL FOUNDATION REPORT for

Sound Walls, Retaining Walls and MSE Walls

SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 16.2/18.6
EA 12-0F0311

EMI Project No. 08-115
Date: June 17, 2009

EARTH MECHANICS, INC.

Geotechnical and Earthquake Engineering

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

June 17, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Attention: Mr. Steve Huff, P.E.

Subject: **Final Foundation Report for Sound Walls, Retaining Walls and MSE Walls**
SR-57 Northbound Improvement Project, Orange County, California
12-Ora-57, PM 16.2/18.6, EA 12-0F0311

Dear Mr. Huff:

Attached please find the final Foundation Report for the sound walls, retaining walls and MSE walls within the SR-57 Northbound Improvement project. This report contains the findings and conclusions of our field investigation and laboratory testing program. This report also contains our recommendations for the foundation design and construction of the sound walls, retaining walls and MSE walls.

An earlier version of this foundation report, dated March 3, 2009, was prepared by EMI and reviewed by Caltrans. Copies of the review sheets and our responses are attached in Appendix D. This report has been revised to incorporate our responses to the review comments.

We appreciate the opportunity to provide geotechnical design services for this project. If you have any questions, please call us.

Sincerely,
EARTH MECHANICS, INC.

Chien-Tai Yang, RCE 66374
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
CHIEN-TAI YANG
NO. C66374
EXP. 6-30-2010
CIVIL
STATE OF CALIFORNIA

Lino Cheang, GE 2345
Project Manager

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

FINAL FOUNDATION REPORT

SOUND WALLS, RETAINING WALLS AND MSE WALLS
SR-57 NORTHBOUND IMPROVEMENT PROJECT
ORANGE COUNTY, CALIFORNIA
12-Ora-57, PM 16.2/18.6
EA 12-0F0311

Prepared for:

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Prepared By:

Earth Mechanics, Inc.
17660 Newhope Street, Suite E
Fountain Valley, California 92708

EMI Project No. 08-115

June 17, 2009

TABLE OF CONTENTS

Section	Page
1.0 INTRODUCTION	**1**
1.1 Purpose and Scope of Study	1
1.2 Project Description	1
2.0 FIELD INVESTIGATION AND LABORATORY TESTING	**6**
2.1 Field Investigation	6
2.2 Laboratory Testing	8
3.0 GEOLOGY AND SEISMICITY	**9**
3.1 Topography and Drainage	9
3.2 Physiography	9
3.3 Geologic Structure	9
3.4 Geologic Hazards	11
3.5 Stratigraphy	11
3.6 Seismicity	13
4.0 SUBSURFACE CONDITIONS	**14**
4.1 Soil Conditions	14
4.2 Groundwater Conditions	16
5.0 CONCLUSIONS AND RECOMMENDATIONS	**17**
5.1 Seismic Design Criteria	17
5.2 Liquefaction	17
5.3 Soil Corrosivity	17
5.4 Foundation Design for Type 1 Retaining Walls	19
5.5 Foundation Design for Sound Walls on Retaining Walls	21
5.5.1 Spread Footing	21
5.5.2 Pile Foundation	22
5.6 Foundation Design for Sound Walls	24
5.7 Foundation Design for MSE Walls	24
5.8 Global Stability Analyses	26
6.0 CONSTRUCTION RECOMMENDATIONS	**28**
6.1 Earthwork	28
6.2 Pile Construction	28
6.3 Review of Construction Plans	28
6.4 Geotechnical Observation and Testing	29
7.0 LIMITATIONS	**30**
8.0 REFERENCES	**31**

List of Tables Page

Table 1-1. Wall Information 2
Table 2-1. Geotechnical Exploration Information 6
Table 4-1. Idealized Soil Profile and Strength Parameters 14
Table 5-1. Local Seismic Sources 17
Table 5-2. Soil Corrosion Test Results 18
Table 5-3. Allowable Foundation Settlement 19
Table 5-4. Recommended Mininum Overexcavation Depths for Type 1 Retaining Walls 20
Table 5-5. Bearing Pressures For Sound Walls on Retaining Walls 21
Table 5-6. Recommended Minimum Overexcavation Depths For Sound walls on Retaining Walls 22
Table 5-7. Recommended Pile Tip Elevations For Sound walls on Retaining Walls 23
Table 5-8. Lateral Pile Solutions For RW 492 23
Table 5-9. Lateral Pile Solutions For RW 462 and 496 24
Table 5-10. Bearing Pressures For MSE Walls 25
Table 5-11. Recommended Minimum Overexcavation Depths For MSE Walls 25

List of Figures Page

Figure 1-1. Site Location Map 4
Figure 1-2. Wall Location Map 5
Figure 3-1. Regional Fault and Physiographic Map 10
Figure 3-2. Geological Map 12

APPENDICES

Appendix A. Log of Test Borings Sheets
Appendix B. Laboratory Test Results
Appendix C. Design Calculations
Appendix D. Caltrans Review Comments and EMI Responses

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF STUDY

This Foundation Report presents the findings and conclusions of a geotechnical investigation conducted by Earth Mechanics, Inc. (EMI). It presents foundation design and construction recommendations for proposed sound walls, retaining walls and mechanically stabilized earth (MSE) walls within the State Route (SR)-57 Northbound Improvement project in Orange County, California. A site location map is presented in Figure 1-1.

This work was performed for the Orange County Transportation Authority (OCTA) and EMI is a subconsultant to RBF Consulting (RBF). The geotechnical services provided for this project included the following tasks:

- Field exploration consisting of drilling and logging exploratory borings and conducting cone penetrometer test (CPT) soundings;
- Laboratory testing of selected bulk and relatively undisturbed soil samples;
- Engineering calculations and analysis to develop foundation design and construction recommendations; and
- Preparation of this report presenting our findings, conclusions, and recommendations.

1.2 PROJECT DESCRIPTION

The Department of Transportation (Caltrans) – District 12, in cooperation with OCTA, proposed to widen northbound SR-57 by adding one northbound through lane. The project limits are between 0.2 mile south of Orangethorpe Avenue and 0.2 mile north of Yorba Linda Boulevard along northbound SR-57. Within the project limits, there are interchanges located at Orangethorpe Avenue, Chapman Avenue, Nutwood Avenue and Yorba Linda Boulevard.

The project includes seven bridge structures, a tieback wall, retaining walls, MSE walls, sound walls, sound walls on retaining walls, drainage facilities, sign structures, and pavement widenings. This report pertains to the sound walls, retaining walls and MSE walls only; separate bridge foundation reports are prepared for each bridge structure, tieback wall and sign structures.

A total of fourteen walls are proposed to accommodate adding one northbound through lane. Locations and stationing of these walls are presented in Figure 1-2 and Table 1-1, respectively.

- RW No. 462 is a combination of sound walls and sound walls on retaining walls, located along the eastside of the Orangethorpe Avenue off-ramp. The total wall length along the retaining wall is about 705 feet. The retaining wall height is up to 16 feet and the sound wall height is up to 12 feet;
- RW 466 and 474 are also a combination of sound walls and sound walls on retaining walls, located along the SR-57 mainline adjacent to the Orangethorpe Avenue Undercrossing (UC). The wall lengths are about 552 and 380 feet for RW 466 and 474, respectively. The maximum retaining wall heights are 14 and 12 feet for RW 466 and 474, respectively. The sound wall height is up to 12 feet for RW 466 and 474;

TABLE 1-1. WALL INFORMATION

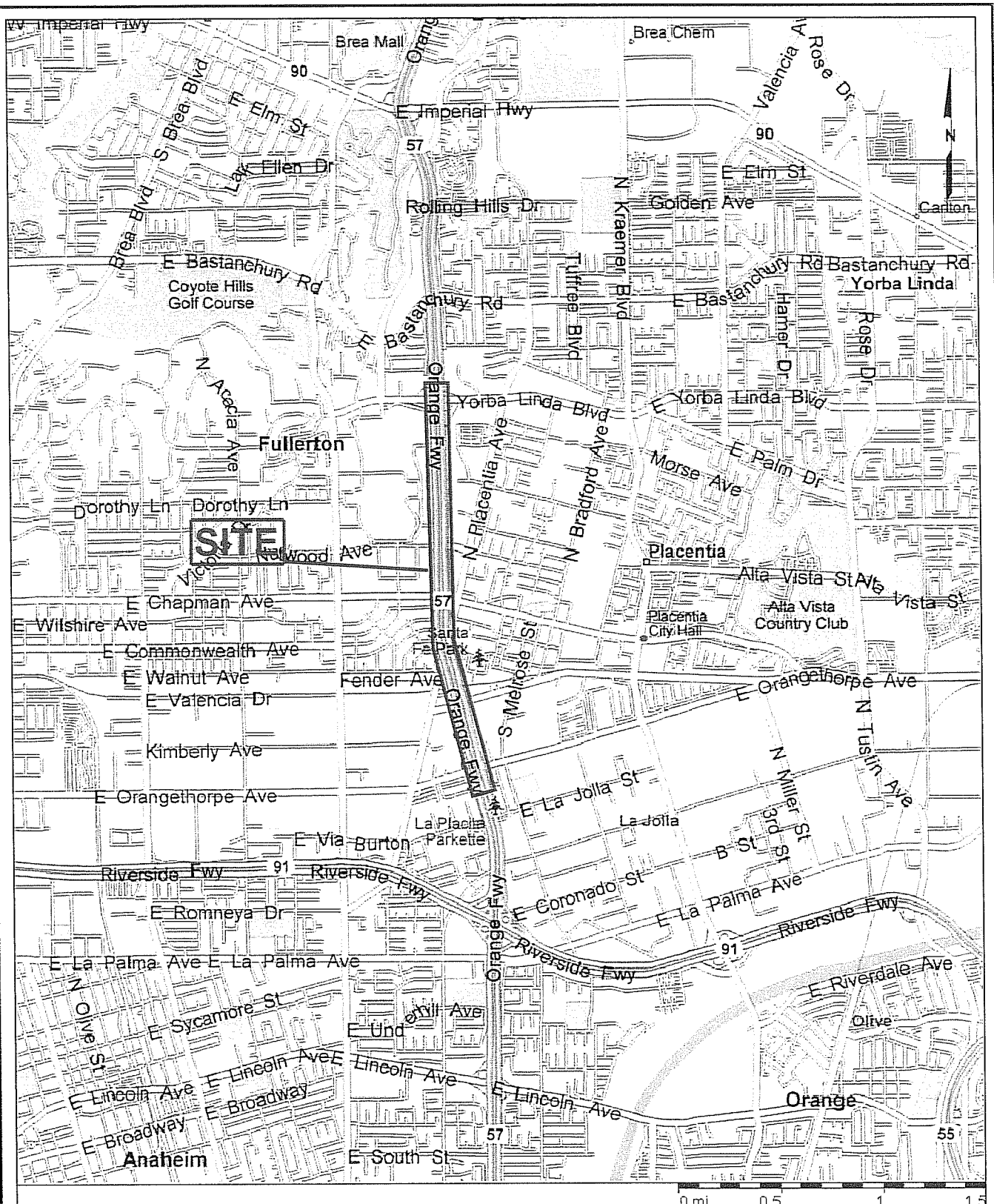
RW No.	Wall Limit	Wall Type	Stationing
462	"B"-Line 461+43 thru 468+48	SW	"B"-Line 467+74 thru 468+48
		SW/RW	"B"-Line 461+43 thru 467+74
466	"B"-Line 465+83 thru 471+40	SW	"B"-Line 465+83 thru 471+08
		SW/RW	"B"-Line 471+08 thru 471+40
474	B"-Line 473+20 thru 477+00	SW	"B"-Line 476+39 thru 477+00
		SW/RW	"B"-Line 473+20 thru 476+39
476	"V"-Line 74+35 thru 83+95	RW	"V"-Line 74+35 thru 75+62 "V"-Line 83+69 thru 83+95
		MSE	"V"-Line 75+62 thru 83+69
486	"B"-Line 485+05 thru 489+85	RW	"B"-Line 485+05 thru 489+85
492	"B"-Line 491+45 thru 494+72	RW	"B"-Line 491+45 thru 494+31
		SW/RW	"B"-Line 494+31 thru 494+72
496	"B"-Line 496+27 thru 506+12	SW/RW	"B"-Line 496+27 thru 496+55 "B"-Line 505+67 thru 506+12
		SW/MSE	"B"-Line 496+55 thru 505+67
512	"G-3"-Line 10+80 thru 16+85	RW	"G-3"-Line 10+80 thru 16+85
514	"B"-Line 515+06 thru 519+17	RW	"B"-Line 515+06 thru 519+17
522	"B"-Line 520+78 thru 528+66	RW	"B"-Line 520+78 thru 528+66
526	"B"-Line 526+04 thru 533+73	SW	"B"-Line 531+04 thru 533+57
		SW/RW	"B"-Line 526+04 thru 531+04 "B"-Line 533+57 thru 533+73
536	"B"-Line 535+32 thru 540+80	SW	"B"-Line 535+56 thru 540+80
		SW/RW	"B"-Line 535+32 thru 535+56
538	"H-8"-Line 39+40 thru 47+60	SW	"H-8"-Line 39+40 thru 39+88 "H-8"-Line 46+30 thru 47+60
		SW/RW	"H-8"-Line 39+88 thru 46+30
576	"I-3"-Line 74+04 thru 81+00	RW	"I-3"-Line 74+04 thru 81+00

Note: 1. "B"-Line = SR-57 Mainline; "V"-Line: Orangethorpe Avenue On-Ramp; "G-3"-Line: Chapman Avenue Off-Ramp; "H-8"- Line: Nutwood Avenue On-ramp;"I-3"-Line: Yorba Linda Boulevard On-Ramp

2. SW: sound walls; SW/RW: sound walls on retaining walls; RW: cantilevered retaining walls; SW/MSE: sound walls on MSE

- RW 476 consists of cantilevered retaining walls and MSE walls, located along the eastside of the Orangethorpe Avenue on-ramp. The wall length is about 957 feet and the maximum wall heights are 18 and 22.5 feet for cantilevered retaining walls and MSE walls, respectively;

- RW 486 is a series of cantilevered retaining walls, located along the SR-57 mainline between the South Placentia Overhead (OH) and Crowther Avenue UC. The wall length is about 480 feet and the wall height is up to 16 feet;
- RW 492 is a combination of cantilevered retaining walls and sound walls on retaining walls, located along the SR-57 mainline between the Crowther Avenue UC and Placentia OH. The wall length is about 319 feet. The maximum wall height is 16 feet for cantilevered retaining walls and sound walls on retaining walls. The sound wall height is up to 10'-4";
- RW 496 consists of sound walls on retaining walls and sound walls on MSE walls, located along the SR-57 mainline between the Placentia OH and Placentia Avenue UC. The wall length is about 985 feet. The maximum wall height is about 26 feet for cantilevered retaining walls and MSE walls, and the sound wall height is up to 10'-4";
- RW 512 is a series of cantilevered retaining walls, located along the eastside of the Chapman Avenue off-ramp. The wall length is about 598 feet and the retaining wall height is up to 18 feet;
- RW 514 and 522 are cantilevered retaining walls, located along the SR-57 mainline adjacent to the Chapman Avenue UC. The wall lengths are about 405 and 786 feet for RW 514 and 522, respectively. The maximum retaining wall height is 14 feet for RW 514 and 522;
- RW 526 and 536 are a combination of sound walls and sound wall on retaining walls, located along the SR-57 mainline adjacent to the Nutwood Avenue UC. The wall lengths are about 772 and 547 feet for RW 526 and 536, respectively. The maximum retaining wall heights are 12 and 14 feet for RW 526 and 536, respectively. The sound wall height is up to 14'-4";
- RW 538 is a combination of sound walls and sound walls on retaining walls, located along the eastside of the Nutwood Avenue on-ramp. The wall length is about 809 feet. The retaining wall height is up to 8 feet and the sound wall height is up to 14'-4";
- RW 576 is a series of cantilevered retaining walls, located along the eastside of the Yorba Linda Boulevard on-ramp. The wall length is about 656 feet and the retaining wall height is up to 14 feet.



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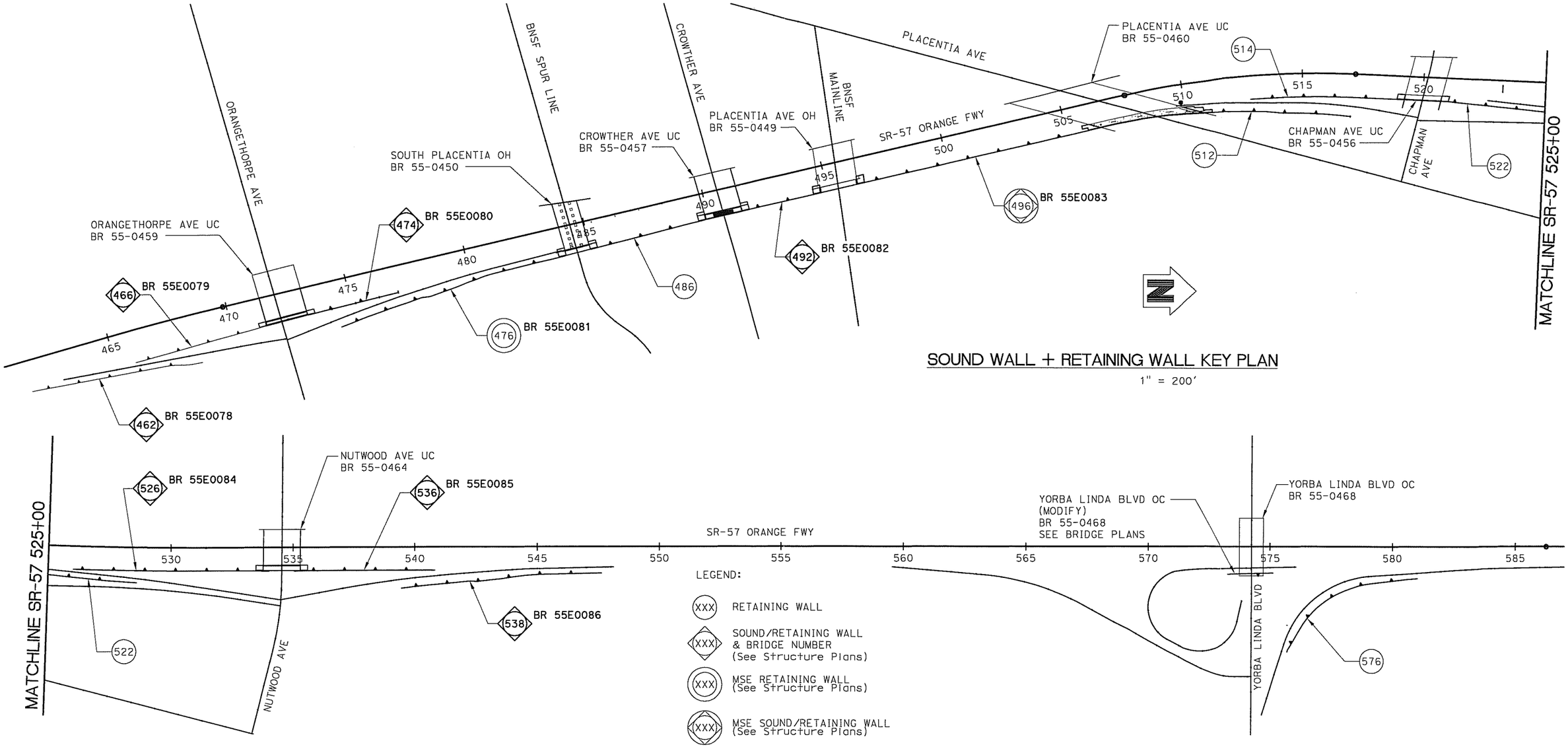
SITE LOCATION MAP

Figure 1-1

SR-57 Northbound Improvement Project

Project No. 08-115

Date: 03-03-09



SOUND WALL + RETAINING WALL KEY PLAN

1" = 200'

LEGEND:

- (XXX) RETAINING WALL
- (XXX) SOUND/RETAINING WALL & BRIDGE NUMBER (See Structure Plans)
- (XXX) MSE RETAINING WALL (See Structure Plans)
- (XXX) MSE SOUND/RETAINING WALL (See Structure Plans)

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	**SR-57 Northbound Improvement Project**		**Sound Wall & Retaining Wall Key Plan**
	EMI Project No.: 08-115	Date: 05-17-2009	**Figure 1-2**

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 FIELD INVESTIGATION

A copy of the As-Built Log-of-Test-Borings (LOTB) sheets is included in Appendix A. About 2 feet should be added to the elevation on the as-built LOTB sheets to match the current vertical datum (NAV88).

A geotechnical field investigation was conducted between August 25 and October 1, 2008. Forty-four exploratory borings and fifteen cone penetrometer tests (CPTs) were accomplished under the supervision of EMI for the project. Out of these, 35 exploratory soil borings and 14 CPTs were used for design of the wall foundations. Boring information, including exploration number, stations, offsets, ground surface elevations, bottom of hole elevations and water level measurements for the soil borings/CPTs are summarized in Table 2-1. Locations of the exploratory borings/CPTs are shown on the LOTB sheets provided in Appendix A.

TABLE 2-1. GEOTECHNICAL EXPLORATION INFORMATION

Boring	*Station*	*Offset (feet)*	*Station Line*	*GSE (ft)*	*GWE (ft)*	*Boring Depth (ft)*	*Method*
A-08-001	471+5	97RT	SR-57 ("B"-Line)	225.4	NE	91.5	HSA
A-08-002	472+27	115RT	SR-57 ("B"-LINE)	206.1	NE	71.5	HSA
A-08-003	473+35	90RT	SR-57 ("B"-LINE)	227.8	NE	91.5	HSA
A-08-004	483+85	90RT	SR-57 ("B"-LINE)	231.9	NE	90.4	HSA
A-08-005	485+12	90RT	SR-57 ("B"-LINE)	233.5	NE	91.5	HSA
A-08-006	489+69	80RT	SR-57 ("B"-LINE)	237.9	NE	90.5	HSA
A-08-007	**491+67**	**80RT**	SR-57 ("B"-LINE)	239.5	NE	64.5	HSA
A-08-008	494+45	80RT	SR-57 ("B"-LINE)	241.9	NE	96.5	HSA
A-08-009	496+47	80RT	SR-57 ("B"-LINE)	243.7	NE	91.5	HSA
A-08-010	505+67	80RT	SR-57 ("B"-LINE)	243.5	NE	106.5	HSA
A-08-011	507+45	100RT	SR-57 ("B"-LINE)	217.4	NE	71.5	HSA
A-08-012	507+94	97RT	SR-57 ("B"-LINE)	217.9	NE	71.5	HSA
A-08-013	510+43	89RT	SR-57 ("B"-LINE)	241.3	NE	91.0	HSA
A-08-014	519+3	70RT	SR-57 ("B"-LINE)	250.1	NE	90.9	HSA
A-08-015	521+9	71RT	SR-57 ("B"-LINE)	252.1	NE	91.8	HSA
A-08-016	533+58	68RT	SR-57 ("B"-LINE)	259.0	NE	90.8	HSA
A-08-017	535+70	66RT	SR-57 ("B"-LINE)	258.0	NE	91.5	HSA
A-08-018	573+88	127RT	SR-57 ("B"-LINE)	301.1	NE	61.5	HSA
A-08-019	574+55	127RT	SR-57 ("B"-LINE)	301.1	NE	61.5	HSA
A-08-101	460+71	120RT	SR-57 ("B"-LINE)	207.2	NE	31.5	HSA
A-08-102	463+10	125RT	SR-57 ("B"-LINE)	207.3	NE	31.5	HSA
CPT-08-103	464+22	137RT	SR-57 ("B"-LINE)	207.3	NE	69.2	CPT

TABLE 2-1 (CONT). GEOTECHNICAL EXPLORATION INFORMATION

Boring	*Station*	*Offset (feet)*	*Station Line*	*GSE (ft)*	*GWE (ft)*	*Boring Depth (ft)*	*Method*
CPT-08-104	465+35	147RT	SR-57 ("B"-LINE)	207.3	NE	74.2	CPT
A-08-105	467+40	148LT	SR-57 ("B"-LINE)	210.9	NE	71.5	HSA
A-08-106	468+90	195RT	SR-57 ("B"-LINE)	205.4	NE	61.5	HSA
CPT-08-107	475+01	186RT	SR-57 ("B"-LINE)	211.0	NE	65	CPT
A-08-108	476+98	94RT	SR-57 ("B"-LINE)	228.7	NE	71.0	HSA
A-08-109	478+37	138RT	SR-57 ("B"-LINE)	226.1	NE	71.5	HSA
CPT-08-110	480+40	111RT	SR-57 ("B"-LINE)	228.2	NE	50.0	CPT
CPT-08-111	487+00	90RT	SR-57 ("B"-LINE)	233.9	NE	60.9	CPT
CPT-08-112	499+75	79RT	SR-57 ("B"-LINE)	244.1	NE	45.9	CPT
CPT-08-113	503+16	82RT	SR-57 ("B"-LINE)	243.9	NE	48.4	CPT
CPT-08-114	513+48	83RT	SR-57 ("B"-LINE)	242.0	NE	54.5	CPT
CPT-08-115	515+71	83RT	SR-57 ("B"-LINE)	245.5	NE	64.1	CPT
A-08-116	516+31	172RT	SR-57 ("B"-LINE)	231.8	NE	61.5	HSA
CPT-08-117	524+12	91RT	SR-57 ("B"-LINE)	253.1	NE	79.7	CPT
CPT-08-118	526+05	92RT	SR-57 ("B"-LINE)	252.4	NE	77.3	CPT
A-08-119	528+64	119RT	SR-57 ("B"-LINE)	238.0	NE	61.5	HSA
CPT-08-120	529+40	80RT	SR-57 ("B"-LINE)	255.9	NE	80.4	CPT
A-08-121	531+86	80RT	SR-57 ("B"-LINE)	257.8	NE	31.5	HSA
A-08-122	537+80	72RT	SR-57 ("B"-LINE)	257.3	NE	30.8	HSA
A-08-123	539+47	160RT	SR-57 ("B"-LINE)	250.0	NE	31.5	HSA
A-08-124	540+94	82RT	SR-57 ("B"-LINE)	253.6	NE	31.5	HSA
CPT-08-125	542+28	117RT	SR-57 ("B"-LINE)	251.1	NE	80.2	CPT
A-08-126	543+21	109RT	SR-57 ("B"-LINE)	251.0	NE	61.5	HSA
CPT-08-127	544+64	97RT	SR-57 ("B"-LINE)	250.9	NE	79.6	CPT
A-08-128	546+84	102RT	SR-57 ("B"-LINE)	251.0	NE	31.5	HSA
A-08-137	574+40	394RT	SR-57 ("B"-LINE)	290.0	NE	31.5	HSA
A-08-138	578+33	135RT	SR-57 ("B"-LINE)	283.0	NE	31.5	HSA

Notes:

1. Stations and offsets are measured relative to the identified Station Lines and are approximate.
2. GSE = Approximate Ground Surface Elevation.
3. GWE = Approximate Groundwater Elevation; NE = Groundwater Table Not Encountered.
4. HSA = Hollow-stem auger boring; CPT = Cone Penetrometer Test.

The hollow-stem auger (HSA) borings were excavated using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. Subsurface soils and conditions were logged and samples of

soils were collected for laboratory testing. Large bulk samples of near-surface soils were logged and collected. Smaller soil samples were collected from borings generally at 5 feet vertical intervals by means of split-spoon drive samplers; the Standard Penetration Test (SPT) sampler and the Modified California Drive (MCD) sampler were used to collect small disturbed and relatively undisturbed samples, respectively. The SPT sampler (2.4 inches OD) and MCD sampler (3.25 inches OD) were driven a total depth of 18 inches or until refusal, using a 140-pound hammer falling 30 inches. The blowcounts for the last 12 inches of penetration (or less penetration depths as noted on the logs) were recorded on the boring logs and were used to correlate with in-situ soil strengths. The MCD is a split-barrel sampler with a tapered cutting tip and lined with a series of 1-inch tall brass rings.

The CPT soundings were performed using an electronic cone penetrometer in general accordance with current ASTM Standards (ASTM D5778 and ASTM D3441). The CPT equipment consisted of a cone penetrometer assembly mounted at the end of a series of hollow sounding rods. The cone penetrometer assembly consisted of a conical tip with a 60° apex angle and a projected cross sectional area of 1.55 in^2 (10 cm^2) and a cylindrical friction sleeve with a surface area of 23.25 in^2 (150 cm^2). The interior of the cone penetrometer is instrumented with strain gauges that allow simultaneous measurements of cone tip and friction sleeve resistance during penetration. The cone penetrometer assembly is continuously pushed into the soil by a set of hydraulic rams at a standard rate of 0.79 inch per second (20 mm per second) while the cone tip resistance and sleeve friction resistance are recorded every 1.967 inches (50 mm) and stored in digital form. A specially designed all-wheel drive 25-ton truck provides the required reaction weight for pushing the cone assembly and is also used to transport and house the testing equipment. Soil behavior type interpretations are based on guidelines by Robertson and Campanella (1989).

2.2 LABORATORY TESTING

Soil samples considered representative of the subsurface conditions were tested to obtain or derive relevant physical and engineering soil properties. The following laboratory tests were conducted to supplement the observations recorded during the field investigation:

- In-situ Moisture Content and Unit Weight
- Pocket Penetrometer
- Percent Passing No. 200 Sieve
- Atterberg Limits
- Direct Shear
- UU Triaxial Test
- Consolidation
- Minimum Resistivity, pH, Sulfate Content and Chloride Content

The laboratory tests were conducted in general accordance with California Test Methods or American Society for Testing and Materials (ASTM) Standards. Laboratory test results are included in Appendix B.

3.0 GEOLOGY AND SEISMICITY

3.1 TOPOGRAPHY AND DRAINAGE

The project corridor is in the eastern part of the Los Angeles Basin along the southern margin of the Coyote Hills and the Puente Hills (Figure 3-1). Just north of the project corridor, the Puente Hills rise to an elevation of about 1,400 feet. The southwestern edge of the Puente Hills is paralleled by a series of low-elevation plains and hills; the Santa Fe Plain and the Coyote Hills are to the west of the project corridor, and the Richfield and Kraemer Hills are to the east. The elevations of these hills range from about 500 feet just west of the project to about 300 feet in the east. The ground upon which the project is located slopes gently to the south. Elevations along the project corridor range from about 280 feet in the north to about 200 feet on the south.

The project corridor traverses the ancient flood plains and alluvial fans of Fullerton Creek and the Santa Ana River. The major drainage in the area is the Santa Ana River which flows westerly south of the site. Fullerton Creek, a tributary to the Santa Ana River, drains southwesterly from the Puente Hills just west of the project corridor.

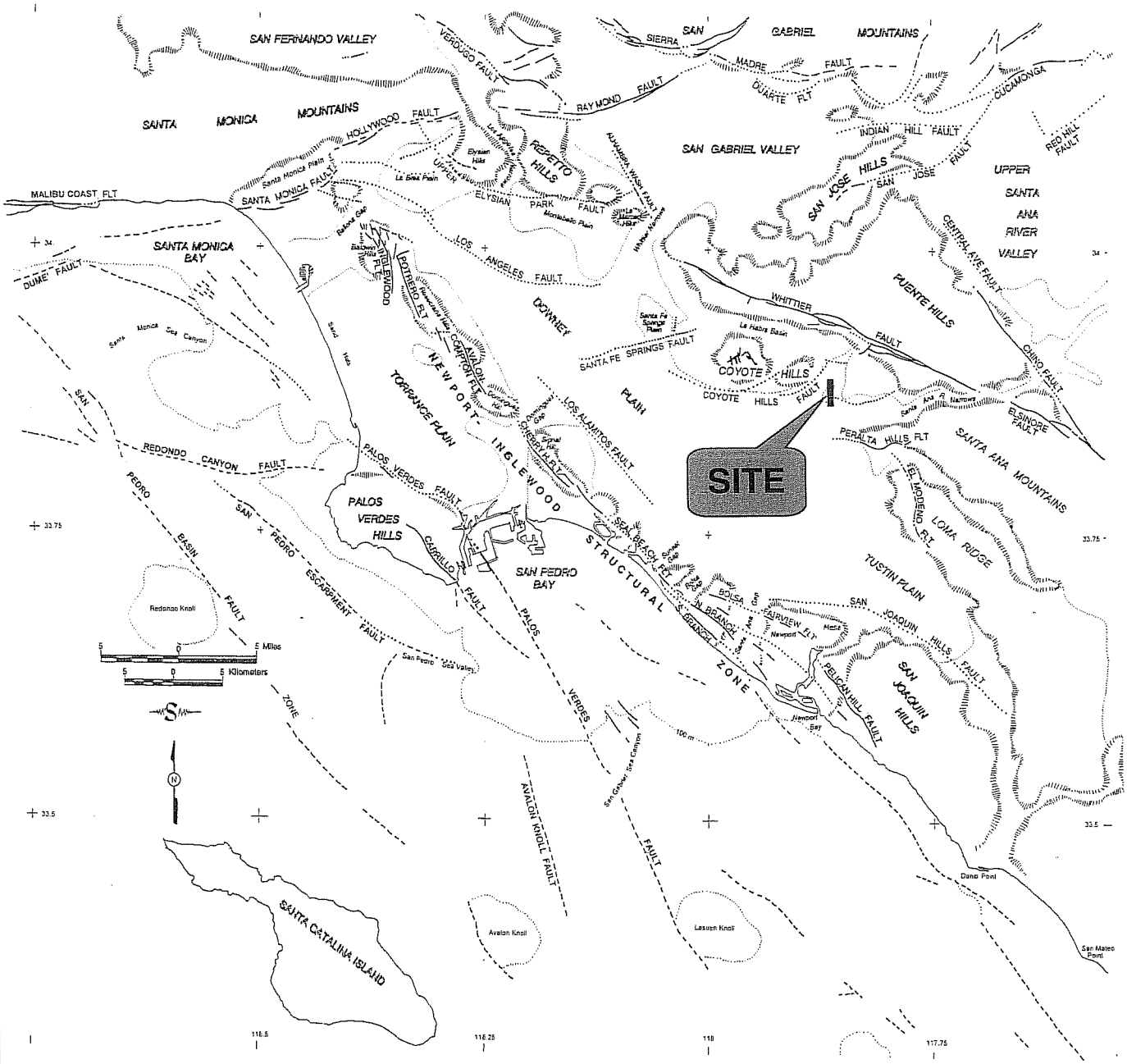
3.2 PHYSIOGRAPHY

The site area is at the eastern edge of the Los Angeles physiographic basin, a large, relatively flat, low-lying, coastal plain surrounded by mountains on the north, east, and southeast (Figure 3-1). The floor of the Los Angeles Basin is relatively flat but slopes gradually southwesterly from an elevated marginal apron to sea level along the coastline. The western margin of the Los Angeles Basin is bordered by the sea and the Palos Verdes Hills. The eastern margin is bordered by the Puente Hills and Santa Ana Mountains. The Coyote Hills, Santa Fe Springs Plain, Richfield Hills, and Kramer Hills are low elevation uplifts along the southern margin of the Puente Hills.

3.3 GEOLOGIC STRUCTURE

The geologic structure at the site is quite simple and is characterized by flat-lying Quaternary sediments overlying gently folded Tertiary sedimentary rocks. These strata rise gently to the Coyote Hills, Richfield Hills, and Kraemer Hills where they are arched upward to form anticlinal folds. The site is on the south limb of these anticlines with the early Pleistocene and Tertiary age strata dipping gently to the south and overlain by younger flat-lying Quaternary sediments.

The nearest active or potentially active surface faults are the Peralta Hills and Whittier faults (Figure 3-1). The low-elevation plains and hills along the eastern margin of the Los Angeles Basin are underlain by a series of east-west trending, en echelon, faults and folds in the subsurface; the major faults within this trend are, from north to south, the Los Angeles (Las Cienegas), Santa Fe Springs, and Coyote Hills faults (Figure 3-1). This group of faults is known as the Puente Hills fault system. Other poorly known segments of this thrust fault system underlie the Richfield and Kramer hills. All of these faults are blind thrust or reverse faults that approach within about a mile or so of the ground surface. They are identified on seismic reflection geophysical data only and are below the depths of oil wells.



SR-57 Northbound Improvement Project

Earth Mechanics, Inc.
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REGIONAL FAULT AND PHYSIOGRAPHIC MAP

Figure 3-1

Project No. 08-115

Date: 01-17-09

The Peralta Hills fault may be related to the Puente Hills fault system. The Peralta Hills fault is exposed along the south flank of the Peralta Hills where it displaces Tertiary-age rocks upward and over younger Quaternary alluvium. The fault extends westerly below the Santa Ana River channel where it creates barriers to ground-water flow (Figure 3-2). The barriers extend about to the SR 57 freeway just north of the Lincoln Avenue (Morton and Miller, 1981). The location of the Peralta Hills fault is well up on the flank of the hills rather than at the base of the hills indicating that it is not the only fault responsible for uplift and folding of the Peralta Hills. There must be a deeper unknown blind thrust fault below the Peralta Hills thrust fault but this feature has never been directly identified.

The Whittier fault is a major strike slip fault that extends northwesterly along the southwest flank of the Puente Hills northeast of the site (Figure 3-1). The Whittier fault is associated with the Chino fault and the Elsinore fault and together these faults form a major fault system that extends from the Los Angeles Basin into northern Mexico.

The El Modeno fault is a north-south trending feature within Loma Ridge, one of the foothills of the Santa Ana Mountains, southeast of the site. The feature is poorly known but is known to displace Holocene soil in Loma Ridge. Although the fault is grouped with the Peralta Hills fault on the Caltrans seismic hazard map (Mualchin 1996), it appears to be a discrete normal or strike-slip fault unrelated to the thrust faults of the Peralta Hills. Although the fault must be considered active because it displaces Holocene soil, the feature has a very long (thousands of years) recurrence interval.

3.4 GEOLOGIC HAZARDS

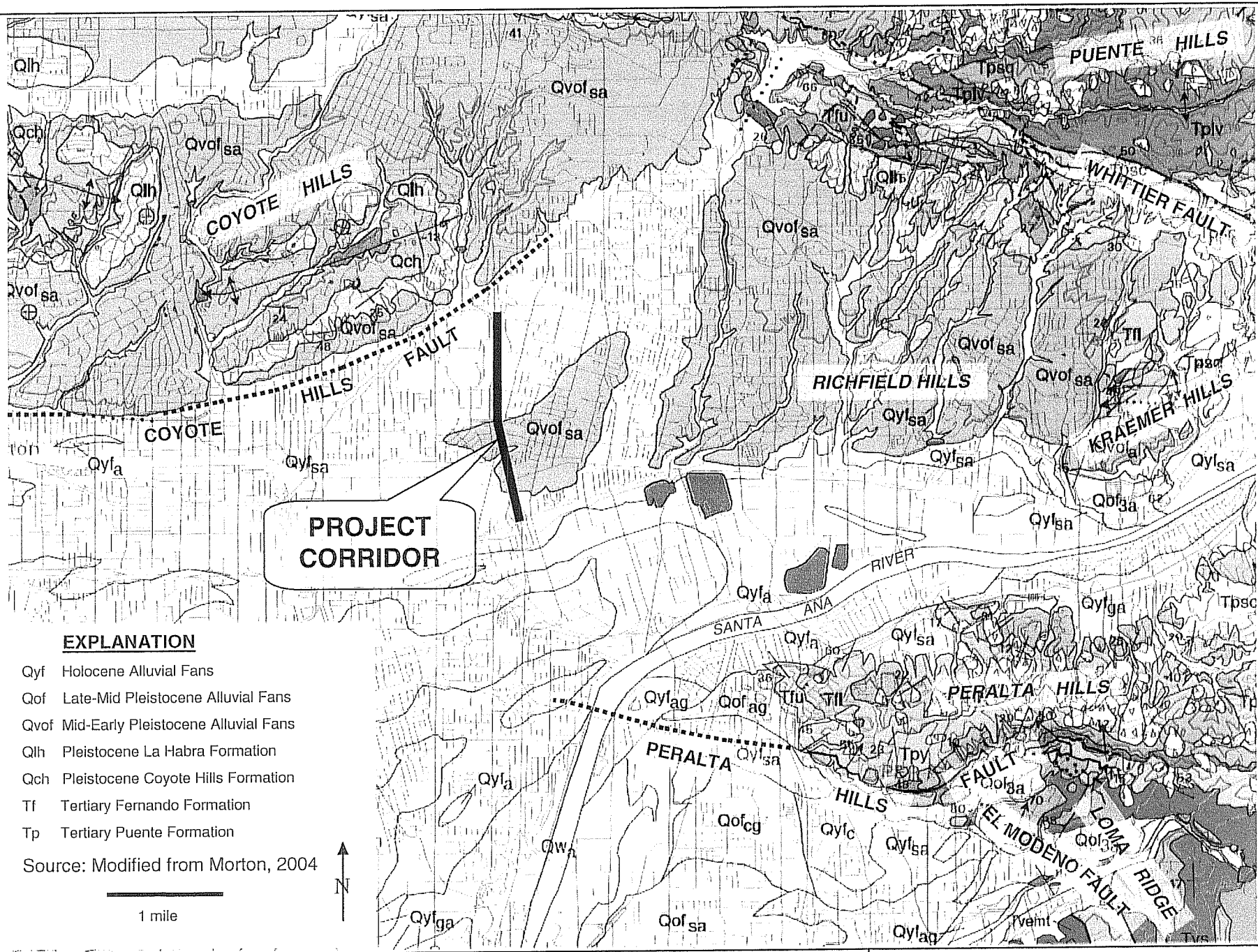
There are no steep slopes within the corridor so landsliding is not likely. There are no active faults so surface fault rupture is not likely. There are no known volcanos in the site region. The site is far from the sea on elevated land so Tsunamis are not a hazard.

The site is not identified on the State seismic hazard maps of the La Habra, and Anaheim and Newport Beach quadrangles as being susceptible to liquefaction (California Geological Survey/Division of Mines and Geology, 1997a, 1997b). This is due primarily to the depth of historically highest ground water being greater than 50 feet.

3.5 STRATIGRAPHY

Regional studies (e.g. Morton, 2004; Morton and Miller, 1981; Durham and Yerkes, 1964; California Department of Water Resources, 1961) indicate that the site area is underlain by Quaternary sediments overlying older Quaternary and Tertiary sediments and sedimentary rocks.

The surficial deposits are primarily Holocene and Pleistocene alluvial fan deposits (Figure 3-2). Older formations exposed in the hills and underlying the corridor are, in descending order, the Pleistocene-age La Habra and Coyote Hills, the Pliocene Fernando, and Pliocene-Miocene-age Puente formations. Along the corridor, the La Habra Formation is at an elevation of about sea level and therefore these older units are well below the level of interest for this project.


PROJECT CORRIDOR
COYOTE HILLS FAULT
COYOTE HILLS
PERALTA HILLS FAULT
PERALTA HILLS
RICHFIELD HILLS
KRAEMER HILLS
PUENTE HILLS
WHITTIER FAULT
EL MODENO FAULT
LOMA RIDGE
SANTA ANA RIVER
Qlh
Qch
Qvof sa
Qyf a
Qyf sa
Qyf ag
Qof ag
Qyf sa
Qyf ga
Qof cg
Qyf c
Qyf sa
Qof sa
Qyf ag
Qyf sa
Qof 3a
Qyf sa
Qyf ga
Tpsc
Tpsc
Tpsc

3.6 SEISMICITY

The largest historical earthquake within the Los Angeles Basin was the 1933 Long Beach earthquake of M_W=6.4 (M_L = 6.3) which is generally believed to have been associated with the Newport-Inglewood Structural Zone. The association of the 1933 event with the NISZ was based on abundant ground failures along the NISZ trend, but no unequivocal surface rupture was identified. Hauksson and Gross (1991) reevaluated the seismicity data and relocated the 1933 earthquake hypocenter to a depth of about 6 miles below the Huntington Beach-Newport Beach city boundary.

Other damaging earthquakes in the Los Angeles region include the 1971 San Fernando, the 1987 Whittier, and the 1994 Northridge events. The 1971 San Fernando (M_L= 6.4, M_W=6.7) earthquake occurred along the northern margin of the San Fernando Valley and produced a surface rupture which coincided partly with a zone of mapped surface faults along the mountain-valley margin. The more-recent 1987 Whittier earthquake (M_L=5.9, M_W=5.9) and the 1994 Northridge (M_L=6.4, M_W = 6.7) earthquake were not associated with surface faulting. Such events indicate that seismic hazards analysis must consider subsurface faulting as well as surface faulting. The Whittier event occurred at a depth of about 10 miles on a northerly dipping thrust fault dipping from the Coyote Hills area, under the Repetto and Puente Hills, to below the San Gabriel Valley. The Northridge event occurred at a depth of about 12 miles on a south-dipping reverse fault below the San Fernando Valley.

Another significant earthquake in the region was the 1812 earthquake which caused damage at the San Juan Capistrano Mission. The location and magnitude of the 1812 earthquake are unknown but geological studies (Jacoby et al., 1988; Fumal et al., 1993; Weldon et al., 2004) postulated that it did not occur in the Capistrano area, but rather was a large (M> 7.0) distant event on the San Andreas fault in the Wrightwood area of the San Gabriel Mountains.

A recent magnitude 5.4 (M_W) earthquake occurred on 29 July 2008 below the Puente Hills northeast of the site at a depth of about 10 miles. This event was a reverse type fault with a left- lateral component of slip. The causative fault is unknown. The epicenter is between the Whittier and Chino faults. The orientation of the preferred focal plane of the focal mechanism solution is somewhat compatible with the Whittier fault. The Whittier fault may have a reverse component of slip but is believed to be primarily a right-lateral fault. Furthermore dip of the preferred focal plane and the distribution of aftershocks are not very compatible with the Whittier fault. The northerly dipping buried thrust faults under the Peralta Hills, Richfield Hills, or Kraemer Hills could have been source because the preferred focal plane dips northeasterly similar to the northerly dipping faults. However, the distribution of the aftershocks does not seem compatible with the orientations of these faults.

4.0 SUBSURFACE CONDITIONS

4.1 SOIL CONDITIONS

Due to the extent of the project (about 2.4 miles long), and the varying ground surface elevations and stratigraphy observed in exploratory boreholes and CPT's, idealized subsurface profiles were developed for each wall. These idealized soil profiles and design strength parameters for foundation design are presented in Table 4-1.

TABLE 4-1. IDEALIZED SOIL PROFILES AND STRENGTH PARAMETERS

Approx. Elevation (ft)	*Predominant Soil Type*	*Total Unit Weight (pcf)*	*Friction Angle (degree)*	*Cohesion/ Undrained Shear Strength (psf)*	*Expansion Potential*
RW 462 and 466					
+225.4 to +180	Silty Sand, Sand with Silt, and Poorly-graded Sand	120	30-34	150-100	very low to low
+180 to +130	Sand with Silt and Sand	123-128	35-40	100-25	very low to low
RW 474 and 476					
+231.9 to +190	Clayey and Silty Sand and Sand with Silt	120	31-34	150-100	very low to low
+190 to +180	Sandy Lean Clay	120	-	1,200	low to medium
+180 to +145	Sand with Silt	123-128	35-38	100-50	very low to low
RW 486					
+241.0 to +227	Clayey and Silty Sand	120	31	150	very low to low
+227 to +195	Lean Clay with Sand and Sandy Lean Clay	120	-	1,200-1,800	low to medium
+195 to +140	Sand with Silt and Poorly-graded Sand	123-128	34-40	100-25	very low to low
RW 492					
+241.9 to +230	Clayey and Silty Sand	120	31	150	very low to low
+230 to +190	Lean Clay with Sand and Sandy Lean Clay	120	-	1,200-1,800	low to medium
+190 to +165	Sand with Silt and Poorly-graded Sand	123-128	32-40	150-25	very low to low
+165 to +155	Lean Clay with Sand	120	-	2,000-2,500	low to medium
+155 to +145	Sand with Silt and Silty Sand	125-128	36-40	100-25	very low to low

TABLE 4-1 (CONT). IDEALIZED SOIL PROFILES AND STRENGTH PARAMETERS

Approx. Elevation (ft)	*Predominant Soil Type*	*Total Unit Weight (pcf)*	*Friction Angle (degree)*	*Cohesion/ Undrained Shear Strength (psf)*	*Expansion Potential*
RW 496					
+243.7 to +235	Clayey Sand	120	30-31	150	very low to low
+235 to +200	Lean Clay with Sand and Sandy Lean Clay	120-123	-	1,500-2,500	low to medium
+200 to +165	Sand with Silt and Silty Sand	123-128	34-40	150-50	very low to low
+165 to +135	Lean Clay with Sand and Sandy Lean Clay	123-125	-	2,000-3,000	low to medium
RW 512 and 514					
+250.1 to +235	Clayey Sand	120	30-31	150	very low to low
+235 to +200	Lean Clay with Sand and Sandy Lean Clay	120-125	-	1,500-3,000	low to medium
+200 to +165	Sand with Silt and Silty Sand	123-128	34-40	150-50	very low to low
RW 522 and 526					
+253.1 to +223	Lean Clay with Sand and Sandy Lean Clay	120-123	-	1,200-2,000	low to medium
+223 to +218	Silty Sand	120	30	150	very low to low
+218 to +203	Lean Clay with Sand and Sandy Lean Clay	123-125	-	1,500-3,000	low to medium
+203 to +188	Silty and Clayey Sand	123-125	32-35	150-50	very low to low
+188 to +178	Lean Clay with Sand and Sandy Lean Clay	123-125	-	2,500-3,000	low to medium
+178 to +163	Sand with Silt and Silty Sand	123-128	34-40	150-50	very low to low
RW 536 and 538					
+258 to +245	Silty and Clayey Sand	120	30-32	150	very low to low
+245 to +225	Lean Clay with Sand and Sandy Lean Clay	120-125	-	1,500-3,000	low to medium
+225 to +195	Sand with Silt and Silty Sand	120-125	31-35	150-50	very low to low
+195 to +175	Lean Clay with Sand and Sandy Lean Clay	120-125	-	1,500-2,500	low to medium
+175 to +170	Sand with Silt and Silty Sand	125-128	36-40	50	very low to low

TABLE 4-1 (CONT). IDEALIZED SOIL PROFILES AND STRENGTH PARAMETERS

Approx. Elevation (ft)	*Predominant Soil Type*	*Total Unit Weight (pcf)*	*Friction Angle (degree)*	*Cohesion/ Undrained Shear Strength (psf)*	*Expansion Potential*
RW 576					
+290 to +277	Lean Clay with Sand and Sandy Lean Clay	120-123	-	1,200-2,000	low to medium
+277 to +267	Silty and Clayey Sand	120-123	31-32	150	very low to low
+267 to +255	Lean Clay with Sand and Fat Clay	120-123	-	1,800-2,500	low to high
+255 to +240	Silty and Clayey Sand	120-123	32-34	150-100	very low to low

The above soil strength parameters are primarily based on published correlations with SPT blowcounts (Lam and Martin, 1986). The above soil strength parameters are also conservative compared to direct shear test and UU triaxial test results included in Appendix B.

4.2 GROUNDWATER CONDITIONS

During the recent field investigation conducted between August 25 and October 1, 2008, groundwater was not encountered down to El. +133.9 feet which is more than 90 feet from the freeway surface.

The relatively deep water depth is confirmed by the historical groundwater maps published by the California Geological Survey (Seismic Hazard Zones Maps – La Habra, and Anaheim and Newport Beach quadrangles) (CGS, 1997a and 1997b). This map shows the depth to groundwater to be greater than 50 feet.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SEISMIC DESIGN CRITERIA

According to the 1996 Caltrans Seismic Hazard map, the most significant faults relative to the project area are listed in Table 5-1 along with their style of fault, maximum earthquake magnitude, distance to the site and resulting peak bedrock acceleration (PBA).

TABLE 5-1. LOCAL SEISMIC SOURCES

Fault or Fault Zone	Style of Faulting	Maximum Credible Earthquake (MCE) Magnitude	Distance to Site[2] (miles)	Peak Bedrock Acceleration[3] (g)
El Modeno-Peralta Hills (EMP)	Reverse-Thrust[1]	6.50	0.63-2.69	0.6-0.8
Puente Hills Blind Thrust	Reverse-Thrust	7.25	2.69-4.56	0.6-0.7
Whittier-Elsinore (WEE)	Strike-Slip	7.50	3.50-5.19	0.5-0.6

Notes:
(1) Caltrans designates the style of fault for EMP to be "unknown"; we assume a reverse-thrust fault (most conservative).
(2) For the EMP and WEE faults, the distances of each bridge site to these seismic sources were scaled from the 1996 Caltrans Seismic Hazard Map. Distances of each bridge site to the Puente Hills Blind Thrust were obtained from the seismic source model contained within the FRISKSP4.0 computer program (Blake, 2000 and 2004).
(3) The PBA is the larger of the two PBA's obtained from the attenuation relations of Sadigh (1997) and Mualchin (1996).

The resulting design PBAs are 0.8g for the walls located south of Placentia Avenue (RW 462, 466, 474, 476, 486, 492, and 496). The resulting design PBA for the remaining walls is 0.7g.

5.2 LIQUEFACTION

Based on the available boring information, the subject site has a low liquefaction potential due to absence of groundwater within the depths of interest.

5.3 SOIL CORROSIVITY

Thirty-four (34) soil samples were tested to determine minimum resistivity, pH, soluble sulfate content, and soluble chloride content using procedures described in California Test Methods 417, 422, and 643, respectively. Minimum resistivities ranged from 490 to 2,000 ohm-cm. The pH ranged from 7.29 to 8.64. The soluble sulfate ranged from 50 to 1,000 parts per million (ppm), and the soluble chloride ranged from 123 to 416 ppm. The test results are summarized in Table 5-2.

TABLE 5-2. SOIL CORROSION TEST RESULTS

Boring	Station (Offset) / "Station Line"	Sample Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Soluble Sulfate Content (ppm)	Soluble Chloride Content (ppm)
A-08-001	471+5 (97RT)/"B" Line	10	SC	2000	8.64	450	153
A-08-003	473+35 (90RT)/"B" Line	10	CL	1100	8.43	300	216
A-08-004	483+85 (90RT)/"B" Line	15	SC	750	7.54	700	185
A-08-005	485+12 (90RT)/"B" Line	20	SC	2000	8.38	120	173
A-08-006	489+69 (80RT)/"B" Line	15	CL	1800	8.10	100	168
A-08-007	491+67 (80RT)/"B" Line	15	CL	740	7.69	500	162
A-08-008	494+45 (80RT)/"B" Line	10	CL	810	7.65	450	213
A-08-008	494+45 (80RT)/"B" Line	30	CL	510	7.36	750	208
A-08-009	496+47 (80RT)/"B" Line	25	CL	850	7.66	300	142
A-08-010	505+67 (80RT)/"B" Line	5	SC	1300	7.95	100	123
A-08-012	507+94 (97RT)/"B" Line	15	CL	850	7.42	50	245
A-08-013	510+43 (89RT)/"B" Line	21	CL	1050	7.84	200	238
A-08-014	519+3 (70RT)/"B" Line	10	CL	600	7.66	450	158
A-08-015	521+9 (71RT)/"B" Line	20	SC	840	7.60	350	182
A-08-016	533+58 (68RT)/"B" Line	25	CL	1040	7.69	150	312
A-08-016	533+58 (68RT)/"B" Line	35	CL	530	7.51	120	364
A-08-017	535+70 (66RT)/"B" Line	20	CL	490	7.29	250	362
A-08-018	573+88 (127RT)/"B" Line	5	CL	760	8.36	250	223
A-08-018	573+88 (127RT)/"B" Line	40	CL	900	7.85	80	296
A-08-019	574+55 (127RT)/"B" Line	10	CL	750	8.53	280	181
A-08-109	478+37 (138RT)/"B" Line	20	CL	700	7.73	1000	221
A-08-109	478+37 (138RT)/"B" Line	35	CL	500	7.55	300	270
A-08-116	516+31 (172RT)/"B" Line	25	CL	1100	8.33	280	159
A-08-119	528+64 (119RT)/"B" Line	5	CL	980	7.65	400	221
A-08-121	531+86 (80RT)/"B" Line	5	CL	1200	7.95	120	184
A-08-121	531+86 (80RT)/"B" Line	25	CL	940	7.69	50	280
A-08-122	537+80 (72RT)/"B" Line	15	CL	520	7.56	150	416
A-08-123	539+47 (160RT)/"B" Line	20	CL	980	7.86	120	315
A-08-124	540+94 (82RT)/"B" Line	5	CL	1800	8.28	250	175
A-08-126	543+21 (109RT)/"B" Line	2.5	CL	1090	8.35	80	159
A-08-126	543+21 (109RT)/"B" Line	25	CL	1100	7.85	120	262
A-08-128	546+84 (102RT)/"B" Line	5	CL	1500	7.86	50	153

TABLE 5-2 (CONT). SOIL CORROSION TEST RESULTS

Boring	Station (Offset) / "Station Line"	Sample Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Soluble Sulfate Content (ppm)	Soluble Chloride Content (ppm)
A-08-137	574+40 (394RT)/"B" Line	2.5	CL	1060	8.34	50	168
A-08-138	578+33 (135RT)/"B" Line	5	CL	1200	8.18	50	171

Based on the Caltrans Corrosion Guidelines (2003), soils are considered corrosive if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm or greater. Based on the test results and the Caltrans criteria, the on-site soils are not considered to be corrosive to bare metals and concrete.

5.4 FOUNDATION DESIGN FOR TYPE 1 RETAINING WALLS

Settlement and bearing capacity calculations for Type 1 Retaining Walls are shown in Appendix C. These calculations were performed using the soil data in Table 4-1, and foundation dimensions and toe pressures from Caltrans Standard Plans B3-1 (2006c). Based on the results in Appendix C, spread footing foundation is feasible provided overexcavation and recompaction are performed.

The recommended minimum overexcavation depth is largely controlled by the allowable total foundation settlement. The allowable total foundation settlement is estimated to be the sum of settlement induced by the "approximate wall offset values" shown on Caltrans Standard Plans B3-8 and a soil settlement of 1 inch. Using this combination, the total allowable foundation settlement as a function of wall heights is presented in Table 5-3.

TABLE 5-3. ALLOWABLE FOUNDATION SETTLEMENT

Wall Heights	Settlement due to Wall Offset (in)	Soil Settlement (in)	Total Allowable Foundation Settlement (in)
6	0.14	1.0	1.1
8	0.16		1.1
10	0.18		1.2
12	0.20		1.2
14	0.27		1.3
16	0.29		1.3
18	0.36		1.4

The recommended minimum overexcavations for spread footing are given in Table 5-4. The overexcavation bottom should be scarified a minimum depth of 6 inches and compacted in-place to a minimum relative compaction of 90% of maximum density as determined by Caltrans Test Method 216. Prior to backfilling, the excavation bottom should be proof-rolled and after that the excavation

bottom should be inspected by a qualified geotechnical engineer or technician to confirm the presence of an unyielding and competent surface. The horizontal limits of the overexcavation should begin from each edge of the footing bottom and extending down and out at a 45-degree imaginary plane until the plane intersects the recommended excavation depths. In some areas, the 45-degree imaginary plane would intersect temporary shoring. In this case only, the horizontal limit of the overexcavation should begin from the edge of the footing bottom and extending out a minimum of 1 foot and down until the plane intersects the recommended excavation depths. Caltrans Structure Backfill is recommended for backfilling with a minimum relative compaction of 95% of maximum density as determined by Caltrans Test Method 216. Onsite sandy materials may be used as backfill with a minimum relative compaction of 95% of maximum density as determined by Caltrans Test Method 216 provided it meets the requirements of Caltrans Structure Backfill per Section 19-3.06 of Caltrans Standard Specification (2006b).

TABLE 5-4. RECOMMENDED MININUM OVEREXCAVATION DEPTHS FOR TYPE 1 RETAINING WALLS

Retaining Wall	Wall Height (ft)	Recommended Minimum Overexcavation Depth (ft)
476	16 and 18	4.5
	12 and 14	1.0
	10 and less	0.5
486	16	2.5
	14	2.0
	12	1.0
492	16	4.5
	14	4.0
	12	3.0
512	18	2.0
	16 and 14	1.5
	12	1.0
	10 and less	0.5
514	14	3.5
	10	2.0
	8	1.0
	6 and less	0.5
522	14 and 12	4.0
	10	2.0
	8	1.5
	6 and less	0.5
576	14 and 12	1.0
	10 and less	0.5

Note: Overexcavation depth is measured from the footing bottom.

Per Caltrans Bridge Design Specification Section 4.4.5.1 (Caltrans, 2004), a minimum horizontal distance of 4 feet, measured at the top of footings, should be provided between the near face of footing and the face of the finished slopes for footings constructed on slopes. In addition, a minimum embedment depth of 3 feet (measured from the lowest adjacent grade to the footing bottom) is required.

5.5 FOUNDATION DESIGN FOR SOUND WALLS ON RETAINING WALLS

Settlement and bearing capacity calculations for soundwall on retaining wall (SW on RW) are shown in Appendix C. These calculations were performed using the soil data in Table 4-1, and foundation dimensions from Caltrans Sheet XS14-220e. The bearing pressures were provided by RBF and these pressures are given in Table 5-5. The static toe pressures were used to determine foundation settlement, and the seismic toe pressures must be less than the ultimate soil bearing capacity. Based on the results in Appendix C, spread footing foundation is feasible for most walls provided overexcavation and recompaction are performed; pile foundation is recommended at three locations: (1) RW 462 with a wall height (H) equal to 16 feet, (2) RW 492 with wall heights (H) equal to 12 and 16 feet and (3) RW 496 with a wall height (H) equal to 26 feet.

TABLE 5-5. BEARING PRESSURES FOR SOUND WALLS ON RETAINING WALLS

Retaining Wall Heights	Toe Pressures (ksf)	
	Static	Seismic
6	1.88	4.37
8	2.22	6.44
10	2.48	8.77
12	2.68	9.92
14	2.92	11.75
16	3.10	9.96
18	3.36	10.14
20	3.57	12.15
22	3.97	15.59

5.5.1 Spread Footing

The recommended minimum overexcavations for spread footing are given in Table 5-6. The overexcavation bottom should be scarified a minimum depth of 6 inches and compacted in-place to a minimum relative compaction of 90% of maximum density as determined by Caltrans Test Method 216. Prior to backfilling, the excavation bottom should be proof-rolled and after that the excavation bottom should be inspected by a qualified geotechnical engineer or technician to confirm the presence of an unyielding and competent surface. The horizontal limits of the overexcavation should begin from each edge of the footing bottom and extending down and out at a 45-degree imaginary

plane until the plane intersects the recommended excavation depths. In some areas, the 45-degree imaginary plane would intersect temporary shoring. In this case only, the horizontal limit of the overexcavation should begin from the edge of the footing bottom and extending out a minimum of 1 foot and down until the plane intersects the recommended excavation depths. Structure Backfill is recommended for backfilling with a minimum relative compaction of 95% of maximum density as determined by Caltrans Test Method 216. Onsite sandy materials may be used as backfill with a minimum relative compaction of 95% of maximum density as determined by Caltrans Test Method 216 provided it meets the requirements of Caltrans Structure Backfill per Section 19-3.06 of Caltrans Standard Specification (2006b).

TABLE 5-6. RECOMMENDED MINIMUM OVEREXCAVATION DEPTHS FOR SOUND WALLS ON RETAINING WALLS

Retaining Wall	Wall Height (ft)	Recommended Minimum Overexcavation Depth (ft)
462	8 and 10	1.0
	6 and less	0.5
466	14	3.0
	10	2.0
	8	1.5
	6	1.0
474	12	1.0
	6 and 8	0.5
496	16	5.0
526	10 and 12	5.0
	8	3.5
	6 and less	2.0
536	14	3.0
	10	1.5
538	8 and less	2.5

Note: Overexcavation depth is measured from the footing bottom.

Per Caltrans Bridge Design Specification Section 4.4.5.1 (Caltrans, 2004), a minimum horizontal distance of 4 feet, measured at the top of footings, should be provided between the near face of footing and the face of the finished slopes for footings constructed on slopes. In addition, a minimum embedment depth of 3 feet (measured from the lowest adjacent grade to the footing bottom) is required.

5.5.2 Pile Foundation

Pile foundation is recommended at three locations: (1) RW 462 with a wall height (H) equal to 16 feet, (2) RW 492 with wall heights (H) equal to 12 and 16 feet and (3) RW 496 with a wall height (H) equal to 26 feet. The design and specified pile tip elevations are presented in Table 5-7. The piles are designed using both skin friction and end-bearing resistances. The pile capacities are based on

soil resistance only and may be further limited by the pile-head connection details. Due to anticipated hard driving below El. +175 feet at RW 462 and below El. +200 feet at RW 496, steel HP piles are recommended instead of pre-cast concrete piles (Alt-X).

Results of lateral pile analysis in terms of pile-head shear and lateral deflection for both free-head and fixed-head condition are presented in Tables 5-8 and 5-9. The maximum bending moment and the location of maximum moment are also presented in these tables. The solutions presented in Tables 5-8 and 5-9 are entirely based on soil resistance and linear pile properties. Therefore, these values may be limited by the flexural strength (plastic moment) of the piles and other connection details. Linear interpolation can be used for solutions between pile-head deflections of 0.25 and 6 inches.

TABLE 5-7. RECOMMENDED PILE TIP ELEVATIONS FOR SOUND WALLS ON RETAINING WALLS

Retaining Wall	Approx. Footing Bottom El. (ft)	Pile Type	Design Loading (Service) (kips)	Nominal Resistance (kips)		Design Tip Elev. (ft)*	Specified Tip Elev. (ft)	Nominal Driving Resistance Required (kips)
				Compr.	Tension			
462 (H=16') (RW LOL 11+77.75 to 12+26.25)	+191.37	HP 10x42	90	180	90	+157.0 (a) & (b) +161.0 (d)	+157.0	180
492 (H=12' and H=16') (RW LOL 12+79.64 to 13+20.80)	+227.12 (H=12') +224 (H=16')	12-inch Pre-cast Square Concrete (Alt-X)	90	180	90	+173.0 (a) & (b) +194.0 (d)	+173.0	180
496 (H=26') (RW LOL 19+40.42 to 19+84.42)	+214	HP 10x42	90	180	90	+183.0 (a) & (b) +184.0 (d)	+183.0	180

* Design tip elevation is controlled by the following demands: (a) Compression, (b) Tension, and (d) Lateral Loads.

TABLE 5-8. LATERAL PILE SOLUTIONS FOR RW 492

Retaining Wall	Lateral Displacement at Top of Pile (in)	Lateral Load at Top of Pile (kips)	Max. Bending Moment (kip-in)	Depth from Pile Top to Max. Moment (ft)
492 (H=12' and 16') 12" PCC Piles	0.25	11.2	249	3.6
	0.5	16.1	402	4.0
	1	23.2	650	4.8
	2	33.4	1051	5.2
	3	40.4	1393	5.6
	4	45.5	1692	6.0
	6	53.0	2212	6.4

TABLE 5-9. LATERAL PILE SOLUTIONS FOR RW 462 AND 496

Retaining Wall	Lateral Displacement at Top of Pile (in)	Lateral Load at Top of Pile (kips)		Max. Bending Moment (kip-in)		Depth from Pile Top to Max. Moment (ft)	
		Strong	Weak	Strong	Weak	Strong	Weak
462 (H=16') HP10x42 Piles	0.25	14.1	9.4	400	208	4.0	3.2
	0.5	22.2	14.5	736	384	4.4	3.6
	1	32.7	21.2	1284	669	4.8	4.0
	2	46.5	29.8	2158	1111	5.6	4.8
	3	56.7	36.0	2881	1479	6.0	5.2
	4	65.2	41.2	3527	1802	6.4	5.2
	6	79.0	49.7	4669	2375	7.2	6.0
496 (H=26') HP10x42 Piles	0.25	18.7	13.8	442	248	4.0	3.2
	0.5	26.9	19.8	716	400	4.4	3.6
	1	38.8	28.4	1157	645	4.8	4.0
	2	53.0	38.7	1859	1039	5.6	4.4
	3	61.9	45.0	2430	1359	6.0	4.8
	4	68.6	49.8	2922	1631	6.4	5.2
	6	79.1	57.0	3770	2092	7.2	5.6

5.6 FOUNDATION DESIGN FOR SOUND WALLS

A total of six Standard Sound Wall Masonry Blocks on Type 9363/SV Barrier on piles are proposed within the project limit adjacent to RW 462, 466, 474, 526, 536 and 538. Plan Sheets B15-6 thru B15-8 in Caltrans Standard Plans (Caltrans, 2006c) are recommended for foundation design including pile type, length, and spacing. Based on the soil data, wall layout plans provided by the structural engineers, and ground conditions on both sides of these sound walls, we recommend using:

- Case 2 with a friction angle (θ)=30° for sound walls adjacent to RW 462, 466 and 474, and
- Case 1 with θ=25° for sound walls adjacent to RW 526, 536 and 538.

5.7 FOUNDATION DESIGN FOR MSE WALLS

There are two MSE walls within the project limit: RW 476 and 496. We recommend using backfill materials with a friction angle of 34 degrees. The corresponding gradation requirements and property requirements are listed in Caltrans Bridge Design Specification 5.9.3 (Caltrans, 2004). MSE walls should be embedded a minimum depth of 0.1H (where H = height of wall in feet), but no less than 2 feet, below the lowest adjacent grade.

Bearing Pressures and Settlements. Bearing pressures exerted by the MSE soil mass were computed by RBF and these pressures are shown in Table 5-10. The bearing pressures were compared with the soil bearing capacity for an allowable soil settlement of 2 inches per LRFD Bridge Design Specification Section 11.10.4.1 (AASHTO, 2007). This calculation is presented in Appendix C. In order to limit the soil settlement to 2 inches, the minimum overexcavation depth in Table 5-11 is recommended.

Sliding Stability. A friction coefficient of 0.45 is also recommended for checking the sliding stability of the MSE wall.

Leveling Pad. Provided the overexcavation presented in Table 5-11 is implemented, the allowable bearing capacity of the leveling pad supporting the MSE wall panels is 1.5 ksf.

TABLE 5-10. BEARING PRESSURES FOR MSE WALLS

MSE Wall No.	Wall Height (ft)	Bearing Pressure (ksf)
476	12.5	2.63
	15.0	2.96
	17.5	3.48
	20.0	3.79
	22.5	4.10
496	17.5	3.72
	20.0	4.10
	22.67	4.39
	24.5	4.75
	26.67	5.07

TABLE 5-11. RECOMMENDED MINIMUM OVEREXCAVATION DEPTHS FOR MSE WALLS

Retaining Wall	Wall Height (ft)	Recommended Minimum Overexcavation Depth (ft)
476	22.5 and less	1
496	26.67 and 24.5	5
	22.67	4.5
	20	3
	17.5	2

Note: Overexcavation depth is measured from the bottom of leveling pad.

Earthwork. The overexcavation bottom should be scarified a minimum depth of 6 inches and compacted in-place to a minimum relative compaction of 90% of maximum density as determined by Caltrans Test Method 216. Prior to backfilling, the excavation bottom should be proof-rolled and after that the excavation bottom should be inspected by a qualified geotechnical engineer or

technician to confirm the presence of an unyielding and competent surface. The minimum horizontal limits of the overexcavation should begin 1 foot from the outside edge of the leveling pad and the inner edge of the MSE wall backfill, and extend down and out at a 45-degree imaginary plane until the plane intersects the recommended excavation depths. In some areas, the 45-degree imaginary plane would intersect temporary shoring. In this case only, the horizontal limit of the overexcavation should begin from the edge of the footing bottom and extending out a minimum of 1 foot and down until the plane intersects the recommended excavation depths. Onsite materials can be used as backfill with a minimum relative compaction of 95% of maximum density as determined by Caltrans Test Method 216. Structural Backfill is not required for backfilling below the MSE walls because MSE walls can tolerate more settlement than conventional cantilevered walls and the overexcavation areas are best suited to bury the lead contaminated soils encountered in this project. Details of the aerially deposited lead (ADL) investigation and the results and recommendations are documented in a separated report (EMI, 2009).

Drainage. To direct the infiltrated water away from MSE walls, underdrain pipes are needed. The underdrain pipes should be installed according to standard Caltrans MSE Wall details.

5.8 GLOBAL STABILITY ANALYSES

Global stability analyses were conducted using the computer program PCSTABL (Achilleos, 1988) for both static and pseudostatic conditions. The critical (highest) sections along the retaining following walls were analyzed:

- RW 462: 16-foot-high sound walls on retaining walls at about Sta. 463+40,
- RW 466: 14-foot-high sound walls on retaining walls at about Sta. 471+20,
- RW 474: sound wall on 12-foot-high retaining wall at about Sta. 473+25,
- RW 476: 22-foot-high MSE wall at about Sta. 479+00,
- RW 486: 16-foot-high Type 1 wall at about Sta. 489+80,
- RW 492: 18-foot-high Type 1 wall at about Sta. 491+50,
- RW 496: 26-foot-high MSE wall at about Sta. 505+60,
- RW 512: 18-foot-high Type 1 wall at about Sta. 511+60,
- RW 514: 14-foot-high Type 1 wall at about Sta. 519+15,
- RW 522: 14-foot-high Type 1 wall at about Sta. 527+00,
- RW 526: sound wall on 12-foot-high retaining wall at about Sta. 529+00,
- RW 536: sound wall on 14-foot-high retaining wall at about Sta. 535+35,
- RW 538: sound wall on 8-foot-high retaining wall at about Sta. 541+00, and
- RW 576: 14-foot-high Type 1 wall at about Sta. 575+00.

Results of this analysis are presented in Appendix C. The factor of safety for a deep-seated failure is greater than 1.5 under static condition with a 2-foot soil surcharge to represent traffic loading. Slope stability analysis under pseudostatic condition was performed using a seismic coefficient equal to

0.2g (which is the smaller of either one-third the horizontal peak ground acceleration or 0.2g) in accordance with guidelines provided in Section 3.12 of the Caltrans Guidelines for Foundation Investigations and Reports (Caltrans, 2006a). Analysis indicates that the factor of safety is greater than 1.1 under pseudostatic condition.

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 EARTHWORK

Earthwork should be performed in accordance with Caltrans Standard Specifications, Section 19 (Caltrans, 2006b). Appropriate measures should be taken to prevent damage to adjacent structures and utilities. Any design and construction of temporary sloping, sheeting, or shoring should be made the contractor's responsibility. It should be noted that it is the responsibility of the contractor to oversee the safety of the workers in the field during construction. The contractor shall conform to all applicable occupational and health standards, rules, regulations, and orders established by the State of California. In addition, other State, County, or Municipal regulations may supersede the recommendations presented in this section. If a trench shoring design and safety plan is required, the geotechnical consultant should review the plan to confirm that recommendations presented in this report have been applied to the design.

During the recent field investigation conducted between August 25 and October 1, 2008, groundwater was not encountered down to El. +133.9 feet which is more than 90 feet from the freeway surface. Based on the historical groundwater maps published by the California Geological Survey (Seismic Hazard Zones Maps – La Habra, and Anaheim and Newport Beach Quadrangles) (CGS, 1997a, 1997b), the depth to groundwater is greater than 50 feet. Therefore, groundwater is not expected to be encountered during footing construction. However, groundwater level can fluctuate due to seasonal rainfall amount, local irrigation and groundwater recharge program and other man-made conditions. If groundwater is encountered, it should be controlled in accordance with Section 19-3.04 of the Caltrans Standard Specifications (2006b).

6.2 PILE CONSTRUCTION

Piles should be driven at least to the specified tip elevation and the bearing value should be checked with the pile-driving formula given in Section 49-1.08 of the Caltrans Standard Specifications (2006b). However, if the specified tip elevation is reached without achieving the design load, pile driving should continue until bearing is attained. In this case, it may be prudent to allow the pile to "set up" before continuing the driving.

The selected pile-driving hammer such as diesel-type hammers should be able to deliver sufficient energy to drive the piles at a penetration rate of not less than 1/8 inch per blow at the required bearing value. Vibratory hammers and predrilling are not allowed for pile installation.

Based on the available soil boring data, hard driving may be encountered below El. +175 feet at RW 462 and below El. +200 feet at RW 496. Contractor should be prepared for hard driving conditions.

6.3 REVIEW OF CONSTRUCTION PLANS

Recommendations contained in this report are based on preliminary plans. The geotechnical consultant should review the final construction plans and specifications in order to confirm that the general intent of the recommendations contained in this report have been incorporated into the final construction documents. Recommendations contained in this report may require modification or additional recommendations may be necessary based on the final design.

6.4 GEOTECHNICAL OBSERVATION AND TESTING

It is recommended that inspections and testing be performed by the geotechnical consultant during the following stages of construction:

- Grading operations, including excavations and placement of compacted fill
- Shoring installation
- Footing excavations
- Pile installation
- Removal or installation of support of buried utilities or structures
- When any unusual subsurface conditions are encountered

7.0 LIMITATIONS

This report is intended for the use of RBF Consulting, Orange County Transportation Authority and Caltrans for foundation design and construction for the sound walls, retaining walls, and MSE walls within the SR-57 Northbound Improvement project. This report is based on the project as described and the information obtained from the exploratory borings at the approximate locations indicated on the attached plans. The findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses. In addition, soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project site. However, subsurface conditions and characteristics of soils between exploratory borings can vary. The findings reflect an interpretation of the direct evidence obtained. The recommendations presented in this report are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained in this report are applicable to the specific design element(s) and location(s) which is (are) the subject of this report. They have no applicability to any other design elements or to any other locations and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

EMI has no responsibility for construction means, methods, techniques, sequences, or procedures; for safety precautions or programs in connection with the construction; for the acts or omissions of the CONTRACTOR or any other person performing any of the construction; or for the failure of any worker to carry out the construction in accordance with the Final Construction Drawings and Specifications.

Services performed by EMI have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

8.0 REFERENCES

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APPENDIX A

LOG OF TEST BORINGS SHEETS

All the exploratory boring logs in Appendix A are divided into three subsections for different structure types. Appendices A1 thru A3 contain the boring logs for Caltrans Type 1 retaining walls, sound walls on retaining walls, and MSE walls, respectively.

APPENDIX A1

EXPLORATORY BORING LOGS FOR CALTRANS TYPE 1 WALLS

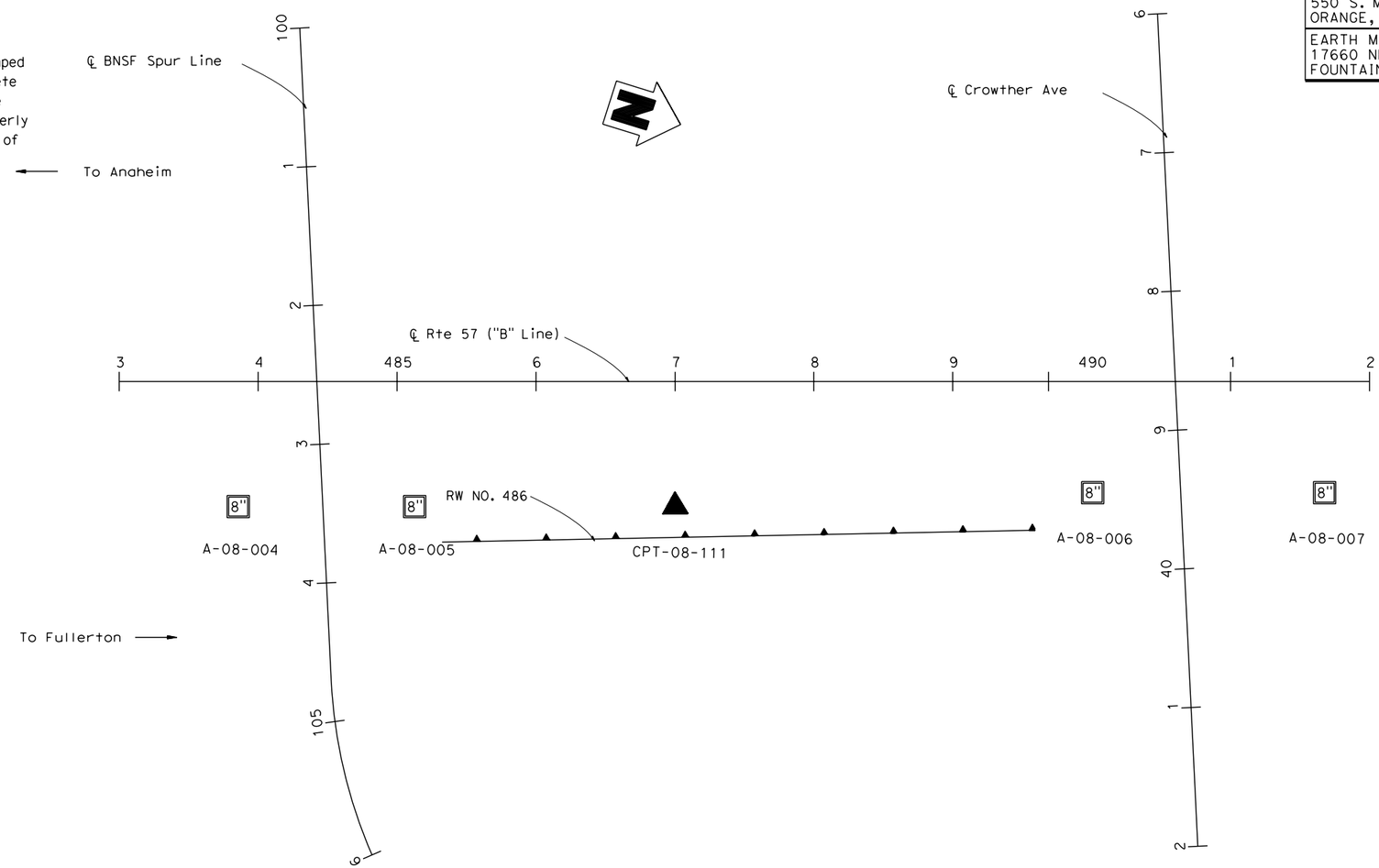
RW 486, RW 512, RW 514, RW 522, and RW 576

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Registered Professional Engineer — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — State of California

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ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.
POST MILES 16.2/18.6

RETAINING WALL NO. 486
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

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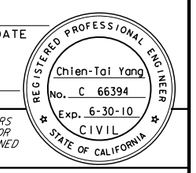
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE



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FOR PLAN VIEW SEE "RETAINING WALL NO. 486, LOG OF TEST BORINGS NO. 1"

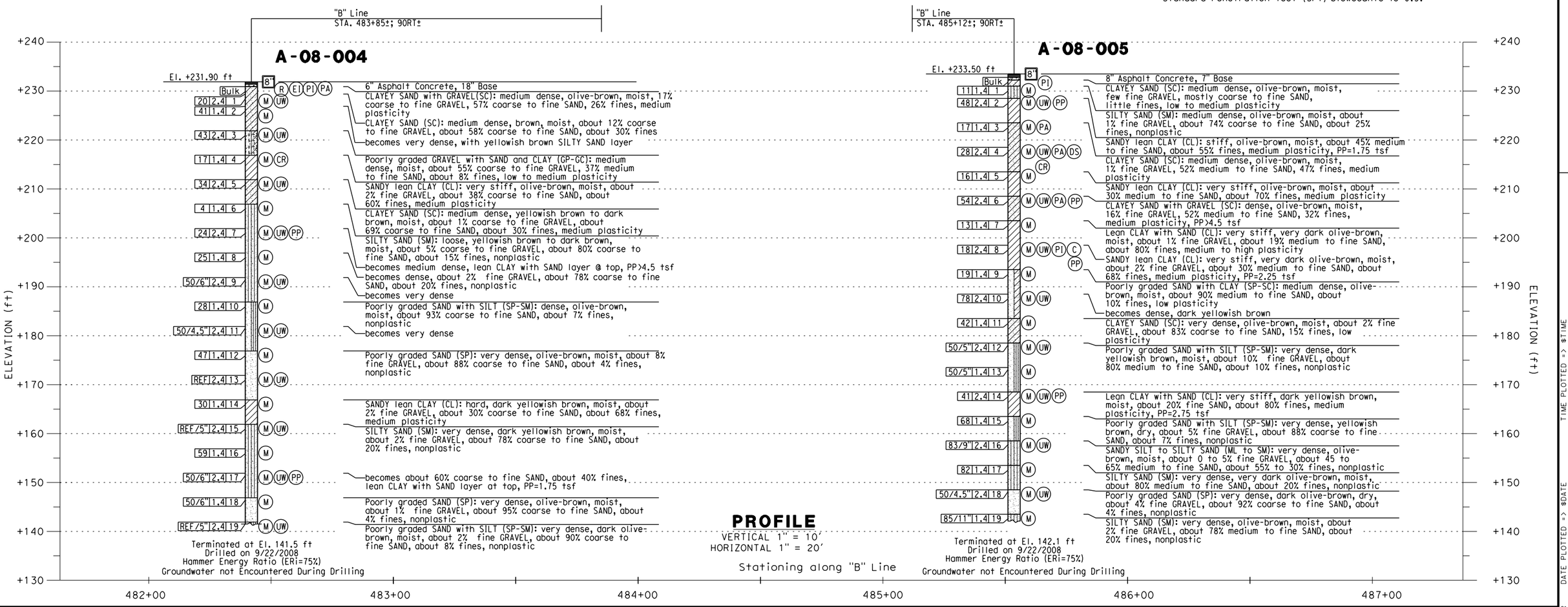
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO.
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6

RETAINING WALL NO. 486
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET OF

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Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

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No. C 66394
Exp. 6-30-10
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STATE OF CALIFORNIA

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FOR PLAN VIEW SEE "RETAINING WALL NO. 486, LOG OF TEST BORINGS NO. 1"

NOTES:

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(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

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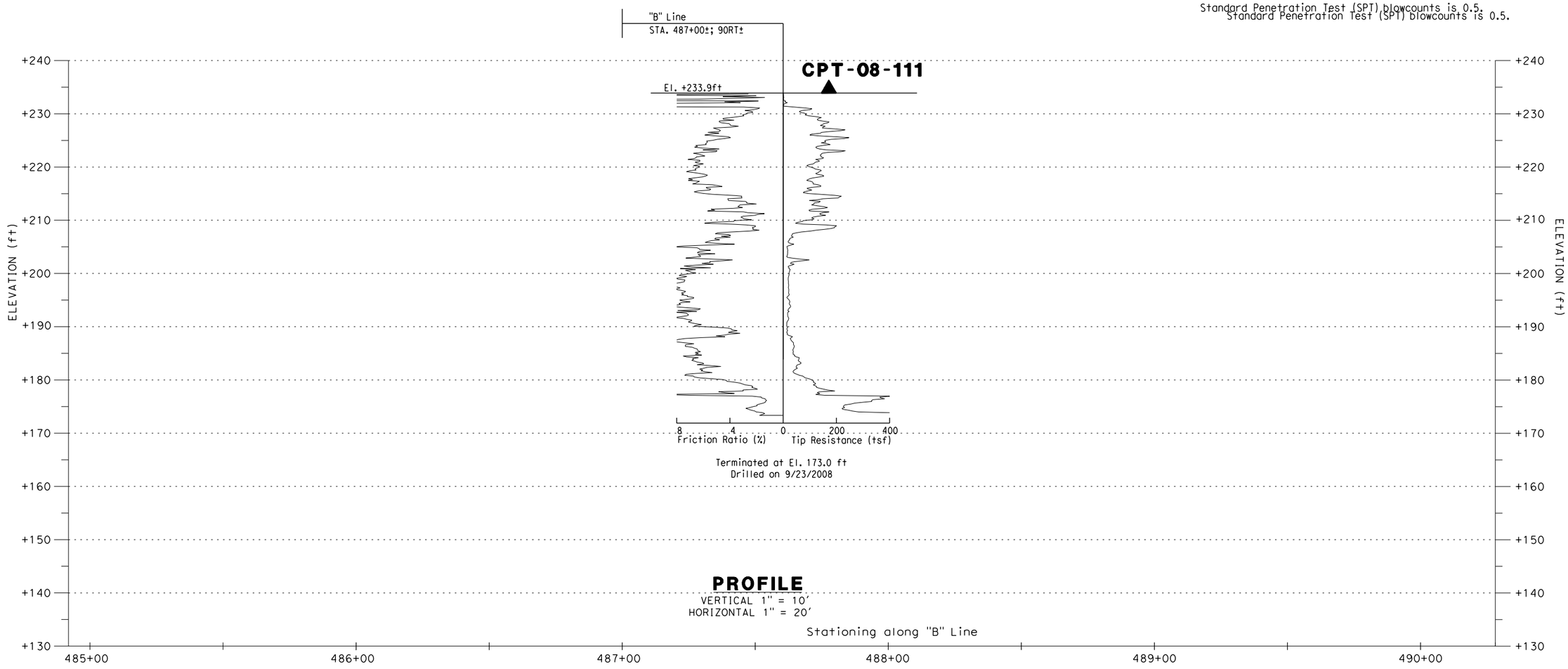

PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

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SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

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NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

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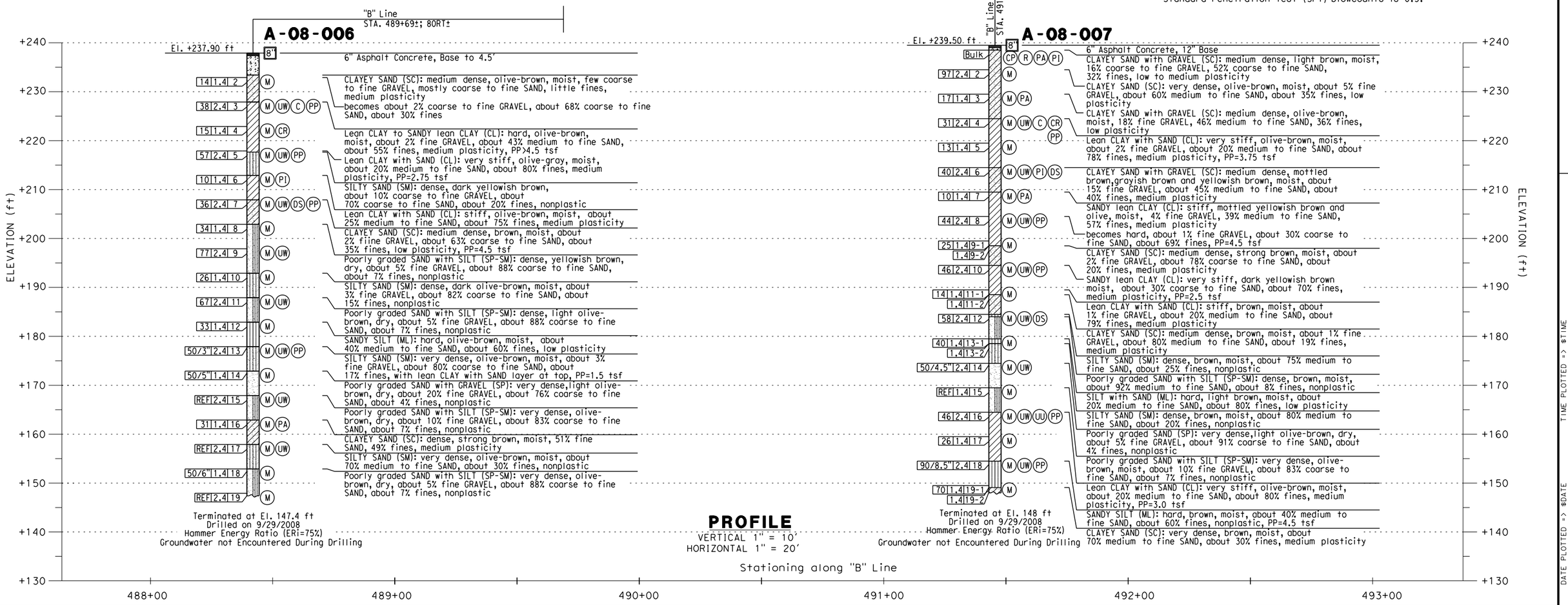
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

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SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6

RETAINING WALL NO. 486
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

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CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

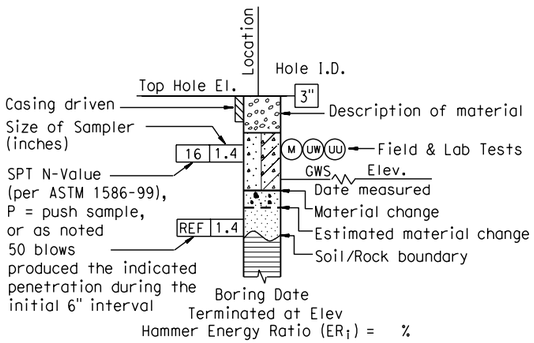
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

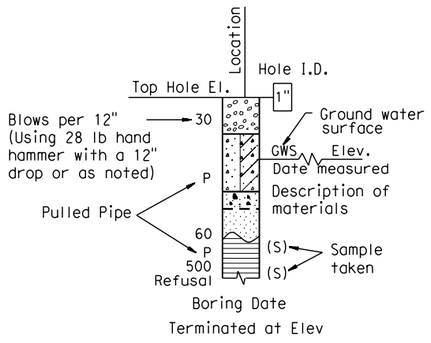
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

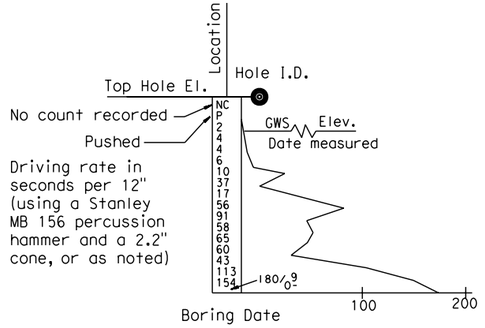
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



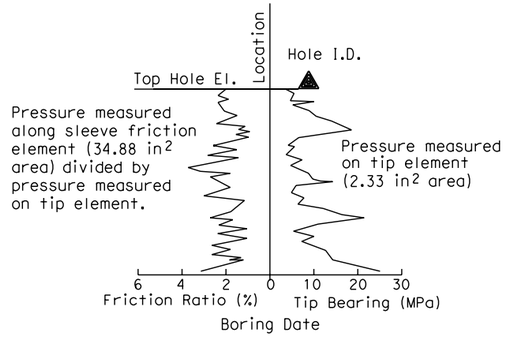
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6	RETAINING WALL NO. 486 LOG OF TEST BORINGS NO. 5
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			CU 12 EA 0F031I	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) / SHEET / OF

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FILE => $REQUEST

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.

POST MILES 16.2/18.6

RETAINING WALL NO. 486
LOG OF TEST BORINGS NO. 6

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

FILE => $REQUEST

DATE PLOTTED => $DATE TIME PLOTTED => $TIME USERNAME => $USER

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		
REGISTERED CIVIL ENGINEER			DATE		
RETAINING WALL NO. 486					
LOG OF TEST BORINGS NO. 7					
NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA		CU: 12 EA: 0F0311		BRIDGE No. X	
				Sheet	of
				X	X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/89
GEOTECHNICAL
STATE OF CALIFORNIA

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	467	491

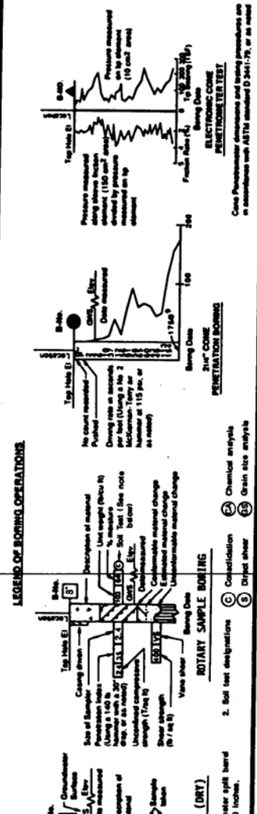
Kul Bhushan 12/20/89
GEOTECHNICAL PROFESSIONAL

10-29-90
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
KUL BHUSHAN
No. GE 000144
Exp. 12/31/1989
GEOTECHNICAL
STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351

LEGEND OF BORING OPERATIONS



LEGEND OF EARTH MATERIALS

GRAVEL, SAND, SILT, CLAY, SANDY CLAY or CLAYEY SAND, SANDY SILT or SILTY SAND, SILTY CLAY, CLAYEY SILT, PEAT (other ORGANIC MATTER), FILL MATERIAL, IGNEOUS ROCK, SEDIMENTARY ROCK, METAMORPHIC ROCK

CONSISTENCY CLASSIFICATION FOR SOILS

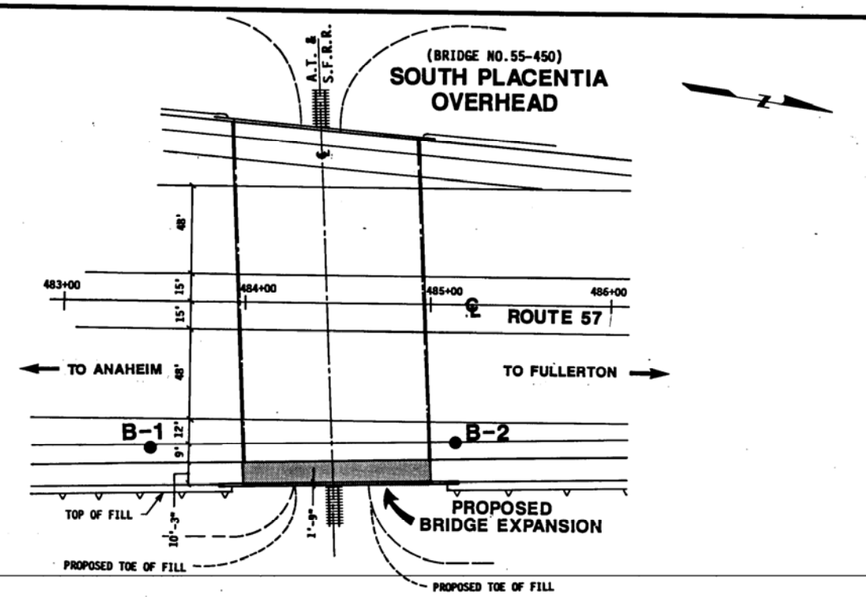
According to the Standard Penetration Test

Penetration Index (Blows / Ft)	Granular	Cohesive
0-4	Very loose	Very soft
5-9	Loose	Soft
10-19	Slightly compact	Stiff
20-34	Compact	Very stiff
35-70	Dense	Hard
>70	Very dense	Very hard

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

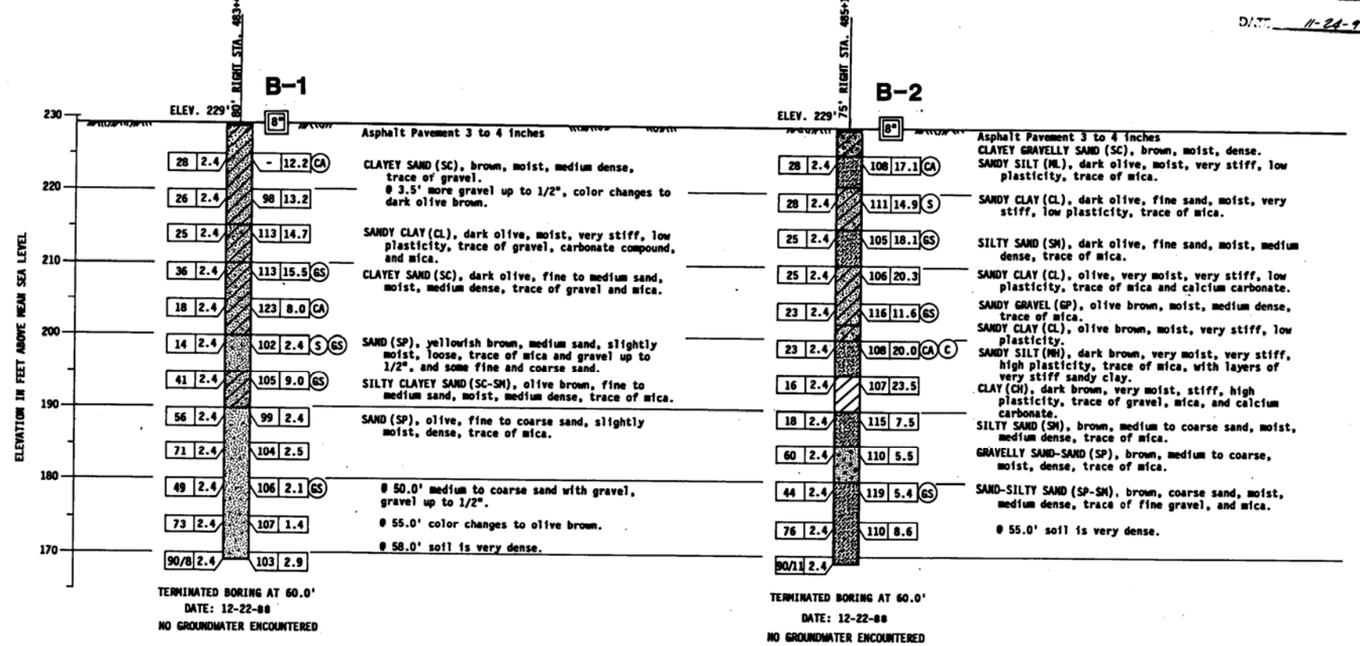
PLAN

SCALE: 1"=40'



PROFILE

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'



AS BUILT NO AS BUILT CHANGES
J. PALMEIRO
CORRECTIONS BY I. MANGLE
CONTRACT NO. 12-020184
DATE 11-24-92

BM 535-D-70 ELEVATION 257.37

FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60 AND 105 FEET NORTHERLY OF THE CENTERLINE OF NUTWOOD AVE..

DESIGN OVERSIGHT 8-22-90
SIGN OFF DATE

DRAWN BY B. BASMADJIAN
CHECKED BY H. ABDALLAH

S. MOHAMAD
FIELD INVESTIGATOR
DATE 12-28-89

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Victor Lee
PROJECT ENGINEER

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12208
EA 020180

BRIDGE NO. 55-450
POST MILE 16.7

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

SOUTH PLACENTIA OVERHEAD (WIDEN)

LOG OF TEST BORINGS

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 9 OF 10

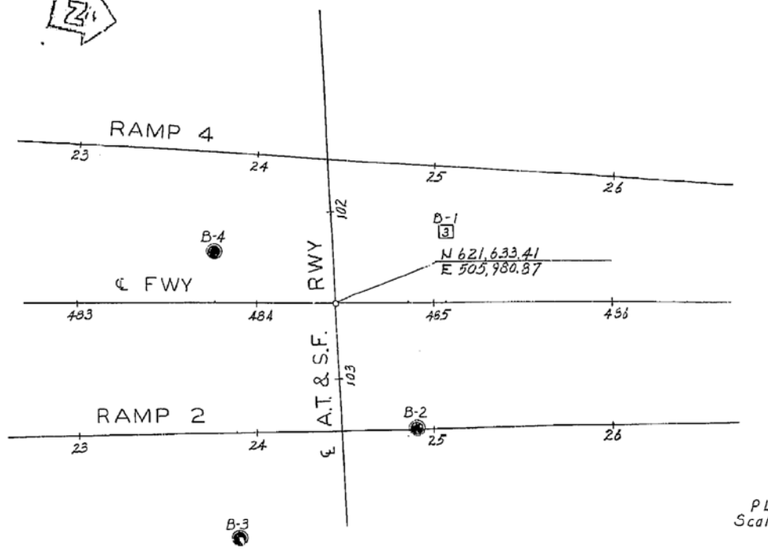
FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	16/18	122	197

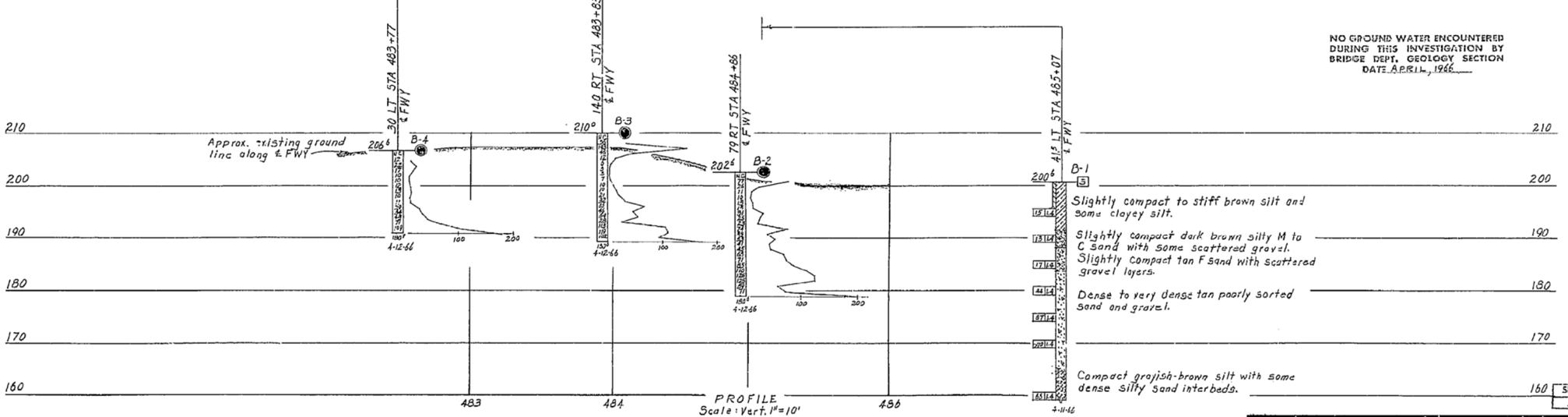
Date approved August 28, 1967

BENCH MARK

B.M. 484-65 Elev. 205.336
Set R.R. spk. in N. side of P.P.#102608 E. 135 Ft. W. of ℄ intersection Frwy. ℄ A.T. & S.F. R.R. spurline 26 Ft. S. of ℄ Tracks 15 Ft. above G/G.



PLAN
Scale: 1" = 40'



PROFILE
Scale: Vert. 1" = 10'
Horiz. 1" = 40'

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE APRIL, 1966

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER _____ DATE _____

RETAINING WALL NO. 486

LOG OF TEST BORINGS NO. 8

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 EA: 0F0311

BRIDGE No. X

Sheet X of X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

FIELD STUDY	by D.L. Crandall	4-12-66
DRAWN	by R.K. Sutch	4-22-66
CHECKED	by L.C. Cheang	4-26-66

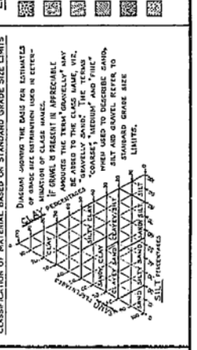
Approved: [signature] Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

LEGEND OF EARTH MATERIALS

Gravel; Sand; Silt; Clay; Silty Clay or Clayey Silt; Peat or Organic Matter; Fill Material; Igneous Rock; Sandy Clay or Clayey Sand; Sandy Silt or Silty Sand; Sedimentary Rock; Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS



NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

AS BUILT PLANS
Contract No. 07-032124
Date Completed _____
Document No. 70000668

AS BUILT
CORRECTIONS BY Hixson 7-28-69
CONTRACT NO. 07-032124
DATE 4-30-

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SOUTH PLACENTIA OVERHEAD

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-450 R/L | FILE | DRAWING 55450-13

SHEET 13 OF 18

Charge: 07206
W.A. 032121

Disregard prints bearing earlier numbers → PREL. DRAWING NO. PR- 76/67

122

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	476	491

Kul Bhushan 12/28/89
GEOTECHNICAL PROFESSIONAL
10-29-90
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — KUL BHUSHAN — No. GE 000144 — Exp. 12/31/1989 — GEOTECHNICAL — STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
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DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

RETAINING WALL NO. 486

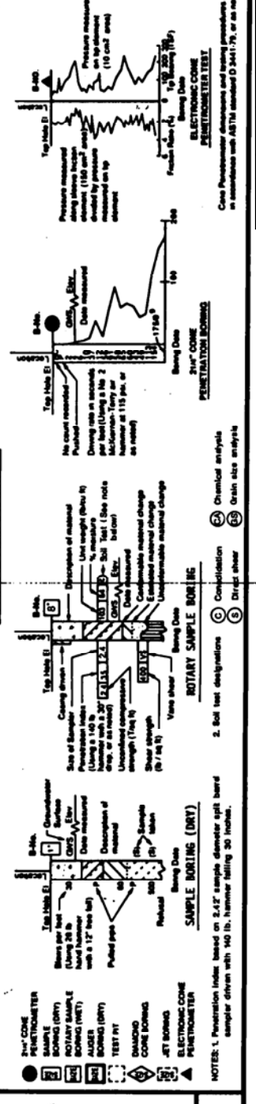
LOG OF TEST BORINGS NO. 9

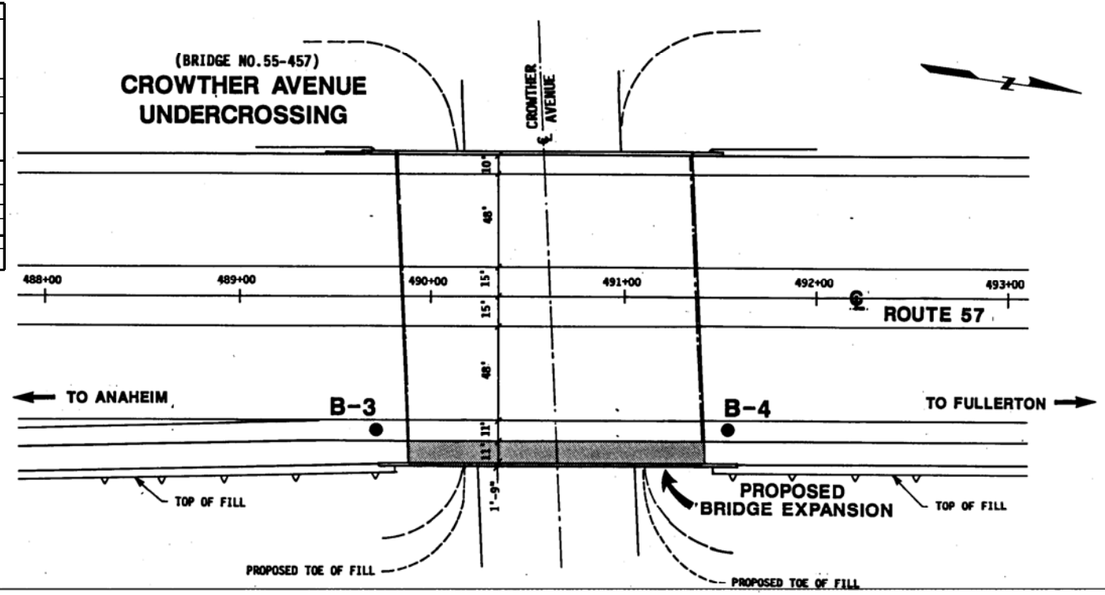
NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 - EA: 0F0311

BRIDGE No.	
X	
Sheet	of
X	X

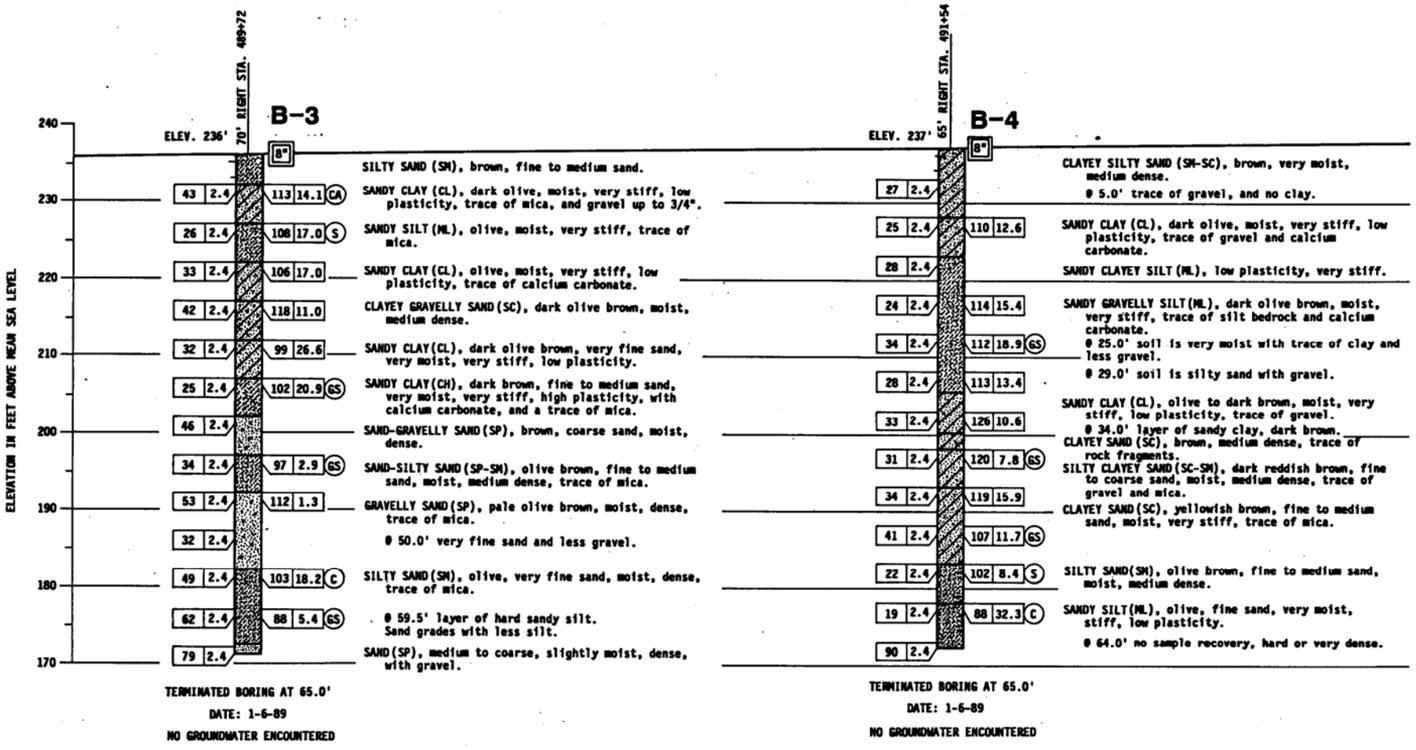
REGISTERED PROFESSIONAL ENGINEER — LIND C. CHEANG — NO. GE 2345 — EXP. 9/30/89 — GEOTECHNICAL — STATE OF CALIFORNIA





PLAN

SCALE: 1"=40'



PROFILE

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'

AS BUILT NO AS BUILT CHANGES
J. PINHEIRO
CORRECTIONS BY L. PANGLE
CONTRACT NO. 12-020184
DATE 11-24-92

BM 535-D-70 — ELEVATION 257.37

FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60 AND 105 FEET NORTHERLY OF THE CENTERLINE OF NUTWOOD AVE..

DESIGN OVERSIGHT — SIGN OFF DATE 8-22-90
DRAWN BY B. BASMADJIAN
CHECKED BY H. ABDALLAH
S. MOHAMAD — FIELD INVESTIGATOR — DATE 12-20-89
PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
PROJECT ENGINEER
BRIDGE NO. 55-457
POST MILE 16.8
CROWTHER AVE. UNDERCROSSING (WIDEN)
LOG OF TEST BORINGS
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3
CU 12208
EA 020180
DISREGARD PRINTS BEARING EARLIER REVISION DATES →
REVISION DATES (PRELIMINARY STAGE ONLY)
SHEET 8 OF 9

DIST	COUNTY	ROUTE	POST MILES – TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	11.1/21.2	477	491

N 622 234.795
E 502,840.365

BENCH MARK

BM 491L-68 Elev. 206.51

Set Rd. + N. Side Crowther Ave. @ B.C.R. to be given E. of Placentia Ave. 292' W of E. Fwy. 32' N. of E. Crowther Ave.

B-4 B-1 B-3 B-5 B-2

C FWY. RTE. 57

489 490 492 493

39

C CROWTHER AVE.

40

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

RETAINING WALL NO. 486

LOG OF TEST BORINGS NO. 10

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No. X

Sheet X of X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

AS - BUILT PLAN — FOR INFORMATION ONLY

Kul Bhushan
GEOTECHNICAL PROFESSIONAL
DATE APPROVED 10-29-90

CROWTHER AVENUE UC (WIDEN)

LOG OF TEST BORINGS

~~CU: 12208~~ EA: 020181 BRIDGE No. 55 - 457

REGISTERED PROFESSIONAL ENGINEER
KUL BHUSHAN
NO. GE 693144
Exp. 12-31-93
GEOTECHNICAL
STATE OF CALIFORNIA

PLAN
Scale: 1" = 20'

AS BUILT

CORRECTIONS BY _____

CONTRACT NO. _____

D/T _____

AS BUILT PLANS
Contract No. 07-052124
Date Completed _____
Document No. 70000668

AS BUILT NO AS BUILT CHANGES
CONTRACT NUMBER 12- 020184
RESIDENT ENGINEER J. PALMEIRO & T. PAMBLE
COMPLETION DATE 11-24-92

PROFILE
Scale: Vert. 1" = 10'
Horiz. 1" = 20'

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION DATE NOV & DEC 1965

B-4 B-5 B-3 B-1 B-2

Upper existing ground line along ℄ Fwy. RTE. 57

07'LT. Sta. 489+87 ℄ Fwy. RTE. 57 20.0ft. Rt. Sta. 489+95 ℄ Fwy. RTE. 57

On ℄ Sta. 491+03 ℄ Fwy. RTE. 57

48'Lt. Sta. 491+28 ℄ Fwy. RTE. 57

69'Rt. Sta. 491+35 ℄ Fwy. RTE. 57

210 200 190 180

209.4 209.2 208.8 207.1 207.1

11-11-65 12-6-65 11-12-65 11-11-65

Loose, brown, silty, very fine to medium sand.
Loose, buff, gravelly, very fine to very coarse sand
Compact to dense, buff, gravelly, very fine to very coarse sand.
Dense, tan, silty, very fine to fine sand with occasional thin gravel layers.

489 490 491 492

LEGEND OF EARTH MATERIALS

Gravel; Sand; Silt; Clay; Sandy Clay on Clayey Base; Sandy Silt on Silty Base; Silty Clay on Clayey Base; Peat, Muck, Organic Matter; Fill Material; Igneous Rock; Sedimentary Rock; Metamorphic Rock

Penetrometer; 2½" Core Penetrometer; Sonotube Borings (Cast); Rotary Borings (Cast); Auger Borings (Cast); Jet Borings; Core Borings; Test Pit

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

CROWTHER AVENUE
UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-457 | INL | DRAWING 55457-12

Charge: 07205
W.A.: 032121

Disregard prints bearing earlier revisions

PREL. DRAWING NO. PR- 79

SHEET 9 OF 9

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

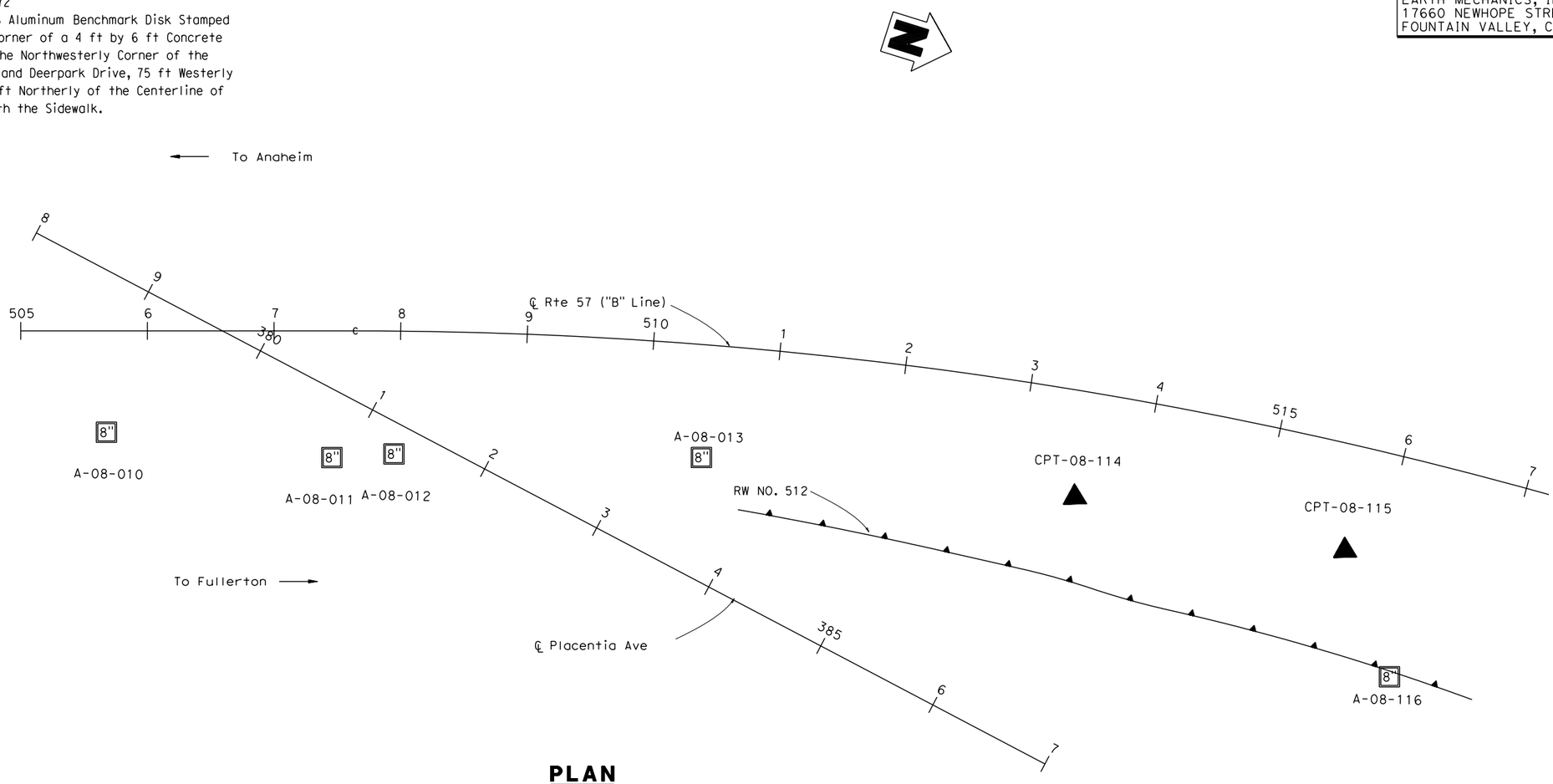
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN
1" = 50'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO.
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6

RETAINING WALL NO. 512
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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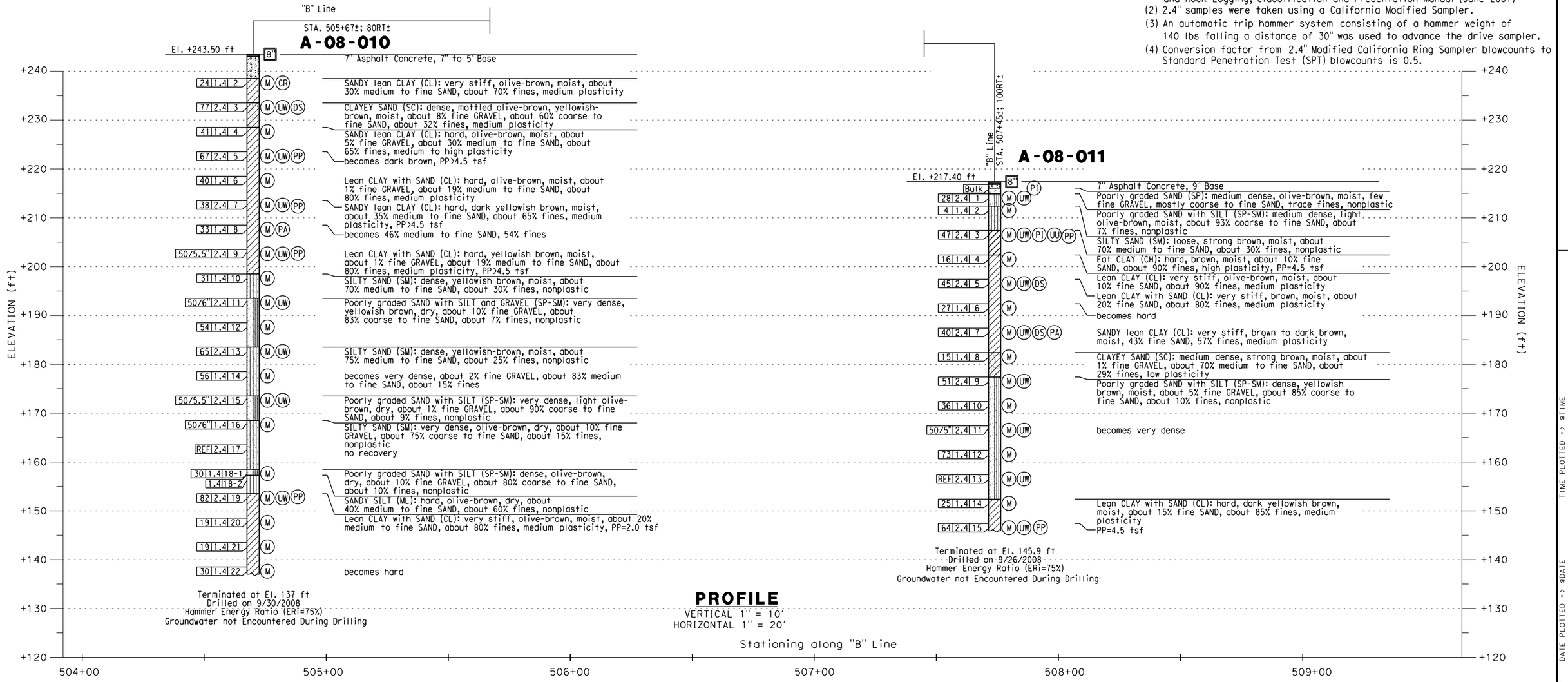
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 512, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO.
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6

RETAINING WALL NO. 512
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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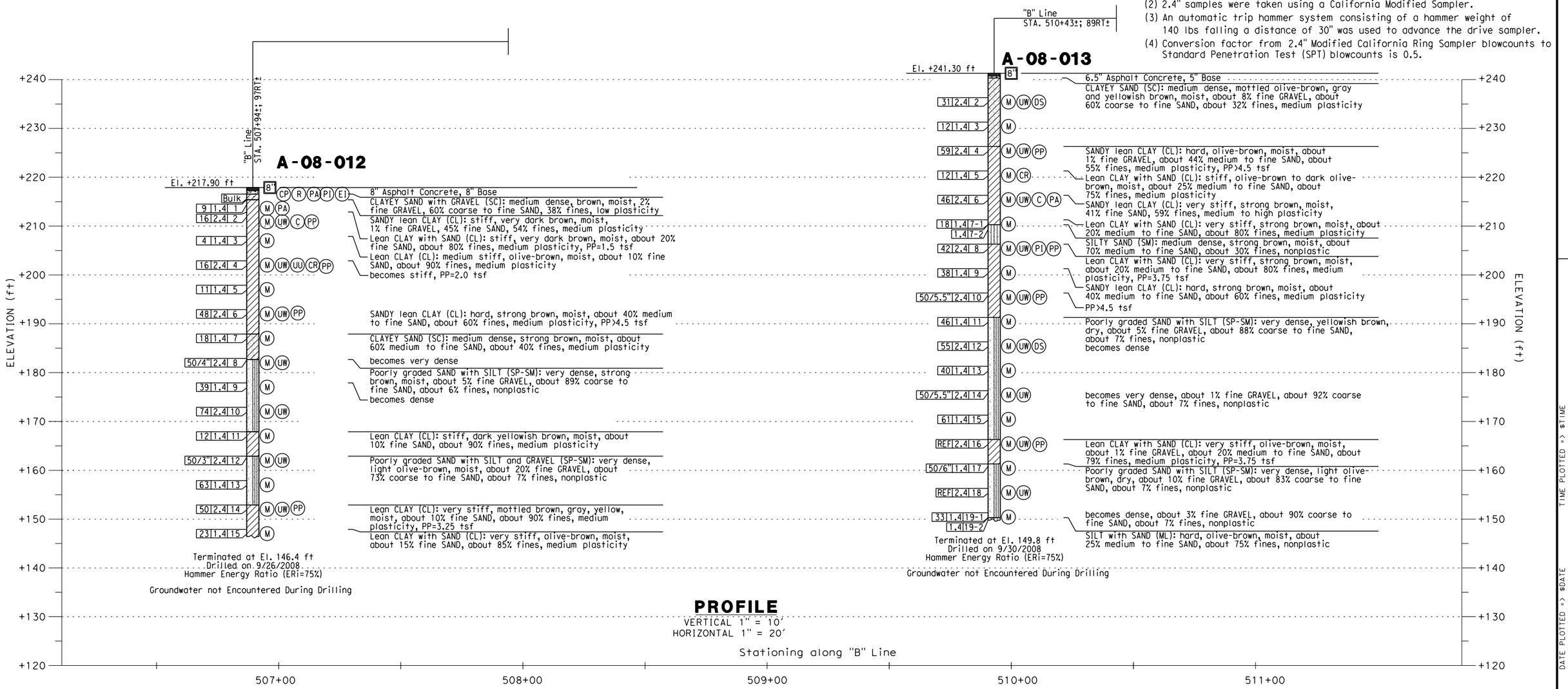
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 512, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO.
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6

RETAINING WALL NO. 512
LOG OF TEST BORINGS NO. 3

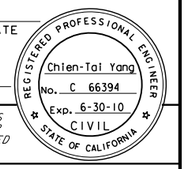
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3
CU 12
EA 0F0311
DISREGARD PRINTS BEARING EARLIER REVISION DATES →
REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09
SHEET OF

FILE => $REQUEST
USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE



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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 512, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

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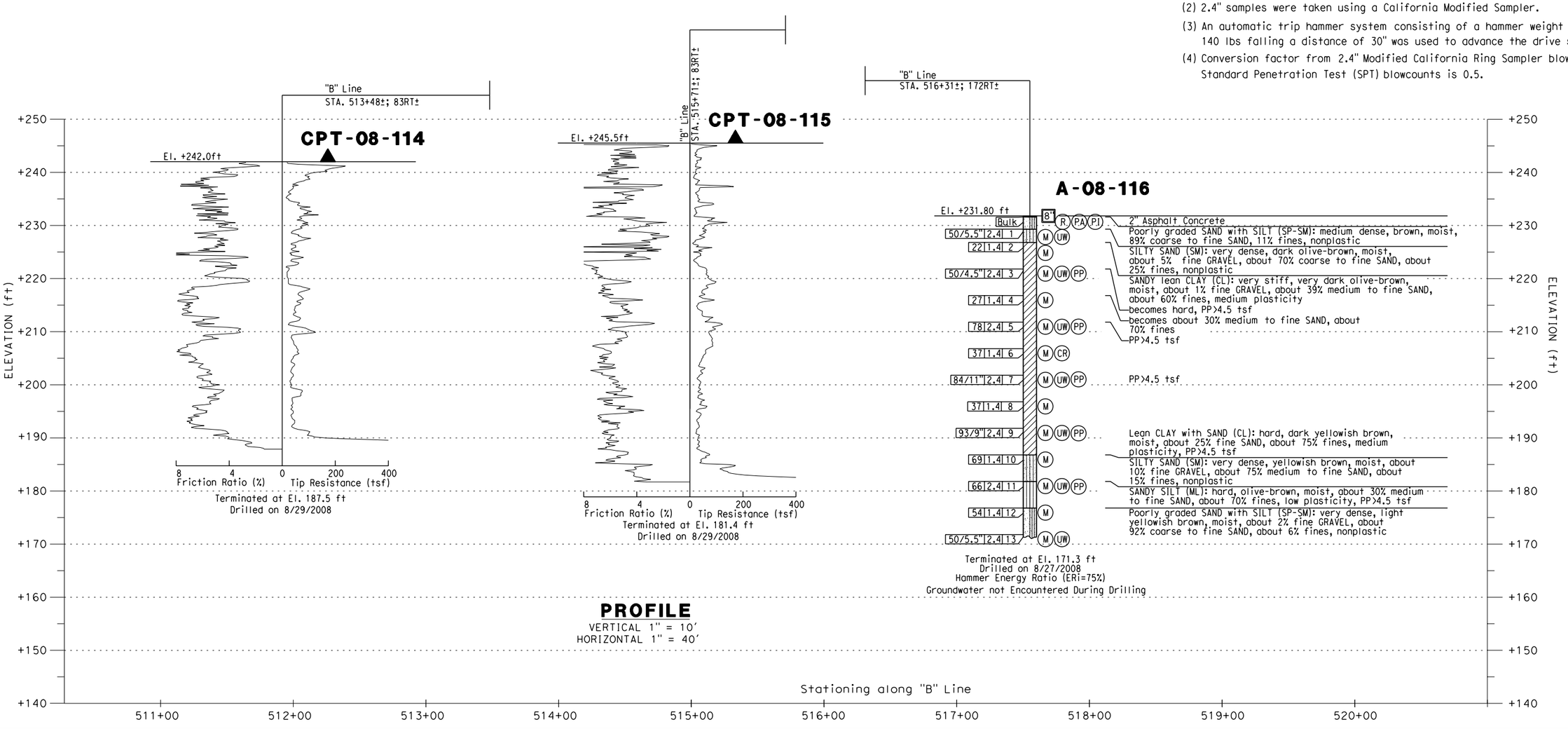
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO.
SIGN OFF DATE	CHECKED BY: L. Cheang				POST MILES 16.2/18.6

RETAINING WALL NO. 512
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)										SHEET	OF
4/30/09										X	X

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
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ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

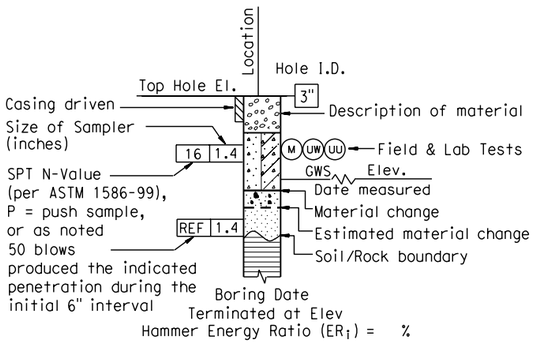
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

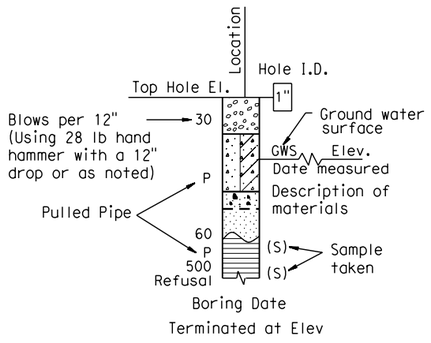
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

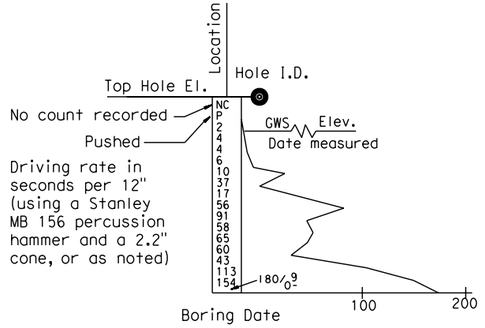
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



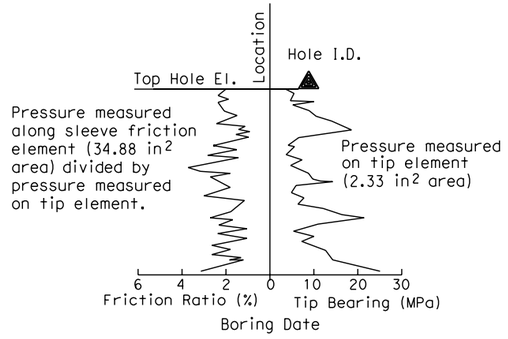
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6	RETAINING WALL NO. 512 LOG OF TEST BORINGS NO. 5	
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3		CU 12 EA 0F031I	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY)		SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FILE => $REQUEST

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.

POST MILES 16.2/18.6

RETAINING WALL NO. 512
LOG OF TEST BORINGS NO. 6

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

FILE => $REQUEST

DATE PLOTTED => $DATE TIME PLOTTED => $TIME USERNAME => $USER

FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET No.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET No.	TOTAL SHEETS
07	ORA	57	15.6/18.6	173	197

Chief, Bridge Department — Chief, Engineering Geology Section

Date Approved August 28, 1967

BENCH MARK

B.M. "505R-65" Elev. 202.22
Set bolt spk. in E. side of P.P. "961367" 203 ft. E. of ℄ Sta. 379+25 Placentia & 150 ft. S. of ℄ Santa Fe Ave. 1' above o/g

B-5 B-6 B-1 B-2 B-3 B-4 B-7

℄ CONST. RTE 57

℄ EXISTING

N 623,791.956
E 505,476.569

503 504 505 506 507 508 509 510

379 380 381

PLACENTIA AVE.

PLAN
Scale 1" = 30'

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		
REGISTERED CIVIL ENGINEER			DATE		
RETAINING WALL NO. 512					
LOG OF TEST BORINGS NO. 7					
NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA	CU: 12 EA: 0F0311	BRIDGE No. X			
		Sheet X	of X		

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE April 1966

AS BUILT
CORRECTIONS BY Hixson dated 7-29-69
CONTRACT NO. 07-032124
DATE 5-11-69

B-1: 46' Lt. Sta. 503+68 ℄ Const. Rte. 57; 214±'
B-2: 35' Lt. Sta. 504+15 ℄ Const. Rte. 57; 214±'
B-7: 106' Rt. Sta. 505+00 ℄ Const. Rte. 57; 217±'
B-6: 47' Lt. Sta. 506+06 ℄ Const. Rte. 57; 213±'
B-5: 70' Lt. Sta. 507+35 ℄ Const. Rte. 57; 214±'
B-4: 60' Rt. Sta. 507+35 ℄ Const. Rte. 57; 215±'
B-3: 10' Rt. Sta. 508+20 ℄ Const. Rte. 57; 215±'

Compact, light brown interbedded sandy silt and silty very fine to medium sand

Dense, yellow-brown to buff, micaceous, very fine to medium sand

Very dense, buff, gravelly, very fine to very coarse sand.

Approx. existing ground line along ℄ Const. Rte 57

Loose to slightly compact brown silt, sandy silt and silty fine sand

Slightly compact dark brown sandy silt with some clay binder

Compact buff silty very fine to fine sand

Very dense buff gravelly poorly sorted sand

Compact brown sandy silt

PROFILE
Scale Vert. 1" = 10'
Horiz. 1" = 30'

SHEET	OF
26	26

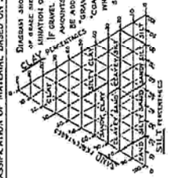
LEGEND OF EXPLORATIONS

- Penetrometer
- 2½" Core Penetrometer
- Sampler Boring (Dry)
- Rotary Boring (Wet)
- Auger Boring (Dry)
- Jet Boring
- Core Boring
- Test Pit

LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Silty Clay or Clayey Silt
- Peat and/or Organic Matter
- Fill Material
- Igneous Rock
- Sandy Clay or Clayey Sand
- Sandy Silt or Silty Sand
- Sedimentary Rock
- Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS



NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY	by D. CRAWFORD 4-4-66
DRAWN	by M. ALLREAD 4-20-66
CHECKED	by W. SAINT 5-10-66

Approved Recommended by Chief, Engineering Geology Section

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PLACENTIA AVENUE UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted	BRIDGE 55-460	FILE	DRAWING 55460-2

PREL. DRAWING No. PR-

Charge 07208
W.A. 032101

Disregard prints bearing earlier numbers

173

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

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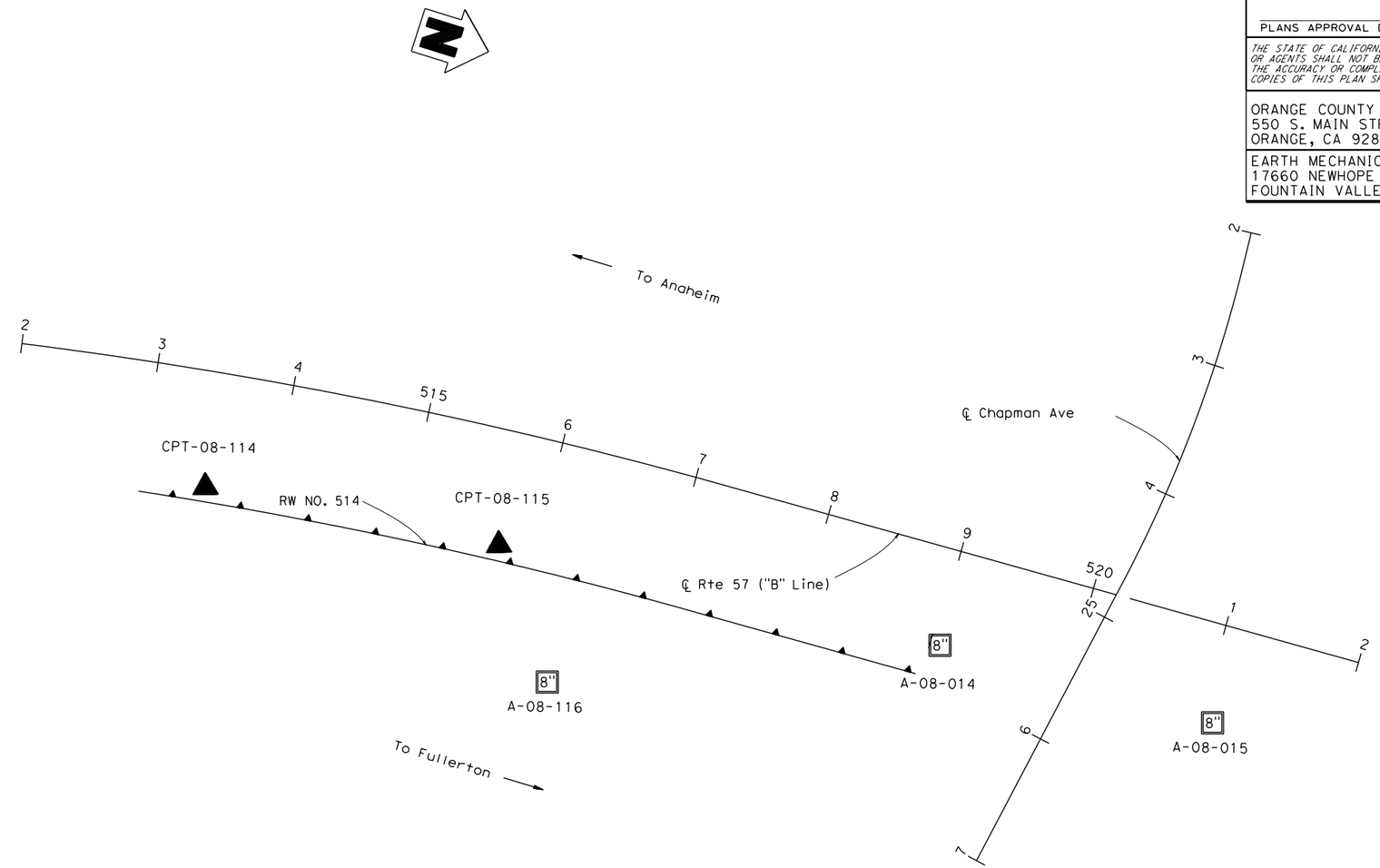
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN

1" = 50'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO.
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6

RETAINING WALL NO. 514
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

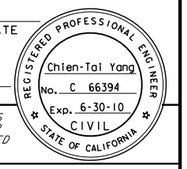
FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE



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ORANGE COUNTY TRANSPORTATION AUTHORITY
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ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 514, LOG OF TEST BORINGS NO. 1"

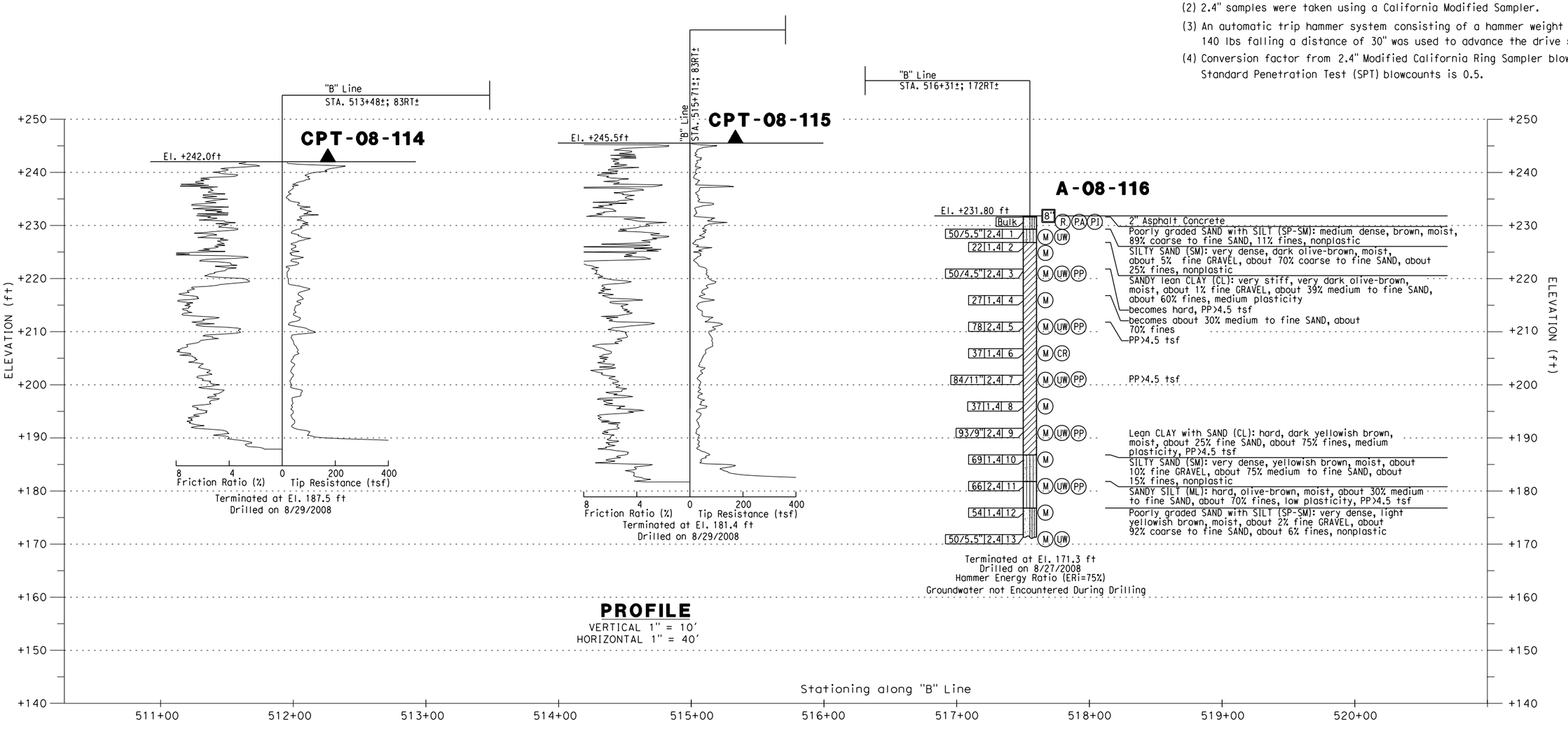
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO.
SIGN OFF DATE	CHECKED BY: L. Cheang				POST MILES 16.2/18.6

RETAINING WALL NO. 514
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET X OF X

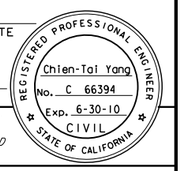
FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE



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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 514, LOG OF TEST BORINGS NO. 1"

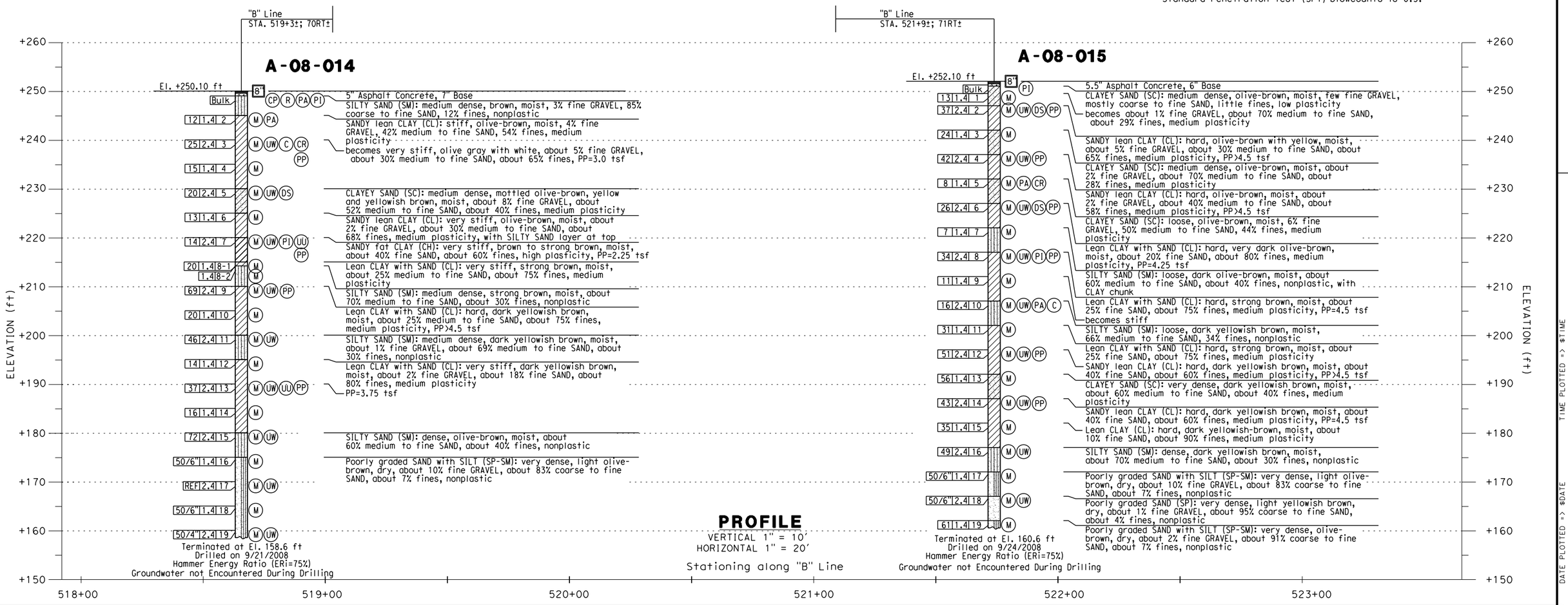
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.

POST MILES
16.2/18.6

RETAINING WALL NO. 514
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

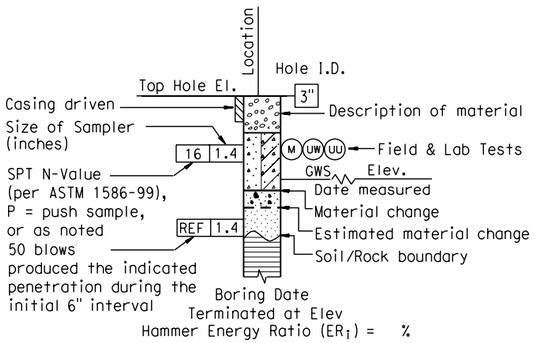
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

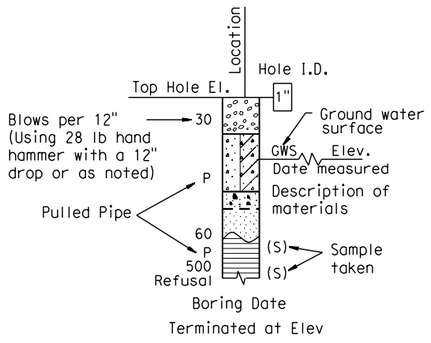
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

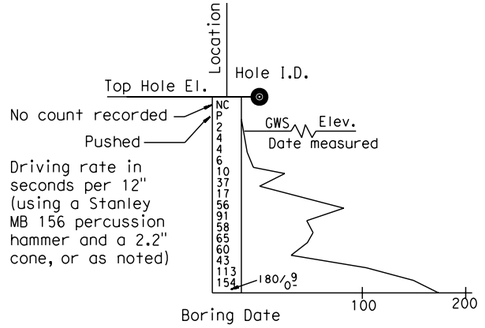
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



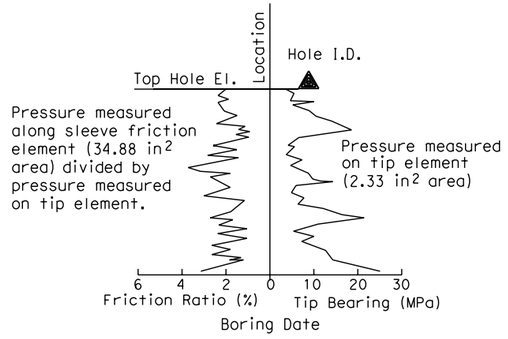
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6	RETAINING WALL NO. 514 LOG OF TEST BORINGS NO. 4
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			CU 12 EA 0F031I	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) / SHEET / OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.

POST MILES 16.2/18.6

RETAINING WALL NO. 514
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	Ora	57	15.6/21.8	185	197

Date Approved August 28, 1967

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		
REGISTERED CIVIL ENGINEER			DATE		

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

RETAINING WALL NO. 514

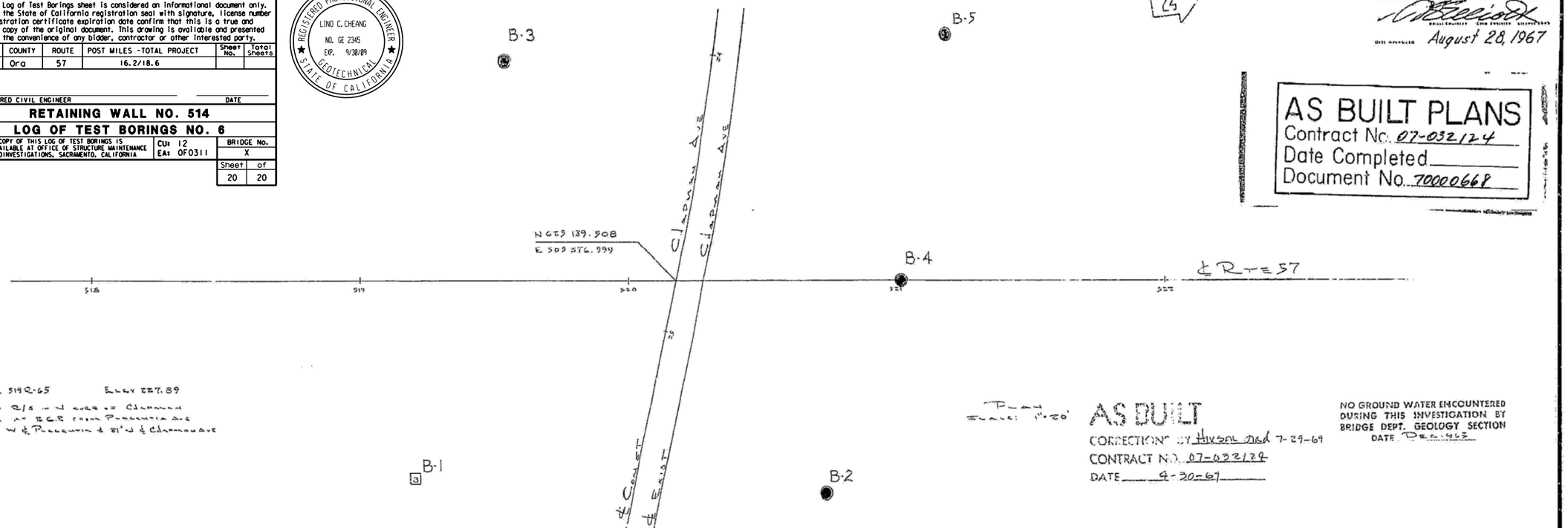
LOG OF TEST BORINGS NO. 6

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No. X

Sheet 20 of 20



LEGEND OF EARTH MATERIALS

Gravel	Silty Clay or Clayey Silt	Penetrometer	Sampler Boring (Dry)	Auger Boring (Dry)	Jet Boring
Sand	Peat and Organic Matter	2½" Cone Penetrometer	Rotary Boring (Wet)	Core Boring	Test Pit
Silt	Fill Material				
Clay	Igneous Rock				
Sandy Clay or Clayey Sand	Sedimentary Rock				
Sandy Silt or Silty Sand	Metamorphic Rock				

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRAIN SIZE LIMITS

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY	H. W. C. Sun, Inc.
DRAWN	H. W. C. Sun, Inc.
CHECKED	Approved Recommended for ... Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

185

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SHEET 12 OF 12

CHAPMAN AVENUE UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-456 | FILE | DRAWING 55456-12

Clancy 07208
W.O. 032121

Disregard prints bearing earlier numbers →

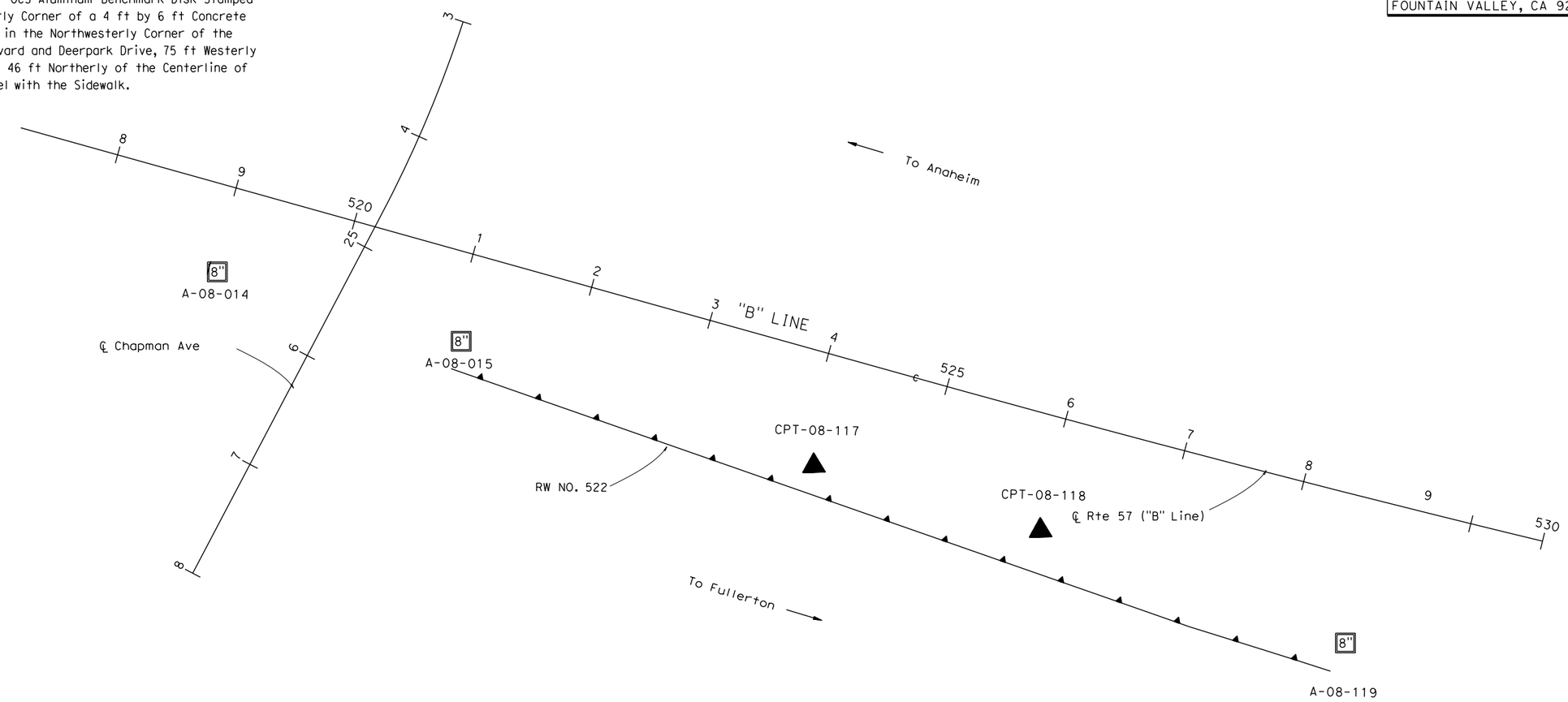
PREL. DRAWING NO. PR- 5/67

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Chien-Tai Yang
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J.Fang
CHECKED BY: L.Cheang

FIELD INVESTIGATION BY:
R.Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C.Yang
PROJECT ENGINEER

BRIDGE NO.
POST MILES 16.2/18.6

RETAINING WALL NO. 522
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

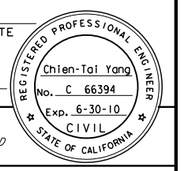
FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE



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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 522, LOG OF TEST BORINGS NO. 1"

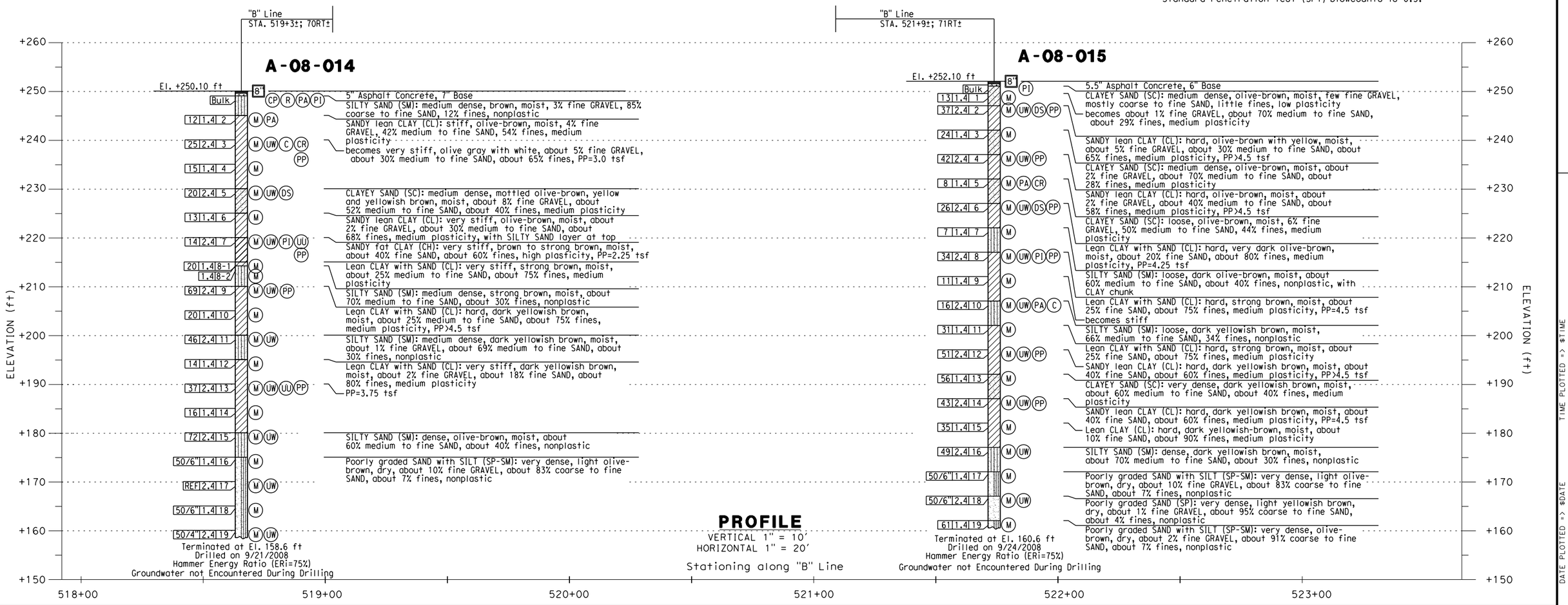
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.

POST MILES
16.2/18.6

RETAINING WALL NO. 522
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

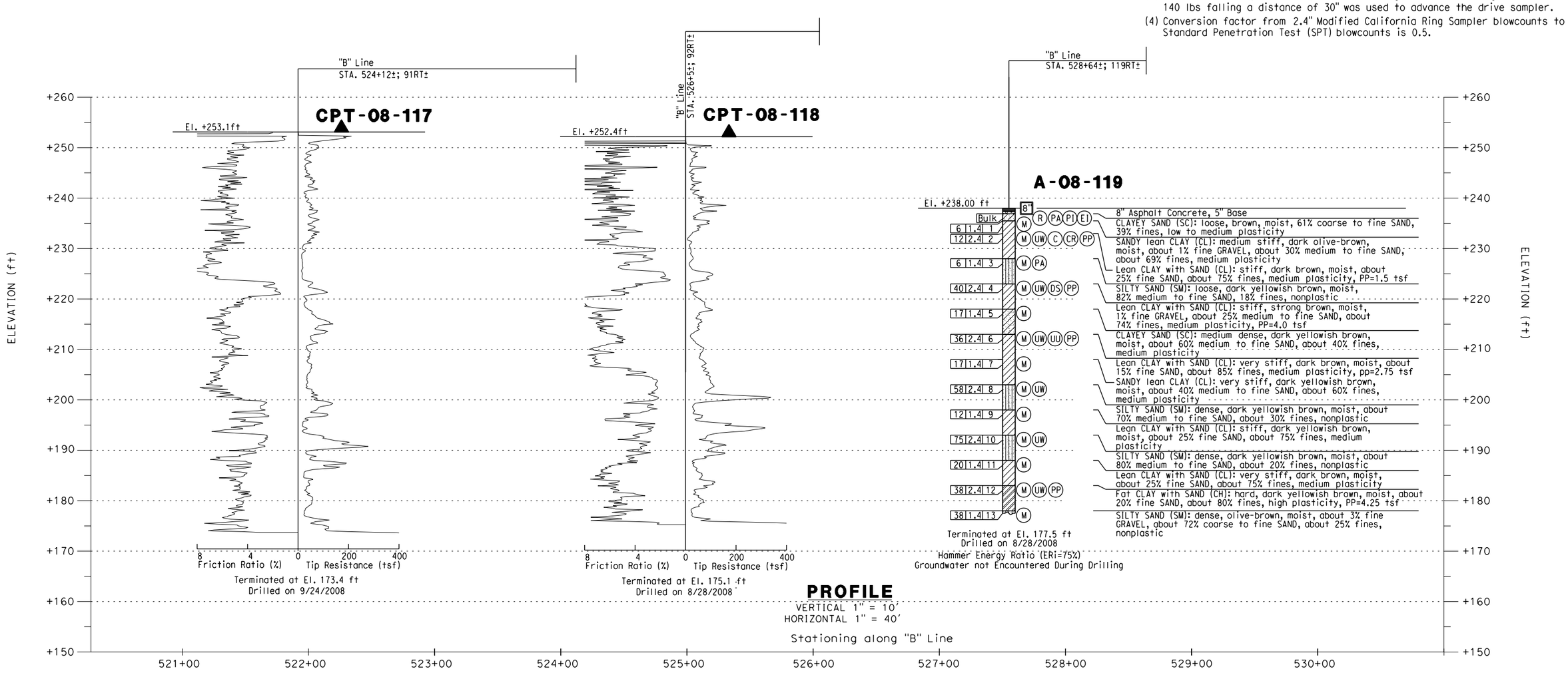
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 522, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J.Fang CHECKED BY: L.Cheang	FIELD INVESTIGATION BY: R.Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C.Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6

RETAINING WALL NO. 522
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)	SHEET	OF
4/30/09	X	X

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

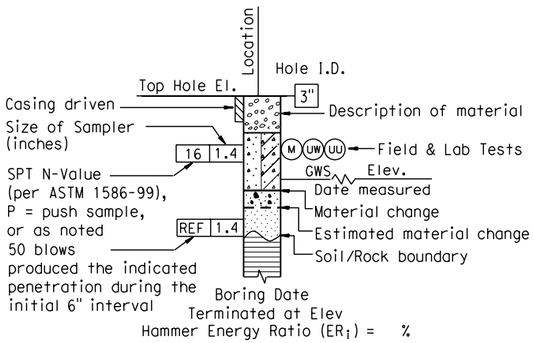
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

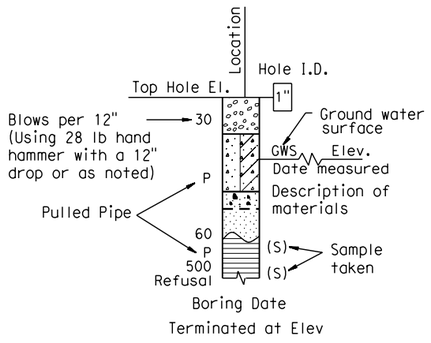
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

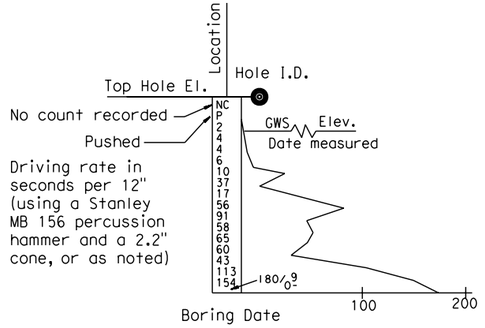
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



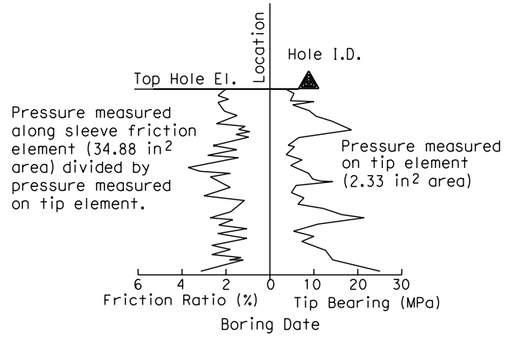
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6	RETAINING WALL NO. 522 LOG OF TEST BORINGS NO. 4
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			CU 12 EA 0F031I	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) / SHEET / OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FILE => $REQUEST

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166); Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Chien-Tai Yang
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang, No. C 66394, Exp. 6-30-10, CIVIL, STATE OF CALIFORNIA

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.
POST MILES 16.2/18.6

RETAINING WALL NO. 522
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	Ora	57	15.6/21.8	185	197

Date Approved August 28, 1967

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

RETAINING WALL NO. 522

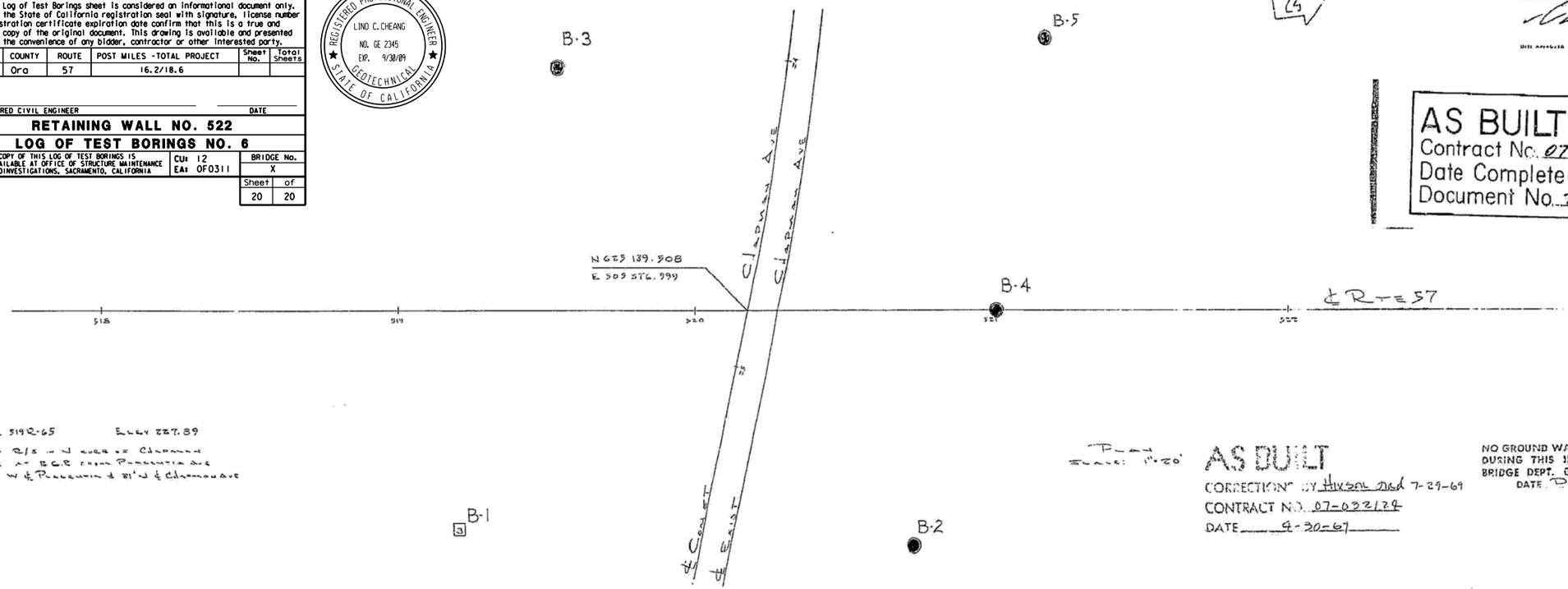
LOG OF TEST BORINGS NO. 6

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No. X

Sheet 20 of 20



LEGEND OF EARTH MATERIALS

Gravel; Sand; Silt; Clay; Silty Clay or Clayey Silt; Peat and Organic Matter; Fill Material; Igneous Rock; Sandy Clay or Clayey Sand; Sedimentary Rock; Sandy Silt or Silty Sand; Metamorphic Rock

Penetrometer; 2½" Cone Penetrometer; Sampler Boring (Dry); Rotary Boring (Wet); Auger Boring (Dry); Jet Boring; Core Boring; Test Pit

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRAIN SIZE LIMITS

Diagram showing the case for estimates of percentages of constituents to determination of class names.

If gravel is present in appreciable amounts the term "gravelly" may precede the terms "clay," "silt," "sand" or "gravelly sand." The terms "coarse," "medium" and "fine" when used to describe sand, silt and gravel refer to standard grain size limits.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY	H. W. C. Chan, Inc.
DRAWN	By: T. Stanley
CHECKED	By: A. Godfrey, Jr.

Approved Recommended for ... Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

185

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SHEET 12 OF 12

CHAPMAN AVENUE UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-456 | FILE | DRAWING 55456-12

Clance 07208
W.O. 032121

Disregard prints bearing earlier numbers →

PREL. DRAWING NO. PR- 5/67

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

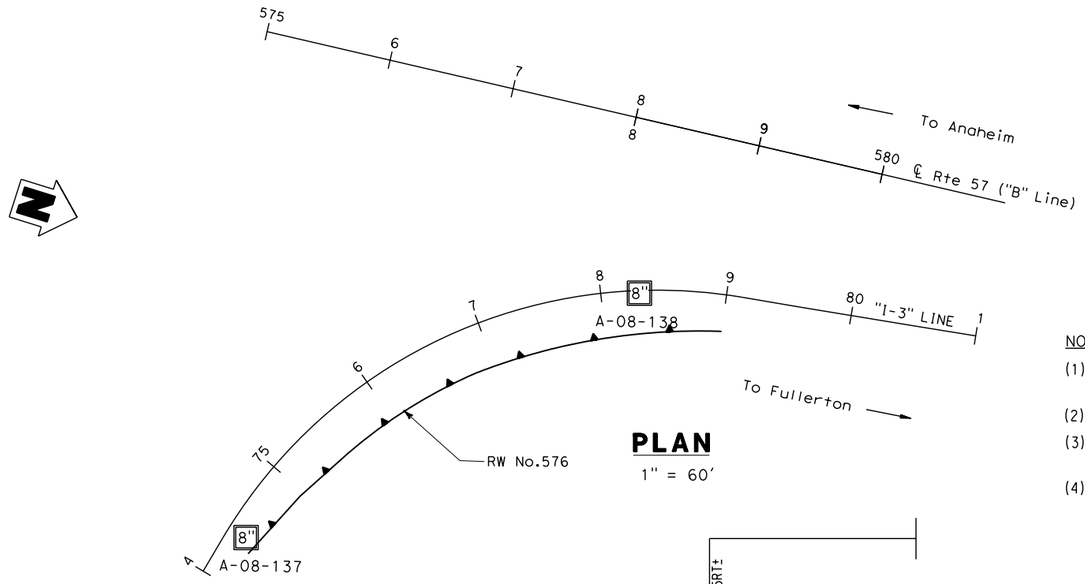
EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 60'

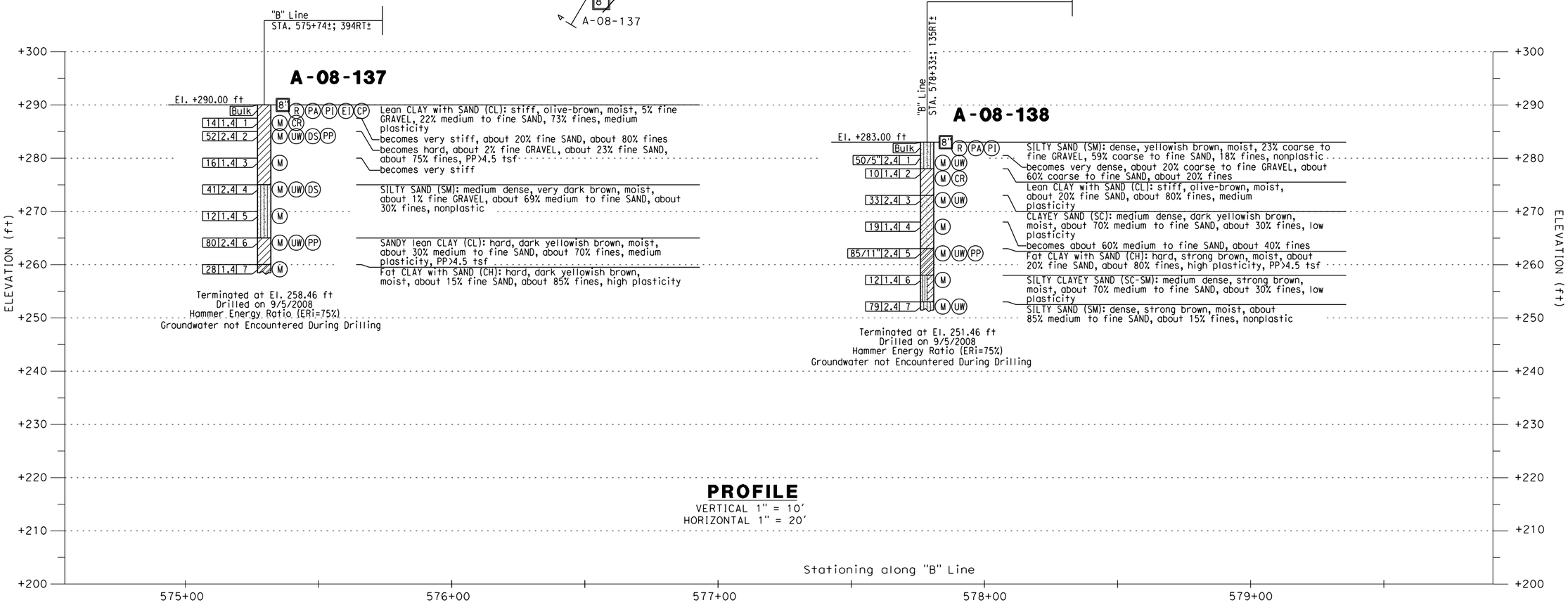
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO.
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6

RETAINING WALL NO. 576
LOG OF TEST BORINGS No. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)											SHEET	OF
4/30/09											X	X

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

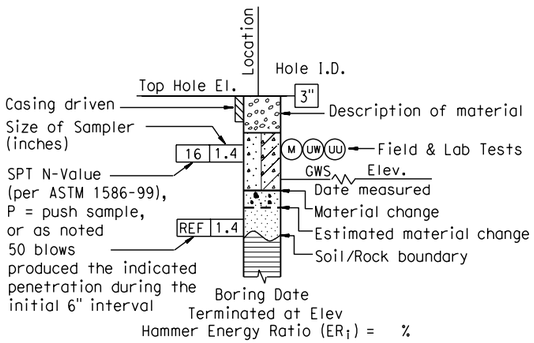
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

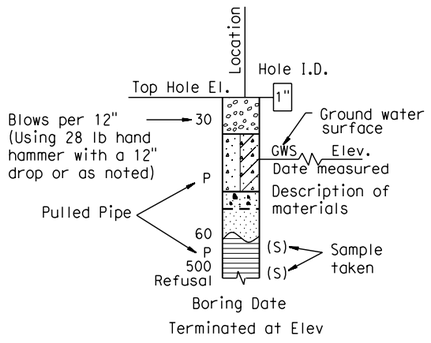
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

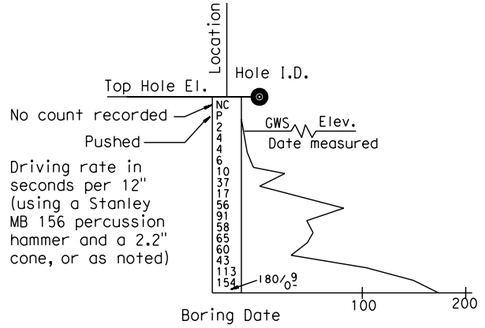
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



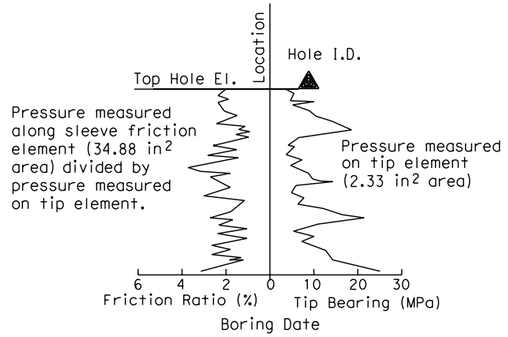
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6	RETAINING WALL NO. 576 LOG OF TEST BORINGS NO. 2
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			CU 12 EA 0F031I	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) / SHEET / OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FILE => $REQUEST

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.

POST MILES 16.2/18.6

RETAINING WALL NO. 576
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

FILE => $REQUEST

DATE PLOTTED => $DATE TIME PLOTTED => $TIME USERNAME => $USER

APPENDIX A2

EXPLORATORY BORING LOGS FOR SOUND WALLS ON RETAINING WALLS

RW 462, RW 466, RW 474, RW 492, RW 526, RW 536, and RW 538

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

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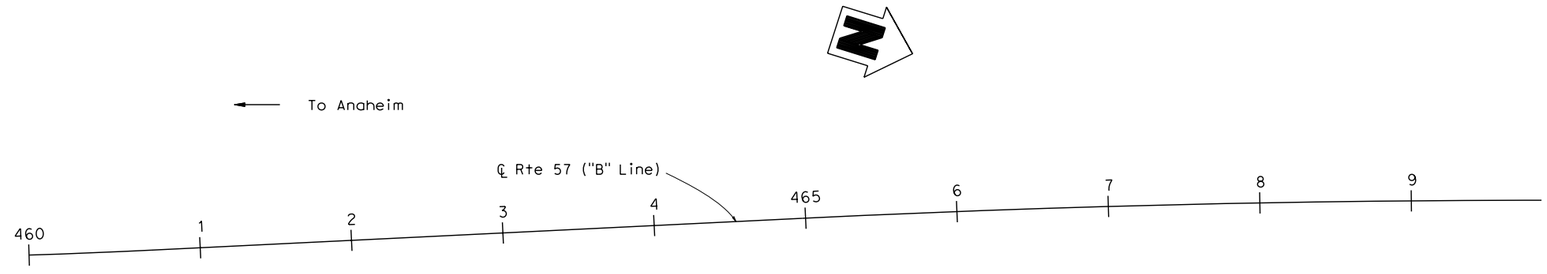

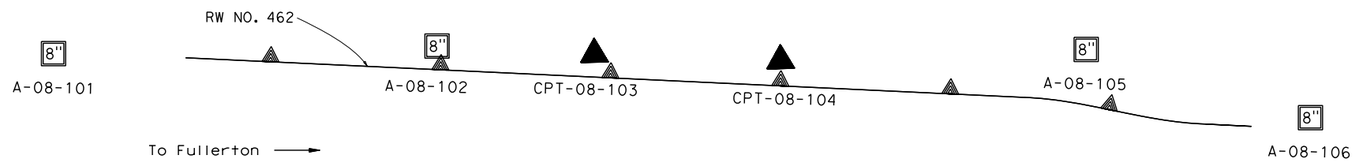

PLAN

1" = 50'

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0078
POST MILES 16.2/18.6

RETAINING WALL NO. 462
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

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Chien-Tai Yang NO. C 66394 EXP. 6-30-10 REGISTERED PROFESSIONAL ENGINEER GEOTECHNICAL STATE OF CALIFORNIA

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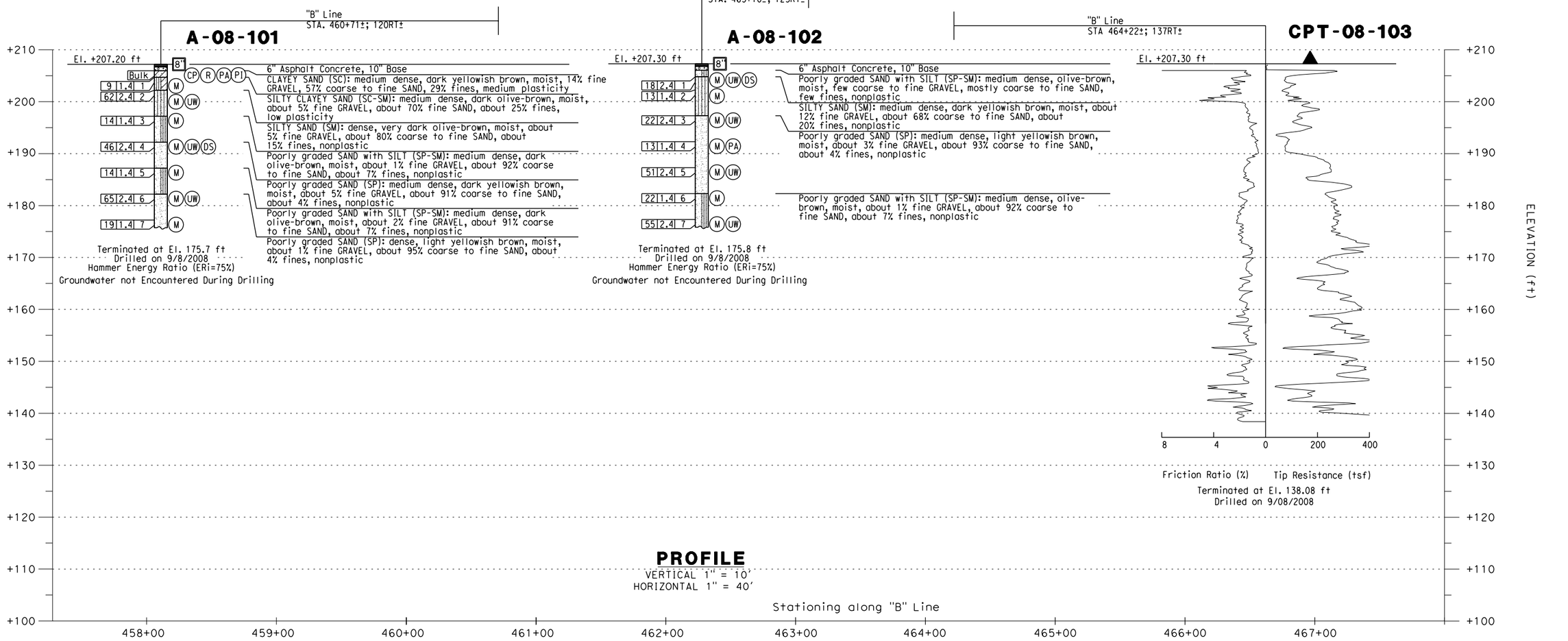
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 462, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO. 55E0078	RETAINING WALL NO. 462	
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 2	
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			CU 12 EA 0F0311	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09	SHEET X OF X

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

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FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 462, LOG OF TEST BORINGS NO. 1"

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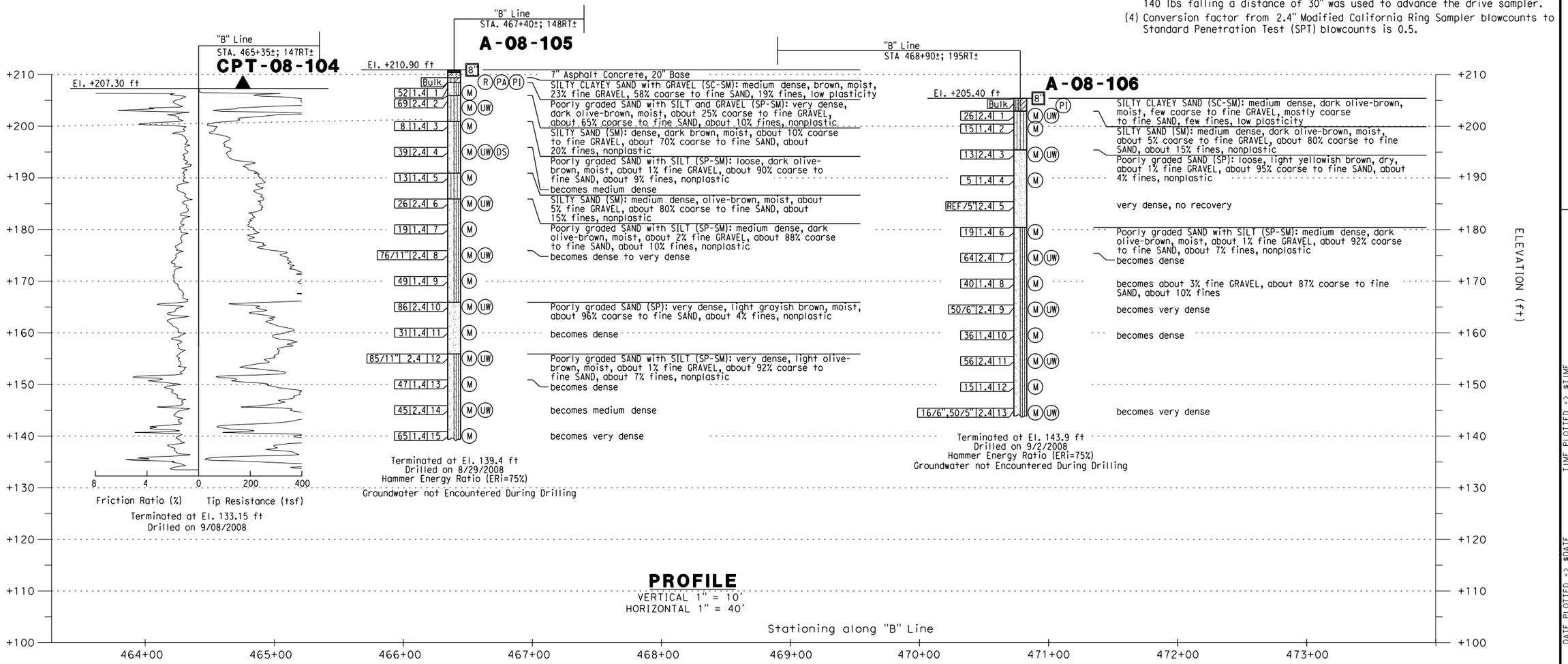
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0078	RETAINING WALL NO. 462
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 39 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

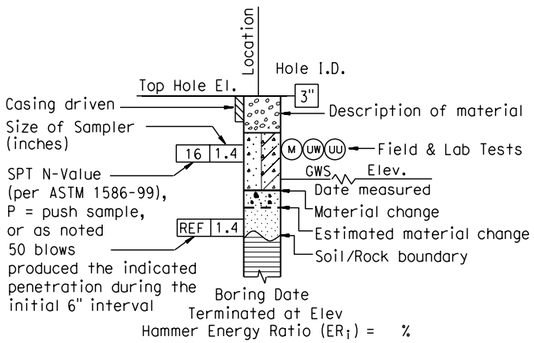
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

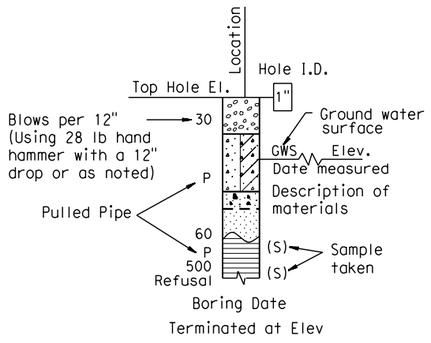
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

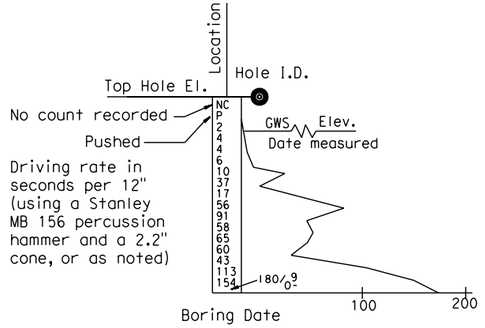
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



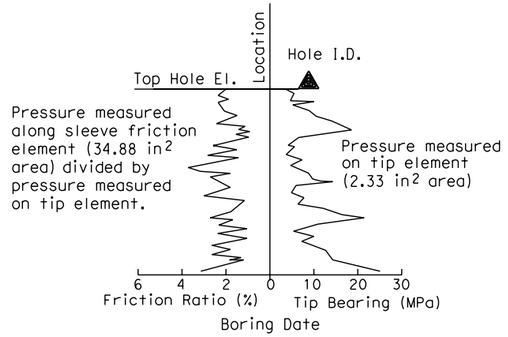
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0078 POST MILES 16.2/18.6

RETAINING WALL NO. 462
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166); Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0078
POST MILES 16.2/18.6

RETAINING WALL NO. 462
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

FILE => $REQUEST

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Chien-Tai Yang
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

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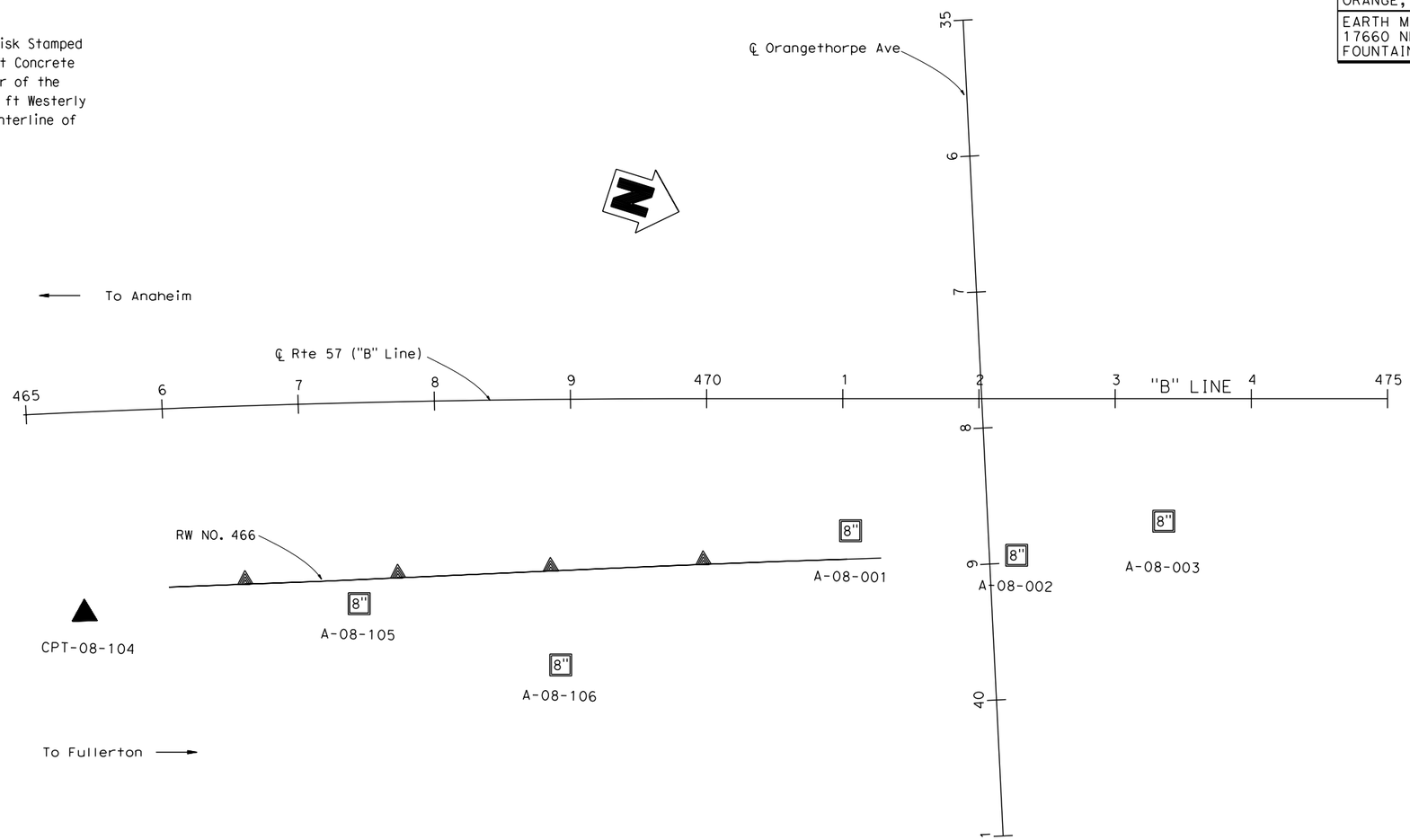
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN
1" = 50'

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0079
POST MILES 16.2/18.6

RETAINING WALL NO. 466
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

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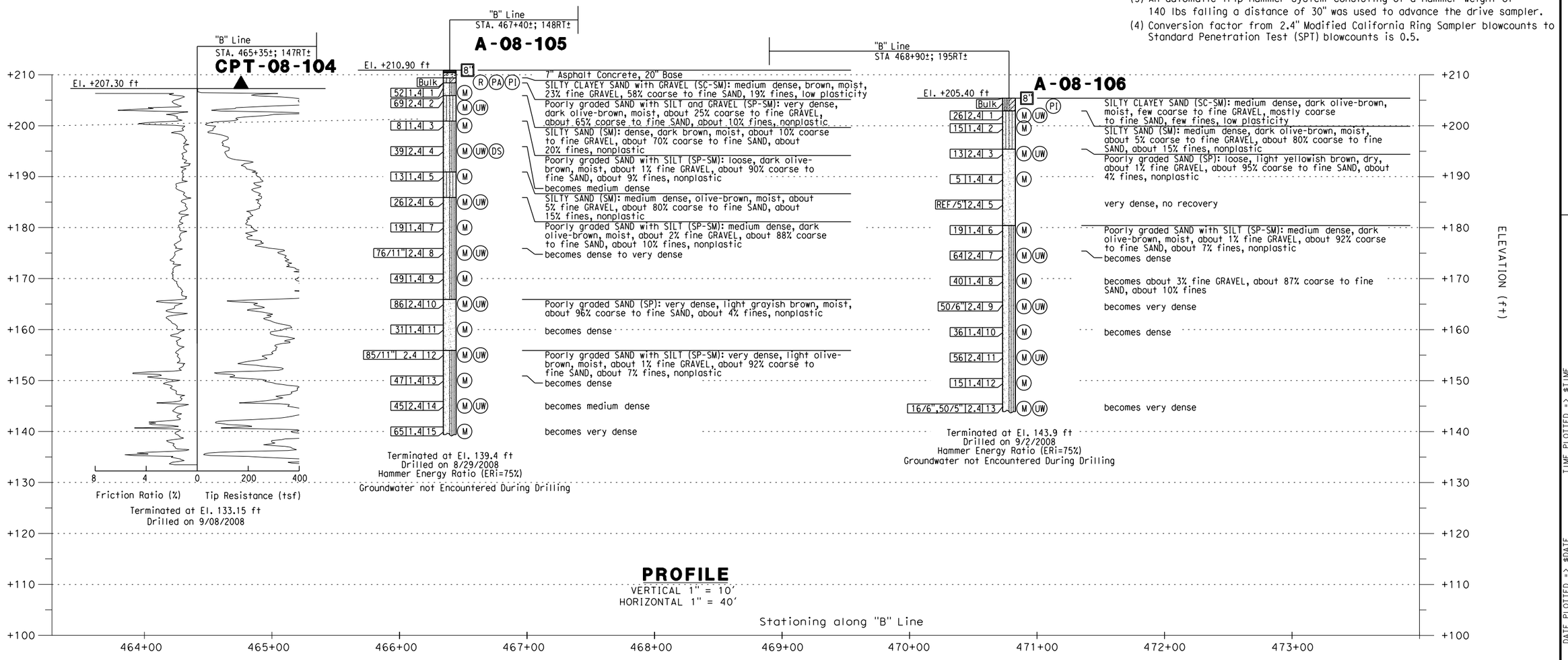
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 466, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0079	RETAINING WALL NO. 466
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 39 OF 46

FILE => $REQUEST

DATE PLOTTED => $DATE TIME PLOTTED => $TIME USERNAME => $USER

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
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ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
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FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 466, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

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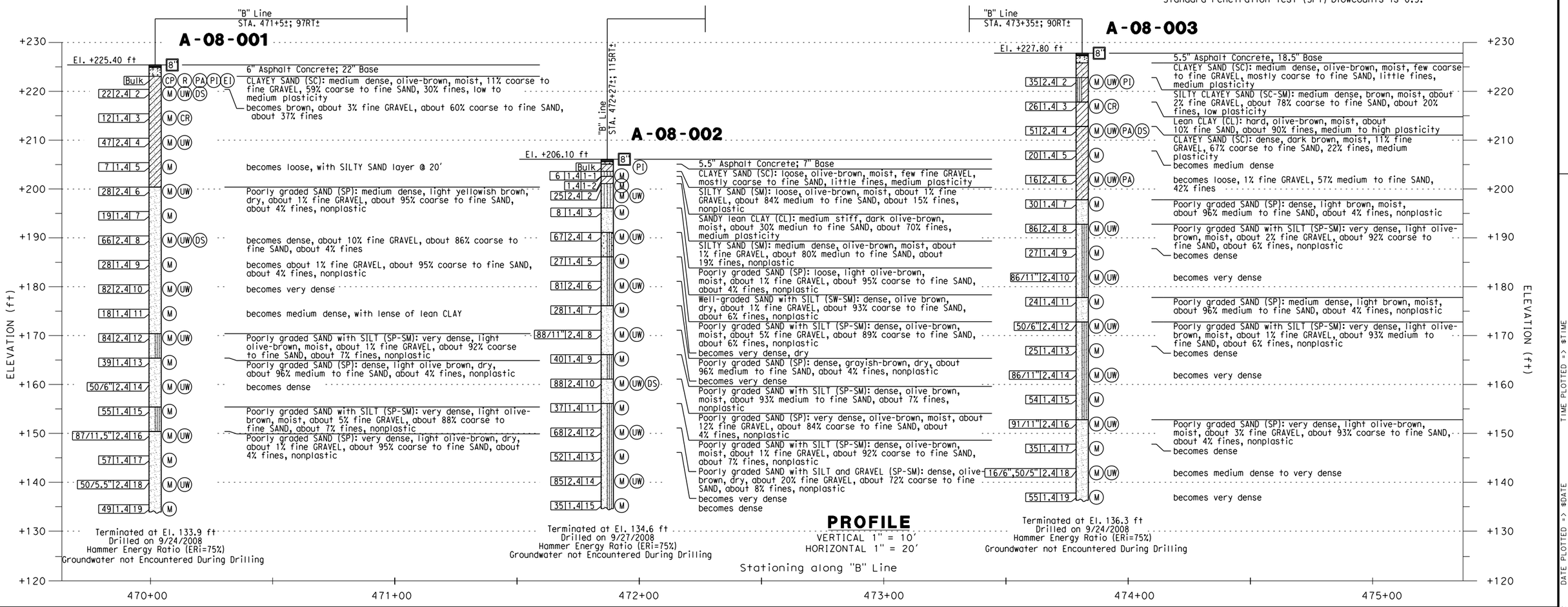

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0079
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6

RETAINING WALL NO. 466
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

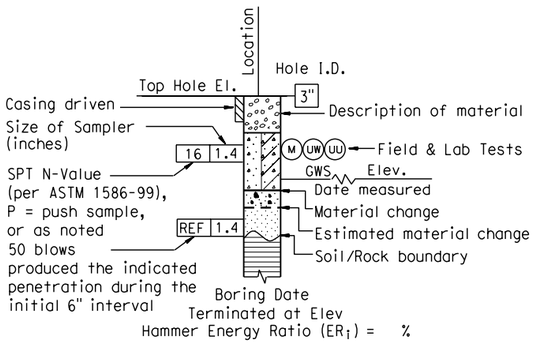
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

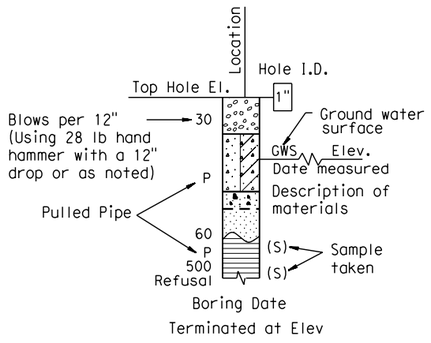
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

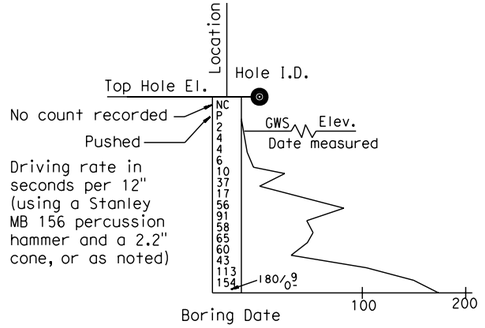
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



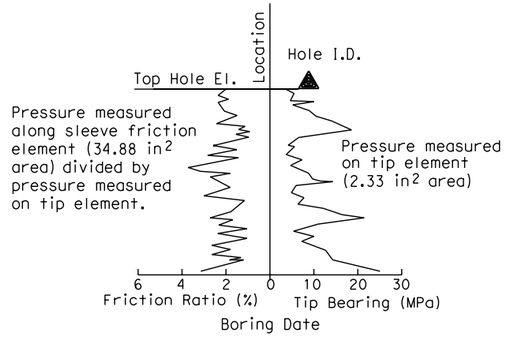
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0079 POST MILES 16.2/18.6

RETAINING WALL NO. 466
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90)
Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166)
Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0079
POST MILES 16.2/18.6

RETAINING WALL NO. 466
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

FILE => $REQUEST

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57, 91	15.6/16.6, 5.0/6.7	726	852

REGISTERED PROFESSIONAL ENGINEER

8-26-96
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — LINO CHEANG — No. C 41401 — Exp. 09-30-99 — CIVIL — STATE OF CALIFORNIA

EARTH MECHANICS, INC.
Geotechnical & Earthquake Engineering
17660 NEWHOPE STREET, SUITE E ● FOUNTAIN VALLEY, CA. 92708
Phone (714) 751-3826

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

RETAINING WALL NO. 466

LOG OF TEST BORINGS NO. 6

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

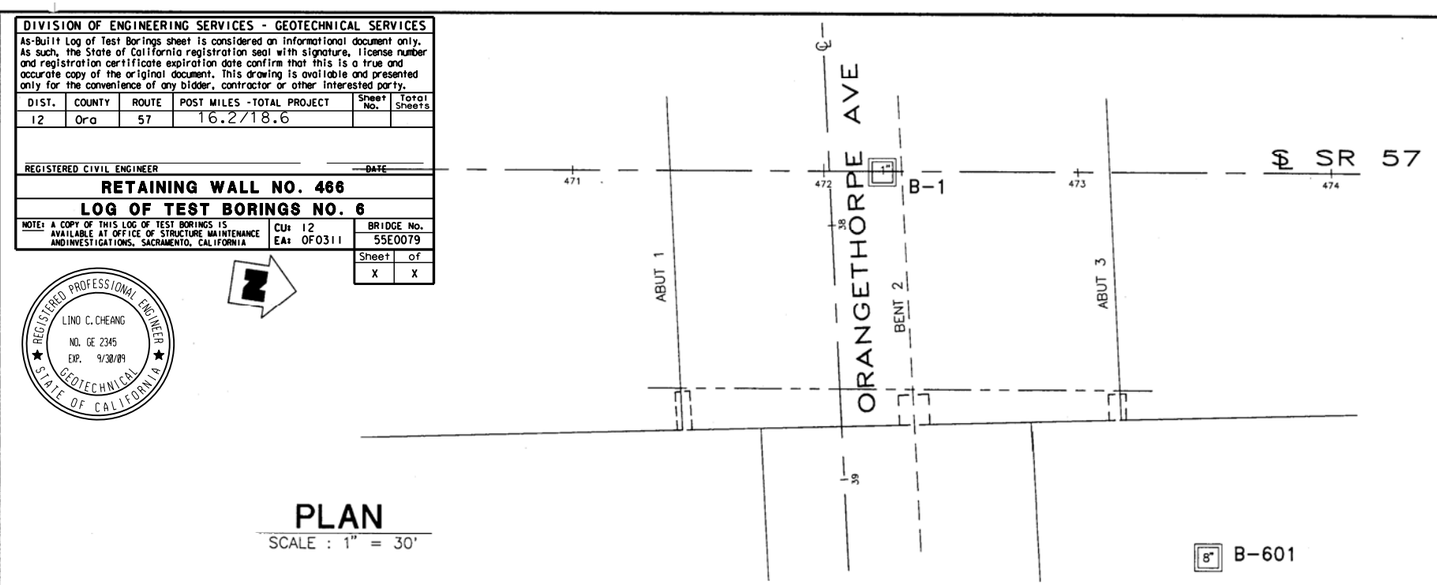
BRIDGE No. 55E0079

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER — LINO C. CHEANG — NO. GE 2345 — EXP. 9/30/09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLAN

SCALE : 1" = 30'



NO AS-BUILT CHANGES

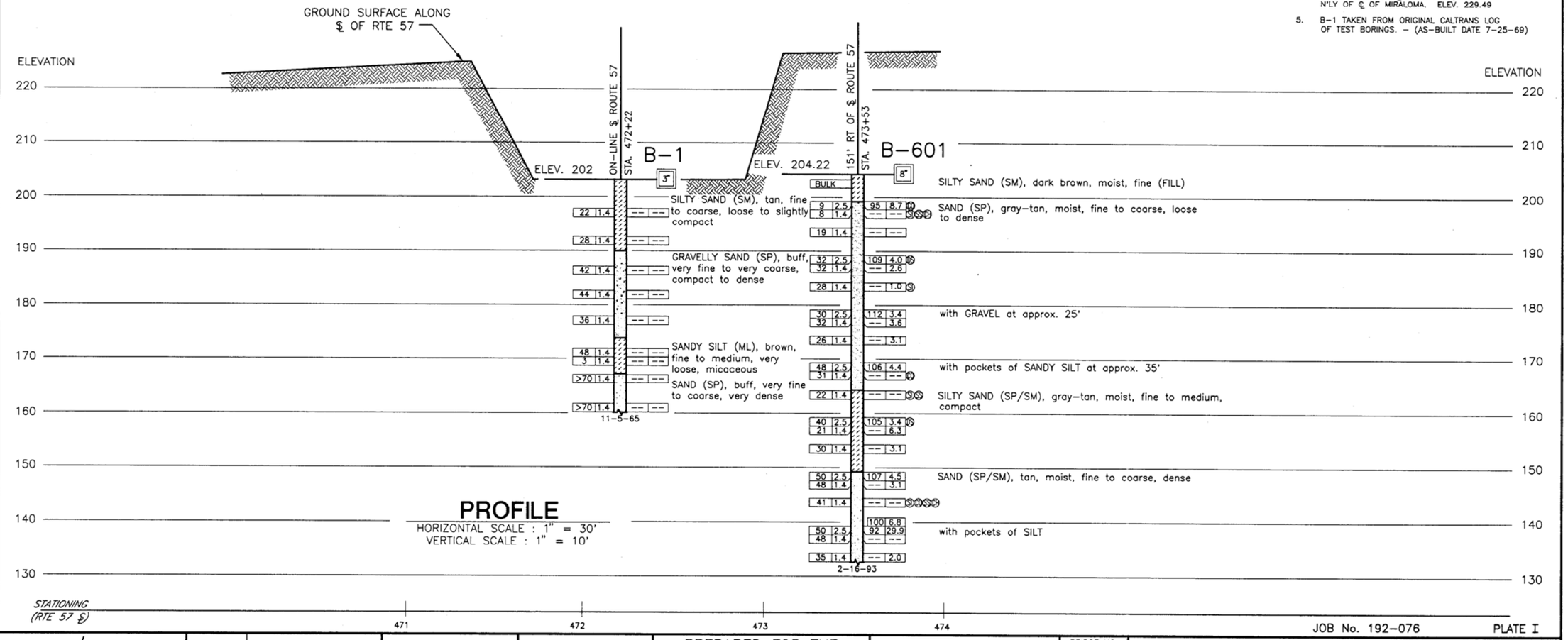
AS BUILT
CORRECTIONS BY AK ALAHMAD
CONTRACT NO. 12-0125 U4
DATE 04-25-00

NOTES:

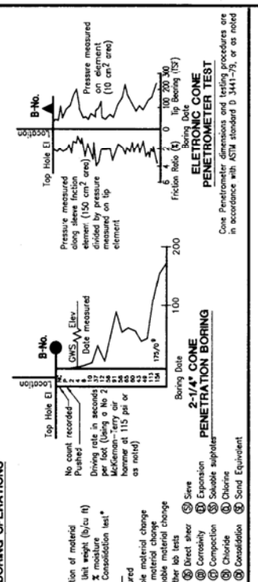
1. NO GROUNDWATER ENCOUNTERED.
2. ELEVATIONS BASED ON SURVEY BY COAST SURVEYING, INC.
3. BORING B-601 LOGGED BY ENRIQUE RIUTORT, STAFF ENGINEER.
4. BENCHMARK – 57/91–B–88(PM 15.9) –3.5 IN. DIA. CADT STA. MARK DISK SET IN EPOXY ON TOP OF PCC SIDEWALK ON THE NE'LY CORNER OF THE MIRALOMA AVE. BRIDGE OVER RTE–57 FWY, ABOUT 150 FT. E'LY OF ℄ OF RTE–57, 36 FT. N'LY OF ℄ OF MIRALOMA. ELEV. 229.49
5. B–1 TAKEN FROM ORIGINAL CALTRANS LOG OF TEST BORINGS. – (AS–BUILT DATE 7–25–69)

PROFILE

HORIZONTAL SCALE : 1" = 30'
VERTICAL SCALE : 1" = 10'



JOB No. 192–076 PLATE I



LEGEND OF EARTH MATERIALS

GRAVEL · SAND · SILT · CLAY · SANDY CLAY or CLAYEY SAND · SANDY SILT or SILTY SAND · SILTY CLAY · CLAYEY SILT · PEAT and/or ORGANIC MATTER · FILL MATERIAL · IGNEOUS ROCK · SEDIMENTARY ROCK · METAMORPHIC ROCK

CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

Penetration Index (blows/ft)	Granular	Cohesive
0–4	Very loose	Very soft
5–9	Loose	Soft
10–19	Slightly compact	Stiff
20–34	Compact	Very stiff
35–69	Dense	Hard
>70	Very dense	Very hard

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BE NGUYEN — DESIGN OVERSIGHT — SIGN OFF DATE 3-13-96	DRAWN BY	JOE MAGLIATO	E.A. RIUTORT — FIELD INVESTIGATOR — DATE 2-16-93	M&T AGRA — Geotechnical and Environmental Services	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Y. NIEN WANG — PROJECT ENGINEER	BRIDGE NO. 55-0459 / POST MILE 16.4
	CHECK BY	E.A. RIUTORT					CU 12209 EA 0125U1

ORANGETHORPE AVE UC (WIDEN)
LOG OF TEST BORINGS

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 8-24-94, 5/24/95

SHEET 14 OF 15

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

8-26-96
TO ACCOMPANY PLANS DATED

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57, 91	15.6/16.6, 5.0/6.7	727	852

Dist.	County	Route	Post Miles Section	Sheet No.	Total Sheets
12	Ora.	57	16.4	247	247

Date Approved October 17, 1996

BENCH MARK
BM "X72 R-EE" Elev 203.41
Set P/S in S. curb Orangethorpe Ave. 134' E. of ℄ Orange Fwy. 100' W of ℄ Nebraska Ave.

B-1 N 620,443.821 E 506,258.785

℄ CONST. RTE 57

℄ SURVEY LINE ORANGETHORPE AVE.

STA. 471 472 473

B-1 B-2 B-3 B-4 B-5

PLAN
Scale: 1" = 20'

NO AS-BUILT CHANGES

AS BUILT
CORRECTIONS BY A.M. ALAHMAD
CONTRACT NO. 12-0125 U4
DATE 04-25-00

AS-BUILT PLANS
Contract No. 07-032114
Date Completed
Document No. 20000575

PROFILE
Scale: Vert. 1" = 10'
Horiz. 1" = 20'

Approx. existing ground line along ℄ CONST. RTE 57

NO GROUND WATER ENCOUNTERED
DURING THIS INVESTIGATION BY
BRIDGE DEPT. GEOLOGY SECTION
DATE 11-65

B-2: 12"ø CIDH Pile Sta 471+45 ℄ CONST. RTE 57; 11-8-65
B-3: 12"ø CIDH Pile Sta 471+41 ℄ CONST. RTE 57; Clay 11-8-65
B-1: Pile Sta 472+22 ℄ CONST. RTE 57; Clay 11-5-65
B-4: 12"ø CIDH Pile Sta 472+71 ℄ CONST. RTE 57; 11-9-65
B-5: 12"ø CIDH Pile Sta 472+71 ℄ CONST. RTE 57; 11-9-65

Loose to slightly compact, fine, silty, fine to coarse sand.
Compact to dense, buff, gravelly, very fine to very coarse sand.
Very loose, brown, micaceous, sandy silt.
Very dense, buff very fine to coarse sand.

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER ____ DATE ____

RETAINING WALL NO. 466

LOG OF TEST BORINGS NO. 7

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 EA: 0F0311

BRIDGE No. 55E0079

Sheet X of X

REGISTERED PROFESSIONAL ENGINEER
LIND C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

LEGEND OF BORING OPERATIONS
Penetrometer; 2½" Core Penetrometer; Sounding (inv); Sounding (dyn); Rotary Boring (dry); Rotary Boring (wet); Auger Boring (dry); Jet Boring; Core Boring; Test Pit

LEGEND OF EARTH MATERIALS
Gravel; Silty Clay or Clayey Silt; Sand; Organic Matter; Silt; Fill Material; Clay; Igneous Rock; Sedimentary Rock; Sandy Clay or Clayey Sand; Sandy Silt or Silty Sand; Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
10 10

ORANGETHORPE AVENUE OVERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-459 | FILE | DRAWING 55459-10

BE NGUYEN
DESIGN OVERSIGHT
SIGNOFF DATE 3-13-96

NOTE:
ADDITIONAL AS-BUILT FOUNDATION DATA MAY BE AVAILABLE AT THE OFFICE OF TRANSPORTATION MATERIALS AND RESEARCH 5900 FOLSOM BOULEVARD, SACRAMENTO, CALIFORNIA 95819

DESIGN	BY J. Hueser	CHECKED	D. Kuang	
DETAILS	BY T. Elofson	CHECKED	D. Novak	
QUANTITIES	BY J. Hueser	CHECKED	L. Woo	

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Y. Nien Wang
PROJECT ENGINEER

CU 12209
EA 0125U1

BRIDGE No. 55-0459
POST MILE 16.4

ORANGETHORPE AVE UC (WIDEN)
AS-BUILT LOG OF TEST BORINGS

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 5/3/94

SHEET 15 OF 15

Design Filename: /usr3/5539/design/dgn/GT0060A.dgn
Plotted on: 10-MAY-1994 10:06
Generated by: USERNAME

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Chien-Tai Yang
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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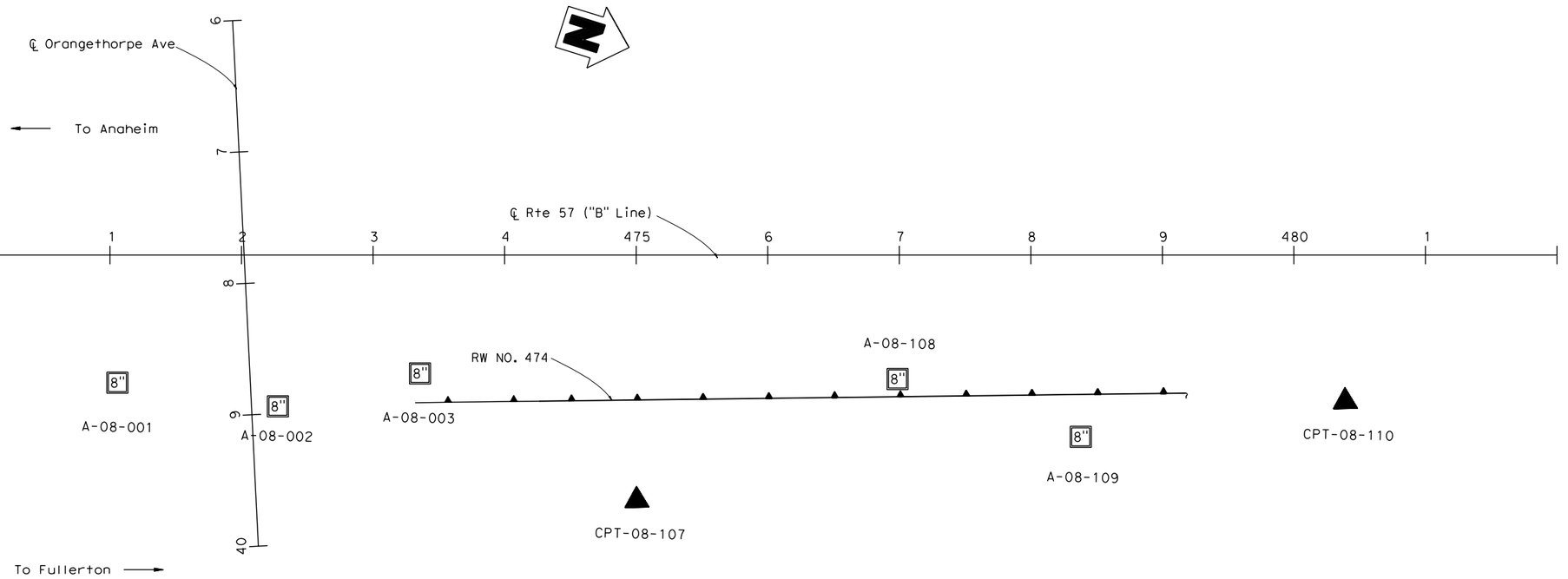
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN
1" = 50'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER	BRIDGE NO. 55E0080 / POST MILES 16.2/18.6	RETAINING WALL NO. 474 LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 474, LOG OF TEST BORINGS NO. 1"

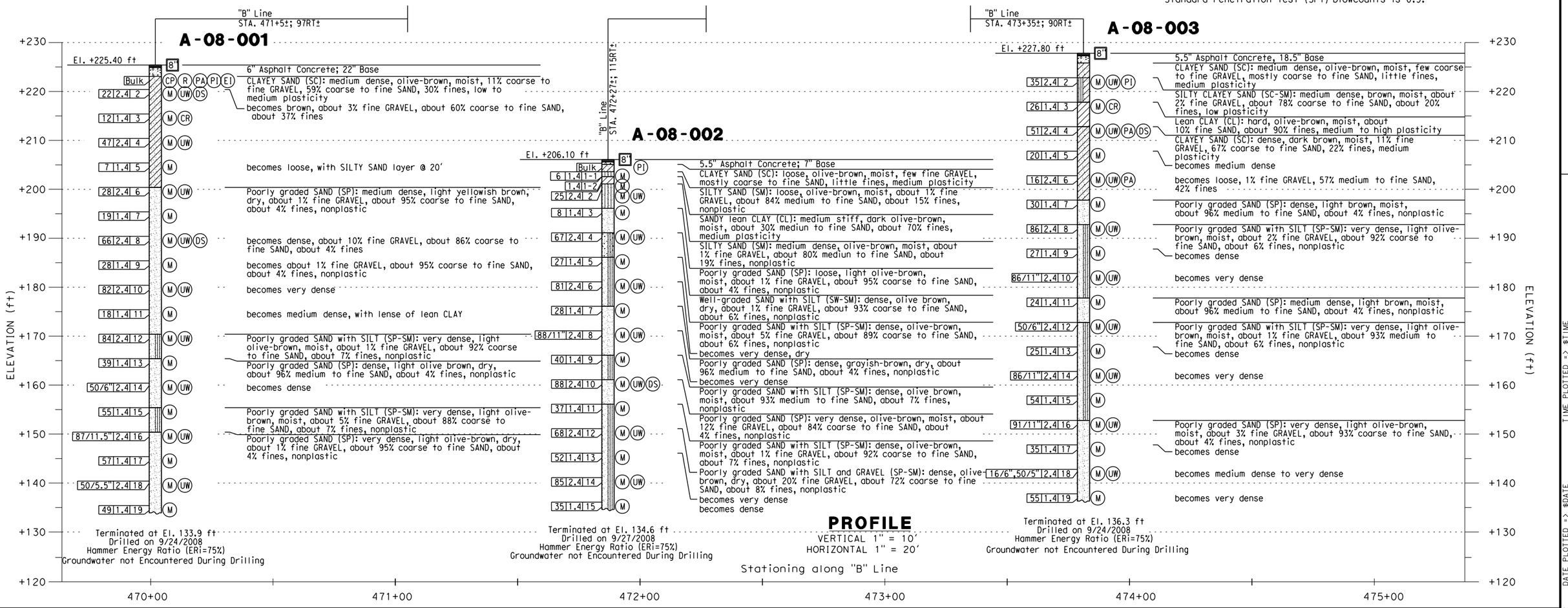
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0080 POST MILES 16.2/18.6

RETAINING WALL NO. 474
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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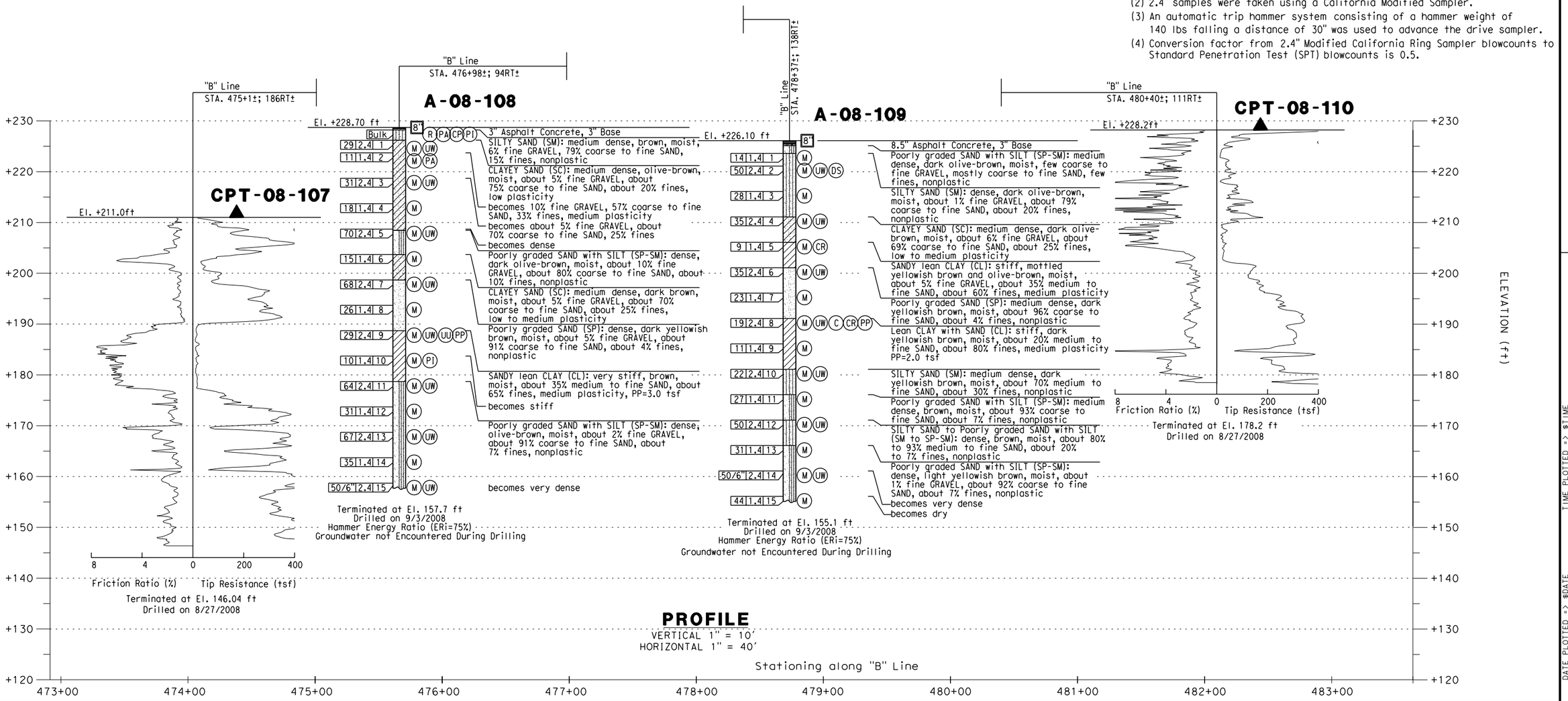
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 474, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0080
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6

RETAINING WALL No. 474
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 40 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

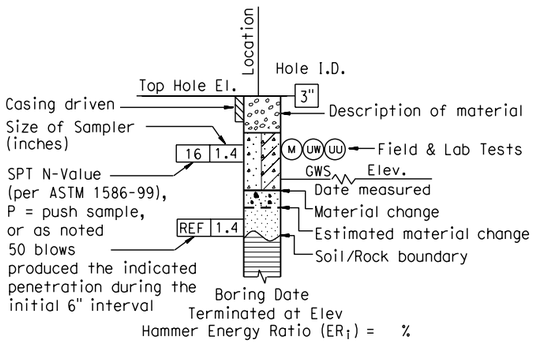
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

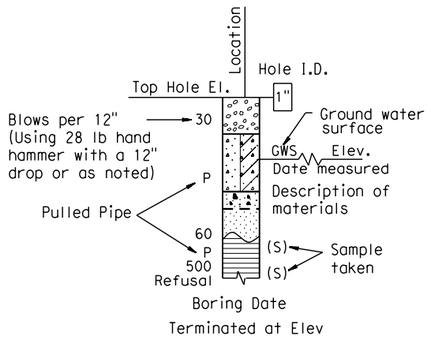
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

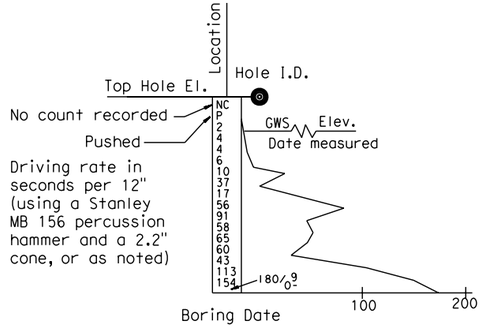
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



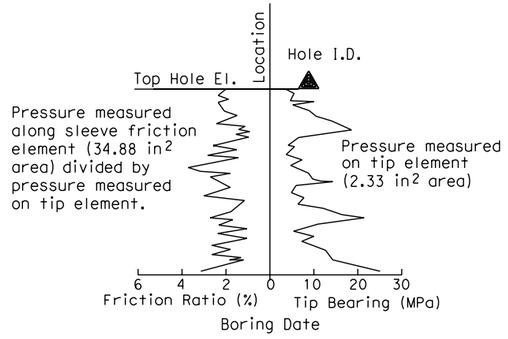
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0080 POST MILES 16.2/18.6	RETAINING WALL NO. 474 LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166); Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0080
POST MILES 16.2/18.6

RETAINING WALL NO. 474
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

FILE => $REQUEST

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57, 91	15.6/16.6, 5.0/6.7	726	852

REGISTERED PROFESSIONAL ENGINEER

8-26-96
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — LINO CHEANG — No. C 41401 — Exp. 09-30-99 — CIVIL — STATE OF CALIFORNIA

EARTH MECHANICS, INC.
Geotechnical & Earthquake Engineering
17660 NEWHOPE STREET, SUITE E ● FOUNTAIN VALLEY, CA. 92708
Phone (714) 751-3826

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DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

RETAINING WALL NO. 474

LOG OF TEST BORINGS NO. 6

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

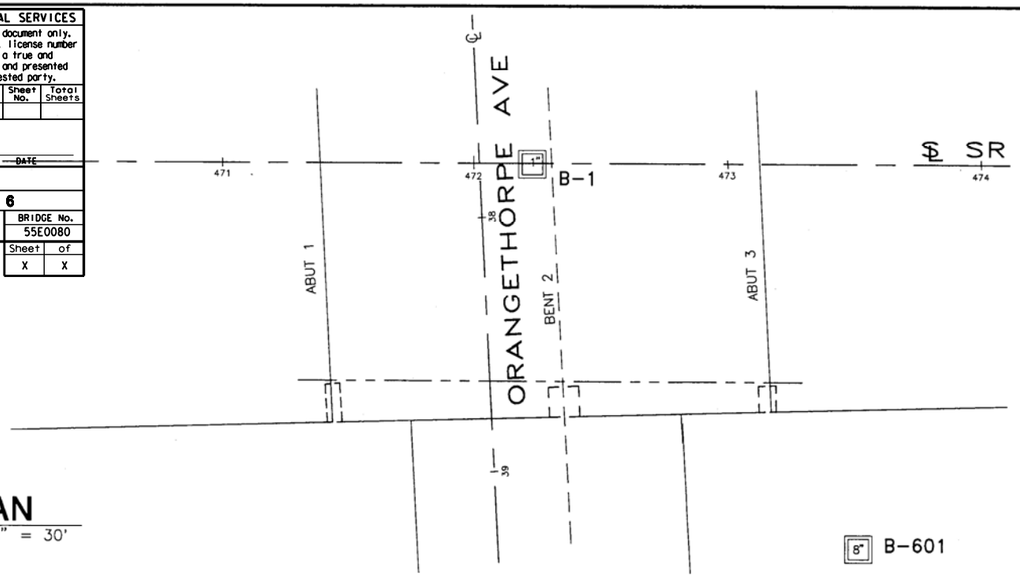
BRIDGE No. 55E0080

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER — LINO C. CHEANG — NO. GE 2345 — EXP. 9/30/09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLAN

SCALE : 1" = 30'



NO AS-BUILT CHANGES

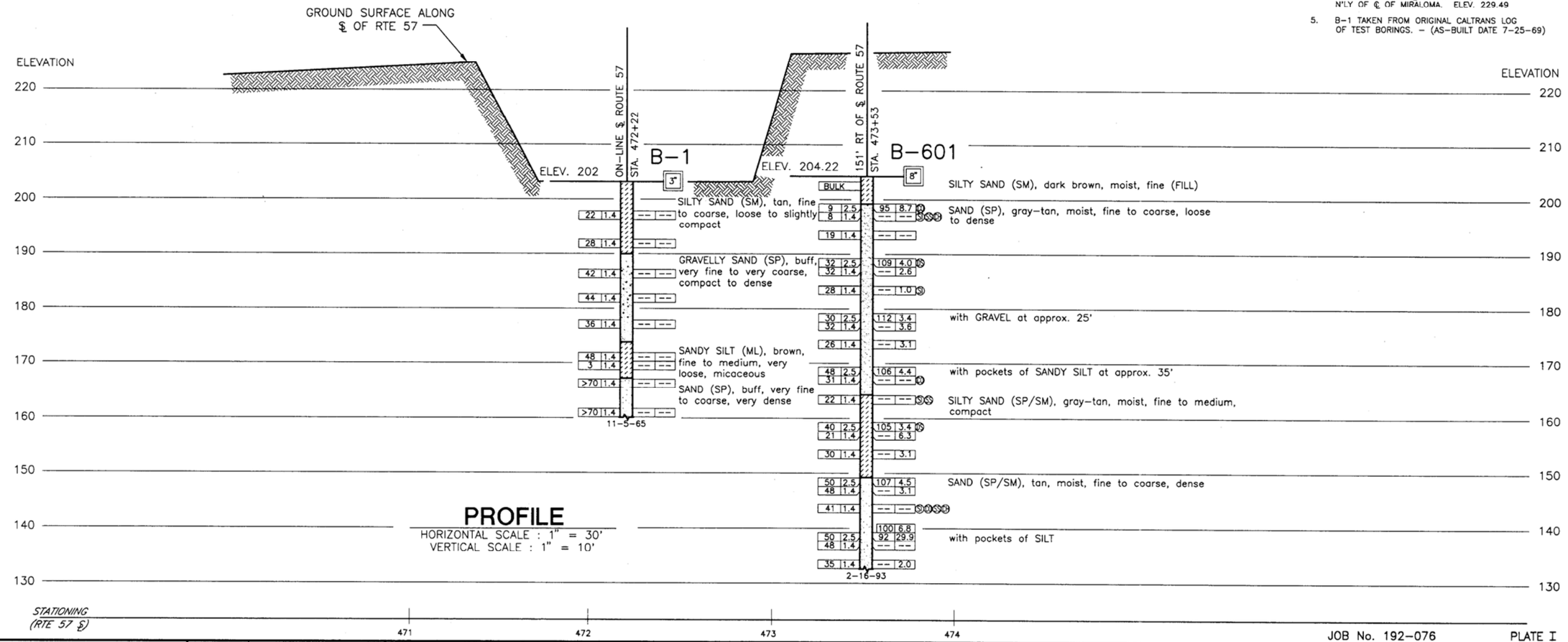
AS BUILT
CORRECTIONS BY AK ALAHMAD
CONTRACT NO. 12-0125 U4
DATE 04-25-00

NOTES:

1. NO GROUNDWATER ENCOUNTERED.
2. ELEVATIONS BASED ON SURVEY BY COAST SURVEYING, INC.
3. BORING B-601 LOGGED BY ENRIQUE RIUTORT, STAFF ENGINEER.
4. BENCHMARK – 57/91–B–88(PM 15.9) –3.5 IN. DIA. CADT STA. MARK DISK SET IN EPOXY ON TOP OF PCC SIDEWALK ON THE NE'LY CORNER OF THE MIRALOMA AVE. BRIDGE OVER RTE–57 FWY, ABOUT 150 FT. E'LY OF ℄ OF RTE–57, 36 FT. N'LY OF ℄ OF MIRALOMA. ELEV. 229.49
5. B–1 TAKEN FROM ORIGINAL CALTRANS LOG OF TEST BORINGS. – (AS–BUILT DATE 7–25–69)

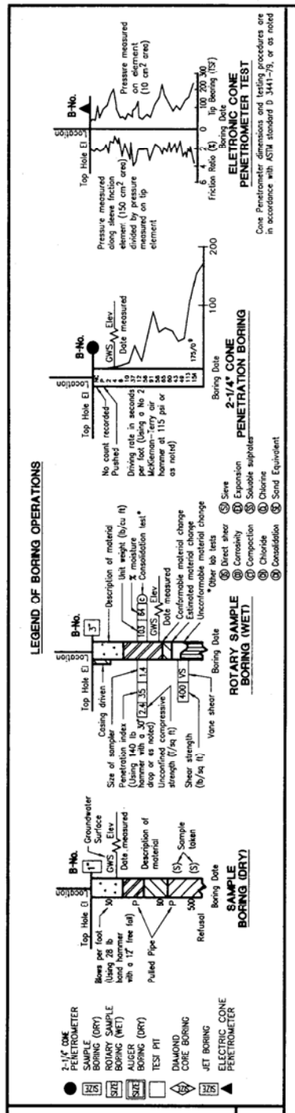
PROFILE

HORIZONTAL SCALE : 1" = 30'
VERTICAL SCALE : 1" = 10'

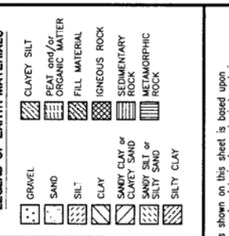


JOB No. 192–076 PLATE I

LEGEND OF BORING OPERATIONS



LEGEND OF EARTH MATERIALS



CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

Penetration Index (blows/ft)	Granular	Cohesive
0–4	Very loose	Very soft
5–9	Loose	Soft
10–19	Slightly compact	Stiff
20–34	Compact	Very stiff
35–69	Dense	Hard
>70	Very dense	Very hard

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BE NGUYEN — DESIGN OVERSIGHT — SIGN OFF DATE 3-13-96	DRAWN BY	JOE MAGLIATO	E.A. RIUTORT — FIELD INVESTIGATOR — DATE 2-16-93	M&T AGRA — Geotechnical and Environmental Services	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	Y. NIEN WANG — PROJECT ENGINEER	BRIDGE NO. 55-0459 / POST MILE 16.4
	CHECK BY	E.A. RIUTORT				CU 12209 EA 0125U1	

ORANGETHORPE AVE UC (WIDEN)
LOG OF TEST BORINGS

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 8-24-94, 5/24/95

SHEET 14 OF 15

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

8-26-96
TO ACCOMPANY PLANS DATED

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57, 91	15.6/16.6, 5.0/6.7	727	852

LEGEND OF BORING OPERATIONS

Penetrometer; 2½" Core Penetrometer; Sounding (inv); Rotary Boring (air); Rotary Boring (mud); Auger Boring (dry); Jet Boring; Core Boring; Test Pit

LEGEND OF EARTH MATERIALS

Gravel; Sand; Silt; Clay; Silty Clay or Clayey Silt; Organic Matter; Fill Material; Igneous Rock; Sedimentary Rock; Silty Clay or Clayey Silt; Sandy Silt or Silty Sand; Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

Because among the tests are estimated by visual examination and by mechanical analysis, it should be recognized that the terms, "gravel," "sand," "silt," "clay," "silty clay," "sandy silt," "clayey silt," "silty sand," "clayey sand," "gravel and sand," "silt and gravel," refer to constituents having the standard grade size limits.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BENCH MARK

BM "XT2 R-EE" Elev 203.41
Set P/S in S. curb Orangethorpe Ave. 134' E. of ℄ Orange Fwy. 100' W of ℄ Nebraska Ave.

B-1 N 620,443.821 E 506,258.785

℄ CONST. RTE 57

℄ SURVEY STA. LINE ORANGETHORPE AVE.

PLAN
Scale: 1" = 20'

PROFILE
Scale: Vert. 1" = 10'
Horiz. 1" = 20'

Approx. existing ground line along ℄ CONST. RTE 57

B-1: Loose to slightly compact, fine, silty, fine to coarse sand.
Compact to dense, buff, gravelly, very fine to very coarse sand.
Very loose, brown, micaceous, sandy silt.
Very dense, buff very fine to coarse sand.

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE 11-65

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER ____ DATE ____

RETAINING WALL NO. 474

LOG OF TEST BORINGS NO. 7

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No. 55E0080

Sheet X of X

REGISTERED PROFESSIONAL ENGINEER
LIND C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

NO AS-BUILT CHANGES

AS BUILT
CORRECTIONS BY A.M. ALAHMAD
CONTRACT NO. 12-0125 U4
DATE 04-25-00

AS-BUILT PLANS
Contract No. 07-032114
Date Completed
Document No. 20000575

Dist. 12 | County Ora. | Route 57 | Post Miles Section 16.4 | Sheet 247 | Total Sheets 247

Wm. R. Higgin
Date Approved October 17, 1966

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

ORANGETHORPE AVENUE OVERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-459 | FILE | DRAWING 55459-10

BE NGUYEN
DESIGN OVERSIGHT
SIGNOFF DATE 3-13-96

NOTE:
ADDITIONAL AS-BUILT FOUNDATION DATA MAY BE AVAILABLE AT THE OFFICE OF TRANSPORTATION MATERIALS AND RESEARCH 5900 FOLSOM BOULEVARD, SACRAMENTO, CALIFORNIA 95819

	BY		CHECKED
DESIGN	J. Hueser		D. Kuang
DETAILS	T. Elofson		D. Novak
QUANTITIES	J. Hueser		L. Woo

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Y. Nien Wang
PROJECT ENGINEER

CU 12209
EA 0125U1

BRIDGE No. 55-0459
POST MILE 16.4

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)
5/3/94

ORANGETHORPE AVE UC (WIDEN)
AS-BUILT LOG OF TEST BORINGS

SHEET 15 OF 15

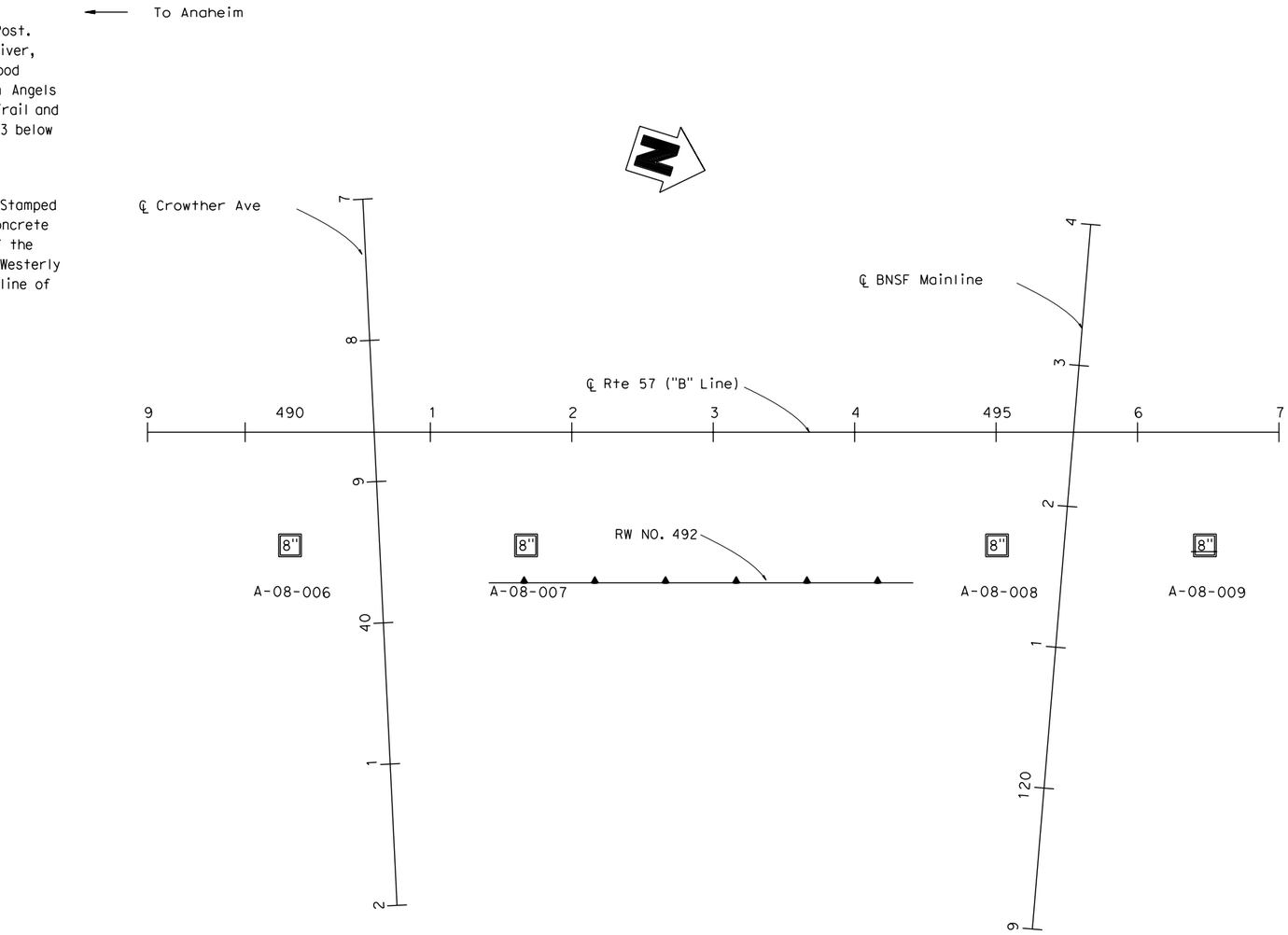
Design Filename: /usr3/5839/design/d2/d0404d.dgn
Plotted on: 10-MAY-1994 08:06
Generated by USERNAME

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0082
POST MILES 16.2/18.6

RETAINING WALL NO. 492
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FILE => $REQUEST

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 492, LOG OF TEST BORINGS NO. 1"

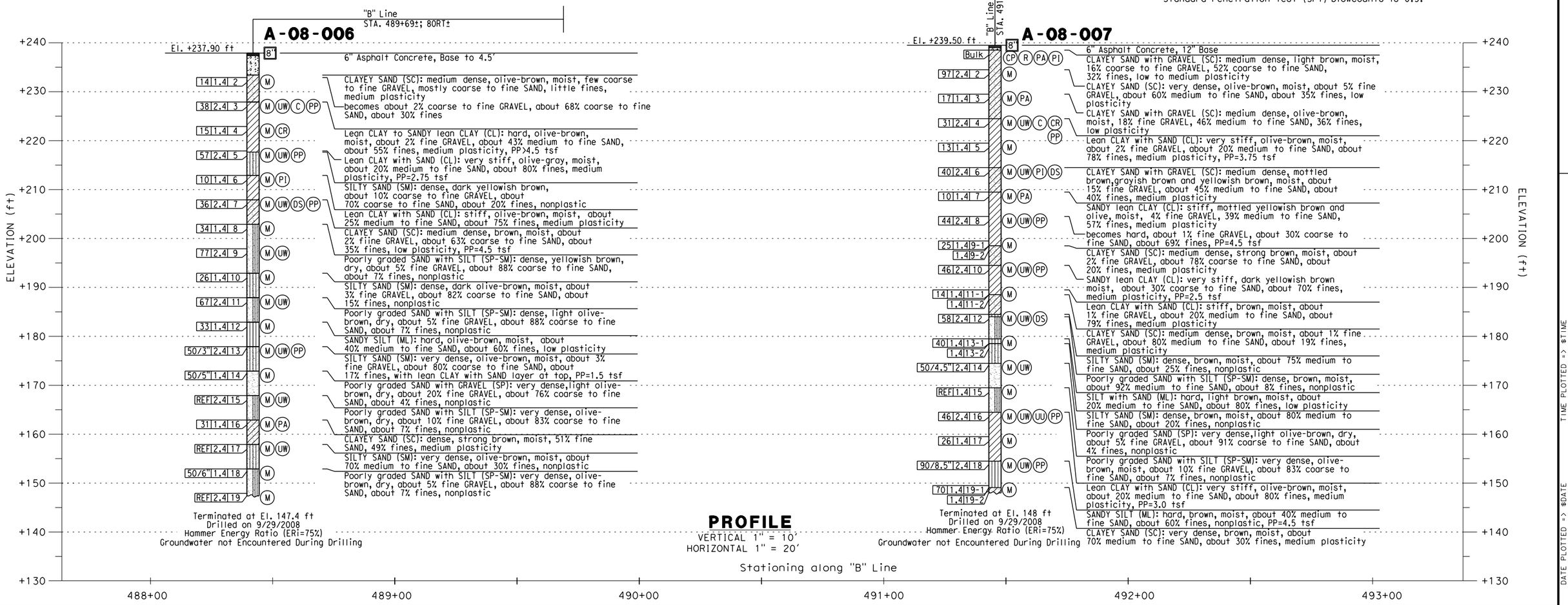
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO. 55E0082
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6

RETAINING WALL NO. 492
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 492, LOG OF TEST BORINGS NO. 1"

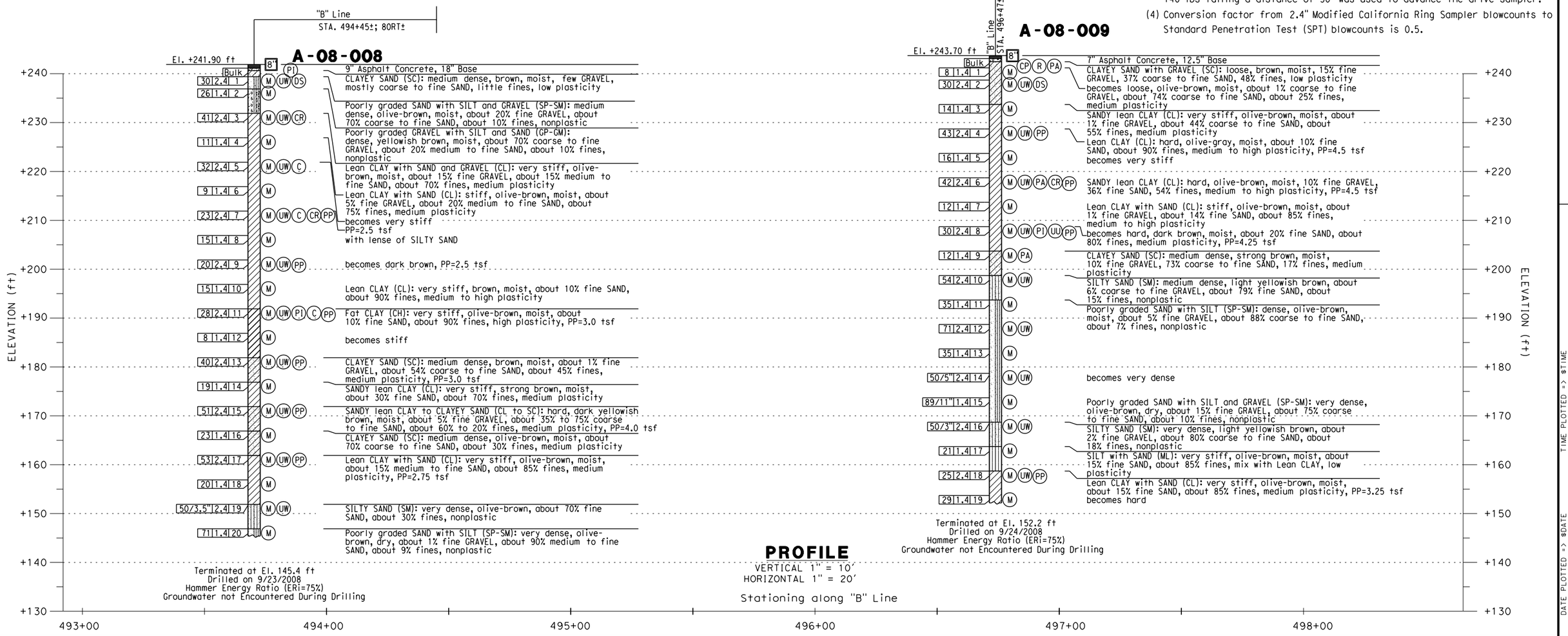
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0082 POST MILES 16.2/18.6

RETAINING WALL NO. 492
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

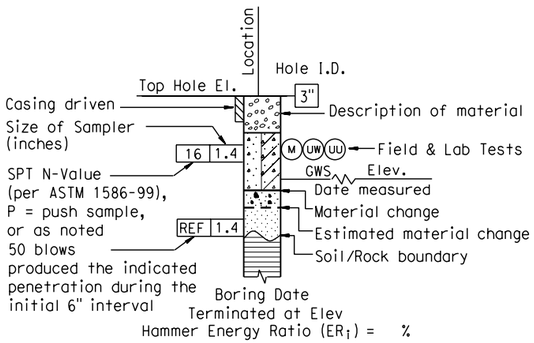
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

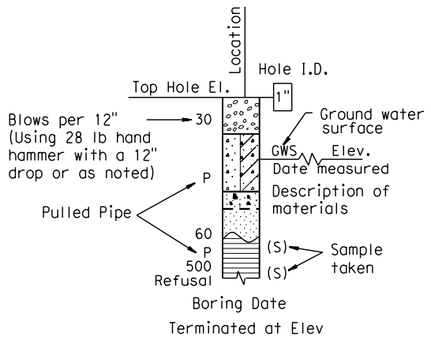
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

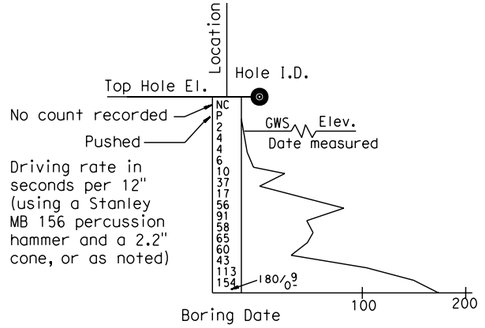
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



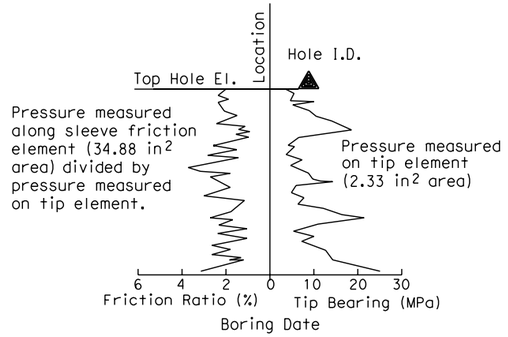
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0082 POST MILES 16.2/18.6	RETAINING WALL NO. 492 LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90)
Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166)
Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0082
POST MILES 16.2/18.6

RETAINING WALL NO. 492
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

FILE => $REQUEST

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	476	491

Kul Bhushan 12/28/89
GEOTECHNICAL PROFESSIONAL
10-29-90
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — KUL BHUSHAN — No. GE 000144 — Exp. 12/31/1989 — GEOTECHNICAL — STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

RETAINING WALL NO. 492

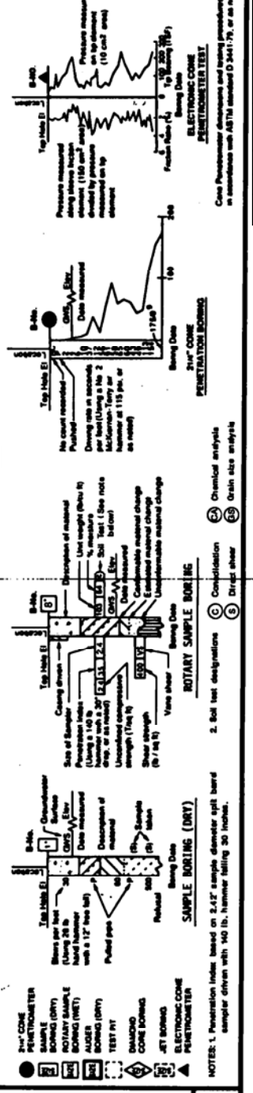
LOG OF TEST BORINGS NO. 6

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

Cu: 12 -
Ea: 0F0311

BRIDGE No.	
55E0082	
Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER — LINO C. CHEANG — NO. GE 2345 — EXP. 9/30/89 — GEOTECHNICAL — STATE OF CALIFORNIA



LEGEND OF BORING OPERATIONS

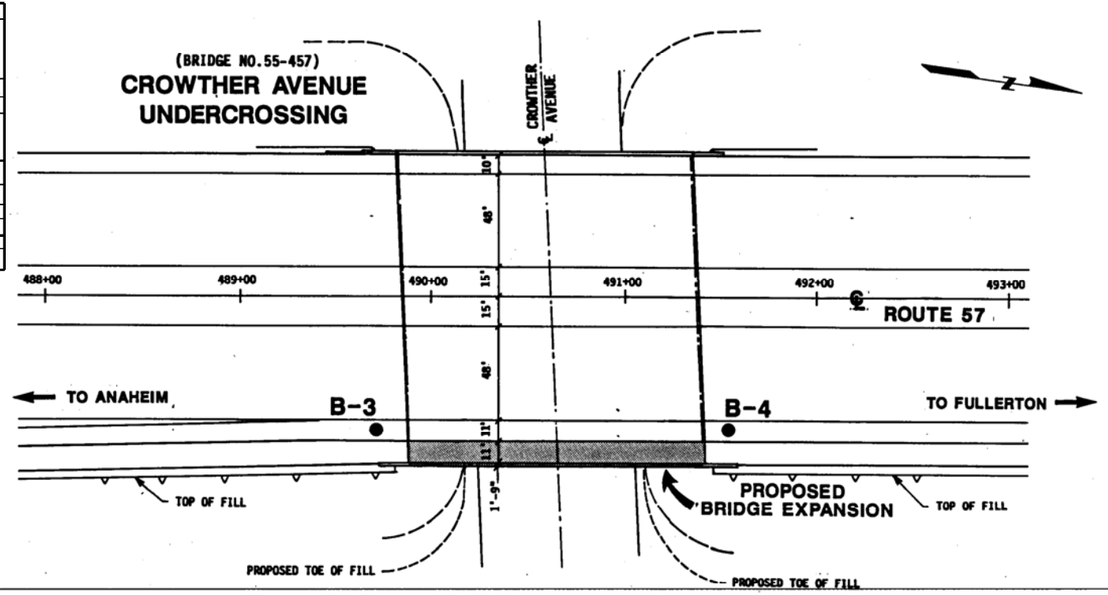
LEGEND OF EARTH MATERIALS

GRAVEL · SAND · SILT · CLAY · SANDY CLAY or CLAYEY SAND · SILTY SAND or SILTY CLAY · CLAYEY SILT · PEAT and/or ORGANIC MATTER · FILL MATERIAL · IGNEOUS ROCK · SEDIMENTARY ROCK · METAMORPHIC ROCK

CONSISTENCY CLASSIFICATION FOR SOILS
According to the Standard Penetration Test

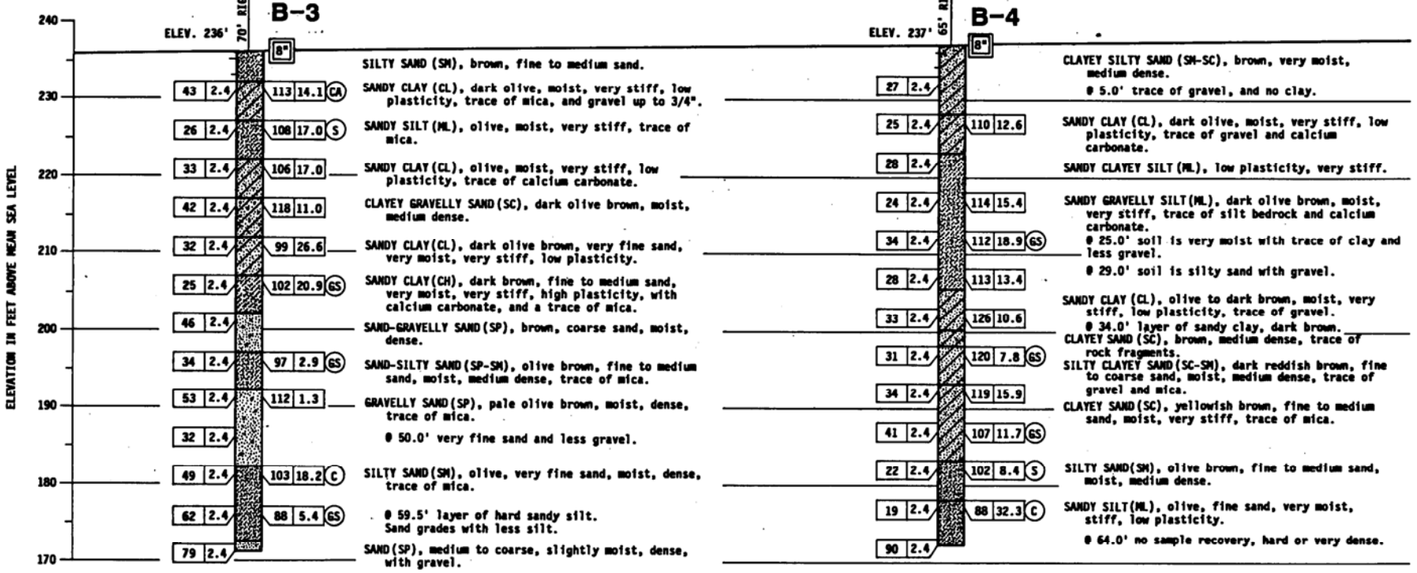
Penetration Index (Blows / Ft)	Granular	Cohesive
0-4	Very loose	Very soft
5-9	Loose	Soft
10-19	Slightly compact	Firm
20-34	Compact	Very stiff
35-69	Dense	Hard
>70	Very dense	Very hard

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.



PLAN

SCALE: 1"=40'



PROFILE

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'

AS BUILT NO AS BUILT CHANGES
J. PINHEIRO
CORRECTIONS BY I. PANGLE
CONTRACT NO. 12-020184
DATE 11-24-92

BM 535-D-70 — ELEVATION 257.37

FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60 AND 105 FEET NORTHERLY OF THE CENTERLINE OF NUTWOOD AVE..

DESIGN OVERSIGHT — SIGN OFF DATE 8-22-90
DRAWN BY B. BASMADJIAN
CHECKED BY H. ABDALLAH
S. MOHAMAD — FIELD INVESTIGATOR — DATE 12-20-89

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Gary Antonucci — PROJECT ENGINEER

BRIDGE NO. 55-457
POST MILE 16.8

CROWTHER AVE. UNDERCROSSING (WIDEN)

LOG OF TEST BORINGS

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12208
EA 020180

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 8 OF 9

DIST	COUNTY	ROUTE	POST MILES – TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	11.1/21.2	477	491

N 622 234.795
E 502,840.365

BENCH MARK

BM 491-Loc 5 Elev. 206.51

Set Rd. + N. side Crowther Ave. @ B.C.R. to W. gutter E. of Placentia Ave. 292' W. of E. Fwy. 32' N. of C. Crowther Ave.

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER _____ DATE _____

RETAINING WALL NO. 492

LOG OF TEST BORINGS NO. 7

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No. 55E0082

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

B-4 B-5 B-3 B-1 B-2

℄ FWY. RTE. 57

489 490 492 493

℄ CROWTHER AVE.

PLAN
Scale: 1" = 20'

AS - BUILT PLAN — FOR INFORMATION ONLY

Kul Bhushan
GEOTECHNICAL PROFESSIONAL
DATE APPROVED 10-29-90

CROWTHER AVENUE UC (WIDEN)

LOG OF TEST BORINGS

CU: ~~12208~~	BRIDGE No.
EA: 020181	55 - 457

REGISTERED PROFESSIONAL ENGINEER
KUL BHUSHAN
NO. GE 693144
Exp. 12-31-93
GEOTECHNICAL
STATE OF CALIFORNIA

AS BUILT

CORRECTIONS BY _____

CONTRACT NO. _____

D/T _____

AS BUILT PLANS
Contract No. 07-052124
Date Completed _____
Document No. 70000668

AS BUILT NO AS BUILT CHANGES
CONTRACT NUMBER 12- 020184
RESIDENT ENGINEER J. PALMEIRO & T. PAMBLE
COMPLETION DATE 11-24-92

PROFILE
Scale: Vert. 1" = 10'
Horiz. 1" = 20'

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE NOV & DEC. 1965

Upper existing ground line along ℄ Fwy. RTE. 57

B-4: 209± — 07'LT. Sta. 489+87 ℄ Fwy. RTE. 57
B-5: 209? — 20'RT. Sta. 489+95 ℄ Fwy. RTE. 57
On ℄ Sta. 491+03 ℄ Fwy. RTE. 57: 208?
B-3: 207?
48'LT. Sta. 491+28 ℄ Fwy. RTE. 57
B-1: 207?
69'RT. Sta. 492+35 ℄ Fwy. RTE. 57
B-2

Loose, brown, silty, very fine to medium sand.
Loose, buff, gravelly, very fine to very coarse sand
Compact to dense, buff, gravelly, very fine to very coarse sand.
Dense, tan, silty, very fine to fine sand with occasional thin gravel layers.

11-11-65 — 11-12-65 — 12-6-65 — 11-11-65

489 490 491 492

LEGEND OF BORINGS

Penetrometer
2½" Core Penetrometer
Standard Borings (Solid)
Rotary Borings (Solid)
Auger Borings (Dry)
Jet Borings
Core Borings
Test Pit

LEGEND OF EARTH MATERIALS

Gravel — Silty Clay or Clayey Silt
Sand — Peat, Muck or Organic Matter
Silt — Fill Material
Clay — Igneous Rock
Sandy Clay or Clayey Sand — Sedimentary Rock
Sandy Silt or Silty Sand — Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

Particles passing the 3"sq. sieve and retained on the No. 4 sieve are designated as gravel. Of gravels, a mixture of particles predominantly one size or with one size missing in between is designated as "uniform"; a mixture with particles of all intermediate sizes is designated as "well graded". The terms "coarse", "medium" and "fine" are used to subdivide each of the above categories. Particles passing the No. 200 sieve are designated as silt or clay if they are plastic, and as sand if they are non-plastic.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

CROWTHER AVENUE
UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-457 | DRAWING 55457-12

Charge: 07205
W.A.: 032121

Disregard prints bearing earlier revisions.

PREL. DRAWING NO. PR- 79/1

SHEET	OF
9	9

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	490	491

Kul Bhushan 12/28/89
GEOTECHNICAL PROFESSIONAL
10-29-90
PLANS APPROVAL DATE

KUL BHUSHAN
No. GE 000144
Exp. 12/31/1989
REGISTERED PROFESSIONAL ENGINEER
GEOTECHNICAL
STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

RETAINING WALL NO. 492

LOG OF TEST BORINGS NO. 8

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

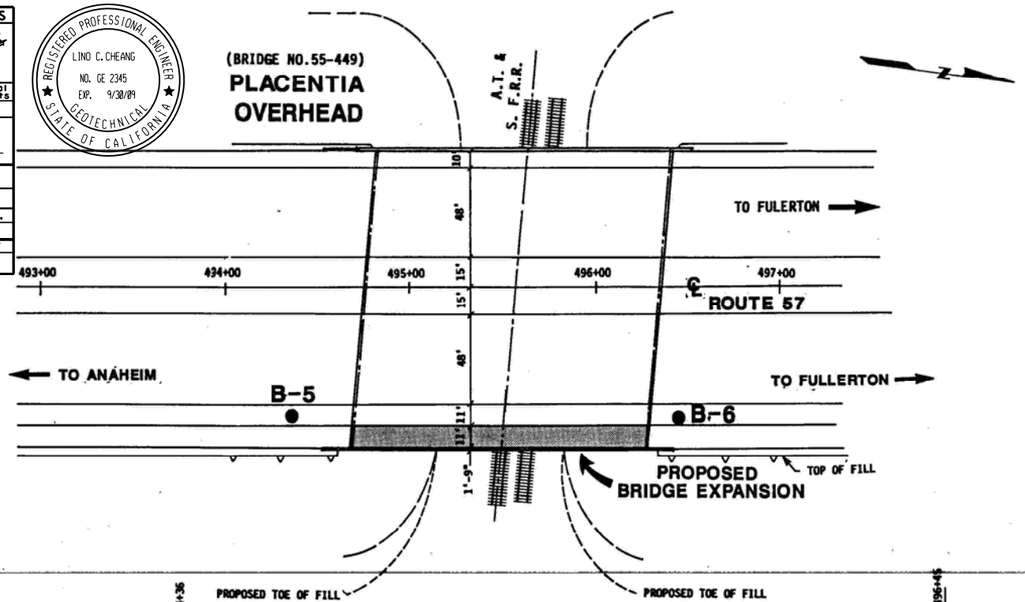
CU: 12
EA: OF0311

BRIDGE No. 55E0089

Sheet 35 of 36

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

(BRIDGE NO.55-449)
PLACENTIA OVERHEAD

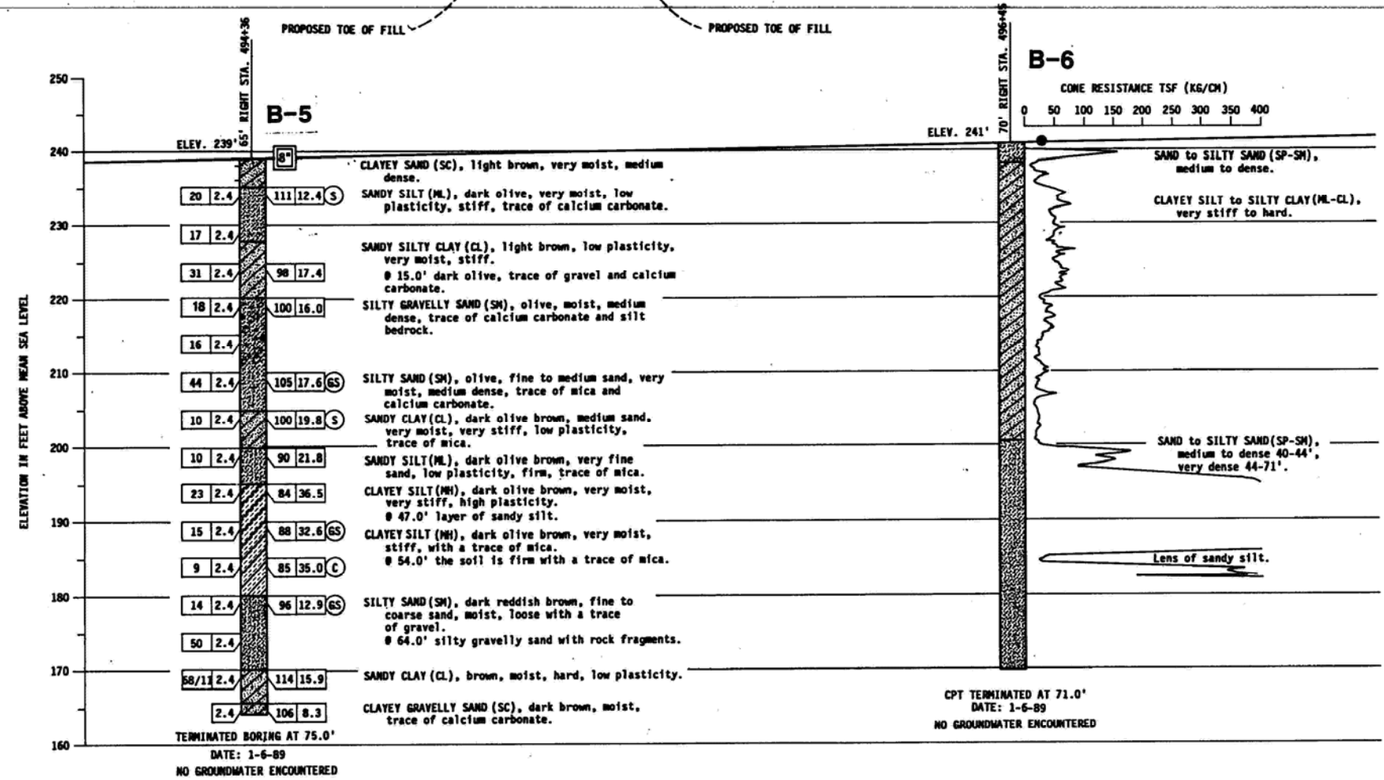


PLAN

SCALE: 1"=40'

PROFILE

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'



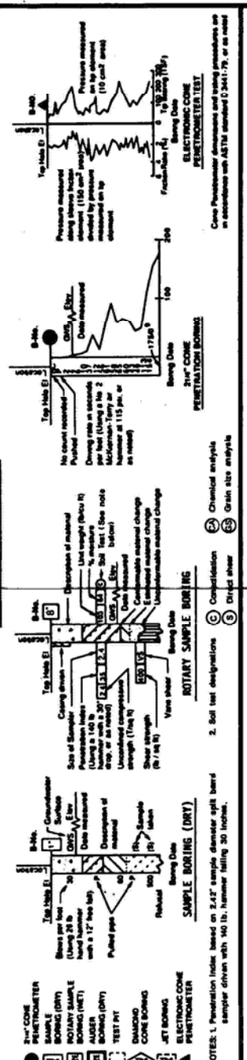
AS BUILT NO AS BUILT CHANGES

CORRECTIONS BY J. PINHEIRO
CONTRACT NO. 12-020184
DATE 11-23-92

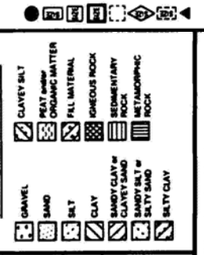
BM 535-D-70 — ELEVATION 257.37

FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60 AND 105 FEET NORTHERLY OF THE CENTERLINE OF NUTWOOD AVE..

LEGEND OF BORING OPERATIONS



LEGEND OF EARTH MATERIALS



CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

Penetration Index (Blows / Ft)	Granular	Cohesive
0-4	Very loose	Very soft
5-9	Loose	Soft
10-19	Slightly compact	Firm
20-34	Compact	Very stiff
35-69	Dense	Hard
>70	Very dense	Very hard

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

DESIGN OVERSIGHT — SIGN OFF DATE 8-22-90

DRAWN BY: B. BASMADJIAN
CHECKED BY: H. ABDALLAH

S. MOHAMAD
FIELD INVESTIGATOR
DATE 12-28-89

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Victor Lee
PROJECT ENGINEER

CU 12208
EA 020181

BRIDGE NO. 55-449
POST MILE 16.9

PLACENTIA OVERHEAD (WIDEN)

LOG OF TEST BORINGS

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 13 OF 14

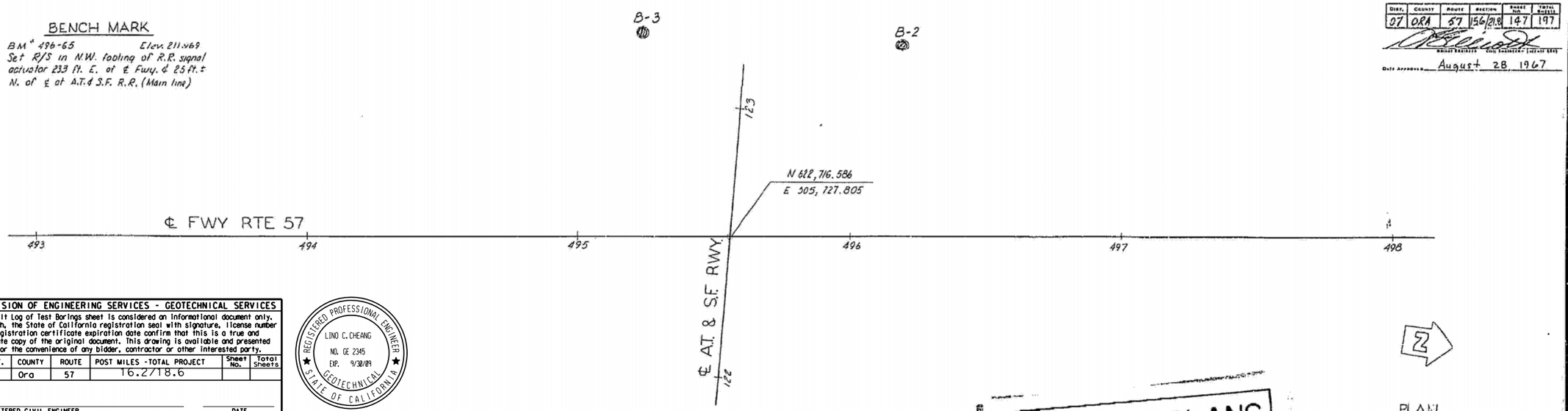
FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	16.2/18.8	147	197

Date Approved August 28, 1967

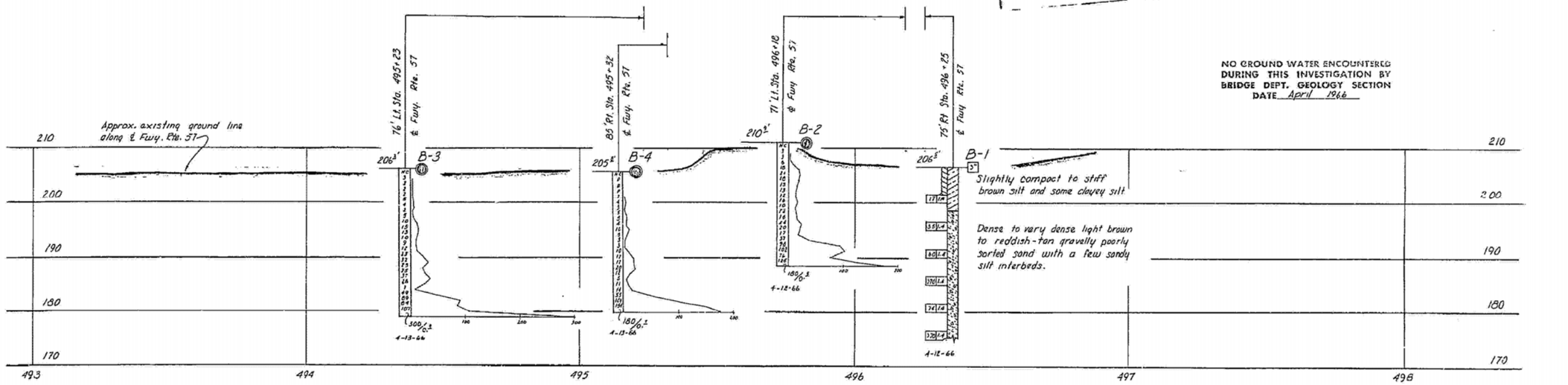
BENCH MARK

BM # 496-65 Elev. 211.469
Set R/S in N.W. footing of R.P. signal actuator 233 ft. E. of ℄ Fwy. & 25 ft.± N. of ℄ A.T.& S.F. R.R. (Main line)



PLAN
Scale 1" = 20'

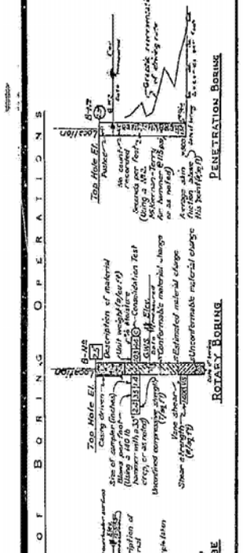
AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668



NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE April 1966

PROFILE
Scale Vert. 1"= 10'
Horiz. 1"= 20'

LEGEND OF BORING OPERATIONS



- Penetrometer
- 2½" Cone Penetrometer
- Sampler Boring (dry)
- Rotary Boring (wet)
- Auger Boring (dry)
- Jet Boring
- Core Boring
- Test Pit

LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Silty Clay or Clayey Silt
- Sandy Clay or Clayey Sand
- Sandy Silt or Silty Sand
- Organic Matter
- Fill Material
- Igneous Rock
- Sedimentary Rock
- Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

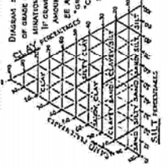


DIAGRAM SHOWING THE BASIS FOR ESTIMATES OF GRADE SIZE AND PROPORTIONS USED TO DETERMINATION OF CLASS NAMES.
IF GRAVEL IS PRESENT IN APPREciable AMOUNTS THE TERM "GRAVELLY" MAY BE USED TO DESCRIBE THE CLASS NAME, ETC. "GRAVELLY SAND", "SILTY GRAVEL", ETC. TERMS "COARSE", "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE SAND, SHALL HAVE REFERENCE TO STANDARD GRAIN SIZE LIMITS.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY	By D. CRAWFORD 4-13-66
DRAWN	By M. ALLREAD 4-21-66
CHECKED	By W. CAIN 5-6-66

Approved Recommended for Approval: Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER ____ DATE ____

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

RETAINING WALL NO. 492

LOG OF TEST BORINGS NO. 9

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No. 55E0082

Sheet 36 of 36

AS BUILT
CORRECTIONS BY Hixson 7-28-69
CONTRACT NO. 07-032124
DATE 5-11-69

SHEET	OF
13	13

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PLACENTIA OVERHEAD

LOG OF TEST BORINGS

SCALE As Noted	BRIDGE 55-449 R/L	FILE	DRAWING 55449-16

147

Charge 07208
W.A. 032121

Disregard prints bearing earlier numbers →

PREL. DRAWING No. PR- 66/67

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

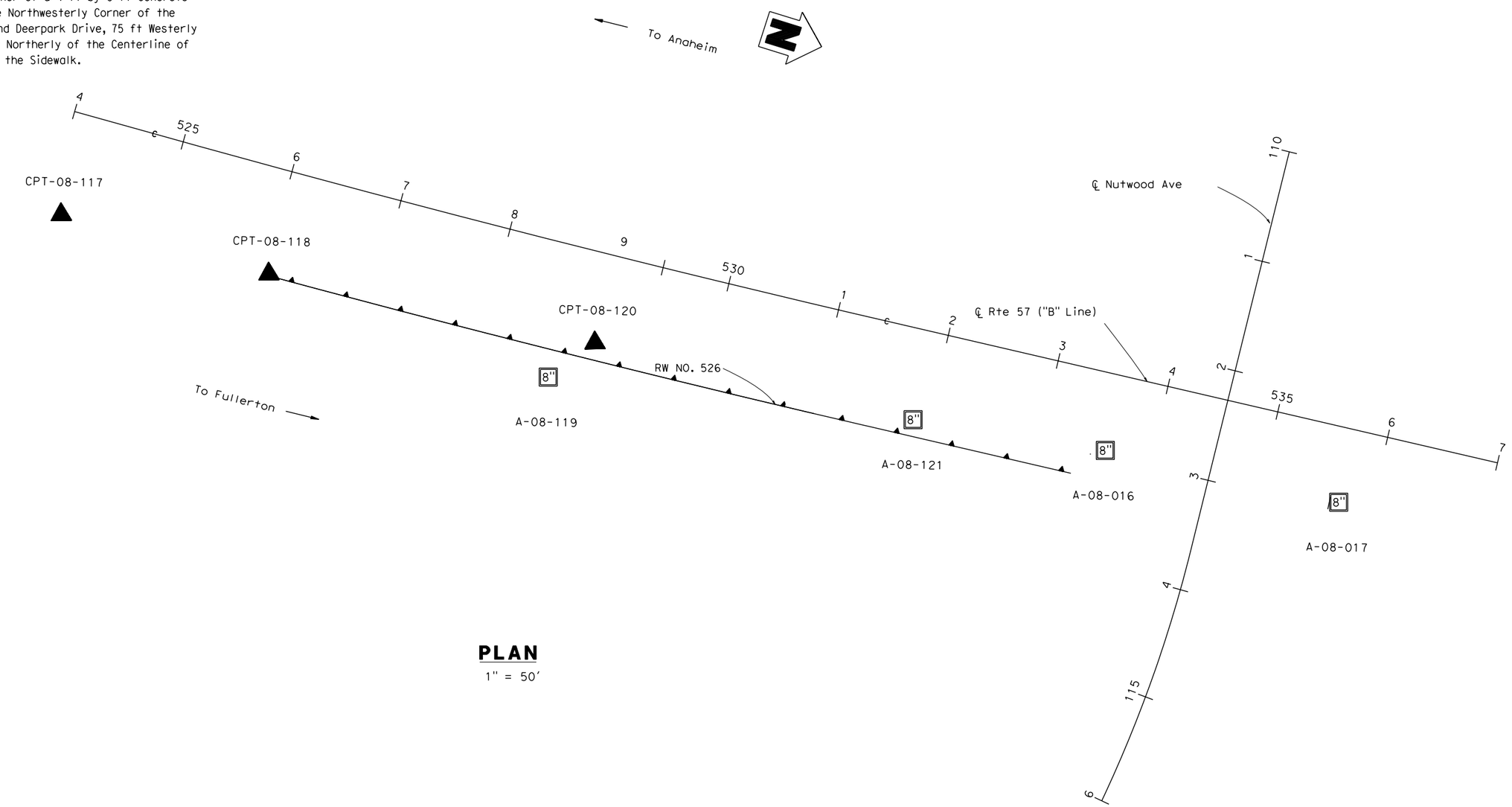
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN

1" = 50'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0084 POST MILES 16.2/18.6

RETAINING WALL NO. 526
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

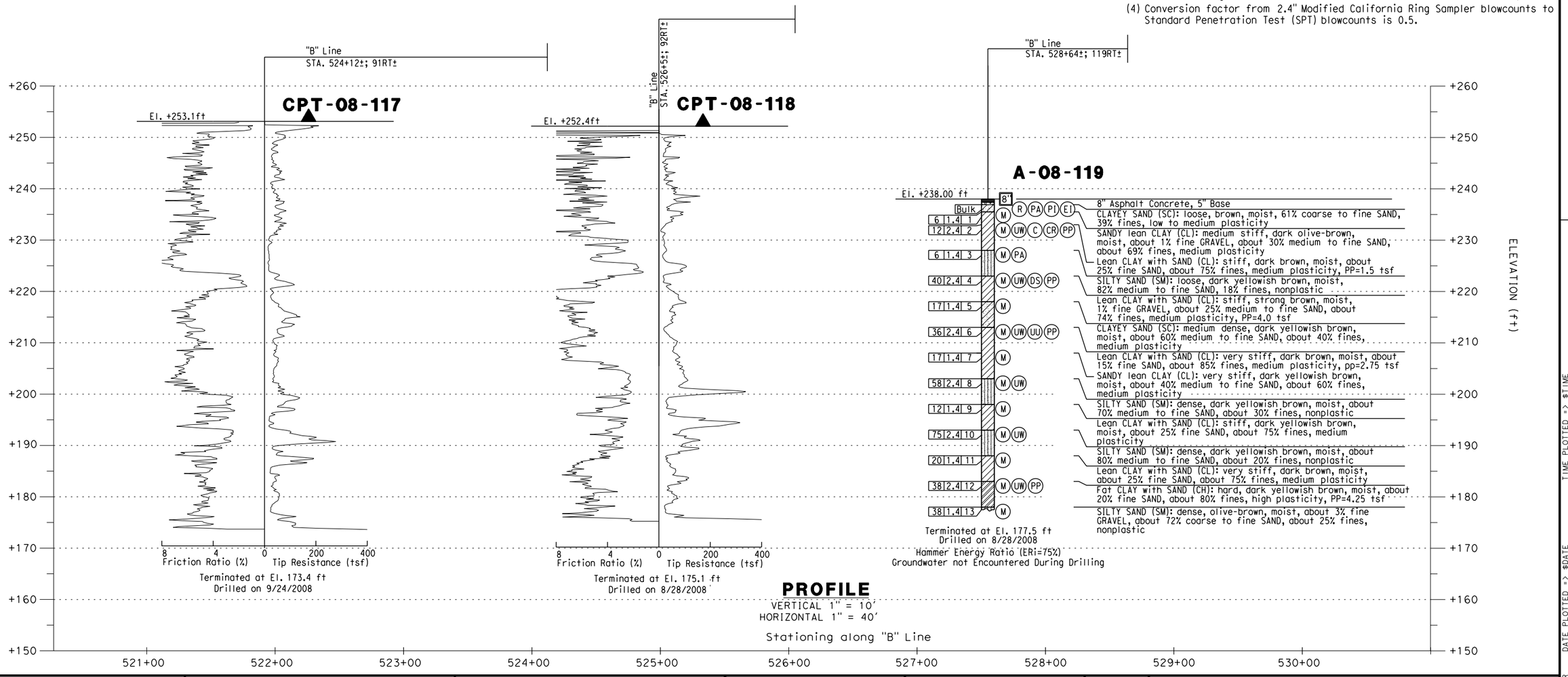
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 526, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0084 POST MILES 16.2/18.6

RETAINING WALL NO. 526
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 42 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

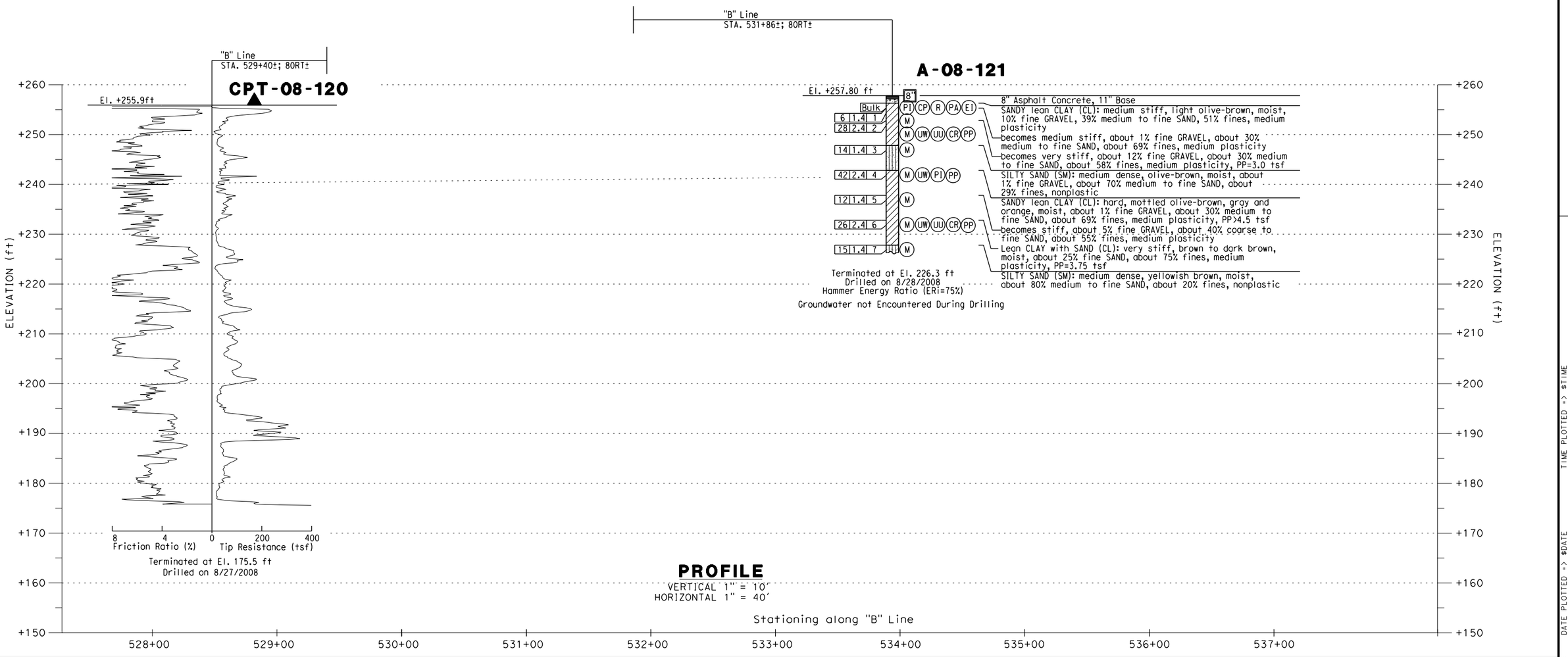
Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 526, LOG OF TEST BORINGS NO. 1"



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO. 55E0084	RETAINING WALL NO. 526
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 44 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

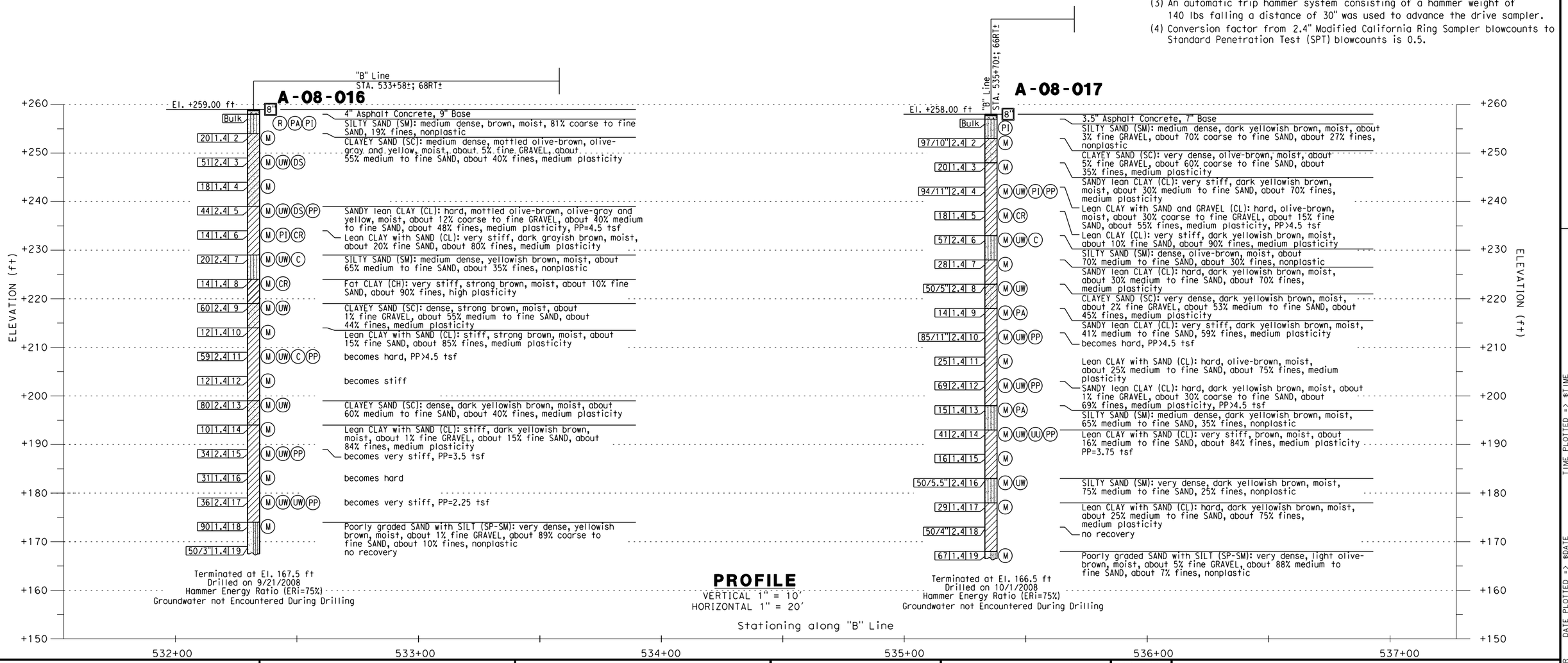
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 526, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER	BRIDGE NO. 55E0084 POST MILES 16.2/18.6

RETAINING WALL NO. 526
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 43 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

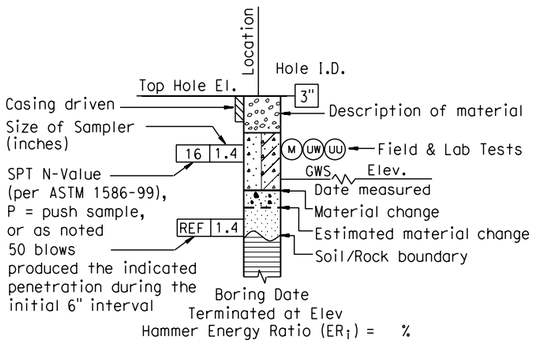
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

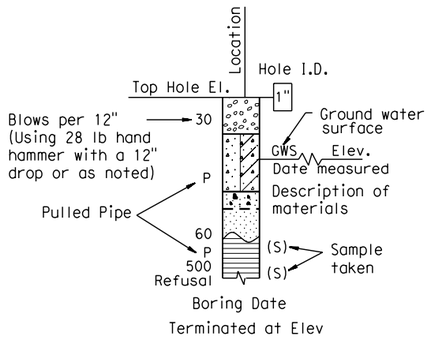
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

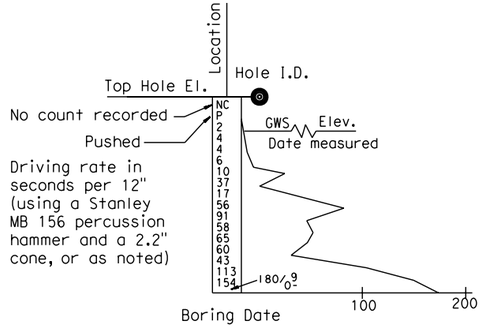
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



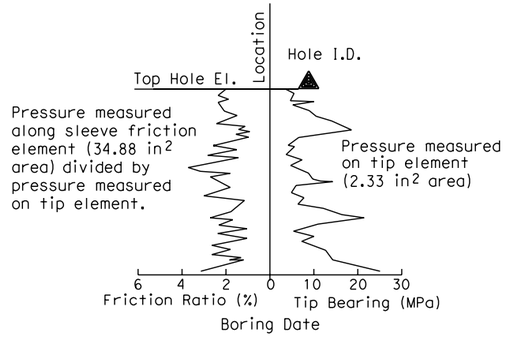
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0084 POST MILES 16.2/18.6

RETAINING WALL NO. 526
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90)
Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166)
Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0084
POST MILES 16.2/18.6

RETAINING WALL NO. 526
LOG OF TEST BORINGS NO. 6

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

FILE => $REQUEST

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	16.2/18.6	197	197

DATE APPROVED: August 28 1967

BENCH MARK

BM "519R-65" Elev. 217.39
Set B/3 in N. curb of Chapman Ave.
@ E.C.R. from Placentia Ave 48' W. of
Placentia & 31' N. of ℄ Chapman

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		
REGISTERED CIVIL ENGINEER			DATE		

RETAINING WALL NO. 526

LOG OF TEST BORINGS NO. 7

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12	BRIDGE No.
EA: 0F0311	55E0084
Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

LEGEND OF BORING OPERATIONS

Penetrometer; 2½" Cone Penetrometer; Sampler Boring (Dry); Rotary Boring (Wet); Auger Boring (Dry); Jet Boring; Core Boring; Test Pit

Penetration Boring — Rotary Boring — 1" Soil Tube

LEGEND OF EARTH MATERIALS

Gravel; Sand; Silt; Clay; Silty Clay or Clayey Silt; Peat and/or Organic Matter; Fill Material; Igneous Rock; Sandy Clay or Silty Clay; Sedimentary Rock; Sandy Silt or Silty Sand; Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

Diagram showing the basis for estimates of hand size distinctions used in determining size limits.

If gravel is present in appreciable quantities the term "gravelly" may be added to the class name, viz. "gravelly silt". The terms "coarse", "medium" and "fine" when used to describe sand, silt and gravel, refer to standard grade size limits.

Silt Particles

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

	By	Date
*FIELD STUDY	K. COFBAILEY	6-29-66
DRAWN	M. ALLRED	7-27-66
CHECKED	C. Ramis	7-29-66

Approved Recommended: Charles E. Elliott, Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

197

B-3 ⑤

N 626,375.396
E 505,410.087

112

℄ FWY RTE 57

534 535

B-2 ⑫

℄ NUTWOOD AVE

113

B-1 ⑫

PLAN
Scale 1"= 20'

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668

63' Lt. Sta. 534+14 ℄ Fwy

93' Lt. Sta. 534+29 ℄ Fwy

10' Lt. Sta. 535+10 ℄ Fwy

Approx. existing ground line along ℄ Fwy Rte 57

B-1 — 234.8

B-3 — 234.4 — ⑤ Loose to slightly compact brown fine sand

B-2 — 235.5

Compact brown silty fine sand

Compact brown medium to fine sand

Loose brown fine sand

Slightly compact to compact brown silty fine sand

Slightly compact brown fine sand

Slightly compact brown silty fine sand

Compact to dense brown medium to fine sand

240 230 220 210 200 190 180 170

533 534 535 536

300 200 100 100/0.5 — 6-29-66

300/0.2 — 6-29-66

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE June 1966

AS BUILT
CORRECTIONS BY: #1 X-Sec Plot 7-27-67
CONTRACT NO. 07-032124
DATE 9-30-67

PROFILE
Scale Vert. 1"= 10'
Horiz. 1"= 20'

SHEET	OF
12	12

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

NUTWOOD AVENUE UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted	BRIDGE 55-464	FILE	DRAWING 55464-12

Disregard prints bearing earlier numbers → PREL. DRAWING NO. PR- 11/67

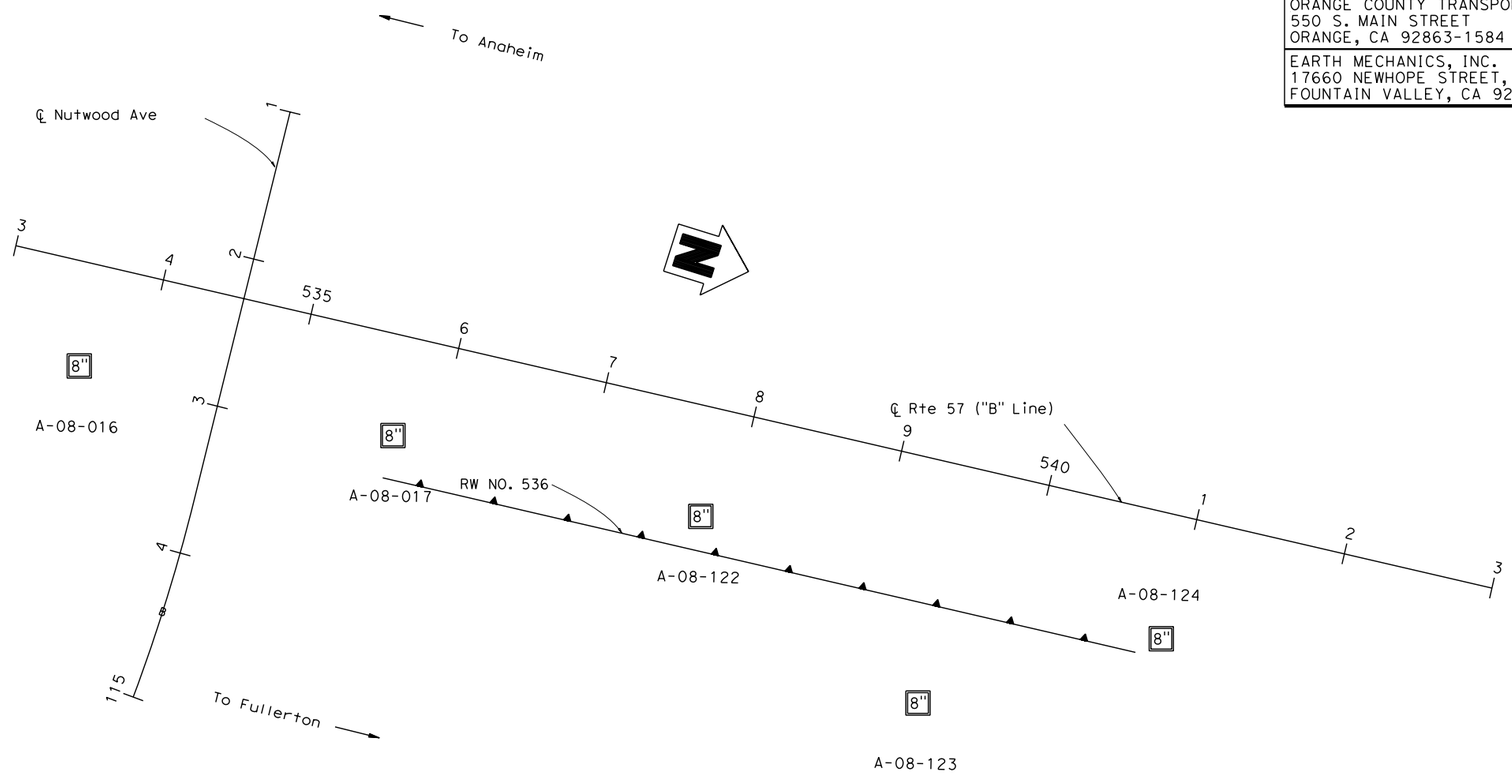
Charge 07208
W. A. 032131

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 50'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0085
POST MILES 16.2/18.6

RETAINING WALL NO. 536
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

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SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FILE => $REQUEST

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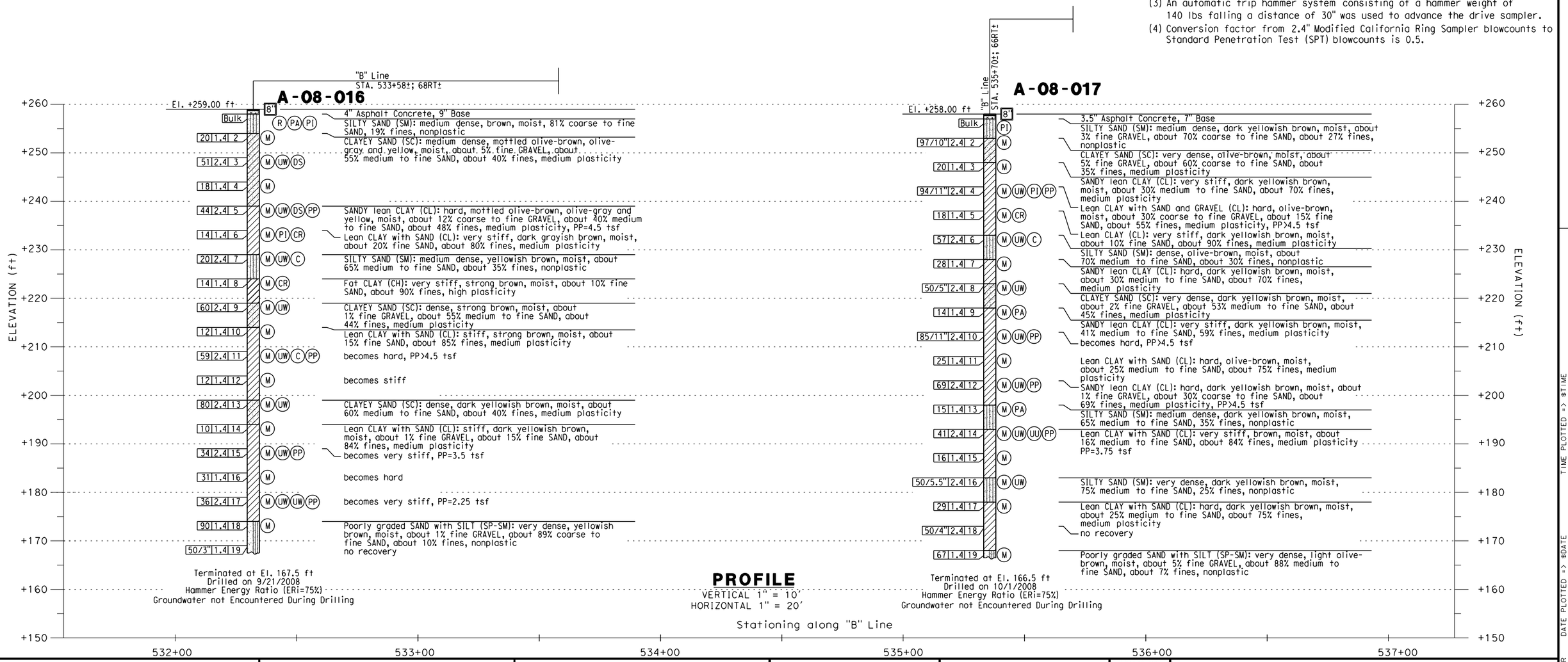
EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 536, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER	BRIDGE NO. 55E0085 POST MILES 16.2/18.6

RETAINING WALL NO. 536
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 43 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
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REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

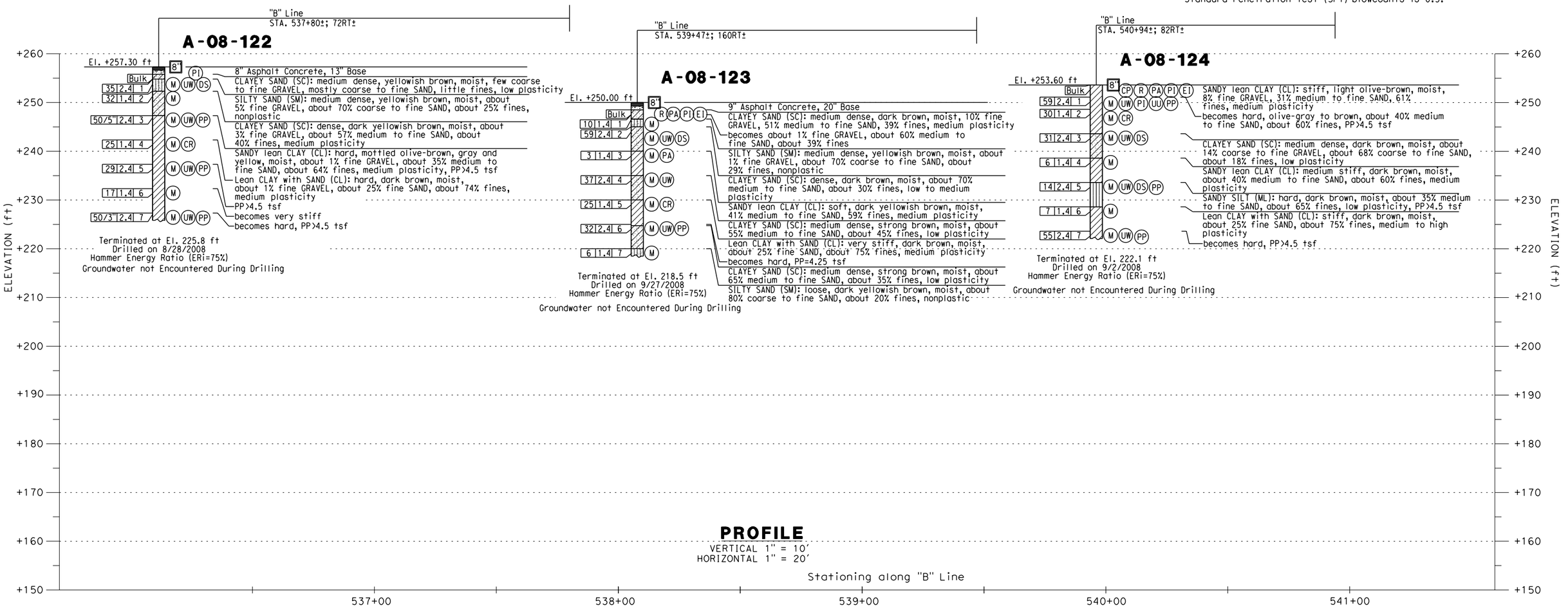
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 536, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0085 POST MILES 16.2/18.6	RETAINING WALL NO. 536 LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 45 OF 46

FILE => $REQUEST

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
USERNAME => $USER

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
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ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

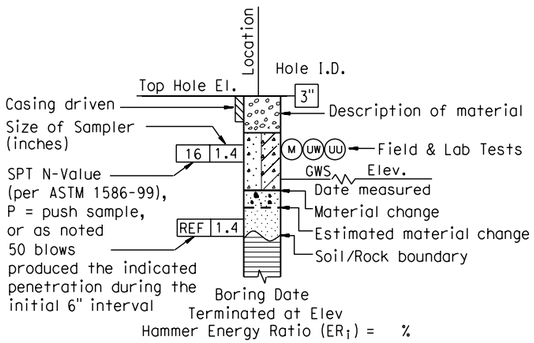
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

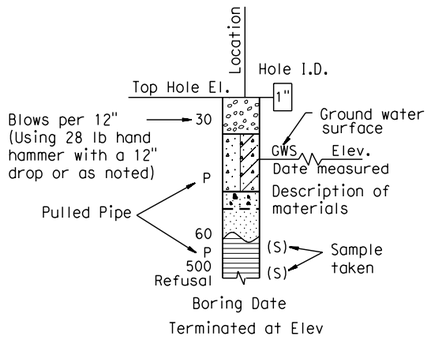
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

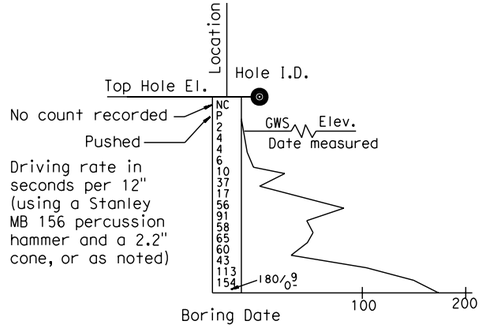
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



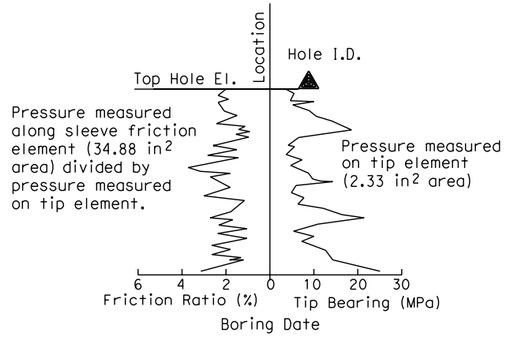
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0085 POST MILES 16.2/18.6

RETAINING WALL NO. 536
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90)
Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166)
Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0085
POST MILES 16.2/18.6

RETAINING WALL NO. 536
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

FILE => $REQUEST

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	16.2/18.6	197	197

DATE APPROVED: August 28 1967

BENCH MARK

BM "519R-65 Elev. 217.39
Set B/3 in N. curb of Chapman Ave.
@ E.C.R. from Placentia Ave 48' W. of
Placentia & 31' N. of ℄ Chapman

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER _____ DATE _____

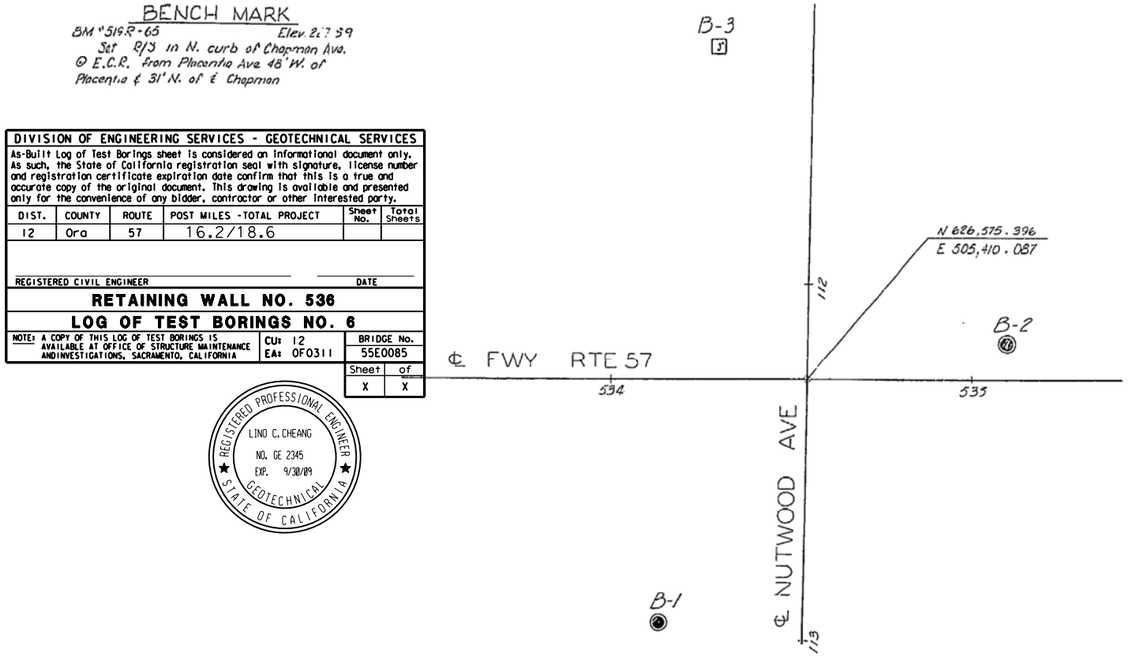
RETAINING WALL NO. 536

LOG OF TEST BORINGS NO. 6

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12	BRIDGE No. 55E0085
EA: 0F0311	Sheet X of X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA



PLAN
Scale 1"= 20'

AS BUILT PLANS
Contract No. 07-032124
Date Completed _____
Document No. 70000668

LEGEND OF BORING OPERATIONS

- Penetrometer
- 2½" Cone Penetrometer
- Sampler Boring (Dry)
- Rotary Boring (Wet)
- Auger Boring (Dry)
- Jet Boring
- Core Boring
- Test Pit
- Penetration Boring
- Rotary Boring
- 1" Soil Tube

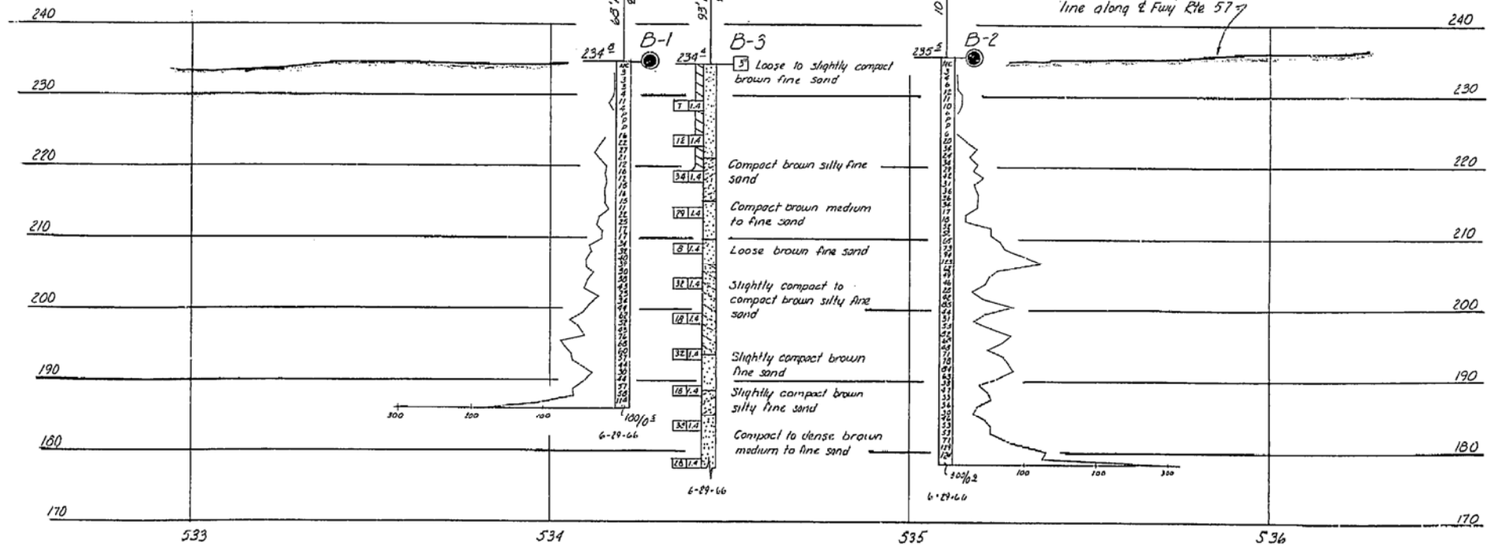
LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Silty Clay or Clayey Silt
- Peat and/or Organic Matter
- Fill Material
- Igneous Rock
- Sandy Clay or Silty Clay
- Sedimentary Rock
- Sandy Silt or Silty Sand
- Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

Diagram showing the basis for estimates of hand, bit, auger-drill used in material classification. If gravel is present in appreciable quantities the term "gravelly" may be added to the class name, viz. "gravelly silt". The terms "coarse", "medium" and "fine" when used to describe sand, silt and gravel, refer to standard grade size limits.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.



NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE June 1966

AS BUILT
CORRECTIONS BY: #1 X-Sec Plan 7-29-69
CONTRACT NO. 07-032124
DATE 9-30-69

PROFILE
Scale Vert. 1"= 10'
Horiz. 1"= 20'

SHEET	OF
12	12

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

NUTWOOD AVENUE UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted	BRIDGE 55-464	FILE	DRAWING 55464-1/2

Disregard prints bearing earlier numbers → PREL. DRAWING NO. PR- 11/67

	By	Date
FIELD STUDY	K. COFBAILEY	6-29-66
DRAWN	M. ALLRED	7-27-66
CHECKED	C. Ramis	7-29-66

Approved Recommended: Charles E. Elliott, Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

197

Charge 07208
W. A. 032131

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

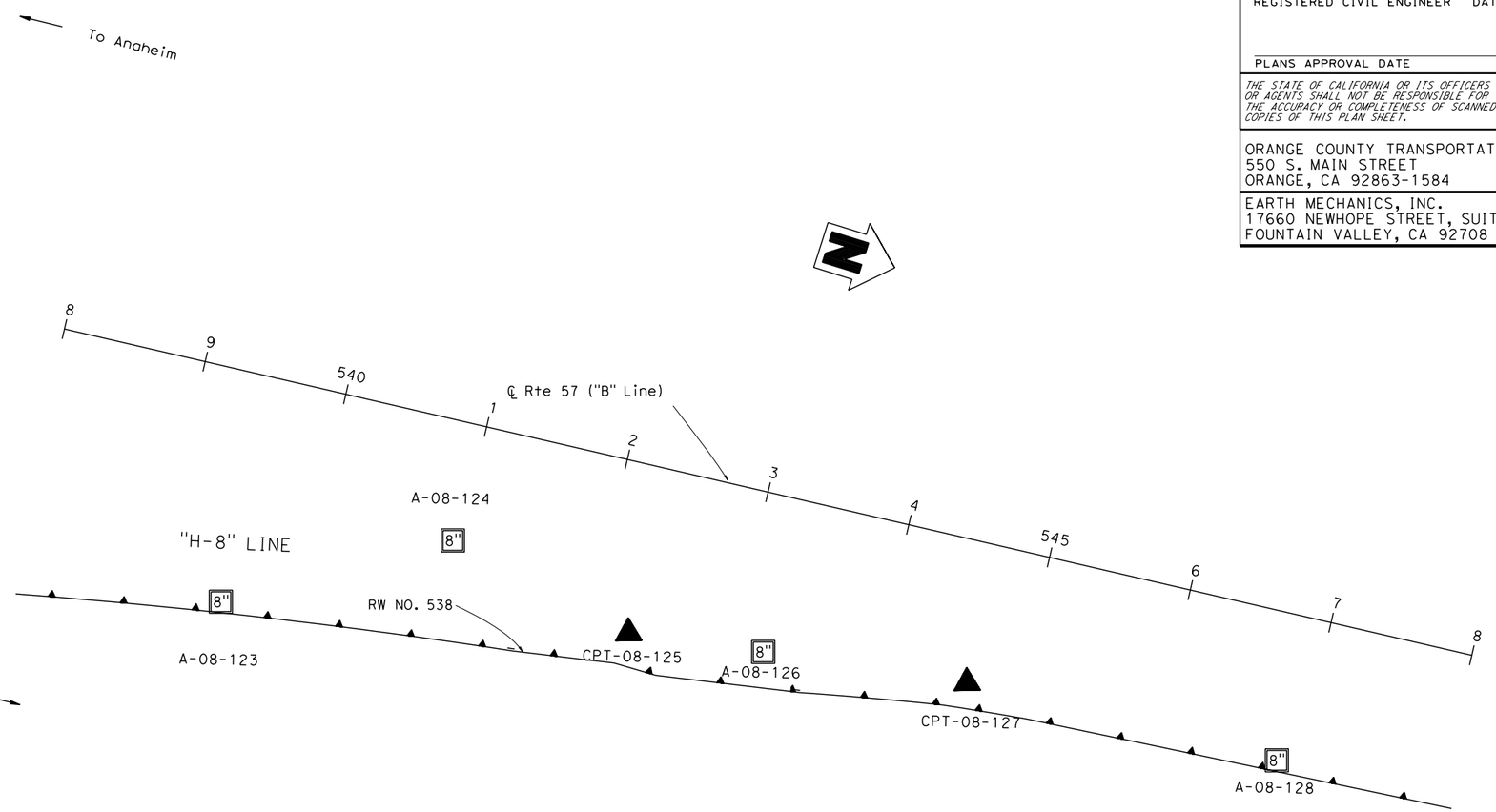
EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 50'

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0086
POST MILES 16.2/18.6

RETAINING WALL NO. 538
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

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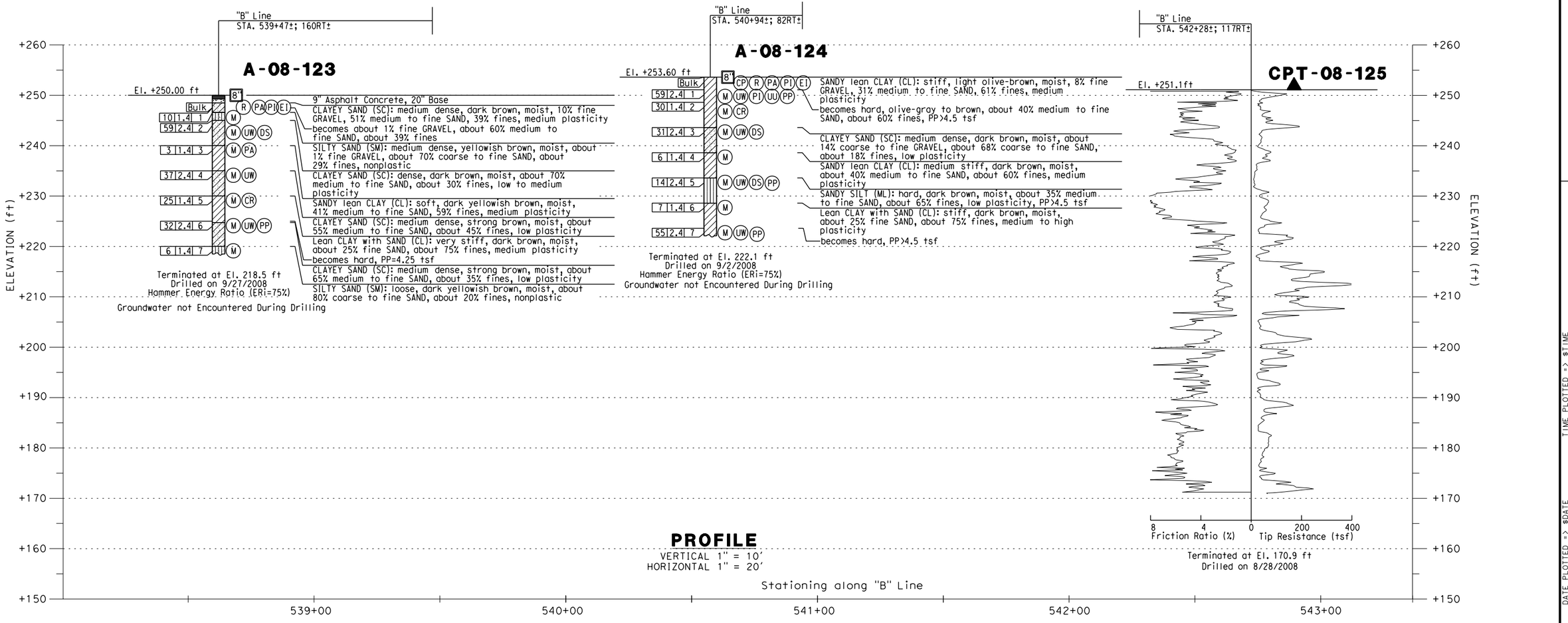
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 538, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0086 POST MILES 16.2/18.6	RETAINING WALL NO. 538 LOG OF TEST BORINGS NO. 2
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie				

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 45 OF 46

FILE => $REQUEST

DATE PLOTTED => $DATE TIME PLOTTED => $TIME USERNAME => $USER

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

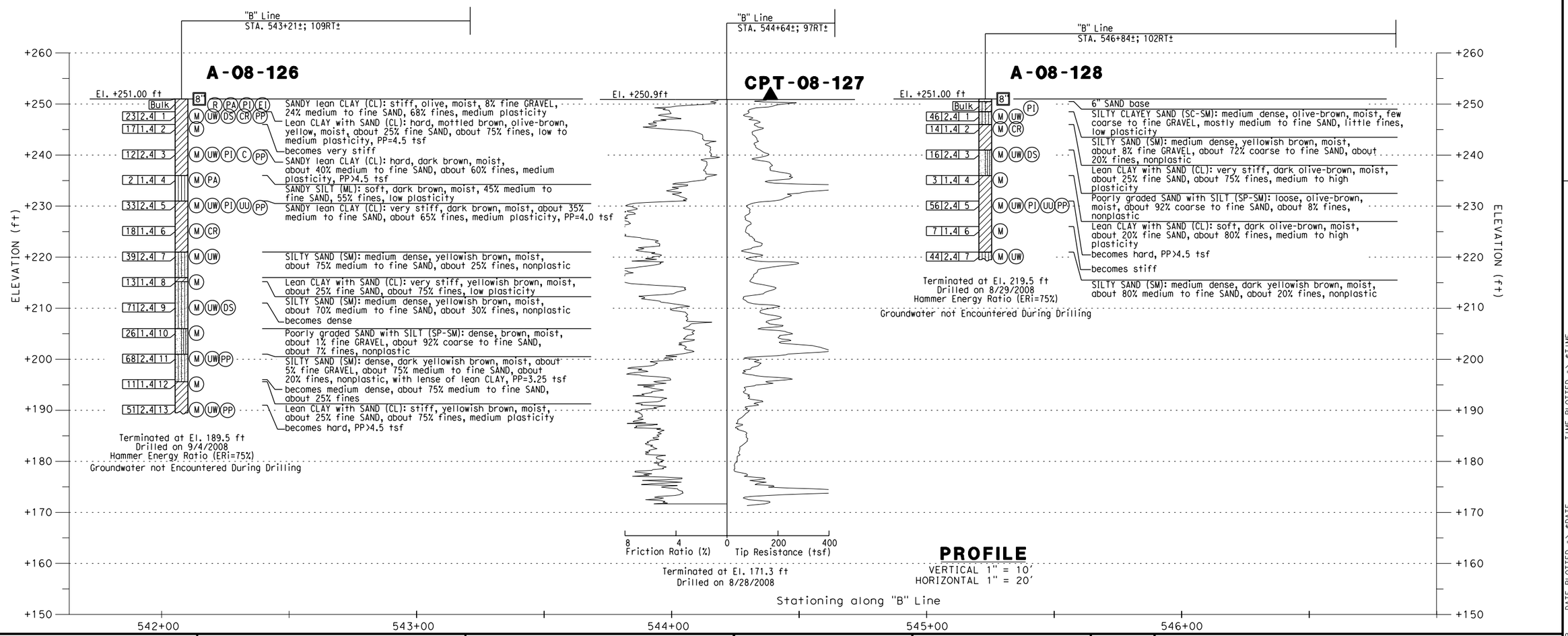
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 538, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0086 / POST MILES 16.2/18.6	RETAINING WALL NO. 538 LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 46 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

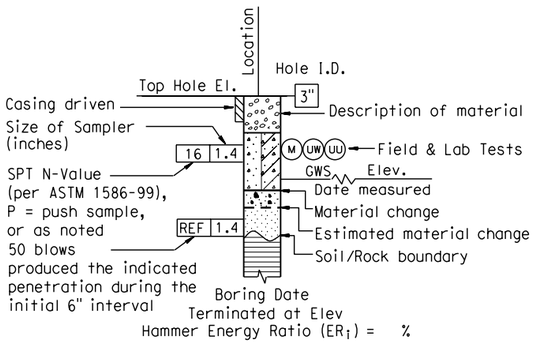
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

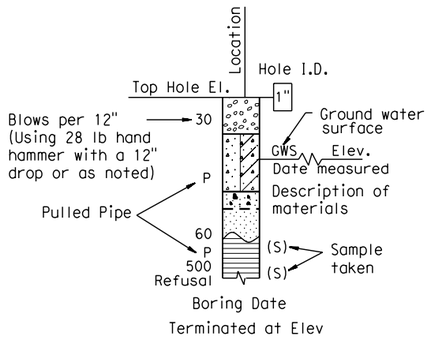
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

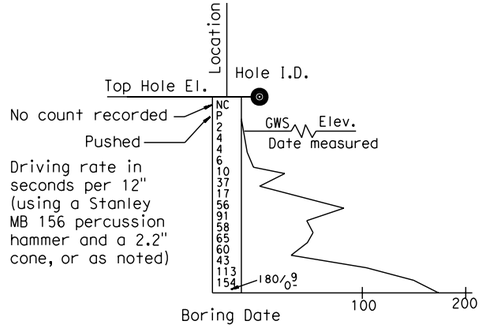
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



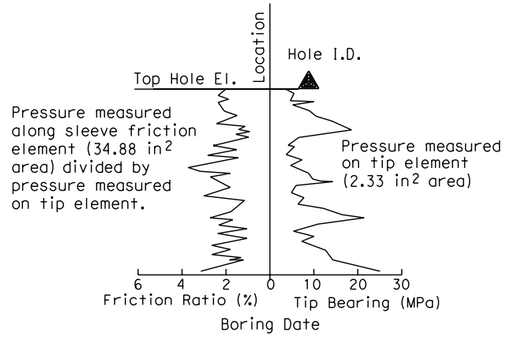
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0086 POST MILES 16.2/18.6

RETAINING WALL NO. 538
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 36 OF 46

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0086
POST MILES 16.2/18.6

RETAINING WALL NO. 538
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 37 OF 46

FILE => $REQUEST

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

APPENDIX A3

EXPLORATORY BORING LOGS FOR MSE WALLS

RW 476 and RW 496

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Chien-Tai Yang
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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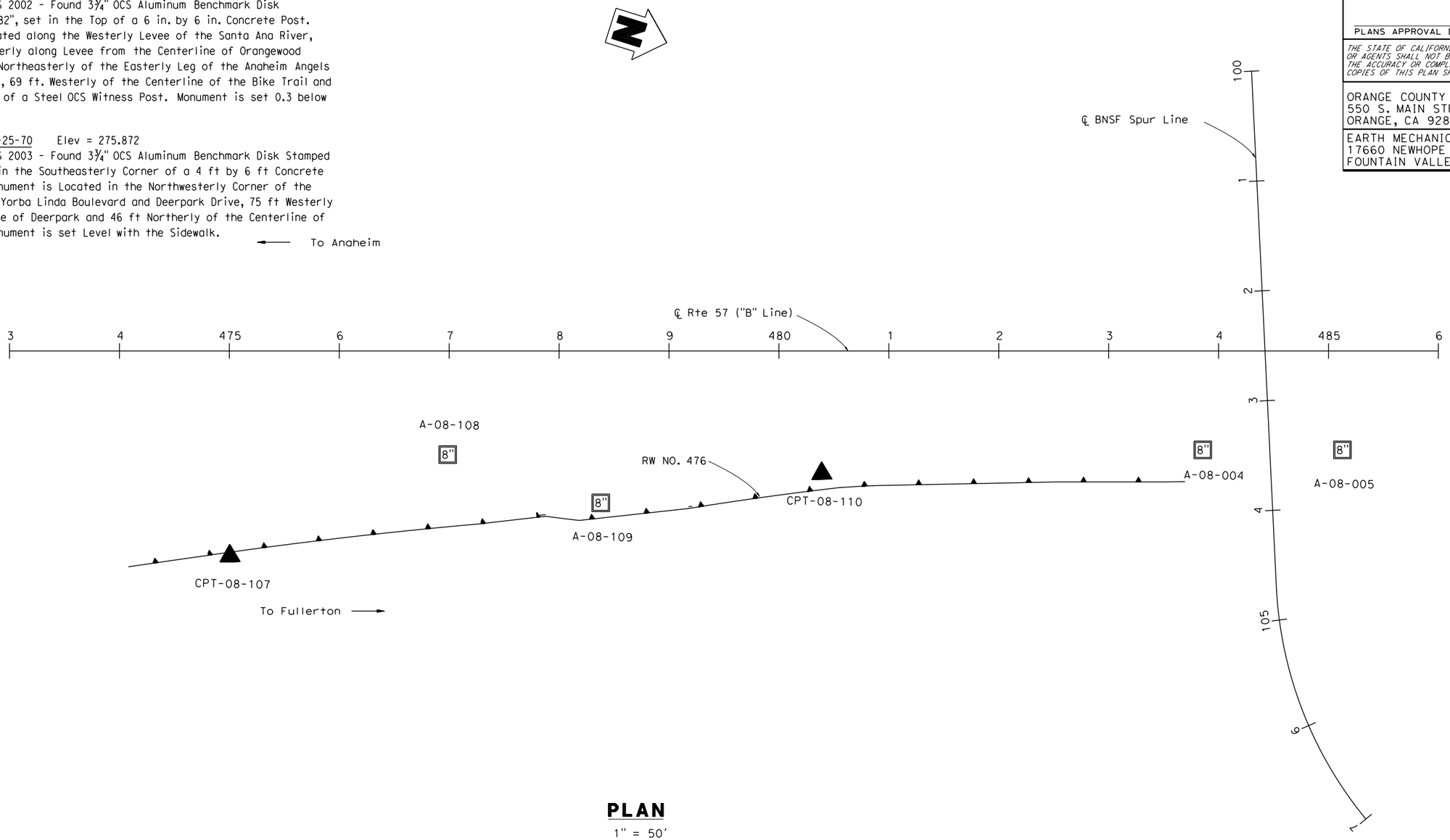
FOUNTAIN VALLEY, CA 92708



PLAN
1" = 50'

DESIGN OVERSIGHT / SIGN OFF DATE	DRAWN BY: J. Fang / CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER	BRIDGE NO. 55E0081 / POST MILES 16.2/18.6	RETAINING WALL NO. 476 / LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3
CU 12 EA 0F0311
DISREGARD PRINTS BEARING EARLIER REVISION DATES →
REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09
SHEET OF
FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL — REGISTERED PROFESSIONAL ENGINEER — STATE OF CALIFORNIA

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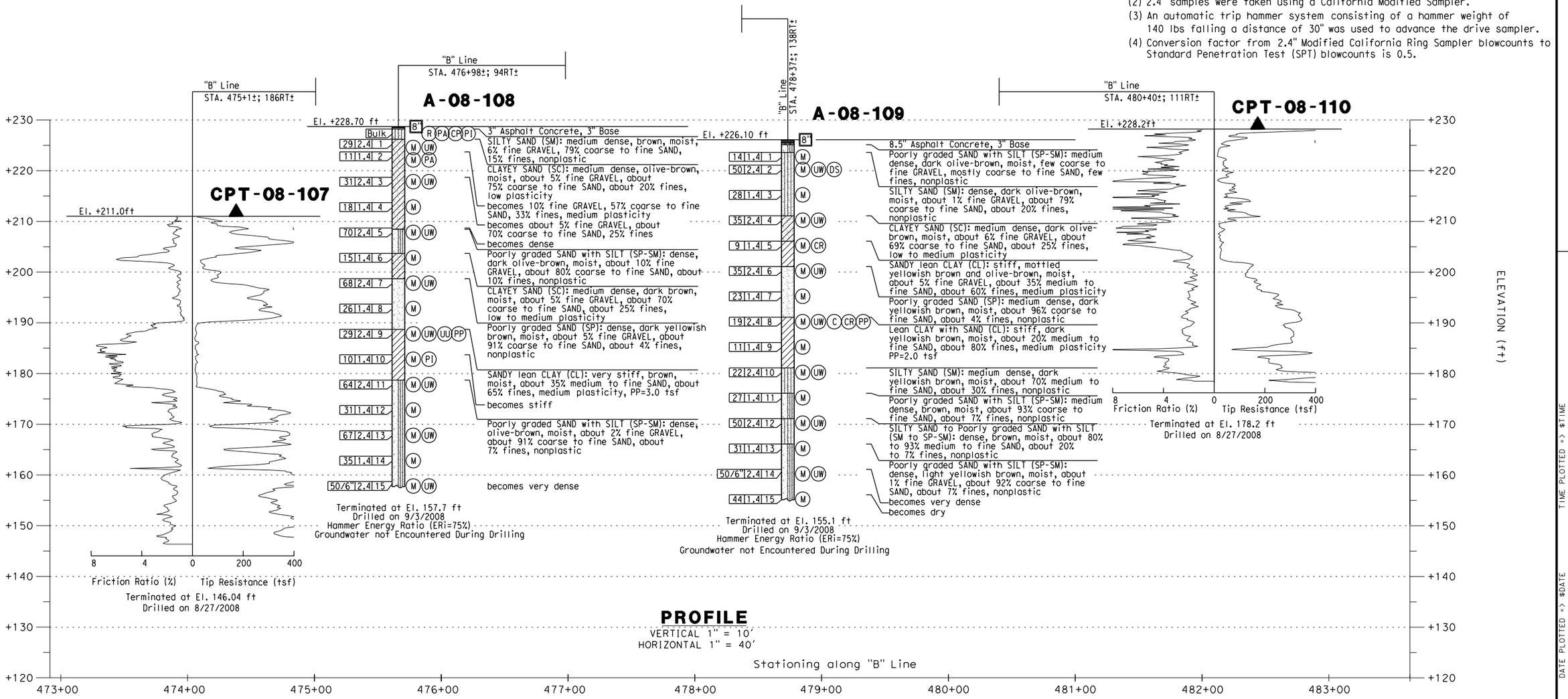
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 476, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0081	RETAINING WALL NO. 476	
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6	LOG OF TEST BORINGS NO. 2	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET 16 OF 17

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

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Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
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EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
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FOR PLAN VIEW SEE "RETAINING WALL NO. 476, LOG OF TEST BORINGS NO. 1"

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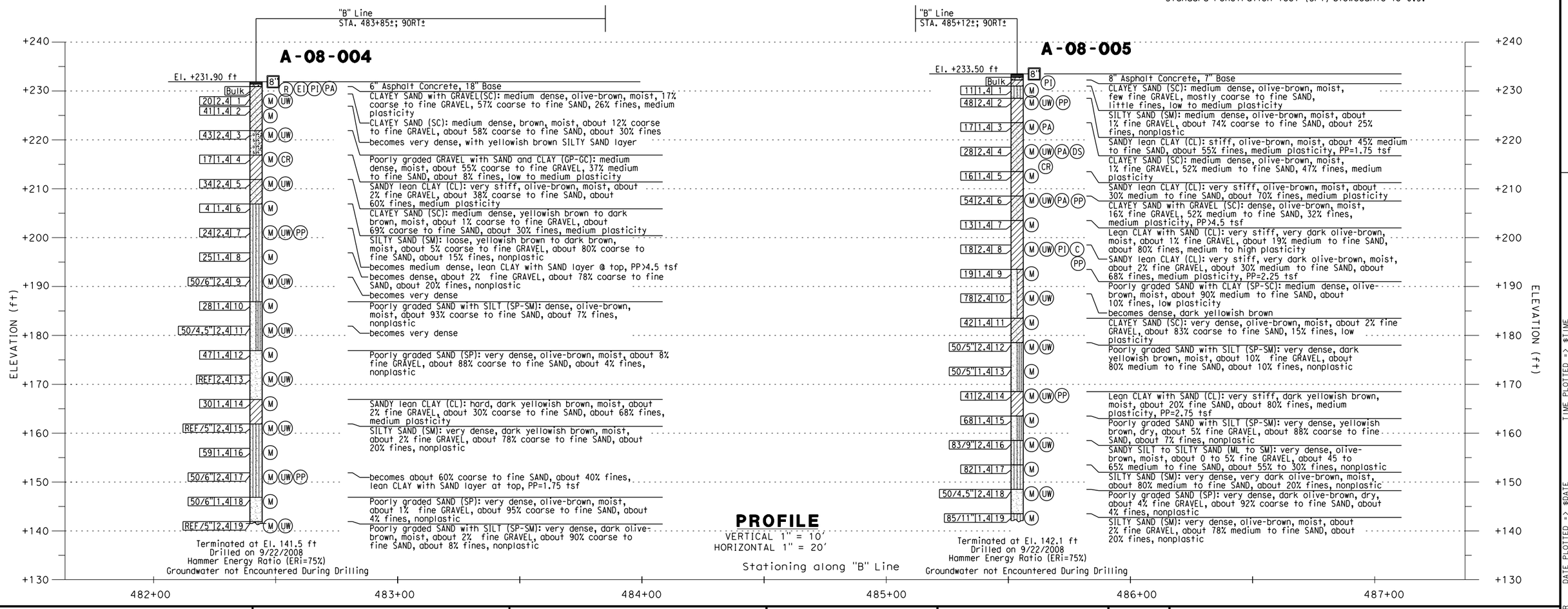

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang	BRIDGE NO. 55E0081
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6

RETAINING WALL NO. 476
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

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SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

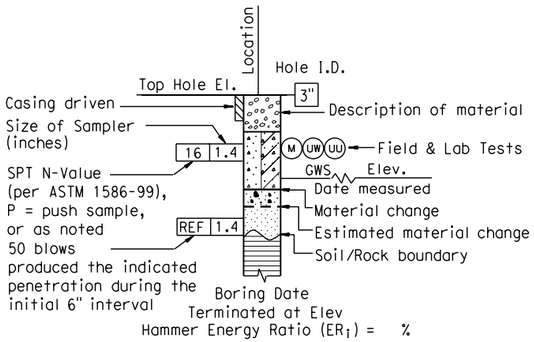
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

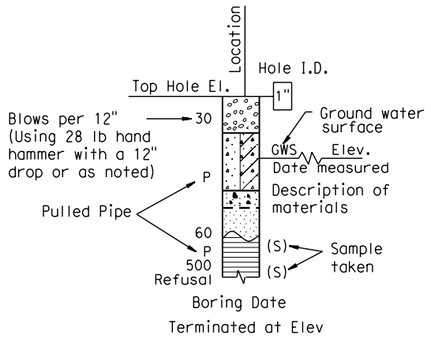
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

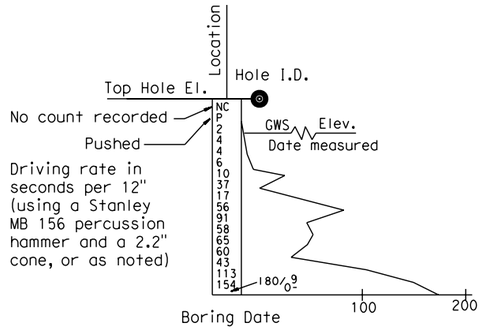
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



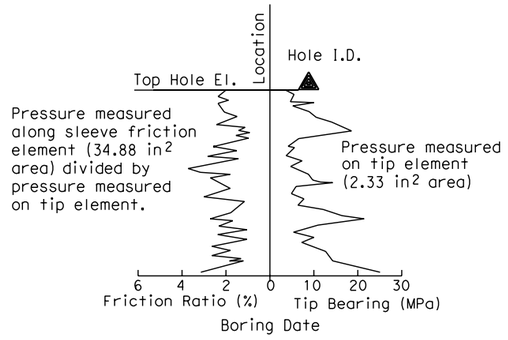
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0081 POST MILES 16.2/18.6

RETAINING WALL NO. 476
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 14 OF 17

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0081
POST MILES 16.2/18.6

RETAINING WALL NO. 476
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 15 OF 17

FILE => $REQUEST

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		
REGISTERED CIVIL ENGINEER			DATE		

RETAINING WALL NO. 476

LOG OF TEST BORINGS NO. 6

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No. 55E0081

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/89
GEOTECHNICAL
STATE OF CALIFORNIA

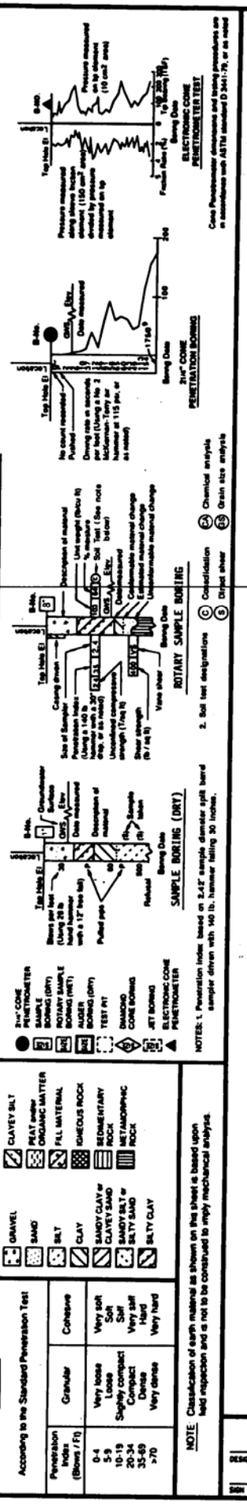
DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	467	491

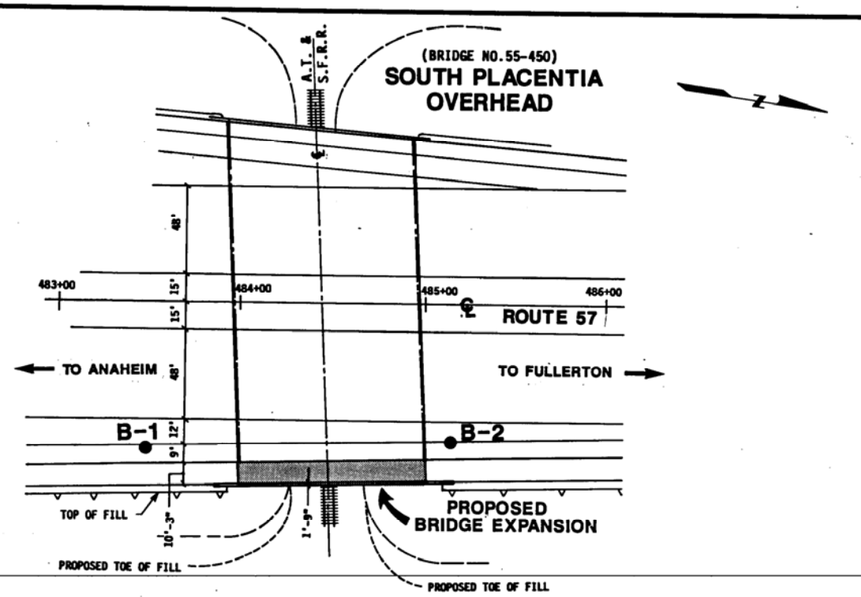
Kul Bhushan 12/20/89
GEOTECHNICAL PROFESSIONAL

10-29-90
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
KUL BHUSHAN
No. GE 000144
Exp. 12/31/1989
GEOTECHNICAL
STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351



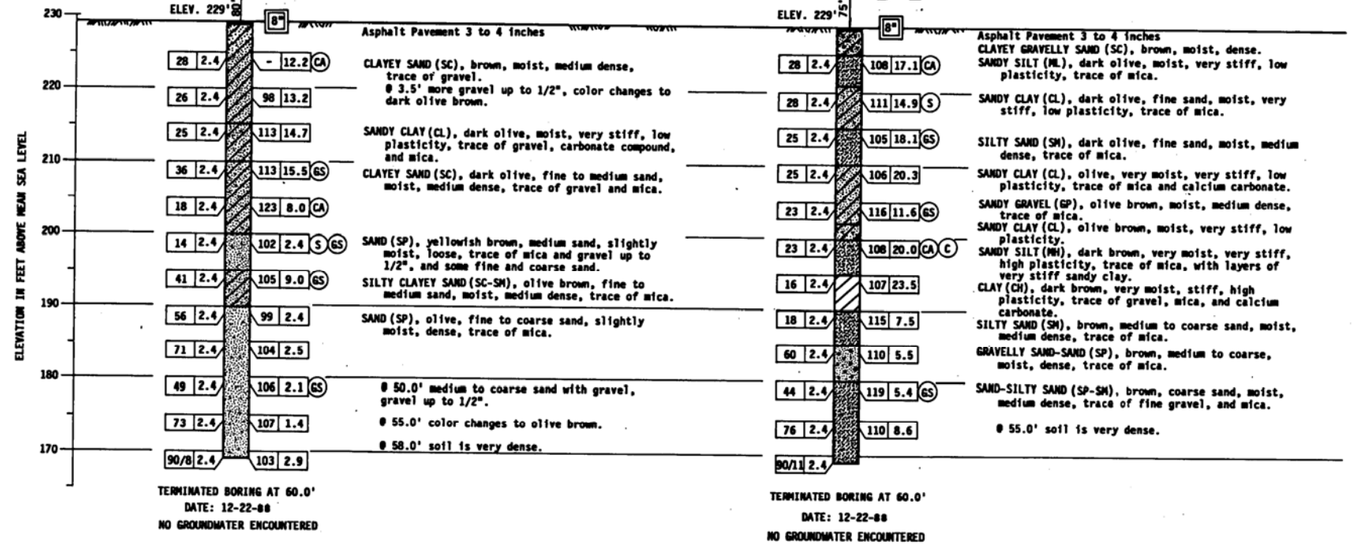


PLAN

SCALE: 1"=40'

PROFILE

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'



AS BUILT

NO AS BUILT CHANGES
J. PALMEIRO

CORRECTIONS BY I. MANGLE

CONTRACT NO. 12-020184

DATE 11-24-92

BM 535-D-70 ELEVATION 257.37

FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60 AND 105 FEET NORTHERLY OF THE CENTERLINE OF NUTWOOD AVE..

DESIGN OVERSIGHT 8-22-90
SIGN OFF DATE

DRAWN BY B. BASMADJIAN
CHECKED BY H. ABDALLAH

S. MOHAMAD
FIELD INVESTIGATOR
DATE 12-28-89

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Victor Lee
PROJECT ENGINEER

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12208
EA 020180

BRIDGE NO. 55-450
POST MILE 16.7

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 9 OF 10

SOUTH PLACENTIA OVERHEAD (WIDEN)

LOG OF TEST BORINGS

FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	BACK/AHEAD	SHEET NO.	TOTAL SHEETS
07	ORA	57	16.6/18.122	122	197

Date approved August 28, 1967

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER _____ DATE _____

RETAINING WALL NO. 476

LOG OF TEST BORINGS NO. 7

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 EA: 0F0311

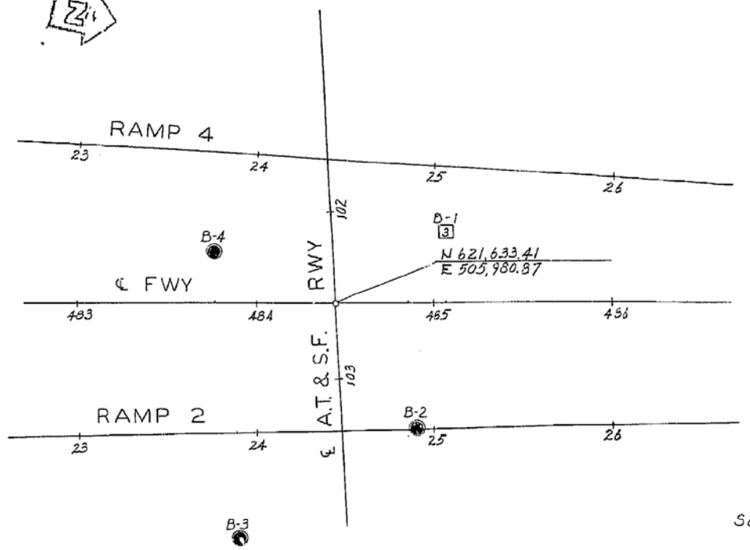
BRIDGE No. 55E0081

Sheet	of
X	X

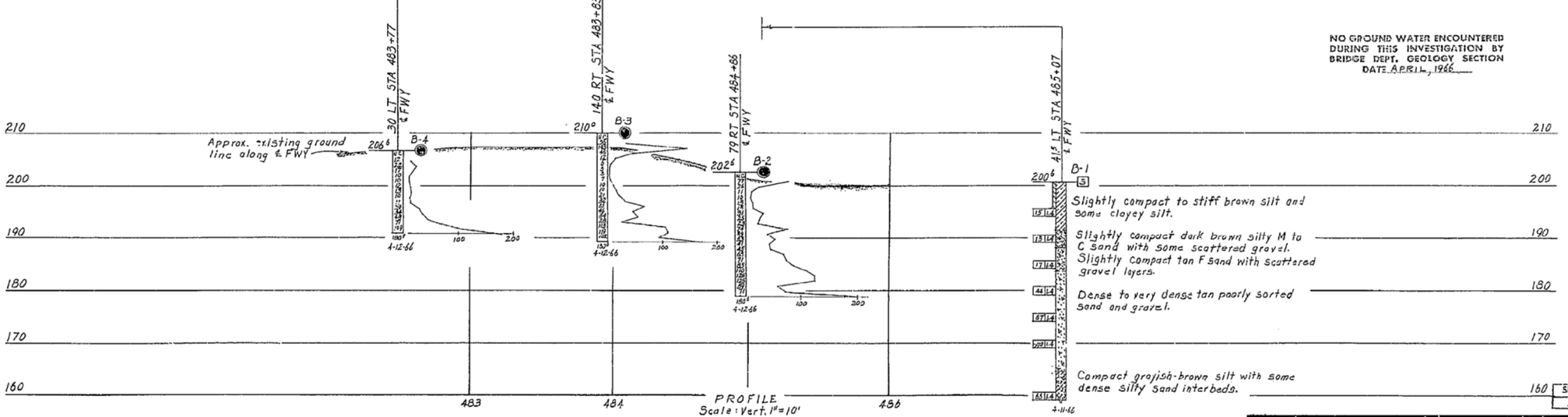
REGISTERED PROFESSIONAL ENGINEER — LINO C. CHEANG — NO. GE 2345 — EXP. 9/30/09 — GEOTECHNICAL — STATE OF CALIFORNIA

BENCH MARK

B.M. 484-65 Elev. 205.336
Set R.R. spk. in N. side of P.P. #102608 E. 135 Ft. W. of ℄ intersection Frwy. ℄ A.T. & S.F. R.R. spurline 26 Ft. S. of ℄ Tracks 15 Ft. above O/G.

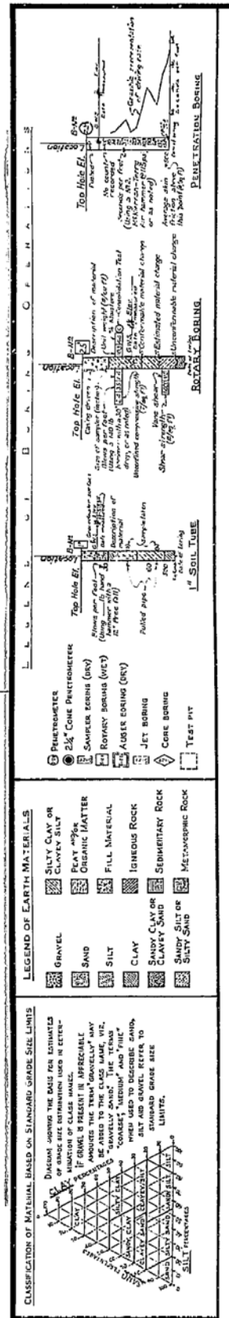


PLAN
Scale: 1" = 40'



PROFILE
Scale: Vert. 1" = 10'
Horiz. 1" = 40'

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE APRIL, 1966



NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY	H.D.L. Cranfill	4-12-66
DRAWN	H.A.R. Soltis	4-22-66
CHECKED	L.C. Cheang	4-26-66

Approved: [signature] Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

AS BUILT PLANS
Contract No. 07-032124
Date Completed _____
Document No. 70000668

AS BUILT
CORRECTIONS BY Hixson 7-28-69
CONTRACT NO. 67-032124
DATE 4-30-

Charge: 07206
W.A. 032121

Disregard prints bearing earlier numbers →

PREL. DRAWING NO. PR- 76/67

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SOUTH PLACENTIA OVERHEAD

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-450 R/L | FILE | DRAWING 55450-13

SHEET	OF
13	18

122

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED ENGINEER DATE

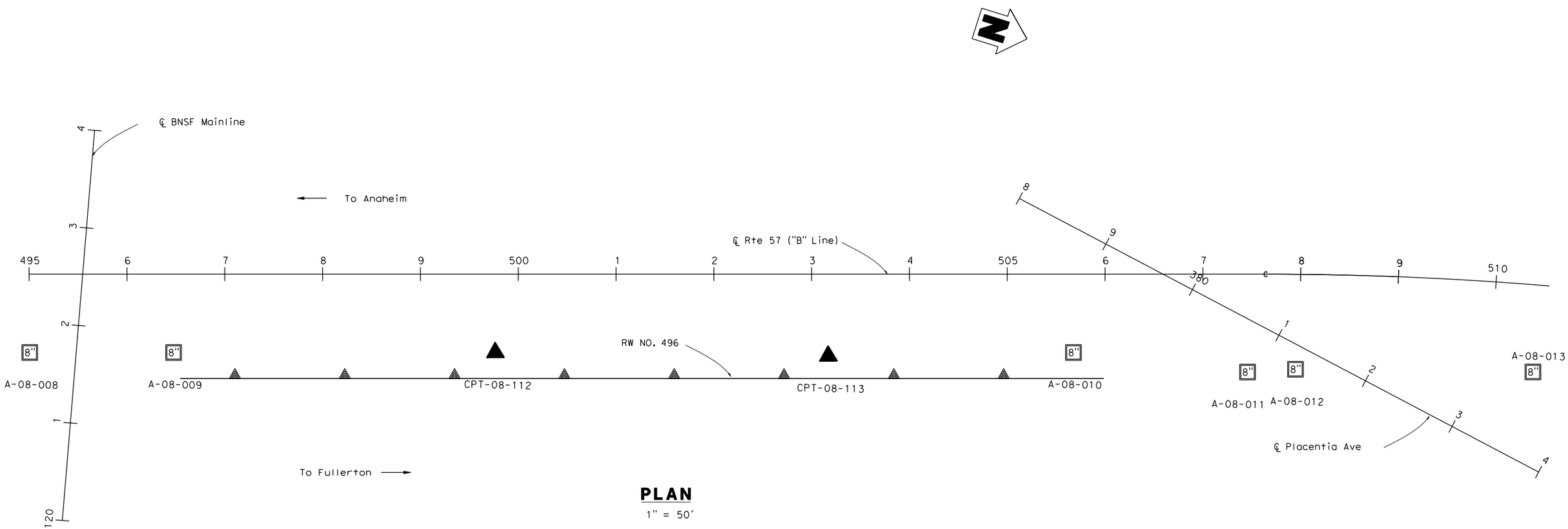
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
L. CHEANG
NO. GE 2345
EXP. 9-30-09
GEOTECHNICAL
STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708



PLAN
1" = 50'

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0083
POST MILES 16.2/18.6

RETAINING WALL NO. 496
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 496, LOG OF TEST BORINGS NO. 1"

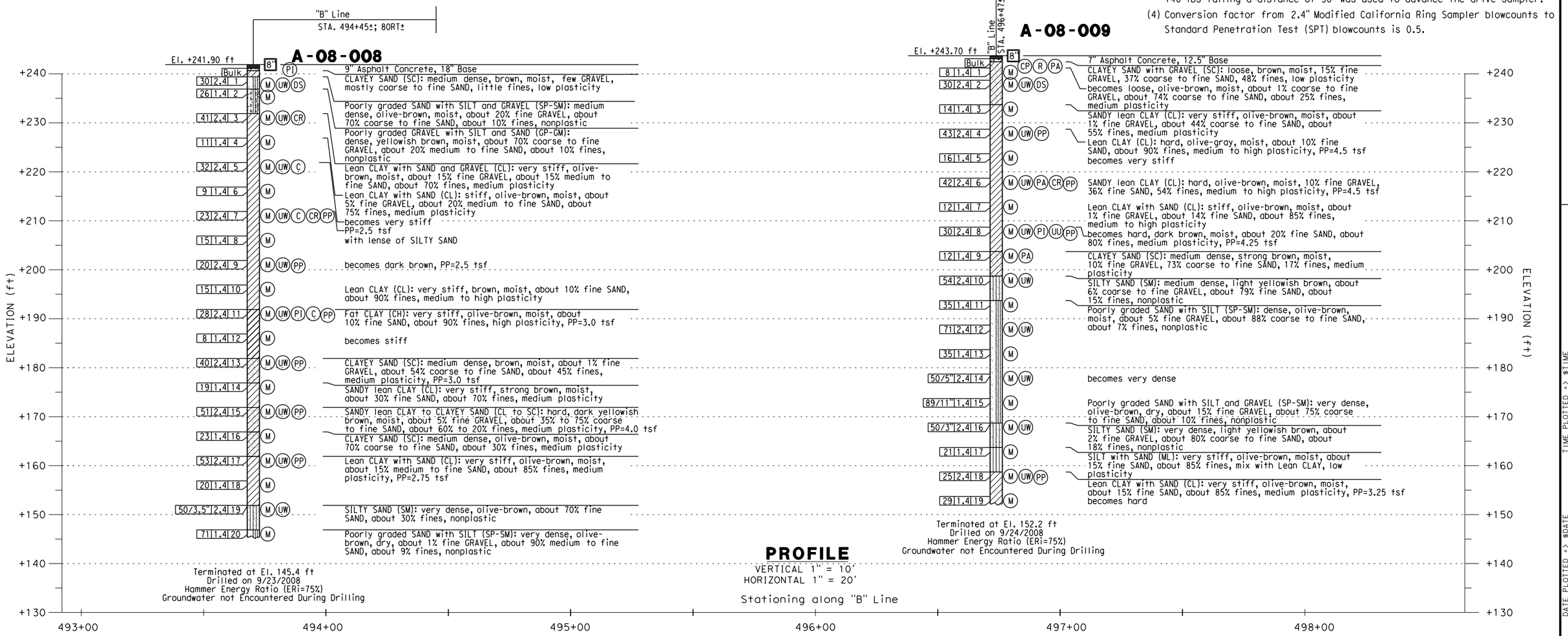
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	**PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION**	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0083 POST MILES 16.2/18.6

RETAINING WALL NO. 496
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED ENGINEER _____ DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:

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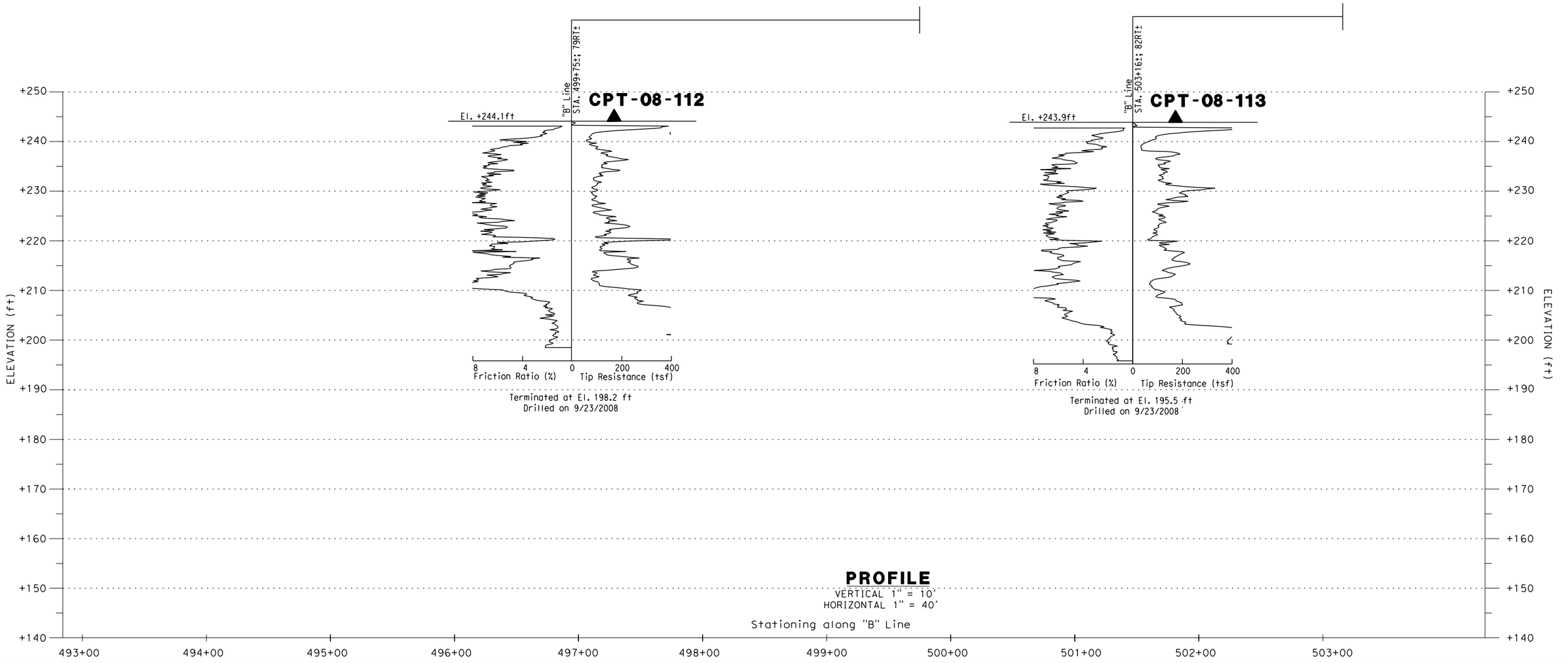
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.

FOR PLAN VIEW SEE "RETAINING WALL NO. 496, LOG OF TEST BORINGS NO. 1"

PLAN

1" = 50'



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 40'

Stationing along "B" Line

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0083 POST MILES 16.2/18.6	RETAINING WALL NO. 496 LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET X OF X

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

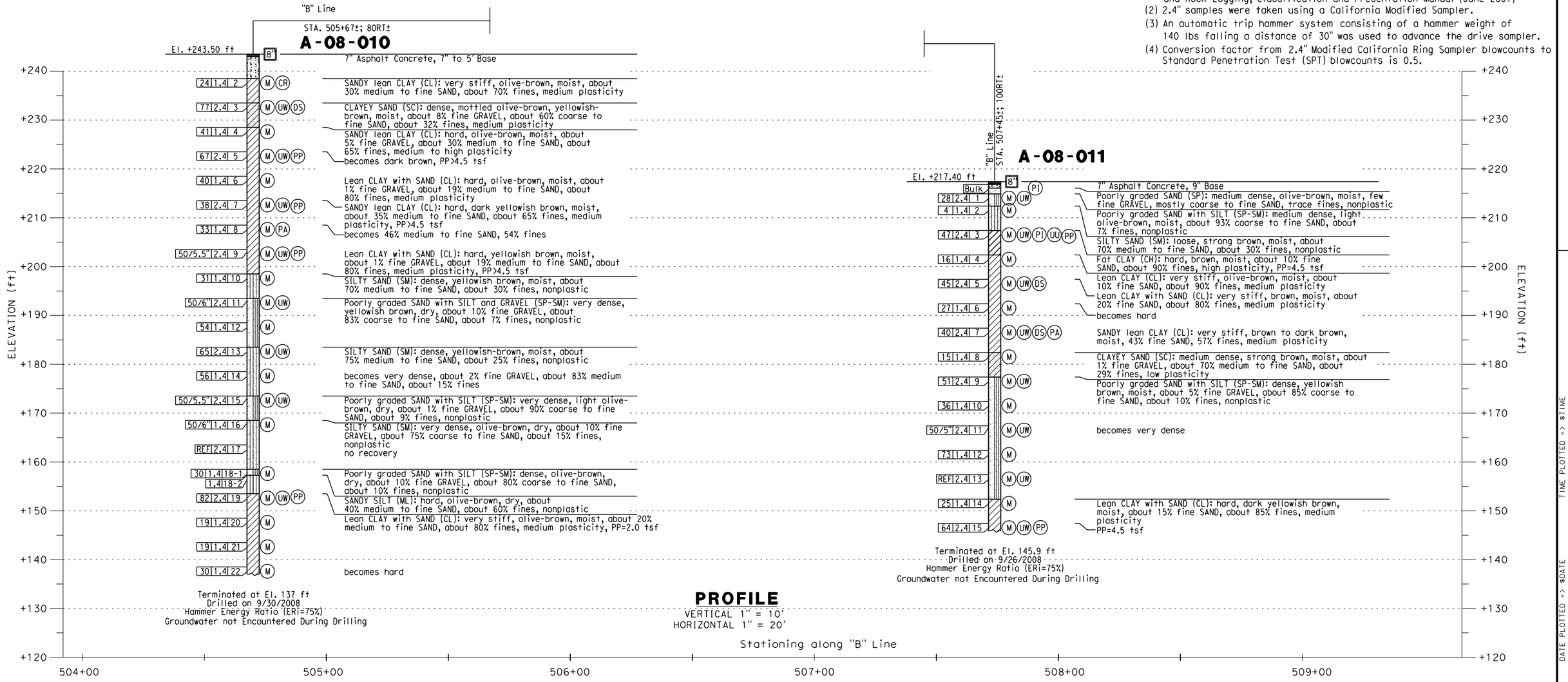
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 496, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	**PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION**	C. Yang	BRIDGE NO. 55E0083
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 16.2/18.6

RETAINING WALL NO. 496
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

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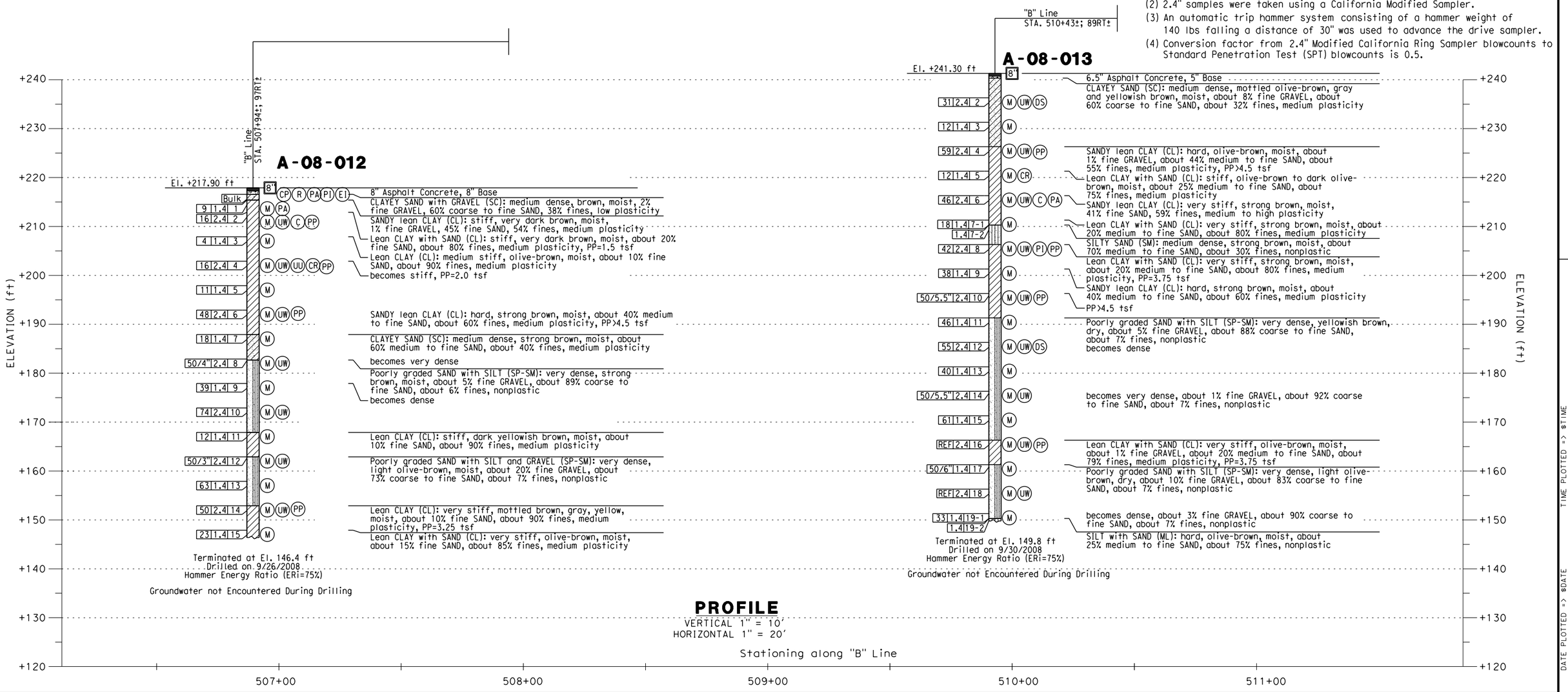
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

FOR PLAN VIEW SEE "RETAINING WALL NO. 496, LOG OF TEST BORINGS NO. 1"

NOTES:

(1) This LOTB sheet was prepgred in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang, PROJECT ENGINEER	BRIDGE NO. 55E0083
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.2/18.6

RETAINING WALL NO. 496
LOG OF TEST BORINGS NO. 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)										SHEET	OF
4/30/09											

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FILE => $REQUEST

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

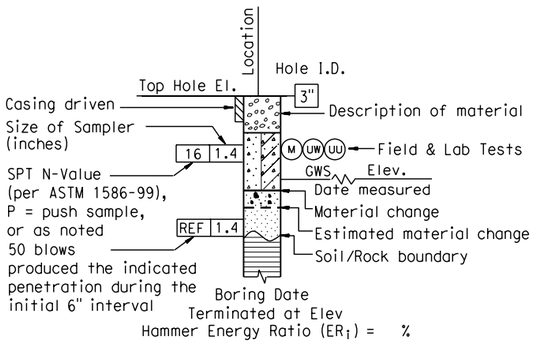
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

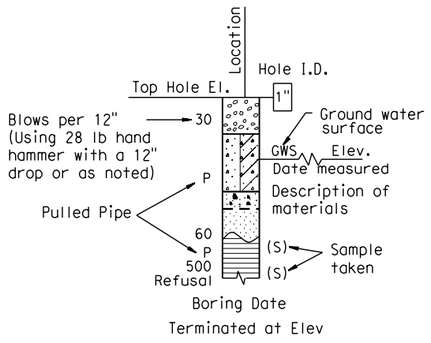
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

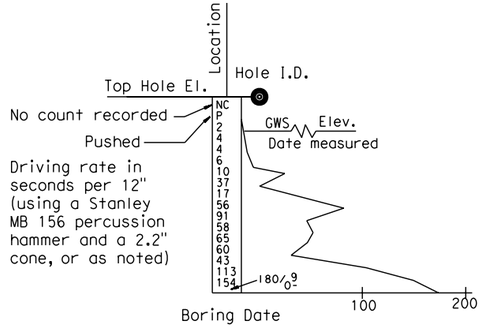
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



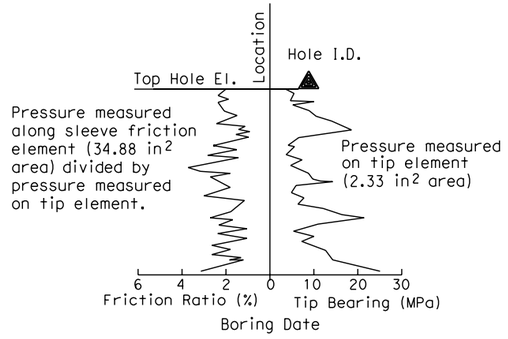
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. 55E0083 POST MILES 16.2/18.6	RETAINING WALL NO. 496 LOG OF TEST BORINGS NO. 6

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) | SHEET | OF

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO. 55E0083
POST MILES 16.2/18.6

RETAINING WALL NO. 496
LOG OF TEST BORINGS NO. 7

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

FILE => $REQUEST

DATE PLOTTED => $DATE TIME PLOTTED => $TIME USERNAME => $USER

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	490	491

Kul Bhushan 12/28/89
GEOTECHNICAL PROFESSIONAL
10-29-90
PLANS APPROVAL DATE

KUL BHUSHAN
No. GE 000144
Exp. 12/31/1989
REGISTERED PROFESSIONAL ENGINEER
GEOTECHNICAL
STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER — DATE

RETAINING WALL NO. 496

LOG OF TEST BORINGS NO. 8

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

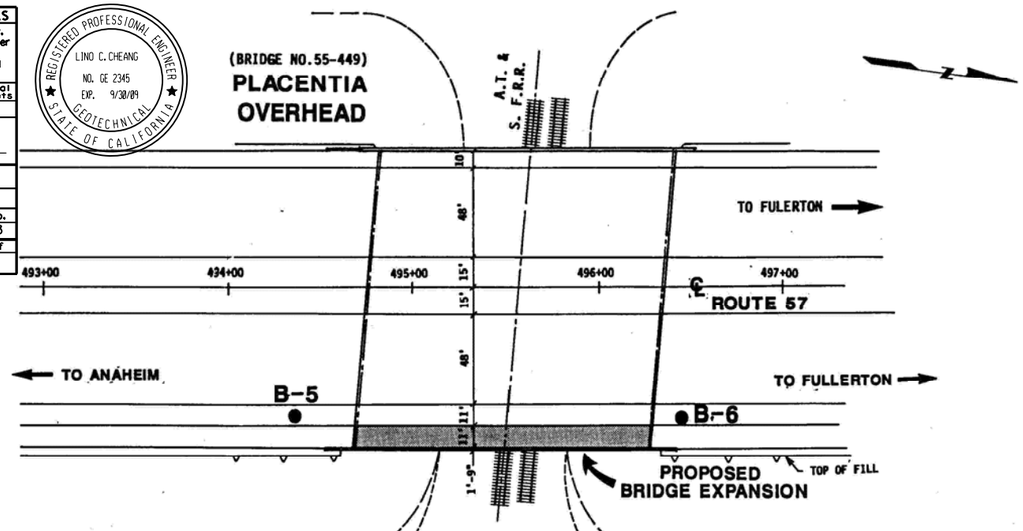
CU: 12
EA: 0F0311

BRIDGE No. 55E0083

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

(BRIDGE NO.55-449)
PLACENTIA OVERHEAD

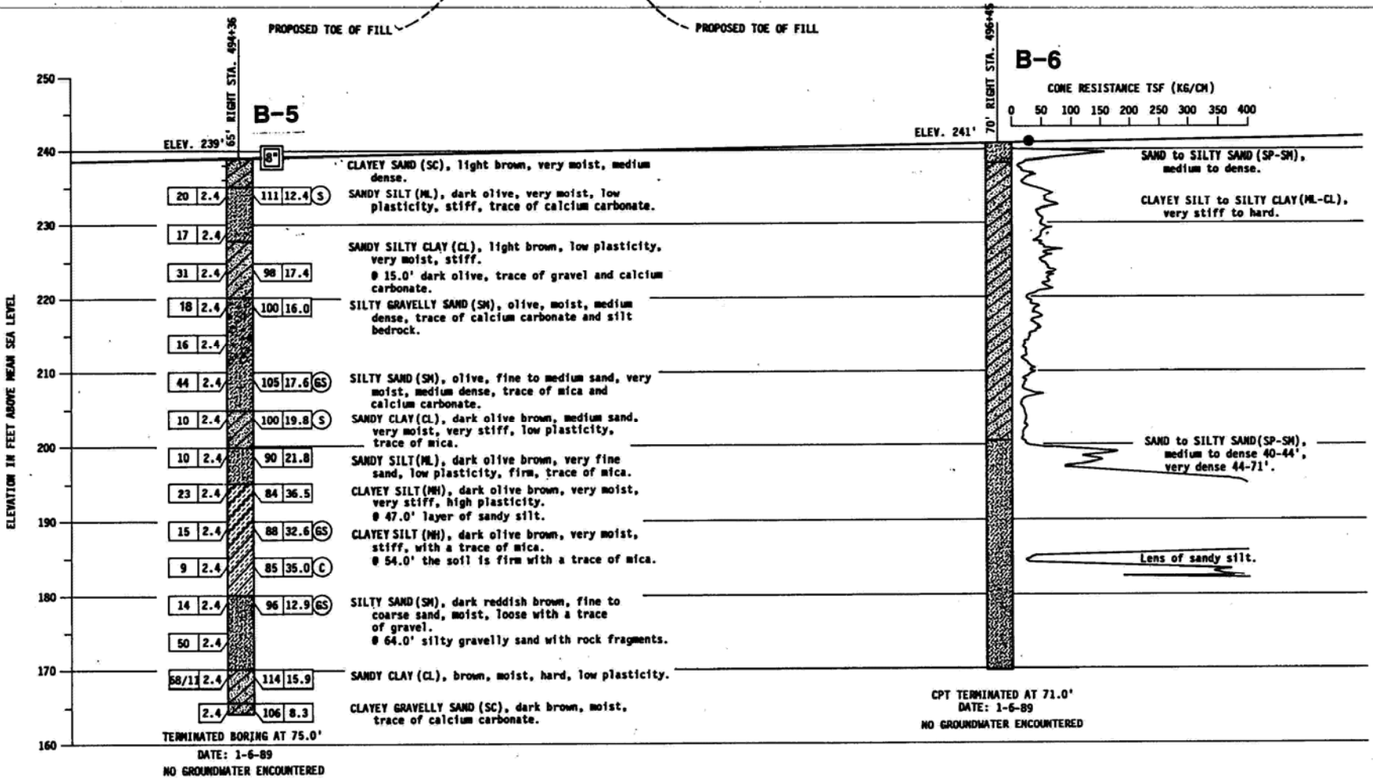


PLAN

SCALE: 1"=40'

PROFILE

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'

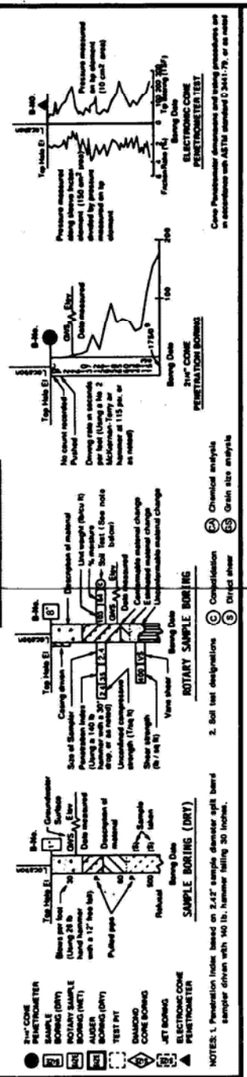


AS BUILT NO AS BUILT CHANGES

CORRECTIONS BY J. PINHEIRO
CONTRACT NO. 12-020184
DATE 11-23-92

BM 535-D-70 — ELEVATION 257.37

FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60 AND 105 FEET NORTHERLY OF THE CENTERLINE OF NUTWOOD AVE..



LEGEND OF EARTH MATERIALS: GRAVEL, SAND, SILT, CLAY, SANDY CLAY or CLAYEY SAND, SANDY SILT or SILTY SAND, SILTY CLAY, CLAYEY SILT, PEAT and/or ORGANIC MATTER, FILL MATERIAL, SEDIMENTARY ROCK, METAMORPHIC ROCK

CONSISTENCY CLASSIFICATION FOR SOILS
According to the Standard Penetration Test

Penetration Index (Blows / Ft)	Granular	Cohesive
0-4	Very loose	Very soft
5-9	Loose	Soft
10-19	Slightly compact	Stiff
20-34	Compact	Very stiff
35-69	Dense	Hard
>70	Very dense	Very hard

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

DESIGN OVERSIGHT — SIGN OFF DATE 8-22-90
DRAWN BY: B. BASMADJIAN
CHECKED BY: H. ABDALLAH
S. MOHAMAD — FIELD INVESTIGATOR — DATE 12-28-89

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Victor Lee — PROJECT ENGINEER

CU 12208
EA 020181

BRIDGE NO. 55-449
POST MILE 16.9

PLACENTIA OVERHEAD (WIDEN)

LOG OF TEST BORINGS

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 13 OF 14

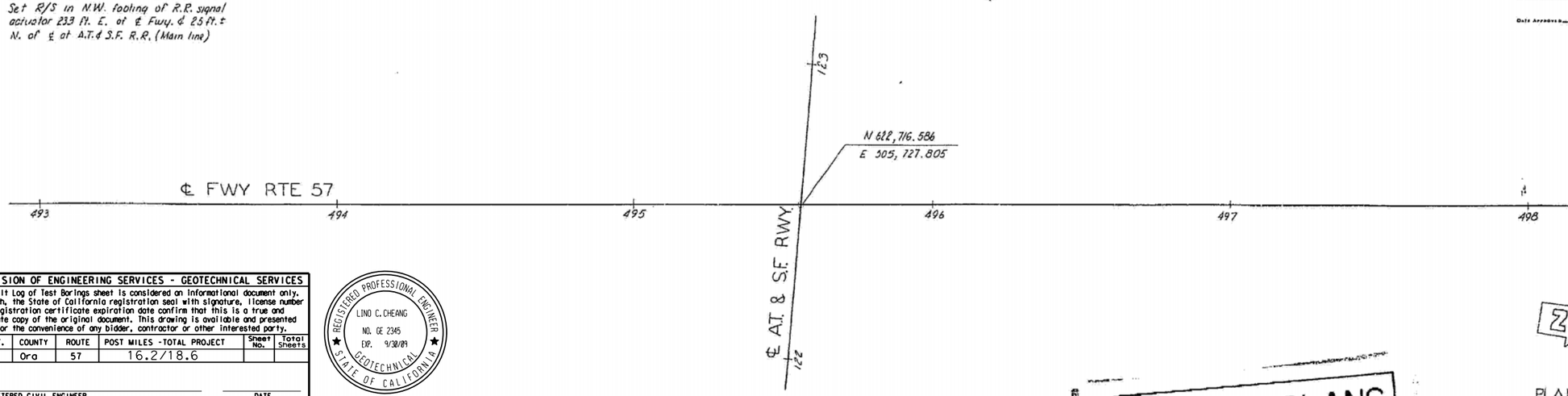
FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	16.2/18.8	147	197

Bridge Engineer — Date Approved August 28, 1967

BENCH MARK

BM # 496-65 Elev. 211.469
Set R/S in N.W. footing of R.P. signal actuator 233 ft. E. of ℄ Fwy. & 25 ft.± N. of ℄ of A.T.& S.F. R.R. (Main line)



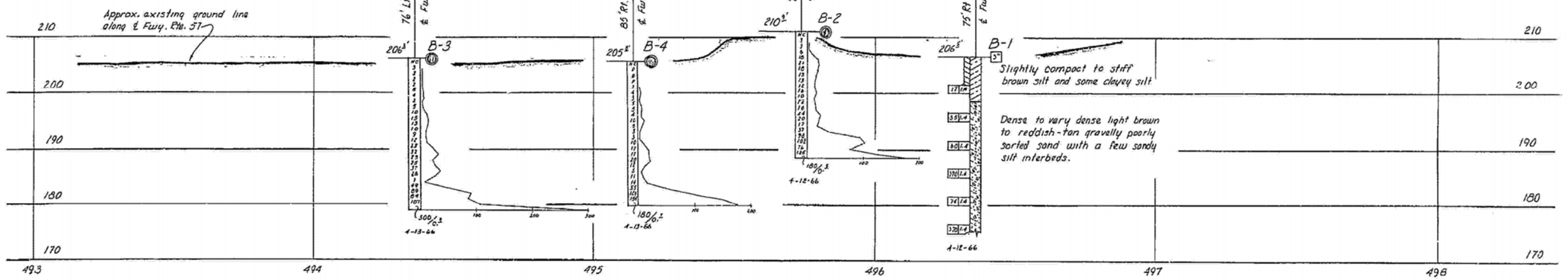
PLAN
Scale 1" = 20'

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		
REGISTERED CIVIL ENGINEER			DATE		
RETAINING WALL NO. 496					
LOG OF TEST BORINGS NO. 9					
NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA		CU: 12 EA: 0F0311		BRIDGE No. 55E0083	
				Sheet X	of X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE April 1966



PROFILE
Scale Vert. 1" = 10'
Horiz. 1" = 20'

AS BUILT
CORRECTIONS BY Hixson 7-28-69
CONTRACT NO. 07-032124
DATE 5-11-69

SHEET	OF
13	13

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PLACENTIA OVERHEAD

LOG OF TEST BORINGS

SCALE As Noted	BRIDGE 55-449 R/L	FILE	DRAWING 55449-16

Charge 07208
W.A. 032121

Disregard prints bearing earlier numbers →

PREL. DRAWING No. PR- 66/67

LEGEND OF BORING OPERATIONS

- Penetrometer
- 2½" Cone Penetrometer
- Sampler Boring (Dry)
- Rotary Boring (Wet)
- Auger Boring (Dry)
- Jet Boring
- Core Boring
- Test Pit

LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Silty Clay or Clayey Silt
- Sandy Clay or Clayey Sand
- Sandy Silt or Silty Sand
- Organic Matter
- Fill Material
- Igneous Rock
- Sedimentary Rock
- Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

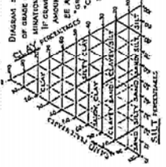


DIAGRAM SHOWING THE BASIS FOR ESTIMATES OF GRADE SIZE AND PROPORTIONS USED TO DETERMINATION OF CLASS NAMES.
IF GRAVEL IS PRESENT IN APPREciable AMOUNTS THE TERM "GRAVELLY" MAY BE USED TO DESCRIBE THE CLASS NAME, ETC. "GRAVELLY SAND", "SILTY GRAVEL", "COARSE", "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE SAND, SHALL HAVE THE SAME SIZE LIMITS AS STANDARD GRADE SIZE LIMITS.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY	By D. CRAWFORD 4-13-66
DRAWN	By M. ALLREAD 4-21-66
CHECKED	By W. CAIN 5-6-66

Approved Recommended for Approval — Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

147

FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET No.	TOTAL SHEETS
7	CALIF.			

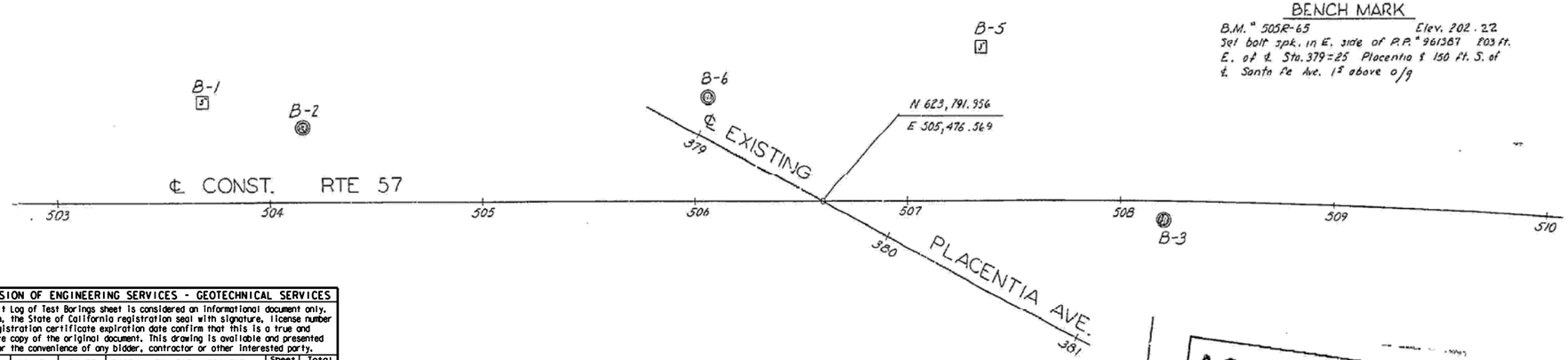
DIST.	COUNTY	ROUTE	SECTION	SHEET No.	TOTAL SHEETS
07	ORA	57	15.6/18.6	173	197

Chief, Bridge Design — Chief, Bridge Construction

Date Approved: August 28, 1967

BENCH MARK

B.M. "505R-65" Elev. 202.22
Set bolt spk. in E. side of P.P. "961387" 203 ft. E. of ℄ Sta. 379+25 Placentia & 150 ft. S. of ℄ Santa Fe Ave. 1' above o/g



PLAN
Scale 1" = 30'

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		
REGISTERED CIVIL ENGINEER			DATE		

RETAINING WALL NO. 496

LOG OF TEST BORINGS NO. 10

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

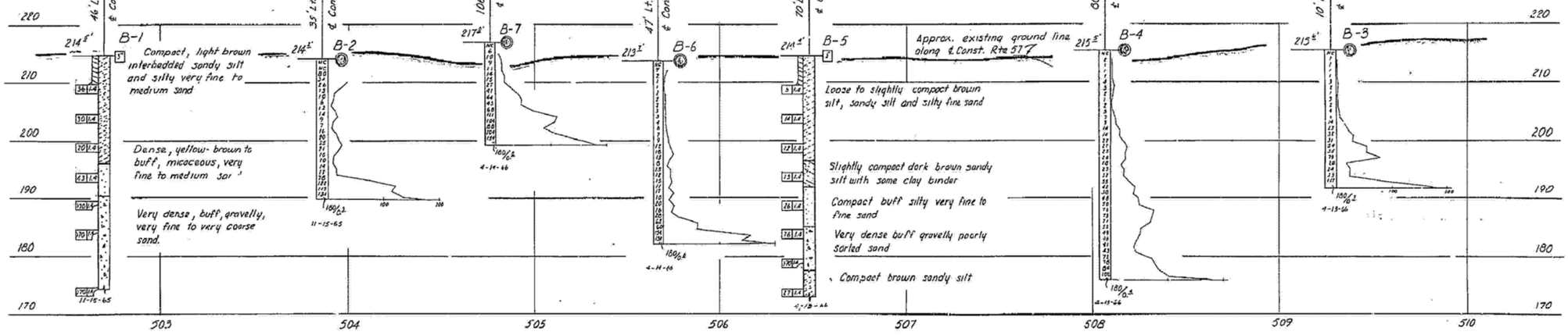
BRIDGE No. 55E0083

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE April 1966

AS BUILT
CORRECTIONS BY Hixson dated 7-29-69
CONTRACT NO. 07-032124
DATE 5-11-69



PROFILE
Scale Vert. 1" = 10'
Horiz. 1" = 30'

SHEET	OF
26	26

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PLACENTIA AVENUE UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted	BRIDGE 55-460	FILE	DRAWING 55460-2

PREL. DRAWING No. PR-

Charge 07208
W.A. 032101

Disregard prints bearing earlier numbers

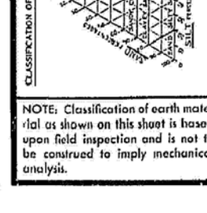
LEGEND OF EXPLORATION OPERATIONS

- Penetrometer
- 2½" Core Penetrometer
- Sampler Boring (Dry)
- Rotary Boring (Wet)
- Auger Boring (Dry)
- Jet Boring
- Core Boring
- Test Pit

LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Silty Clay or Clayey Silt
- Peat and/or Organic Matter
- Fill Material
- Igneous Rock
- Sandy Clay or Clayey Sand
- Sandy Silt or Silty Sand
- Sedimentary Rock
- Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS



NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY	By: D. CRAWFORD	4-4-66
DRAWN	By: M. ALLREAD	4-20-66
CHECKED	By: W. SAINT	5-10-66

Approval Recommended by: Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

173

APPENDIX B

LABORATORY TEST RESULTS

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-001	D-2	5	SC	13.6	133.7									
A-08-001	S-3	10	SC	8.7							2000	8.6	450	153
A-08-001	D-4	15	SC	12.9	138.1									
A-08-001	S-5	20	SM/SC	13.9										
A-08-001	D-6	25	SP	2.7	106.8									
A-08-001	S-7	30	SP	3.4										
A-08-001	D-8	35	SP	3.0	123.8									
A-08-001	S-9	40	SP	2.7										
A-08-001	D-10	45	SP	3.6	115.2									
A-08-001	S-11	50	SP	6.3										
A-08-001	D-12	55	SP-SM	5.1	125.4									
A-08-001	S-13	66	SP	5.5										
A-08-001	D-14	65	SP	3.6	108.7									
A-08-001	S-15	70	SP-SM	3.6										
A-08-001	D-16	75	SP	2.9	112.9									
A-08-001	S-17	80	SP	3.2										
A-08-001	D-18	85	SP	3.8	107.1									
A-08-001	S-19	90	SP	2.9										
A-08-002	S-1-1	2.5	SM	8.6										
A-08-002	S-1-2	3.5	CL	16.5										
A-08-002	D-2	5	SM	14.5	122.9									
A-08-002	S-3	10	SP	3.3										
A-08-002	D-4	15	SW-SM	2.6	121.0									
A-08-002	S-5	20	SP-SM	3.3										
A-08-002	D-6	25	SP-SM	2.9	111.7									
A-08-002	S-7	30	SP	2.6										
A-08-002	D-8	35	SP-SM	2.2	110.1									
A-08-002	S-9	40	SP-SM	2.9										
A-08-002	D-10	45	SP	3.4	110.7									
A-08-002	S-11	50	SP-SM	4.3										
A-08-002	D-12	55	SP-SM	2.0	115.8									
A-08-002	S-13	60	SP-SM	3.4										
A-08-002	D-14	65	SP-SM	2.7	108.8									
A-08-002	S-15	70	SP-SM	2.8										
A-08-003	D-2	5	SC	8.5	141.2									
A-08-003	S-3	10	CL	16.8							1100	8.4	300	216
A-08-003	D-4	15	SC	6.9	140.9			11:67:22						
A-08-003	S-5	20	SC	15.2										
A-08-003	D-6	25	SC	16.9	124.3			1:57:42						
A-08-003	S-7	30	SP	2.7										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-003	D-8	35	SP-SM	2.7	115.1									
A-08-003	S-9	40	SP-SM	2.9										
A-08-003	D-10	45	SP-SM	2.9	112.8									
A-08-003	S-11	50	SP	3.2										
A-08-003	D-12	55	SP-SM	3.7	107.1									
A-08-003	S-13	60	SP-SM	7.1										
A-08-003	D-14	65	SP-SM	3.5	109.6									
A-08-003	S-15	70	SP-SM	3.6										
A-08-003	D-16	75	SP	2.0	106.3									
A-08-003	S-17	80	SP	3.4										
A-08-003	D-18	85	SP	2.3	111.8									
A-08-003	S-19	90	SP	2.6										
A-08-004	D-1	2.5	SC	9.4	134.3									
A-08-004	S-2	5	SC	14.4										
A-08-004	D-3	10	GP-GC	11.6	132.3									
A-08-004	S-4	15	CL	13.1							750	7.5	700	185
A-08-004	D-5	20	SC	8.6	136.5									
A-08-004	S-6	25	SM	5.6										
A-08-004	D-7	30	CL to SM	17.3	128.2	>4.5								
A-08-004	S-8	35	SM	6.6										
A-08-004	D-9	40	SM	6.4	127.2									
A-08-004	S-10	45	SP-SM	4.2										
A-08-004	D-11	50	SP-SM	3.7	112.2									
A-08-004	S-12	55	SP	2.8										
A-08-004	D-13	60	SP	2.7	122.0									
A-08-004	S-14	65	CL	14.7										
A-08-004	D-15	70	SM	8.9	117.7									
A-08-004	S-16	75	SM	11.2										
A-08-004	D-17	80	CL to SM	18.4	124.3	1.75								
A-08-004	S-18	85	SP	3.3										
A-08-004	D-19	90	SP-SM	5.4	112.9									
A-08-005	S-1	2.5	SM	7.1										
A-08-005	D-2	5	CL	10.8	104.1	1.75								
A-08-005	S-3	10	SC	13.0				1:52:47						
A-08-005	D-4	15	SC	13.5	117.9			1:51:48			2000	8.4	120	173
A-08-005	S-5	20	CL	18.6										
A-08-005	D-6	25	SC	12.5	132.2	>4.5		16:52:32						
A-08-005	S-7	30	CL	23.8										
A-08-005	D-8	35	CL	15.0	134.3	2.25				29/16/13				
A-08-005	S-9	40	SP-SC	7.6										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-005	D-10	45	SP-SC	8.4	115.7									
A-08-005	S-11	50	SC	8.1										
A-08-005	D-12	55	SP-SM	7.4	120.4									
A-08-005	S-13	60	SP-SM	3.3										
A-08-005	D-14	65	CL	17.3	132.2	2.75								
A-08-005	S-15	70	SP-SM	2.7										
A-08-005	D-16	75	ML to SM	7.7	124.8									
A-08-005	S-17	80	SM	6.2										
A-08-005	D-18	85	SP	2.0	104.3									
A-08-005	S-19	90	SM	5.3										
A-08-006	S-2	5	SC	13.3										
A-08-006	D-3	10	CL	25.3	127.8	>4.5								
A-08-006	S-4	15	CL	16.5							1800	8.1	100	168
A-08-006	D-5	20	CL to SM	15.7	129.2	2.75								
A-08-006	S-6	25	CL	20.6						38/18/20				
A-08-006	D-7	30	SC	18.0	129.5	4.5								
A-08-006	S-8	35	SP-SM	2.8										
A-08-006	D-9	40	SP-SM	2.2	111.9									
A-08-006	S-10	45	SM	6.1										
A-08-006	D-11	50	SP-SM	1.7	121.0									
A-08-006	S-12	55	ML	20.5										
A-08-006	D-13	60	CL to SM	20.7	126.8	1.5								
A-08-006	S-14	65	SP	1.4										
A-08-006	D-15	70	SP-SM	2.2	122.8									
A-08-006	S-16	75	SC	13.5				0:51:49						
A-08-006	D-17	80	SM	7.8	126.3									
A-08-006	S-18	85	SP-SM	3.0										
A-08-006	D-19	90	SP-SM	2.8										
A-08-007	D-2	5	SC	9.6										
A-08-007	S-3	10	SC	12.4				18:46:36						
A-08-007	D-4	15	CL	16.8	122.1	3.75					740	7.7	500	162
A-08-007	S-5	20	CL	19.1										
A-08-007	D-6	25	SC	12.8	127.2					32/19/13				
A-08-007	S-7	30	CL	18.7				4:39:57						
A-08-007	D-8	35	CL	12.1	132.6	4.5								
A-08-007	S-9	40	CL	10.9										
A-08-007	D-10	45	CL	16.3	122.9	2.5								
A-08-007	S-11	50	CL	17.0										
A-08-007	D-12	55	SM	18.6	112.9									
A-08-007	S-13	60	ML	23.7										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-007	D-14	65	SP	1.3	113.8									
A-08-007	S-15	70	SP-SM	4.5										
A-08-007	D-16	75	CL	30.4	121.2	3								
A-08-007	S-17	80	CL	15.7										
A-08-007	D-18	85	ML	14.5	131.6	4.5								
A-08-007	S-19	90	ML to SC	9.8										
A-08-008	D-1	2.5	SP-SM	7.0	123.6									
A-08-008	S-2	5	GP-GM	2.7										
A-08-008	D-3	10	CL	17.9	126.7						810	7.7	450	213
A-08-008	S-4	15	CL	17.1										
A-08-008	D-5	20	CL	16.0	131.8									
A-08-008	S-6	25	CL	18.4										
A-08-008	D-7	30	CL	20.8	122.5	2.5					510	7.4	750	208
A-08-008	S-8	35	CL	20.1										
A-08-008	D-9	40	CL	18.4	122.3	2.5								
A-08-008	S-10	45	CL	33.6										
A-08-008	D-11	50	CH	32.5	118.3	3.0				58/19/39				
A-08-008	S-12	55	CL	38.4										
A-08-008	D-13	60	CL to SC	14.2	138.7	3.0								
A-08-008	S-14	65	CL	17.2										
A-08-008	D-15	70	CL to SC	11.9	141.2	4.0								
A-08-008	S-16	75	SC	14.5										
A-08-008	D-17	80	CL	20.5	131.2	2.75								
A-08-008	S-18	85	CL	18.3										
A-08-008	D-19	90	SM	16.3	134.3									
A-08-008	S-20	95	SP-SM	2.8										
A-08-009	S-1	2.5	SC	9.8										
A-08-009	D-2	5	SC	12.9	113.7									
A-08-009	S-3	10	CL	12.6										
A-08-009	D-4	15	CL	17.3	109.4	>4.5								
A-08-009	S-5	20	CL	17.8										
A-08-009	D-6	25	CL	15.6	119.7	4.5		10:36:54			850	7.7	300	142
A-08-009	S-7	30	CL	17.6										
A-08-009	D-8	35	CL	16.6	124.7	4.25				42/17/25				
A-08-009	S-9	40	SC	5.3				10:73:17						
A-08-009	D-10	45	SM	1.6	102.7									
A-08-009	S-11	50	SP-SM	2.3										
A-08-009	D-12	55	SP-SM	4.8	109.7									
A-08-009	S-13	60	SP-SM	2.4										
A-08-009	D-14	65	SP-SM	2.0	101.5									

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-009	S-15	70	SP-SM	1.8										
A-08-009	D-16	75	SM	8.3	104.1									
A-08-009	S-17	80	ML	31.6										
A-08-009	D-18	85	CL	21.5	129.5	3.5								
A-08-009	S-19	90	CL	22.1										
A-08-010	S-2	5	CL	10.5							1300	8.0	100	123
A-08-010	D-3	10	SC	9.6	133.2									
A-08-010	S-4	15	CL	11.3										
A-08-010	D-5	20	CL	11.3	134.6	>4.5								
A-08-010	S-6	25	CL	10.9										
A-08-010	D-7	30	CL	8.2	121.8	>4.5								
A-08-010	S-8	35	CL	7.2				0:46:54						
A-08-010	D-9	40	CL	9.2	127.4	>4.5								
A-08-010	S-10	45	SM	3.1										
A-08-010	D-11	50	SP-SM	0.9	128.8									
A-08-010	S-12	55	SP-SM	1.1										
A-08-010	D-13	60	SM	5.6	119.3									
A-08-010	S-14	65	SM	1.7										
A-08-010	D-15	70	SP-SM	0.9	118.6									
A-08-010	S-16	75	SM	1.3										
A-08-010	S-18	85	SP-SM	2.9										
A-08-010	D-19	90	CL	16.4	132.7	2.0								
A-08-010	S-20	95	CL	24.1										
A-08-010	S-21	100	CL	22.7										
A-08-010	S-22	105	CL	17.7										
A-08-011	D-1	2.5	SP-SM	4.2	117.9									
A-08-011	S-2	5	SM	11.1										
A-08-011	D-3	10	CH	27.1	116.6	4.5				66/28/38				
A-08-011	S-4	15	CL	30.8										
A-08-011	D-5	20	CL	19.5	122.3									
A-08-011	S-6	25	CL	12.7										
A-08-011	D-7	30	CL	12.5	135.5			0:43:57						
A-08-011	S-8	35	SC	6.9										
A-08-011	D-9	40	SP-SM	3.6	122.7									
A-08-011	S-10	45	SP-SM	6.6										
A-08-011	D-11	50	SP-SM	6.2	121.8									
A-08-011	S-12	55	SP-SM	4.5										
A-08-011	D-13	60	SP-SM	5.0	121.7									
A-08-011	S-14	65	CL	18.0										
A-08-011	D-15	70	CL	18.4	131.2	4.5								

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-012	S-1	2.5	CL	15.4				1:45:54						
A-08-012	D-2	5	CL	22.4	124.8	1.5								
A-08-012	S-3	10	CL	30.4										
A-08-012	D-4	15	CL	36.7	112.8	2.0					850	7.4	50	245
A-08-012	S-5	20	CL	34.4										
A-08-012	D-6	25	CL	14.0	134.5	>4.5								
A-08-012	S-7	30	SC	14.9										
A-08-012	D-8	35	SP-SM	5.6	119.2									
A-08-012	S-9	40	SP-SM	9.9										
A-08-012	D-10	45	SP-SM	4.7	116.1									
A-08-012	S-11	50	CL	26.4										
A-08-012	D-12	55	SP-SM	2.1	128.7									
A-08-012	S-13	60	SP-SM	5.4										
A-08-012	D-14	65	CL	34.5	115.3	3.25								
A-08-012	S-15	70	CL	19.7										
A-08-013	D-2	5	SC	16.4	125.9									
A-08-013	S-3	10	SC	14.2										
A-08-013	D-4	15	CL	16.4	129.6	>4.5								
A-08-013	S-5	20	CL	16.2							1050	7.8	200	238
A-08-013	D-6	25	CL	15.3	133.4			0:41:59						
A-08-013	S-7	30	CL	22.0										
A-08-013	D-8	35	CL	22.1	121.2	3.75				38/22/16				
A-08-013	S-9	40	CL	14.8										
A-08-013	D-10	45	CL to SC	9.4	137.0	>4.5								
A-08-013	S-11	50	SP-SM	2.0										
A-08-013	D-12	55	SP-SM	1.3	113.6									
A-08-013	S-13	60	SP-SM	8.0										
A-08-013	D-14	65	SP-SM	2.0	104.9									
A-08-013	S-15	70	SP-SM	1.8										
A-08-013	D-16	75	CL	24.7	116.8	3.75								
A-08-013	S-17	80	SP-SM	2.2										
A-08-013	D-18	85	SP-SM	2.9										
A-08-013	S-19-1	90	SP-SM	2.3										
A-08-013	S-19-2	91	ML	23.6										
A-08-014	S-2	5	CL	18.7				4:42:54						
A-08-014	D-3	10	CL	17.5	137.0	3.0					600	7.7	450	158
A-08-014	S-4	15	CL	18.8										
A-08-014	D-5	20	SC	16.1	124.2									
A-08-014	S-6	25	CL	19.0										
A-08-014	D-7	30	CH	28.2	120.6	2.25				65/28/37				

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-014	S-8-1	35	CL	15.2										
A-08-014	S-8-2	35.8	SM	15.0										
A-08-014	D-9	40	CL	26.2	122.9	>4.5								
A-08-014	S-10	45	CL	19.8										
A-08-014	D-11	50	SM	10.3	130.6									
A-08-014	S-12	55	CL	19.1										
A-08-014	D-13	60	CL	20.7	127.3	3.75								
A-08-014	S-14	65	CL	25.8										
A-08-014	D-15	70	SM	8.3	138.1									
A-08-014	S-16	75	SP-SM	1.8										
A-08-014	D-17	80	SP-SM	1.7	115.6									
A-08-014	S-18	85	SP-SM	2.5										
A-08-014	D-19	90	SP-SM	1.8	107.6									
A-08-015	S-1	2.5	SC	12.6										
A-08-015	D-2	5	CL	14.6	121.0	>4.5								
A-08-015	S-3	10	SC	14.0										
A-08-015	D-4	15	CL	18.8	115.0	>4.5								
A-08-015	S-5	20	SC	17.5				6:50:44			840	7.6	350	182
A-08-015	D-6	25	CL	18.0	106.1	4.25								
A-08-015	S-7	30	SM	17.1										
A-08-015	D-8	35	CL	16.2	131.0	4.5				37/15/22				
A-08-015	S-9	40	CL	16.0										
A-08-015	D-10	45	SM	7.6	81.3			0:66:34						
A-08-015	S-11	50	CL	15.2										
A-08-015	D-12	55	CL	12.0	121.5	>4.5								
A-08-015	S-13	60	SC	11.1										
A-08-015	D-14	65	CL	17.0	119.1	4.5								
A-08-015	S-15	70	CL	25.8										
A-08-015	D-16	75	SM	9.0	121.4									
A-08-015	S-17	80	SP-SM	1.8										
A-08-015	D-18	85	SP	1.0	106.8									
A-08-015	S-19	90	SP-SM	2.0										
A-08-016	S-2	5	SC	13.9										
A-08-016	D-3	10	SC	15.5	126.8									
A-08-016	S-4	15	SC	17.2										
A-08-016	D-5	20	SC	20.2	130.3	4.5								
A-08-016	S-6	25	CL	19.8						35/17/18	1040	7.7	150	312
A-08-016	D-7	30	SM	9.7	124.2									
A-08-016	S-8	35	CH	17.5							530	7.5	120	364
A-08-016	D-9	40	SC	11.3	137.7									

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-016	S-10	45	CL	23.7										
A-08-016	D-11	50	CL	15.1	133.9	>4.5								
A-08-016	S-12	55	CL	19.0										
A-08-016	D-13	60	SC	13.1	138.2									
A-08-016	S-14	65	CL	26.2										
A-08-016	D-15	70	CL	18.2	125.1	3.5								
A-08-016	S-16	75	CL	16.2										
A-08-016	D-17	80	CL	20.2	126.7	2.25								
A-08-016	S-18	85	SP-SM	4.3										
A-08-138	D-7	30	SM	2.1	108.8									
A-08-017	D-2	5	SC	10.4										
A-08-017	S-3	10	CL	12.3										
A-08-017	D-4	15	CL	12.8	92.0	>4.5				30/20/10				
A-08-017	S-5	20	CL	19.9							490	7.3	250	362
A-08-017	D-6	25	SM	4.7	123.4									
A-08-017	S-7	30	CL	14.1										
A-08-017	D-8	35	SC	9.1	124.9									
A-08-017	S-9	40	CL	10.2				0:41:59						
A-08-017	D-10	45	CL	12.5	129.5	>4.5								
A-08-017	S-11	50	CL	13.8										
A-08-017	D-12	55	CL	17.4	129.9	>4.5								
A-08-017	S-13	60	SM	7.7				0:65:35						
A-08-017	D-14	65	CL	29.4	124.3	3.75								
A-08-017	S-15	70	CL	17.5										
A-08-017	D-16	75	SM	6.1	106.2									
A-08-017	S-17	80	CL	22.2										
A-08-017	S-19	90	SP-SM	1.0										
A-08-018	S-1	2.5	CL	28.7										
A-08-018	D-2	5	CL	24.4	120.2	1.25					760	8.4	250	223
A-08-018	S-3	10	CL	19.4										
A-08-018	D-4	15	CL	25.0	125.4					43/21/22				
A-08-018	S-5	20	CL	18.2										
A-08-018	D-6	25	CL	16.4	126.2									
A-08-018	S-7	30	SM	12.5										
A-08-018	D-8	35	SM	13.6	116.8									
A-08-018	S-9	40	CL	15.5							900	7.9	80	296
A-08-018	D-10	45	CL	14.9	133.4	>4.5								
A-08-018	S-11	50	SM	15.7										
A-08-018	D-12	55	SP-SM	2.0	106.4									
A-08-018	S-13-1	60	SM	3.8										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-018	S-13-2	60.5	CL	23.1										
A-08-019	D-1	2.5	CL	23.6	122.5	3.25								
A-08-019	S-2	5	CL	28.5										
A-08-019	D-3	10	CL	22.8	119.3	3.25					750	8.5	280	181
A-08-019	S-4	15	CL	23.6										
A-08-019	D-5	20	CL	21.7	120.4	1.5								
A-08-019	S-6	25	SM	3.7										
A-08-019	D-7	30	SM	6.6	118.8									
A-08-019	S-8	35	CL-ML	17.1				0:44:56						
A-08-019	D-9	40	CL	15.8	134.4	>4.5								
A-08-019	S-10	45	SC-SM	12.6										
A-08-019	D-11	50	SM	18.3	128.8									
A-08-019	S-12	55	SM	4.8										
A-08-019	D-13	60	CH	23.0	125.6	>4.5								
A-08-101	S-1	2.5	SC-SM	10.7										
A-08-101	D-2	5	SM	6.3	118.2									
A-08-101	S-3	10	SP-SM	3.7										
A-08-101	D-4	15	SP	2.7	119.8									
A-08-101	S-5	20	SP-SM	4.0										
A-08-101	D-6	25	SP	2.5	114.0									
A-08-101	S-7	30	SP	3.1										
A-08-102	D-1	2.5	SM	4.3	120.1									
A-08-102	S-2	5	SM	4.9										
A-08-102	D-3	10	SP	1.9	111.4									
A-08-102	S-4	15	SP	1.3				3:93:4						
A-08-102	D-5	20	SP	0.9	118.4									
A-08-102	S-6	25	SP-SM	2.6										
A-08-102	D-7	30	SP-SM	3.6	115.2									
A-08-105	S-1	2.5	SP-SM	7.3										
A-08-105	D-2	5	SM	10.2	132.6									
A-08-105	S-3	10	SP-SM	4.4										
A-08-105	D-4	15	SP-SM	5.5	109.7									
A-08-105	S-5	20	SM	7.9										
A-08-105	D-6	25	SP-SM	4.1	109.7									
A-08-105	S-7	30	SP-SM	6.2										
A-08-105	D-8	35	SP-SM	3.2	117.7									
A-08-105	S-9	40	SP-SM	2.7										
A-08-105	D-10	45	SP	3.5	106.1									
A-08-105	S-11	50	SP	2.4										
A-08-105	D-12	55	SP-SM	3.3	117.2									

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-105	S-13	60	SP-SM	2.8										
A-08-105	D-14	65	SP-SM	3.7	111.3									
A-08-105	S-15	70	SP-SM	2.9										
A-08-106	D-1	2.5	SM	3.6	114.5									
A-08-106	S-2	5	SM	5.9										
A-08-106	D-3	10	SP	1.9	104.4									
A-08-106	S-4	15	SP	2.3										
A-08-106	S-6	25	SP-SM	3.6										
A-08-106	D-7	30	SP-SM	4.1	115.0									
A-08-106	S-8	35	SP-SM	3.0										
A-08-106	D-9	40	SP-SM	3.5	117.6									
A-08-106	S-10	45	SP-SM	3.4										
A-08-106	D-11	50	SP-SM	3.1	106.4									
A-08-106	S-12	55	SP-SM	5.0										
A-08-106	D-13	60	SP-SM	4.5	124.3									
A-08-108	D-1	2.5	SC	8.5	131.3									
A-08-108	S-2	5	SC	11.9				10:57:33						
A-08-108	D-3	10	SC	9.6	134.4									
A-08-108	S-4	15	SC	10.5										
A-08-108	D-5	20	SC to SP-SM	3.4	134.2									
A-08-108	S-6	25	SC	15.7										
A-08-108	D-7	30	SP	3.1	115.9									
A-08-108	S-8	35	SP	10.5										
A-08-108	D-9	40	CL	17.0	127.0	3.0								
A-08-108	S-10	45	CL	19.4						33/20/13				
A-08-108	D-11	50	SP-SM	3.3	110.9									
A-08-108	S-12	55	SP-SM	4.2										
A-08-108	D-13	60	SP-SM	3.0	112.6									
A-08-108	S-14	65	SP-SM	2.5										
A-08-108	D-15	70	SP-SM	2.5	111.7									
A-08-109	S-1	2.5	SM	8.8										
A-08-109	D-2	5	SM	4.2	127.5									
A-08-109	S-3	10	SM	8.5										
A-08-109	D-4	15	SC	8.3	132.7									
A-08-109	S-5	20	CL	18.6							700	7.7	1000	221
A-08-109	D-6	25	SP	3.9	105.2									
A-08-109	S-7	30	SP	3.2										
A-08-109	D-8	35	CL	25.9	120.7	2.0					500	7.6	300	270
A-08-109	S-9	40	CL	23.3										
A-08-109	D-10	45	SM	19.6	129.0									

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-109	S-11	50	SP-SM	3.2										
A-08-109	D-12	55	SM to SP-SM	11.5	122.7									
A-08-109	S-13	60	SP-SM	4.1										
A-08-109	D-14	65	SP-SM	3.3	100.0									
A-08-109	S-15	70	SP-SM	2.4										
A-08-116	D-1	2.5	SM	5.3	128.7									
A-08-116	S-2	5	CL	7.5										
A-08-116	D-3	10	CL	11.4	133.8	>4.5								
A-08-116	S-4	15	CL	10.0										
A-08-116	D-5	20	CL	9.1	120.9	>4.5								
A-08-116	S-6	25	CL	12.0							1100	8.3	280	159
A-08-116	D-7	30	CL	9.2	115.9	>4.5								
A-08-116	S-8	35	CL	11.9										
A-08-116	D-9	40	CL	13.3	127.1	>4.5								
A-08-116	S-10	45	SM	1.2										
A-08-116	D-11	50	ML	13.8	121.9	>4.5								
A-08-116	S-12	55	SP-SM	1.2										
A-08-116	D-13	60	SP-SM	1.6	102.9									
A-08-119	S-1	2.5	CL	19.0										
A-08-119	D-2	5	CL	23.1	117.7	1.5					980	7.7	400	221
A-08-119	S-3	10	SM	8.7				0:82:18						
A-08-119	D-4	15	CL	17.6	130.2	4.0								
A-08-119	S-5	20	SC	15.0										
A-08-119	D-6	25	CL	26.4	124.7	2.75								
A-08-119	S-7	30	CL	15.8										
A-08-119	D-8	35	SM	5.6	115.2									
A-08-119	S-9	40	CL	25.7										
A-08-119	D-10	45	SM	5.0	104.0									
A-08-119	S-11	50	CL	18.3										
A-08-119	D-12	55	CH	24.1	125.7	4.25								
A-08-119	S-13	60	SM	12.7										
A-08-121	S-1	2.5	CL	17.5										
A-08-121	D-2	5	CL	18.6	131.0	3.0					1200	8.0	120	184
A-08-121	S-3	10	SM	15.4										
A-08-121	D-4	15	CL	18.4	126.6	>4.5				35/21/14				
A-08-121	S-5	20	CL	19.5										
A-08-121	D-6	25	CL	21.5	129.0	3.75					940	7.7	50	280
A-08-121	S-7	30	SM	5.8										
A-08-122	D-1	2.5	SM	6.7	119.0									
A-08-122	S-2	5	SC	9.8										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

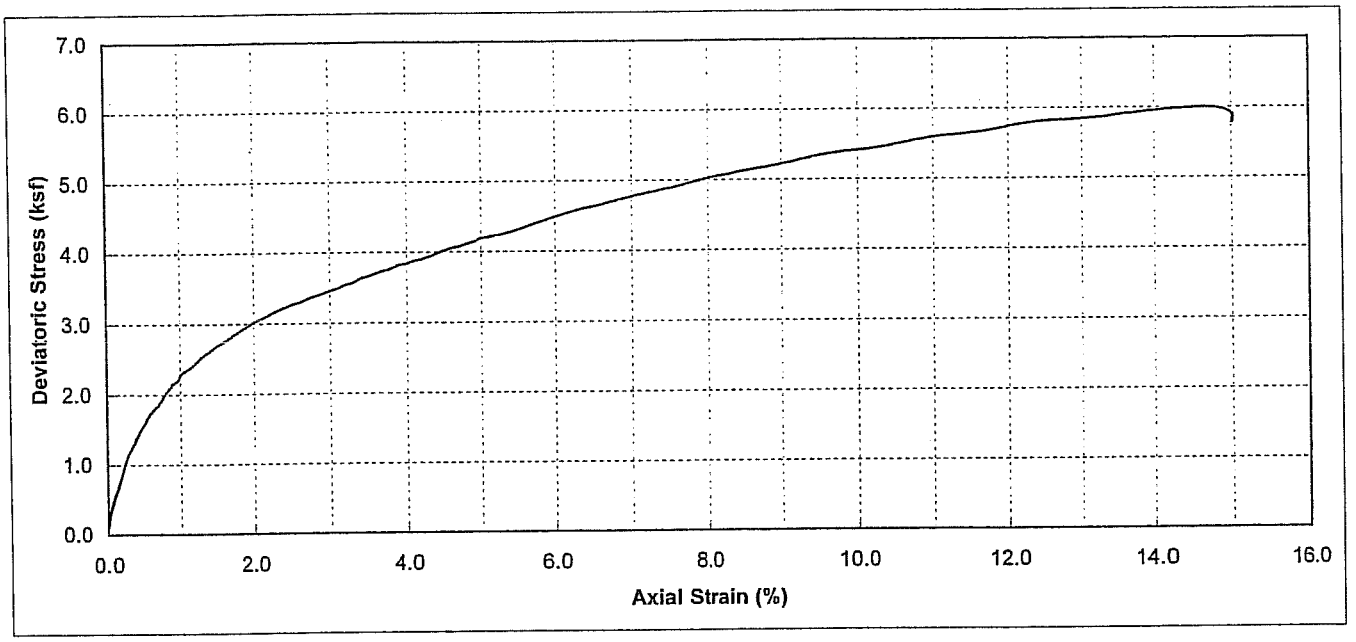
Project No. : 08-115 Project Name : RBF/SR-57 Northbound

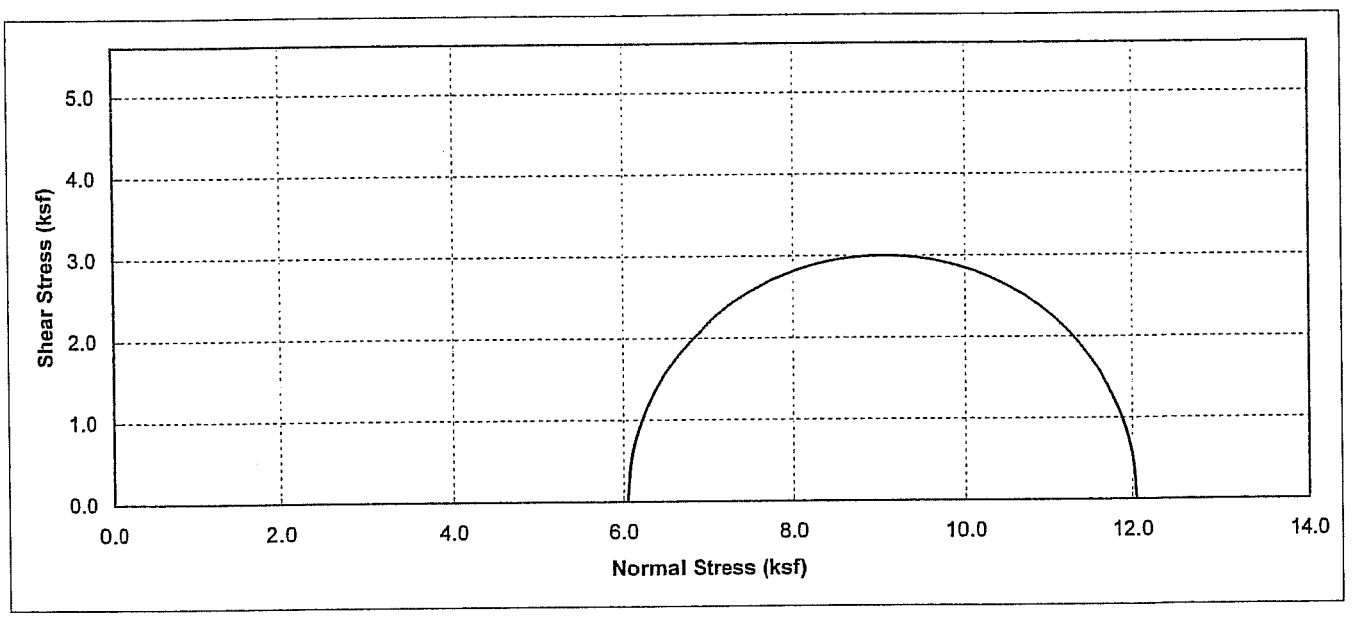
Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-122	S-3	10	CL	9.0	129.3	>4.5								
A-08-122	S-4	15	CL	15.9							520	7.6	150	416
A-08-122	D-5	20	CL	10.3	116.9	>4.5								
A-08-122	S-6	25	CL	11.6										
A-08-122	D-7	30	CL	13.1	133.4	>4.5								
A-08-123	S-1-1	2.5	SC	16.1										
A-08-123	S-1-2	3.4	SM	15.6										
A-08-123	D-2	5	SC	11.1	134.2									
A-08-123	S-3	10	CL	17.7				0:41:59						
A-08-123	D-4	15	SC	10.8	136.0									
A-08-123	S-5	20	CL	20.7							980	7.9	120	315
A-08-123	D-6	25	CL	18.1	128.2	4.25								
A-08-123	S-7	30	SM	8.9										
A-08-124	D-1	2.5	CL	8.6	126.4	>4.5				38/17/21				
A-08-124	S-2	5	CL	10.0							1800	8.3	250	175
A-08-124	D-3	10	SC	13.8	128.2									
A-08-124	S-4	15	CL	16.1										
A-08-124	D-5	20	ML	10.0	121.2	>4.5								
A-08-124	S-6	25	CL	13.0										
A-08-124	D-7	30	CL	16.4	126.3	>4.5								
A-08-126	D-1	2.5	CL	18.3	124.1	4.5					1090	8.4	80	159
A-08-126	S-2	5	CL	18.1										
A-08-126	D-3	10	CL	12.2	127.2	>4.5				34/19/15				
A-08-126	S-4	15	ML	16.5				0:45:55						
A-08-126	D-5	20	CL	17.2	131.3	4.0				39/16/23				
A-08-126	S-6	25	CL	12.3							1100	7.9	120	262
A-08-126	D-7	30	SM	5.1	109.9									
A-08-126	S-8-1	35	CL	22.2										
A-08-126	S-8-2	35.8	SM	11.2										
A-08-126	D-9	40	SM	6.9	112.8									
A-08-126	S-10	45	SP-SM	3.2										
A-08-126	D-11	50	SM	4.5	118.3	3.25								
A-08-126	S-12-1	55	SM	8.0										
A-08-126	S-12-2	55.4	CL	26.9										
A-08-126	D-13	60	CL	15.0	130.9	>4.5								
A-08-128	D-1	2.5	SM	5.8	135.3									
A-08-128	S-2	5	CL	14.8							1500	7.9	50	153
A-08-128	D-3	10	SP-SM	4.7	108.9									
A-08-128	S-4	15	CL	10.5										
A-08-128	D-5	20	CL	18.1	130.4	>4.5				46/19/27				

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : *08-115* **Project Name :** RBF/SR-57 Northbound

Boring No .	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-128	*S-6*	25	CL	27.8										
A-08-128	*D-7*	30	SM	5.6	109.8									
A-08-137	*S-1*	2.5	CL	16.7							1060	8.3	30	168
A-08-137	*D-2*	5	CL	15.5	126.0	>4.5								
A-08-137	*S-3*	10	CL	16.4										
A-08-137	*D-4*	15	SM	5.7	123.9									
A-08-137	*S-5*	20	SM	4.6										
A-08-137	*D-6*	25	CL	8.5	137.4	>4.5								
A-08-137	*S-7*	30	CH	15.1										
A-08-138	*D-1*	2.5	SM	4.2	134.1									
A-08-138	*S-2*	5	CL	18.0							1200	8.2	50	171
A-08-138	*D-3*	10	SC	8.5	115.2									
A-08-138	*S-4*	15	SC	10.1										
A-08-138	*D-5*	20	CH	14.6	135.2	>4.5								
A-08-138	*S-6*	25	SC-SM	8.5										





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-007	D-16	75	Brown, LEAN CLAY With SAND (CL)	95.9	30.43	6.05	6.00	108.5

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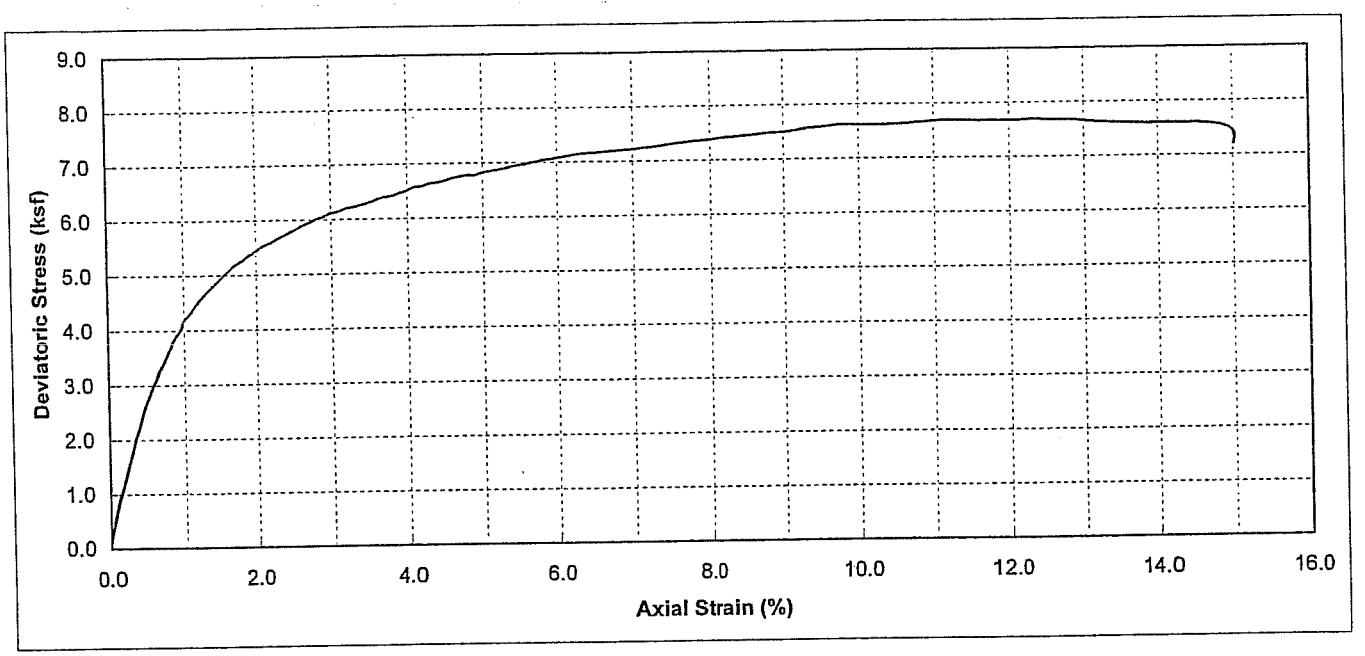
RBF/SR-57 Northbound

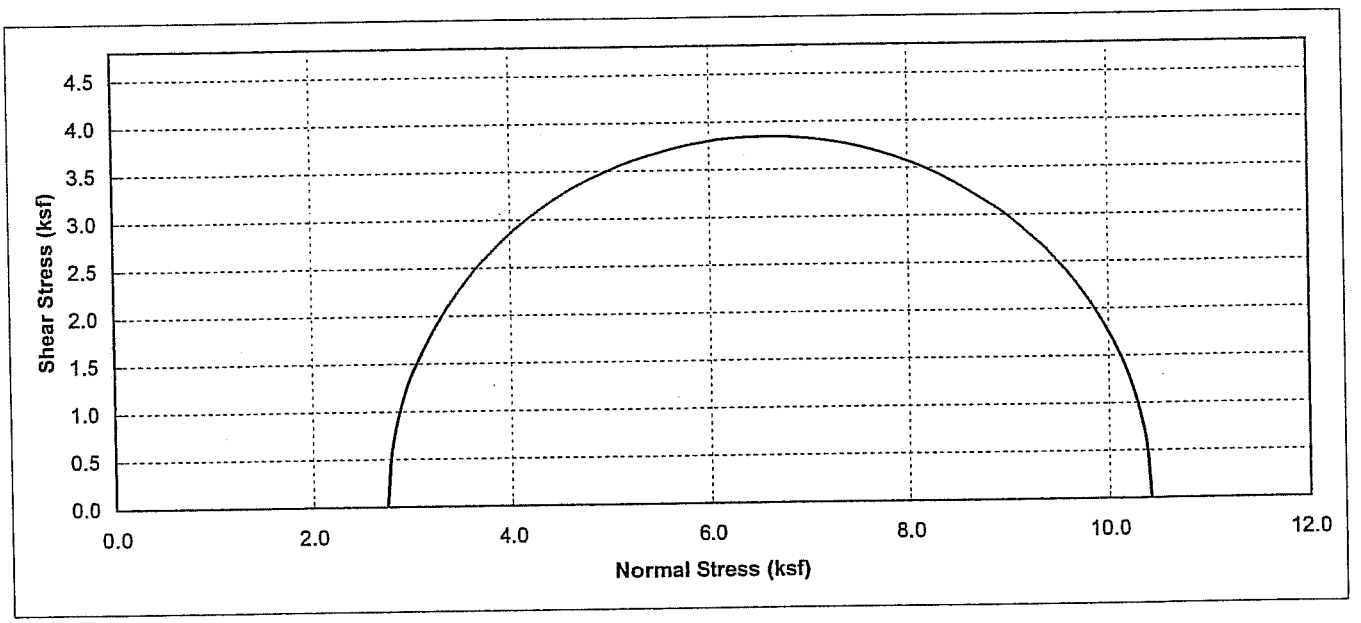
UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/15/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-009	D-8	35	Dark Brown,LEAN CLAY With SAND (CL)	105.7	16.60	2.73	7.69	75.4

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RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/15/08

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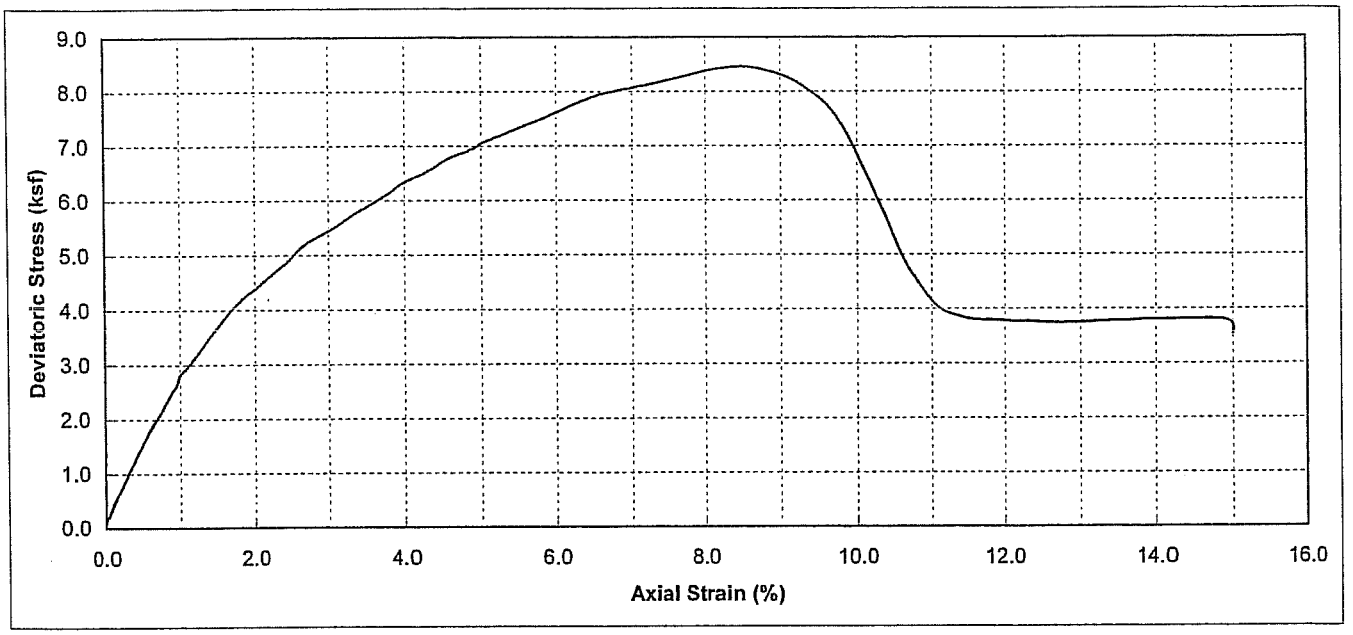

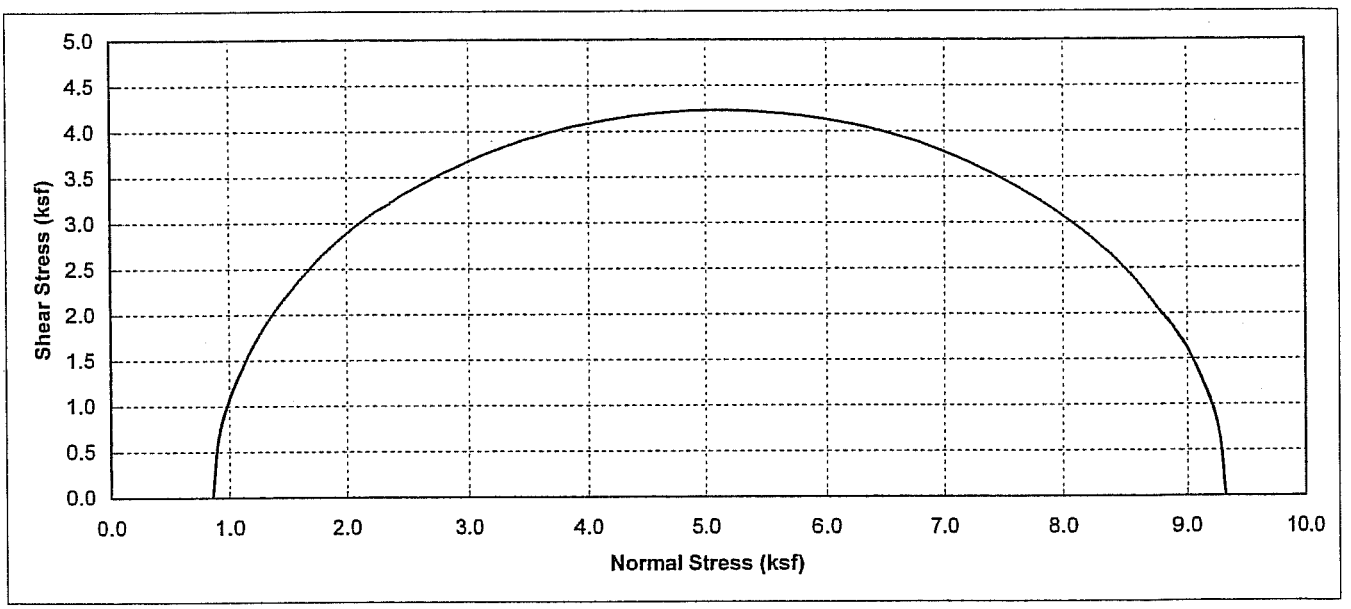

Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-011	D-3	10	Brown, FAT CLAY (CH)	91.6	27.09	0.86	8.46	87.2

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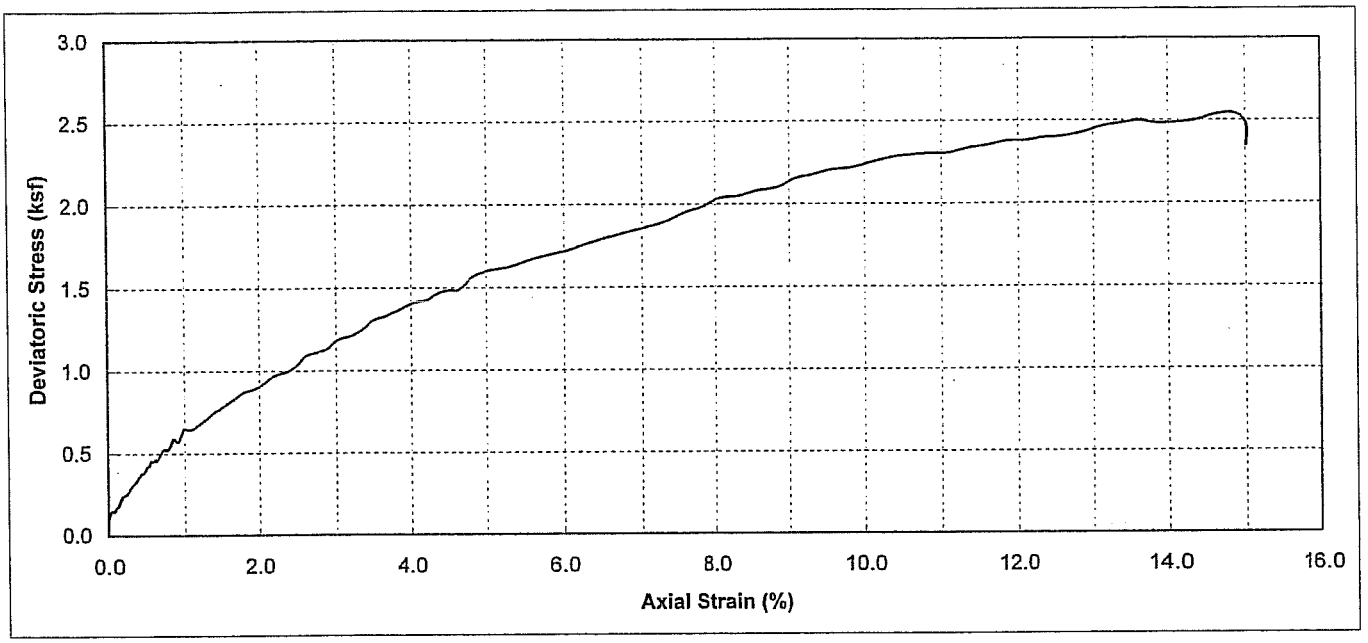
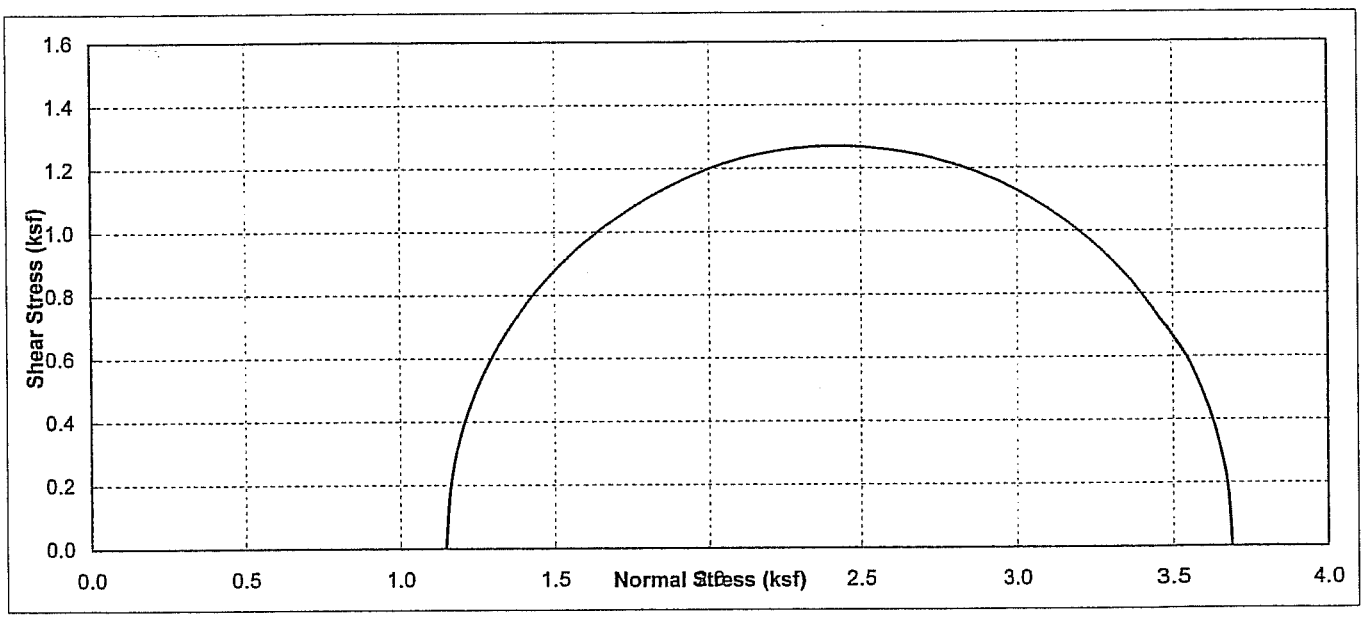
	UNCONSOLIDATED UNDRAINED TEST
Project No. : 08-115 Date : 11/15/08	(ASTM D2850) Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-012	D-4	15	Brown, LEAN CLAY (CL)	82.6	36.67	1.15	2.54	95.2

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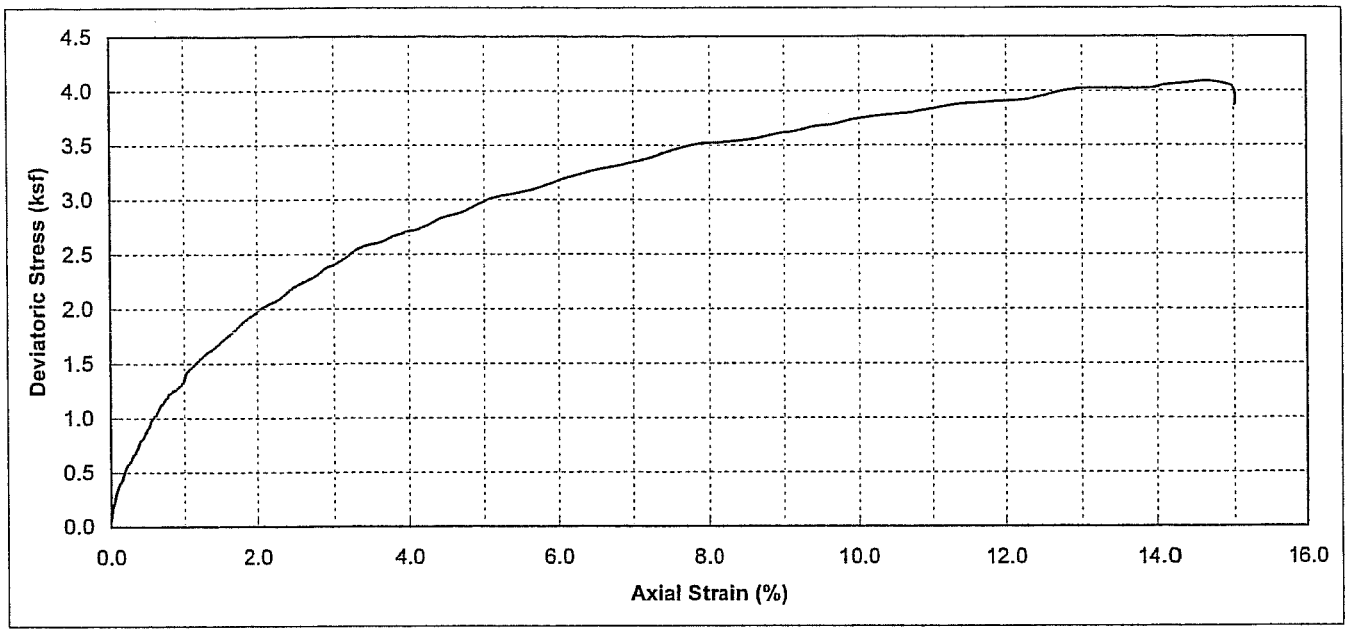
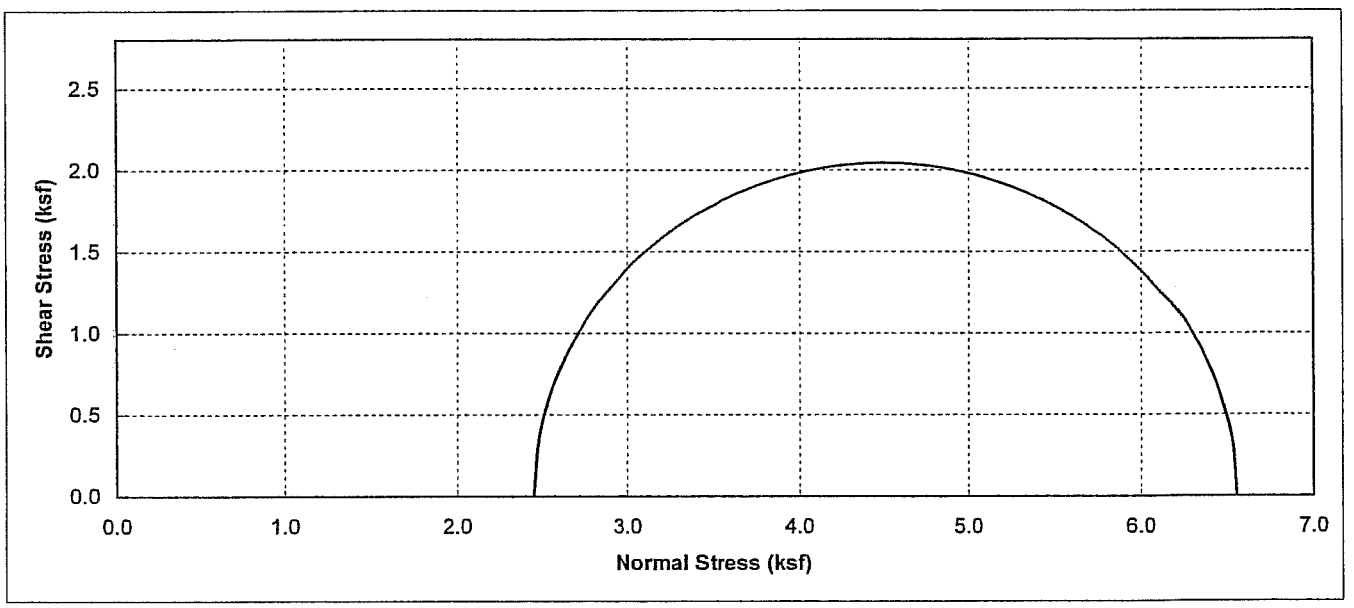
	UNCONSOLIDATED UNDRAINED TEST
Project No. : 08-115 Date : 11/15/08	(ASTM D2850) Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-014	D-7	30	top Brown, FAT CLAY bot Dark Brown SANDY FAT	93.8	28.24	2.45	4.09	95.7

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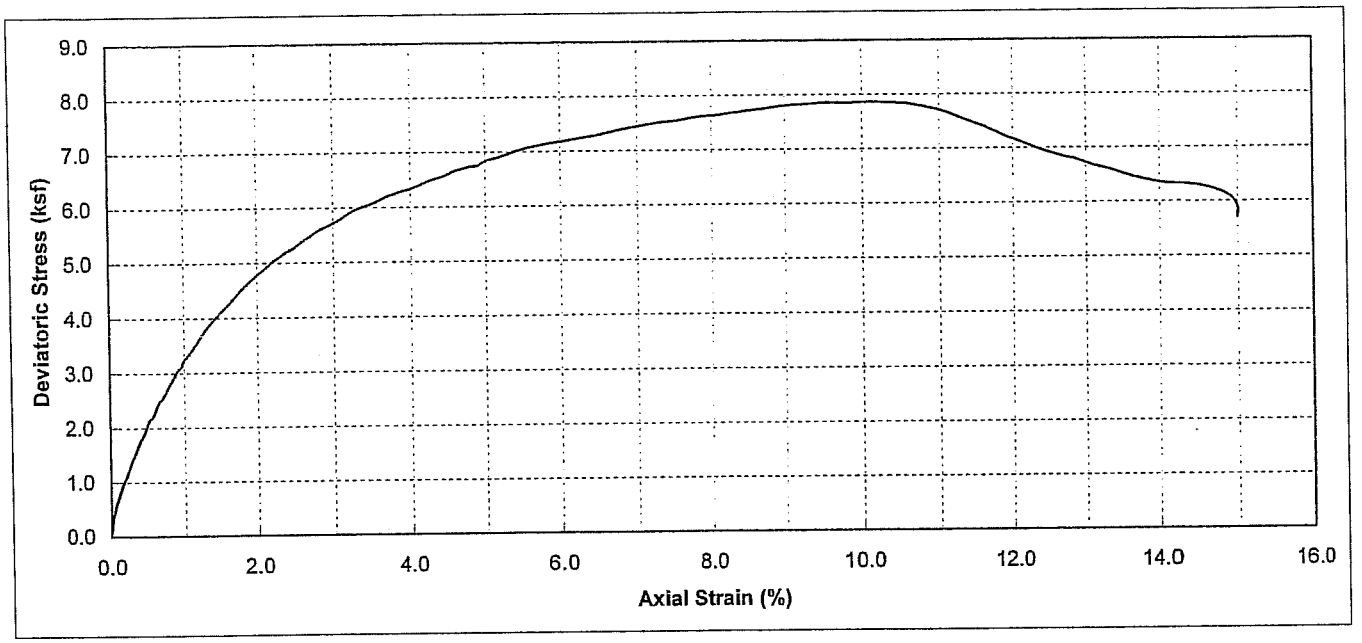
RBF/SR-57 Northbound

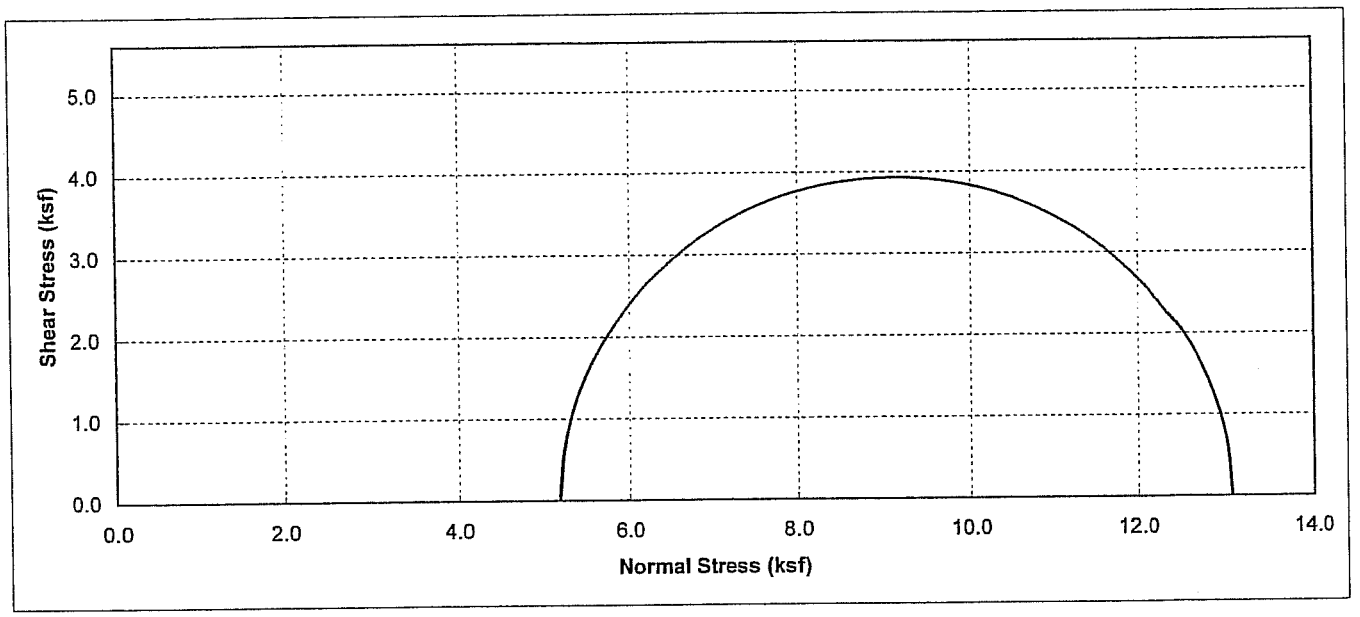
UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/15/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-017	D-14	65	Brown, LEAN CLAY With SAND (CL)	93.3	29.37	5.19	7.86	98.3

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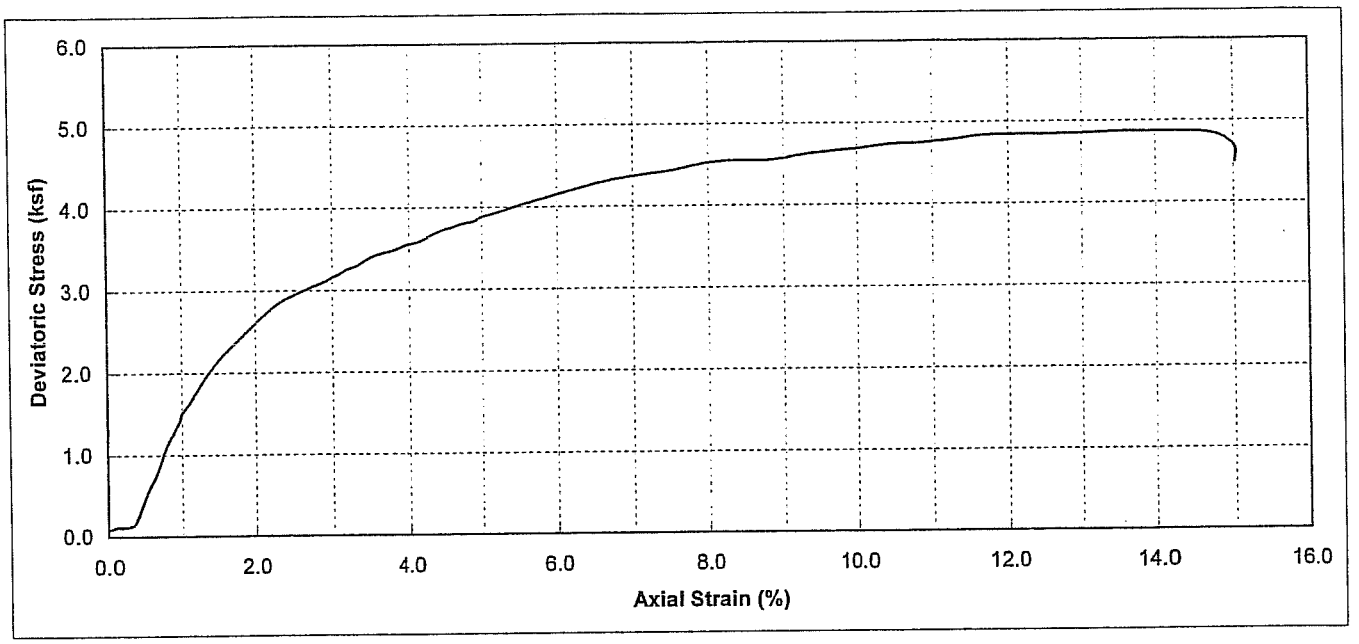
RBF/SR-57 Northbound

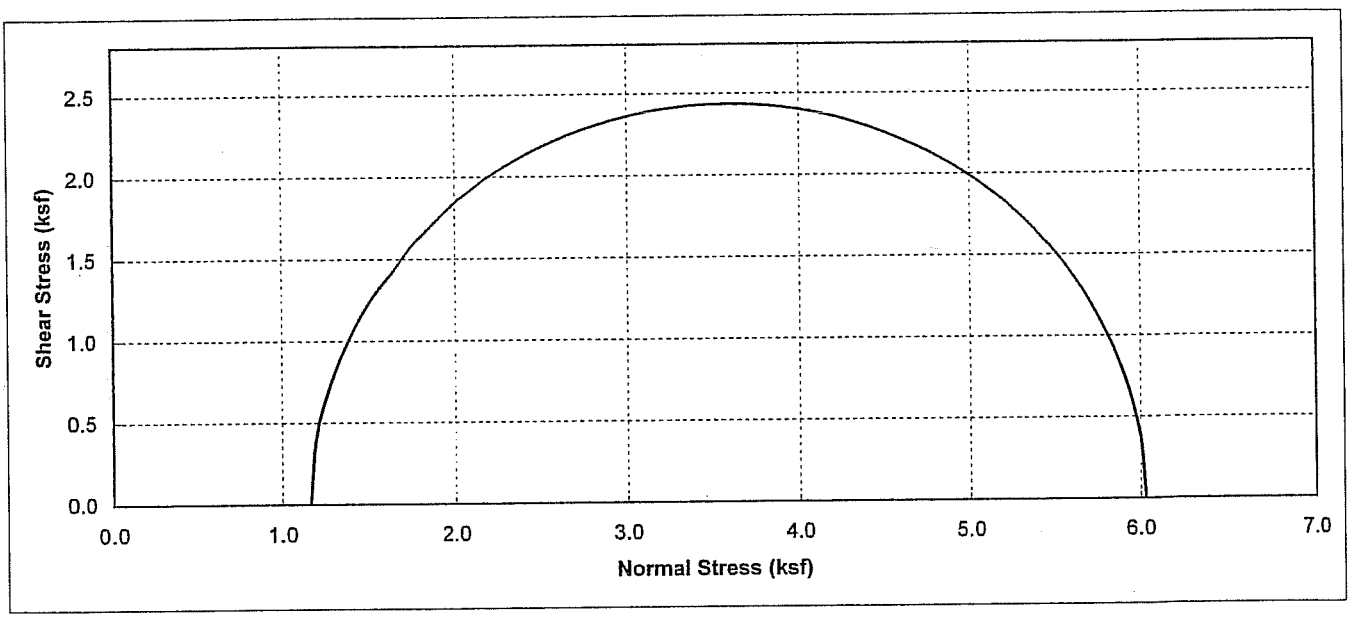
UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/15/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-018	D-4	15	Olive Brown With Olive, SANDY LEAN CLAY (CL)	99.8	24.98	1.16	4.87	98.0

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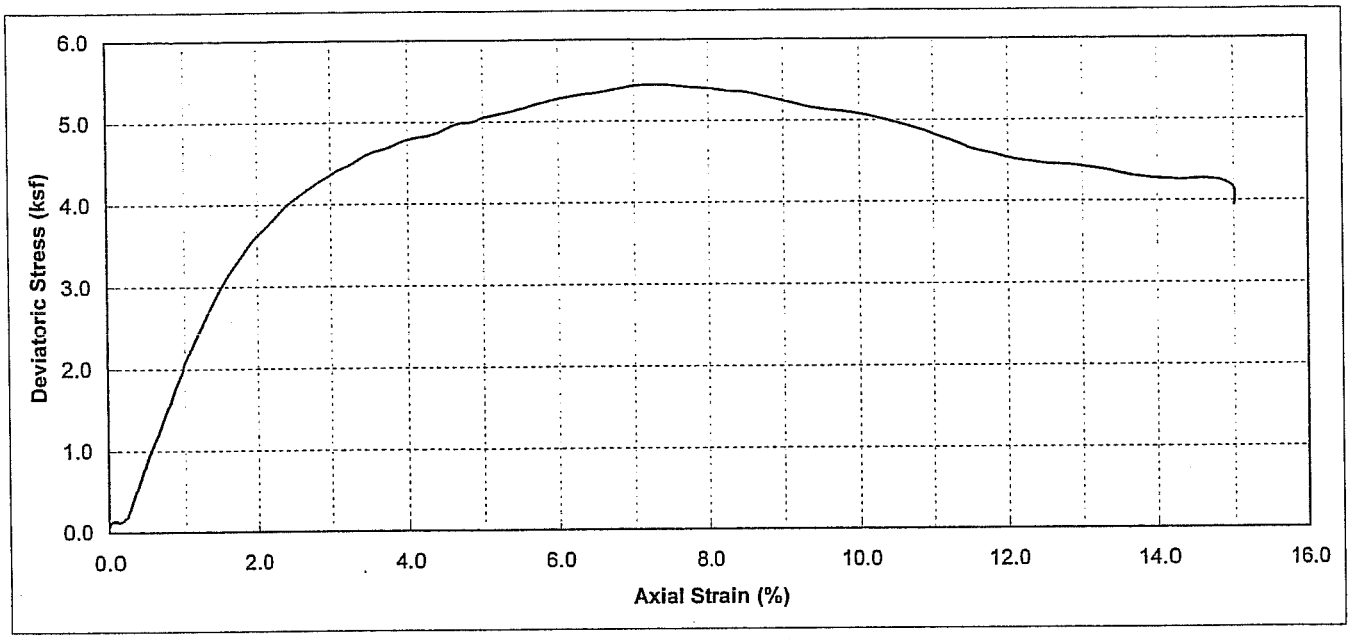
RBF/SR-57 Northbound

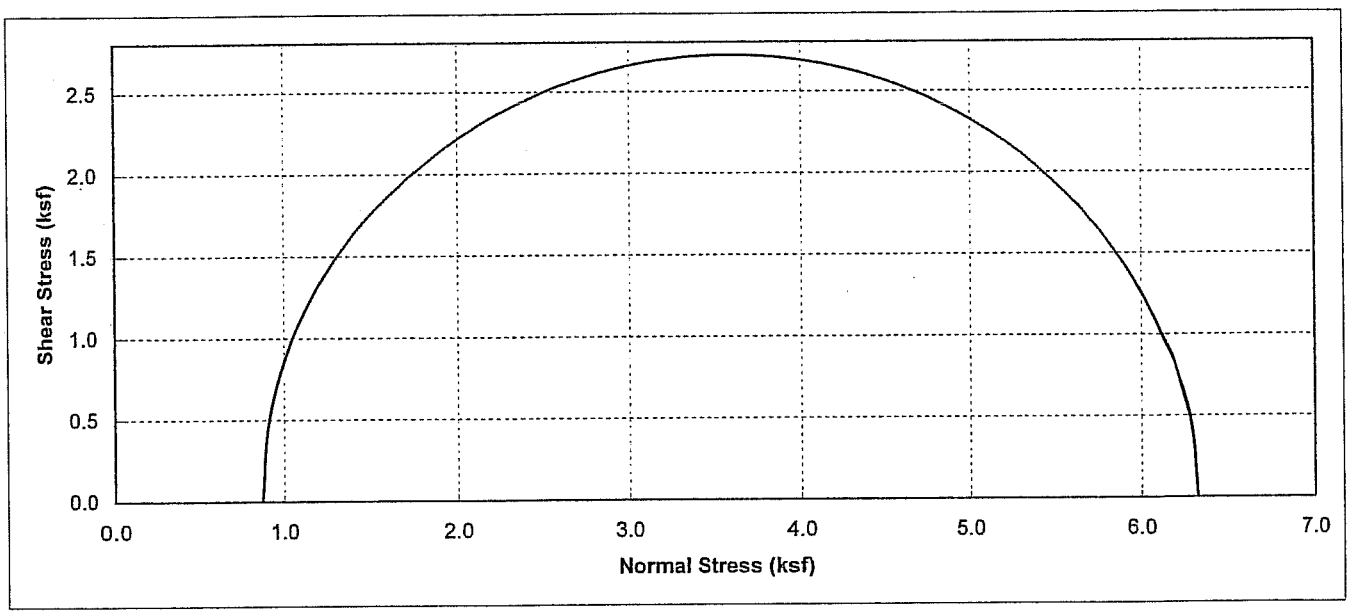
UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/15/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-019	D-3	10	Olive With Olive Brown, LEAN CLAY With SAND (CL)	97.4	22.77	0.86	5.44	84.2

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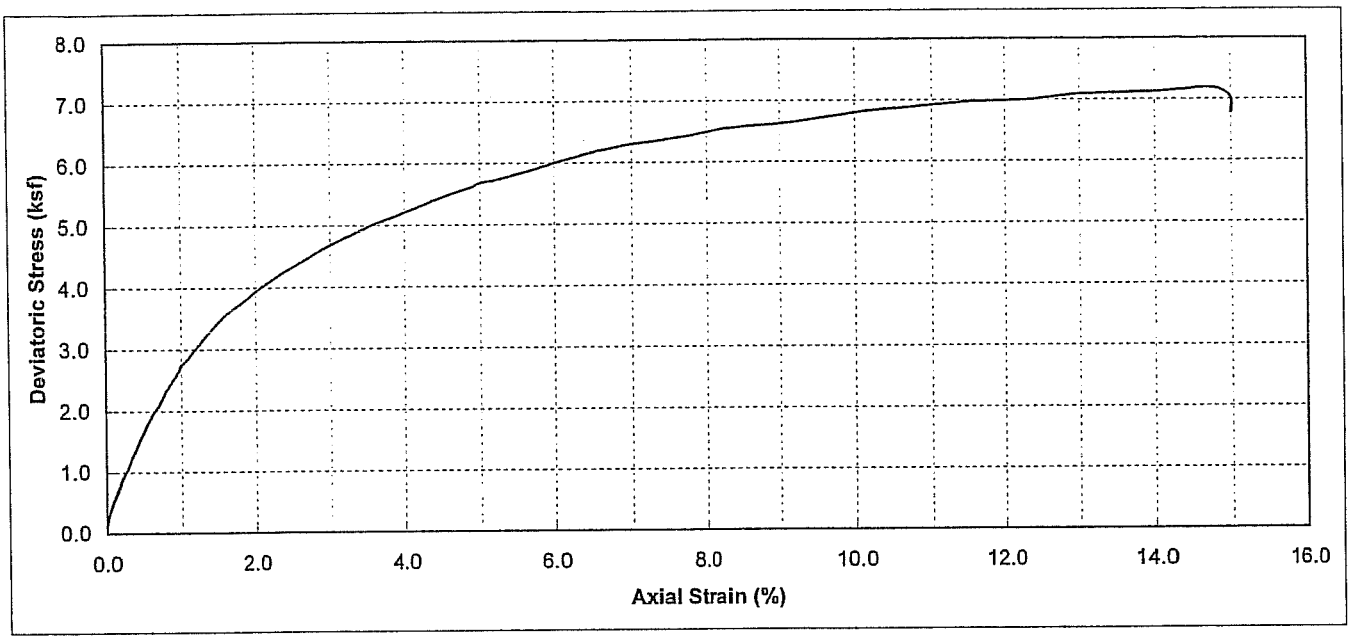
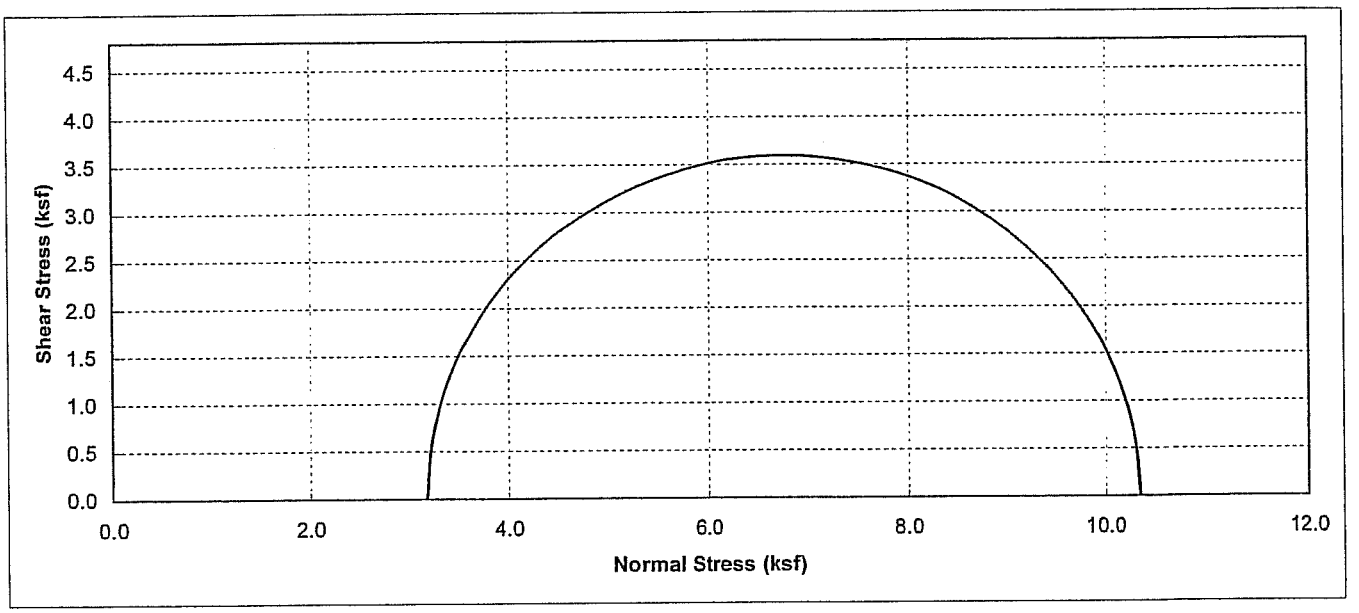
	UNCONSOLIDATED UNDRAINED TEST	
Project No. : 08-115	**Date :** 11/15/08	(ASTM D2850) Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-108	D-9	40	Brown, SANDY LEAN CLAY (CL)	107.5	17.03	3.16	7.19	81.1

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Geotechnical and Earthquake Engineering

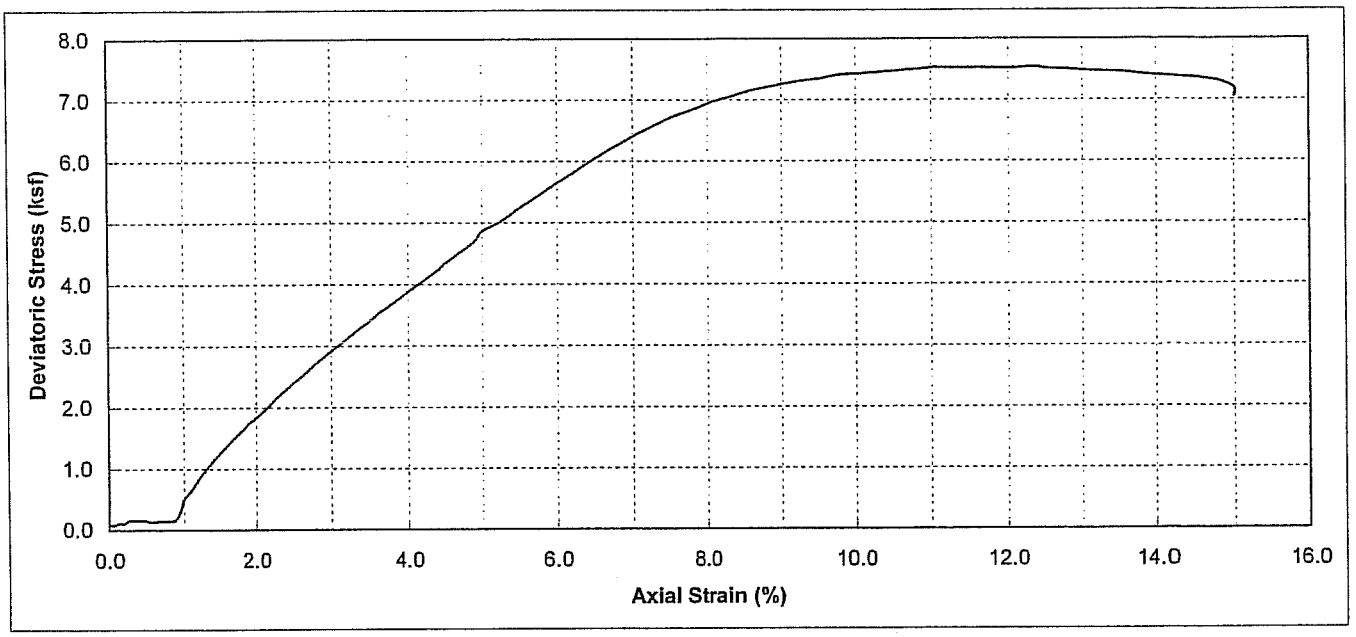
RBF/SR-57 Northbound

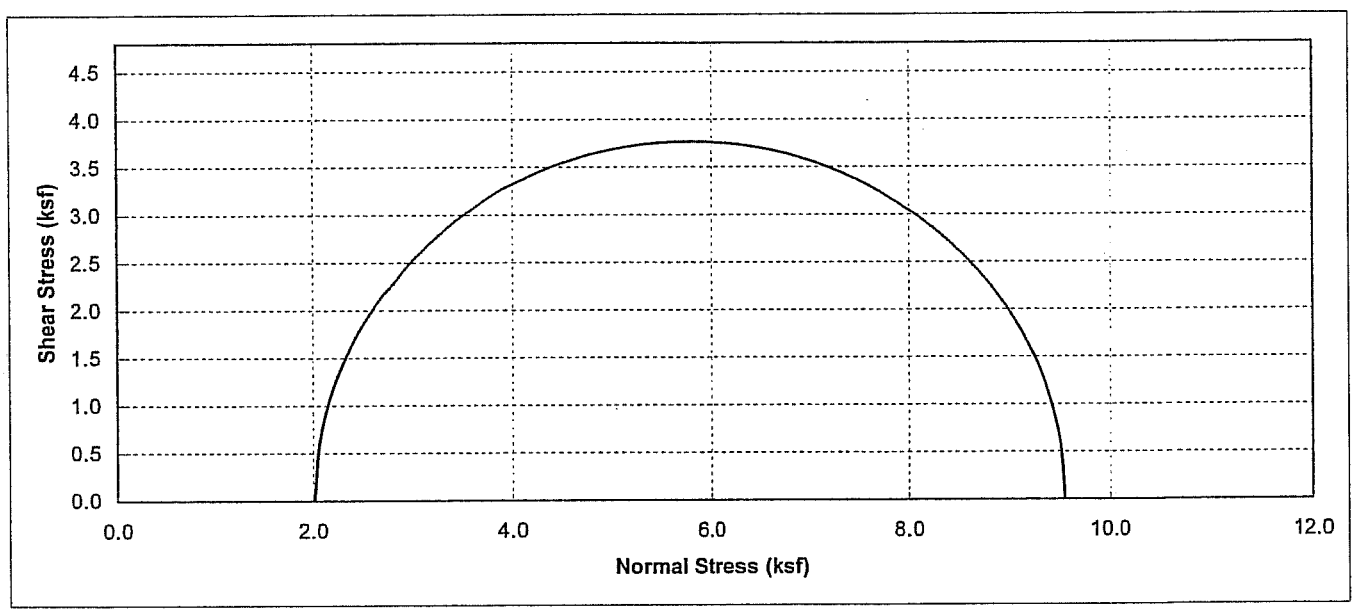
UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/18/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-119	D-6	25	Brown, LEAN CLAY With SAND (CL)	97.7	26.44	2.01	7.54	98.5

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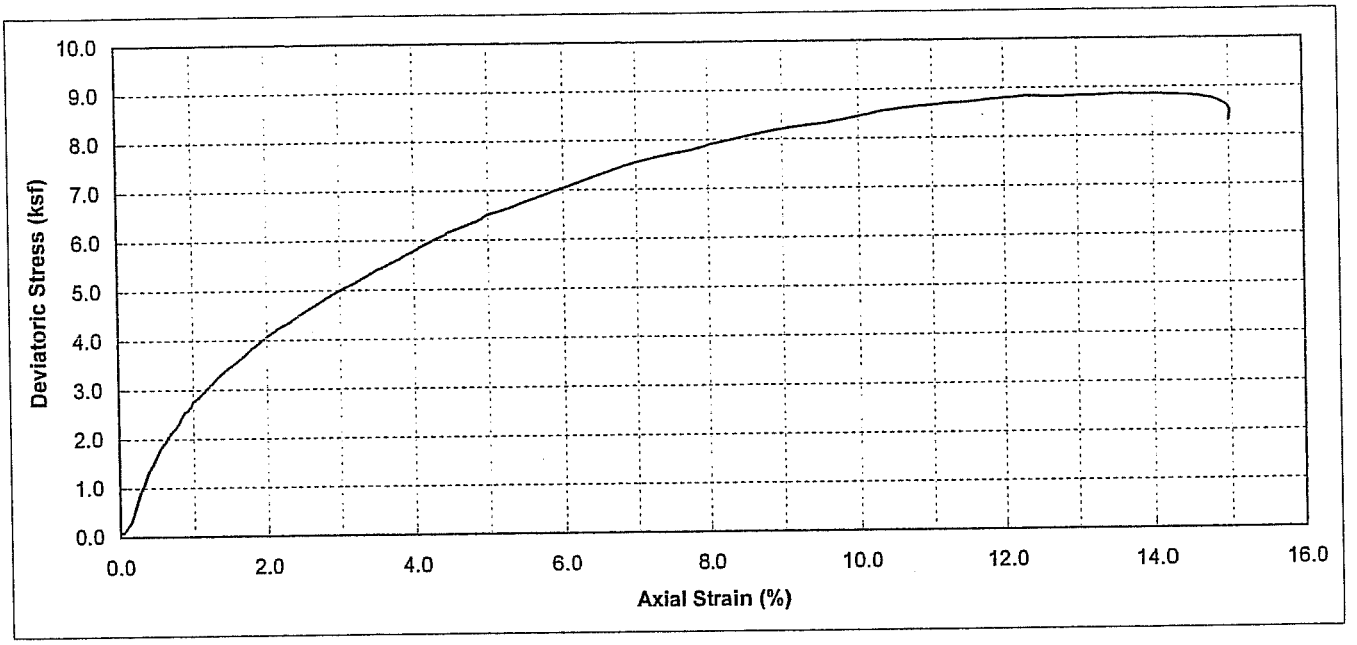
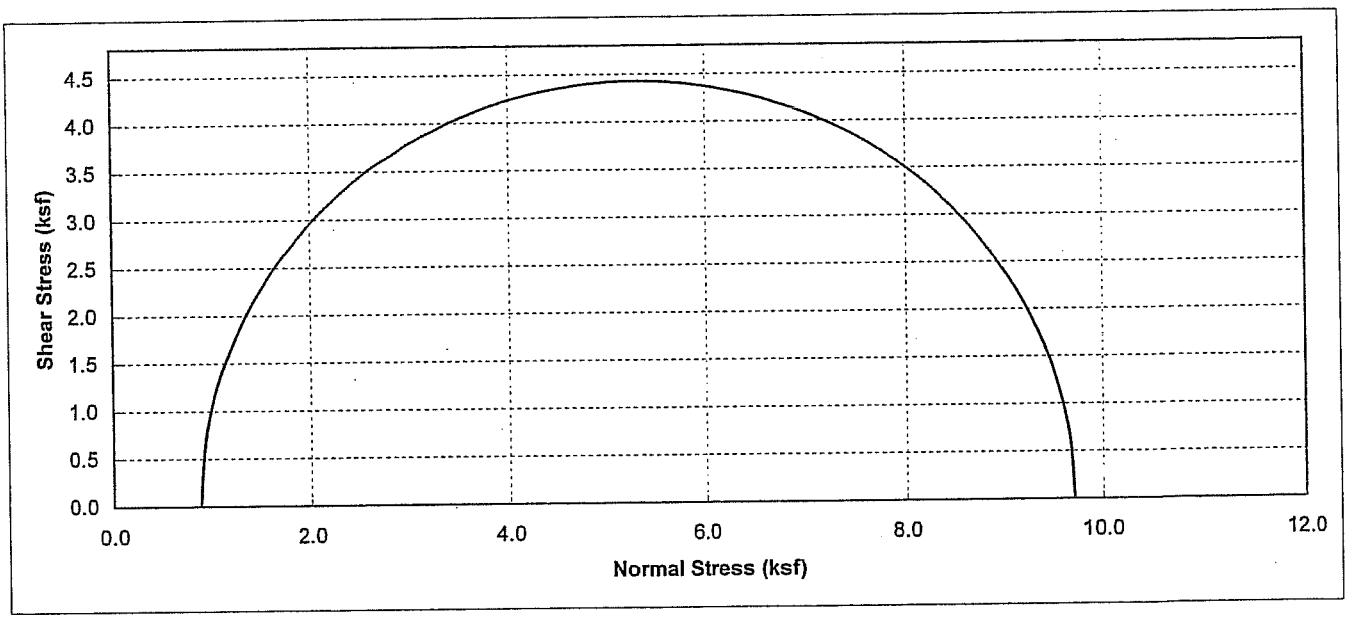
	UNCONSOLIDATED UNDRAINED TEST (ASTM D2850)
Project No. : 08-115 / Date : 11/18/08	Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-121	D-2	5	Dark Olive Brown, SANDY LEAN CLAY (CL)	110.6	18.64	0.87	8.86	96.2

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

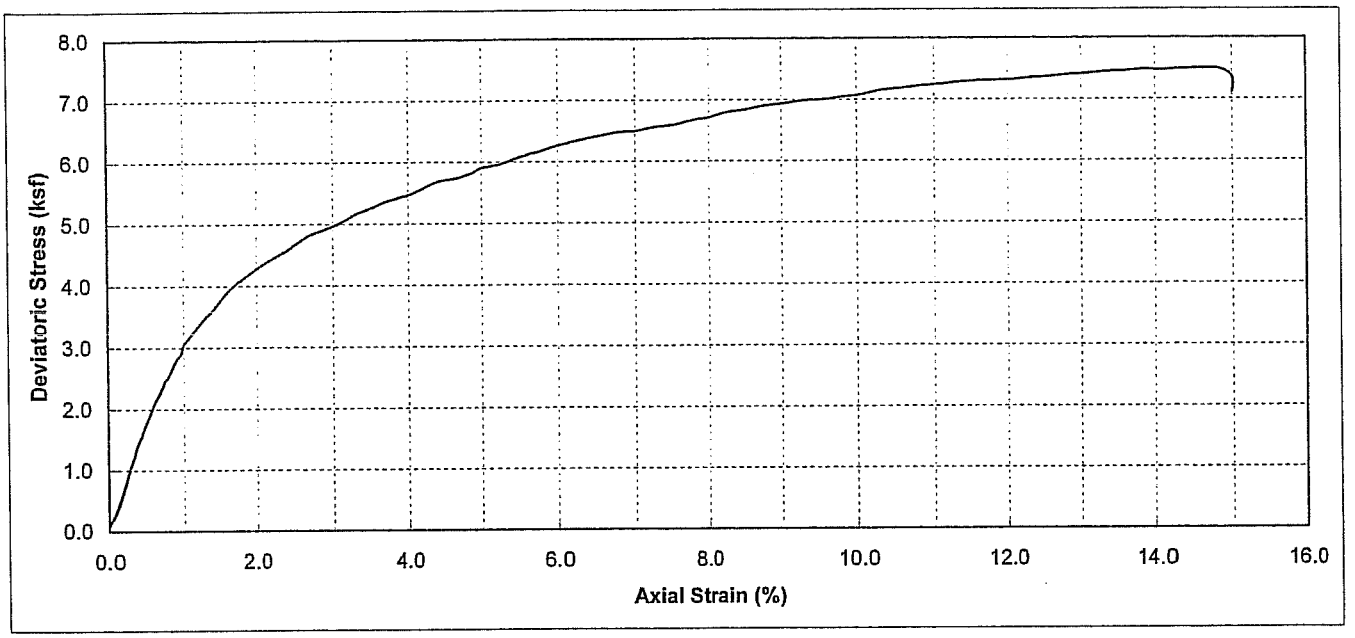
RBF/SR-57 Northbound

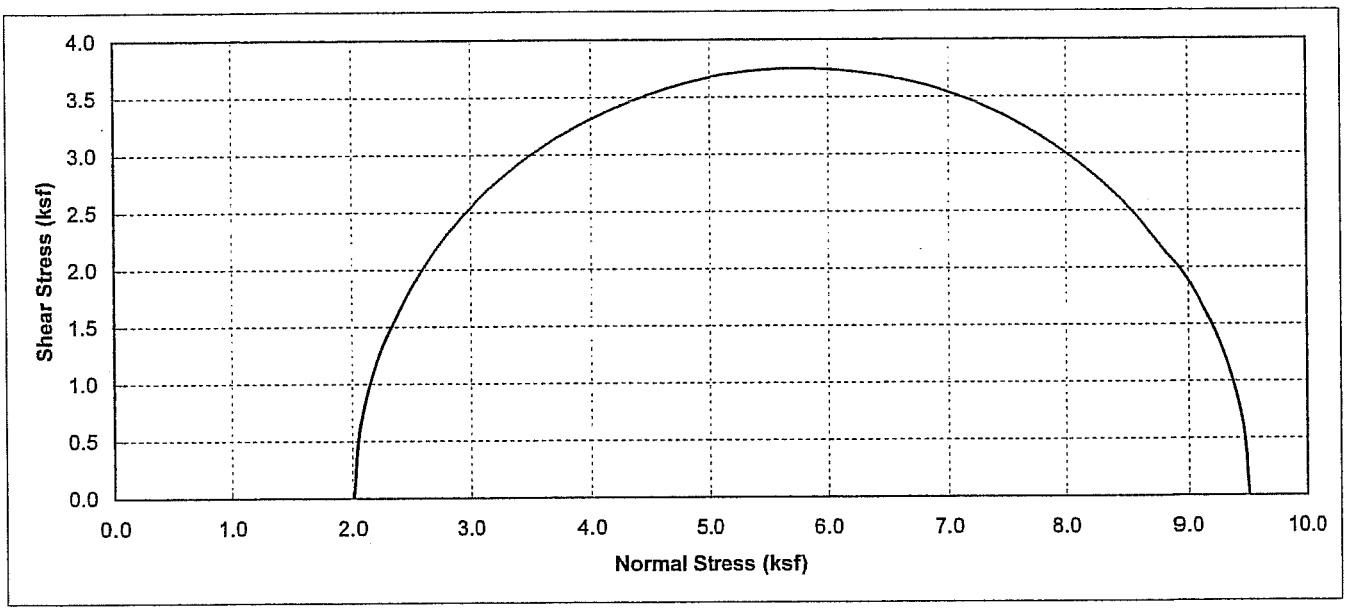
UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/18/08

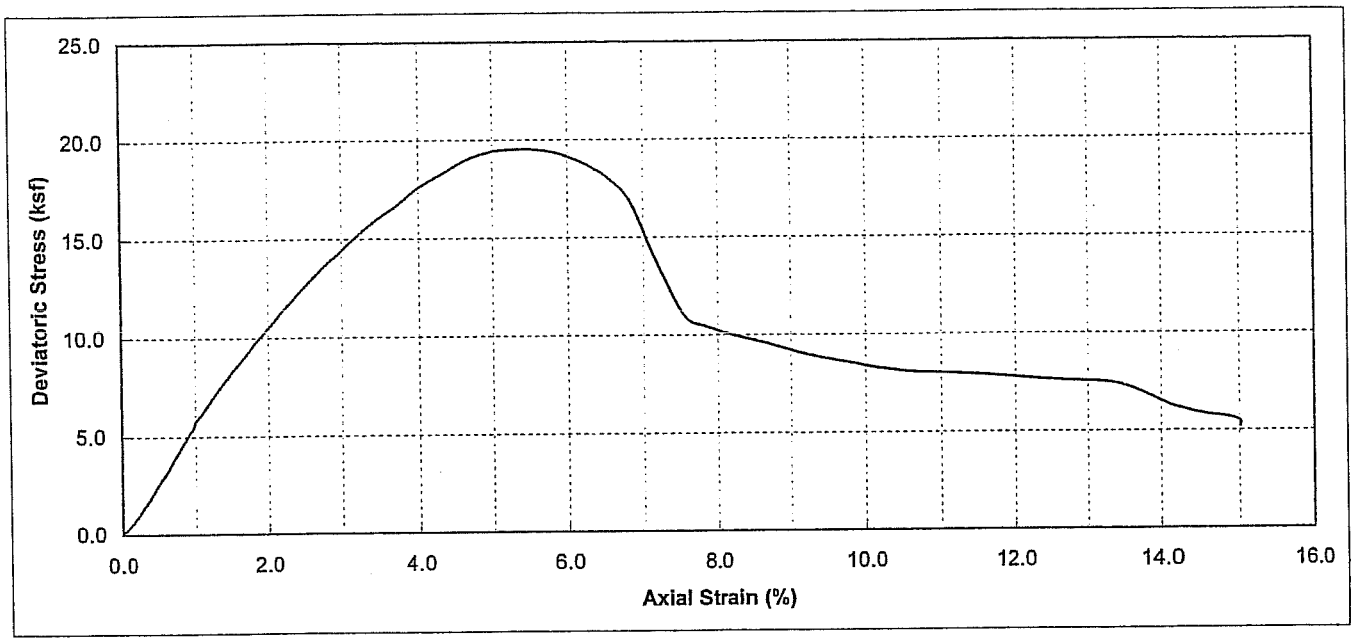
Figure No. :

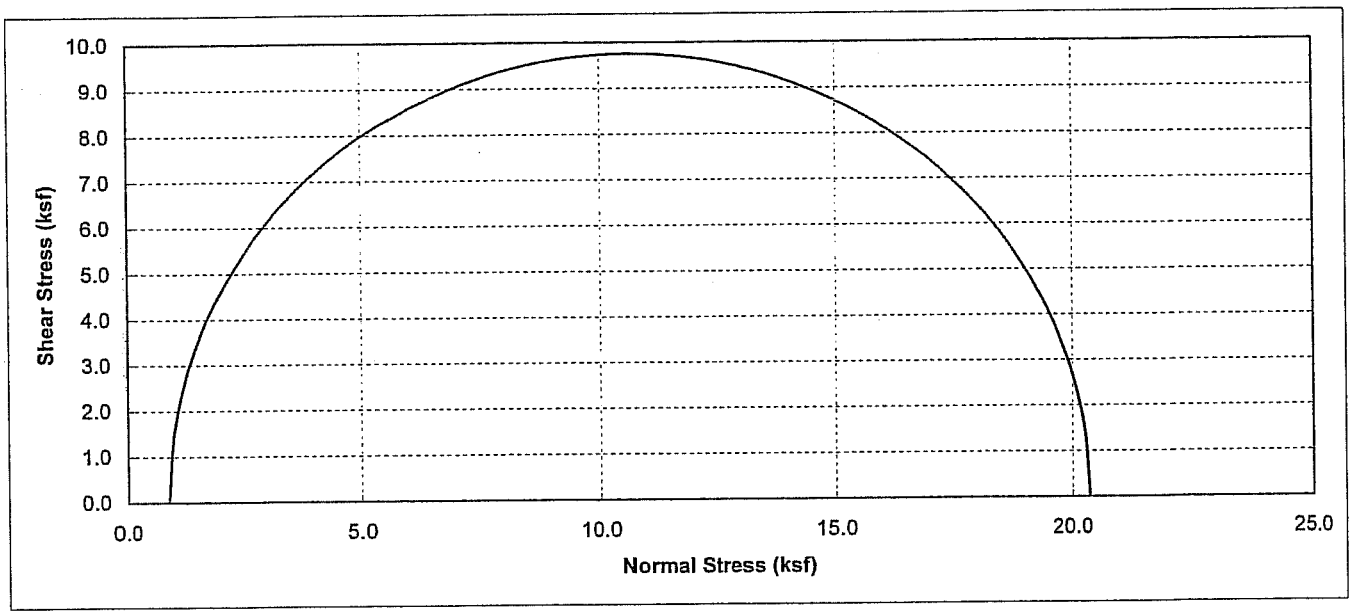




Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-121	D-6	25	Brown to Dark Brown, LEAN CLAY With SAND (CL)	105.6	21.47	2.01	7.50	97.4

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound
	UNCONSOLIDATED UNDRAINED TEST
Project No. : 08-115 Date : 11/19/08	(ASTM D2850) Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-124	D-1	2.5	Olive Gray to brown, LEAN CLAY to SANDY LEAN CLAY	116.0	8.64	0.87	19.51	51.5

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Geotechnical and Earthquake Engineering

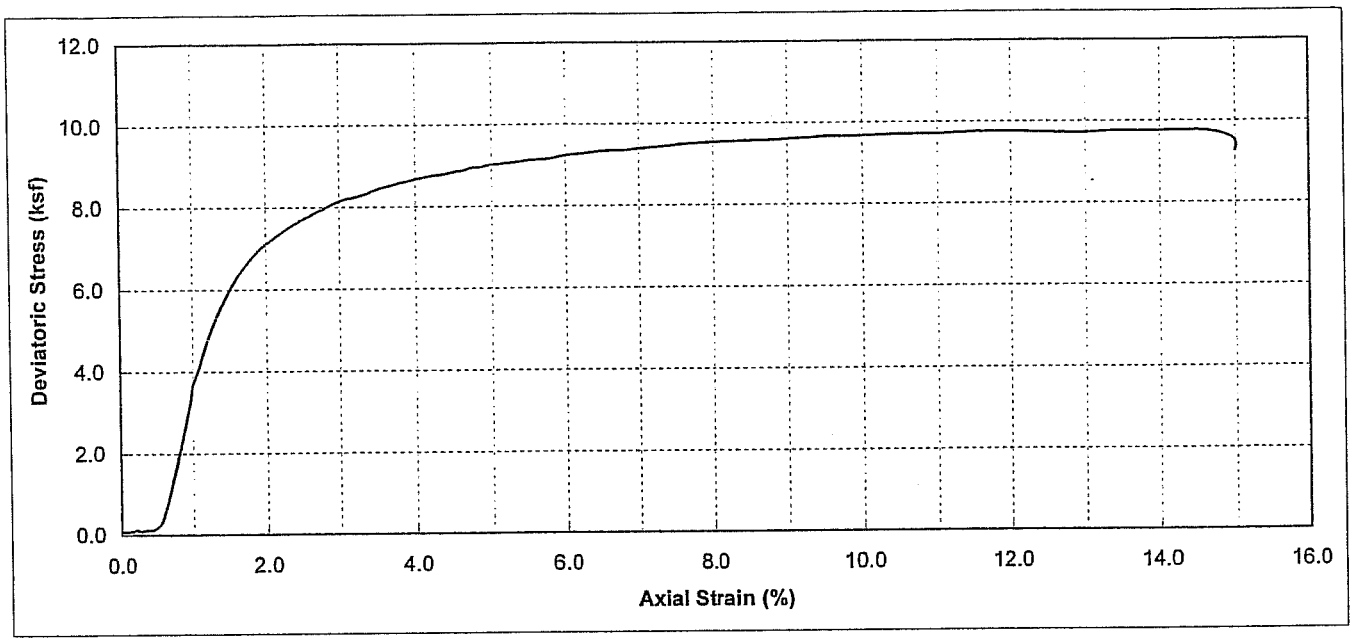
RBF/SR-57 Northbound

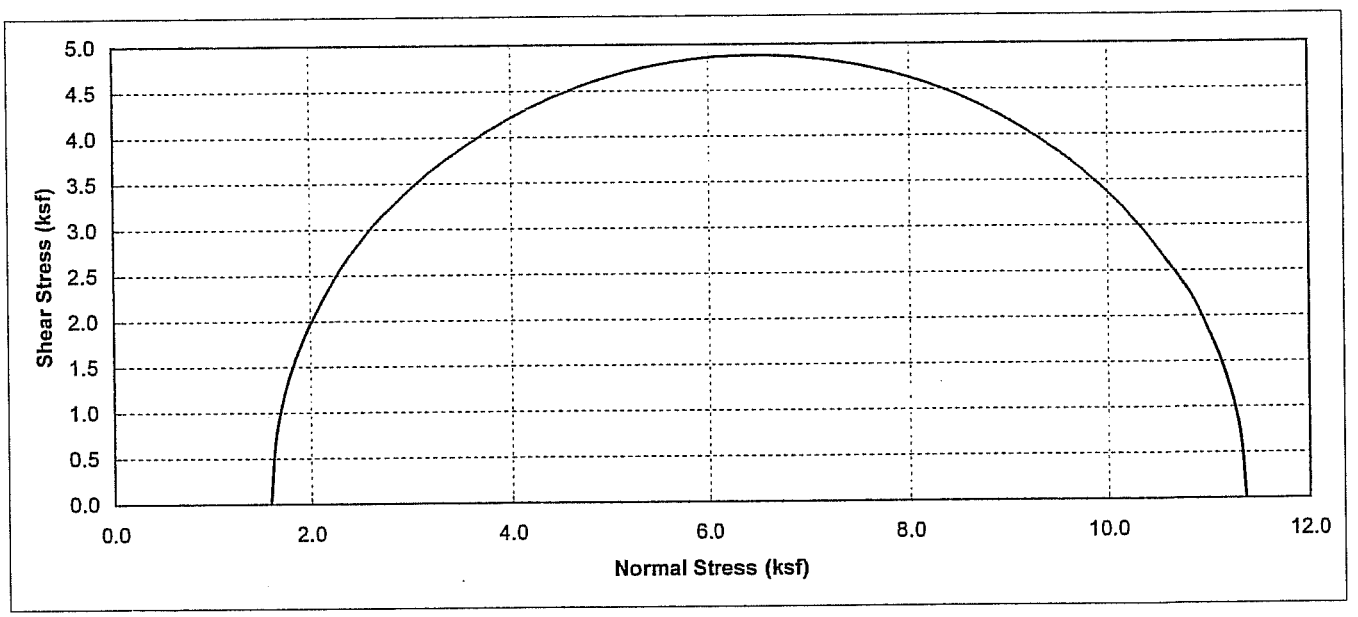
UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/19/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-126	D-5	20	Strong Brown, SANDY LEAN CLAY (CL)	112.2	17.15	1.59	9.76	92.4

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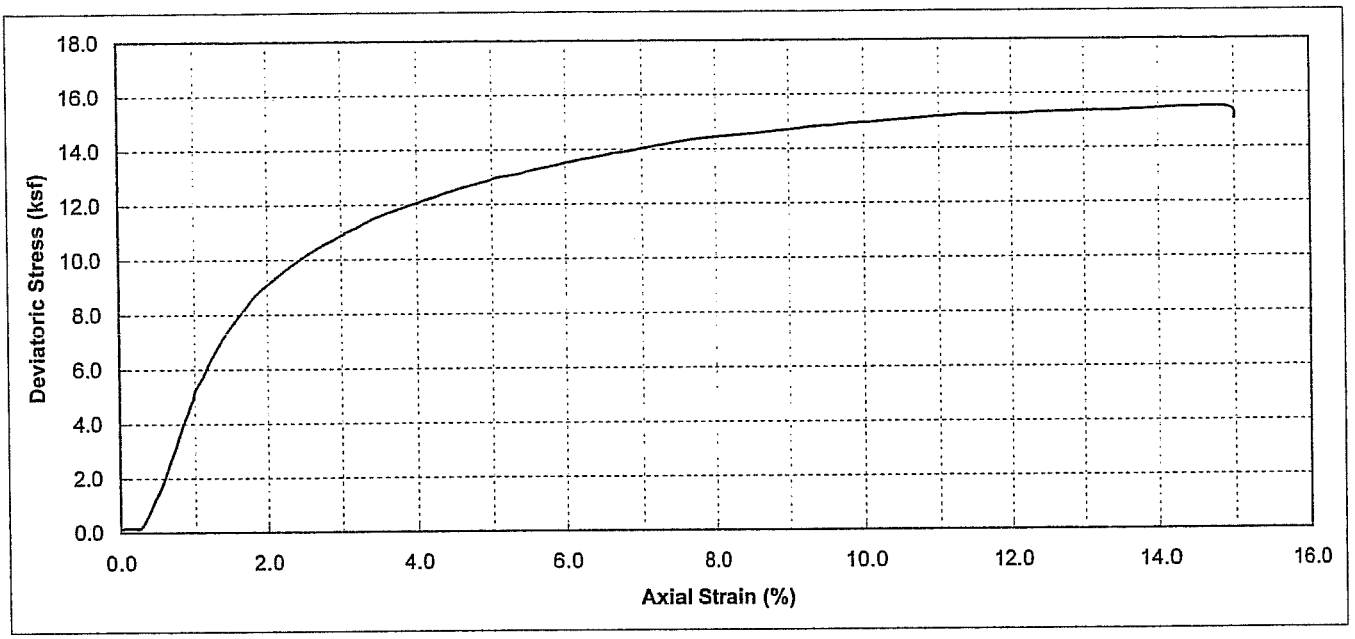
Geotechnical and Earthquake Engineering

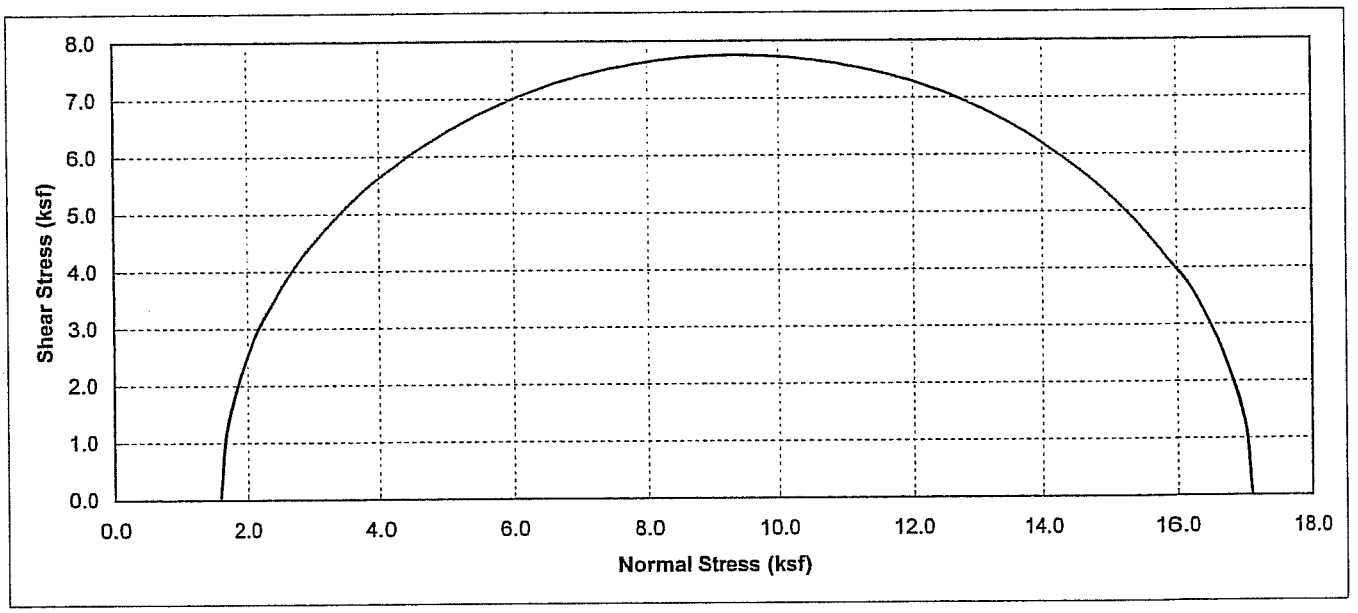
RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115 **Date :** 11/19/08

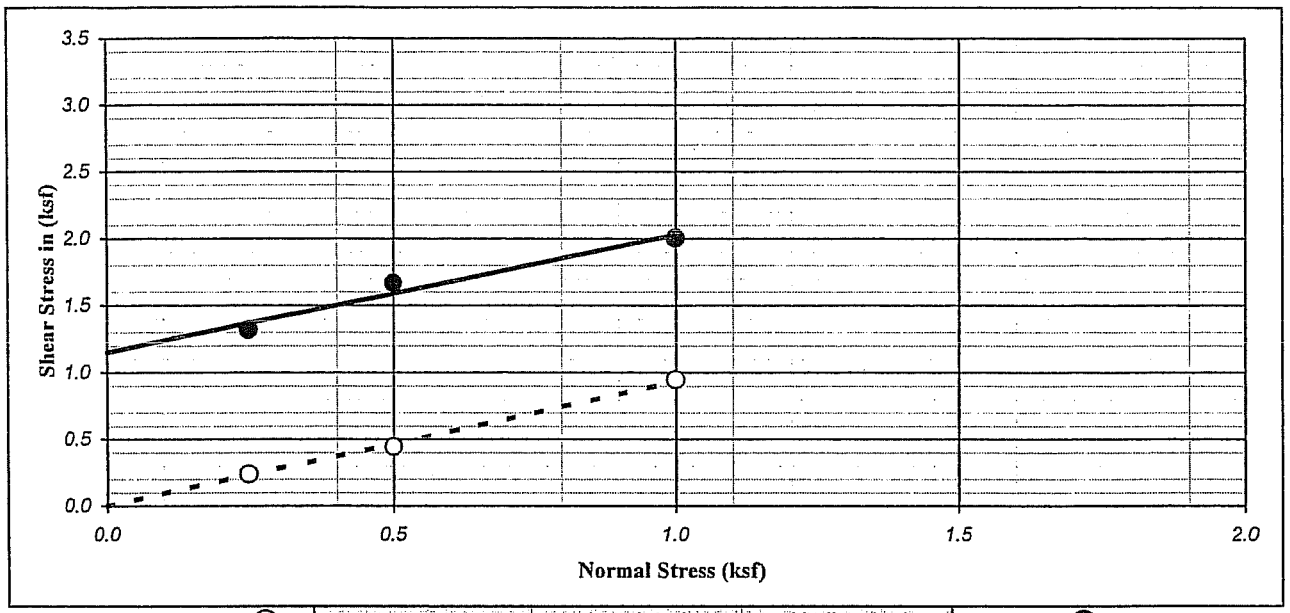
Figure No. :



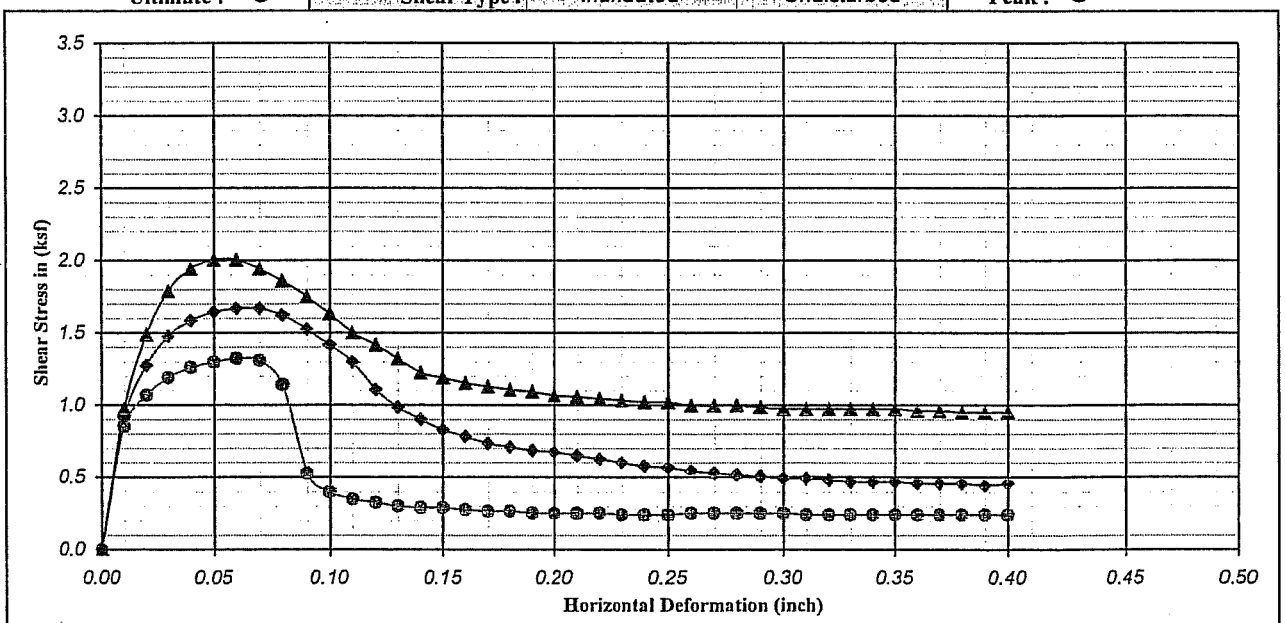


Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-128	D-5	2	Brown, LEAN CLAY With SAND (CL)	110.9	18.14	1.58	15.51	94.3

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	**RBF/SR-57 Northbound**
	UNCONSOLIDATED UNDRAINED TEST
Project No. : 08-115 **Date :** 11/19/08	**(ASTM D2850)** Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-001		Strength Intercept (C) :	1.15	(ksf)	Peak	0.00	(ksf)	Ultimate
Sample No. : D-2			55.16	(kPa)		0.00	(kPa)	
Depth (ft/m) : 5.0	0.00	Friction Angle (ϕ) :	41.27	Degree		43.14	Degree	
Description : Brown, CLAYEY SAND (SC)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	17.43	116.28	18.30	0.45	0.25	11.97	1.32	63.20	0.24	11.49
◆	18.47	113.44	17.86	0.49	0.50	23.94	1.67	79.86	0.44	21.26
▲	17.65	114.83	18.07	0.47	1.00	47.88	2.00	95.95	0.95	45.39

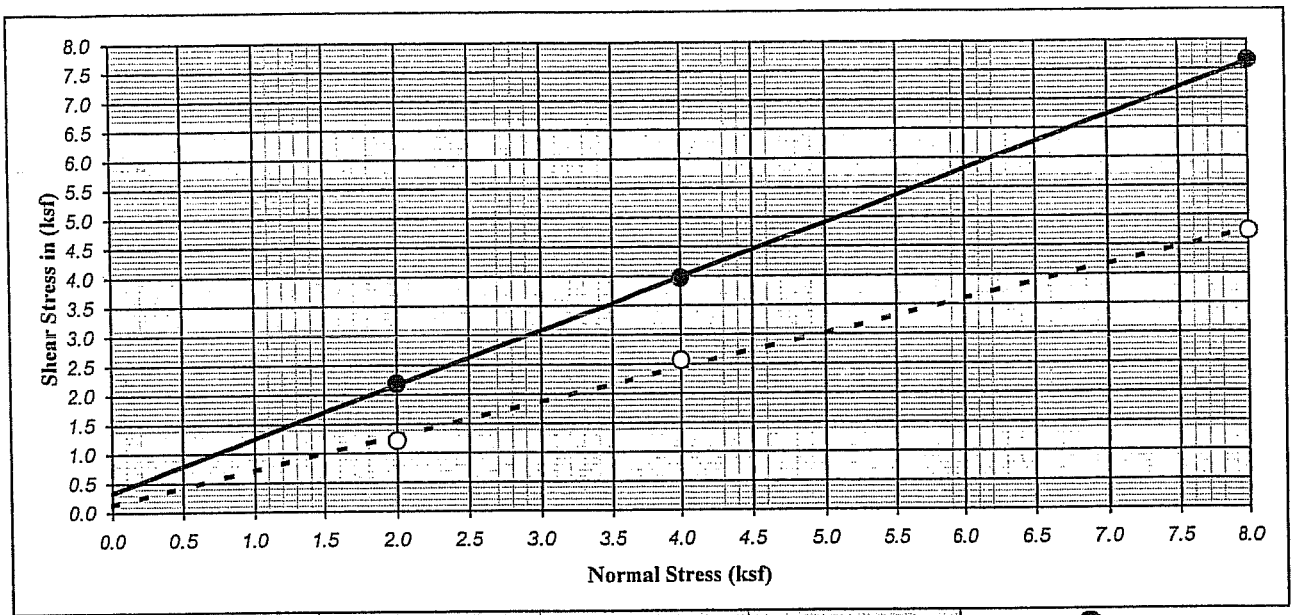
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

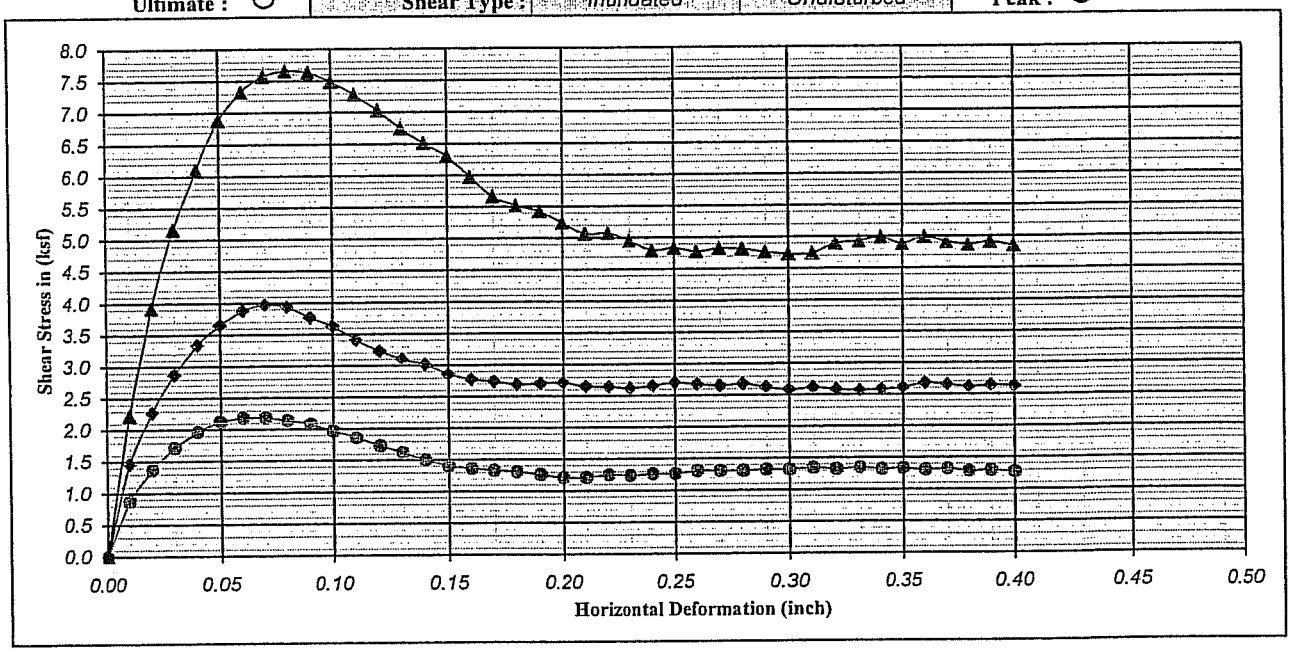
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-001	Strength Intercept (C) :	0.34	(ksf)		0.13	(ksf)		
Sample No. : D-7		16.40	(kPa)	Peak	6.32	(kPa)	Ultimate	
Depth (ft/m) : 35.0 0.00	Friction Angle (ϕ) :	42.40	Degree		30.09	Degree		
Description : Light olive brown, Poorly graded SAND (SP)							Shear Rate (inch/minute) :	0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	16.61	105.01	16.53	0.61	2.00	95.76	2.18	104.57	1.21	58.03
◆	15.39	101.62	16.00	0.66	4.00	191.52	3.97	190.18	2.57	122.96
▲	14.73	104.76	16.49	0.61	8.00	383.04	7.66	366.52	4.73	226.38

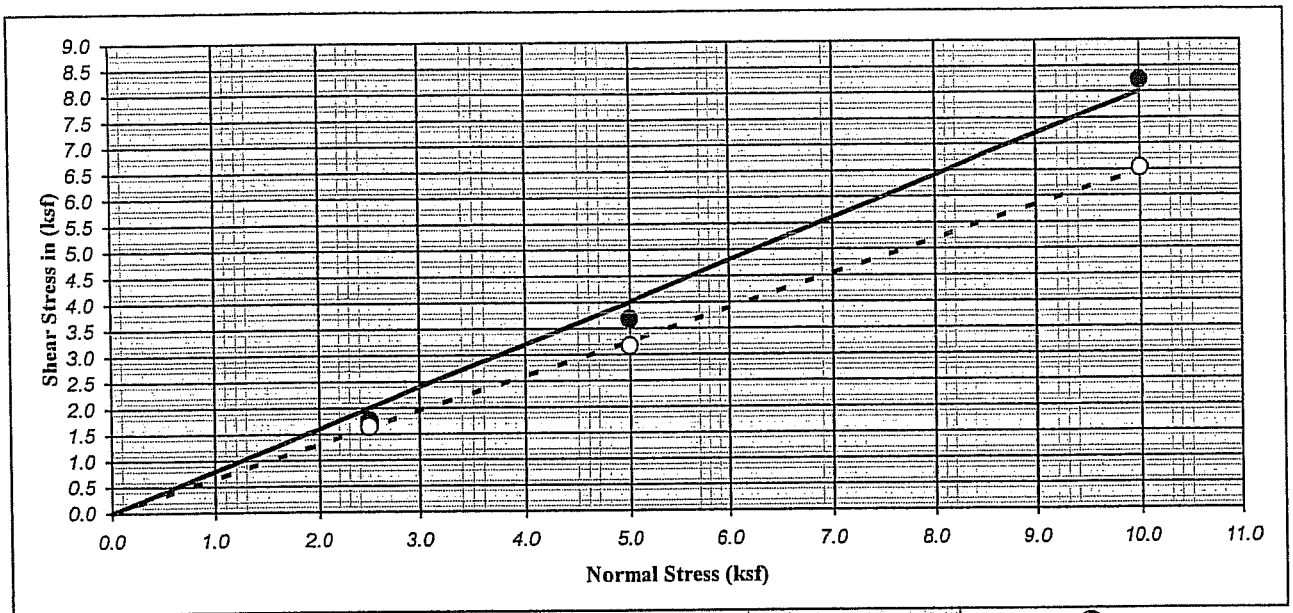
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

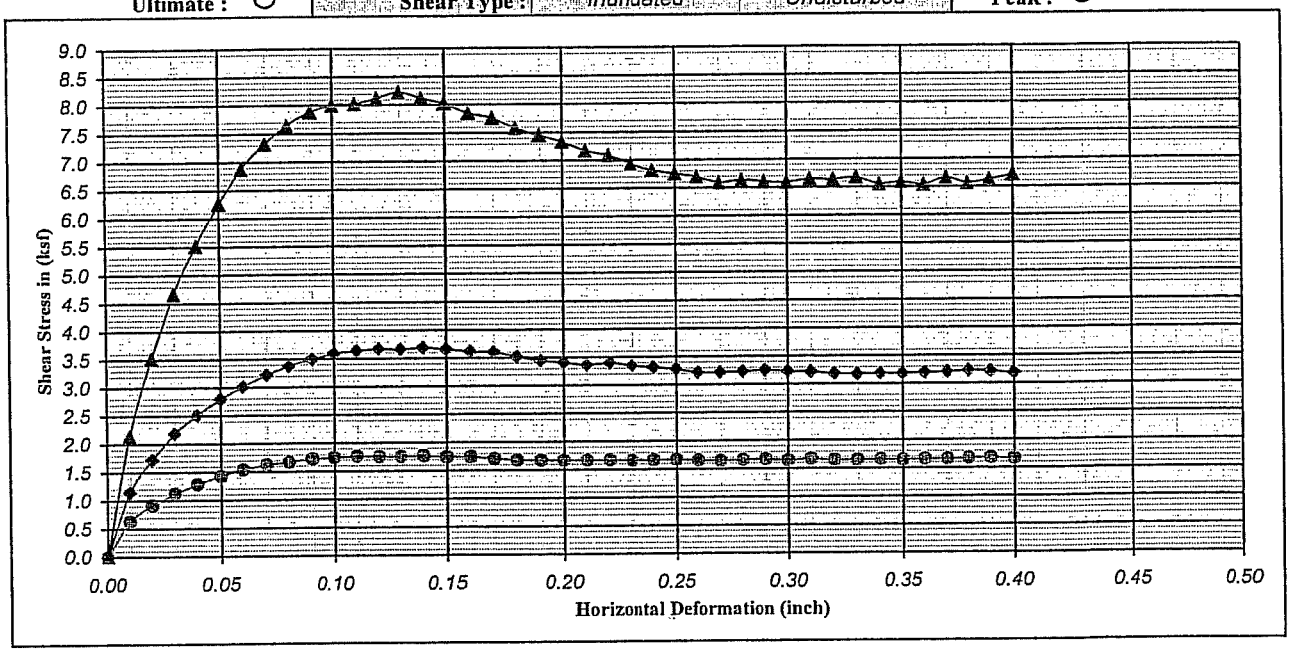
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-002	Strength Intercept (C) :	0.00	(ksf)	Peak	0.00	(ksf)	Ultimate
Sample No. : D-10		0.00	(kPa)		0.00	(kPa)	
Depth (ft/m) : 45.0 0.00	Friction Angle (ϕ) :	38.70	Degree		33.03	Degree	
Description : Olive brown, Poorly graded SAND (SP)					Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	21.34	87.98	13.85	0.92	2.50	119.70	1.76	84.46	1.64	78.71
◆	19.99	91.15	14.35	0.85	5.00	239.40	3.68	176.39	3.17	151.68
▲	18.60	94.70	14.91	0.78	10.00	478.80	8.23	394.10	6.54	313.09

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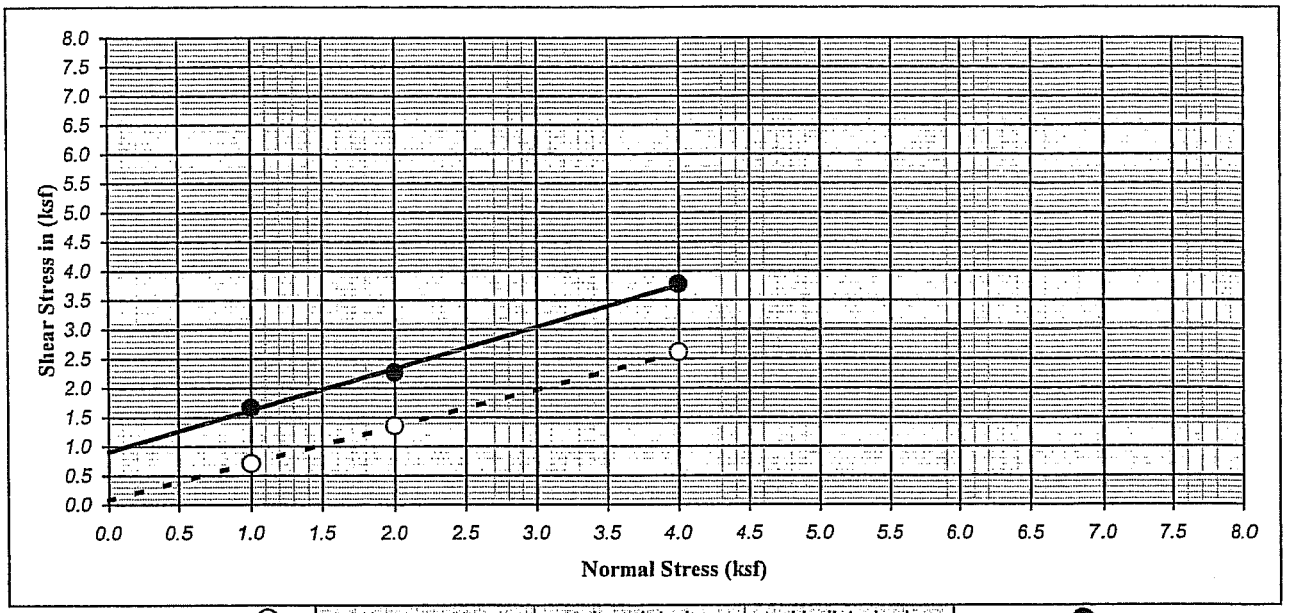
RBF/SR-57 Northbound

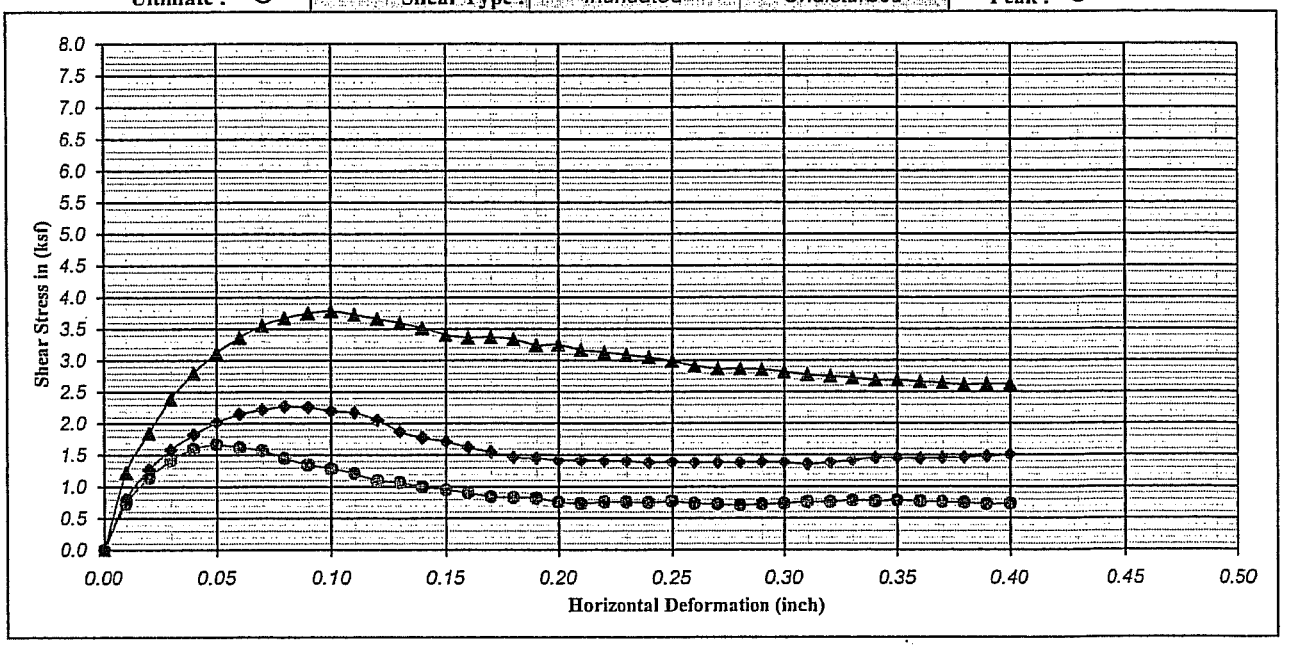
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-003		Strength Intercept (C) :	0.91	(ksf)		0.08	(ksf)		
Sample No. : D-4			43.67	(kPa)	Peak	3.73	(kPa)	Ultimate	
Depth (ft/m) : 15.0	0.00	Friction Angle (ϕ) :	35.43	Degree		32.42	Degree		
Description : Brown, CLAYEY SAND (SC)							Shear Rate (inch/minute) :	0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.17	119.87	18.87	0.41	1.00	47.88	1.67	79.86	0.71	33.90
◆	13.80	121.41	19.11	0.39	2.00	95.76	2.27	108.59	1.36	64.93
▲	7.79	128.82	20.28	0.31	4.00	191.52	3.78	180.99	2.62	125.25

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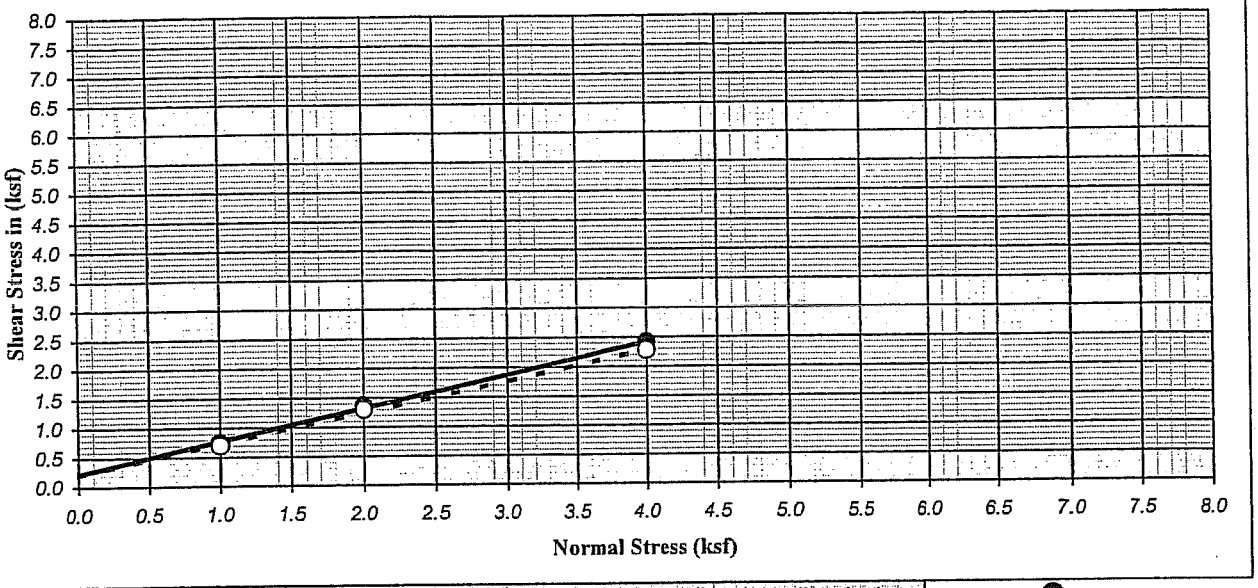
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

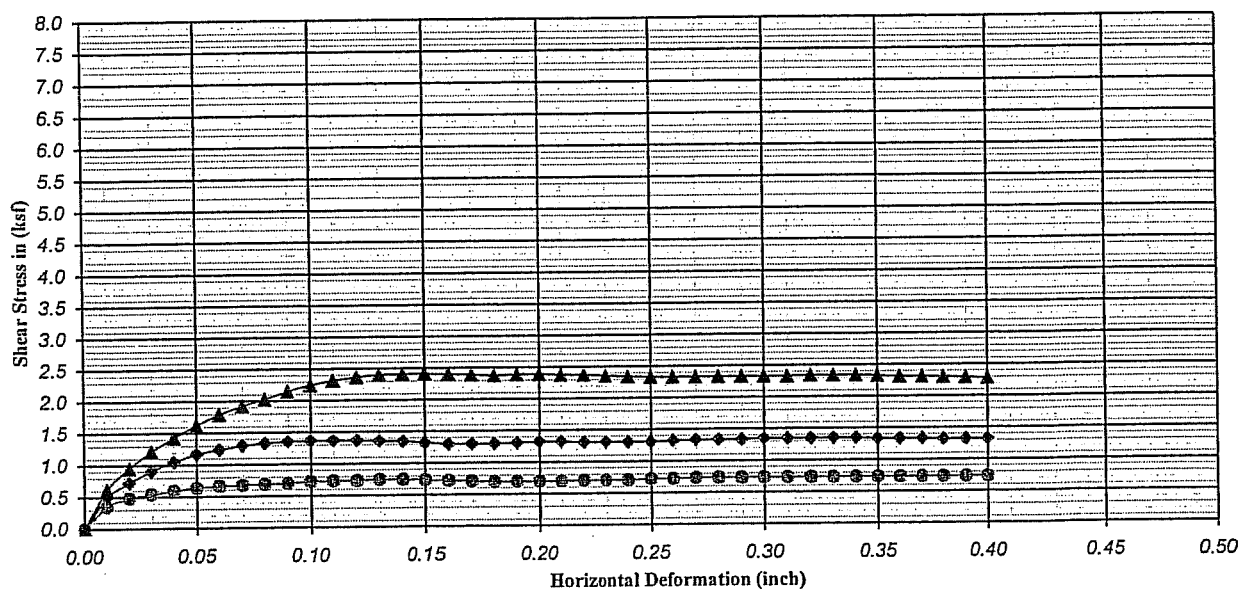
Project No. : 08-115

Date : 11/08/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-005		Strength Intercept (C) :	0.22	(ksf)		0.20	(ksf)	
Sample No. : D-4			10.63	(kPa)	Peak	9.77	(kPa)	Ultimate
Depth (ft/m) : 15.0	0.00	Friction Angle (ϕ) :	28.86	Degree		27.60	Degree	
Description : Olive brown with olive gray, CLAYEY SAND (SC)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	25.41	92.12	14.50	0.83	1.00	47.88	0.74	35.62	0.70	33.32
◆	25.89	93.42	14.70	0.80	2.00	95.76	1.37	65.50	1.30	62.05
▲	25.99	92.76	14.60	0.82	4.00	191.52	2.41	115.49	2.28	109.17

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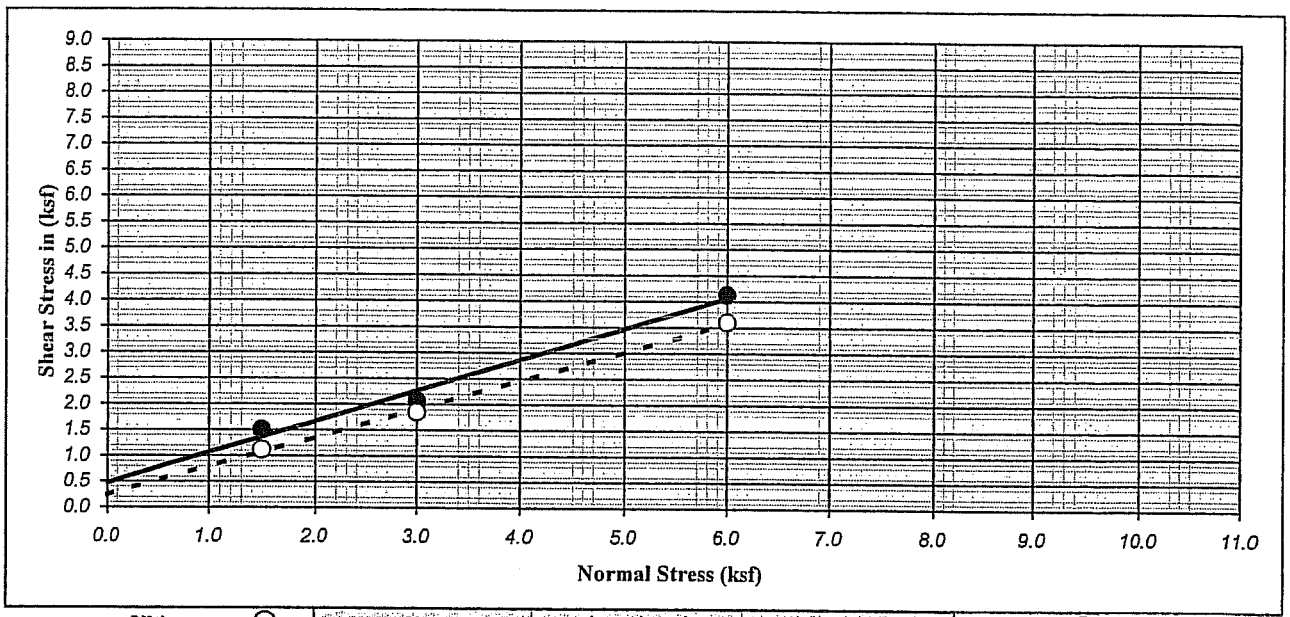
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

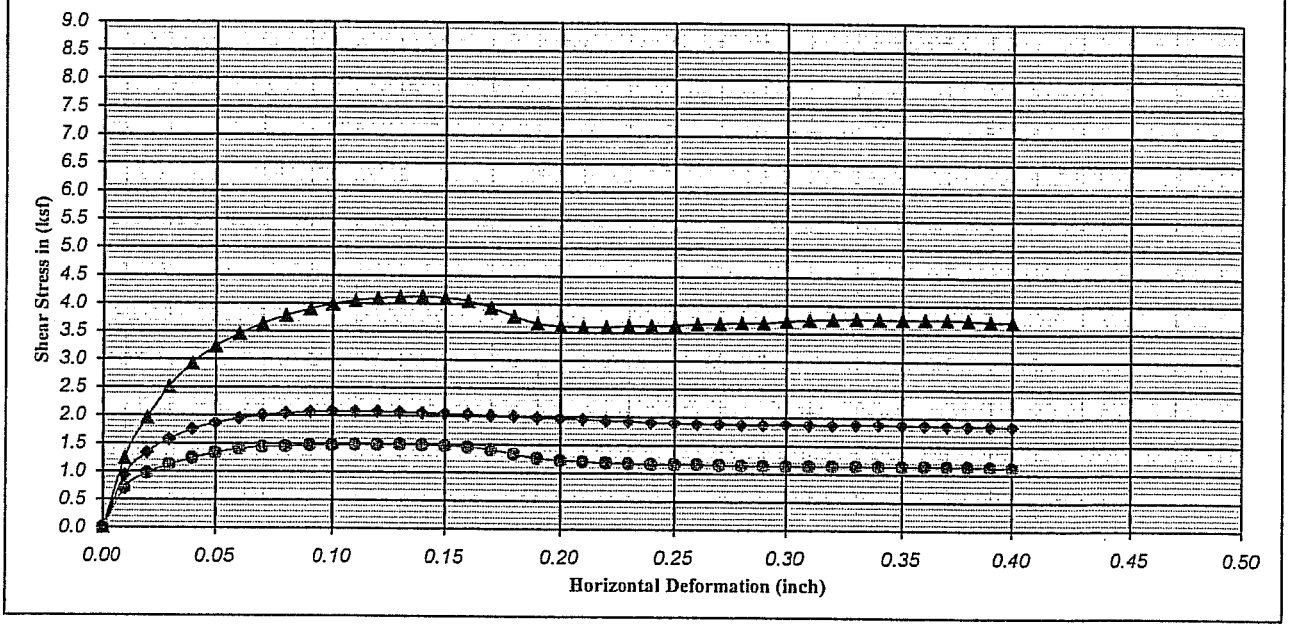
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-006		Strength Intercept (C) :	0.47	(ksf)		0.24	(ksf)	
Sample No. : D-7			22.70	(kPa)	Peak	11.49	(kPa)	Ultimate
Depth (ft/m) : 10.0	0.00	Friction Angle (ϕ) :	30.89	Degree		29.10	Degree	
Description : Brown, CLAYEY SAND (SC)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	50.88	81.26	12.79	1.07	1.50	71.82	1.50	71.82	1.12	53.43
◆	29.72	94.69	14.90	0.78	3.00	143.64	2.08	99.40	1.85	88.48
▲	20.94	99.44	15.65	0.70	6.00	287.28	4.13	197.65	3.60	172.37

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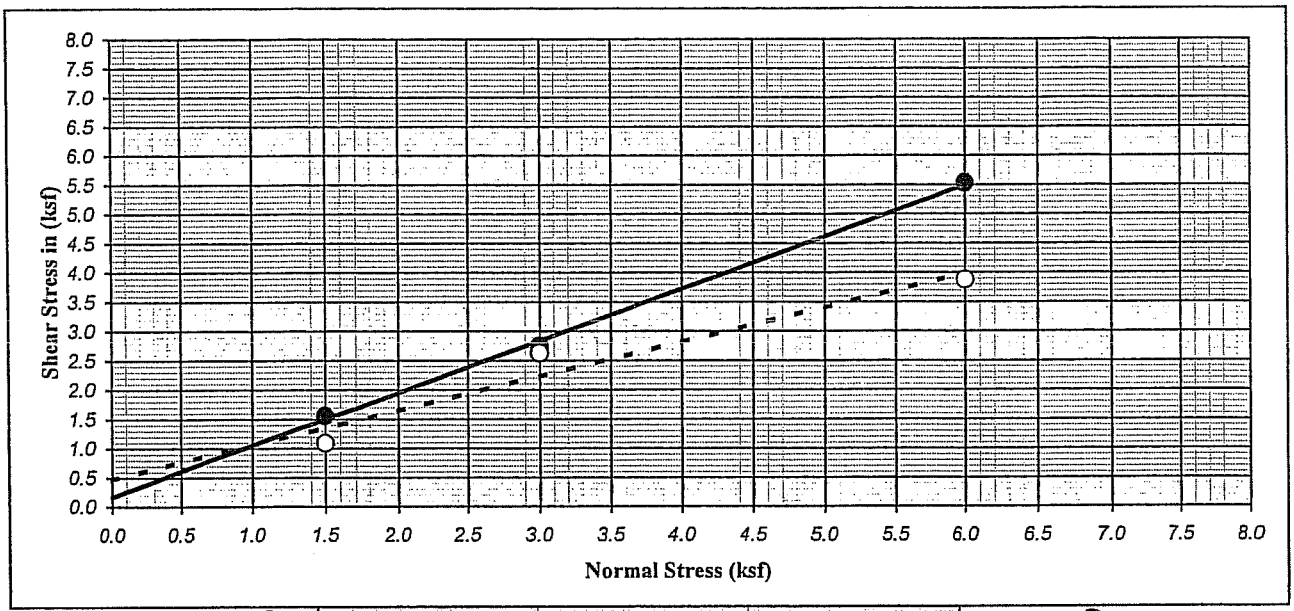
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

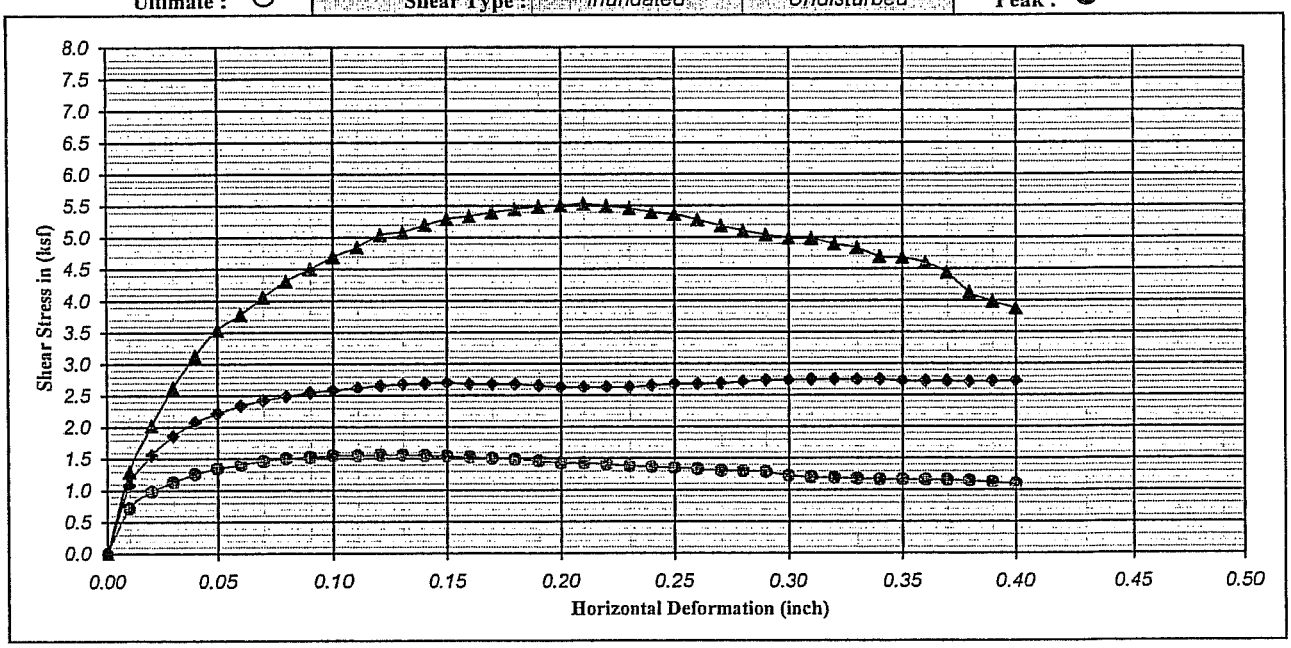
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/13/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No.	: A-08-007	Strength Intercept (C) :	0.17	(ksf)	Peak	0.47	(ksf)	Ultimate
Sample No.	: D-6		8.07	(kPa)		22.41	(kPa)	
Depth (ft/m)	: 25.0 | 0.00	Friction Angle (ϕ) :	41.63	Degree		30.53	Degree	
Description	: Mottled Brown, grayish brown and yellowish brown, CLAYEY SAND with GRAVEL (SC)				Shear Rate (inch/minute) :			0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	25.41	100.29	15.79	0.68	1.50	71.82	1.56	74.69	1.09	52.28
◆	20.12	106.34	16.74	0.59	3.00	143.64	2.75	131.57	2.63	125.83
▲	22.72	101.37	15.95	0.66	6.00	287.28	5.53	264.82	3.88	185.58

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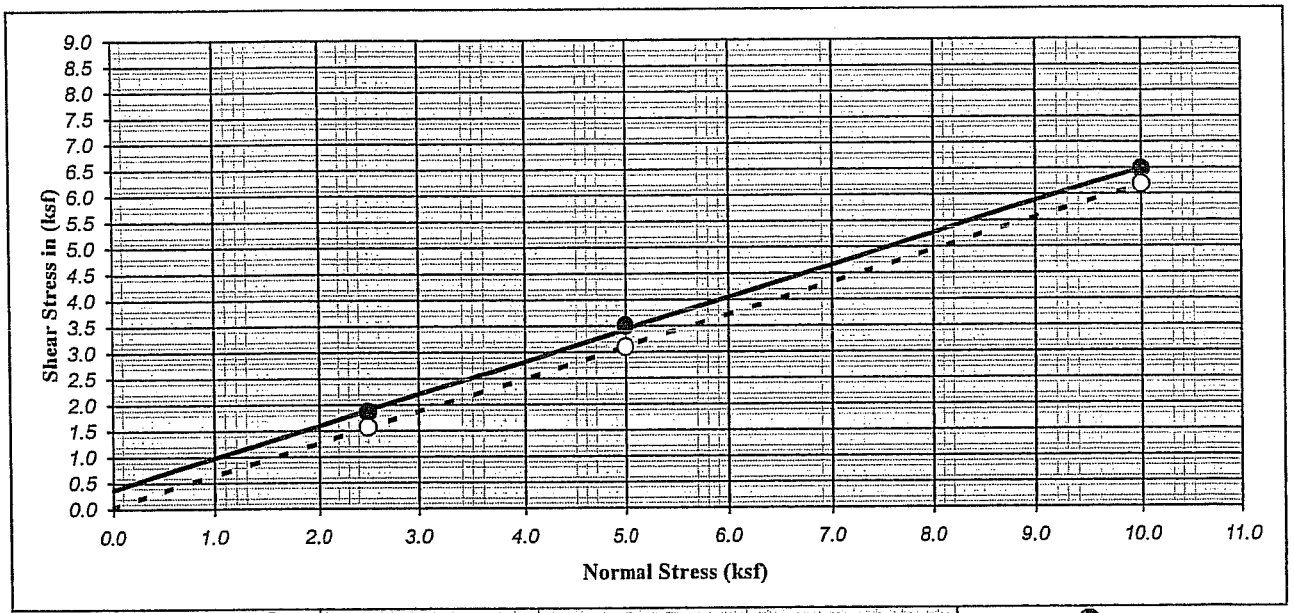
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

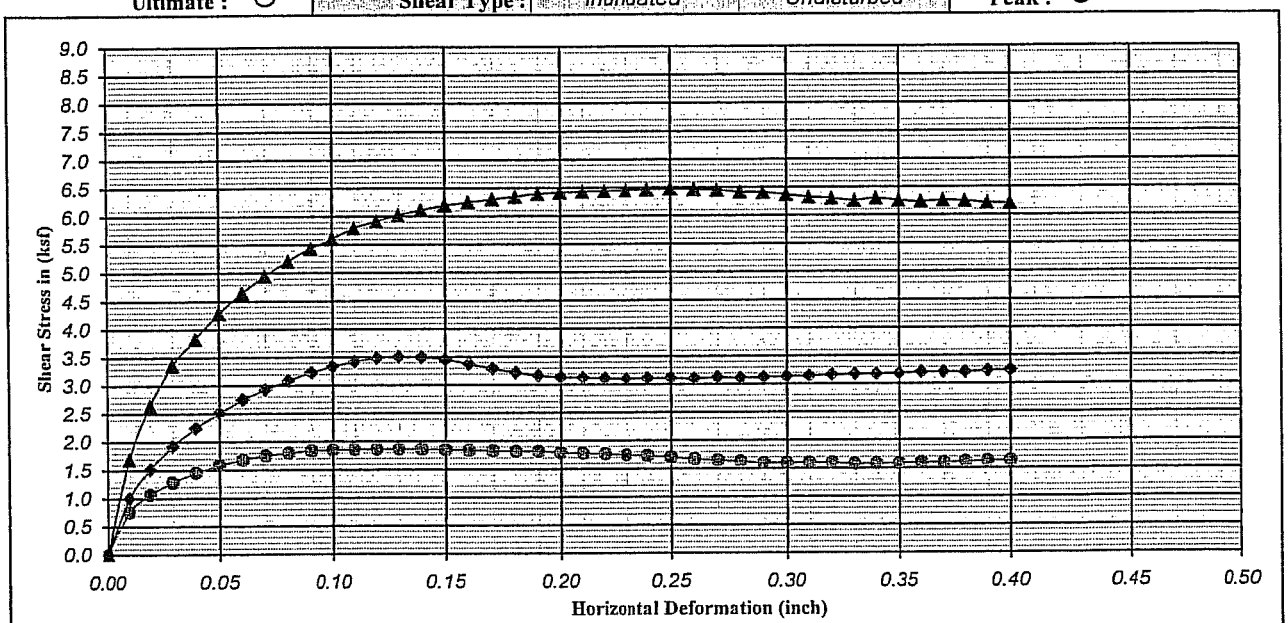
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/13/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-007		Strength Intercept (C) :	0.37	(ksf)	Peak	0.02	(ksf)	Ultimate
Sample No. : D-12			17.84	(kPa)		1.17	(kPa)	
Depth (ft/m) : 55.0	0.00	Friction Angle (ϕ) :	31.50	Degree		31.65	Degree	
Description : Brown, poorly graded SAND with SILT (SP-SM)						Shear Rate (inch/minute) :		0.02

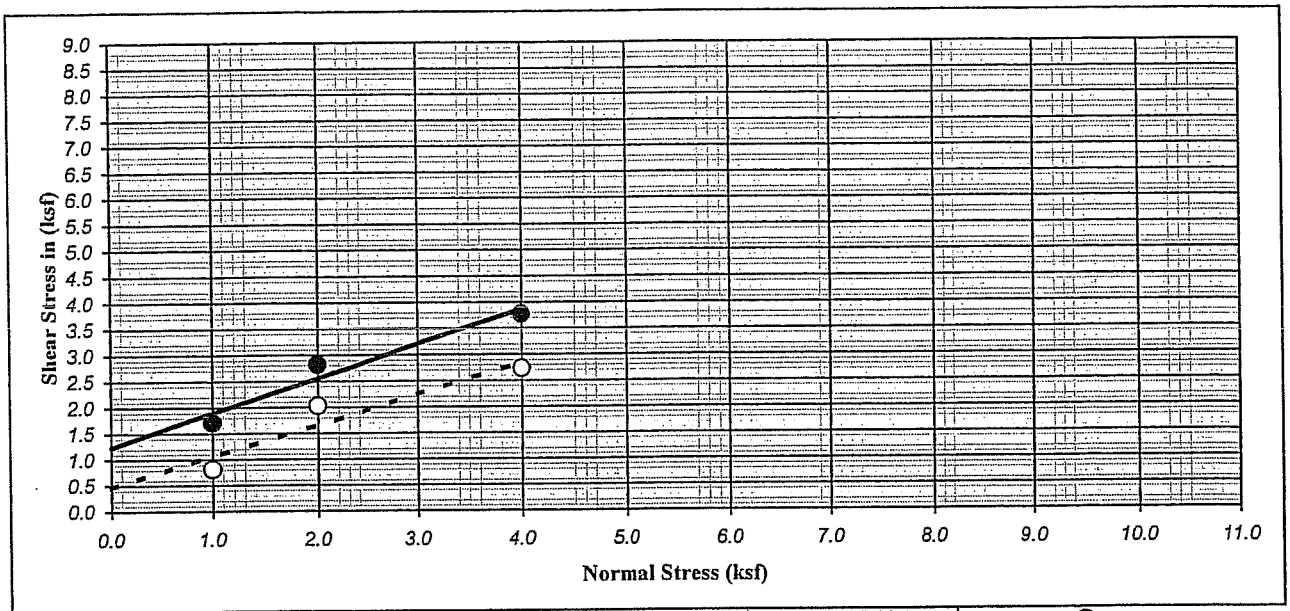
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	24.90	80.29	12.64	1.10	2.50	119.70	1.86	89.06	1.57	75.27
◆	22.32	89.64	14.11	0.88	5.00	239.40	3.50	167.77	3.10	148.24
▲	24.44	81.19	12.78	1.08	10.00	478.80	6.48	310.21	6.19	296.43

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

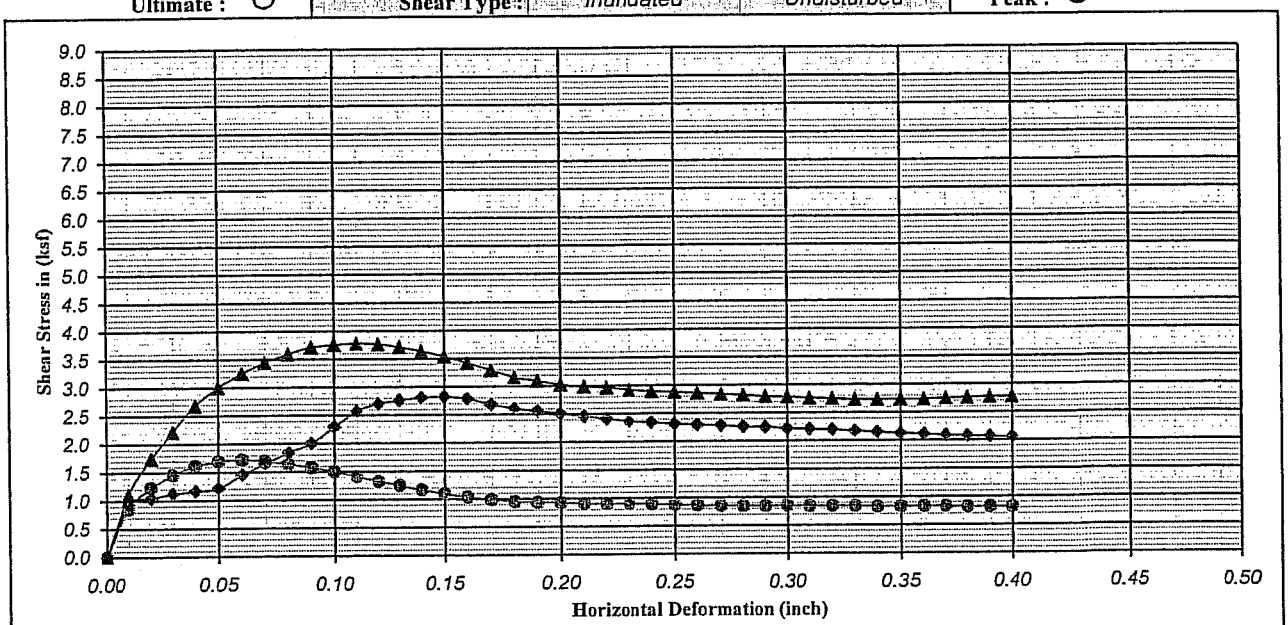
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115	Date : 11/14/08	Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-008		Strength Intercept (C) :	1.24	(ksf)		0.46	(ksf)		
Sample No. : D-5			59.18	(kPa)	Peak	22.12	(kPa)	Ultimate	
Depth (ft/m) : 20.0	0.00	Friction Angle (ϕ) :	33.36	Degree		30.93	Degree		
Description : Olive, Lean CLAY with SAND (CL)							Shear Rate (inch/minute) :	0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	20.33	109.98	17.31	0.53	1.00	47.88	1.72	82.16	0.82	39.07
◆	22.02	105.52	16.61	0.60	2.00	95.76	2.82	135.02	2.03	97.10
▲	18.31	107.45	16.91	0.57	4.00	191.52	3.78	180.99	2.74	131.00

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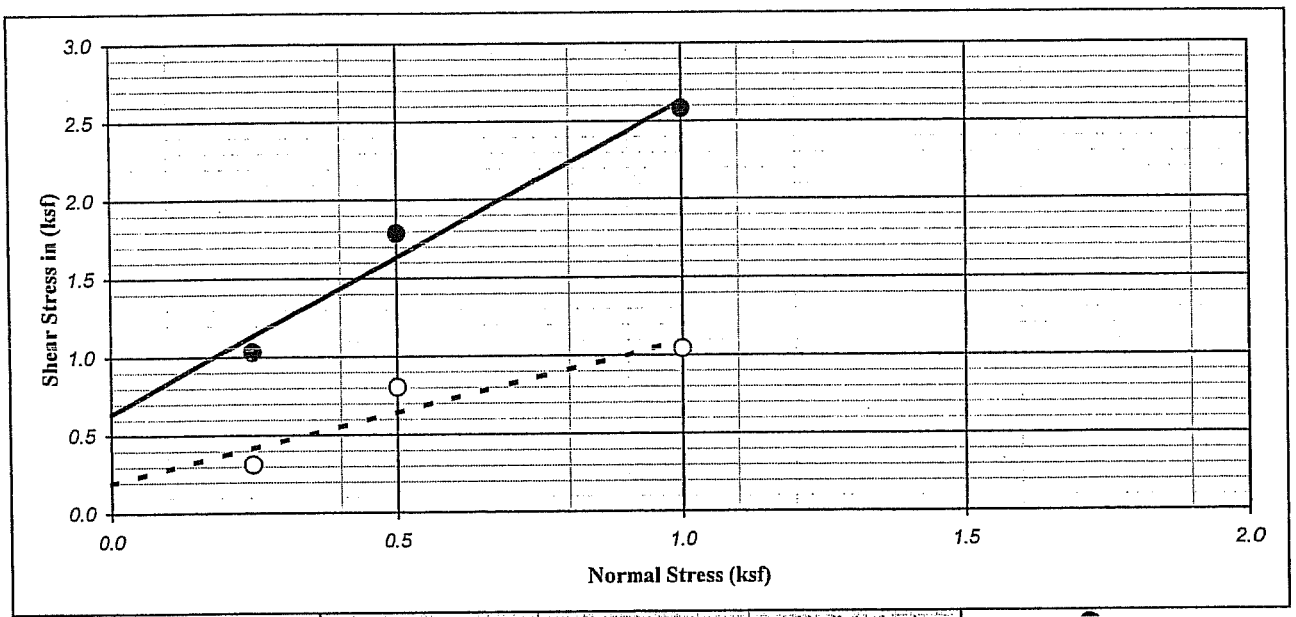
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

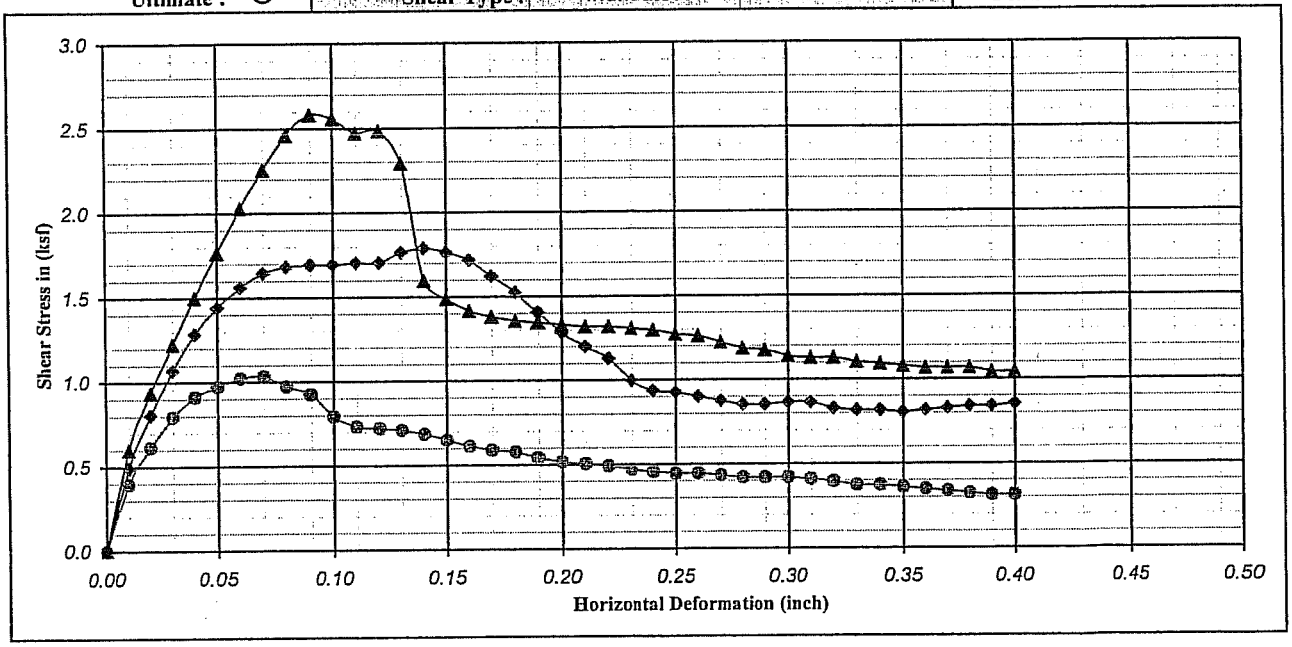
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/14/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-009		Strength Intercept (C) :	0.64	(ksf)		0.19	(ksf)		
Sample No. : D-2			30.45	(kPa)	Peak	9.19	(kPa)	Ultimate	
Depth (ft/m) : 5.0	0.00	Friction Angle (ϕ) :	63.38	Degree		42.15	Degree		
Description : Mottled olive brown, yellowish brown, brown, CLAYEY SAND (SC)						Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	13.01	100.63	15.84	0.68	0.25	11.97	1.03	49.41	0.31	14.94
◆	13.46	102.67	16.16	0.64	0.50	23.94	1.79	85.61	0.80	38.50
▲	13.35	104.37	16.43	0.61	1.00	47.88	2.58	123.53	1.04	49.99

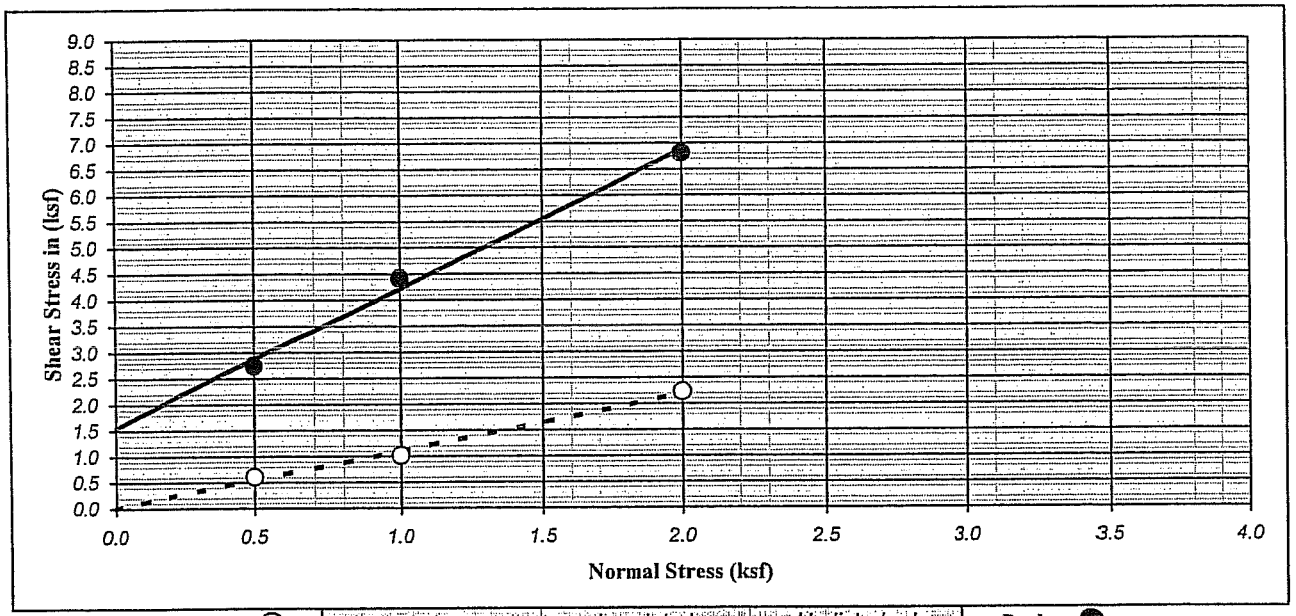
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

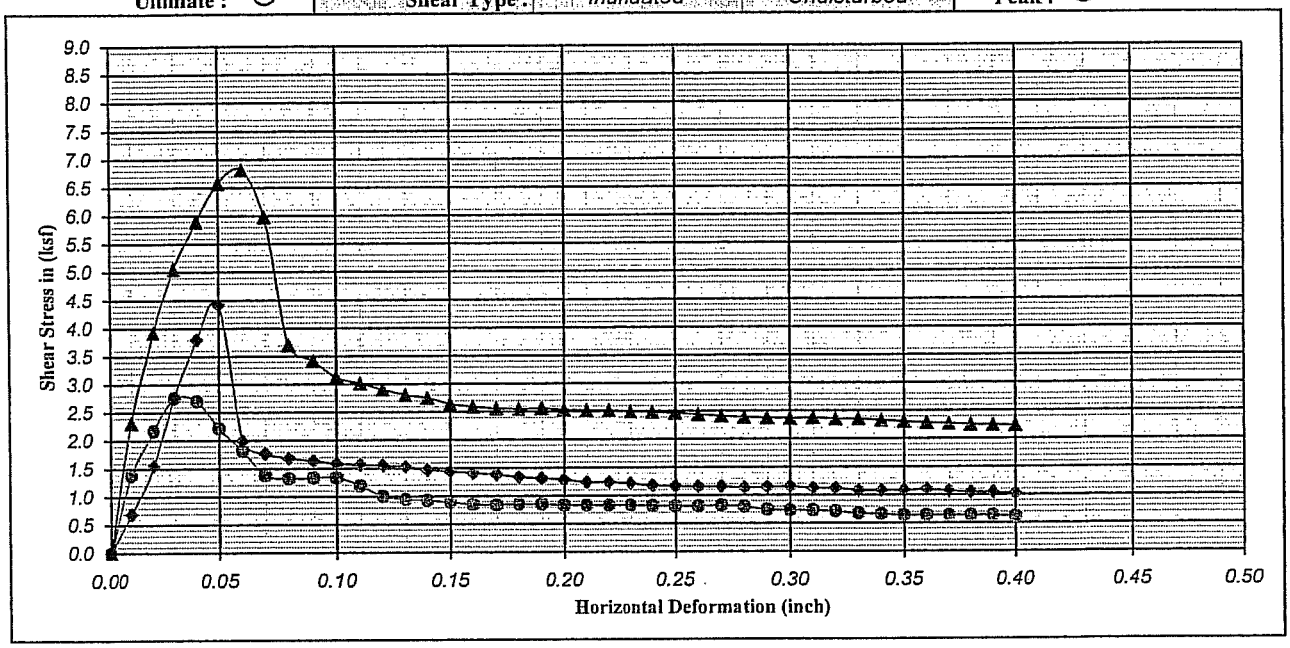
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/21/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-010		Strength Intercept (C) :	1.55	(ksf)	Peak	0.01	(ksf)	Ultimate	
Sample No. : D-3			74.14	(kPa)		0.29	(kPa)		
Depth (ft/m) : 10.0	0.00	Friction Angle (ϕ) :	69.44	Degree		47.70	Degree		
Description : Mottled olive brown, yellowish brown, brown, CLAYEY SAND (SC)						Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	10.14	126.22	19.87	0.34	0.50	23.94	2.75	131.57	0.61	29.30
◆	10.34	123.00	19.36	0.37	1.00	47.88	4.42	211.44	1.02	48.84
▲	10.58	123.26	19.40	0.37	2.00	95.76	6.82	326.30	2.23	106.87

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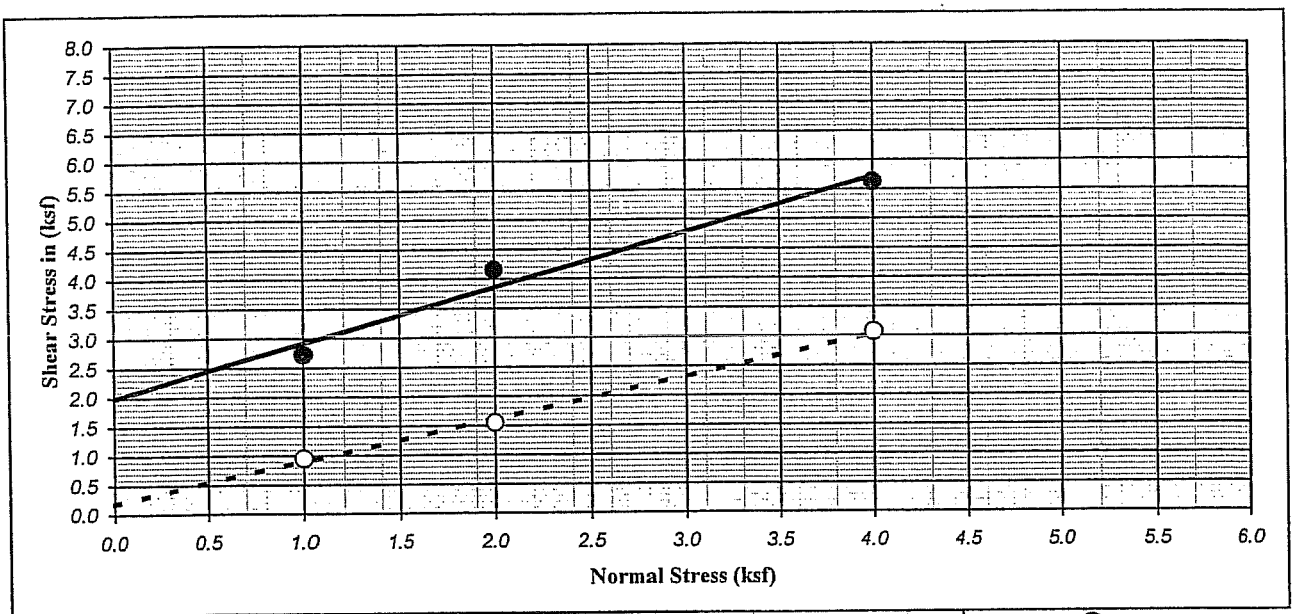
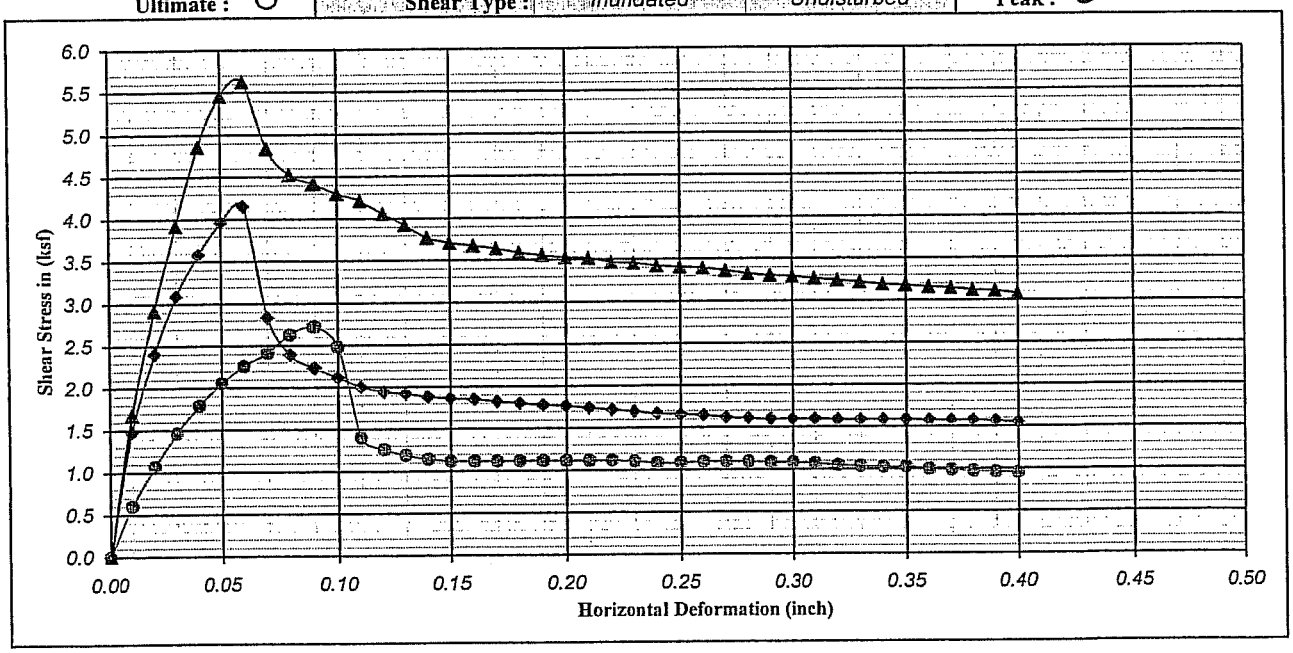
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08 | Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-011	Strength Intercept (C) :	1.99	(ksf)		0.19	(ksf)		
Sample No. : D-5		95.11	(kPa)	Peak	8.91	(kPa)	Ultimate	
Depth (ft/m) : 20.0 | 0.00	Friction Angle (ϕ) :	43.07	Degree		35.59	Degree		
Description : Brown, Lean CLAY with SAND (CL)						Shear Rate (inch/minute) :	0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.35	102.70	16.17	0.64	1.00	47.88	2.72	130.43	0.95	45.39
◆	18.92	106.02	16.69	0.59	2.00	95.76	4.15	198.80	1.55	74.12
▲	16.19	111.34	17.52	0.51	4.00	191.52	5.63	269.42	3.07	147.09

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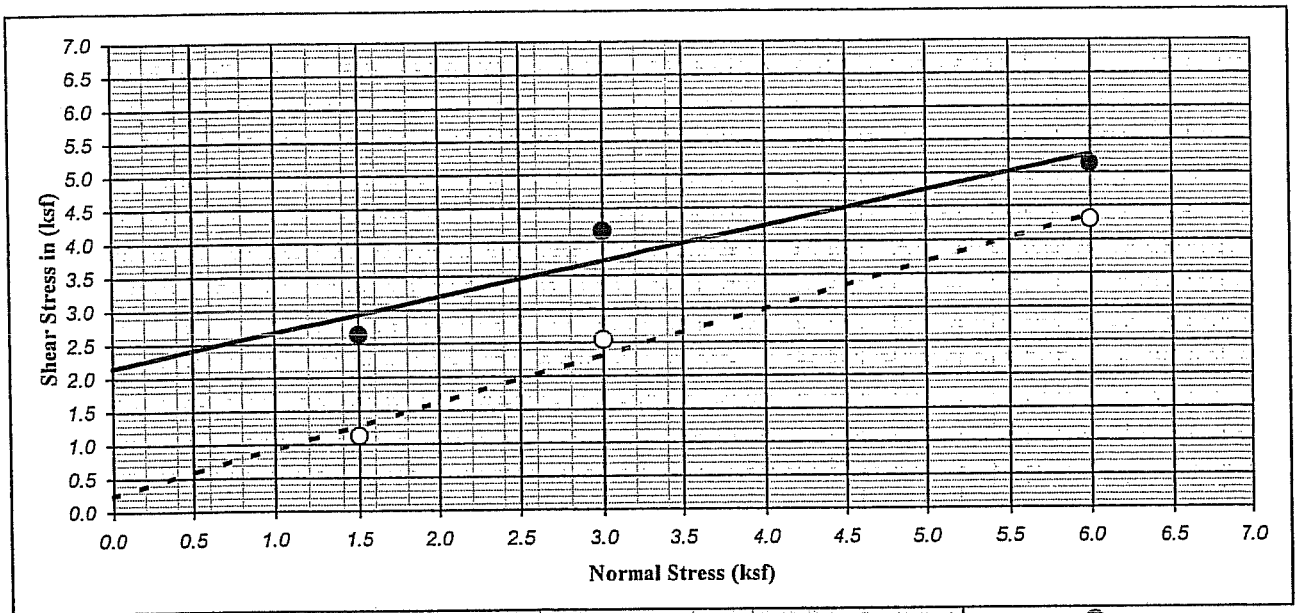
RBF/SR-57 Northbound

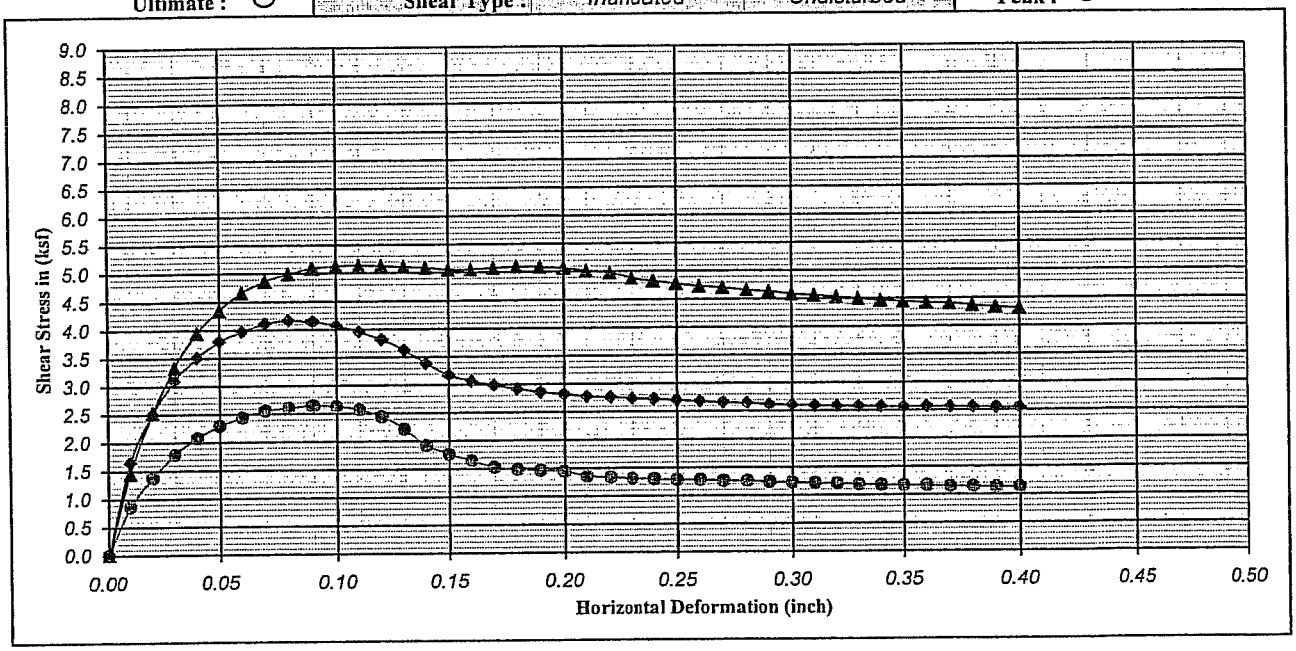
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-011	Strength Intercept (C) :	2.15	(ksf)	Peak	0.25	(ksf)	Ultimate
Sample No. : D-7		103.13	(kPa)		11.78	(kPa)	
Depth (ft/m) : 30.0 | 0.00	Friction Angle (ϕ) :	27.55	Degree		34.59	Degree	
Description : Brown to dark brown, SANDY LEAN CLAY (CL)					Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	16.08	116.72	18.37	0.44	1.50	71.82	2.64	126.40	1.13	54.01
◆	15.82	119.90	18.87	0.41	3.00	143.64	4.16	199.37	2.54	121.81
▲	16.81	117.88	18.55	0.43	6.00	287.28	5.14	245.91	4.31	206.27

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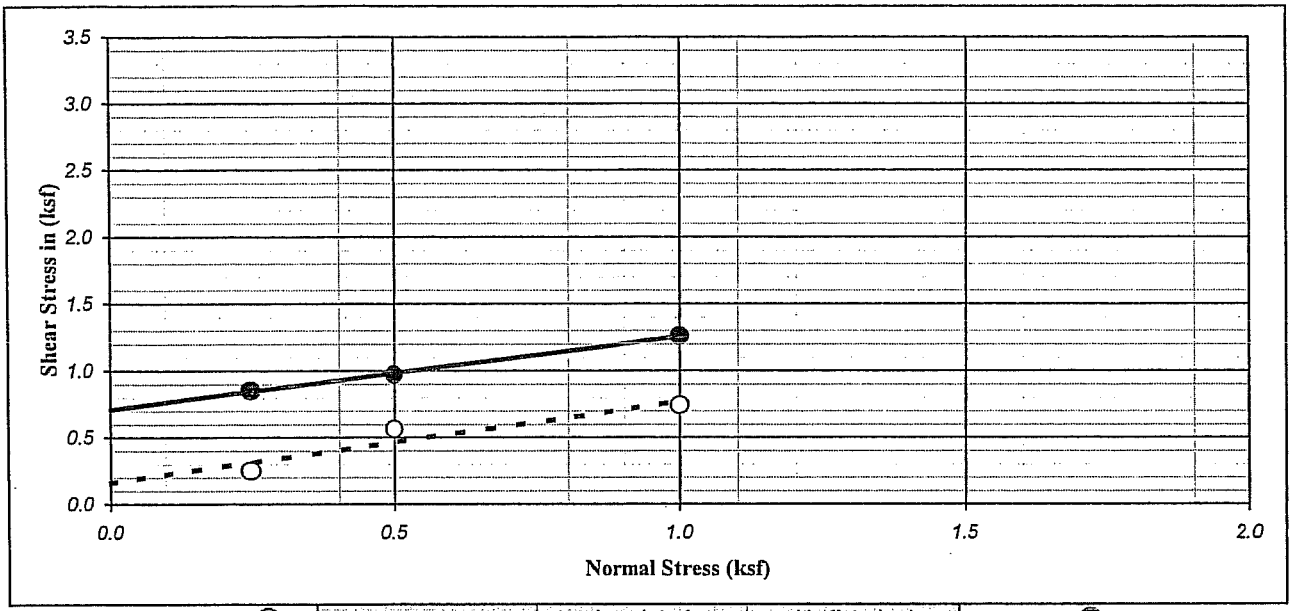
RBF/SR-57 Northbound

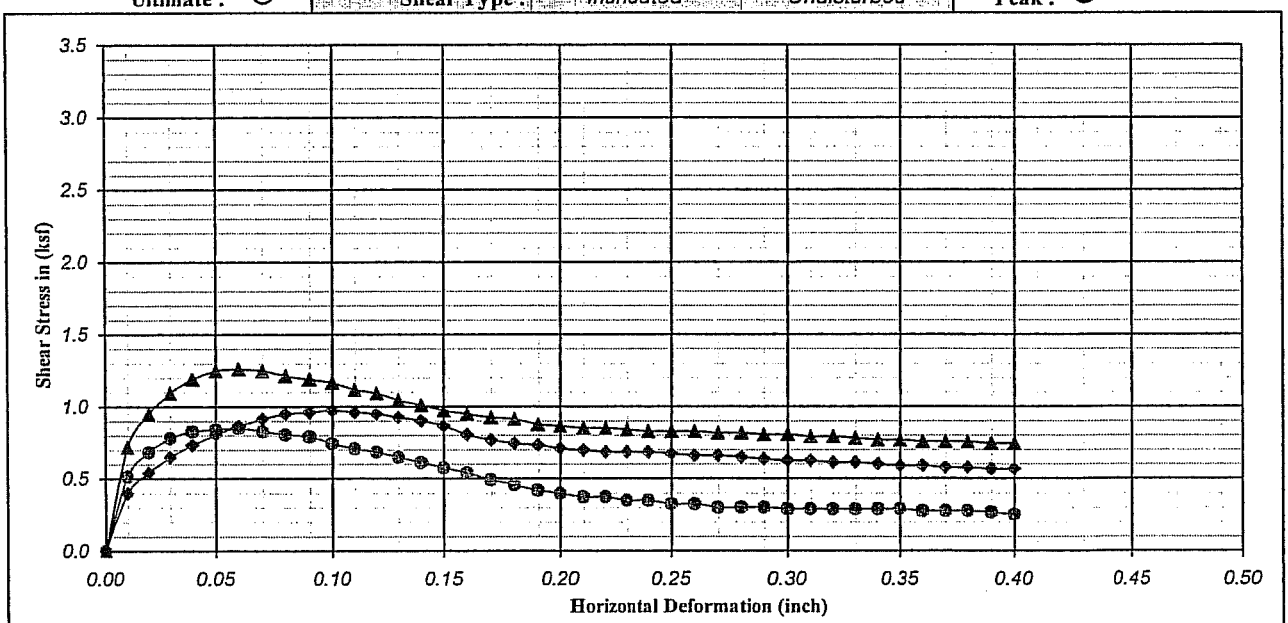
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-013		Strength Intercept (C) :	0.71	(ksf)	Peak	0.16	(ksf)	Ultimate
Sample No. : D-2			33.90	(kPa)		7.76	(kPa)	
Depth (ft/m) : 5.0	0.00	Friction Angle (ϕ) :	28.75	Degree		31.54	Degree	
Description : Mottled olive brown, yellowish brown, CLAYEY SAND (SC)					Shear Rate (inch/minute) :			0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	24.16	102.19	16.08	0.65	0.25	11.97	0.85	40.79	0.25	12.07
◆	23.10	101.16	15.92	0.67	0.50	23.94	0.97	46.54	0.56	27.00
▲	20.94	101.47	15.97	0.66	1.00	47.88	1.26	60.33	0.74	35.62

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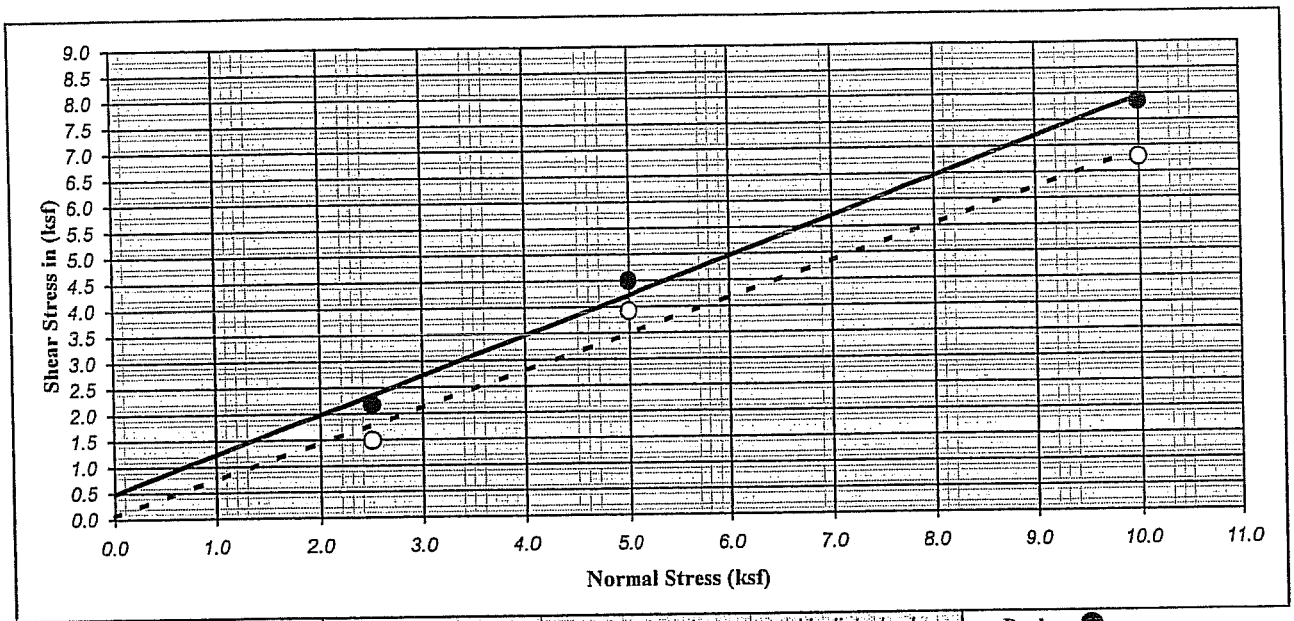
RBF/SR-57 Northbound

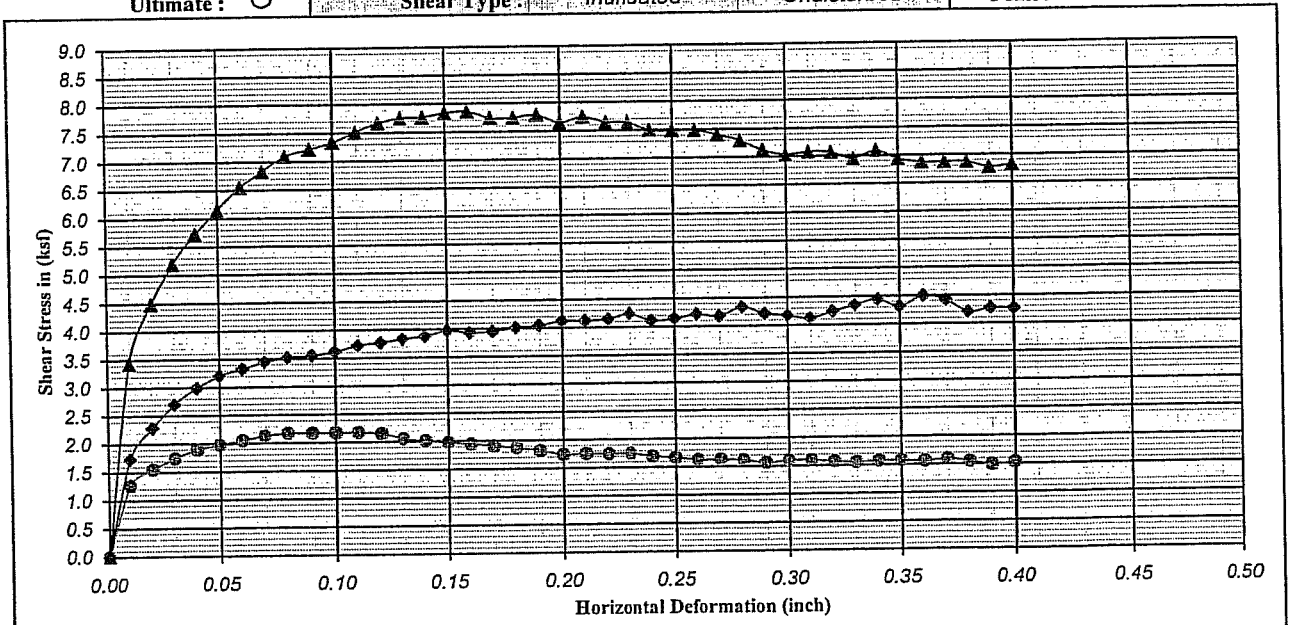
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No.	: A-08-013	Strength Intercept (C) :	0.49	(ksf)	Peak	0.06	(ksf)	Ultimate
Sample No.	: D-12		23.58	(kPa)		2.90	(kPa)	
Depth (ft/m)	: 55.0 0.00	Friction Angle (ϕ) :	36.72	Degree		34.46	Degree	
Description	: Yellowish brown, Poorly-graded SAND with SILT (SP-SM)				Shear Rate (inch/minute) :			0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	17.57	103.83	16.34	0.62	2.50	119.70	2.17	104.00	1.49	71.25
◆	16.58	102.89	16.19	0.64	5.00	239.40	4.50	215.46	3.92	187.88
▲	15.95	107.70	16.95	0.57	10.00	478.80	7.86	376.29	6.78	324.58

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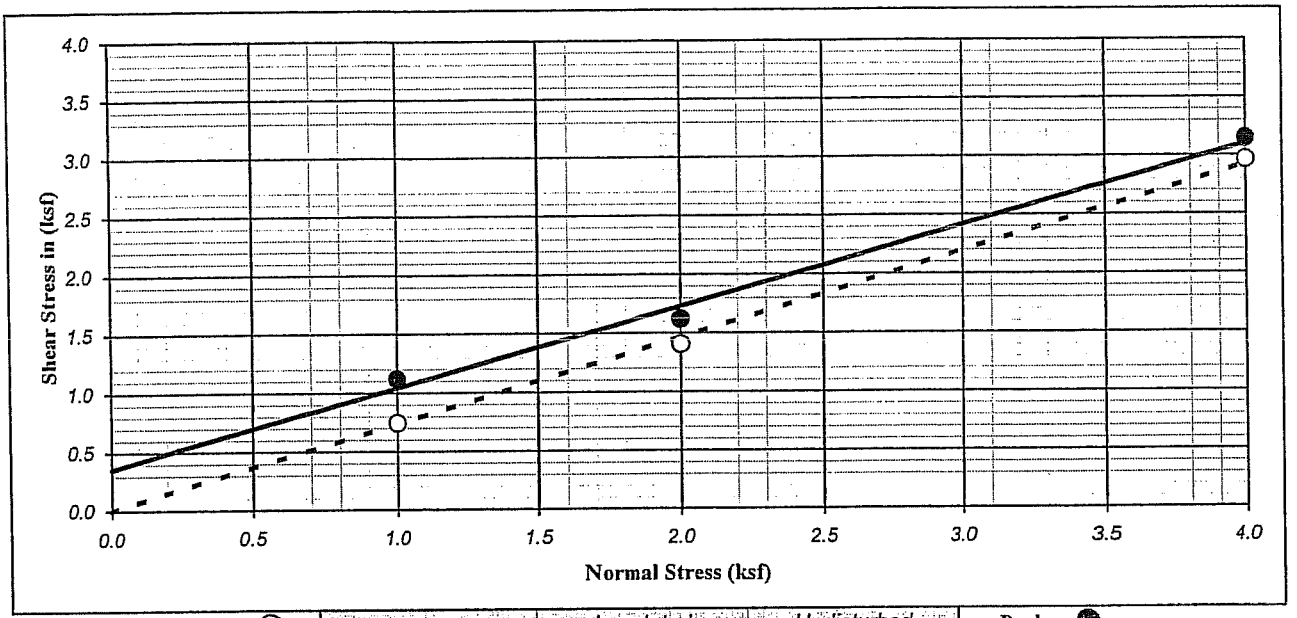
RBF/SR-57 Northbound

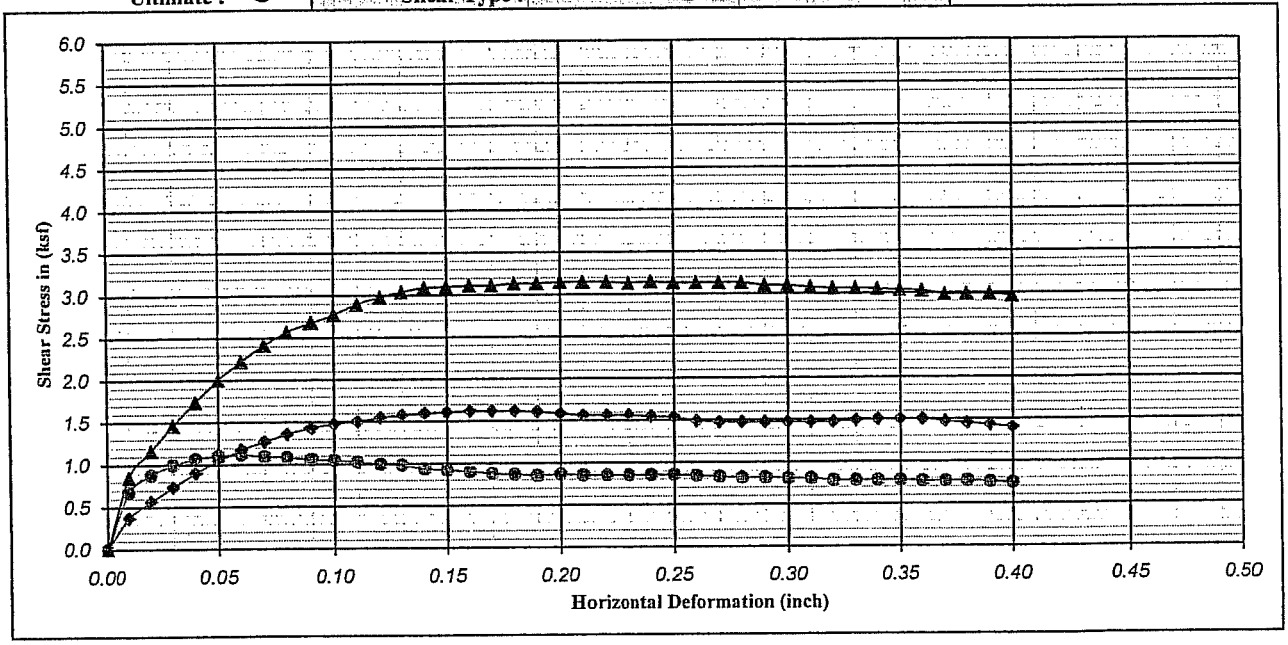
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-014		Strength Intercept (C) :	0.35	(ksf)	Peak	0.00	(ksf)	Ultimate
Sample No. : D-5			16.95	(kPa)		0.00	(kPa)	
Depth (ft/m) : 20.0	0.00	Friction Angle (ϕ) :	34.54	Degree		36.27	Degree	
Description : Mottled olive gray, yellowish brown, yellow, CLAYEY SAND(SC)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	26.35	97.26	15.31	0.73	1.00	47.88	1.12	53.43	0.74	35.62
◆	24.96	92.99	14.64	0.81	2.00	95.76	1.62	77.57	1.40	67.22
▲	24.60	98.14	15.45	0.72	4.00	191.52	3.14	150.53	2.96	141.92

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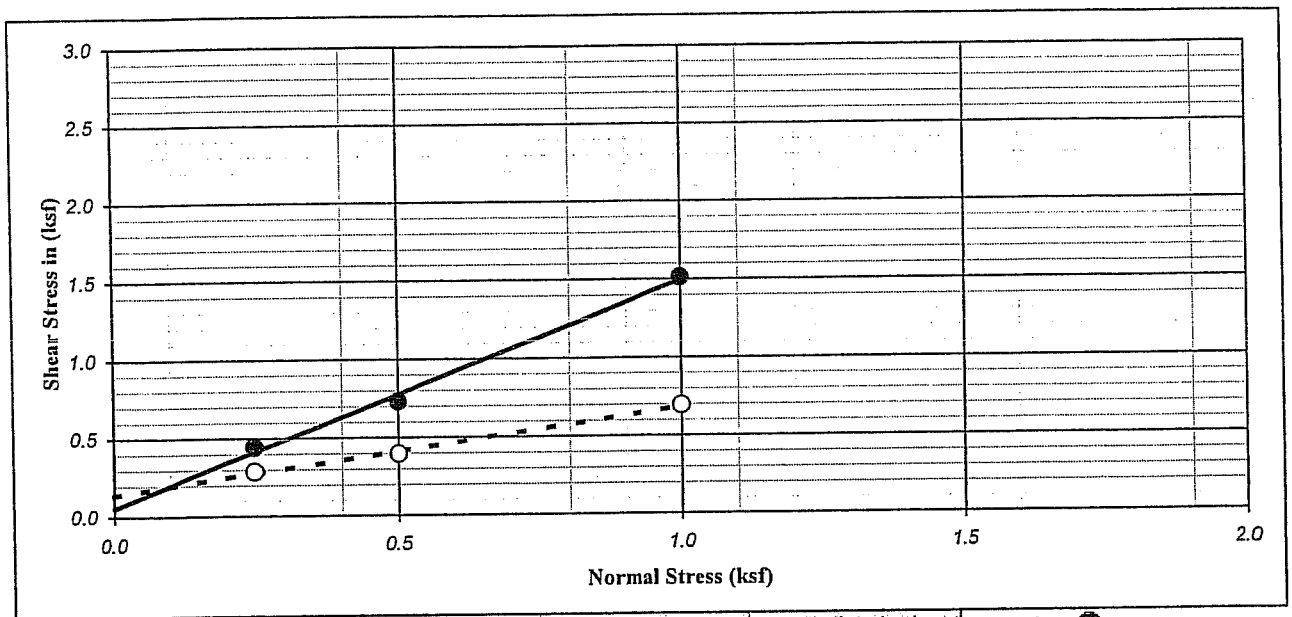
RBF/SR-57 Northbound

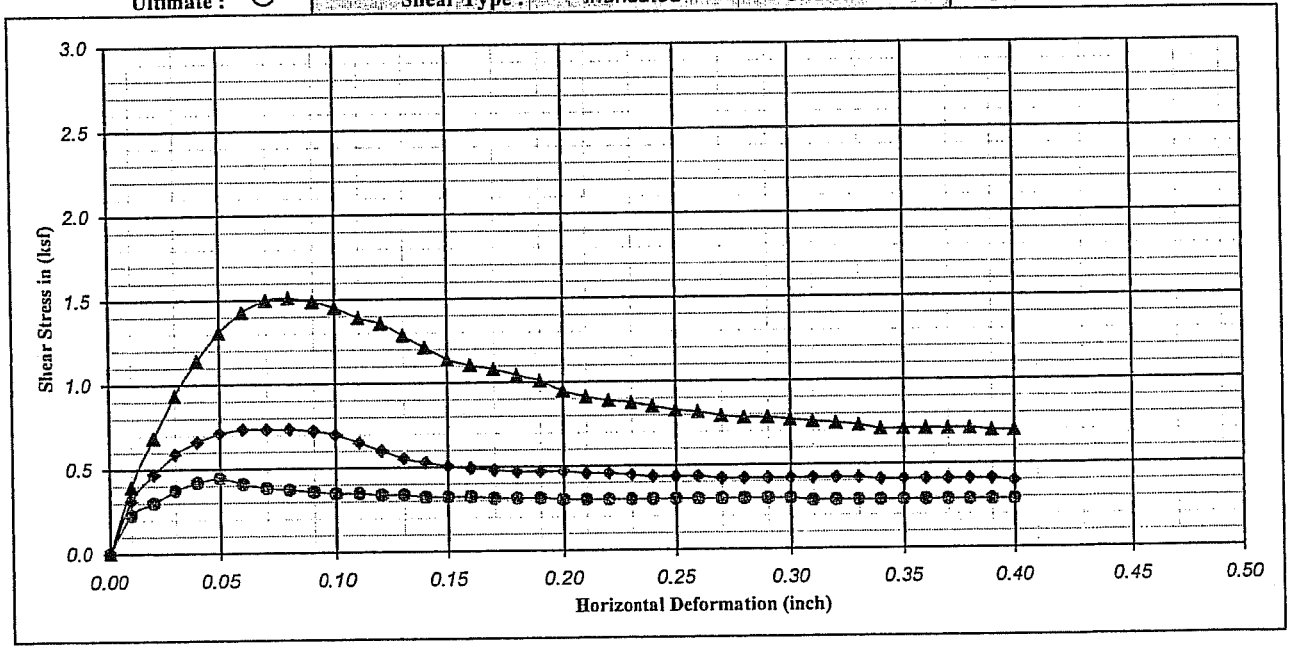
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No.	: A-08-015		Strength Intercept (C) :	0.05	(ksf)		0.14	(ksf)	
Sample No.	: D-2			2.59	(kPa)	Peak	6.61	(kPa)	Ultimate
Depth (ft/m)	: 5.0	0.00	Friction Angle (ϕ) :	55.29	Degree		28.90	Degree	
Description	: Olive brown with yellow, SANDY Lean CLAY (CL)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	29.30	90.50	14.24	0.86	0.25	11.97	0.44	21.26	0.29	13.79
◆	24.81	96.13	15.13	0.75	0.50	23.94	0.73	35.05	0.40	18.96
▲	28.23	95.13	14.97	0.77	1.00	47.88	1.51	72.39	0.70	33.32

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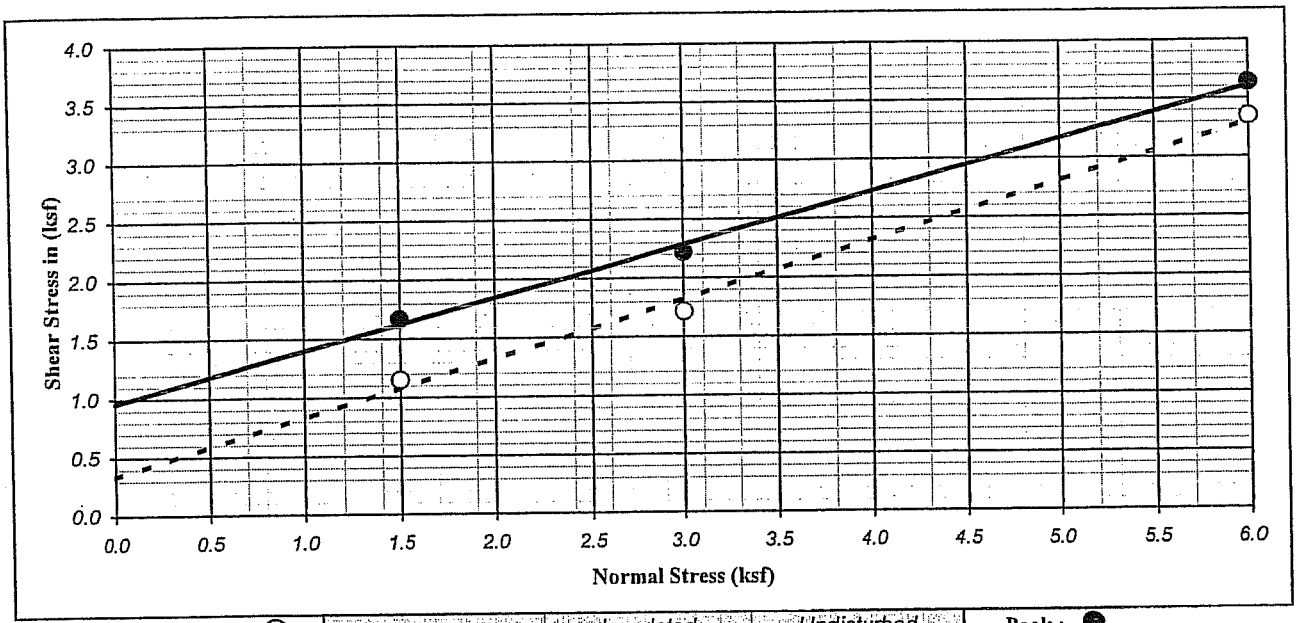
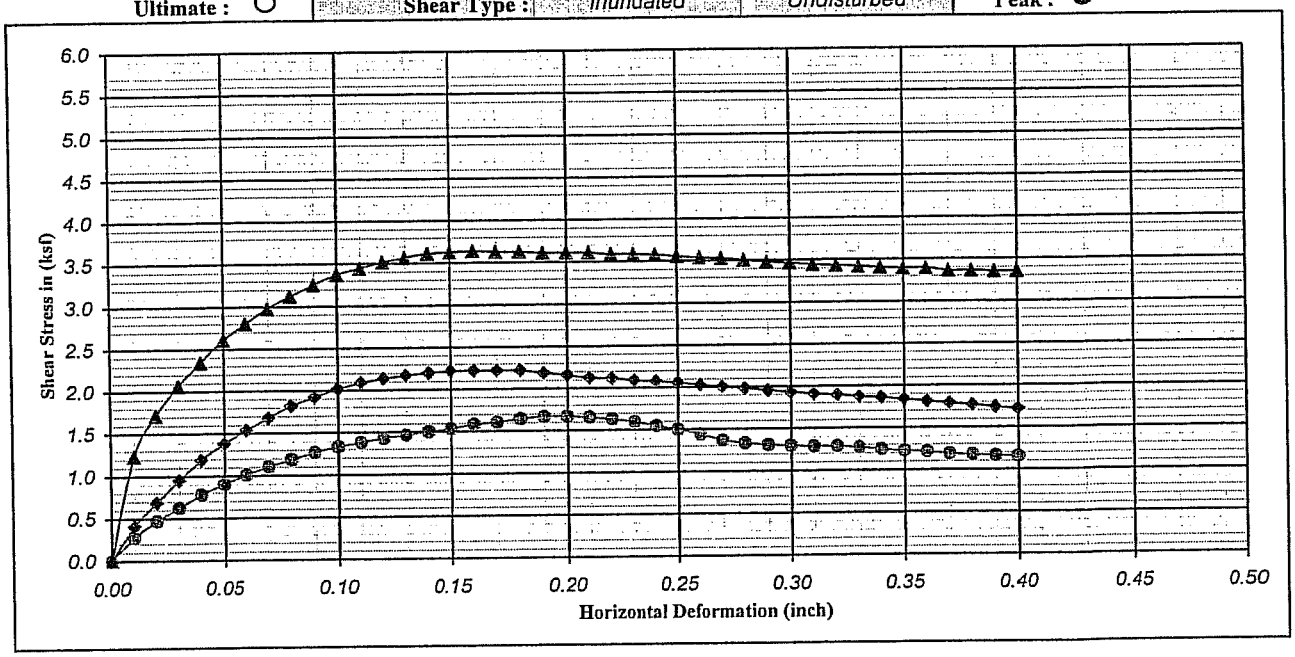
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08 | Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-015		Strength Intercept (C) :	0.96	(ksf)		0.34	(ksf)	
Sample No. : D-6			45.96	(kPa)	Peak	16.09	(kPa)	Ultimate
Depth (ft/m) : 25.0	0.00	Friction Angle (ϕ) :	23.86	Degree		26.38	Degree	
Description : Very dark olive brown, Lean CLAY with SAND (CL)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	28.45	86.81	13.66	0.94	1.50	71.82	1.67	79.86	1.15	55.16
◆	28.71	89.17	14.04	0.89	3.00	143.64	2.22	106.29	1.72	82.16
▲	24.37	94.60	14.89	0.78	6.00	287.28	3.64	174.09	3.35	160.30

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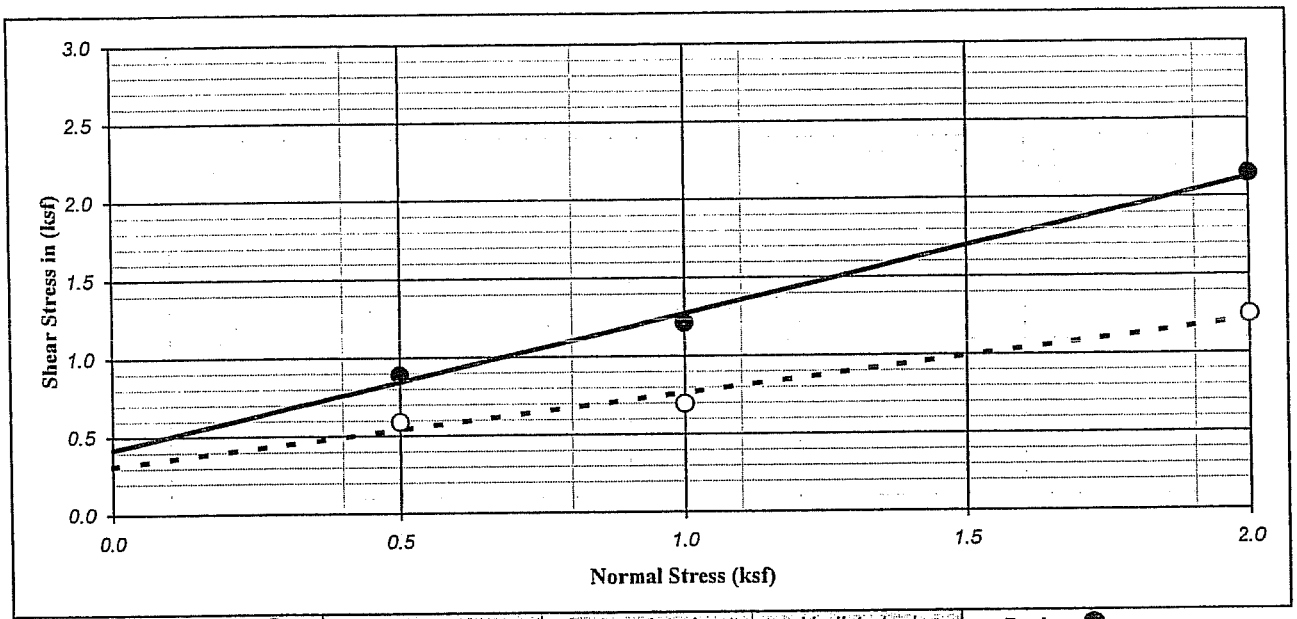
Geotechnical and Earthquake Engineering

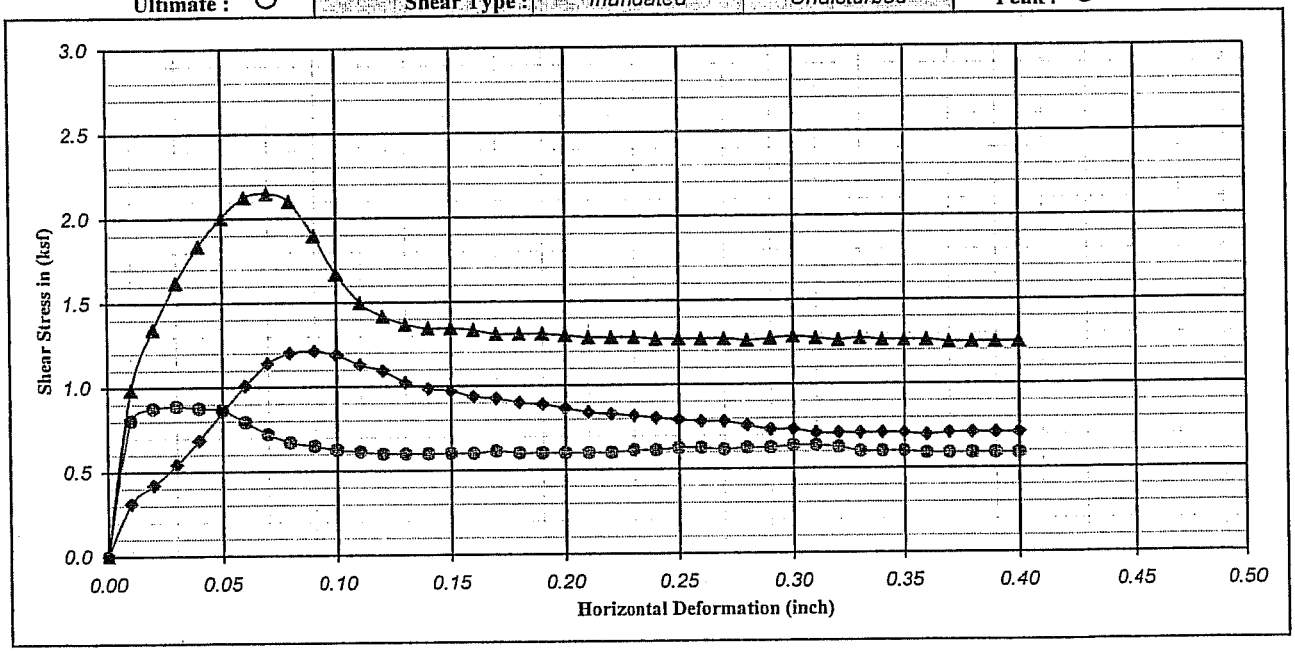
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08 | Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-016		Strength Intercept (C) :	0.42	(ksf)	Peak	0.31	(ksf)	Ultimate
Sample No. : D-3			20.11	(kPa)		14.94	(kPa)	
Depth (ft/m) : 10.0	0.00	Friction Angle (ϕ) :	40.49	Degree		24.51	Degree	
Description : Mottled olive gray, olive brown and yellow, CLAYEY SAND (SC)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	24.50	99.71	15.69	0.69	0.50	23.94	0.89	42.52	0.59	28.15
◆	21.80	99.86	15.72	0.69	1.00	47.88	1.21	58.03	0.70	33.32
▲	21.72	99.56	15.67	0.69	2.00	95.76	2.15	102.85	1.25	59.75

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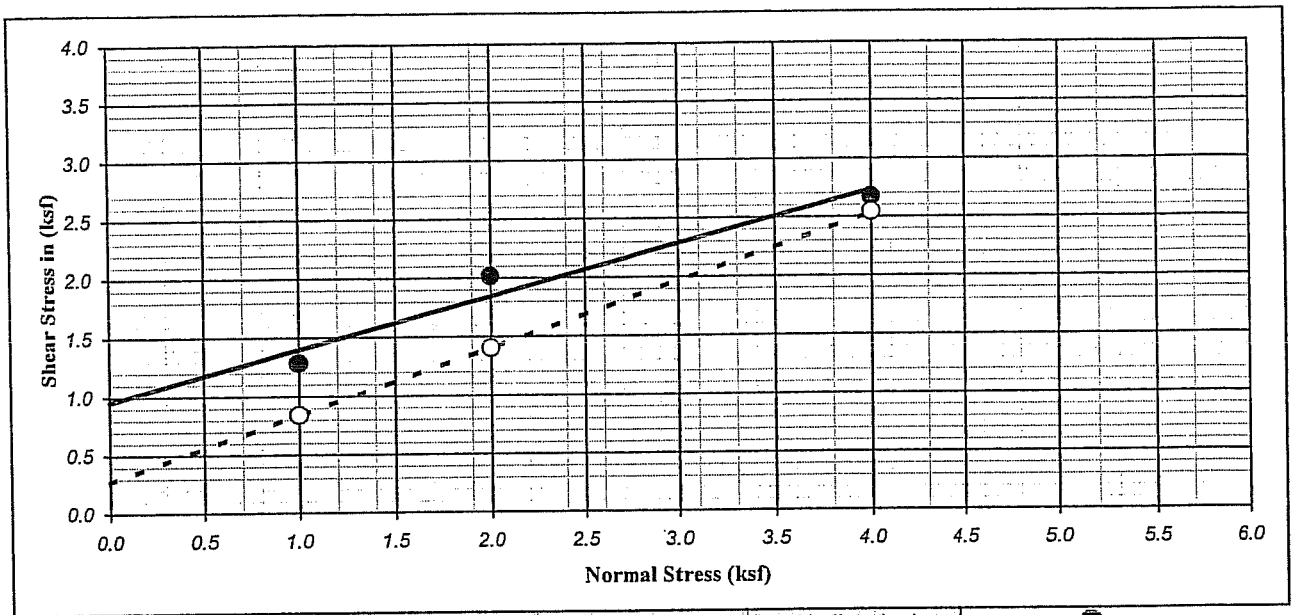
RBF/SR-57 Northbound

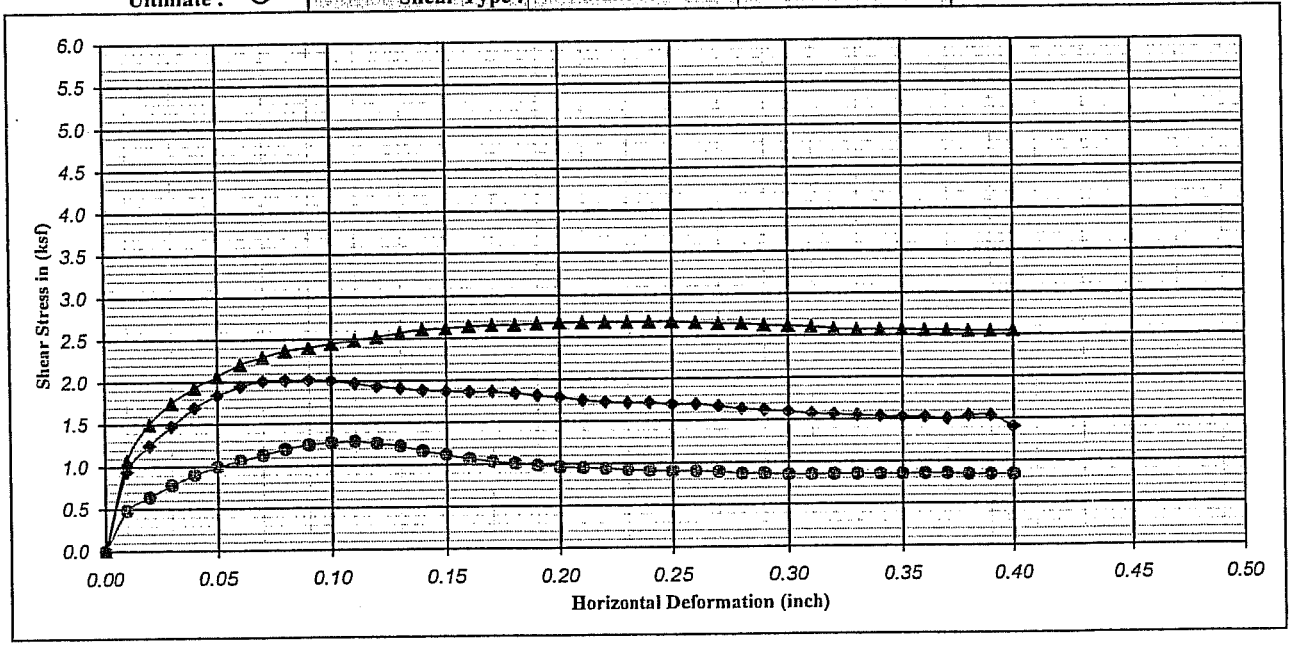
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-016		Strength Intercept (C) :	0.95	(ksf)		0.27	(ksf)	
Sample No. : D-5			45.68	(kPa)	Peak	12.93	(kPa)	Ultimate
Depth (ft/m) : 20.0	0.00	Friction Angle (ϕ) :	23.98	Degree		29.61	Degree	
Description : Mottled olive gray, olive brown and yellow, CLAYEY SAND (SC)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	22.35	104.57	16.46	0.61	1.00	47.88	1.28	61.48	0.84	40.22
◆	23.20	102.74	16.17	0.64	2.00	95.76	2.02	96.53	1.40	67.22
▲	24.59	100.39	15.80	0.68	4.00	191.52	2.68	128.13	2.54	121.81

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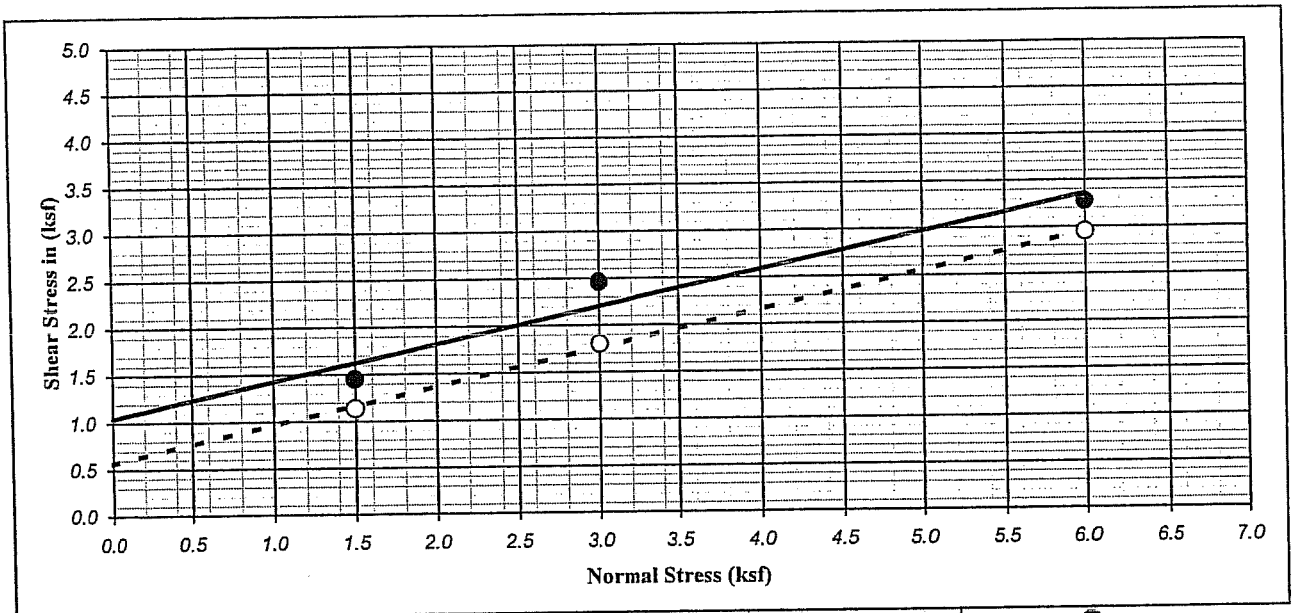
RBF/SR-57 Northbound

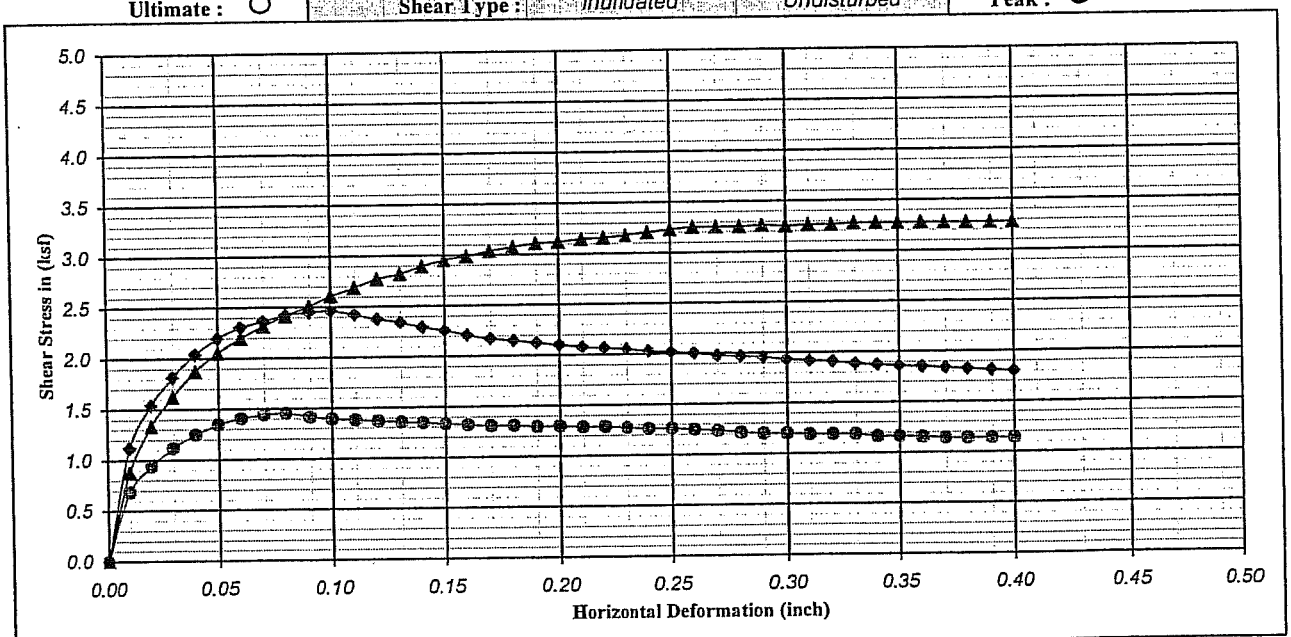
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-018		Strength Intercept (C) :	1.04	(ksf)	Peak	0.56	(ksf)	Ultimate
Sample No. : D-6			49.99	(kPa)		27.00	(kPa)	
Depth (ft/m) : 25.0	0.00	Friction Angle (ϕ) :	21.12	Degree		21.80	Degree	
Description : Yellow brown, Lean CLAY with SAND (CL)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	22.82	102.68	16.16	0.64	1.50	71.82	1.45	69.52	1.14	54.58
◆	23.06	101.31	15.95	0.66	3.00	143.64	2.46	117.78	1.80	86.18
▲	21.75	101.79	16.02	0.66	6.00	287.28	3.28	156.85	2.95	141.34

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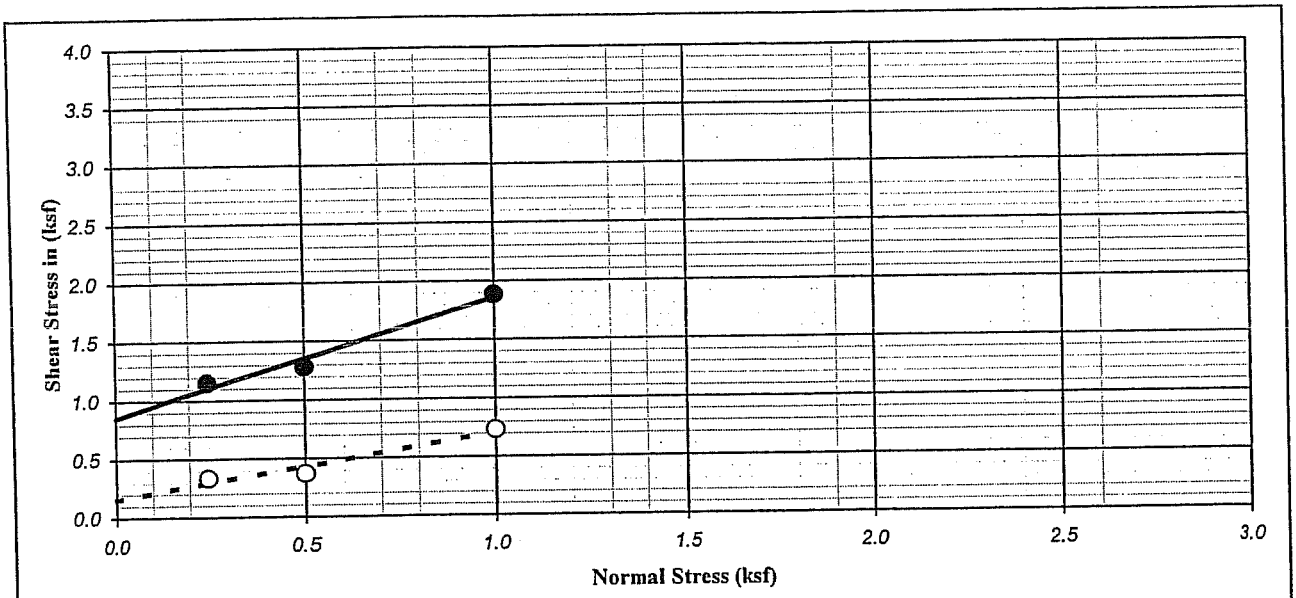
RBF/SR-57 Northbound

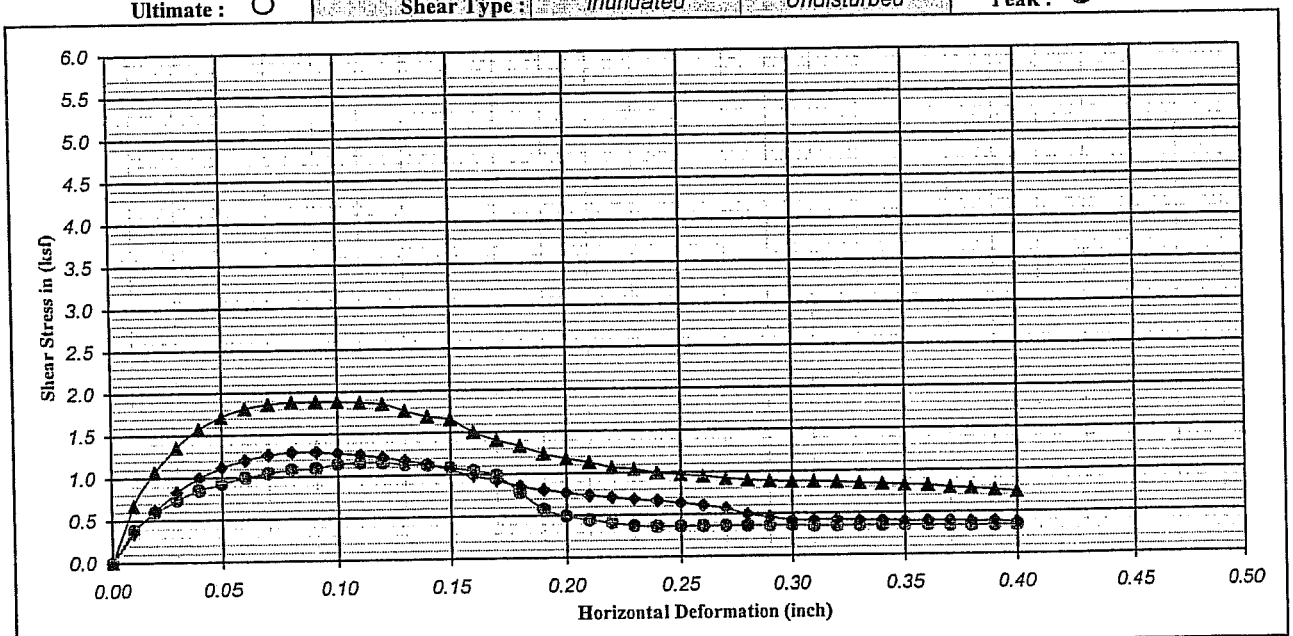
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-019		Strength Intercept (C) :	0.85	(ksf)	Peak	0.16	(ksf)	Ultimate
Sample No. : D-1			40.79	(kPa)		7.47	(kPa)	
Depth (ft/m) : 2.5	0.00	Friction Angle (ϕ) :	45.23	Degree		29.05	Degree	
Description : Olive, Lean CLAY (CL)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	28.15	96.35	15.17	0.75	0.25	11.97	1.15	55.16	0.34	16.09
◆	28.70	93.93	14.78	0.79	0.50	23.94	1.28	61.48	0.37	17.81
▲	27.26	97.26	15.31	0.73	1.00	47.88	1.88	90.21	0.73	35.05

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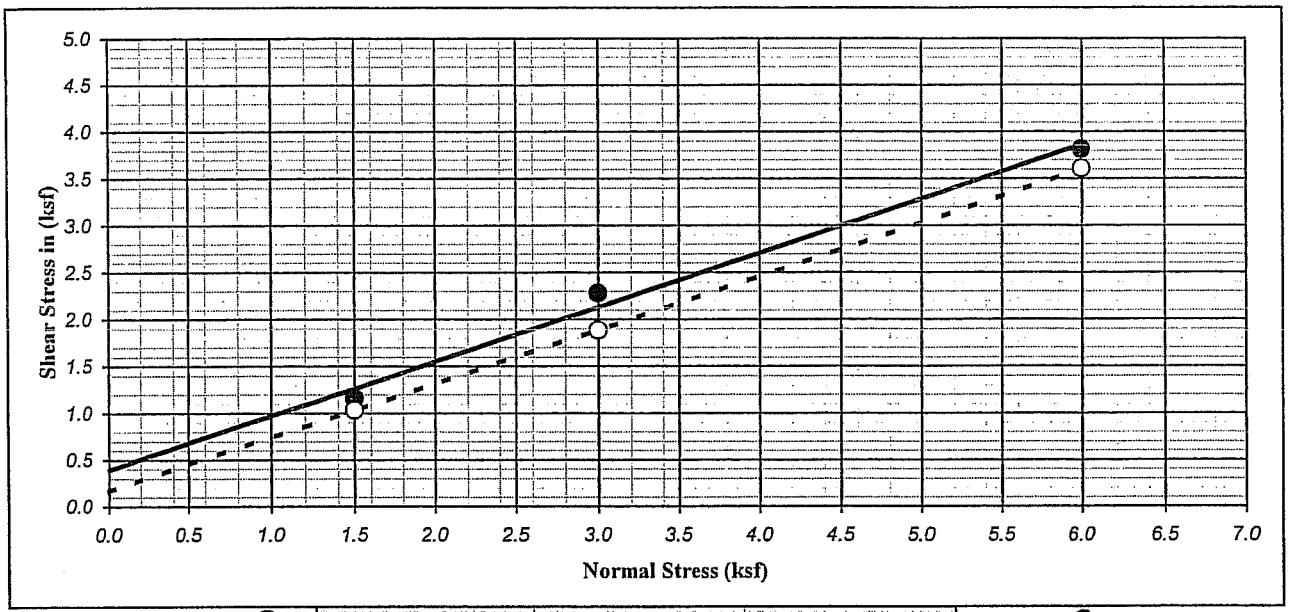
RBF/SR-57 Northbound

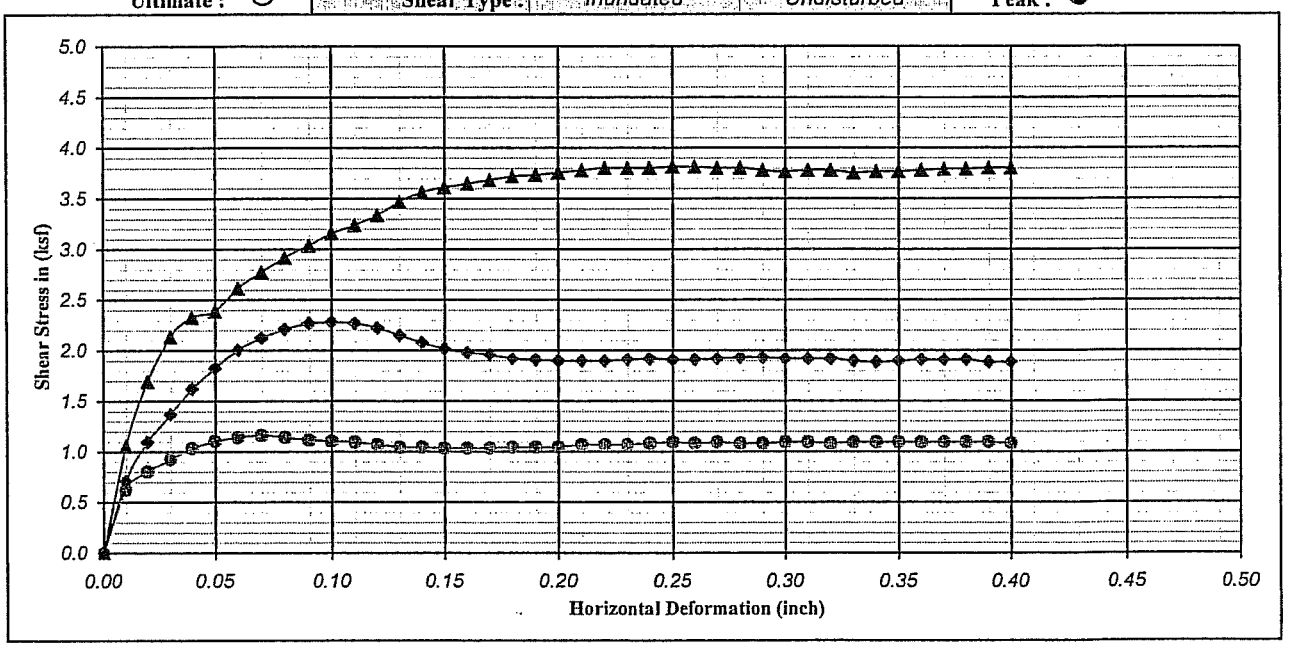
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-019	Strength Intercept (C) :	0.40	(ksf)		0.17	(ksf)		
Sample No. : D-7		18.96	(kPa)	Peak	8.04	(kPa)	Ultimate	
Depth (ft/m) : 30.0 / 0.00	Friction Angle (ϕ) :	30.04	Degree		29.84	Degree		
Description : Yellow brown, SILTY SAND (SM)						Shear Rate (inch/minute) :	0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	15.82	104.09	16.38	0.62	1.50	71.82	1.16	55.73	1.03	49.41
◆	16.53	100.50	15.82	0.68	3.00	143.64	2.28	109.17	1.88	90.21
▲	16.19	96.58	15.20	0.75	6.00	287.28	3.82	182.71	3.61	172.94

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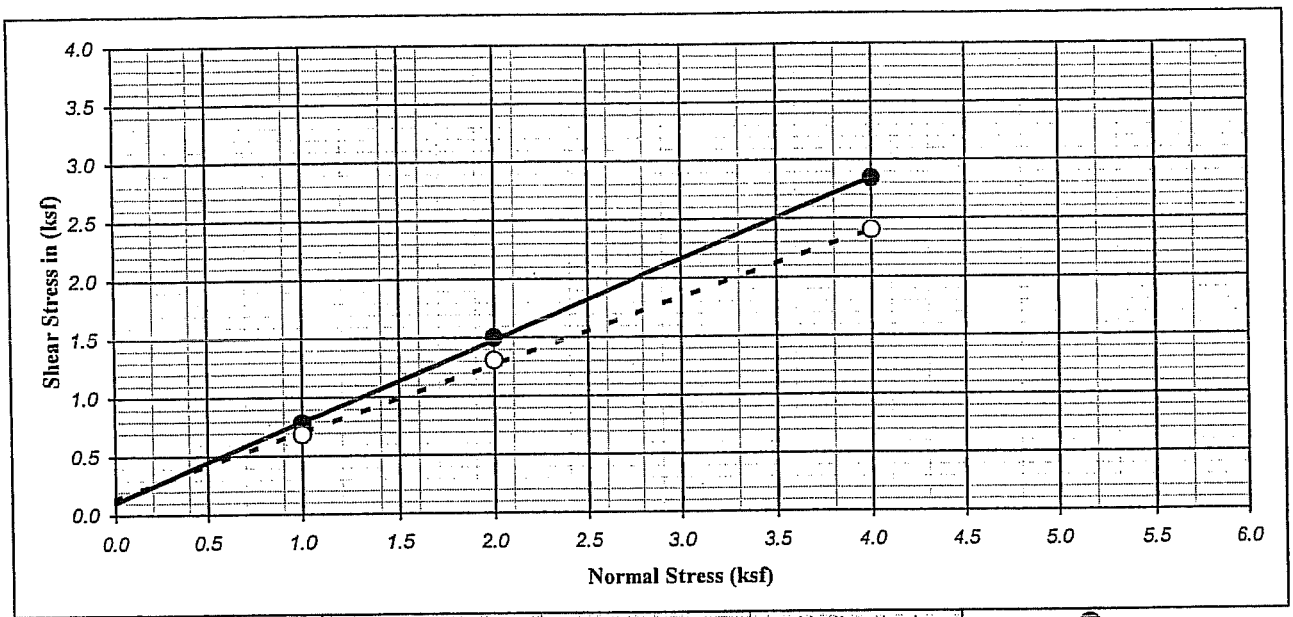
RBF/SR-57 Northbound

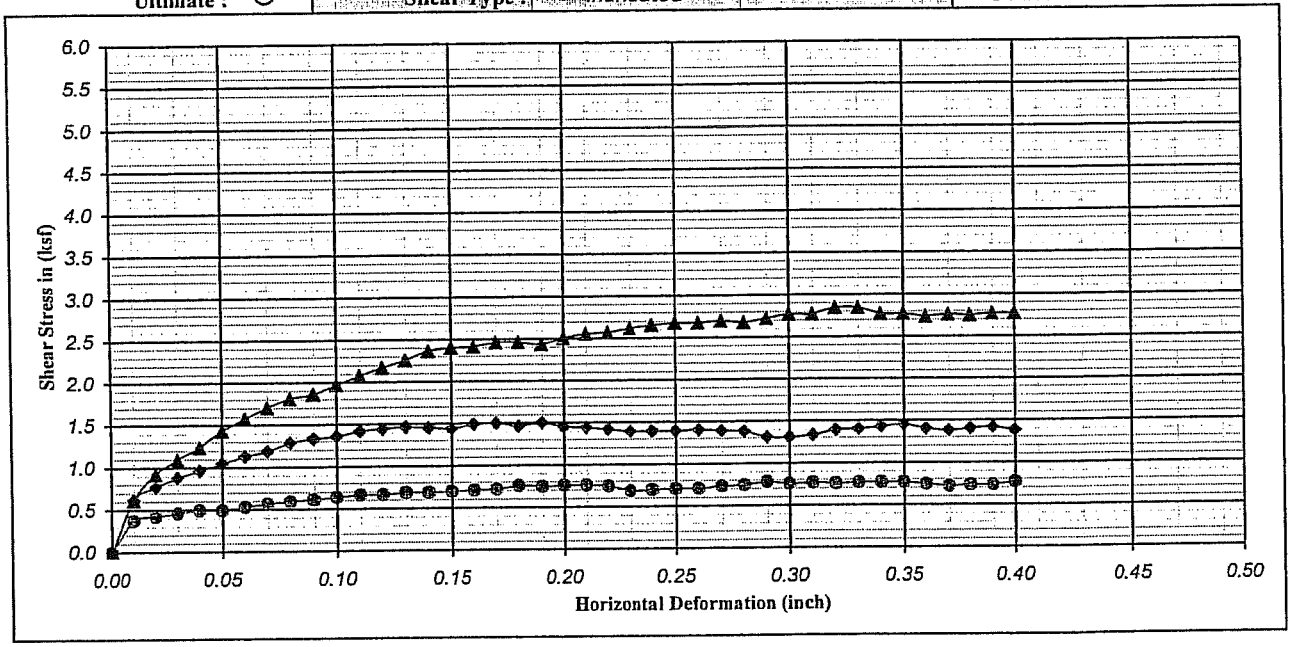
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-101	Strength Intercept (C) :	0.11	(ksf)		0.14	(ksf)	
Sample No. : D-4		5.17	(kPa)	Peak	6.61	(kPa)	Ultimate
Depth (ft/m) : 15.0 0.00	Friction Angle (ϕ) :	34.44	Degree		29.61	Degree	
Description : Dark Yellowish Brown, Poorly-graded SAND (SP)					Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	15.15	99.67	15.69	0.69	1.00	47.88	0.78	37.35	0.68	32.75
◆	14.47	107.35	16.90	0.57	2.00	95.76	1.50	71.82	1.31	62.63
▲	14.30	106.15	16.71	0.59	4.00	191.52	2.84	136.17	2.40	114.91

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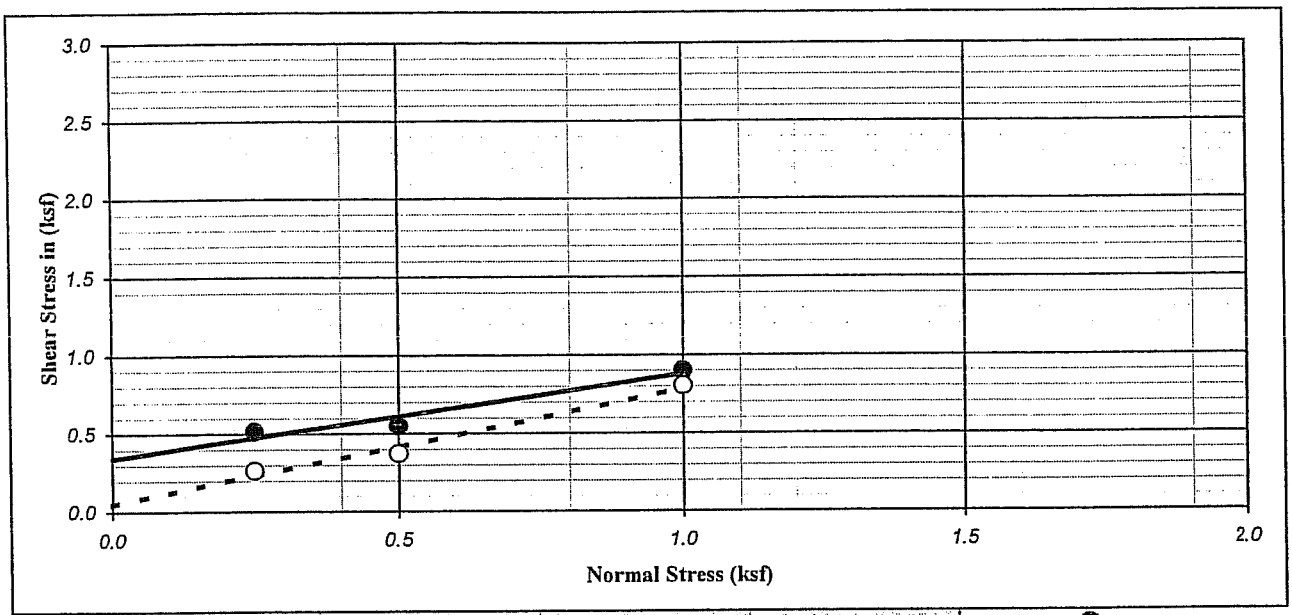
RBF/SR-57 Northbound

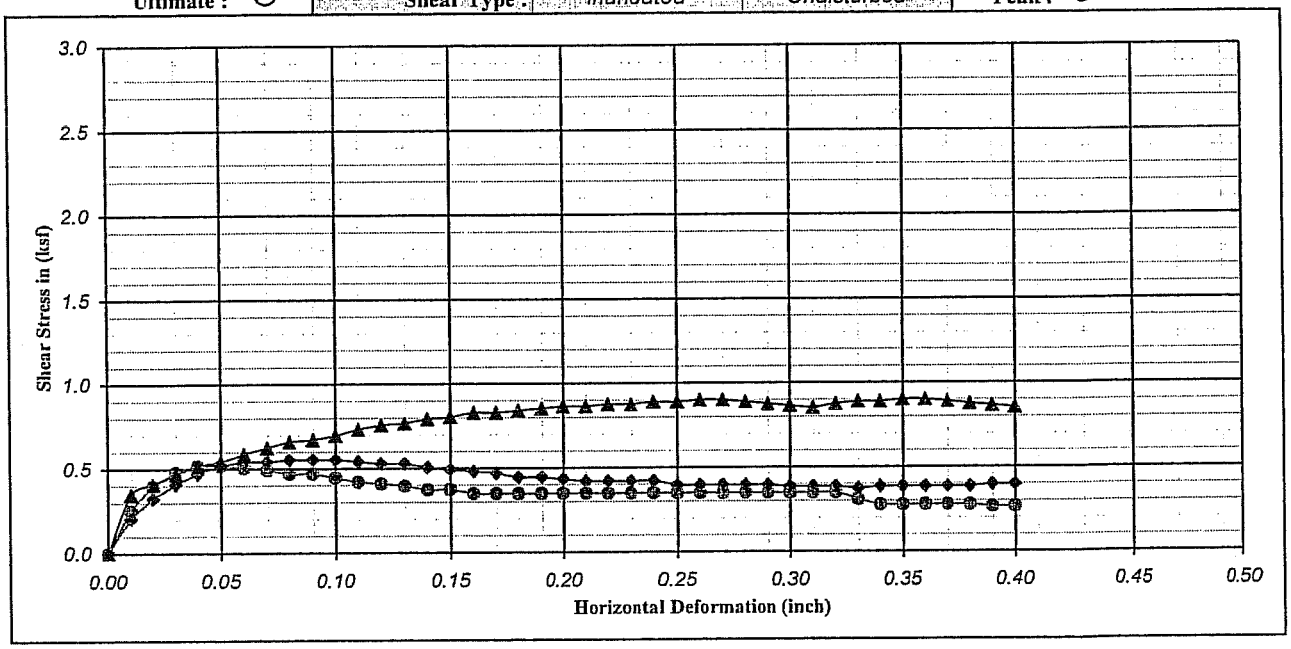
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-102	Strength Intercept (C) :	0.34	(ksf)	Peak	0.05	(ksf)	Ultimate
Sample No. : D-1		16.37	(kPa)		2.30	(kPa)	
Depth (ft/m) : 2.5 / 0.00	Friction Angle (ϕ) :	28.29	Degree		36.52	Degree	
Description : Dark yellow brown, SILTY SAND (SM)					Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	15.59	100.65	15.84	0.67	0.25	11.97	0.52	24.71	0.26	12.64
◆	16.37	98.80	15.55	0.71	0.50	23.94	0.55	26.43	0.37	17.81
▲	15.59	98.66	15.53	0.71	1.00	47.88	0.90	43.09	0.80	38.50

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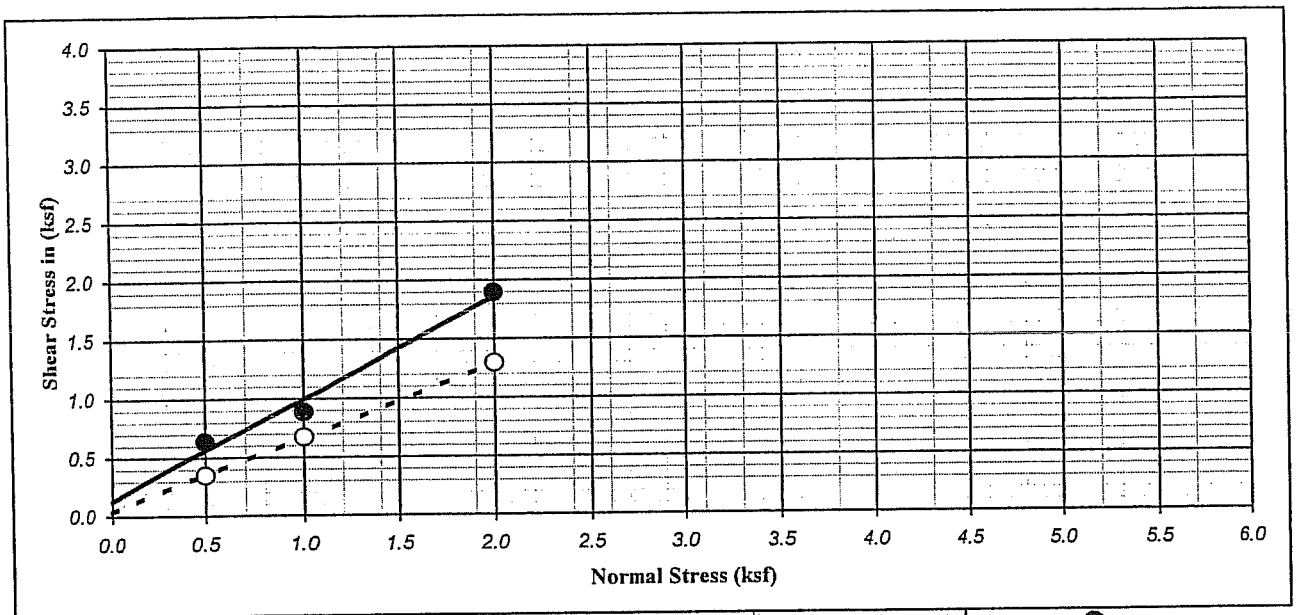
RBF/SR-57 Northbound

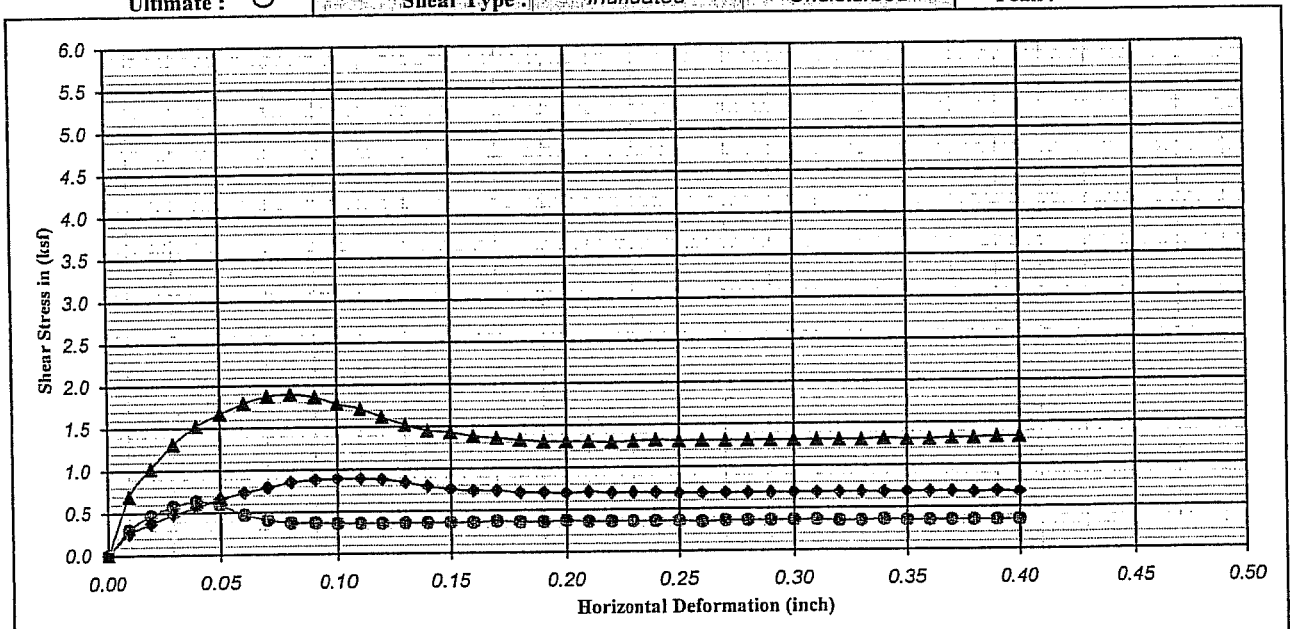
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-105		Strength Intercept (C) :	0.13	(ksf)		0.04	(ksf)	
Sample No. : D-4			6.32	(kPa)	Peak	1.72	(kPa)	Ultimate
Depth (ft/m) : 15.0	0.00	Friction Angle (ϕ) :	40.83	Degree		32.25	Degree	
Description : Light olive brown, Poorly graded SAND with SILT (SP-SM)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.62	94.55	14.88	0.78	0.50	23.94	0.64	30.45	0.35	16.66
◆	21.99	88.51	13.93	0.90	1.00	47.88	0.89	42.52	0.67	32.18
▲	23.09	83.98	13.22	1.01	2.00	95.76	1.90	90.78	1.30	62.05

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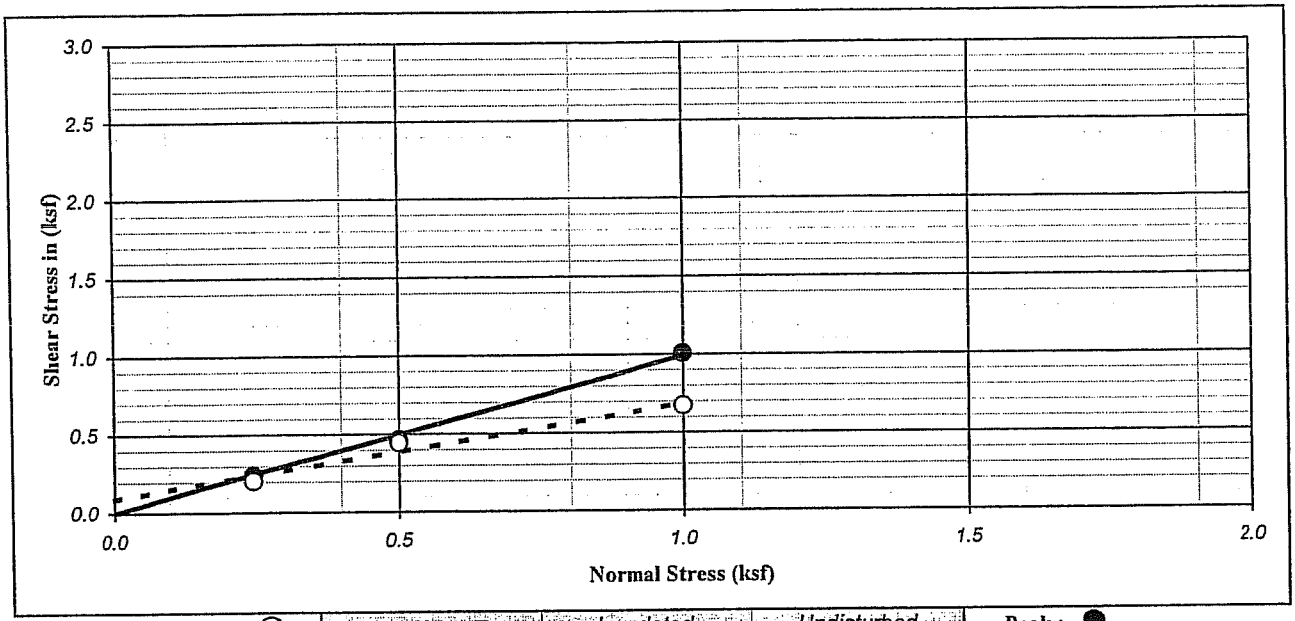
RBF/SR-57 Northbound

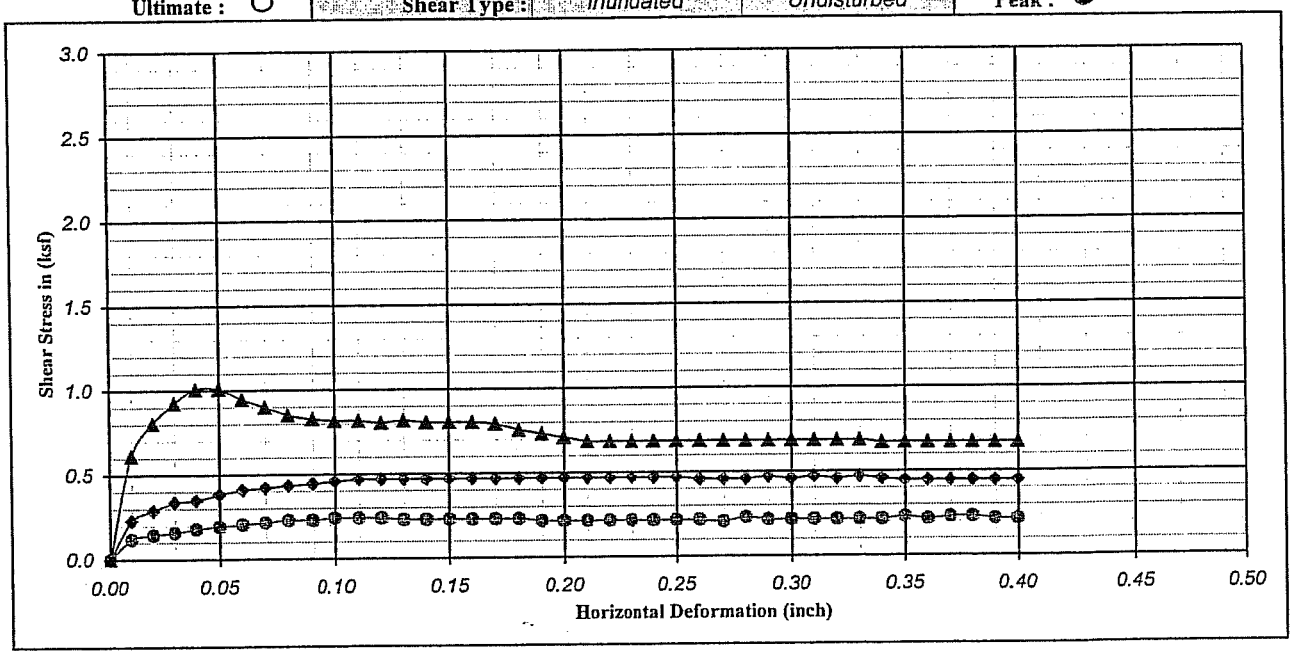
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-109		Strength Intercept (C) :	0.00	(ksf)		0.09	(ksf)		
Sample No. : D-2			0.00	(kPa)	Peak	4.31	(kPa)	Ultimate	
Depth (ft/m) : 5.0	0.00	Friction Angle (ϕ) :	44.77	Degree		30.96	Degree		
Description : Olive brown, SILTY SAND (SM)						Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	15.42	109.37	17.21	0.54	0.25	11.97	0.24	11.49	0.20	9.77
◆	15.01	105.94	16.68	0.59	0.50	23.94	0.47	22.41	0.44	21.26
▲	15.40	111.01	17.47	0.52	1.00	47.88	1.01	48.26	0.67	32.18

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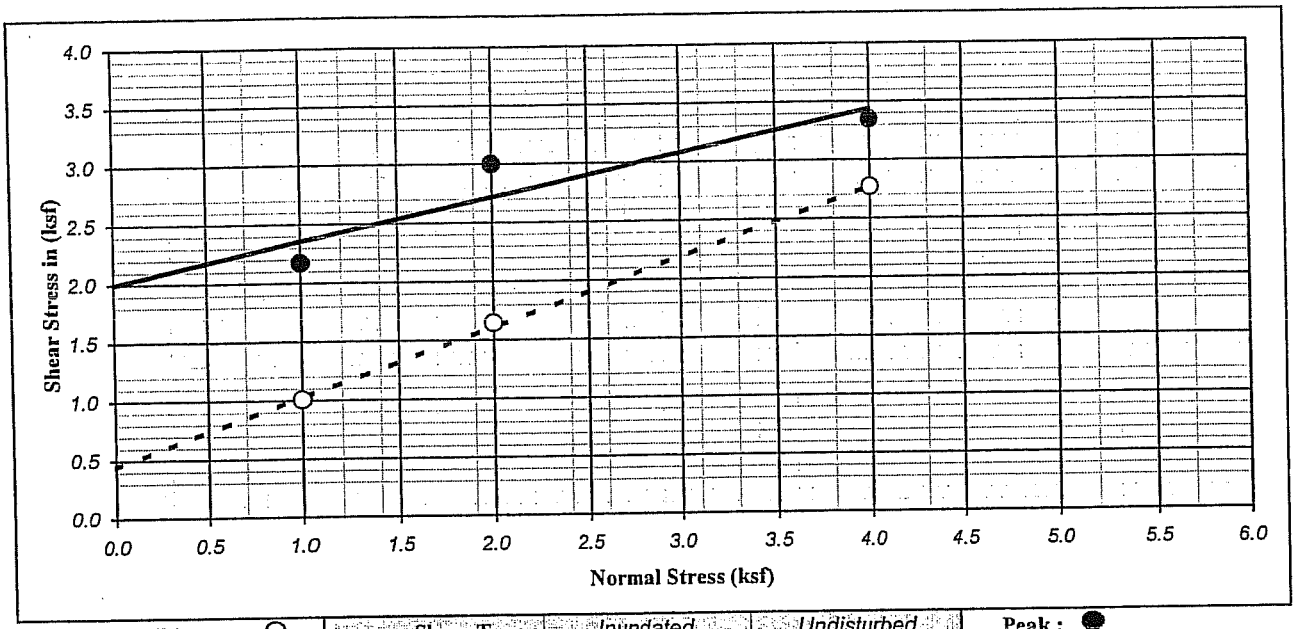
RBF/SR-57 Northbound

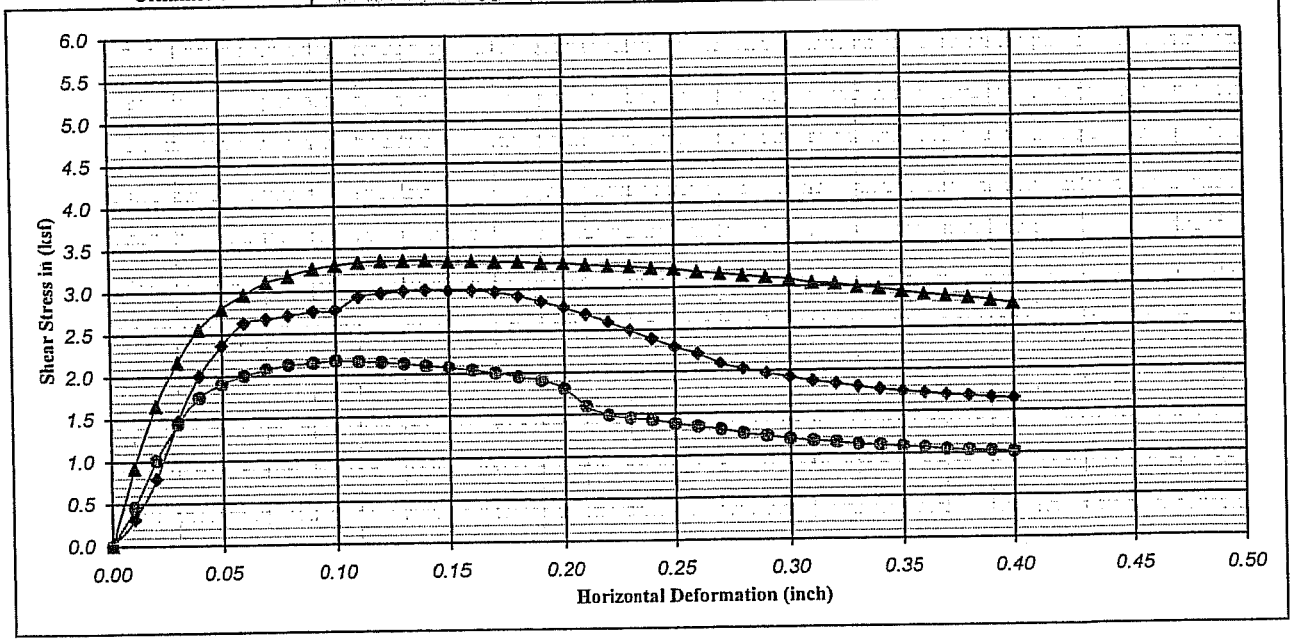
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-119		Strength Intercept (C) :	2.00	(ksf)		0.44	(ksf)		
Sample No. : D-4			95.66	(kPa)	Peak	21.26	(kPa)	Ultimate	
Depth (ft/m) : 15.0	0.00	Friction Angle (ϕ) :	19.84	Degree		30.31	Degree		
Description : Dark yellowish brown, Lean CLAY with SAND (CL)					Shear Rate (inch/minute) :			0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	21.70	106.12	16.70	0.59	1.00	47.88	2.17	104.00	1.01	48.26
◆	20.98	107.63	16.94	0.57	2.00	95.76	3.00	143.64	1.64	78.71
▲	19.71	107.86	16.98	0.56	4.00	191.52	3.35	160.30	2.77	132.72

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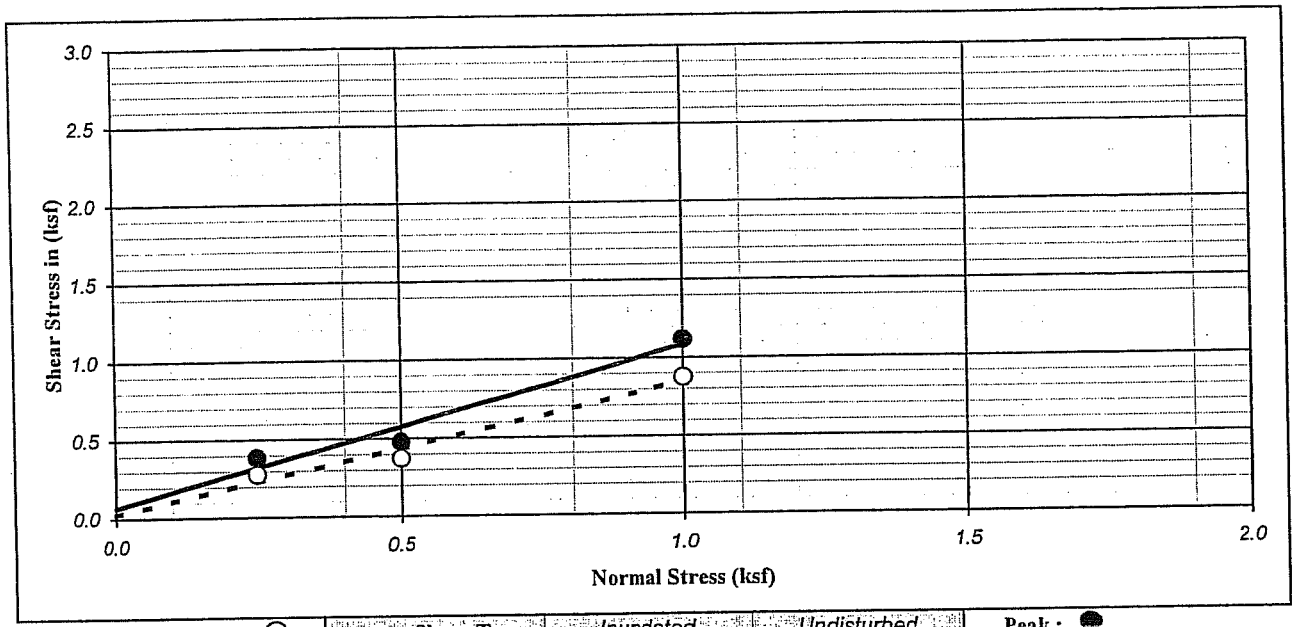
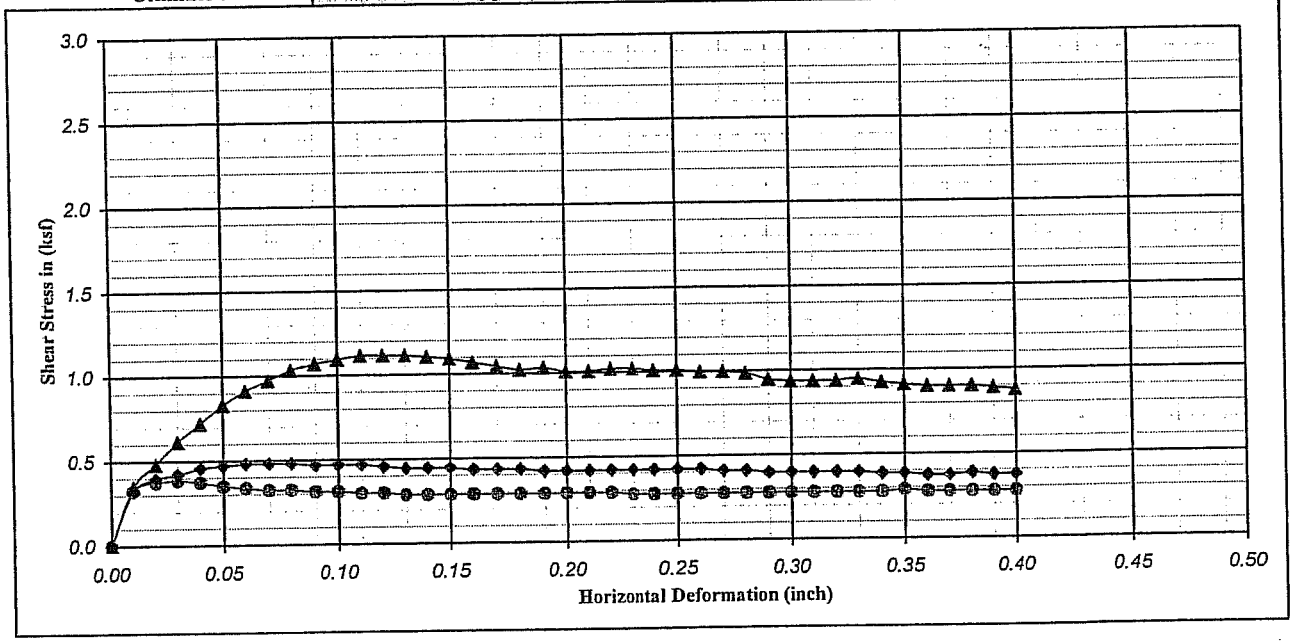
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08 | Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-122		Strength Intercept (C) :	0.07	(ksf)	Peak	0.02	(ksf)	Ultimate
Sample No. : D-1			3.16	(kPa)		1.15	(kPa)	
Depth (ft/m) : 2.5	0.00	Friction Angle (ϕ) :	45.52	Degree		39.68	Degree	
Description : Yellowish brown, SILTY SAND (SM)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.41	102.95	16.20	0.64	0.25	11.97	0.38	18.39	0.28	13.21
◆	20.99	98.22	15.46	0.72	0.50	23.94	0.48	22.98	0.37	17.81
▲	19.67	103.90	16.35	0.62	1.00	47.88	1.12	53.43	0.88	41.94

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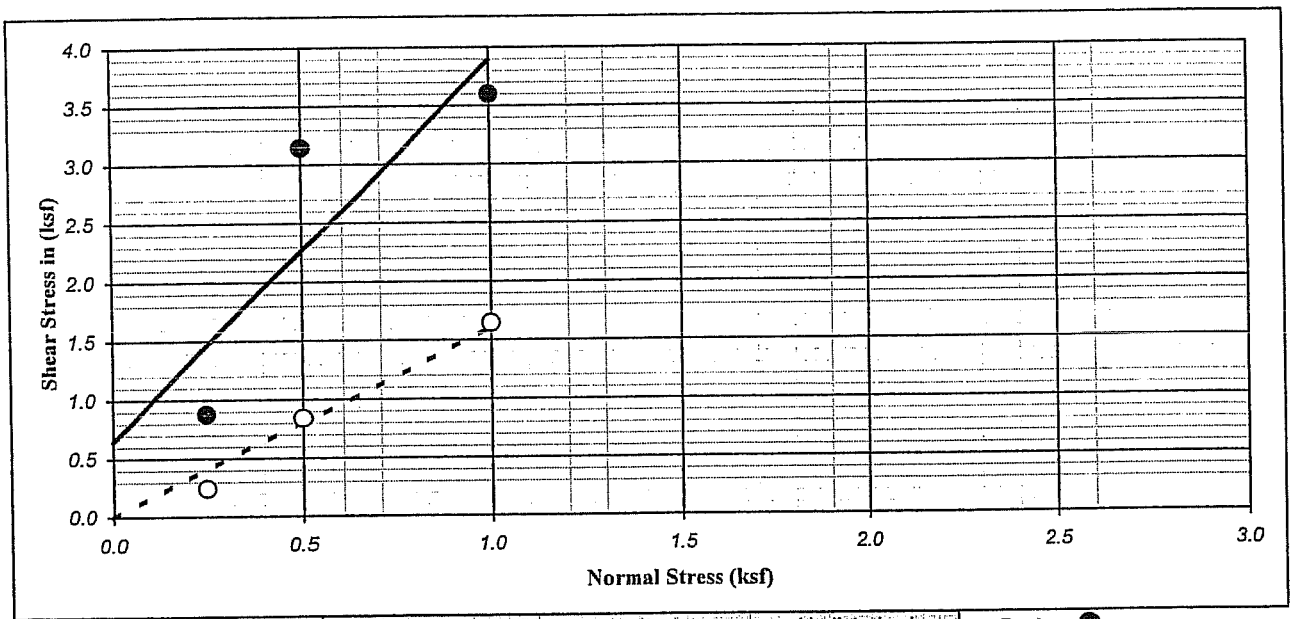
Geotechnical and Earthquake Engineering

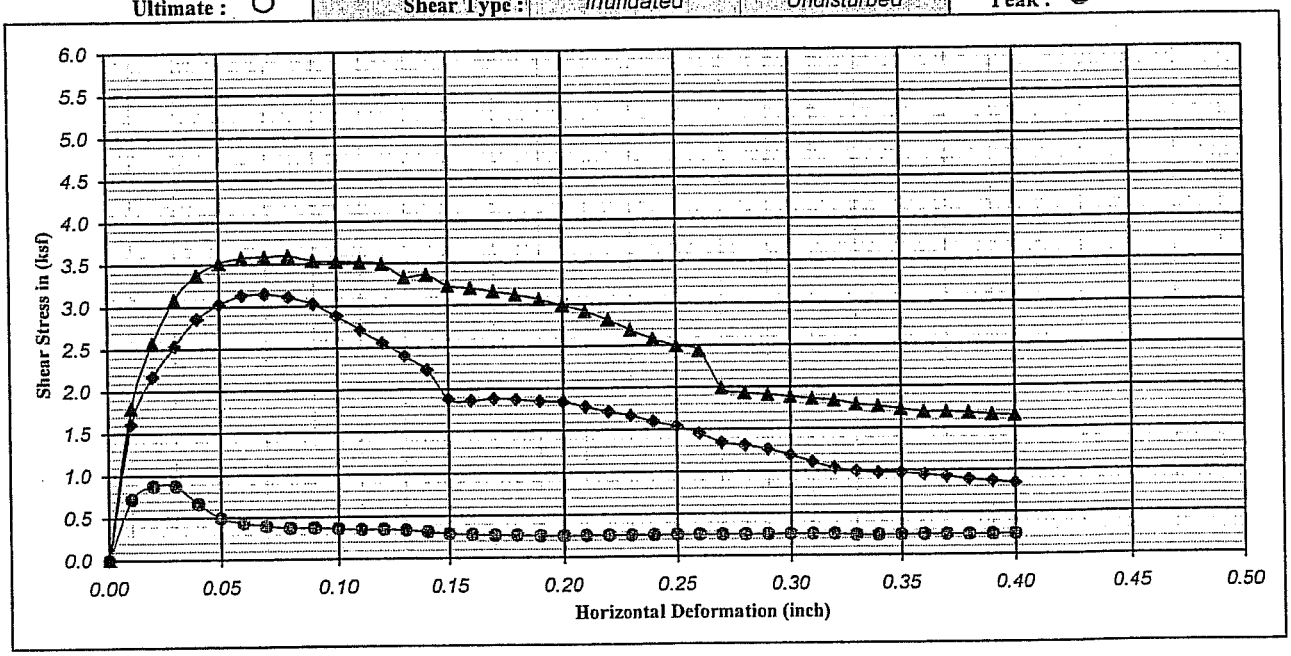
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08 | Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-123		Strength Intercept (C) :	0.65	(ksf)		0.00	(ksf)	
Sample No. : D-2			31.03	(kPa)	Peak	0.00	(kPa)	Ultimate
Depth (ft/m) : 5.0	0.00	Friction Angle (ϕ) :	72.86	Degree		58.29	Degree	
Description : Brown to dark brown, CLAYEY SAND (SC)					Shear Rate (inch/minute) :			0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	15.15	116.23	18.30	0.45	0.25	11.97	0.88	41.94	0.24	11.49
◆	16.17	123.05	19.37	0.37	0.50	23.94	3.14	150.53	0.84	40.22
▲	16.31	120.36	18.94	0.40	1.00	47.88	3.60	172.37	1.64	78.71

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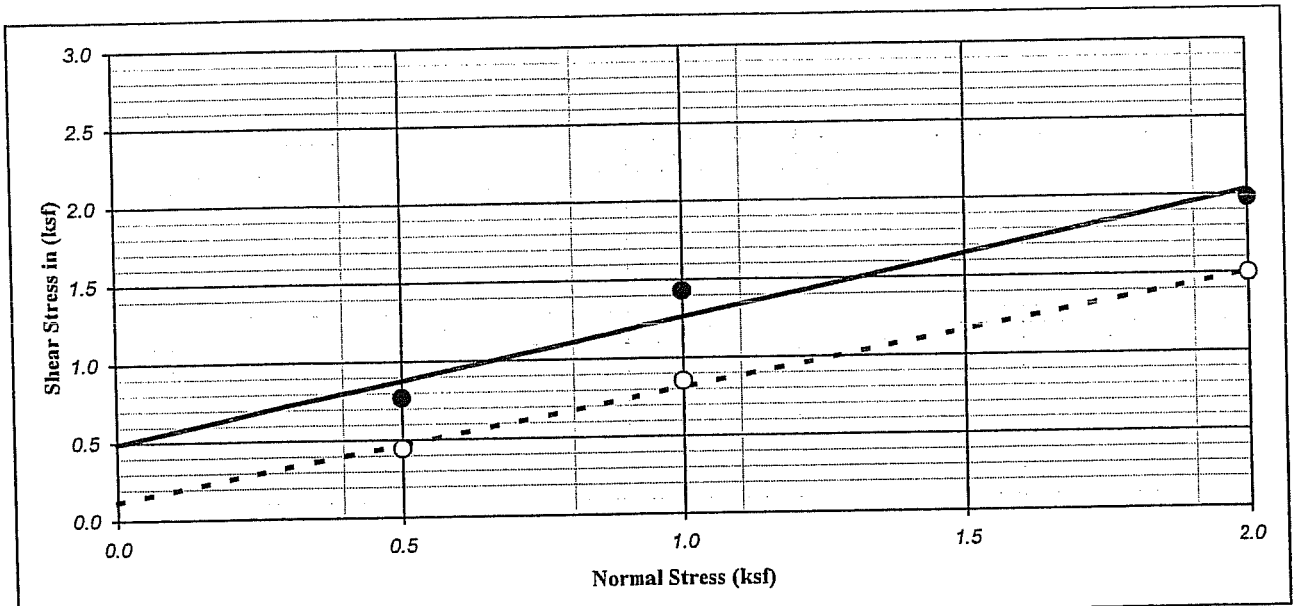
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

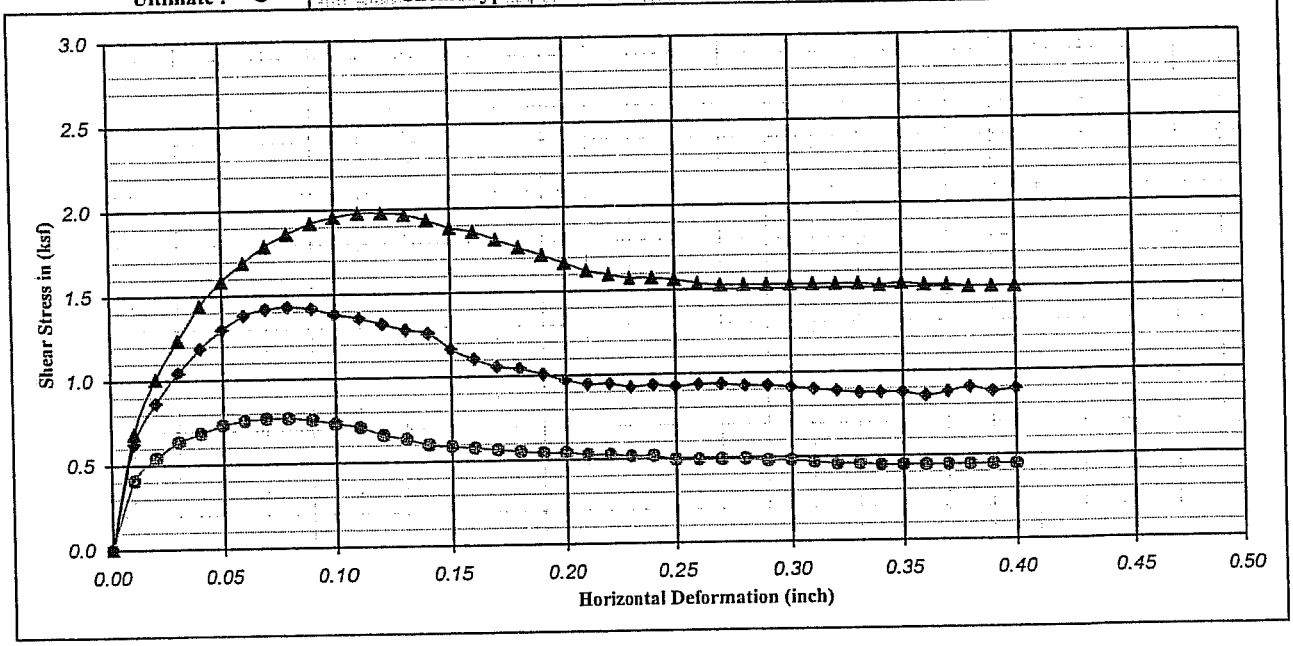
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-124	Strength Intercept (C) :	0.49	(ksf)		0.12	(ksf)	
Sample No. : D-3		23.56	(kPa)	Peak	5.75	(kPa)	Ultimate
Depth (ft/m) : 10.0 0.00	Friction Angle (ϕ) :	37.65	Degree		34.84	Degree	
Description : Brown, CLAYEY SAND (SC)					Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	26.23	101.94	16.05	0.65	0.50	23.94	0.77	36.77	0.44	21.26
◆	18.98	116.04	18.26	0.45	1.00	47.88	1.43	68.37	0.85	40.79
▲	22.20	108.03	17.00	0.56	2.00	95.76	1.98	94.80	1.50	71.82

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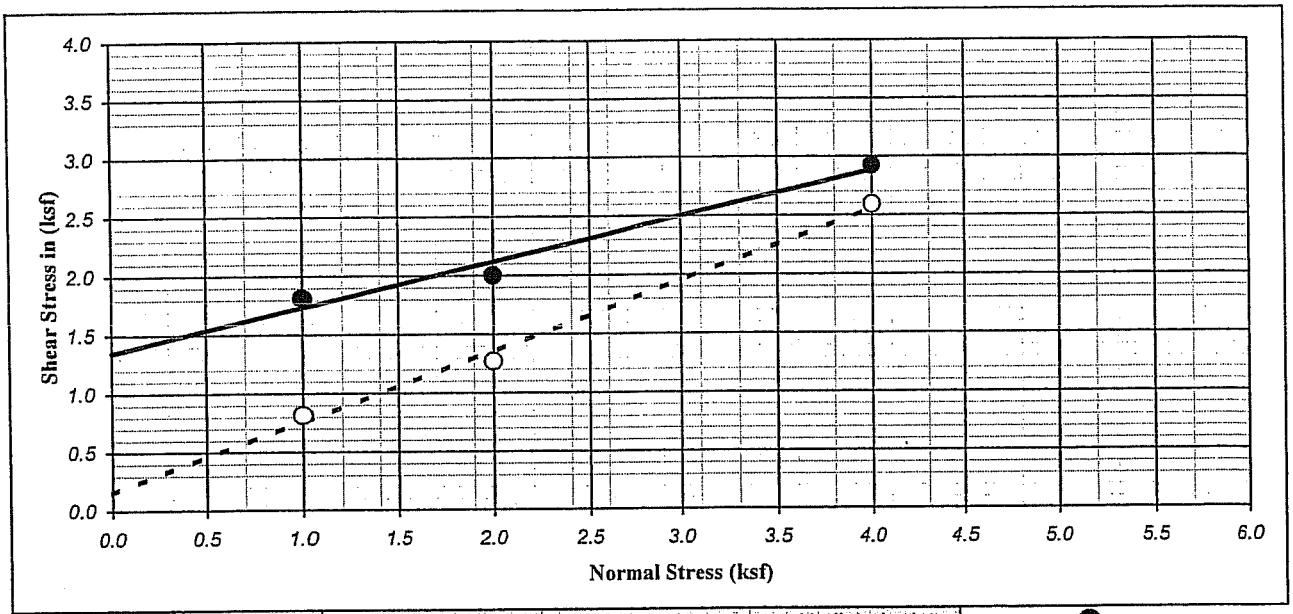
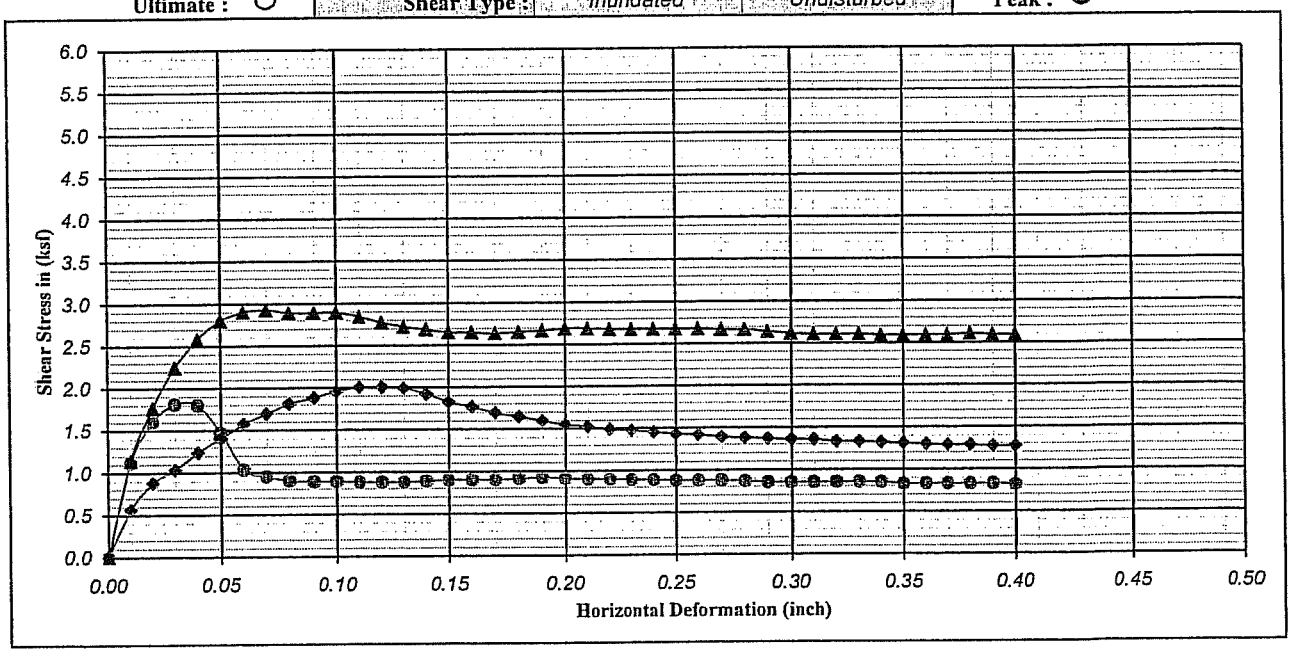
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08 | Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-124		Strength Intercept (C) :	1.35	(ksf)		0.16	(ksf)	
Sample No. : D-5			64.64	(kPa)	Peak	7.47	(kPa)	Ultimate
Depth (ft/m) : 20.0	0.00	Friction Angle (ϕ) :	21.05	Degree		31.04	Degree	
Description : Brown, SANDY SILT (ML)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	22.44	104.10	16.38	0.62	1.00	47.88	1.81	86.76	0.82	39.07
◆	28.81	94.27	14.84	0.79	2.00	95.76	2.00	95.95	1.27	60.90
▲	21.01	101.14	15.92	0.67	4.00	191.52	2.93	140.19	2.59	124.10

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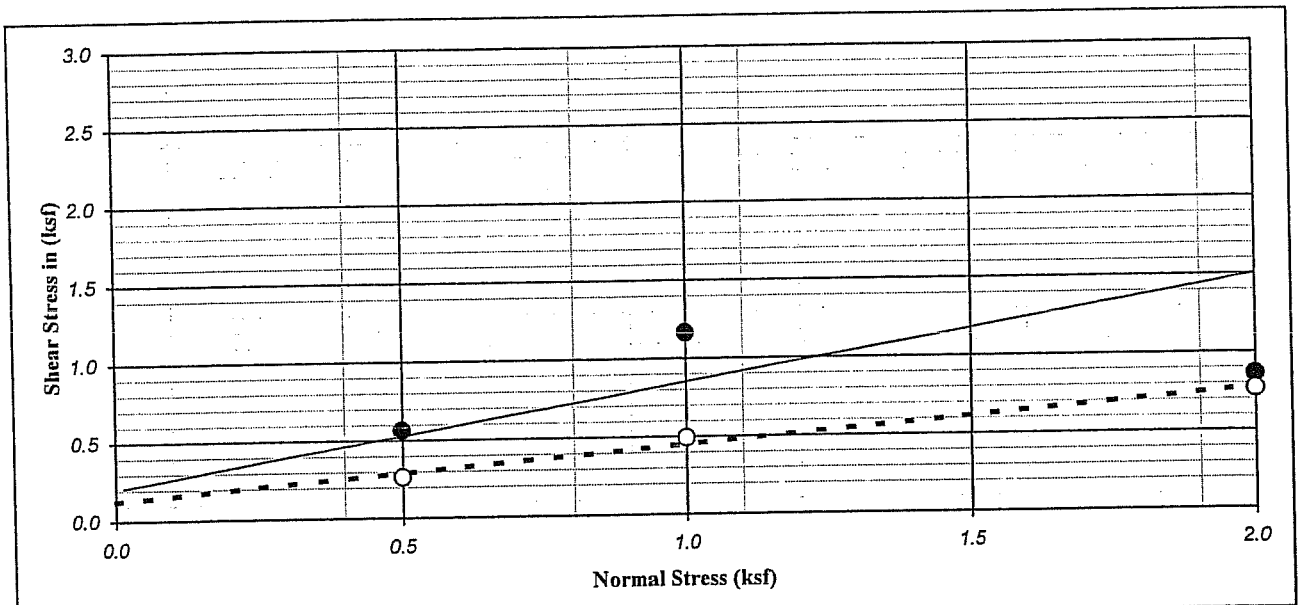
RBF/SR-57 Northbound

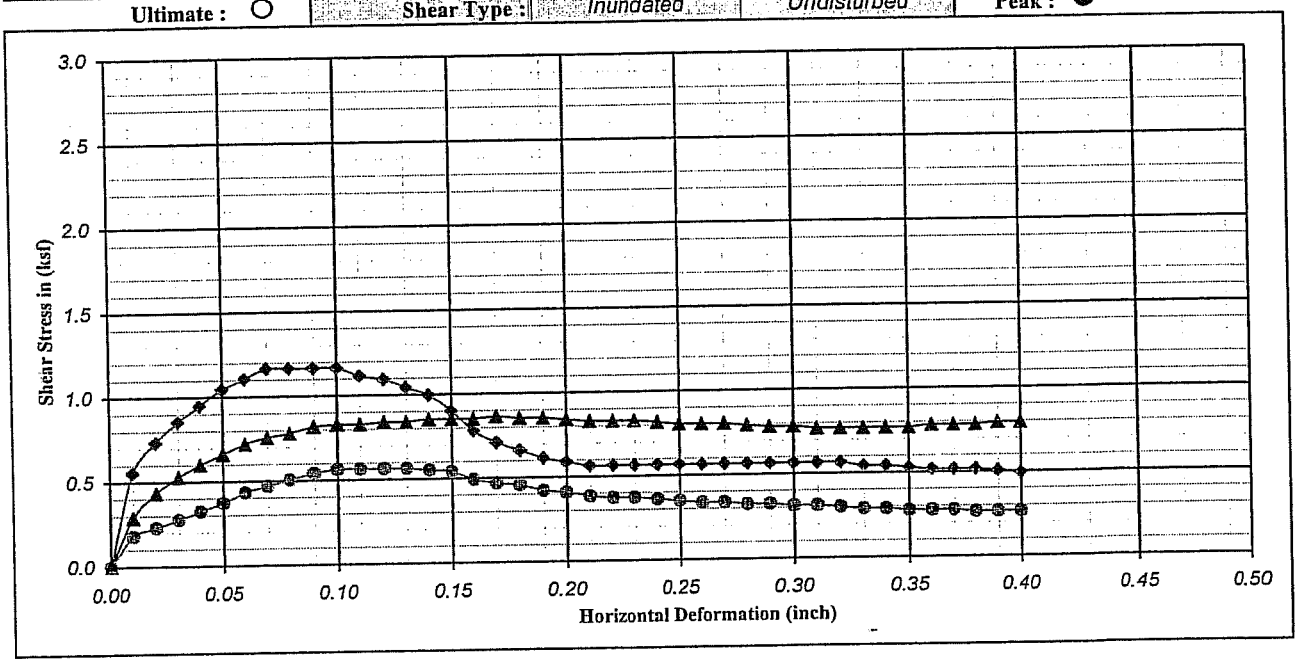
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-126		Strength Intercept (C) :	0.20	(ksf)		0.13	(ksf)	
Sample No. : D-1			9.58	(kPa)	Peak	6.03	(kPa)	Ultimate
Depth (ft/m) : 2.5	0.00	Friction Angle (ϕ) :	30.96	Degree		18.13	Degree	
Description : Mottled brown, olive brown, yellowish brown, Lean CLAY with SAND (CL)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	26.91	98.44	15.49	0.71	0.50	23.94	0.56	27.00	0.26	12.64
◆	25.84	101.95	16.05	0.65	1.00	47.88	1.16	55.73	0.49	23.56
▲	25.23	100.71	15.85	0.67	2.00	95.76	0.86	41.37	0.77	36.77

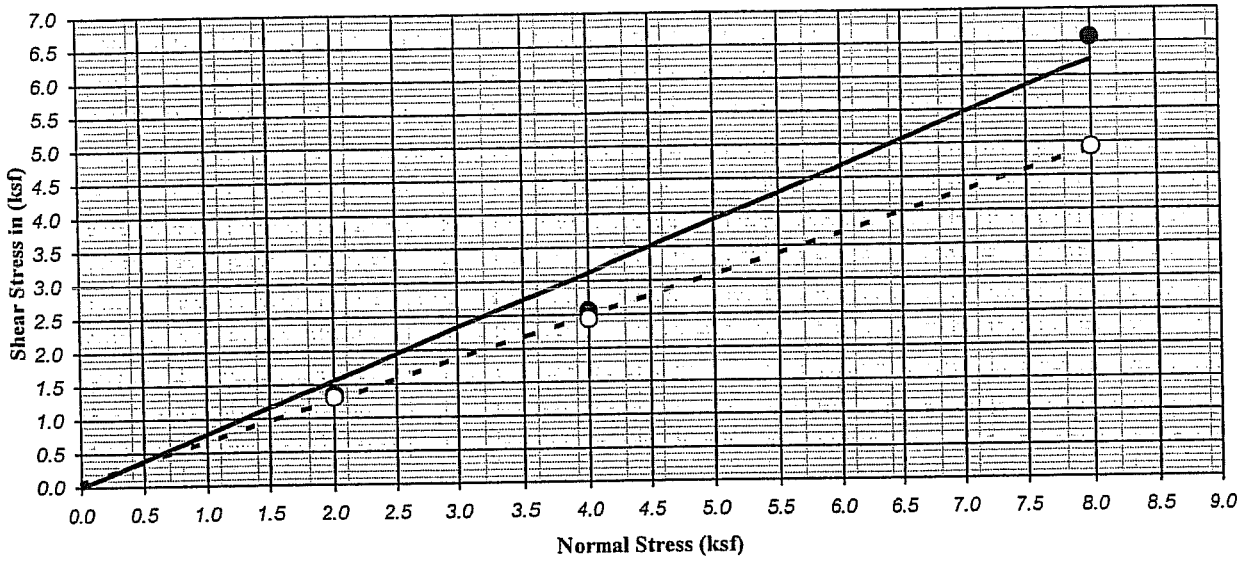
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

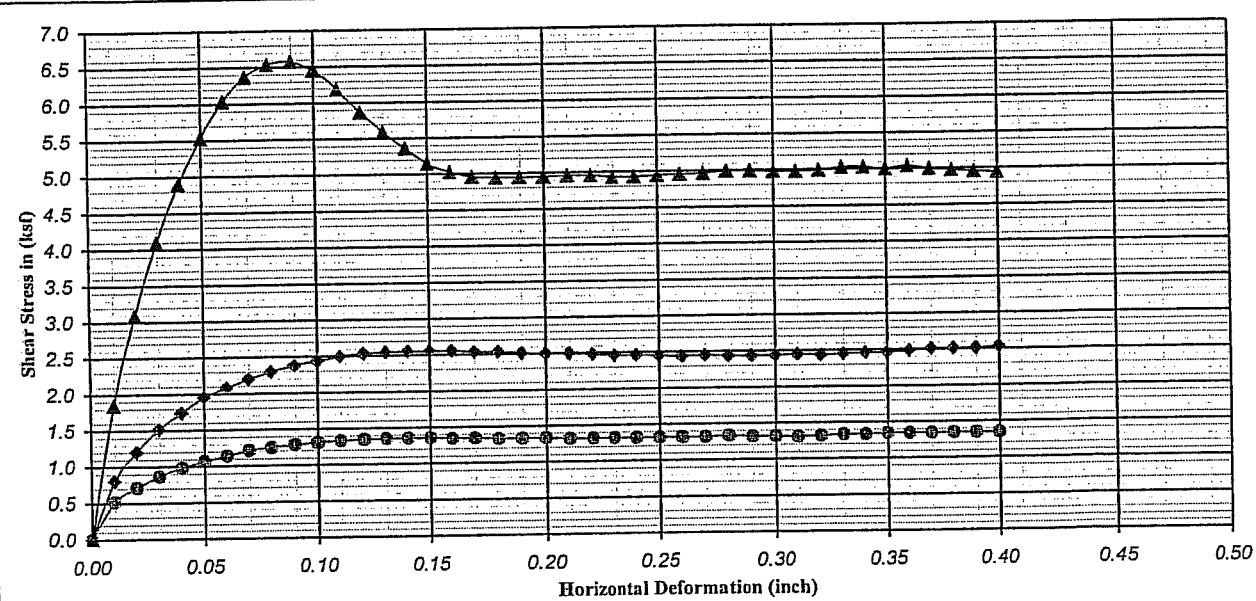
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No.	: A-08-126	Strength Intercept (C) :	0.00	(ksf)		0.06	(ksf)		
Sample No.	: D-9		0.00	(kPa)	Peak	2.87	(kPa)	Ultimate	
Depth (ft/m)	: 40.0 0.00	Friction Angle (ϕ) :	37.96	Degree		31.25	Degree		
Description	: Brown, SILTY SAND (SM)						Shear Rate (inch/minute) :	0.02	

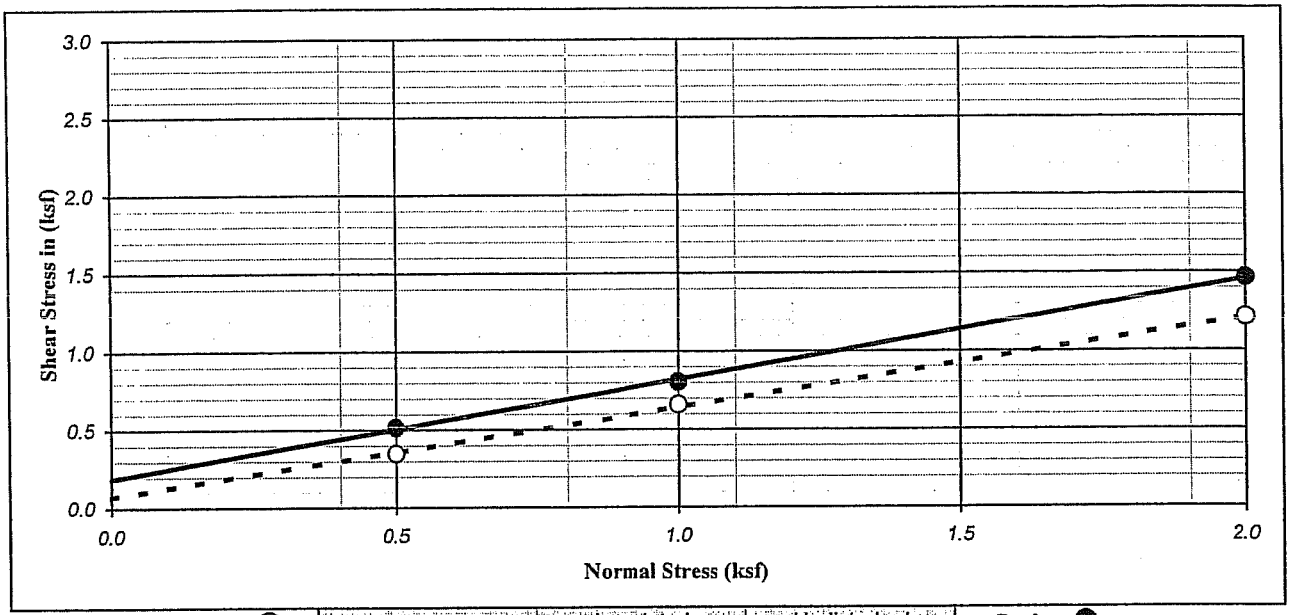
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	24.19	90.95	14.32	0.85	2.00	95.76	1.36	64.93	1.31	62.63
◆	24.11	88.93	14.00	0.90	4.00	191.52	2.56	122.38	2.44	116.64
▲	20.35	92.02	14.48	0.83	8.00	383.04	6.58	314.81	4.93	236.14

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

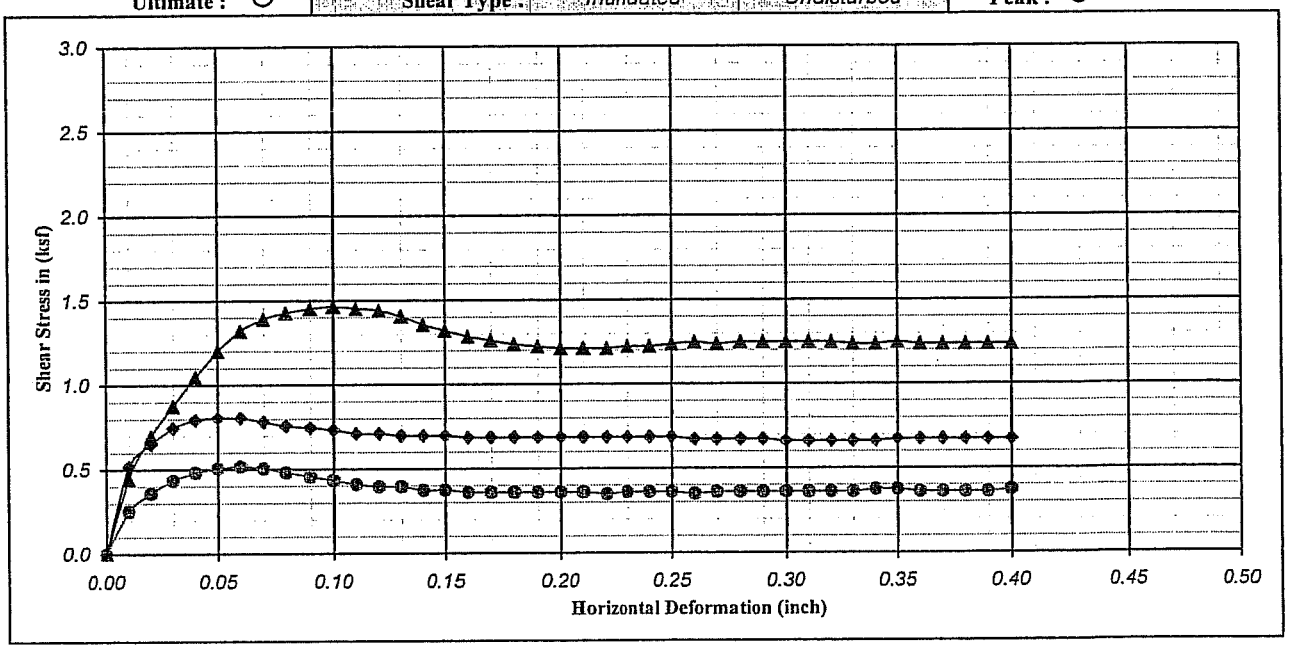
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08 | Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-128	Strength Intercept (C) :	0.19	(ksf)	Peak	0.07	(ksf)	Ultimate
Sample No. : D-3		8.91	(kPa)		3.45	(kPa)	
Depth (ft/m) : 10.0 | 0.00	Friction Angle (ϕ) :	32.46	Degree		29.79	Degree	
Description : Yellowish brown, Poorly graded SAND with SILT (SP-SM)					Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.70	89.91	14.15	0.87	0.50	23.94	0.52	24.71	0.35	16.66
◆	20.30	88.42	13.92	0.91	1.00	47.88	0.80	38.50	0.66	31.60
▲	21.96	84.47	13.30	1.00	2.00	95.76	1.46	70.10	1.21	58.03

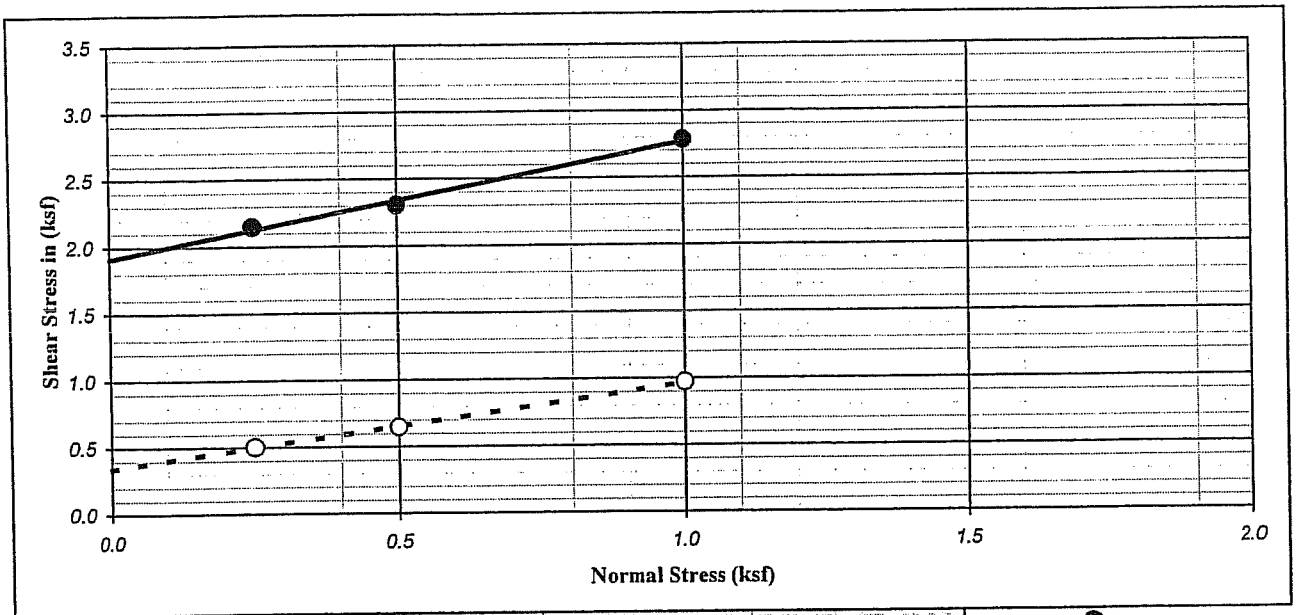
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

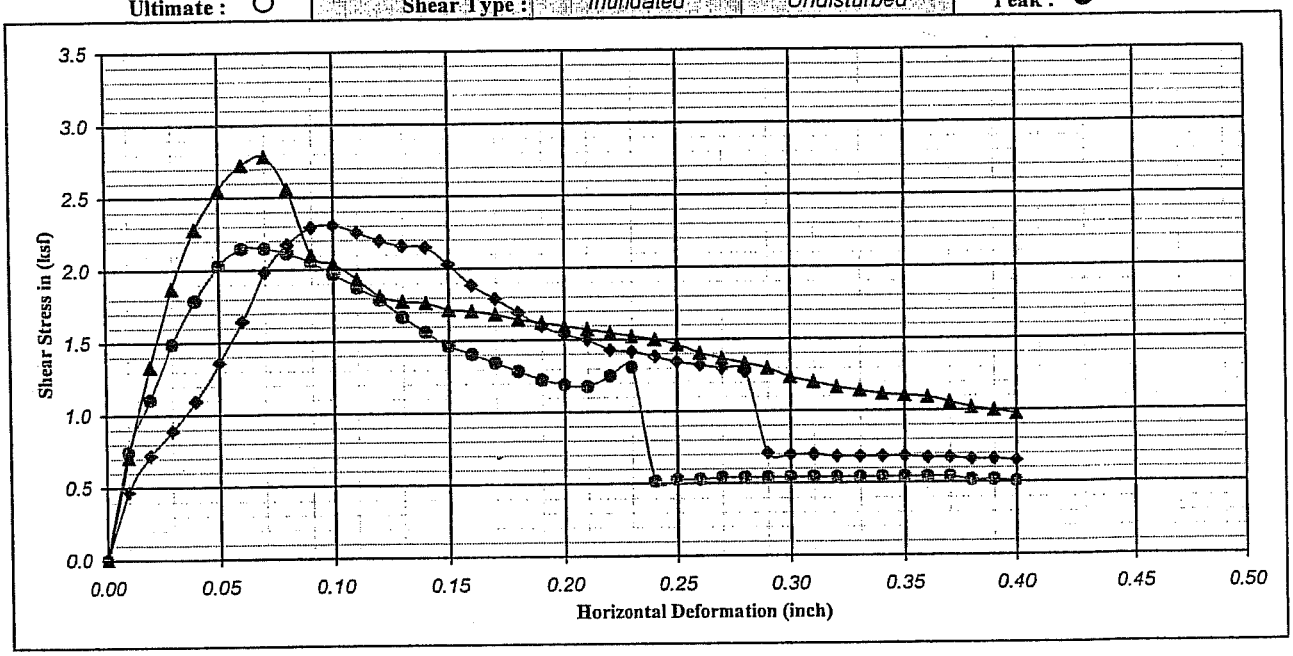
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-137		Strength Intercept (C) :	1.91	(ksf)	Peak	0.34	(ksf)	Ultimate
Sample No. : D-2			91.36	(kPa)		16.37	(kPa)	
Depth (ft/m) : 5.0	0.00	Friction Angle (ϕ) :	40.83	Degree		32.11	Degree	
Description : Mottled olive brown, white, orange, Lean CLAY with SAND (CL)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	41.66	88.58	13.94	0.90	0.25	11.97	2.15	102.85	0.50	24.13
◆	37.73	88.25	13.89	0.91	0.50	23.94	2.30	110.32	0.65	31.03
▲	29.23	93.92	14.78	0.79	1.00	47.88	2.78	133.30	0.97	46.54

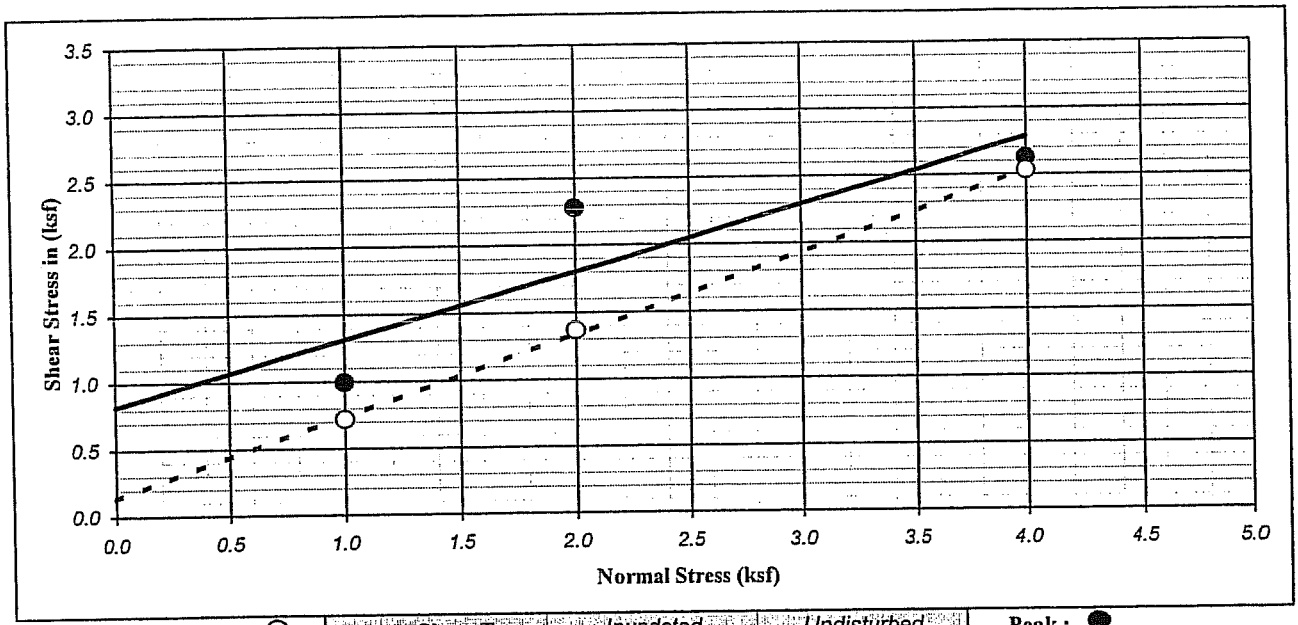
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

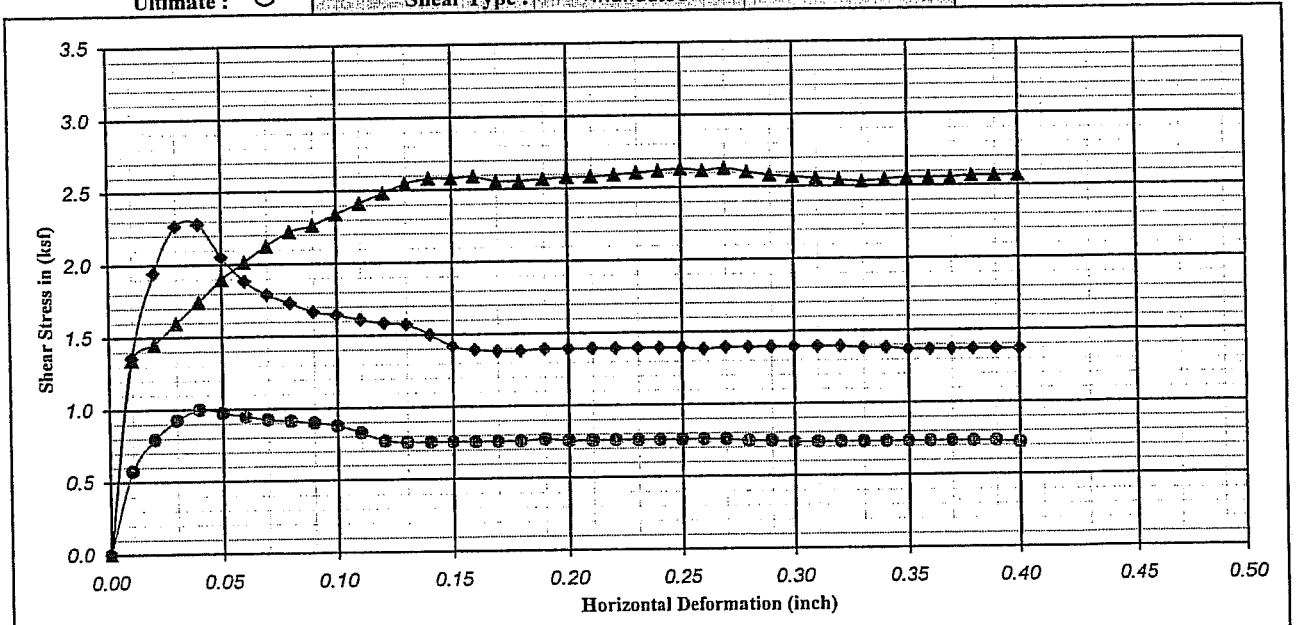
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-137	Strength Intercept (C) :	0.82	(ksf)		0.14	(ksf)		
Sample No. : D-4		39.36	(kPa)	Peak	6.61	(kPa)	Ultimate	
Depth (ft/m) : 15.0 | 0.00	Friction Angle (ϕ) :	26.16	Degree		31.00	Degree		
Description : Very dark brown, SILTY SAND (SM)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	17.82	98.71	15.54	0.71	1.00	47.88	1.00	47.69	0.72	34.47
◆	16.17	102.89	16.19	0.64	2.00	95.76	2.28	109.17	1.37	65.50
▲	19.81	98.79	15.55	0.71	4.00	191.52	2.63	125.83	2.53	121.23

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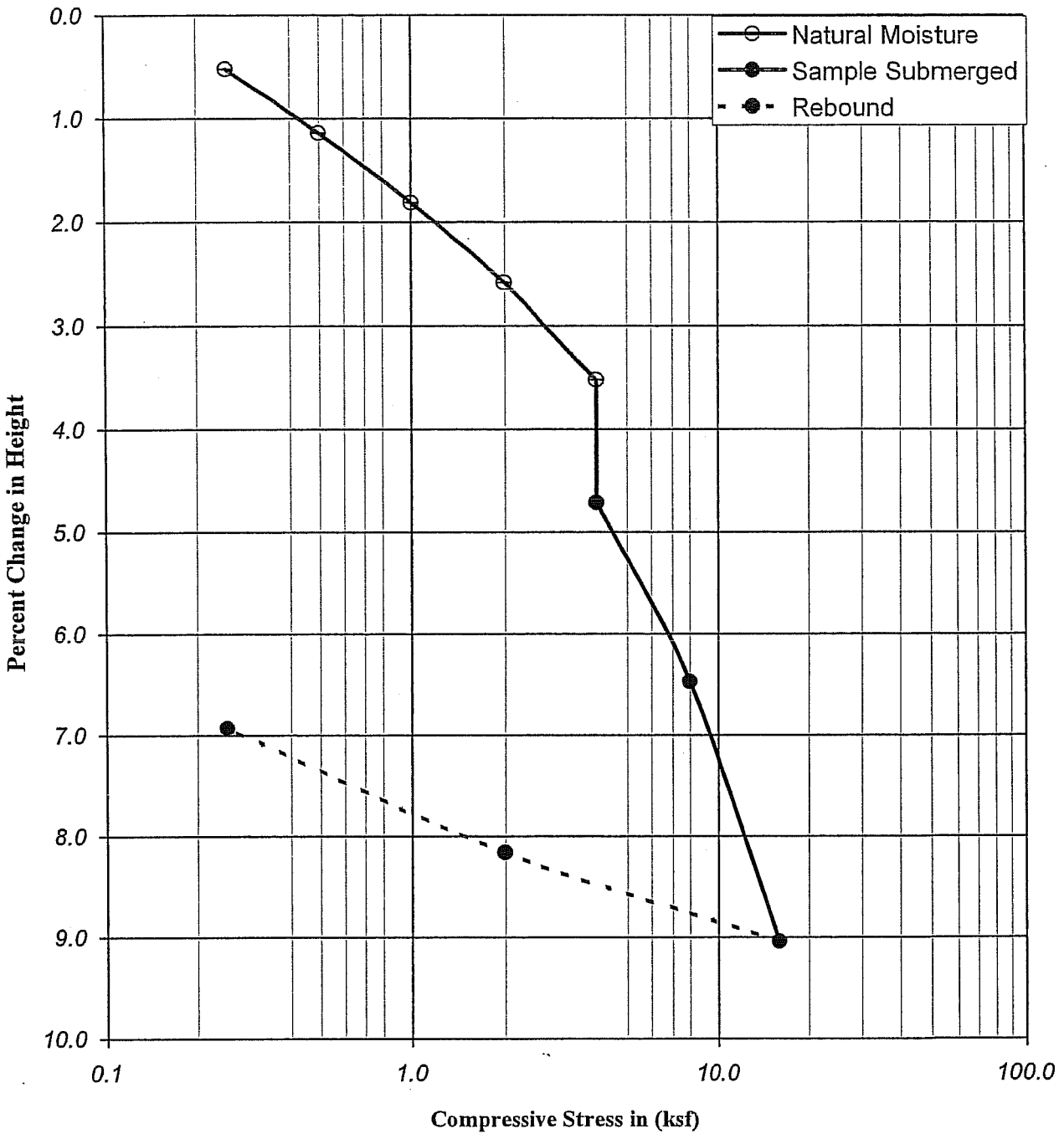
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08 | Figure No. :



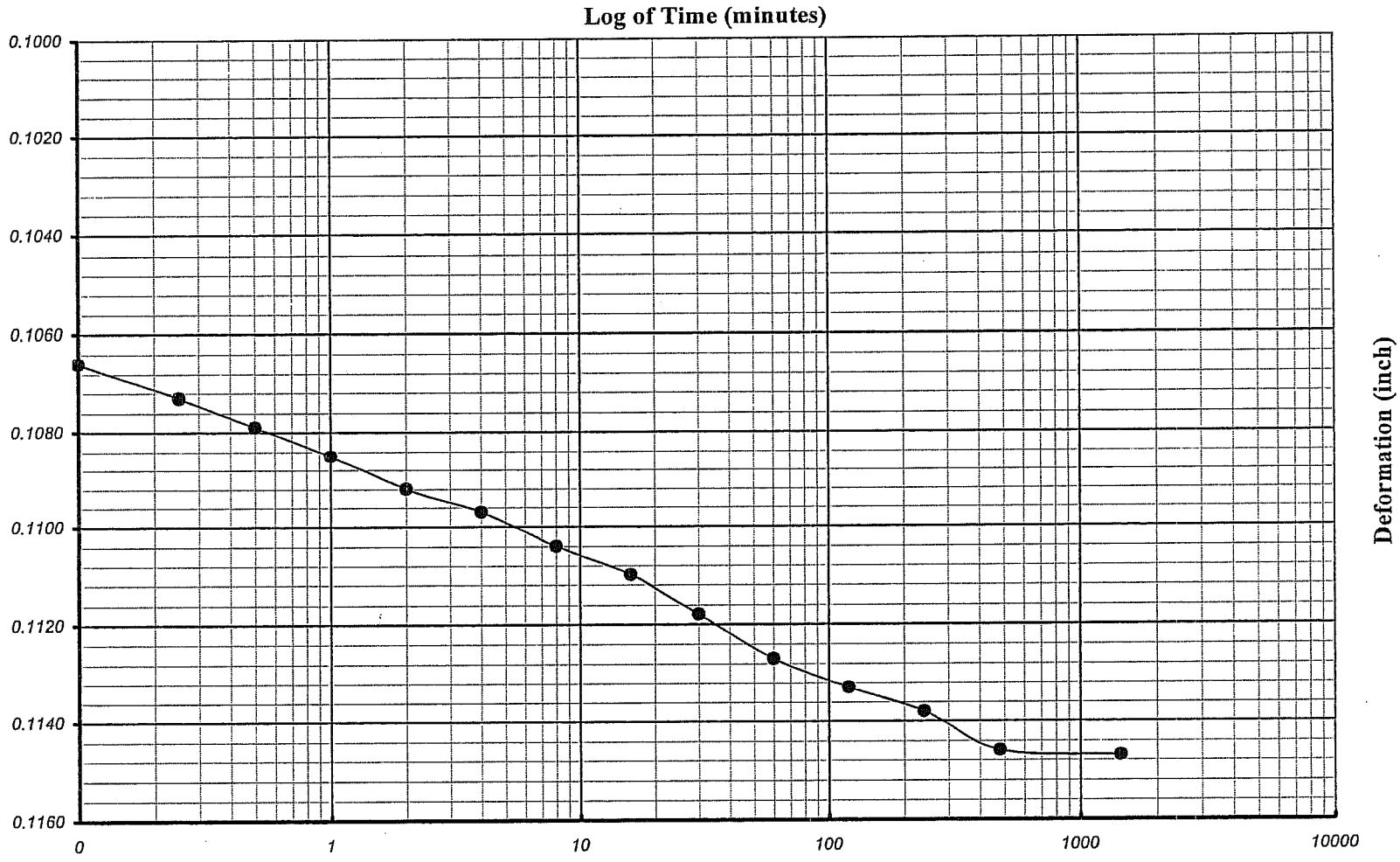
Boring No.	: A-08-005		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-8		Plastic Limit :	-						
Depth (ft)	: 35.0	36.5	Plastic Index :	-	Initial	13.84	115.16	18.13	80.56	0.46
Depth (m)	: 10.68	11.13	Specific Gravity :	2.70	Final	13.47	123.84	19.49	100.71	0.36
Description	: Dark yellowish brown, SANDY lean CLAY (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

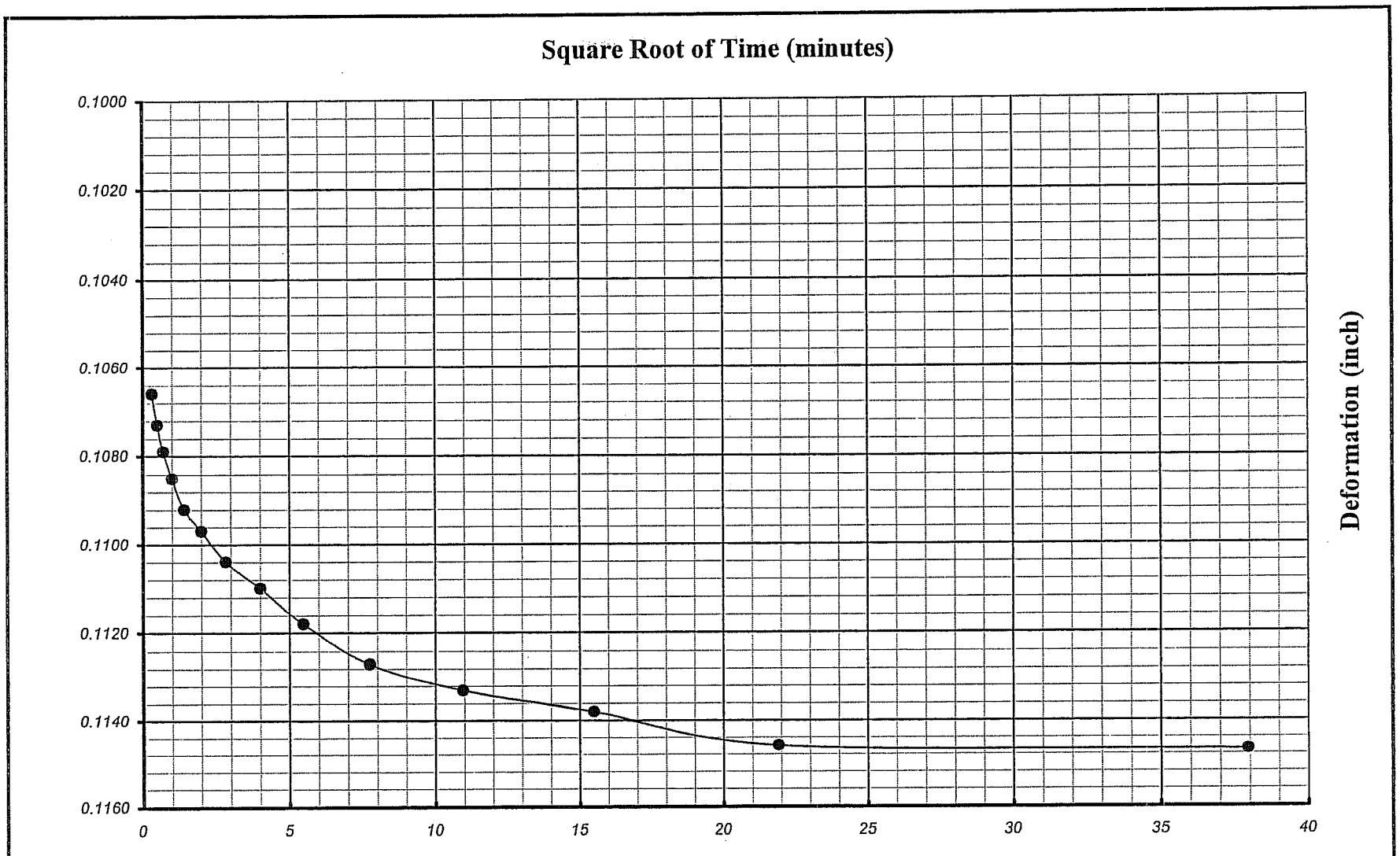
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

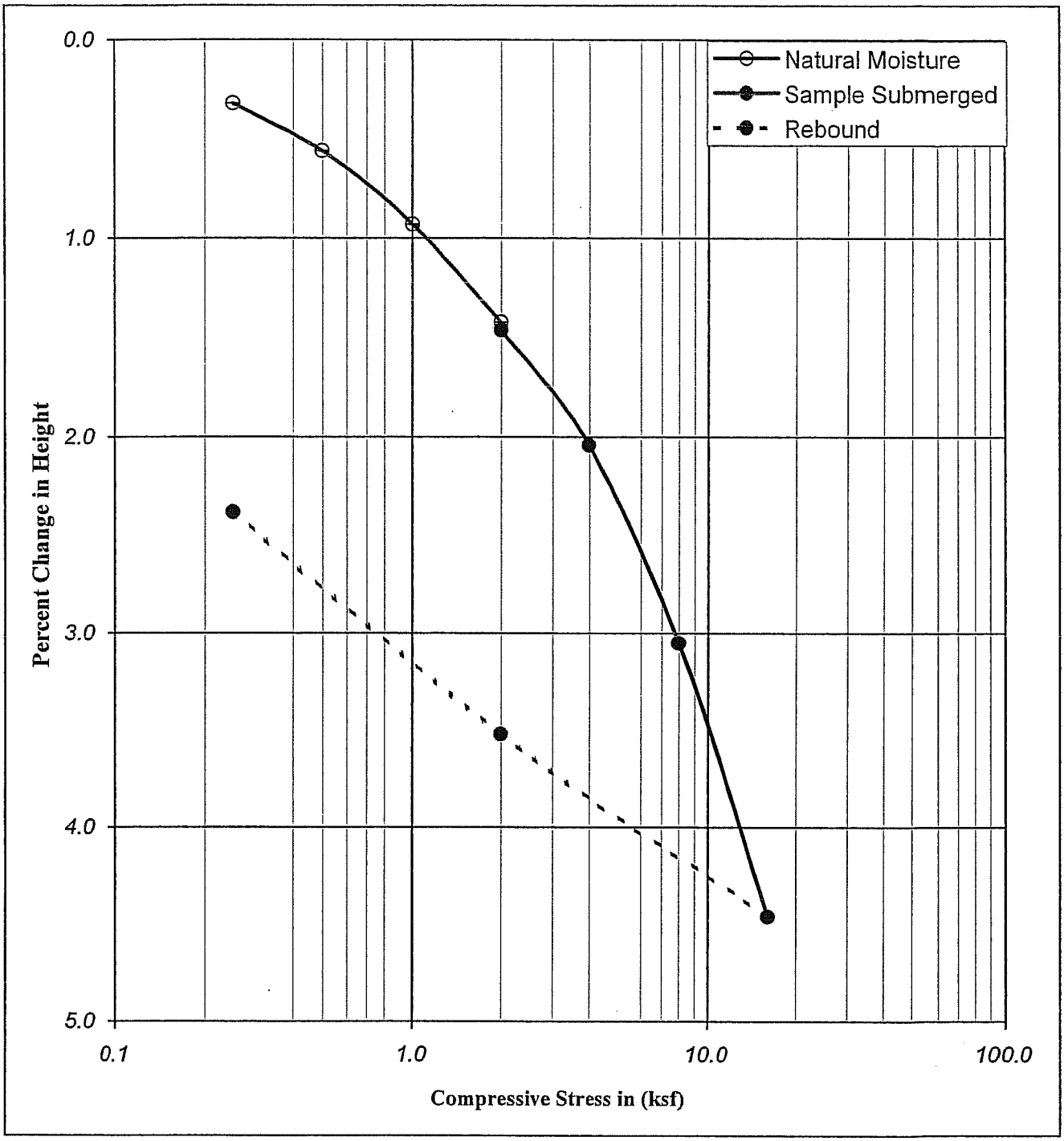
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-005*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-8*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-005*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-8*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



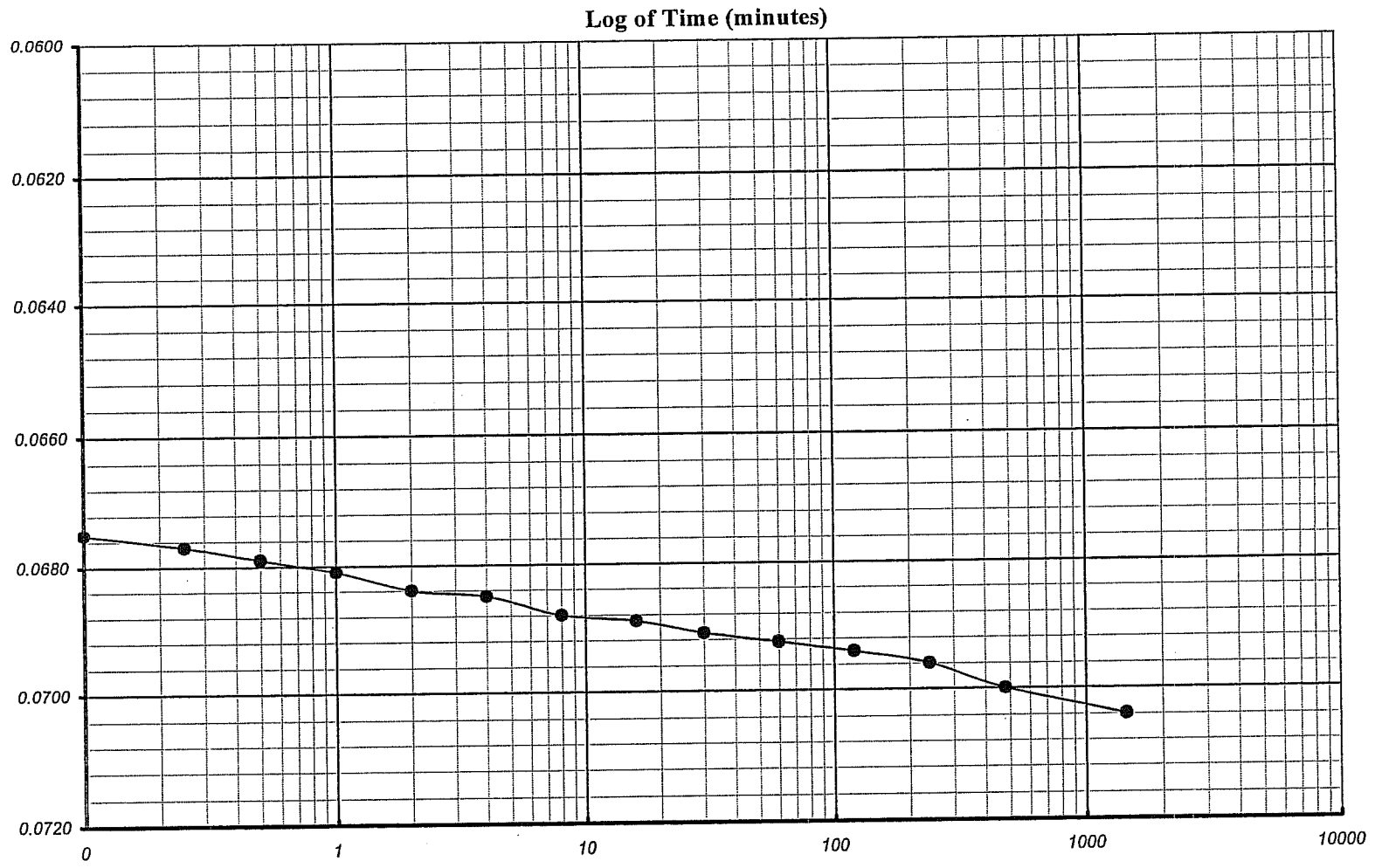
Boring No.	: A-08-006			Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-3			Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft) :	10.0	11.5	Plastic Index :	-	Initial	17.05	109.64	17.26	85.66	0.54
	(m) :	3.05	3.51	Specific Gravity :	2.70	Final	18.30	112.38	17.69	98.86	0.50
Description	: Olive gray with olive brown, SANDY LEAN CLAY (CL)										

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

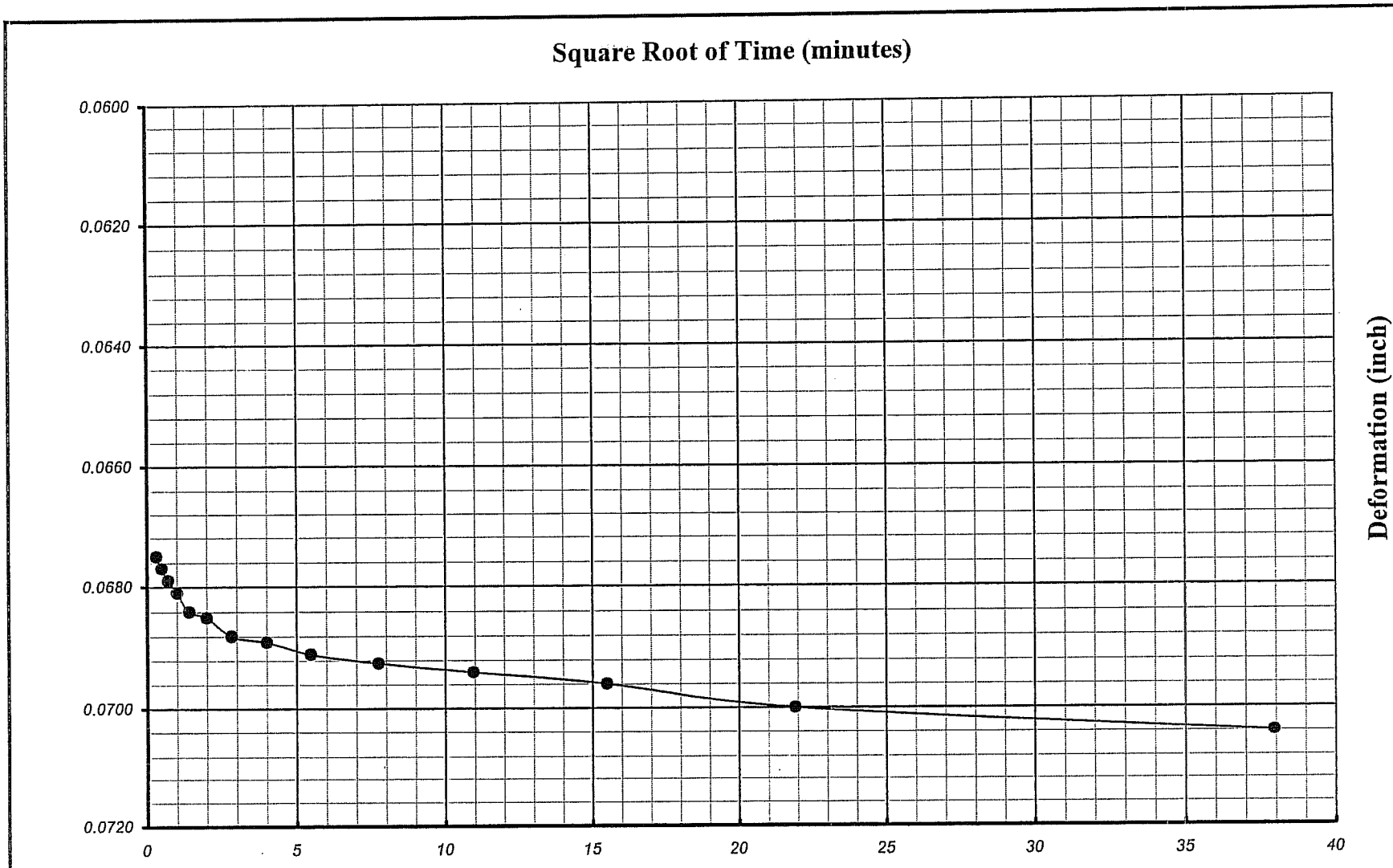
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

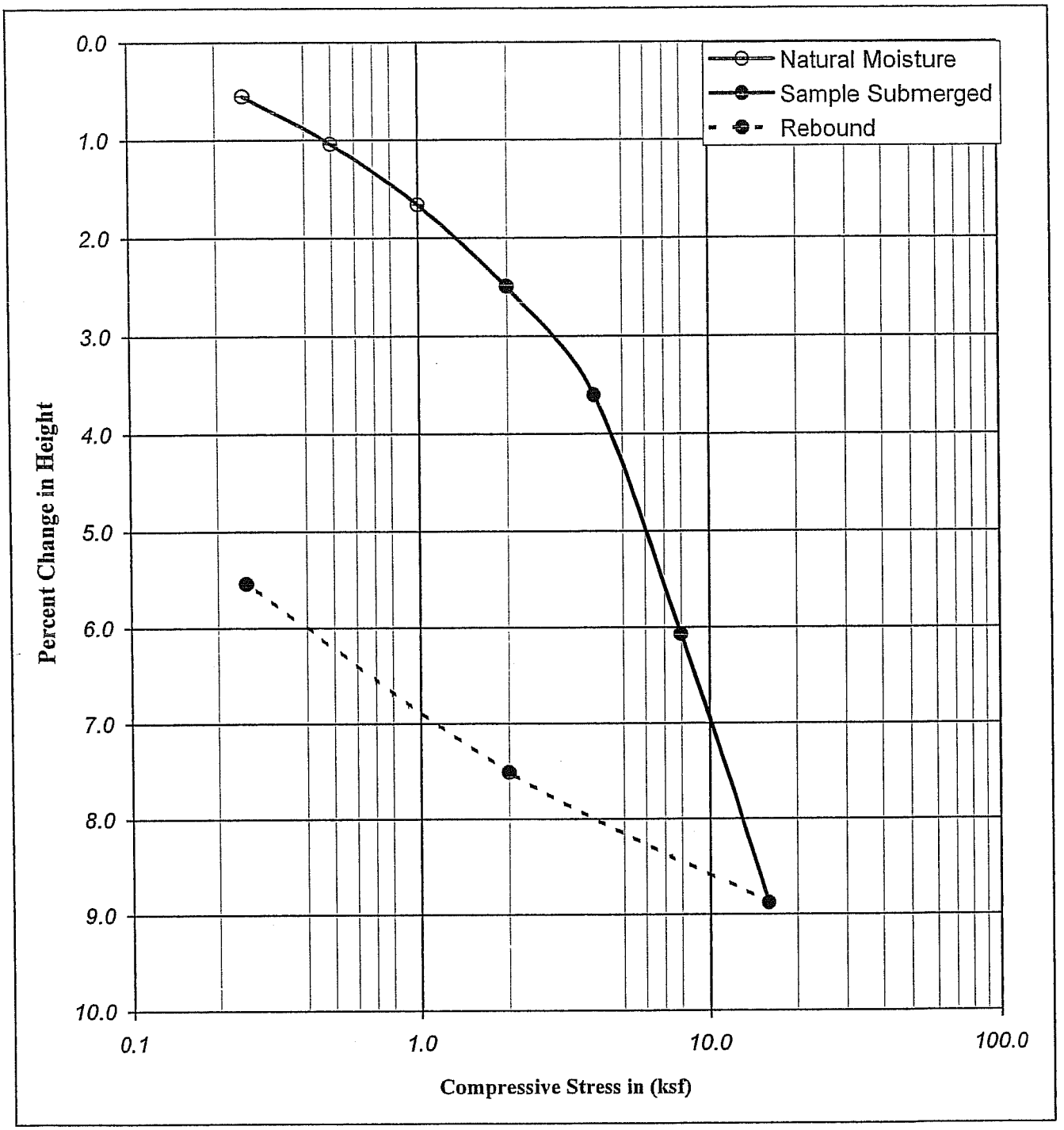
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-006*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-3*	
EMI Project No. : *08-115*		Depth (ft/m) : *10.0* *3.1*	Veritcal Load (ksf/kpa) : *4.00* *191.5*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-006*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-3*	
EMI Project No. : *08-115*		Depth (ft/m) : *10.0* *3.1*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



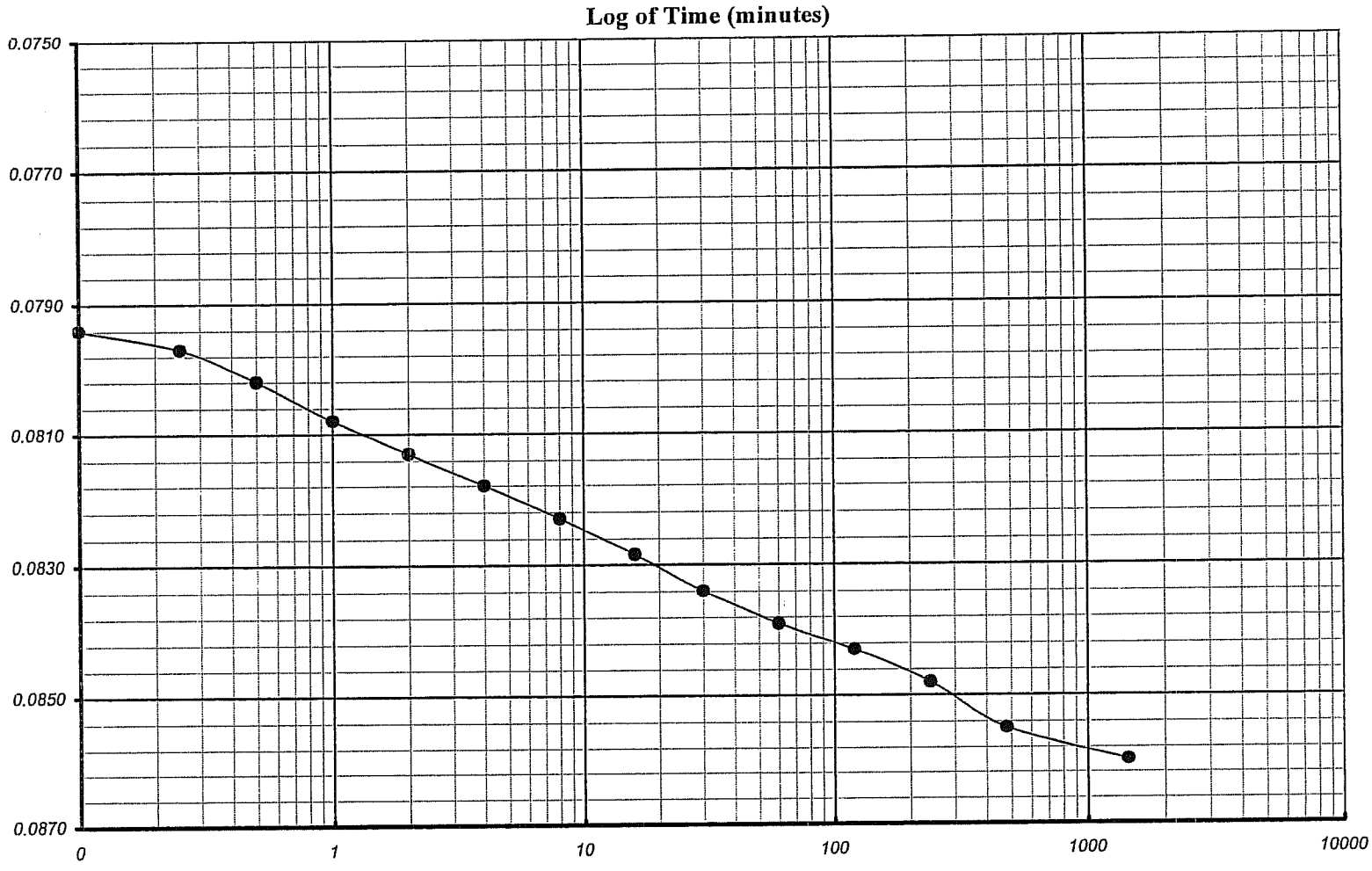
Boring No.	: A-08-007		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-4		Plastic Limit :	-						
Depth (ft)	: 15.0	16.5	Plastic Index :	-	Initial	19.30	102.11	16.07	80.09	0.65
Depth (m)	: 4.58	5.03	Specific Gravity :	2.70	Final	21.16	108.15	17.02	102.28	0.56
Description	: Olive brown, SANDY lean CLAY (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

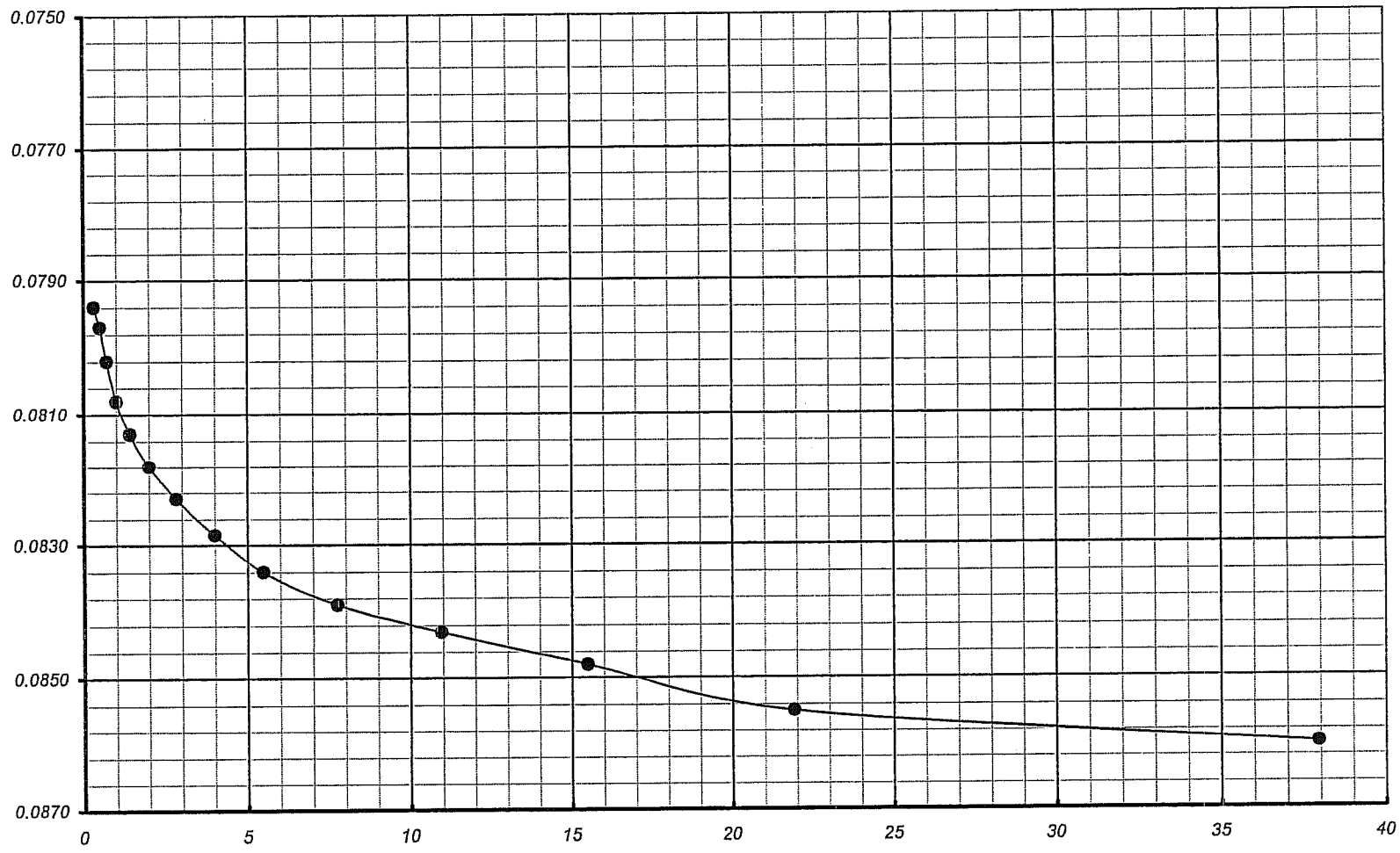
Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

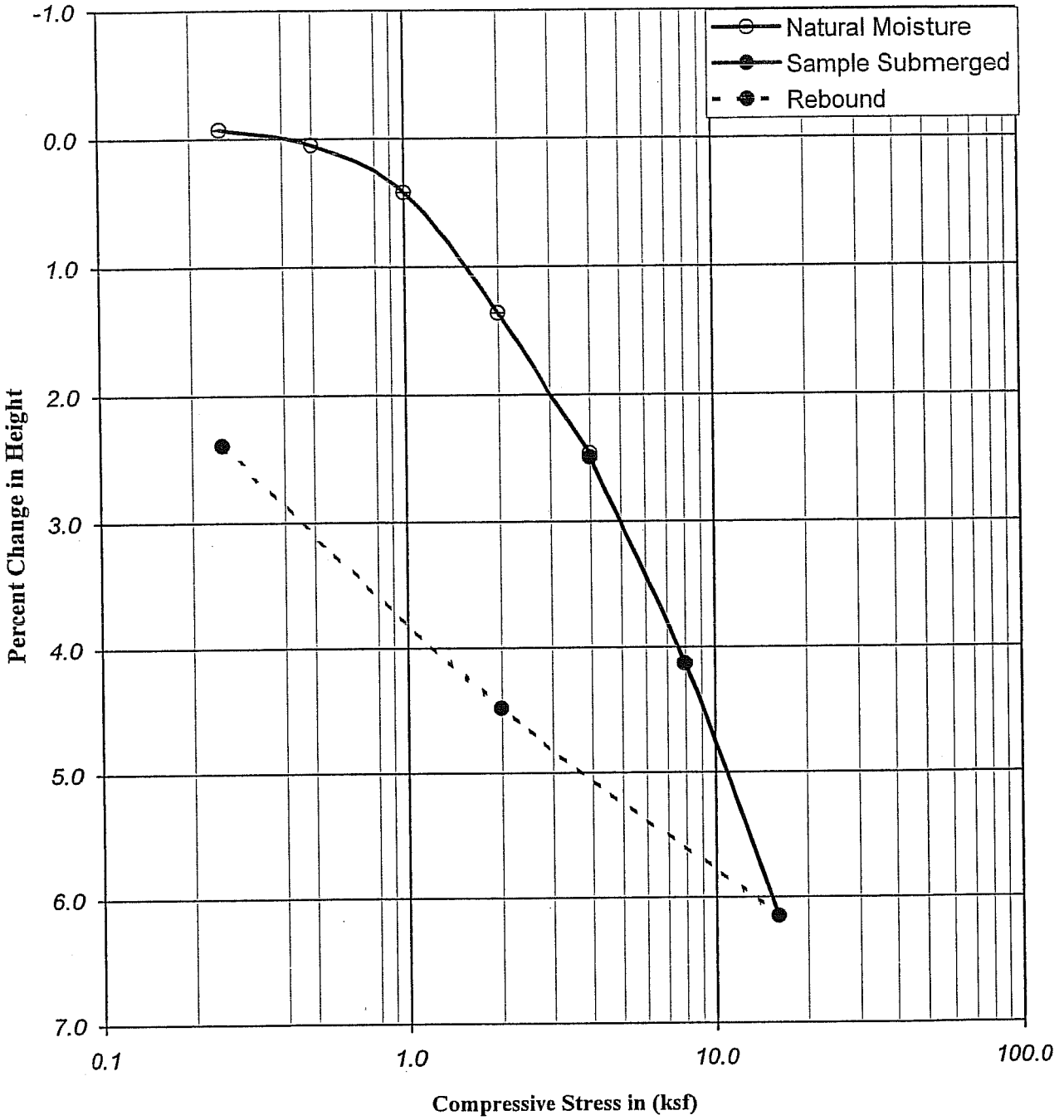


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-007*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-4*	
EMI Project No. : *08-115*		Depth (ft/m) : *15.0* *4.6*	Veritcal Load (ksf/kpa) : *4.00* *191.5*

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-007*	**One-Dimensional Consolidation of Soil** Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-4*	
EMI Project No. : *08-115*		Depth (ft/m) : *15.0* *4.6*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



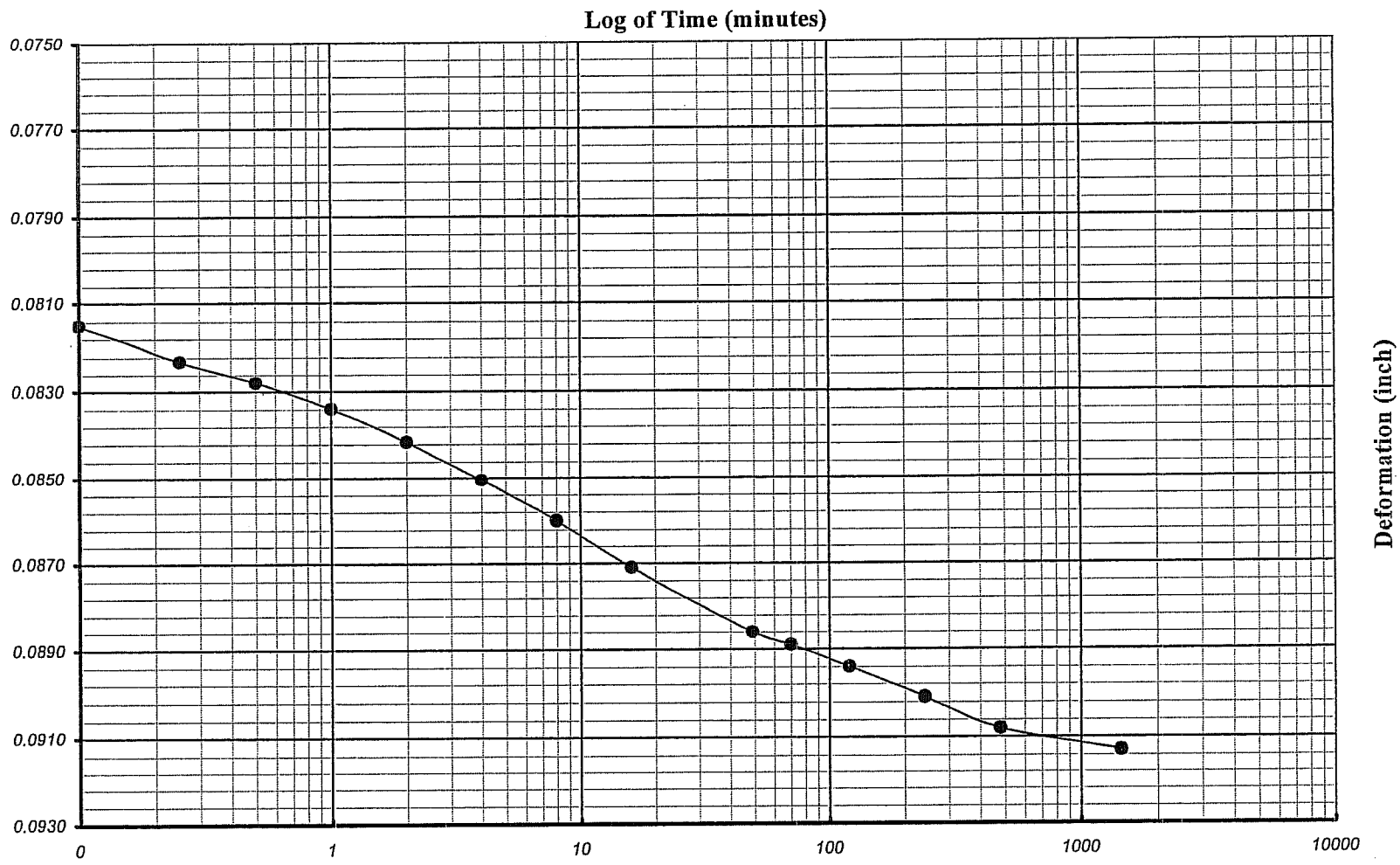
Boring No. : A-08-008				Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No. : D-5				Plastic Limit :	-						
Depth	(ft) : 20.0		21.5	Plastic Index :	-	Initial	21.90	102.37	16.11	91.45	0.65
	(m) : 6.10		6.56	Specific Gravity :	2.70	Final	23.11	104.95	16.52	102.93	0.61
Description : Olive, Lean CLAY With SAND(CL)											

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

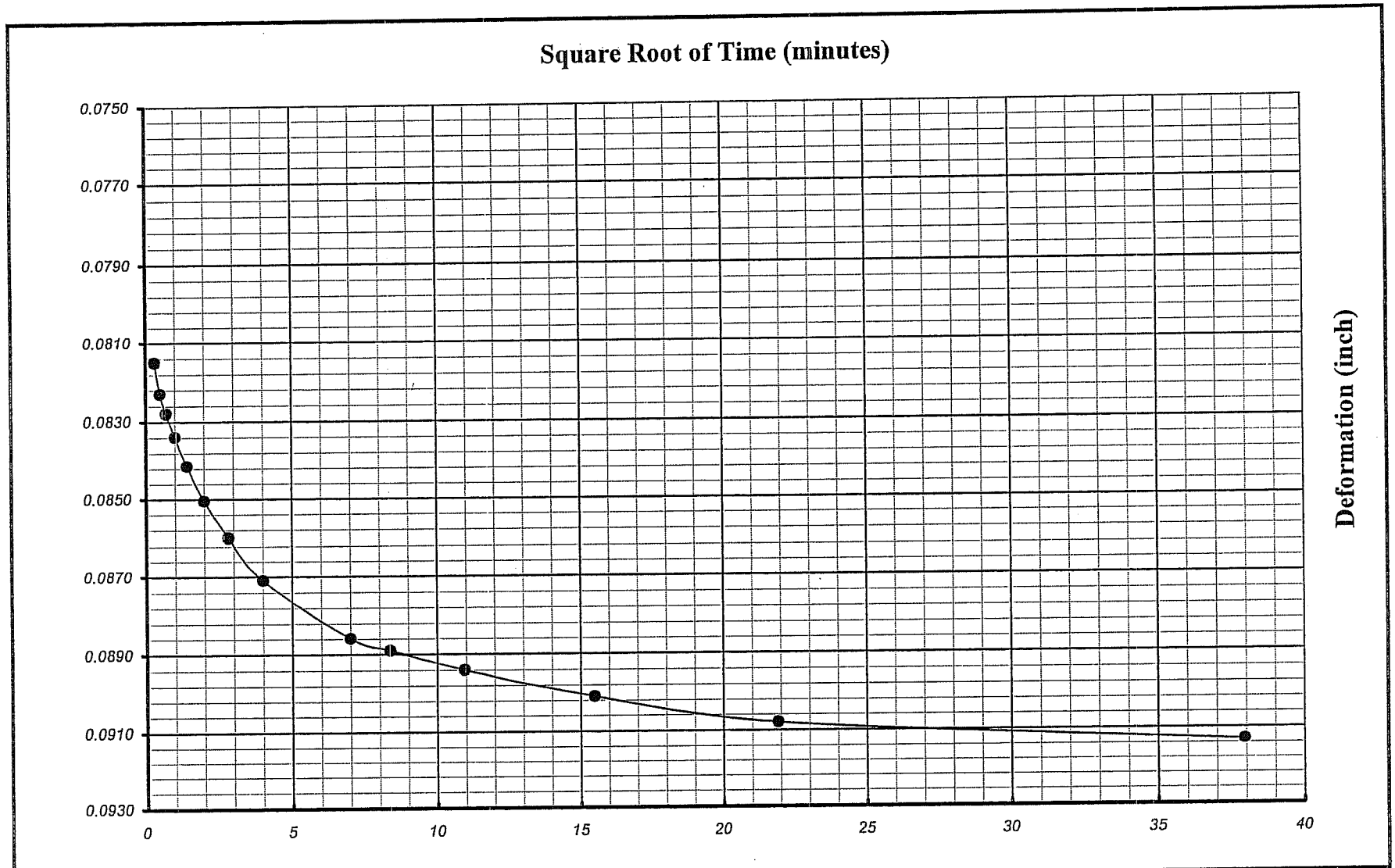
RBF/SR-57 Northbound

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

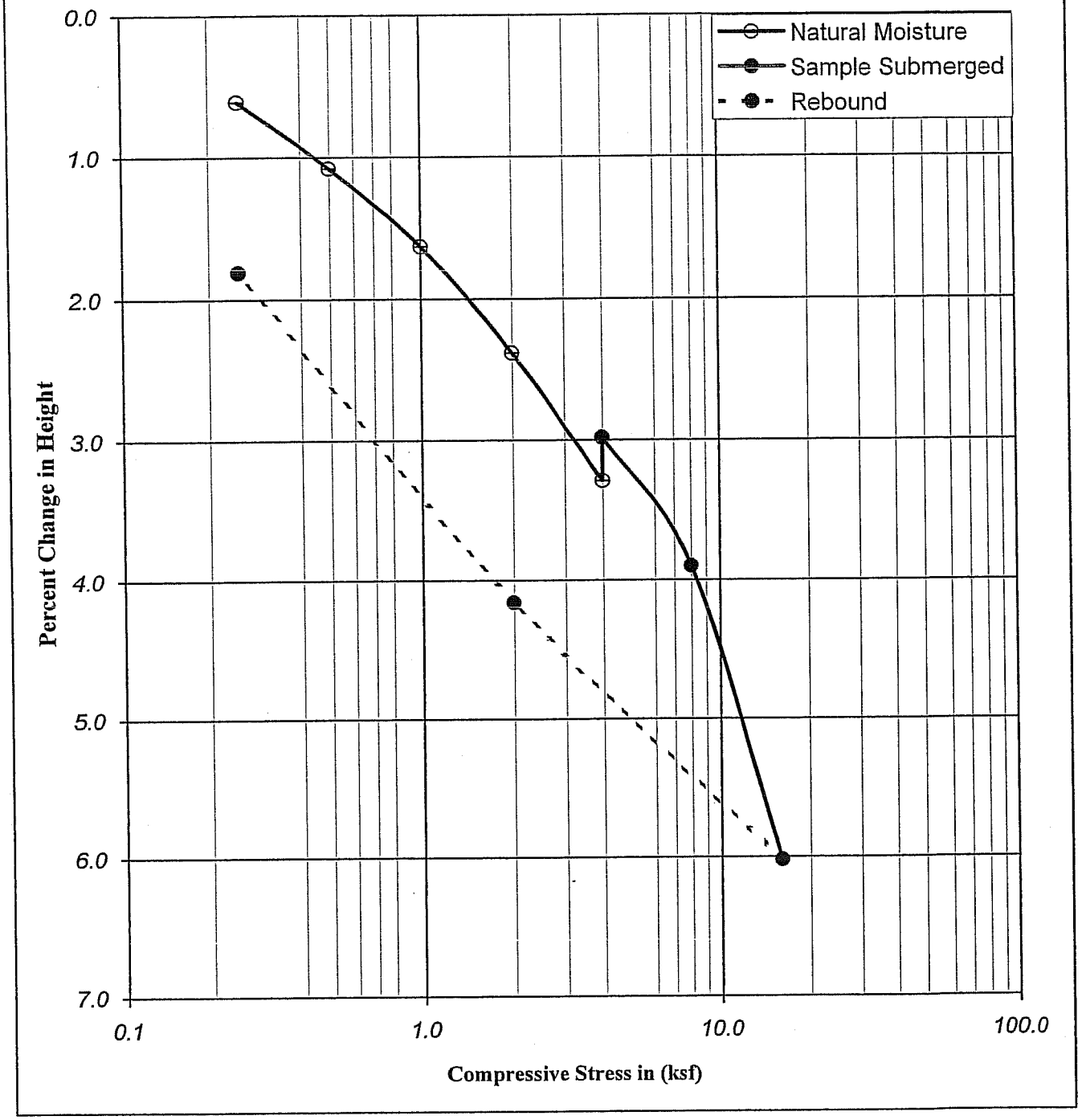
Project No. : 08-115 12/05/08



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-5*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-5*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



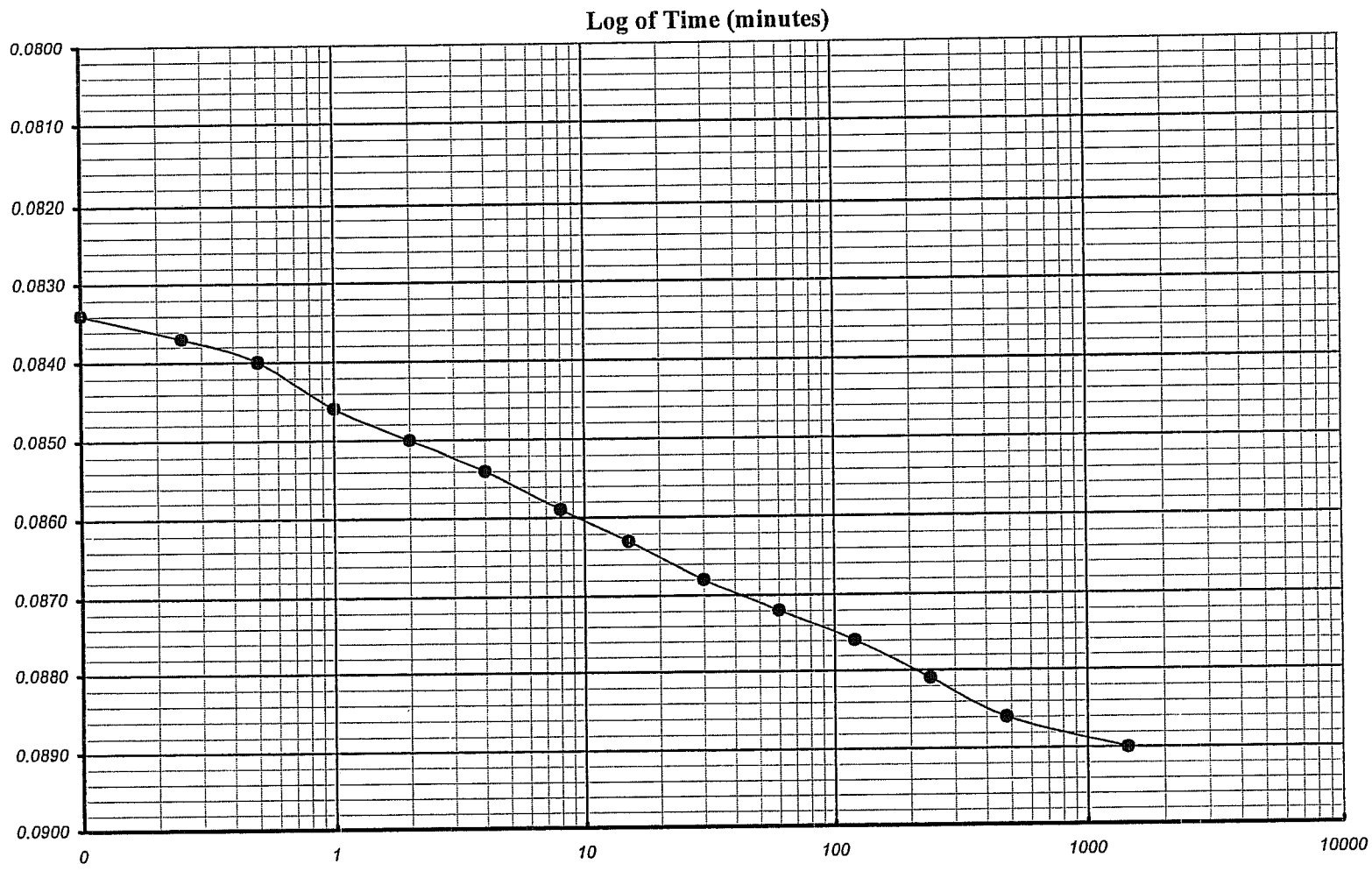
Boring No.	: A-08-008		Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-7		Plastic Limit :	-			(pcf)	(kN/m³)		
Depth (ft)	: 30.0	31.5	Plastic Index :	-	Initial	24.51	99.60	15.68	95.60	0.69
Depth (m)	: 9.15	9.61	Specific Gravity :	2.70	Final	25.56	101.48	15.97	104.41	0.66
Description	: Olive gray, lean CLAY (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

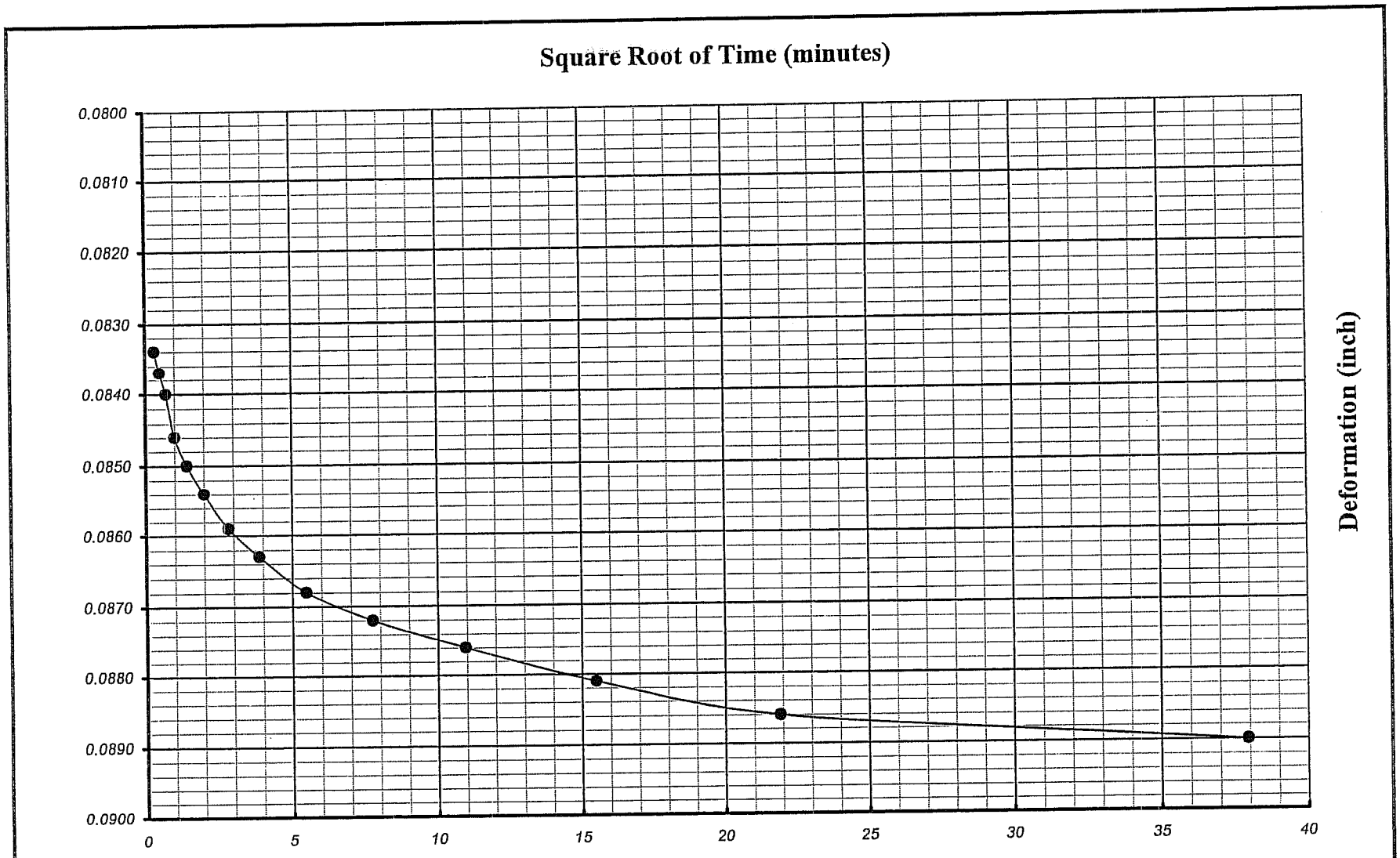
RBF/SR-57 Northbound

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

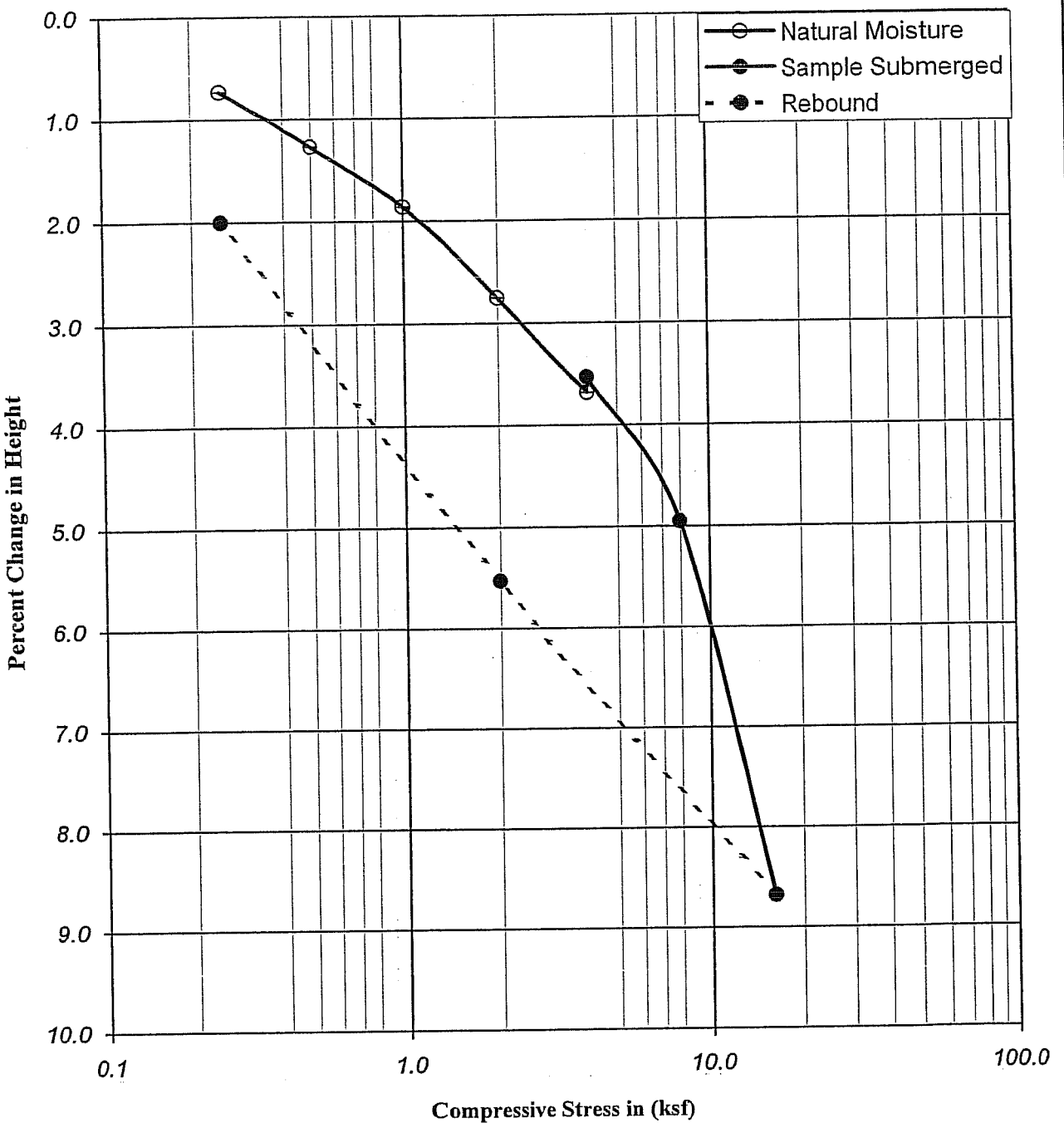
Project No. : 08-115 12/05/08



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-7*	
EMI Project No. : *08-115*		Depth (ft/m) : *30.0* *9.2*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-7*	
EMI Project No. : *08-115*		Depth (ft/m) : *30.0* *9.2*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



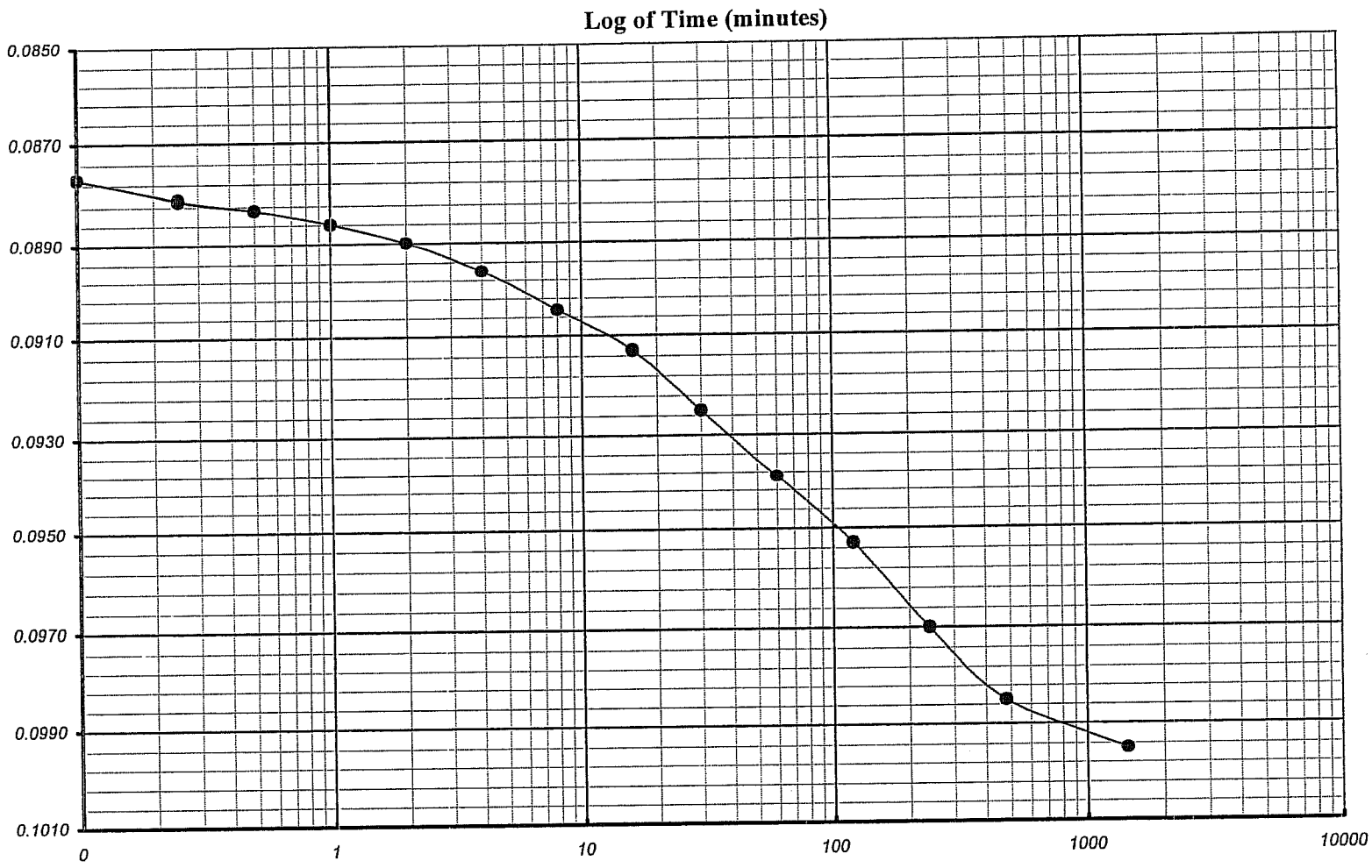
Boring No.	: A-08-008		Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-11		Plastic Limit :	-			(pcf)	(kN/m³)		
Depth (ft)	: 50.0	51.5	Plastic Index :	-	Initial	32.62	88.25	13.89	96.78	0.91
Depth (m)	: 15.25	15.71	Specific Gravity :	2.70	Final	33.01	90.09	14.18	102.31	0.87
Description	: Brown, FAT CLAY (CH)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

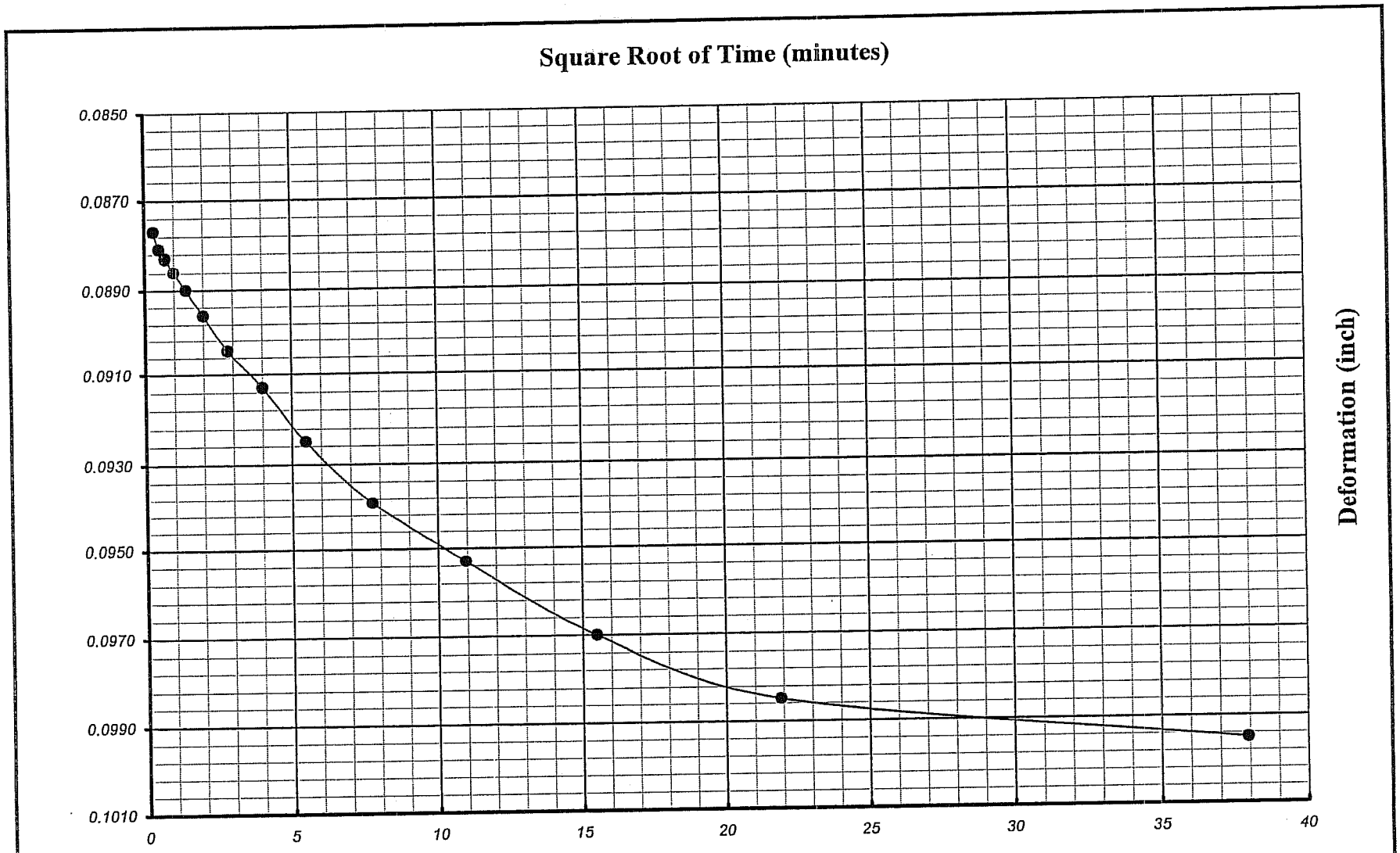
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

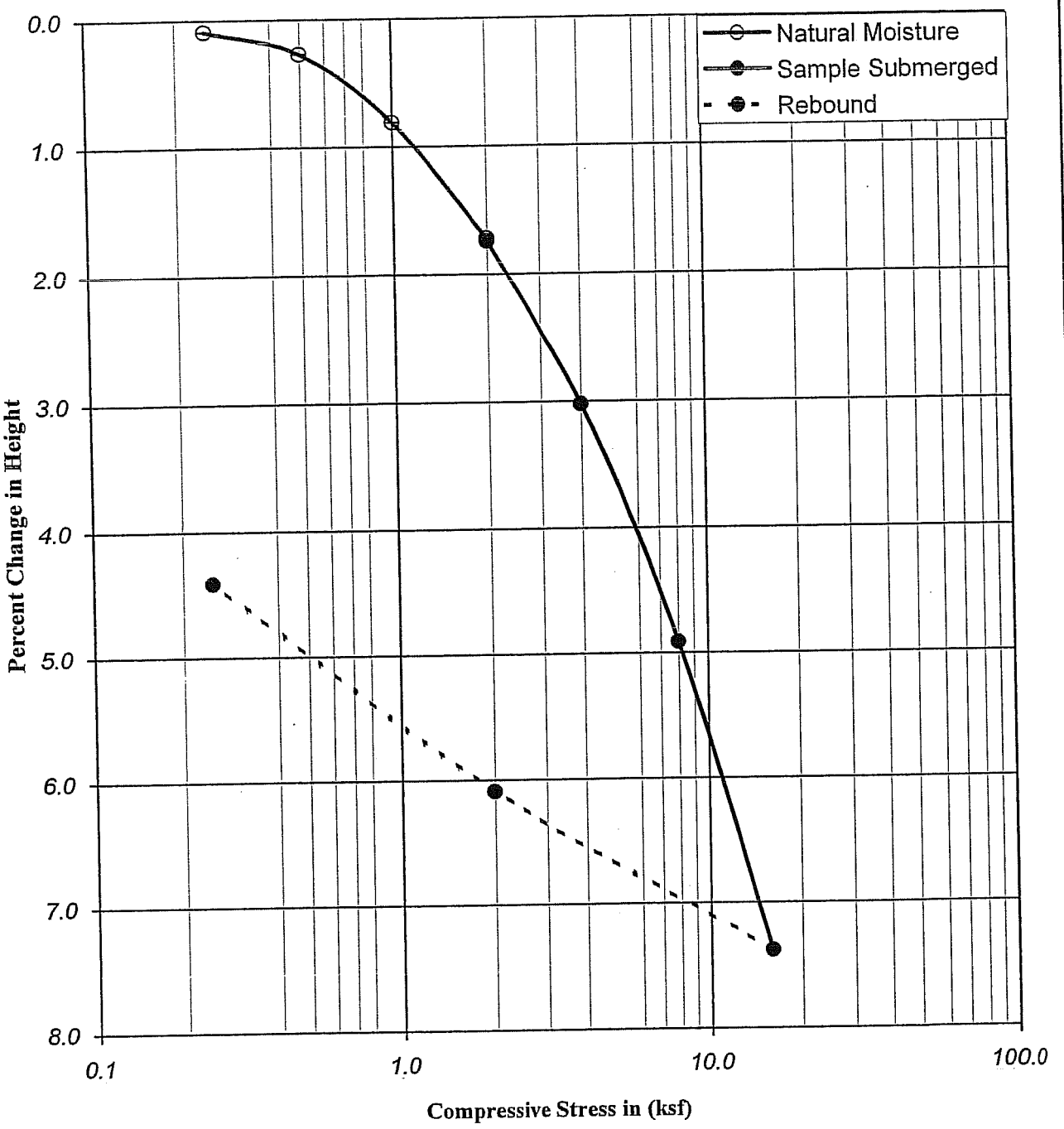
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-11*	
EMI Project No. : *08-115*		Depth (ft/m) : *50.0* *15.3*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-11*	
EMI Project No. : *08-115*		Depth (ft/m) : *50.0* *15.3*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



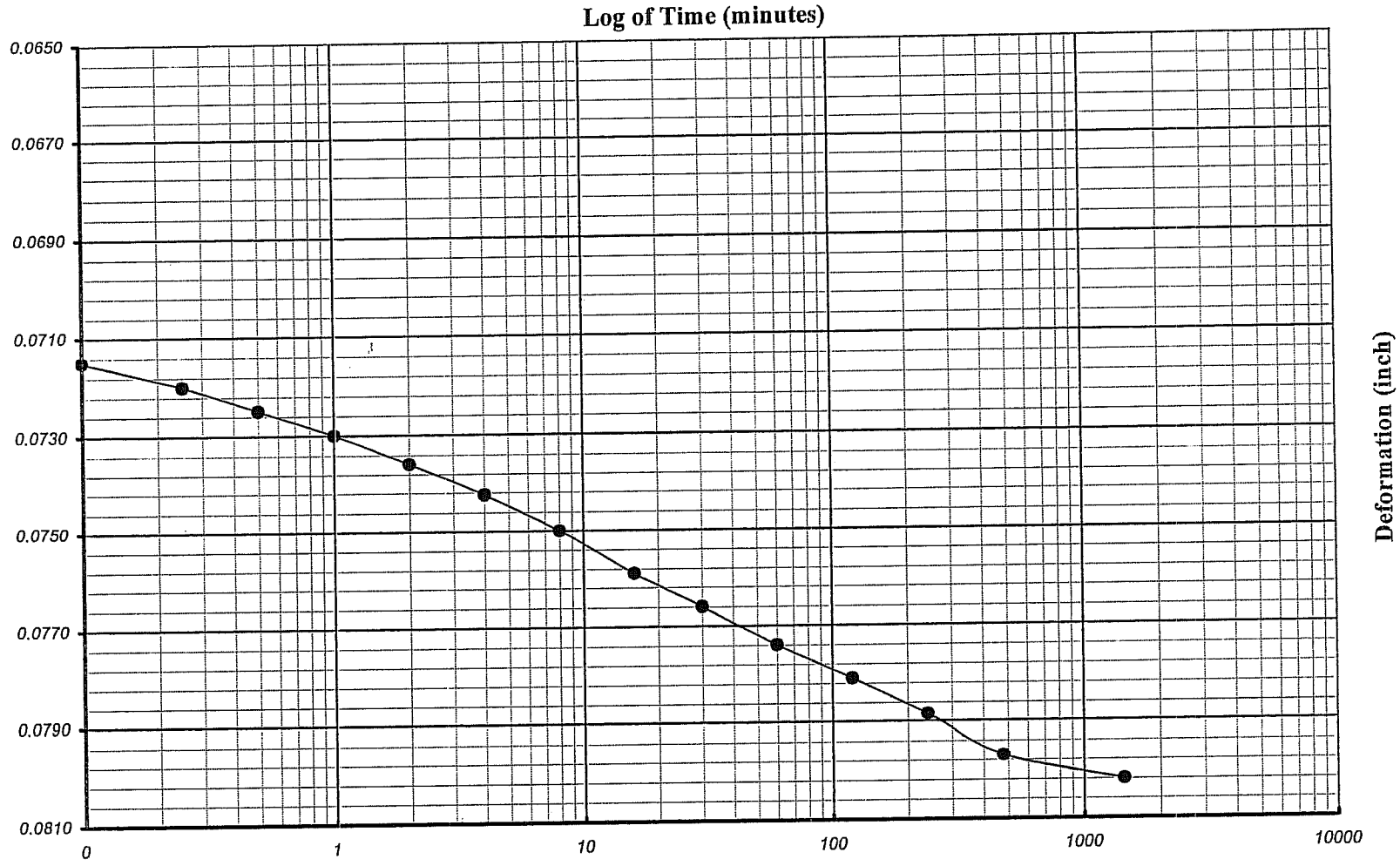
Boring No.	: A-08-012		Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-2		Plastic Limit :	-			(pcf)	(kN/m³)		
Depth (ft)	: 5.0	6.5	Plastic Index :	-	Initial	20.71	105.63	16.63	93.85	0.60
Depth (m)	: 1.53	1.98	Specific Gravity :	2.70	Final	20.02	110.55	17.40	103.00	0.52
Description	: Very dark yellowish brown, lean CLAY with SAND (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

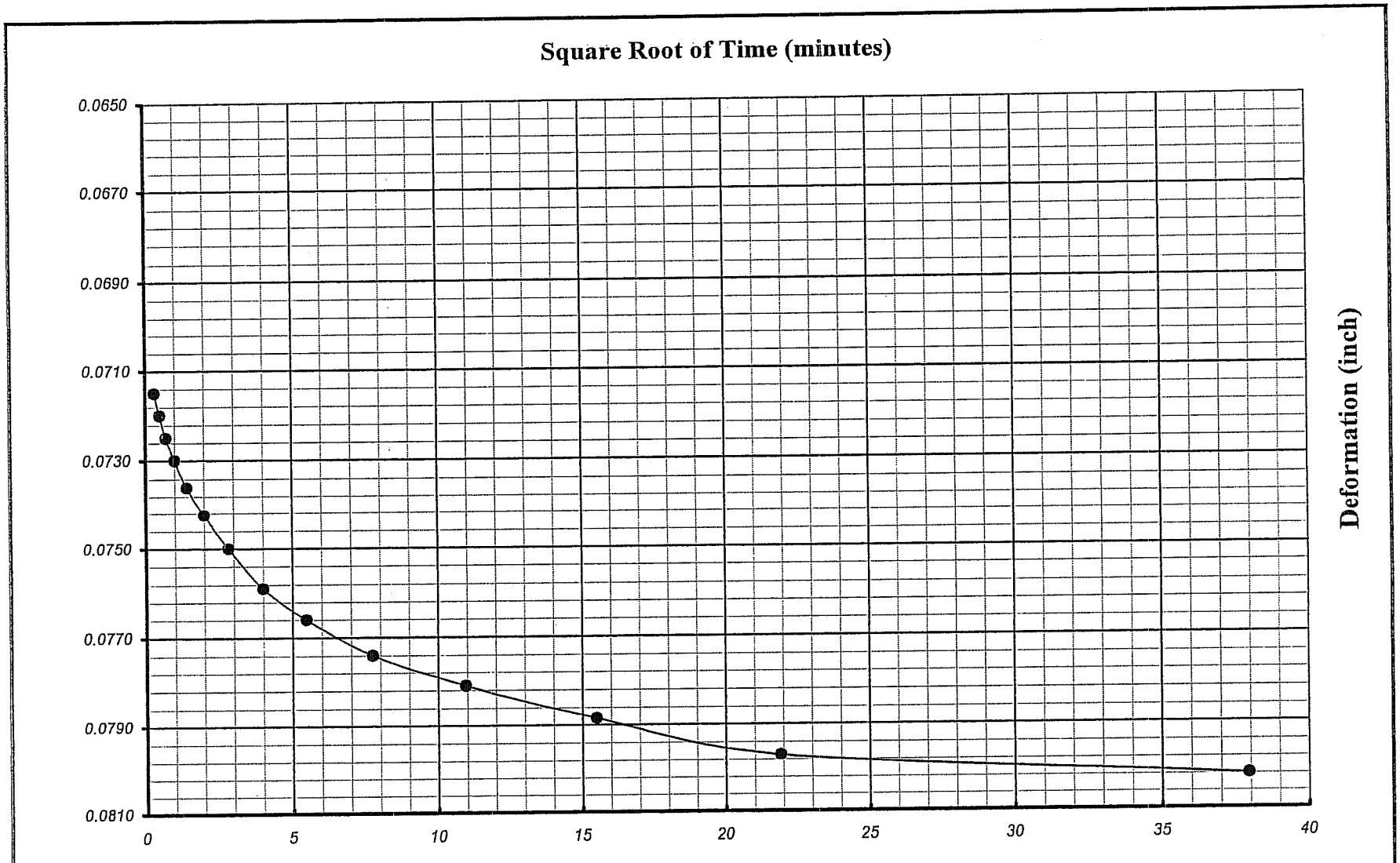
RBF/SR-57 Northbound

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

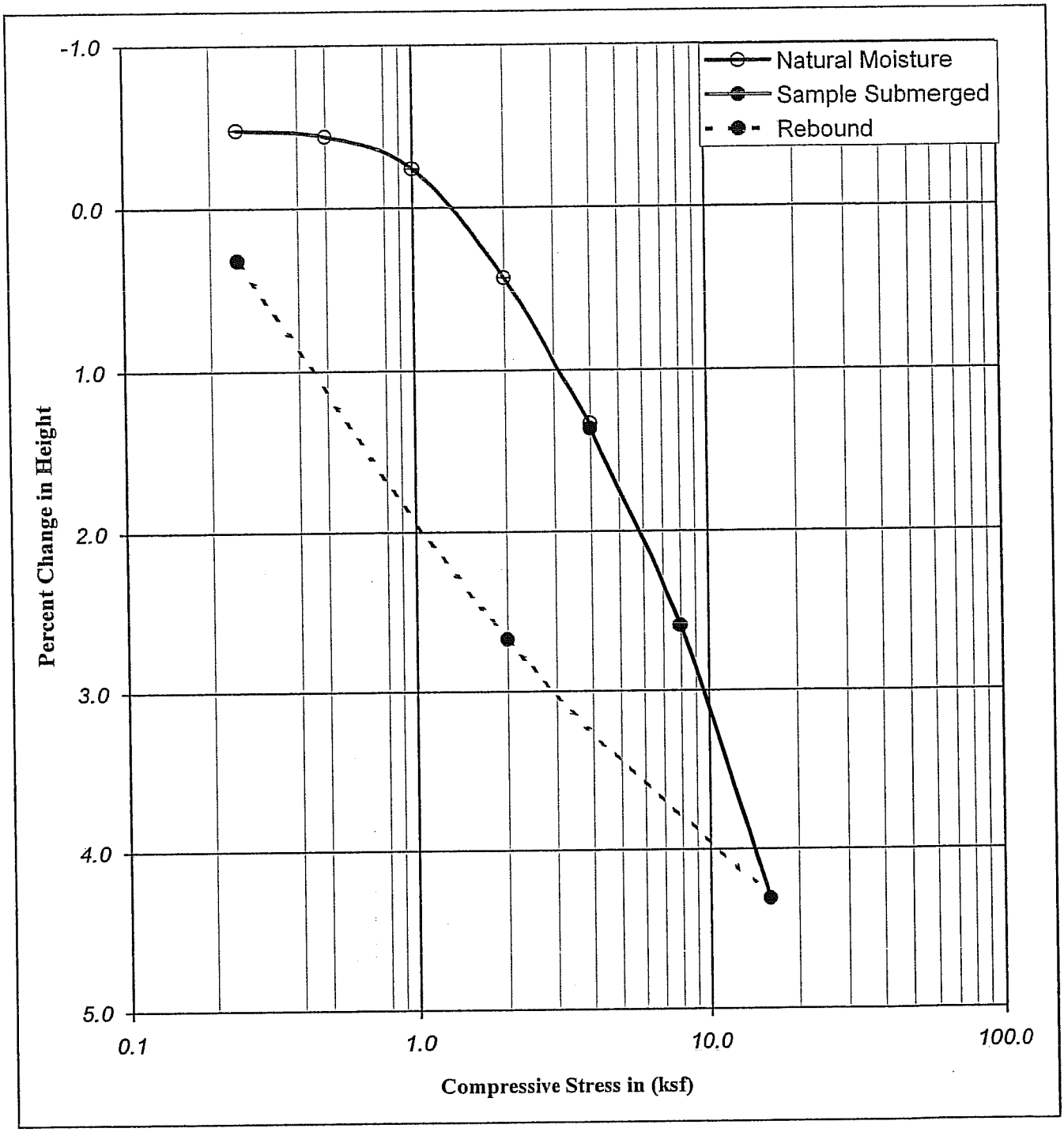
Project No. : 08-115 12/05/08



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-012*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.00* *191.5*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-012*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



Boring No.	: A-08-013		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-6		Plastic Limit :	-						
Depth (ft)	: 25.0	26.5	Plastic Index :	-	Initial	16.10	114.51	18.02	92.10	0.47
Depth (m)	: 7.63	8.08	Specific Gravity :	2.70	Final	17.92	115.43	18.17	105.14	0.46

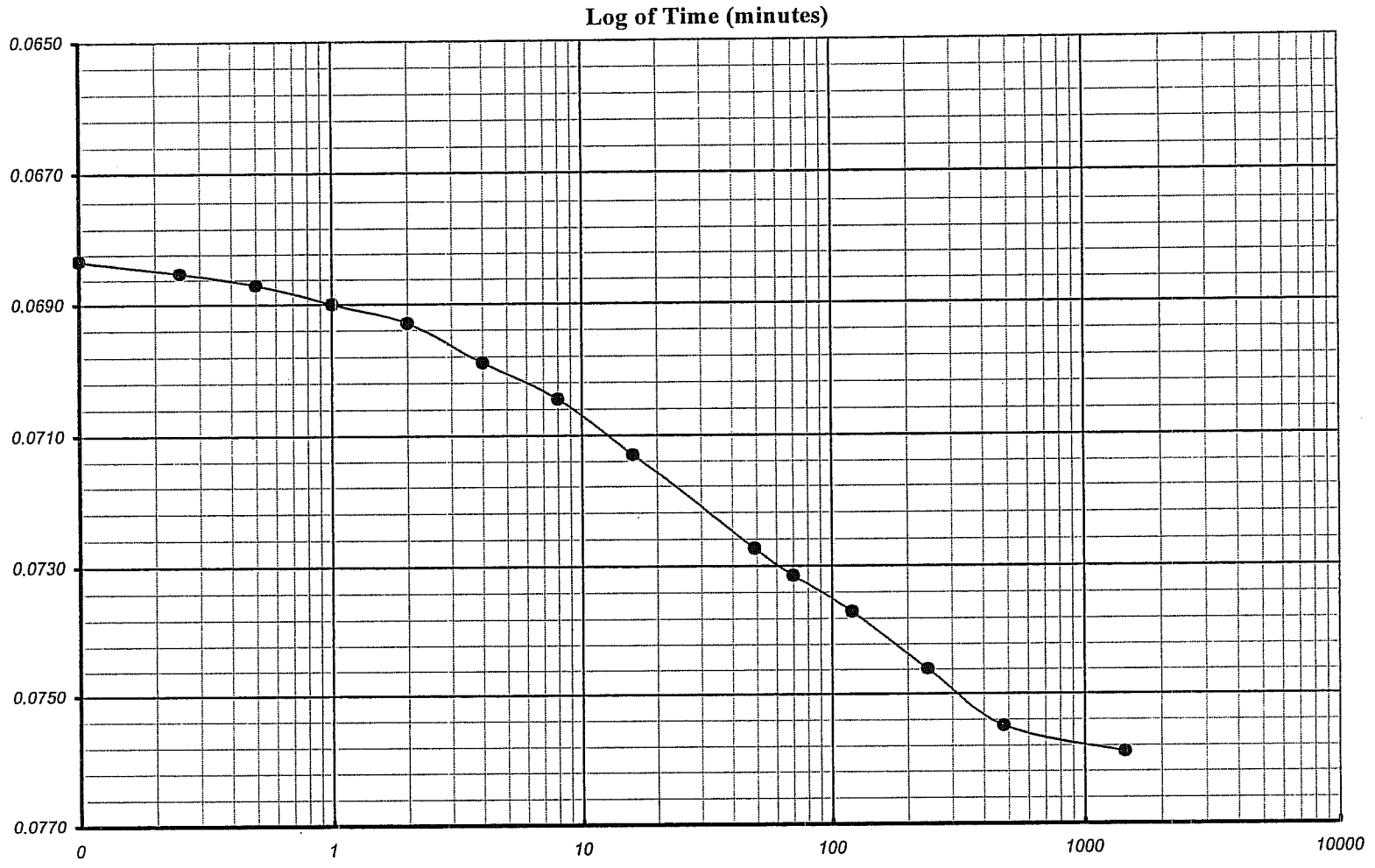
Description : *Strong brown, SANDY lean CLAY (CL)*

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

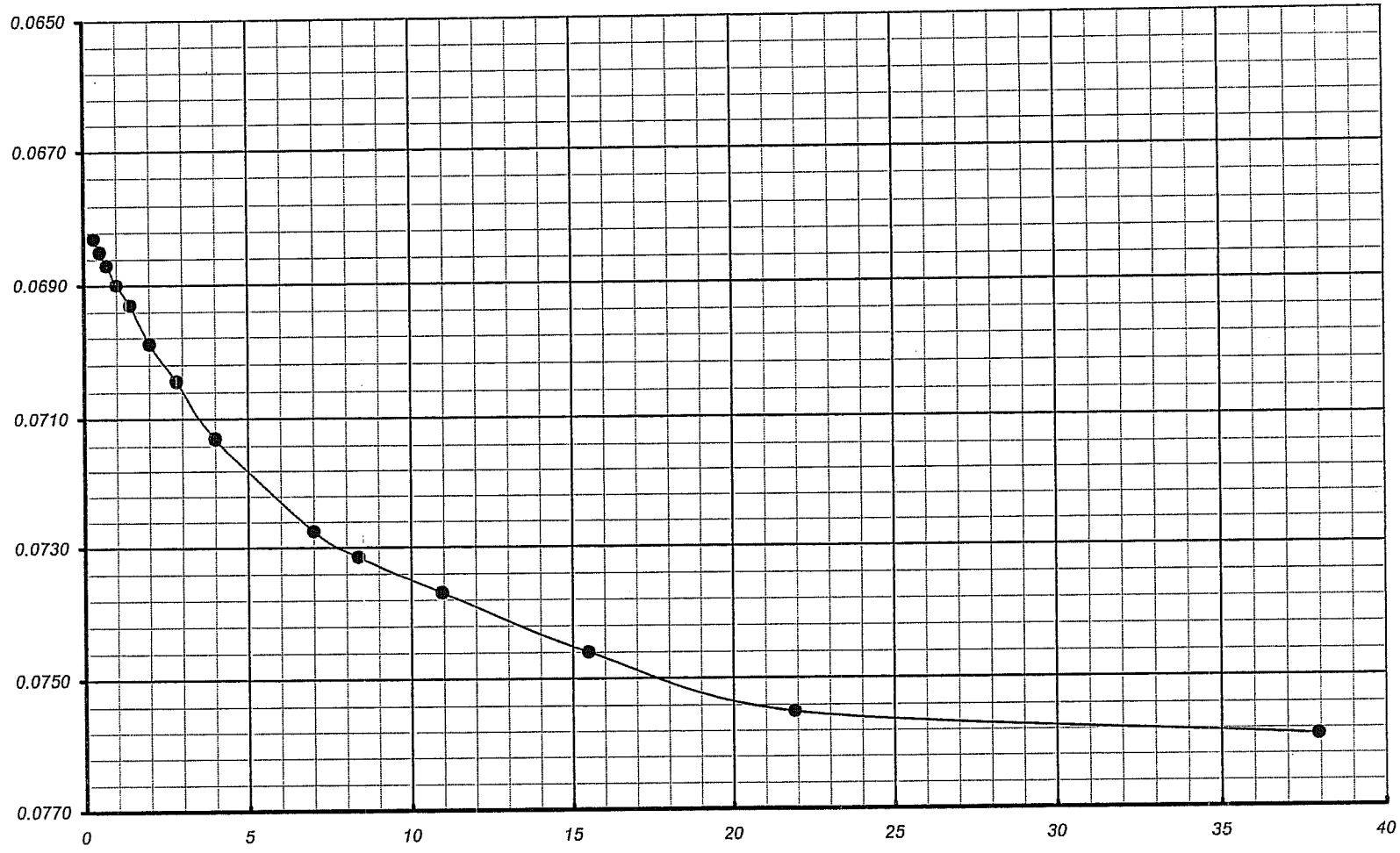
RBF/SR-57 Northbound

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

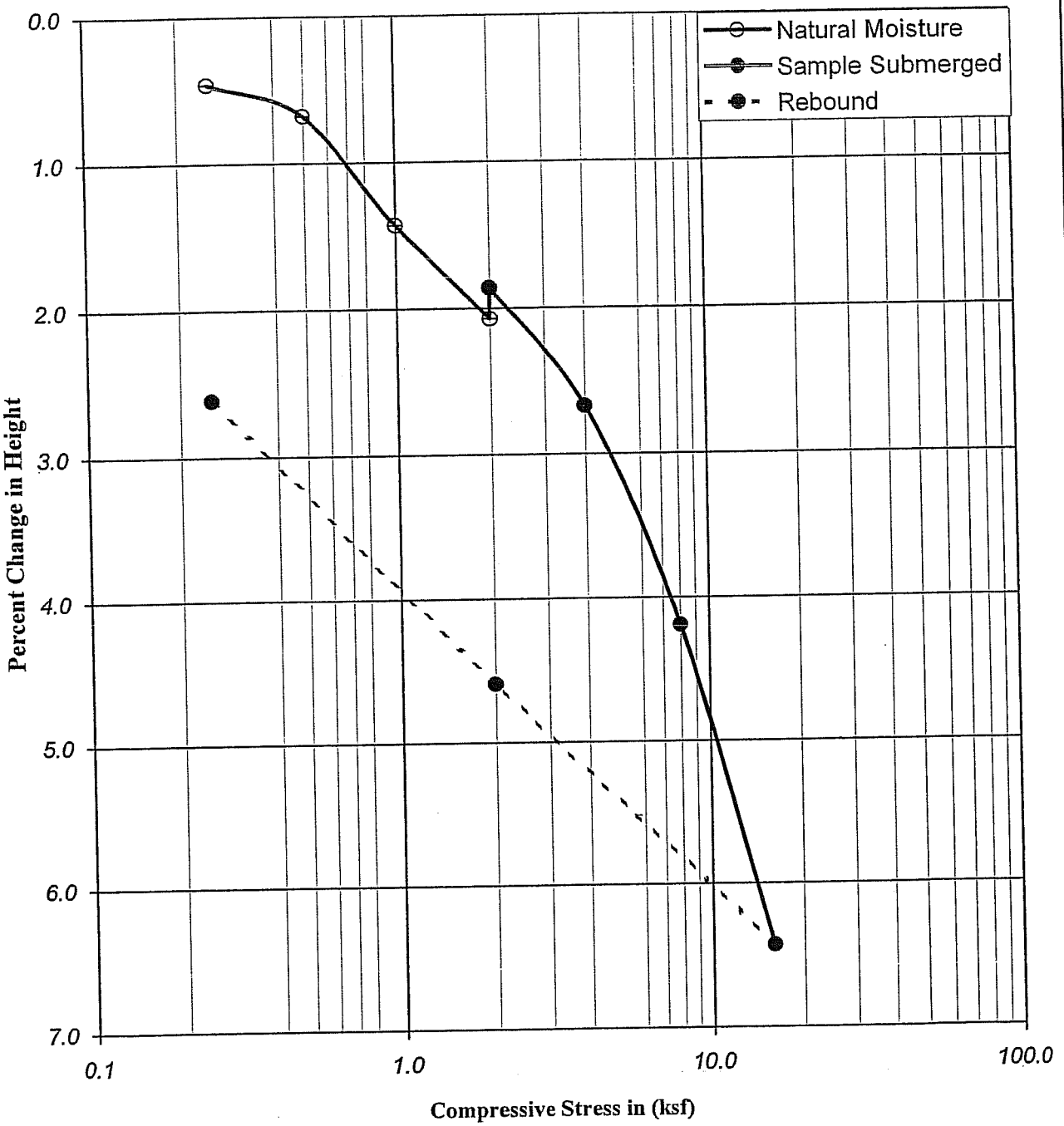
Project No. : *08-115* *12/05/08*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-013*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-6*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-013*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-6*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



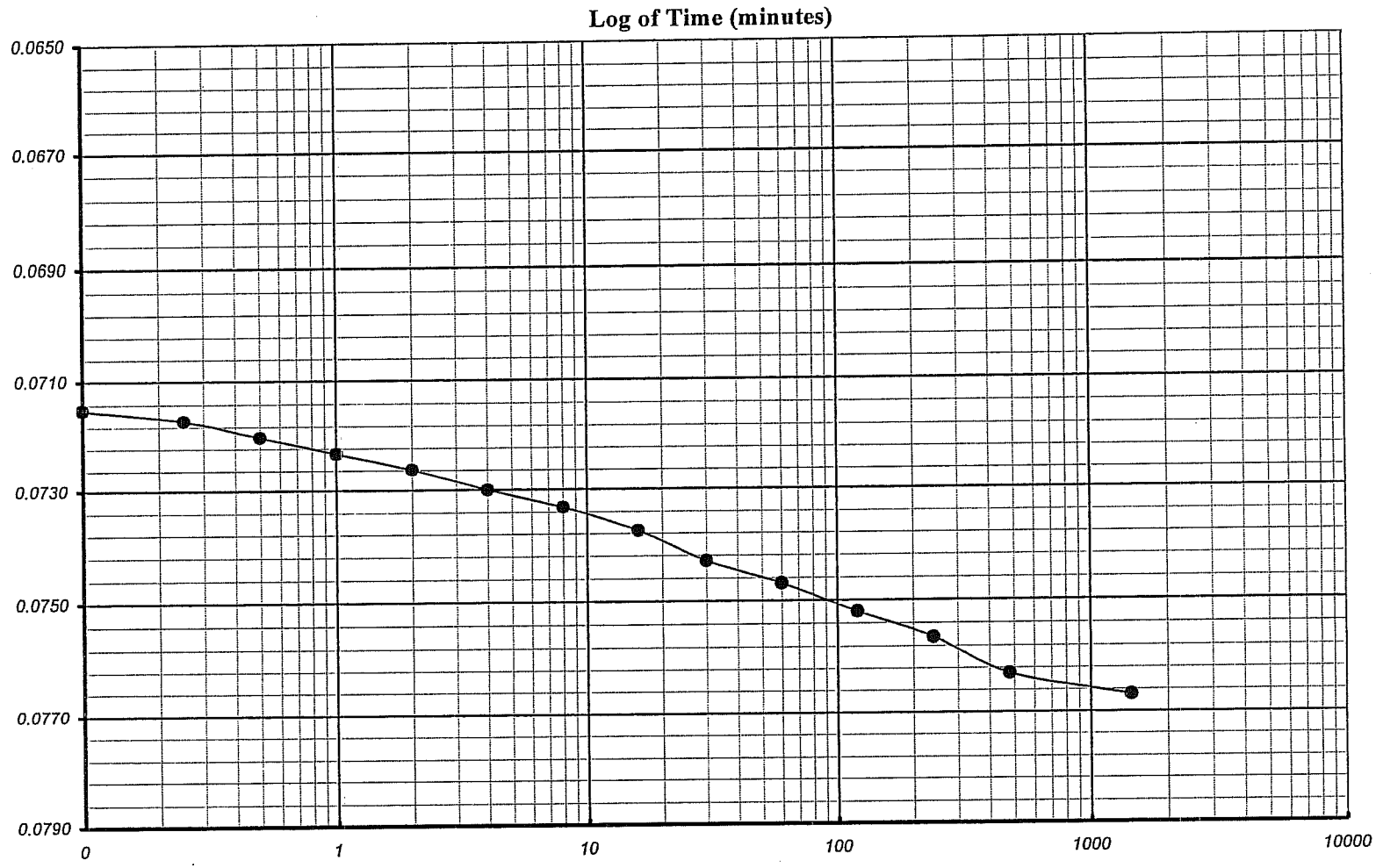
Boring No.	: A-08-014		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-2		Plastic Limit :	-						
Depth (ft)	: 5.0	6.5	Plastic Index :	-	Initial	21.65	106.41	16.75	100.06	0.58
Depth (m)	: 1.53	1.98	Specific Gravity :	2.70	Final	22.30	109.35	17.21	111.20	0.54
Description	: Olive brown mix black, SANDY lean CLAY (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

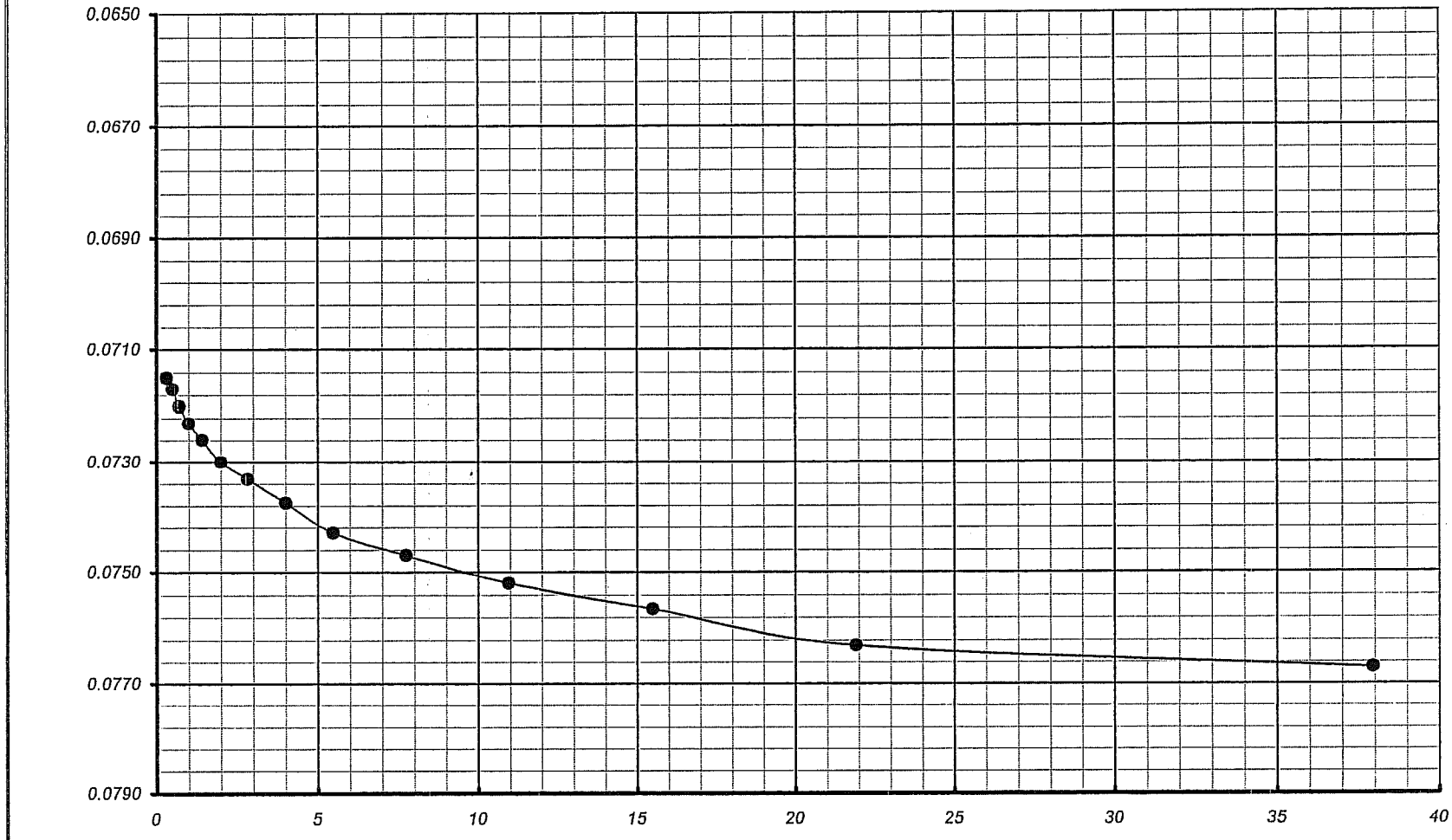
RBF/SR-57 Northbound

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

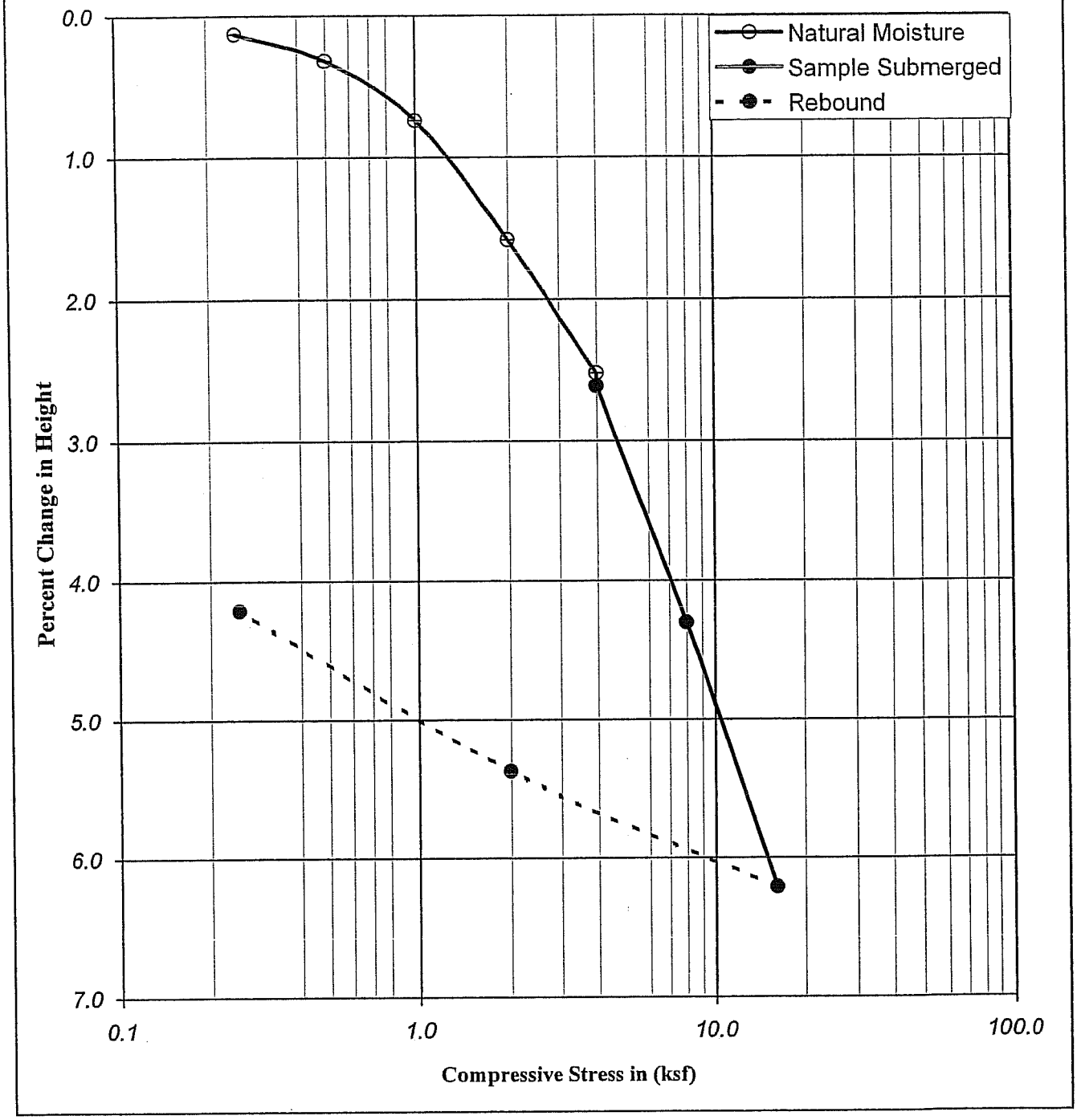
Project No. : 08-115 12/05/08



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-014*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.00* *191.5*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-014*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



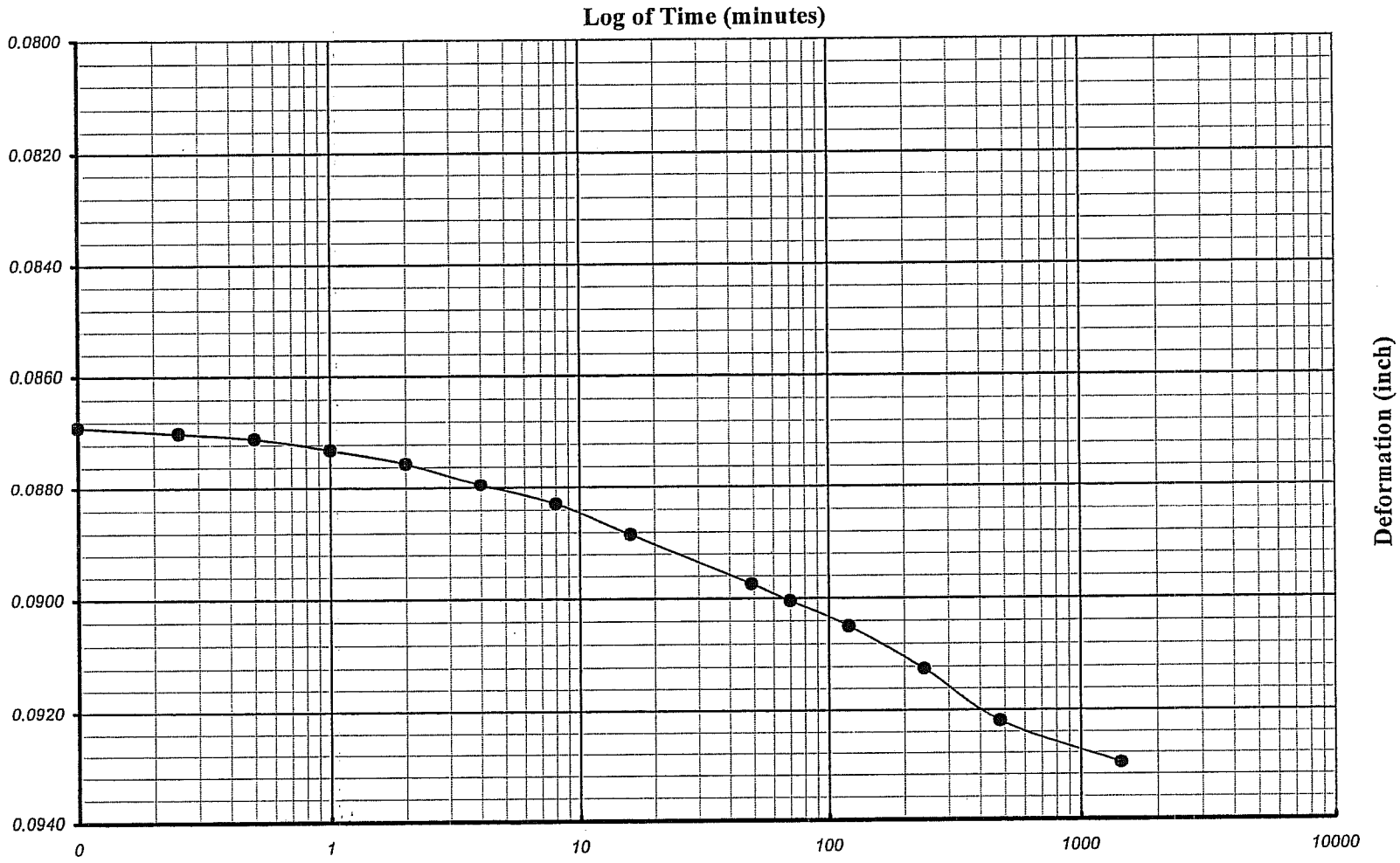
Boring No.	: A-08-015		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m^3)	Percent Saturation	Void Ratio
Sample No.	: D-10		Plastic Limit :	-						
Depth (ft)	: 25.0	26.5	Plastic Index :	-	Initial	13.36	96.70	15.22	48.54	0.74
Depth (m)	: 7.63	8.08	Specific Gravity :	2.70	Final	24.67	100.96	15.89	99.46	0.67
Description	: Yellowish brown, SILTY SAND (SM)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

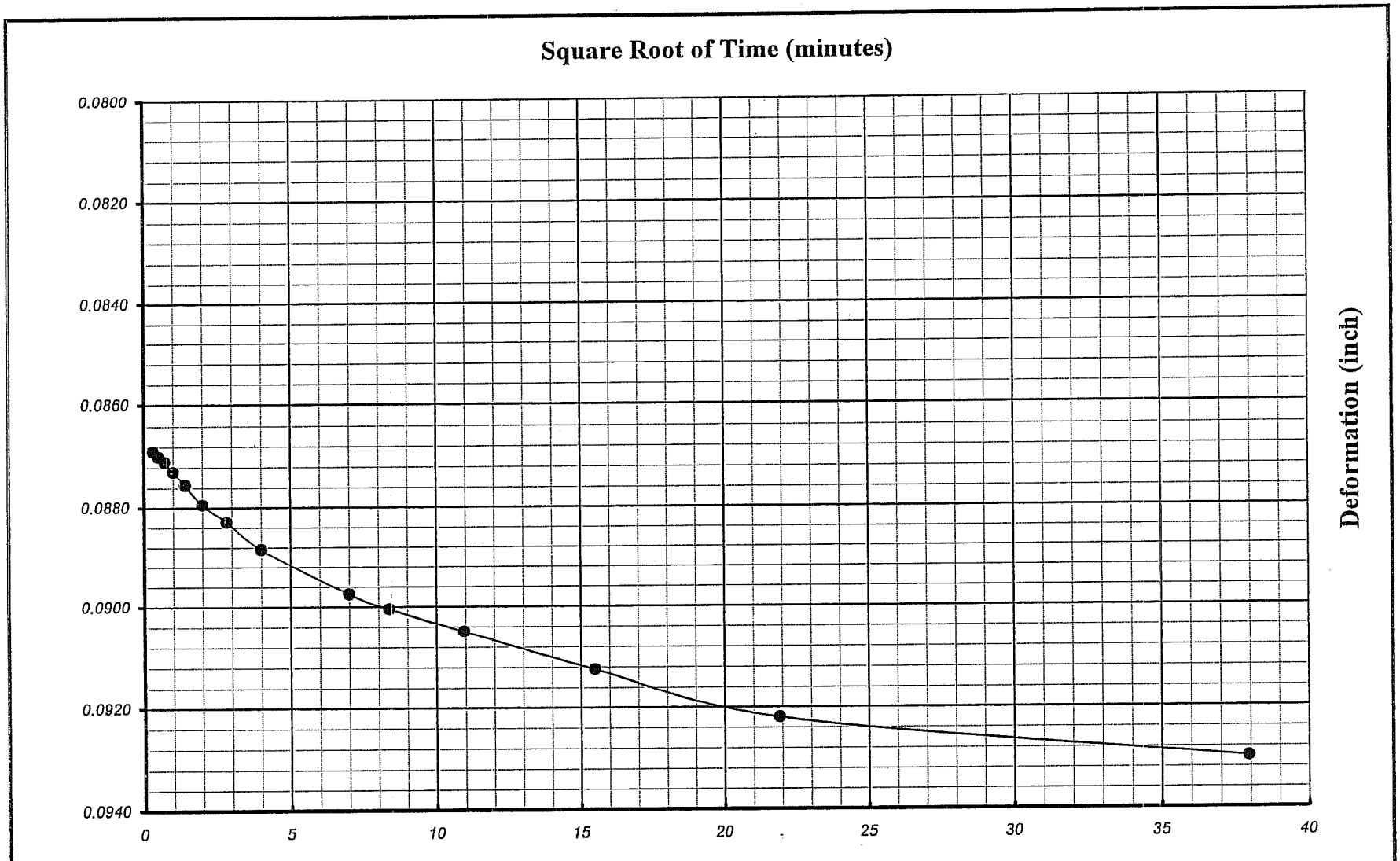
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

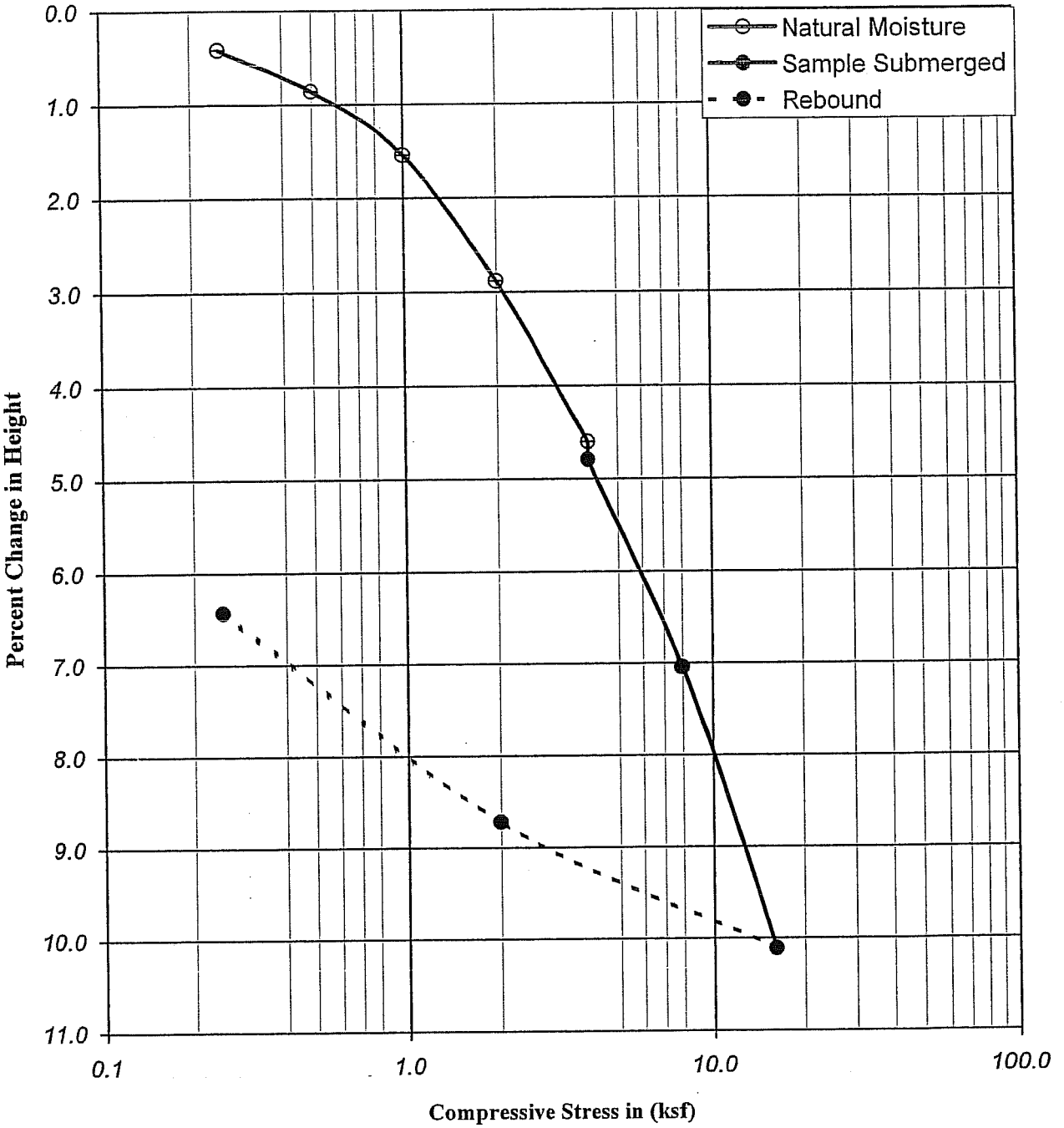
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-015*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-10*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-015*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-10*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



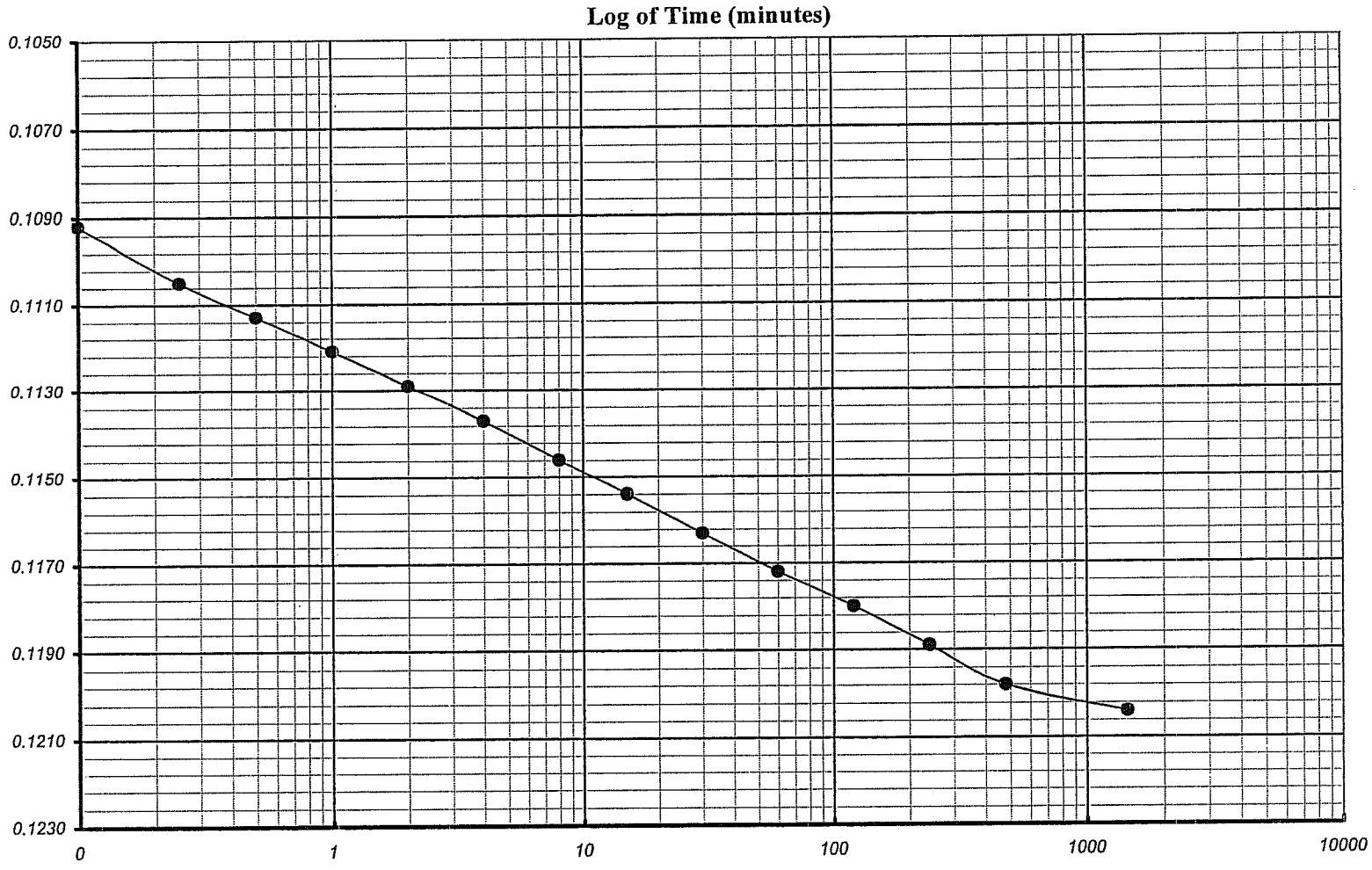
Boring No.	: A-08-016		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m^3)	Percent Saturation	Void Ratio
Sample No.	: D-7		Plastic Limit :	-						
Depth (ft)	: 30.0	31.5	Plastic Index :	-	Initial	18.78	103.85	16.35	81.38	0.62
Depth (m)	: 9.15	9.61	Specific Gravity :	2.70	Final	19.40	111.00	17.47	100.98	0.52
Description	: Dark yellowish brown, lean CLAY with SAND (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

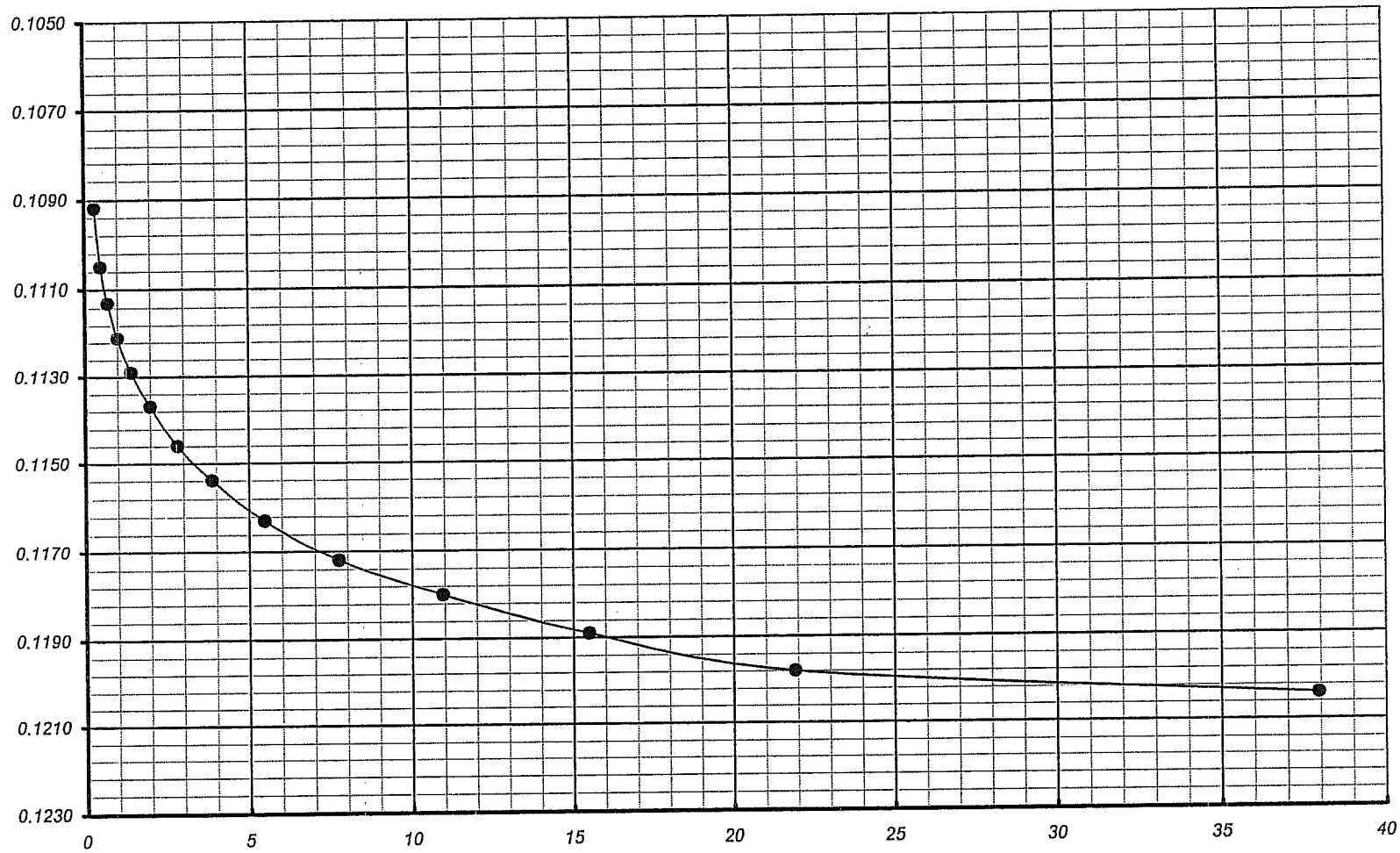
RBF/SR-57 Northbound

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

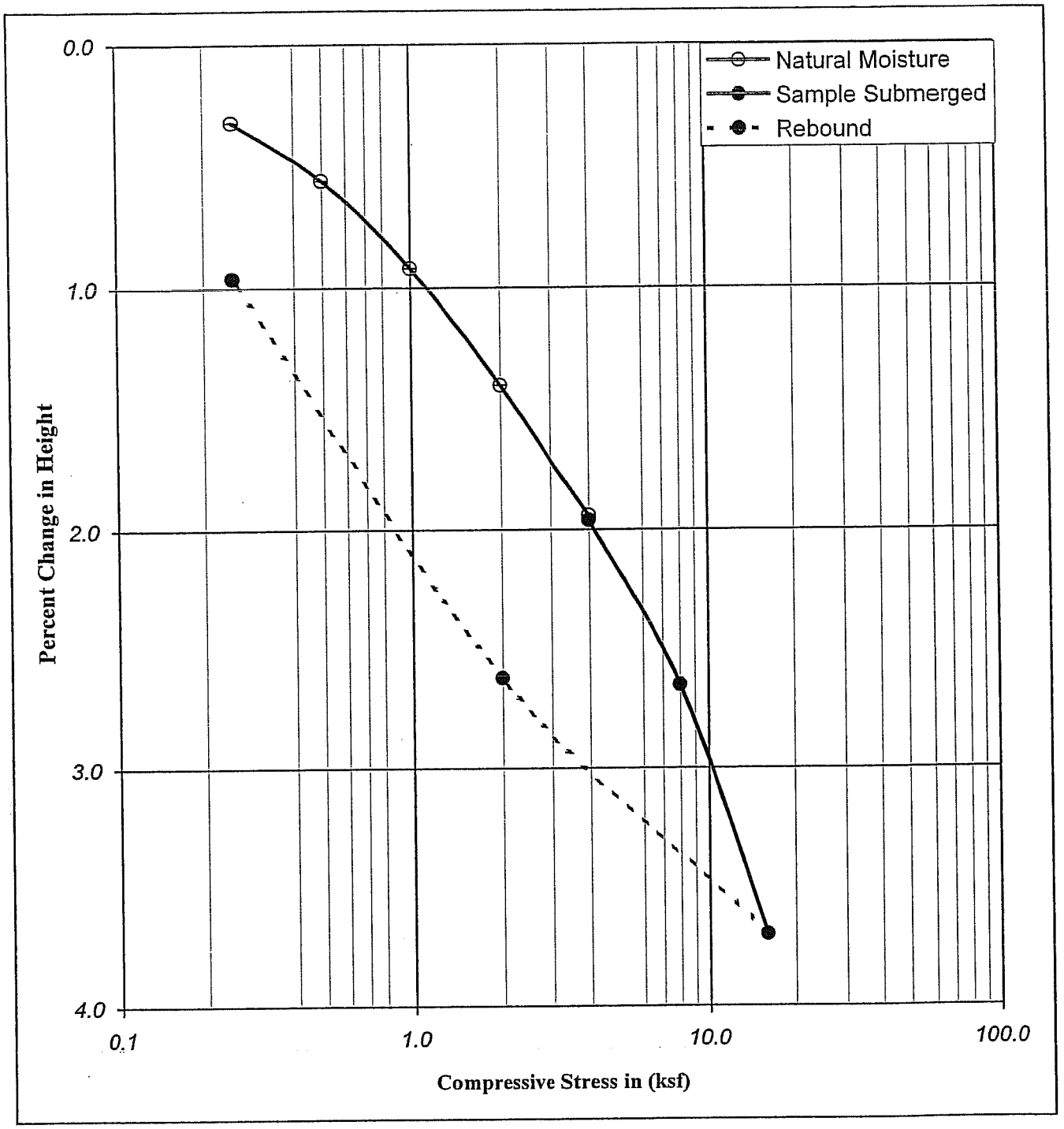
Project No. : *08-115* *12/05/08*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-016*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-7*	
EMI Project No. : *08-115*		Depth (ft/m) : *30.0* *9.2*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-016*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-7*	
EMI Project No. : *08-115*		Depth (ft/m) : *30.0* *9.2*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



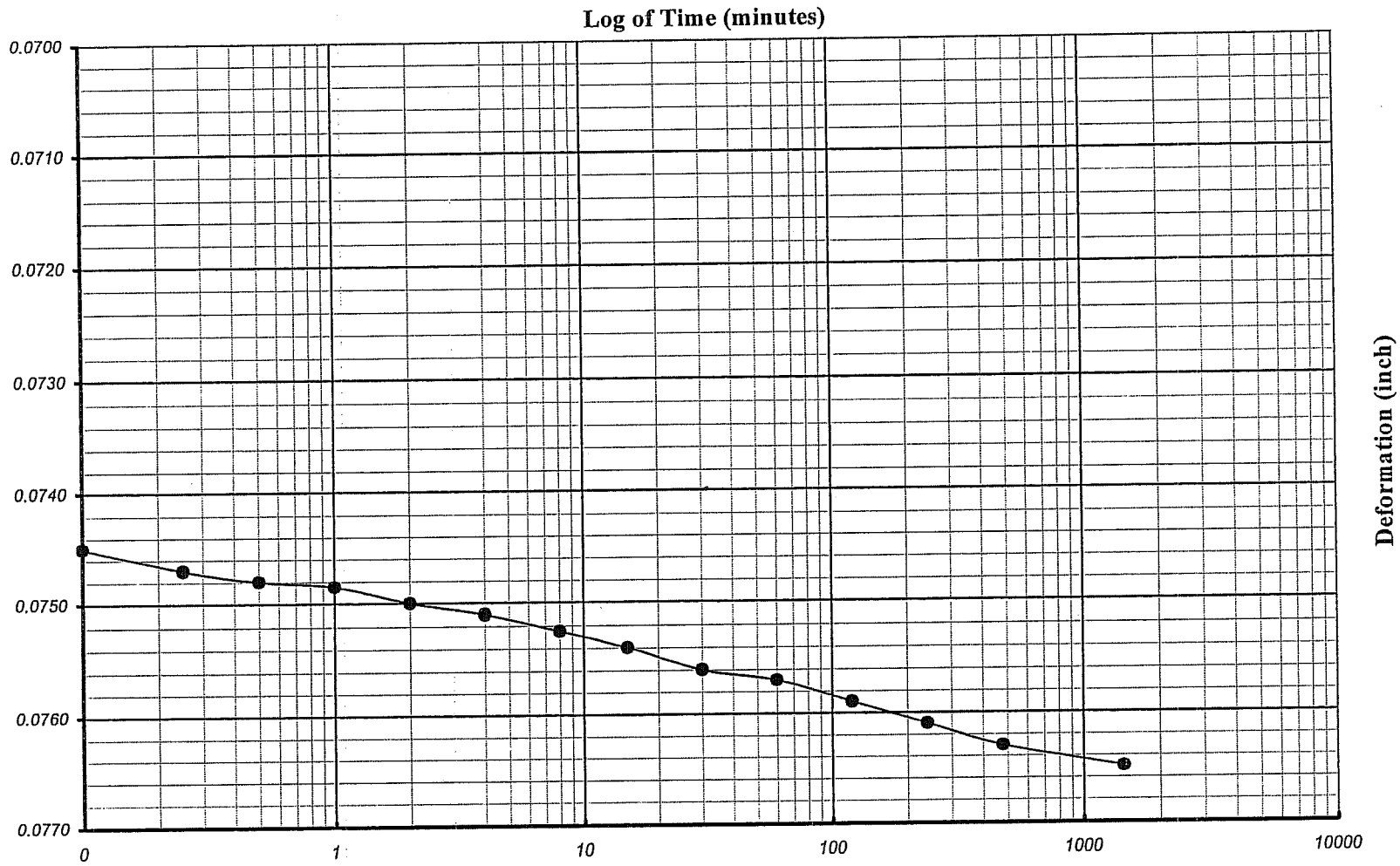
Boring No.	: A-08-016		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m^3)	Percent Saturation	Void Ratio
Sample No.	: D-11		Plastic Limit :	-						
Depth (ft)	: 50.0	51.5	Plastic Index :	-	Initial	15.23	113.96	17.94	85.79	0.48
Depth (m)	: 15.25	15.71	Specific Gravity :	2.70	Final	16.92	115.25	18.14	98.75	0.46
Description	: Dark yellowish brown, Lean CLAY With SAND (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

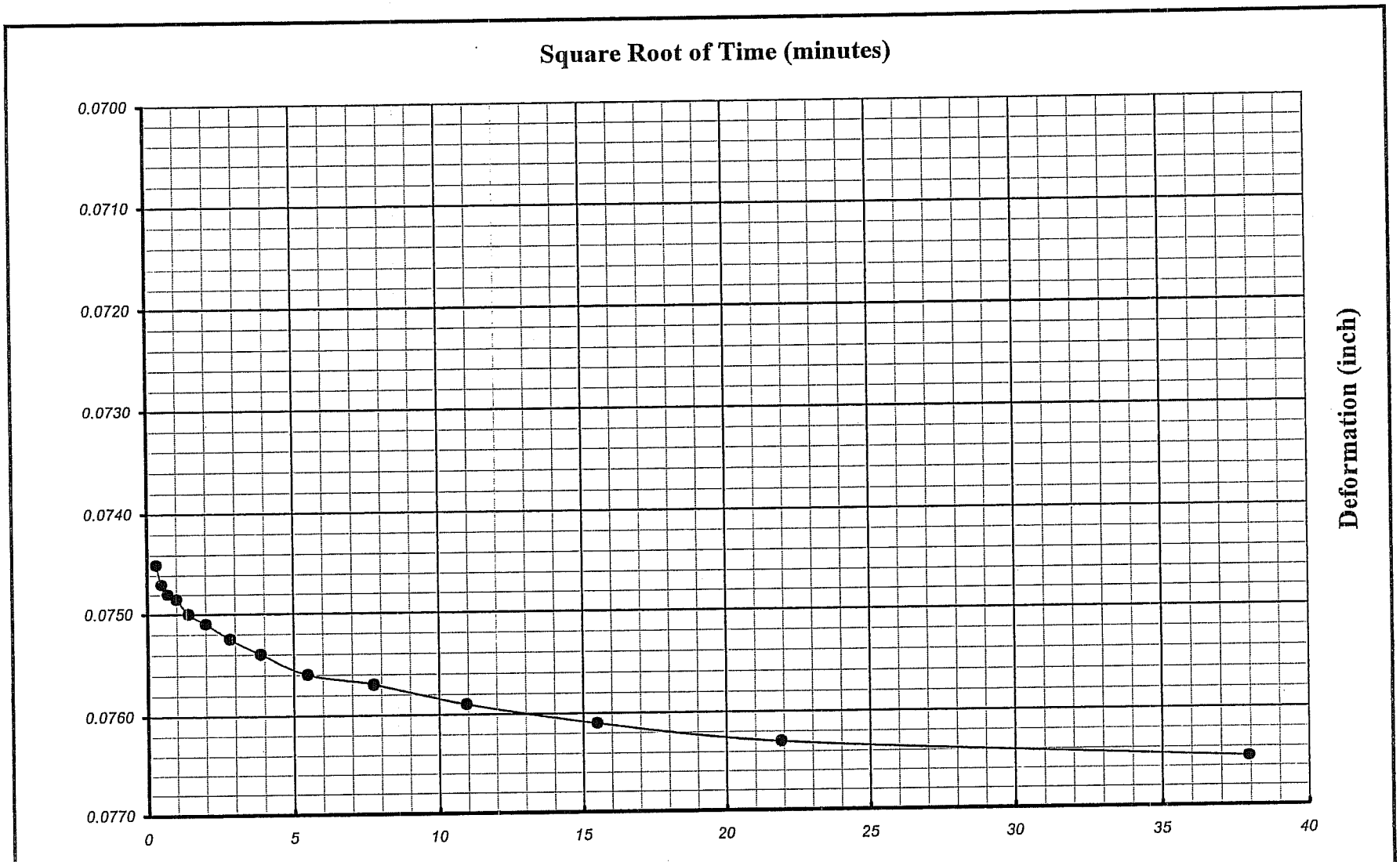
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

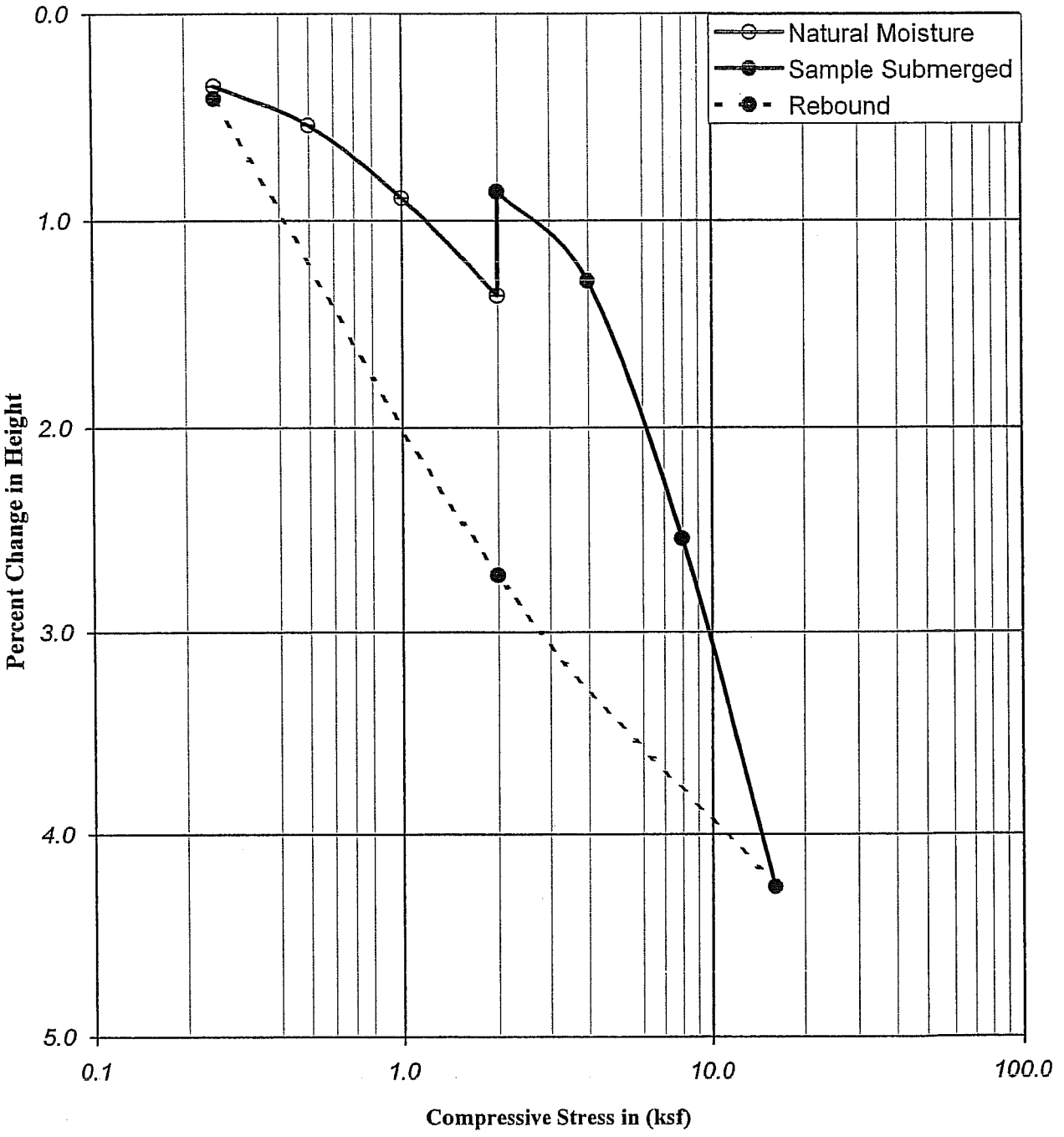
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-016*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-11*	
EMI Project No. : *08-115*		Depth (ft/m) : *50.0* *15.3*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-016*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-11*	
EMI Project No. : *08-115*		Depth (ft/m) : *50.0* *15.3*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



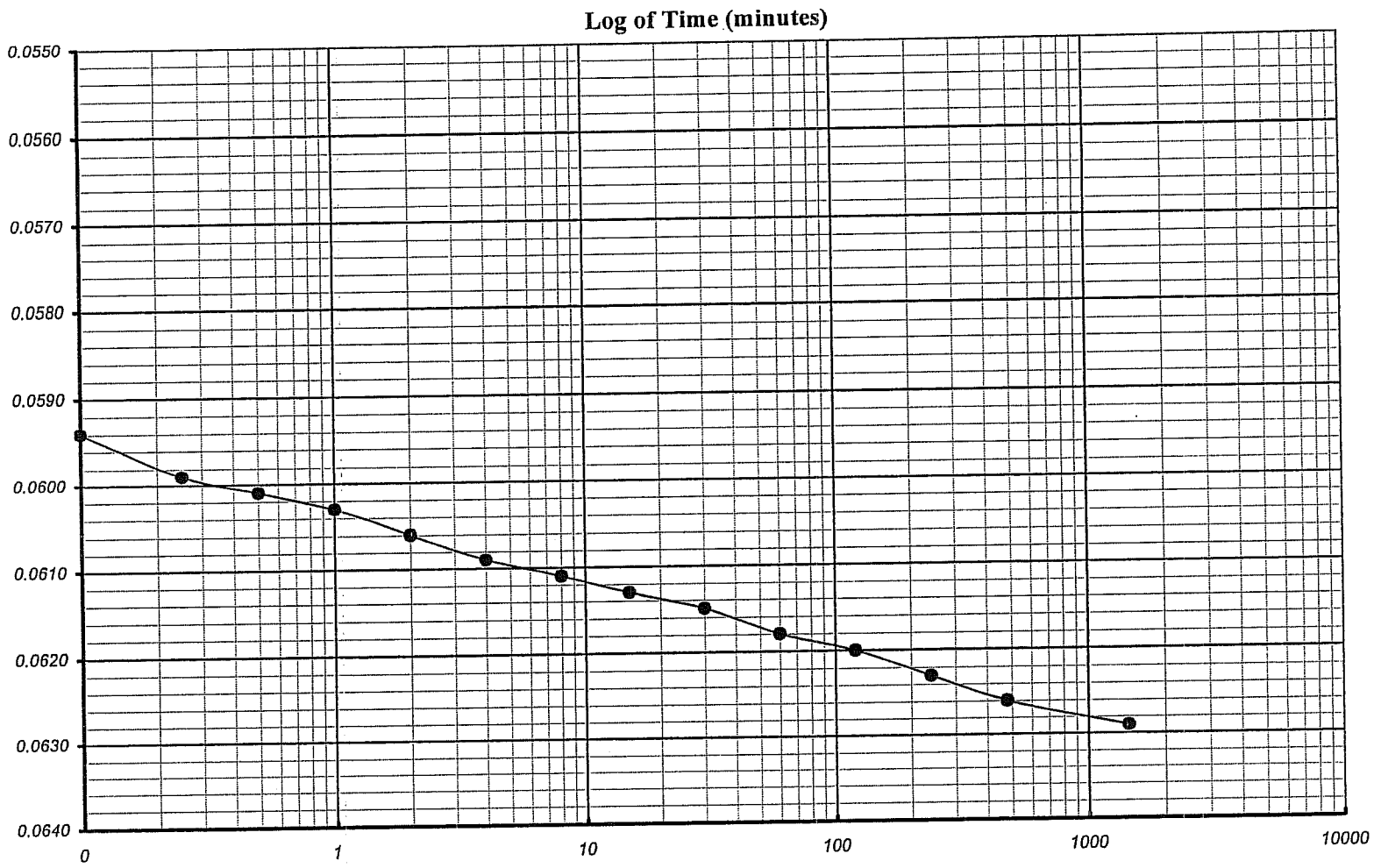
Boring No.		: A-08-017		Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.		: D-6		Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft)	: 25.0	26.5	Plastic Index :	-	Initial	14.38	110.80	17.44	74.49	0.52
	(m)	: 7.63	8.08	Specific Gravity :	2.70	Final	18.30	111.29	17.52	96.01	0.51
Description : Dark brown, lean CLAY with SAND (CL)											

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

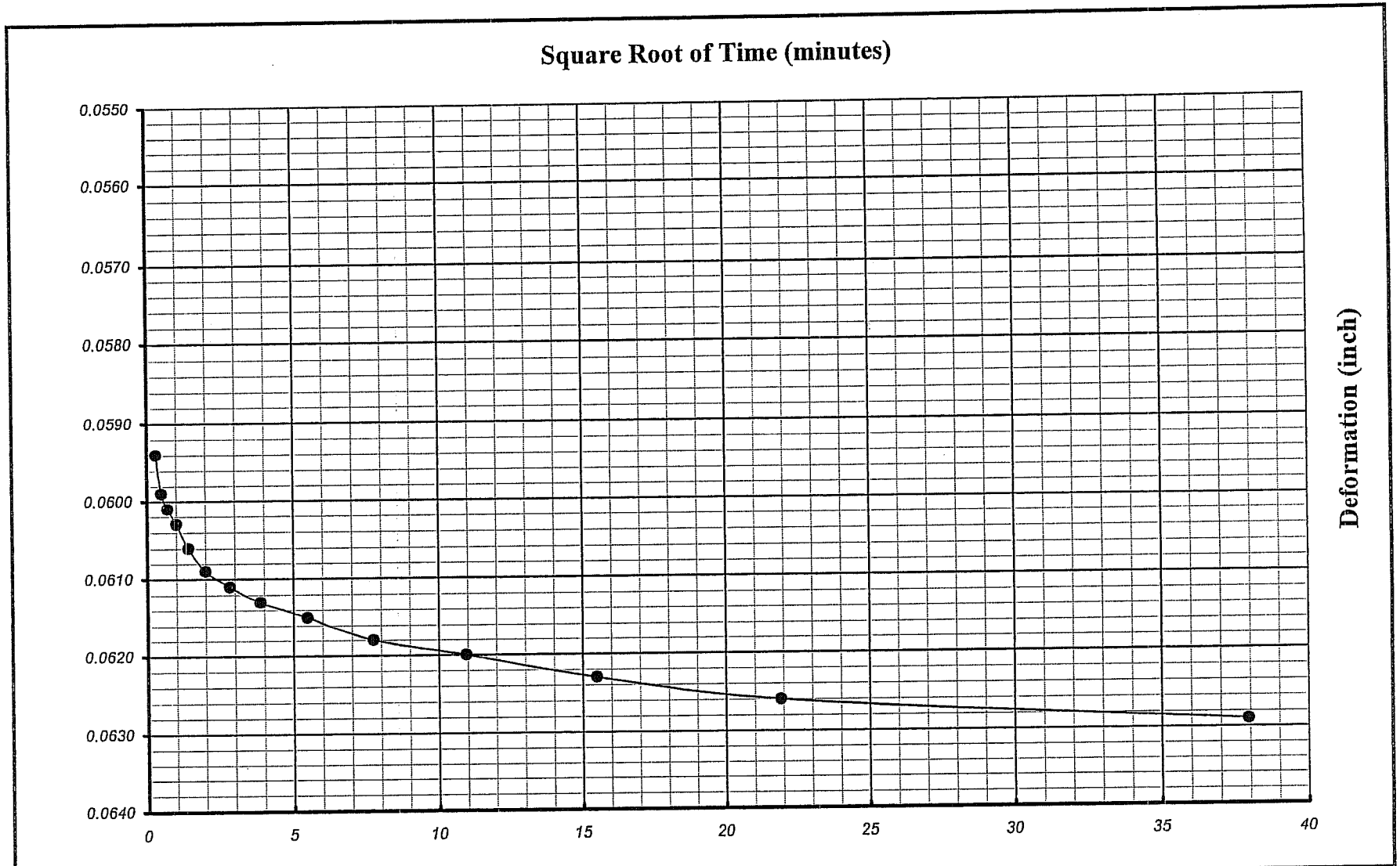
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

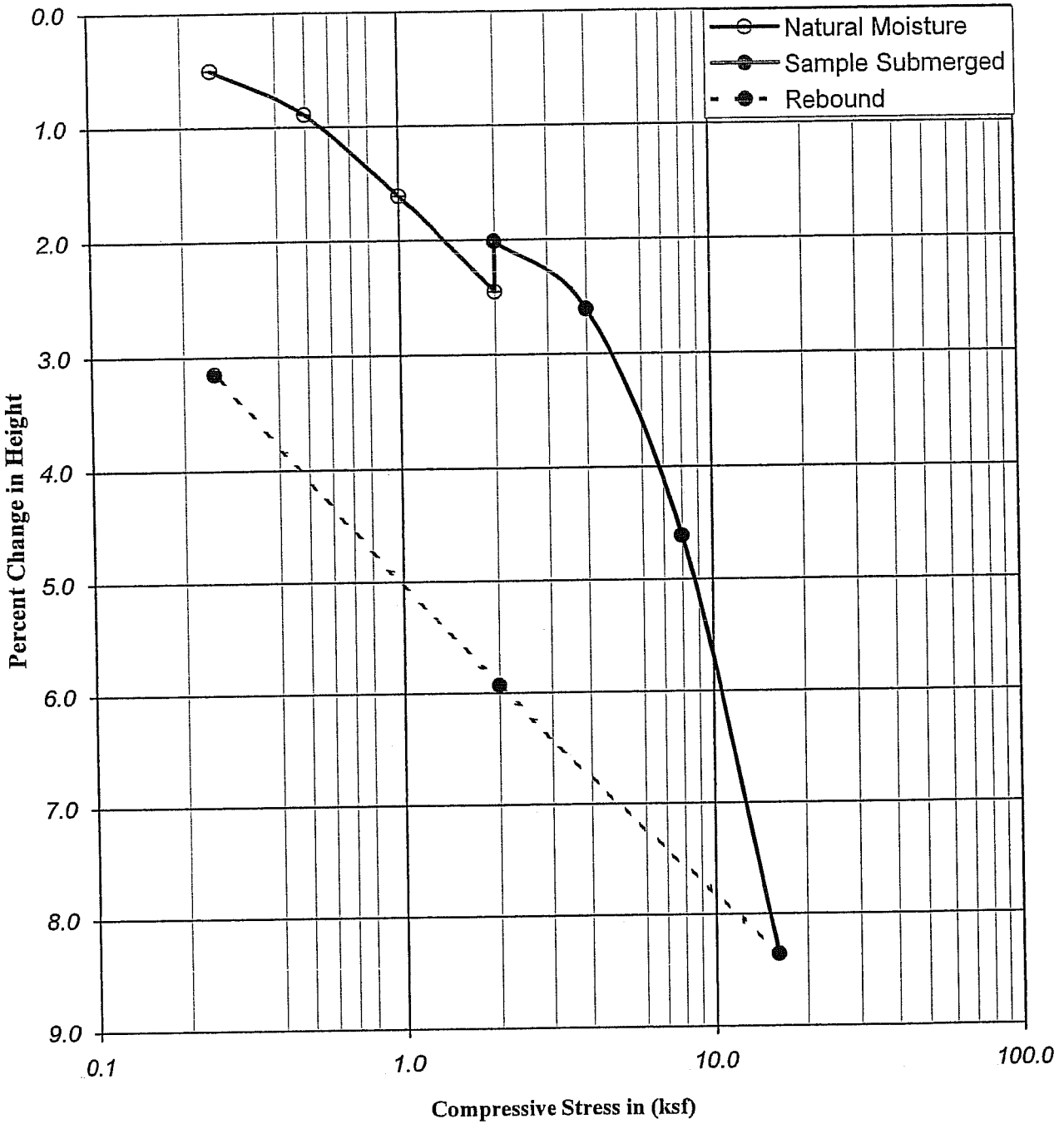
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-017*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-6*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *4.00* *191.5*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound	Boring No. : A-08-017	One-Dimensional Consolidation of Soil Time-Deformation Curve (Square Root of Time Method)
		Sample No. : D-6	
EMI Project No. : 08-115		Depth (ft/m) : 25.0 7.6	Veritcal Load (ksf/kpa) : 4.0 191.5



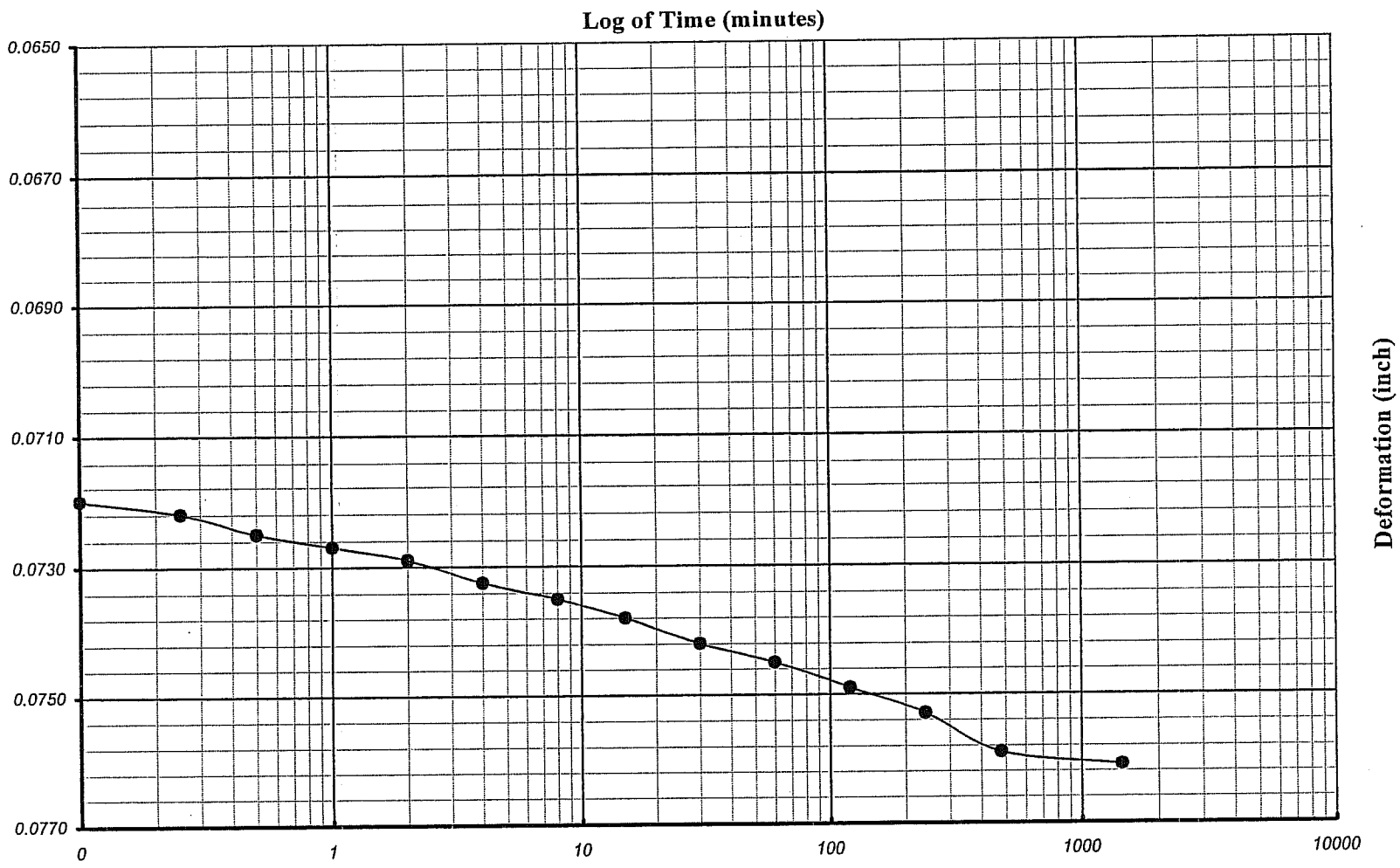
Boring No. : A-08-018			Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m^3)	Percent Saturation	Void Ratio
Sample No. : D-2			Plastic Limit :	-						
Depth	(ft) : 5.0	6.5	Plastic Index :	-	Initial	26.10	96.70	15.22	94.85	0.74
	(m) : 1.53	1.98	Specific Gravity :	2.70	Final	26.84	99.94	15.73	105.55	0.69
Description : Olive brown, lean CLAY with SAND (CL)										

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

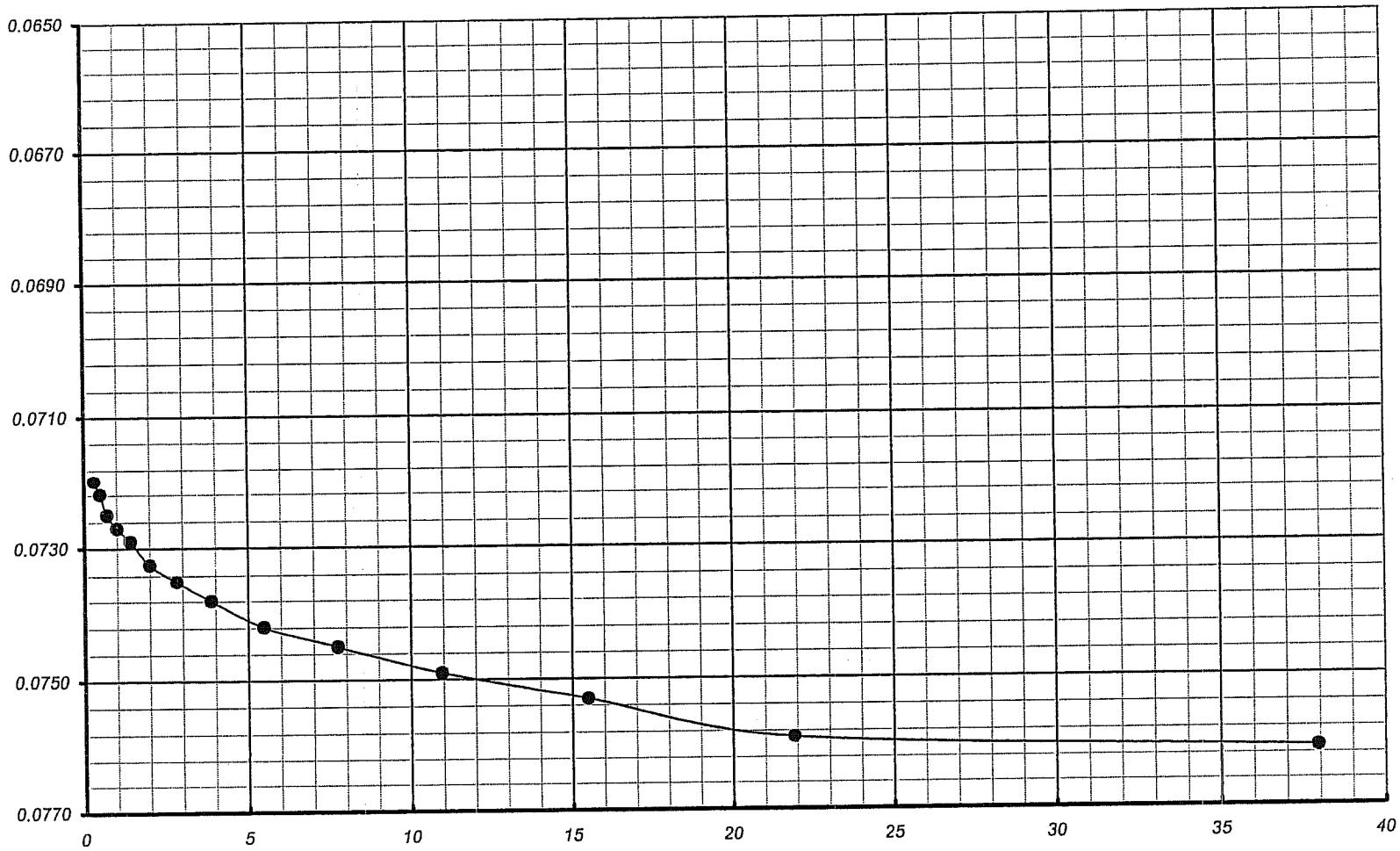
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

Project No. : 08-115 12/05/08

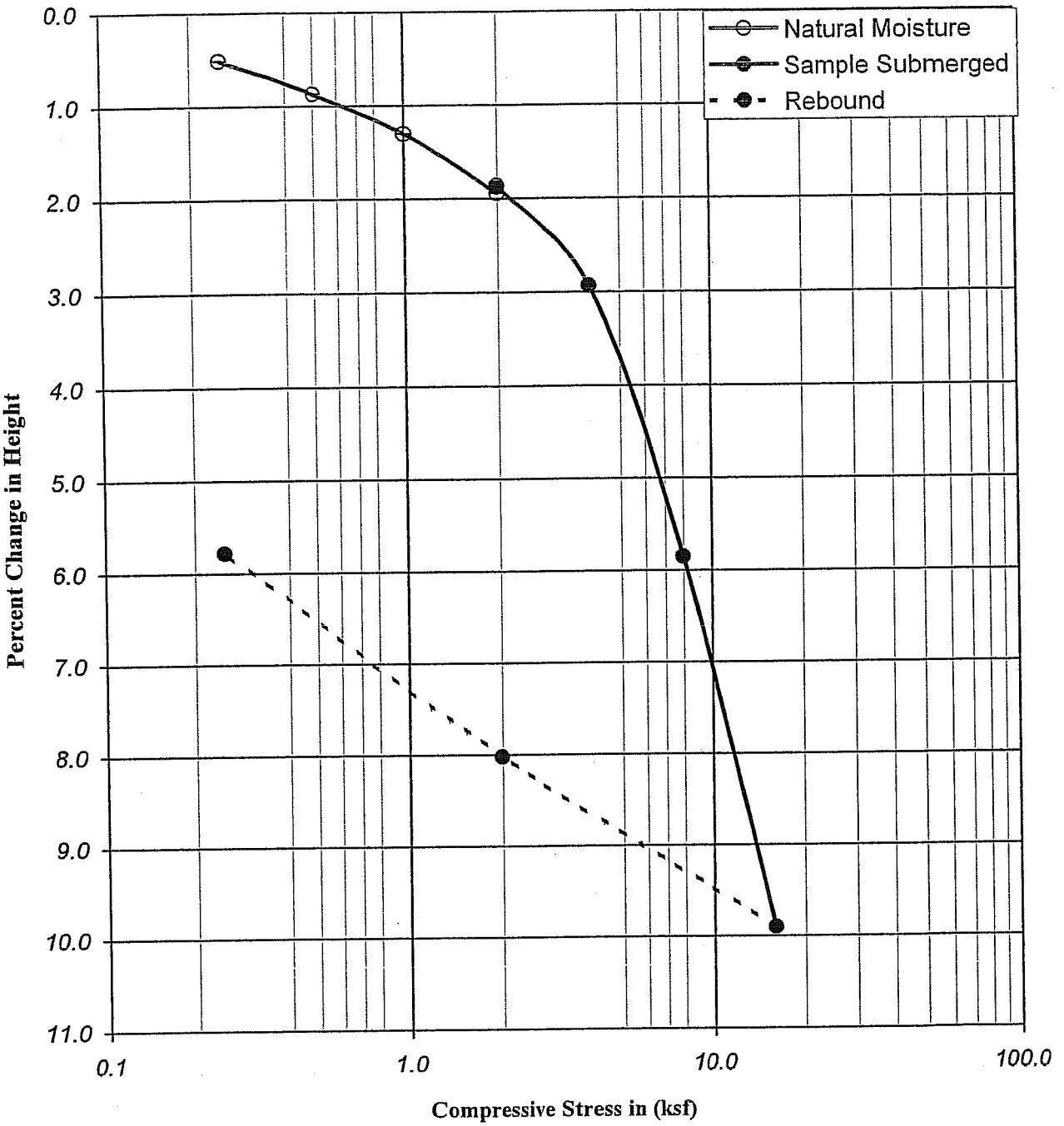


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-018*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.00* *191.5*

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-018*	**One-Dimensional Consolidation of Soil** Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



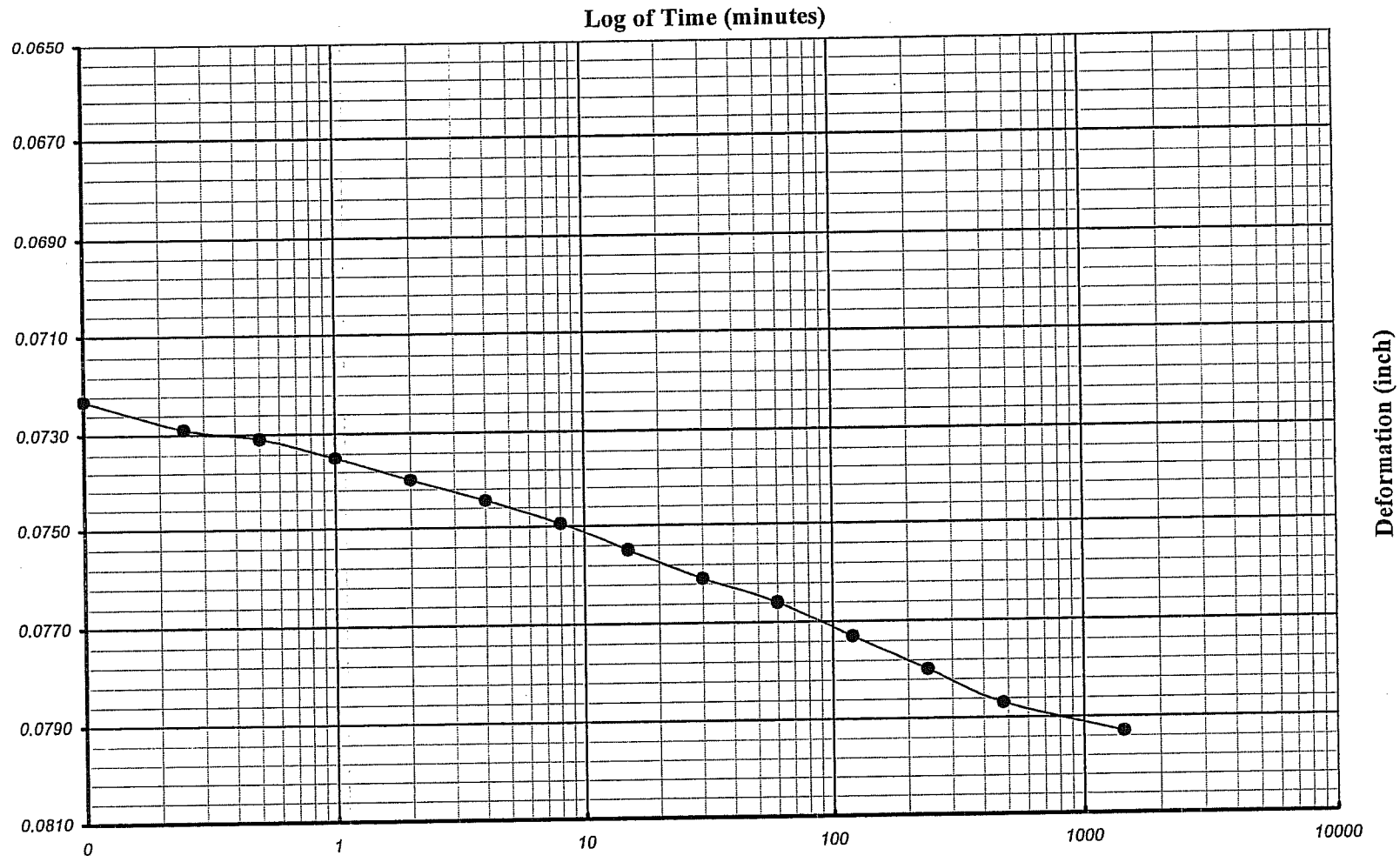
Boring No.	: A-08-019		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-5		Plastic Limit :	-						
Depth (ft)	: 20.0	21.5	Plastic Index :	-	Initial	26.28	94.14	14.82	89.76	0.79
Depth (m)	: 6.10	6.56	Specific Gravity :	2.70	Final	25.19	100.06	15.75	99.33	0.68
Description	: Mottled olive gray, olive brown and brown, lean CLAY(CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

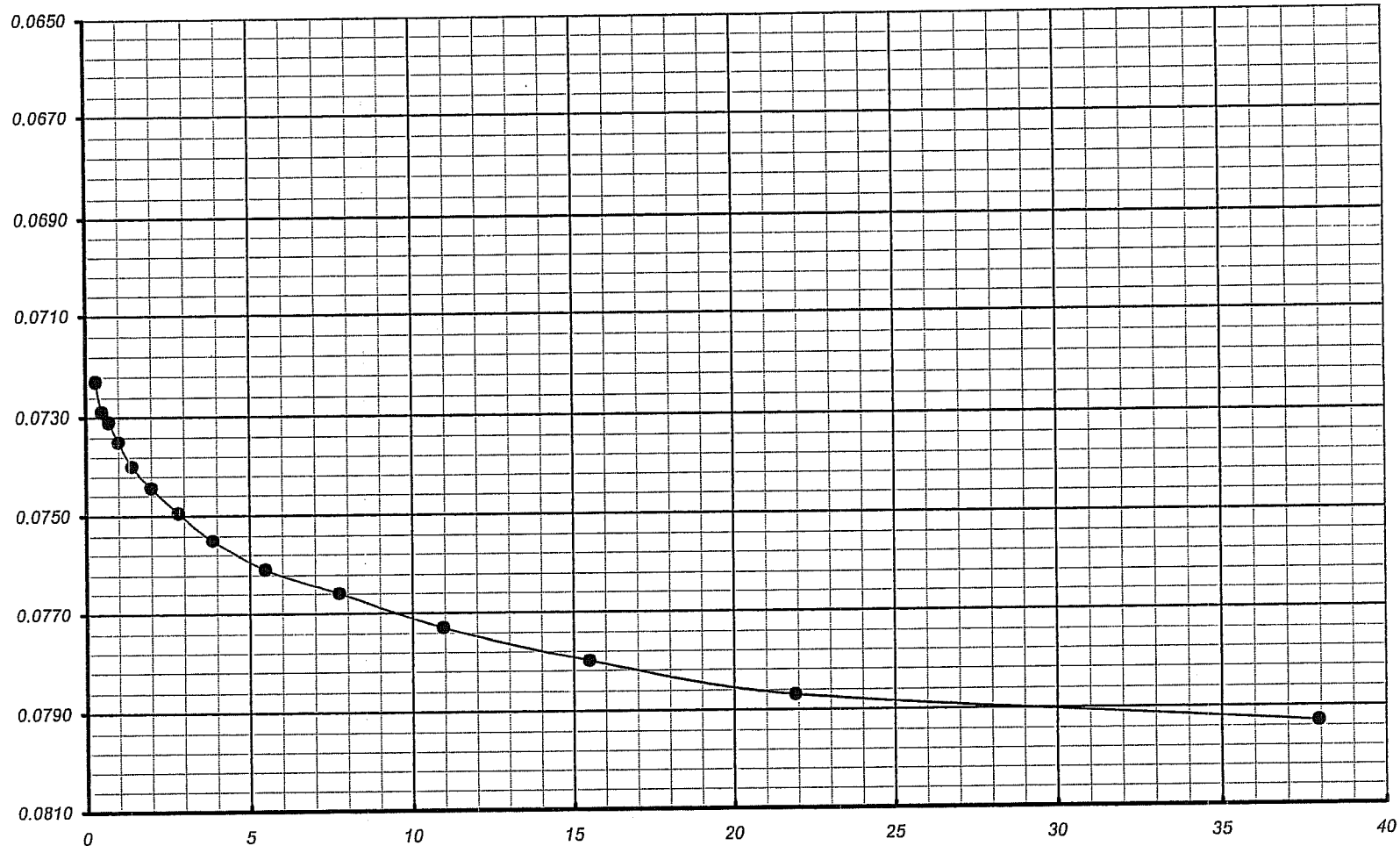
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

Project No. : 08-115 12/05/08

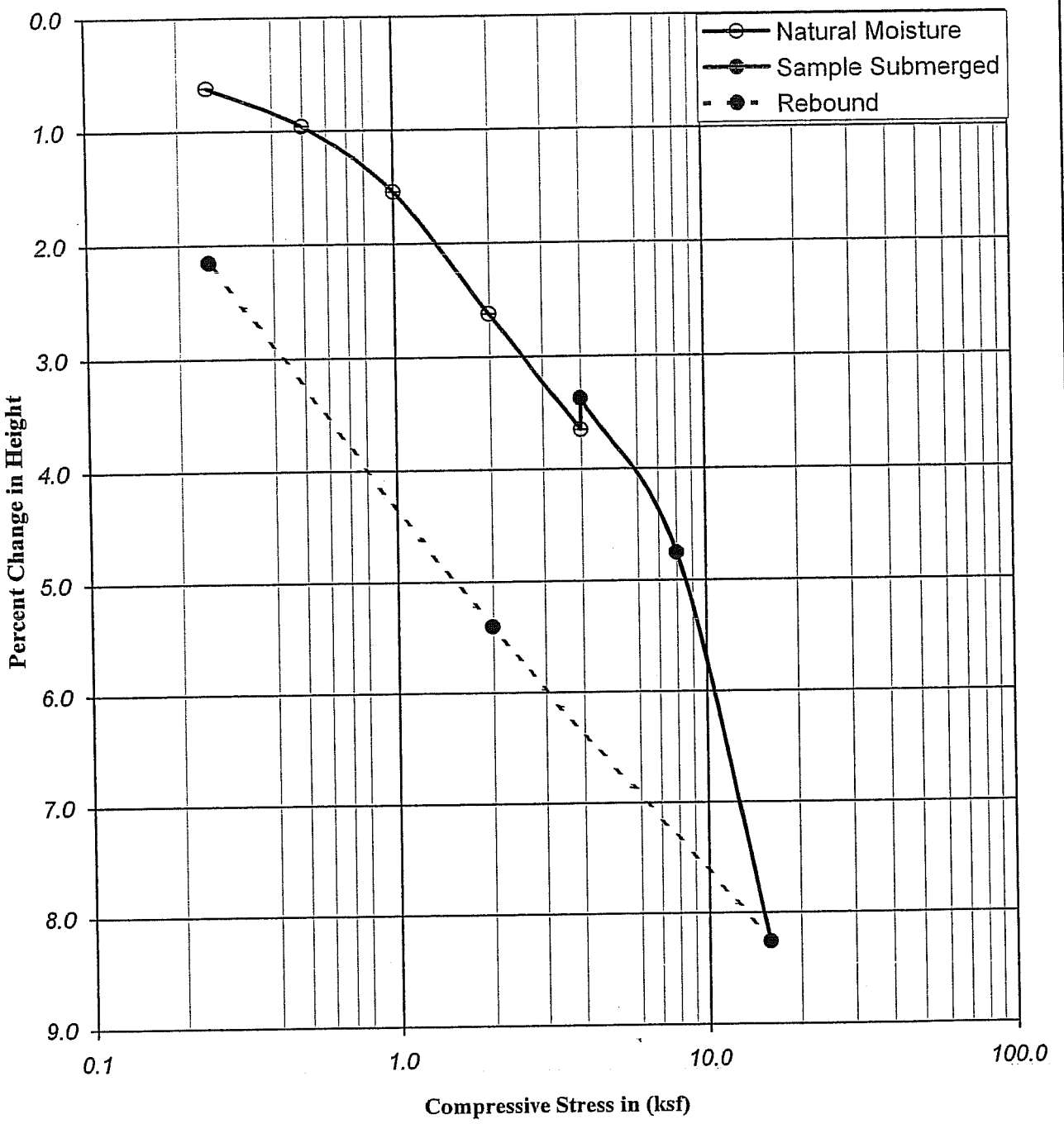


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-019*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-5*	
EMI Project No. : *08-115*		Depth (ft/m) : *20.0* *6.1*	Veritcal Load (ksf/kpa) : *4.00* *191.5*

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-019*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-5*	
EMI Project No. : *08-115*		Depth (ft/m) : *20.0* *6.1*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



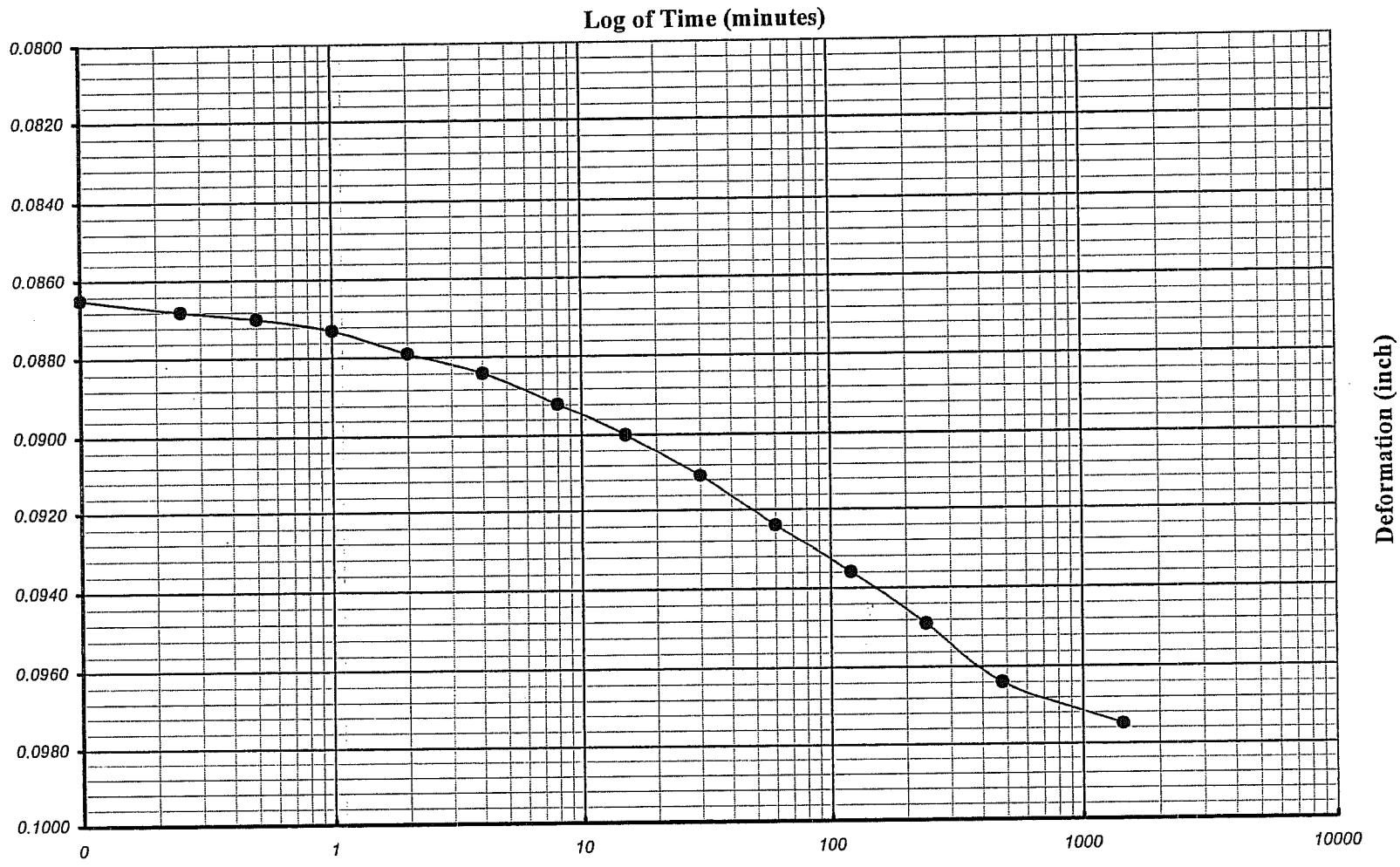
Boring No.	: A-08-109		Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-8		Plastic Limit :	-			(pcf)	(kN/m³)		
Depth (ft)	: 35.0	36.5	Plastic Index :	-	Initial	29.11	93.24	14.68	97.29	0.81
Depth (m)	: 10.68	11.13	Specific Gravity :	2.70	Final	29.27	95.34	15.01	102.89	0.77
Description	: Dark yellowish brown, lean CLAY(CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

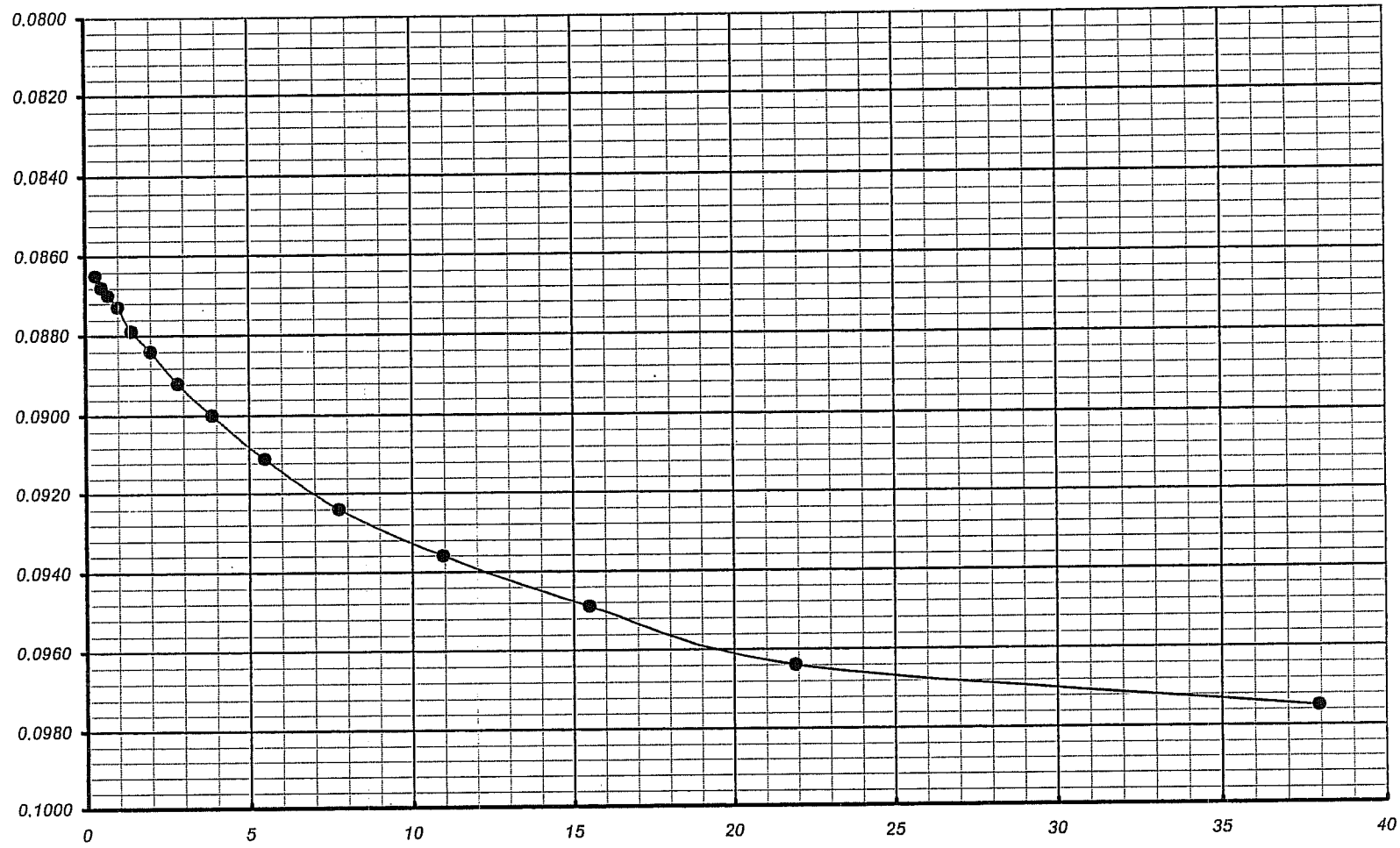
RBF/SR-57 Northbound

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

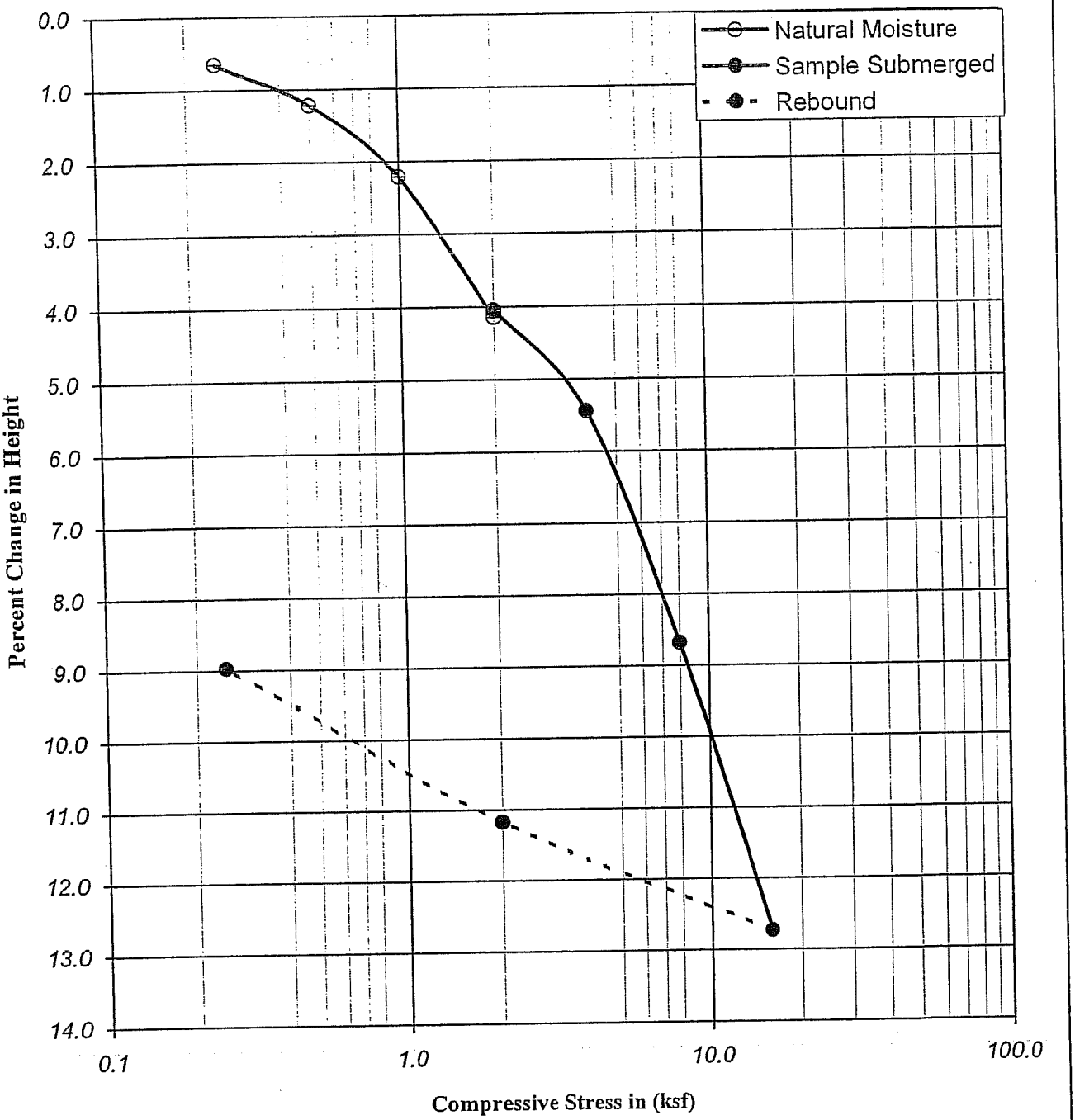
Project No. : 08-115 12/05/08



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-109*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-8*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-109*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-8*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



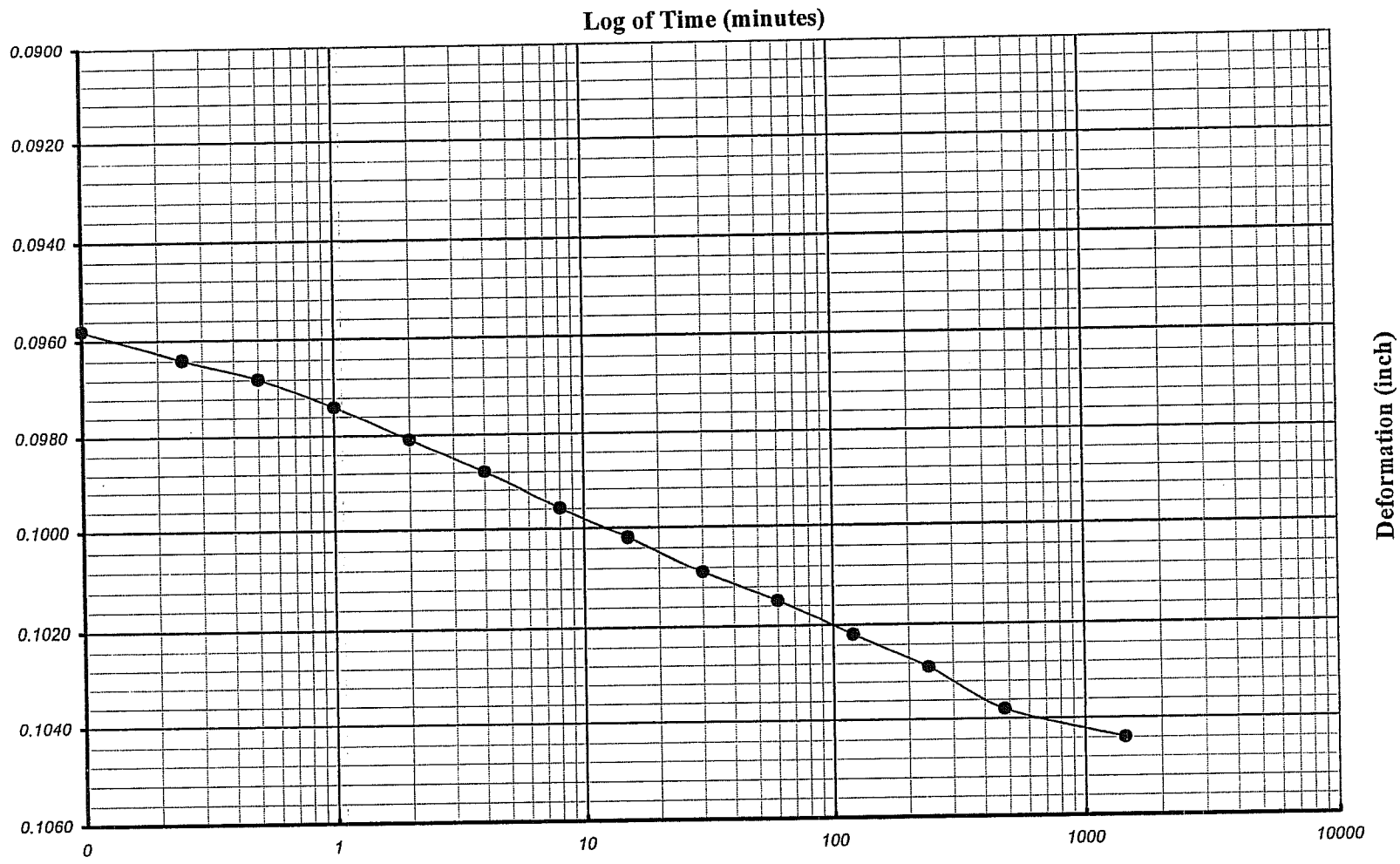
Boring No.	: A-08-119		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-2		Plastic Limit :	-						
Depth (ft)	: 5.0	6.5	Plastic Index :	-	Initial	26.02	92.03	14.49	84.48	0.83
Depth (m)	: 1.53	1.98	Specific Gravity :	2.70	Final	23.61	101.17	15.92	95.67	0.67
Description	: Very dark brown, lean CLAY (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

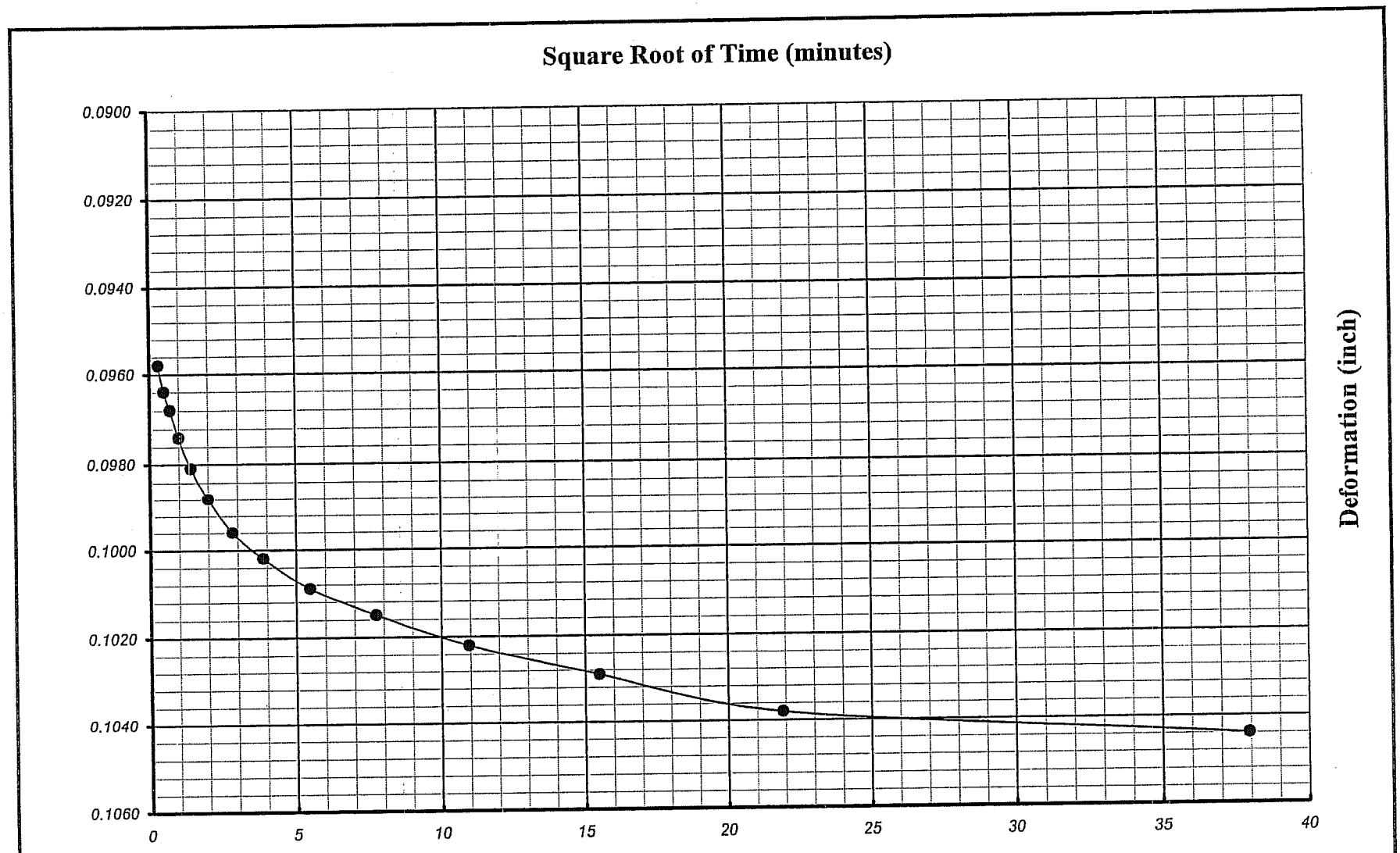
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

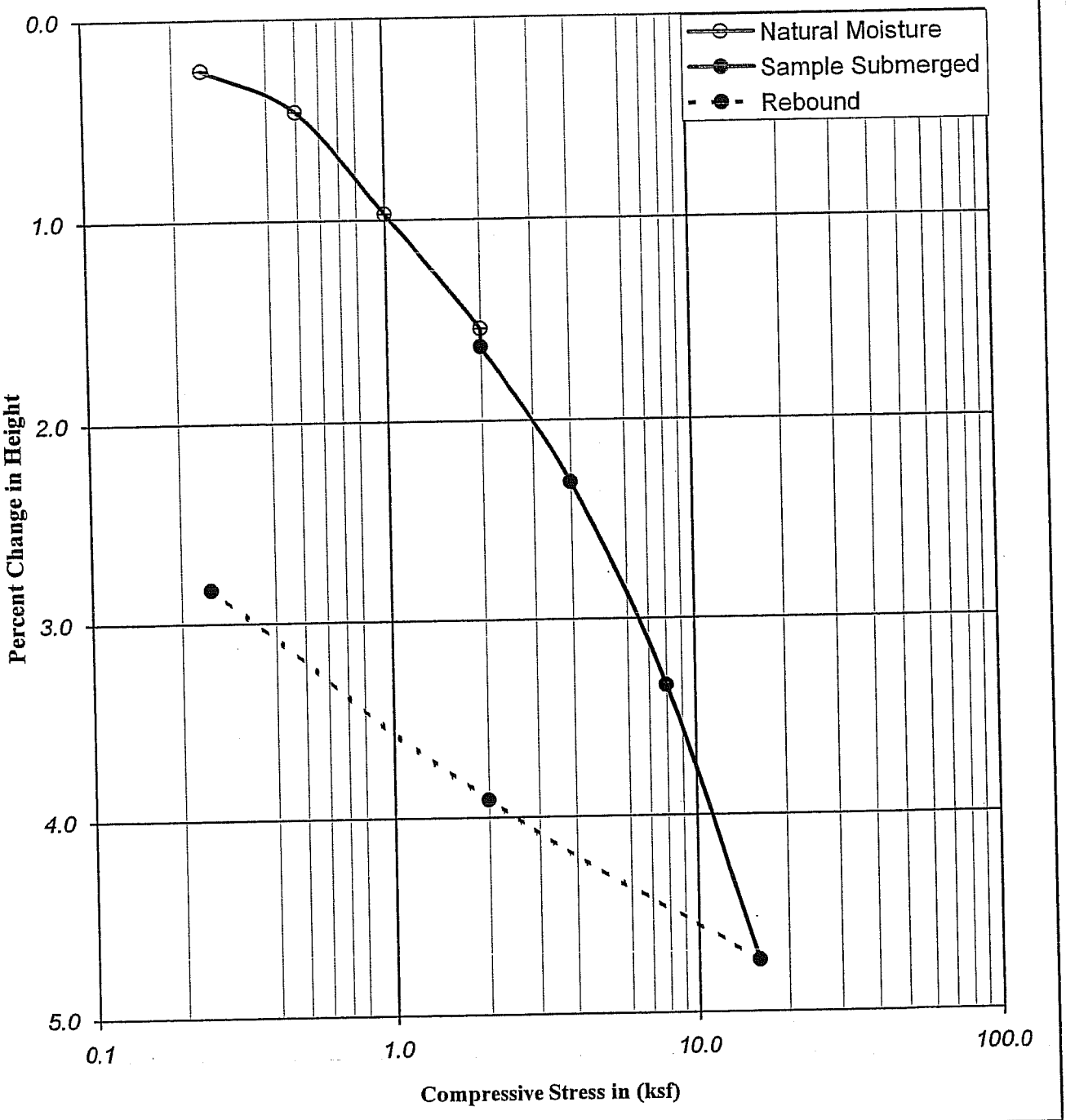
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-119*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.00* *191.5*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-119*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



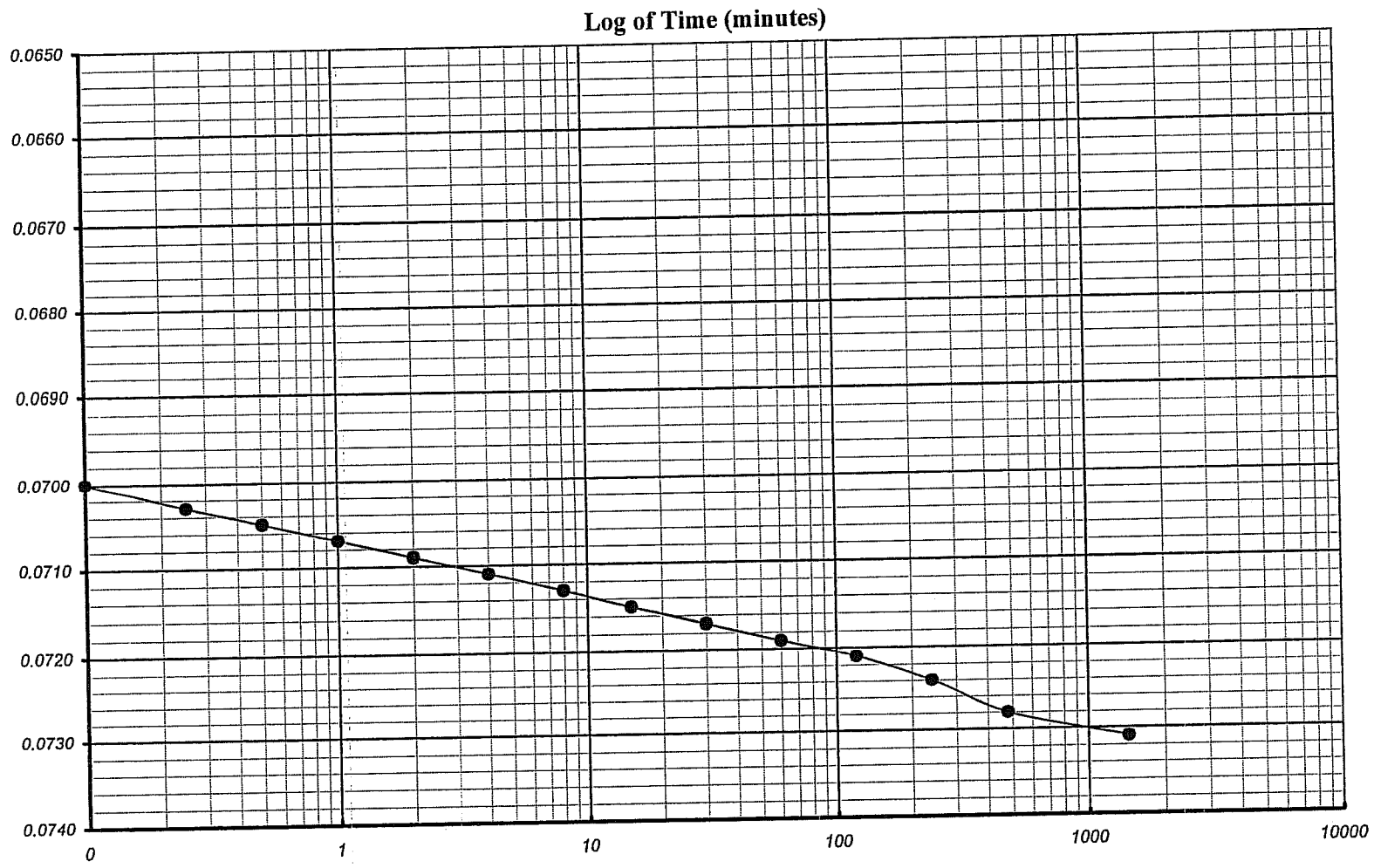
Boring No.	: A-08-126		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m^3)	Percent Saturation	Void Ratio
Sample No.	: D-3		Plastic Limit :	-						
Depth (ft)	: 10.0	11.5	Plastic Index :	-	Initial	12.70	110.76	17.43	65.73	0.52
Depth (m)	: 3.05	3.51	Specific Gravity :	2.70	Final	16.26	114.04	17.95	91.86	0.48
Description	: Dark yellowish brown, SANDY lean CLAY(CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

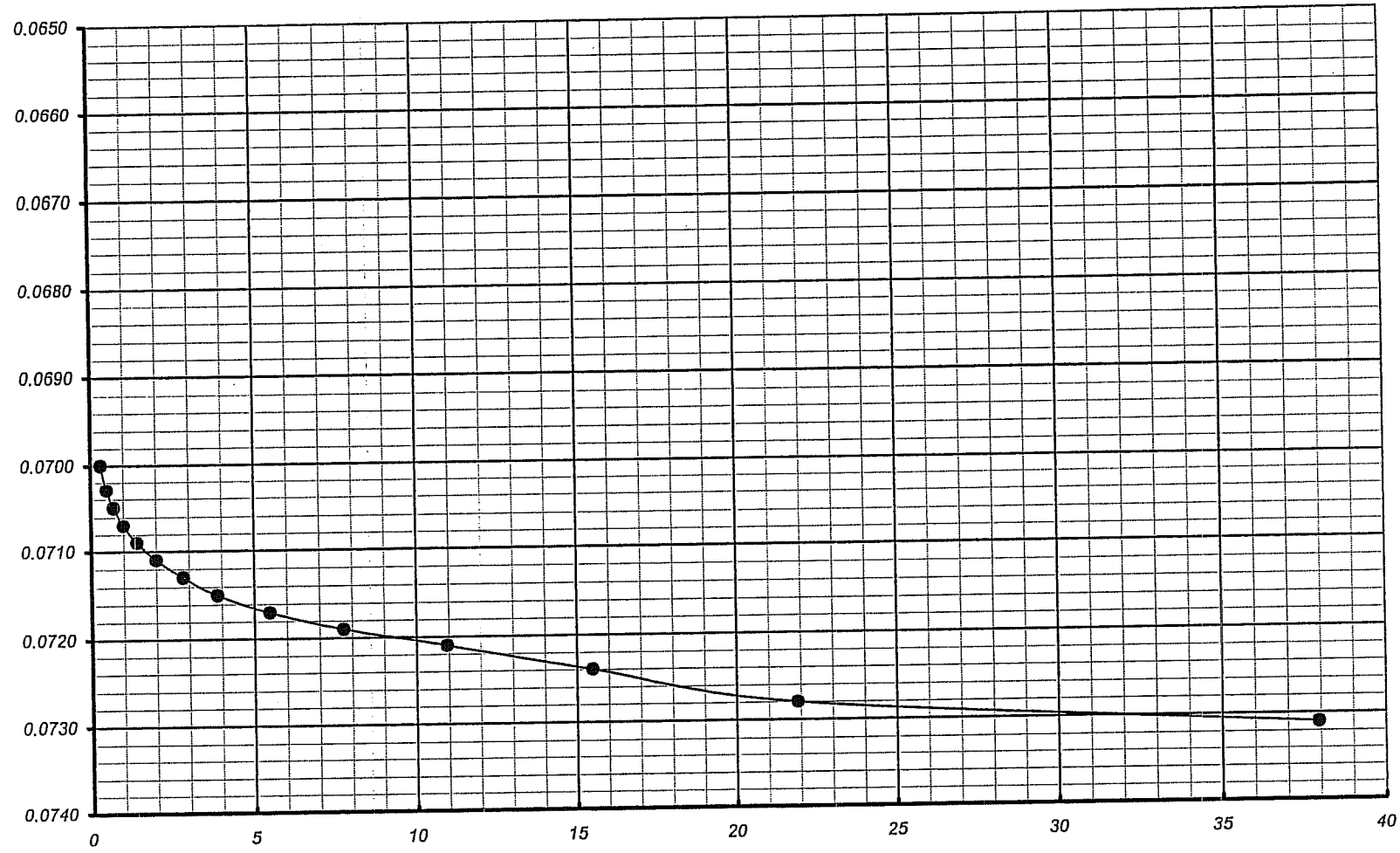
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-126*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-3*	
EMI Project No. : *08-115*		Depth (ft/m) : *10.0* *3.1*	Veritcal Load (ksf/kpa) : *4.00* *191.5*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-126*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Squnre Root of Time Method)**
		Sample No. : *D-3*	
EMI Project No. : *08-115*		Depth (ft/m) : *10.0* *3.1*	Veritcal Load (ksf/kpa) : *4.0* *191.5*

APPENDIX C

DESIGN CALCULATIONS

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project RW 462 Project No. 05-415

By CTY Date 2/26/09 Checked By _____ Date _____ Sheet ____ of ____

RW 462

EL

191 ——— depth 0'

$\gamma = 120$ pcf
$\phi = 31°$
$K = 60$ kci

188 ——— 3'

$\gamma = 133$ pcf
$\phi = 34°$
$K = 100$ kci

173 ——— 18'

$\gamma = 128$ pcf
$\phi = 38°$
$K = 200$ kci

****

2/20/2009 YCT
RW 462 HP10x42

****

SOIL DATA

NUMBER OF SOIL UNITS = 3
DEPTH TO WATER TABLE = 60.00'
UNIT WEIGHT OF WATER = .0624 kcf

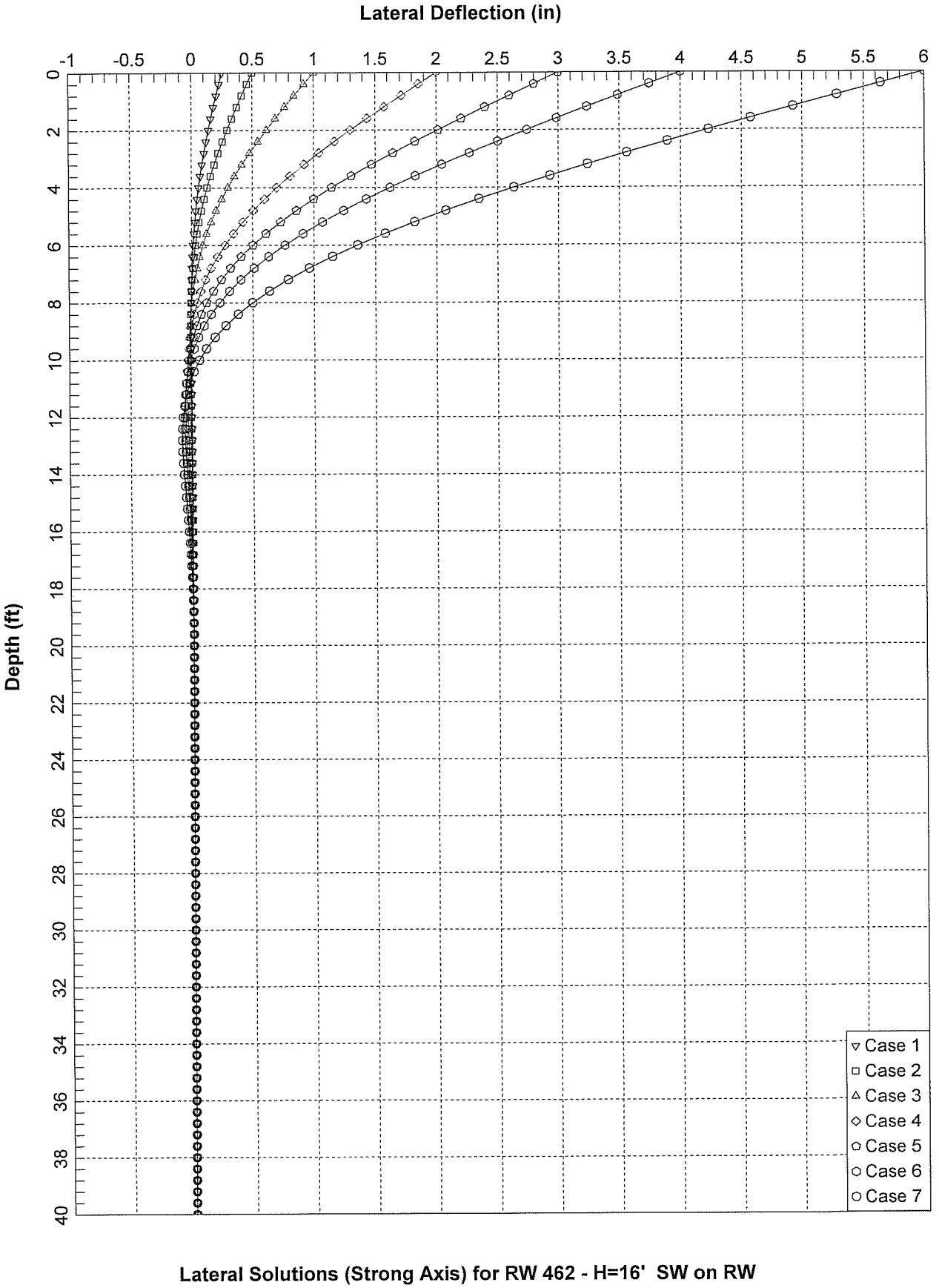
SOIL UNIT	DEPTH (ft)	UNIT WT. (kcf)	CLAY: SAND:	c (ksf) PHI (deg)	Nc Nq	Cac Khc	Cat Kht	delta (deg)
1	.0 - 3.0	.120	SAND	31.00	0.	1.00	.50	26.00
1	3.0 - 18.0	.123	SAND	34.00	62.	1.00	.50	29.00
1	18.0 - 60.0	.128	SAND	38.00	145.	1.00	.50	33.00

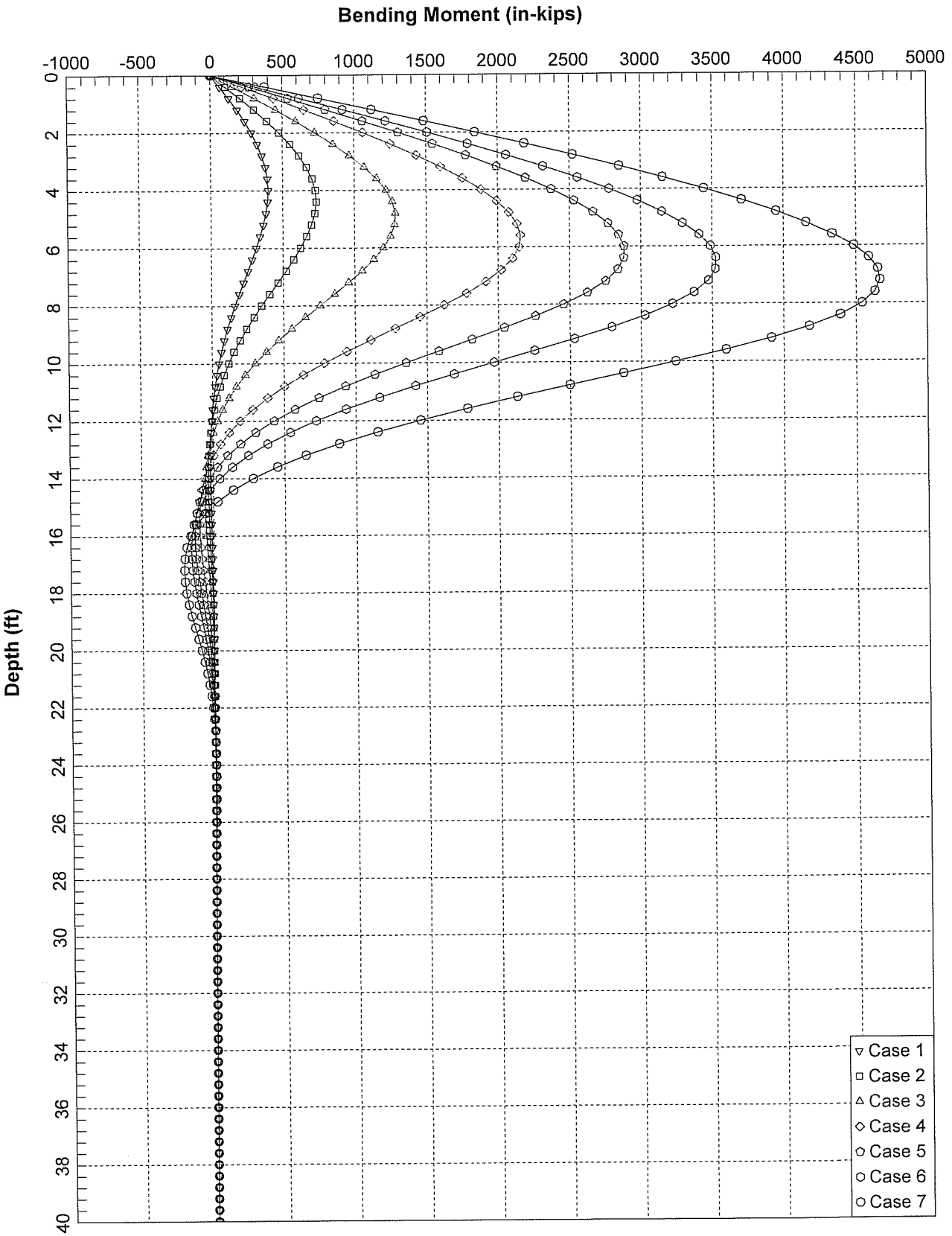
PILE DATA	PILE TOP	PILE TIP
DEPTH	.00	60.00'
CIRCUMFERENCE	3.330	3.330'
CROSS-SECTIONAL AREA	.0860	.0860 ft2

PILE STIFFNESS AE/L = 99999. kips/ft
DISPLACEMENT TO MOBILIZE FULL SKIN FRICTION = 1.670E-02' (= 2.004E-01")
DISPLACEMENT TO MOBILIZE FULL END BEARING = 5.800E-02' (= 6.960E-01")
DEPTH INCREMENT FOR CAPACITY CALCULATIONS = 2.00'
FACTOR OF SAFETY FOR SKIN FRICTION = 1.00
FACTOR OF SAFETY FOR END-BEARING = 1.00

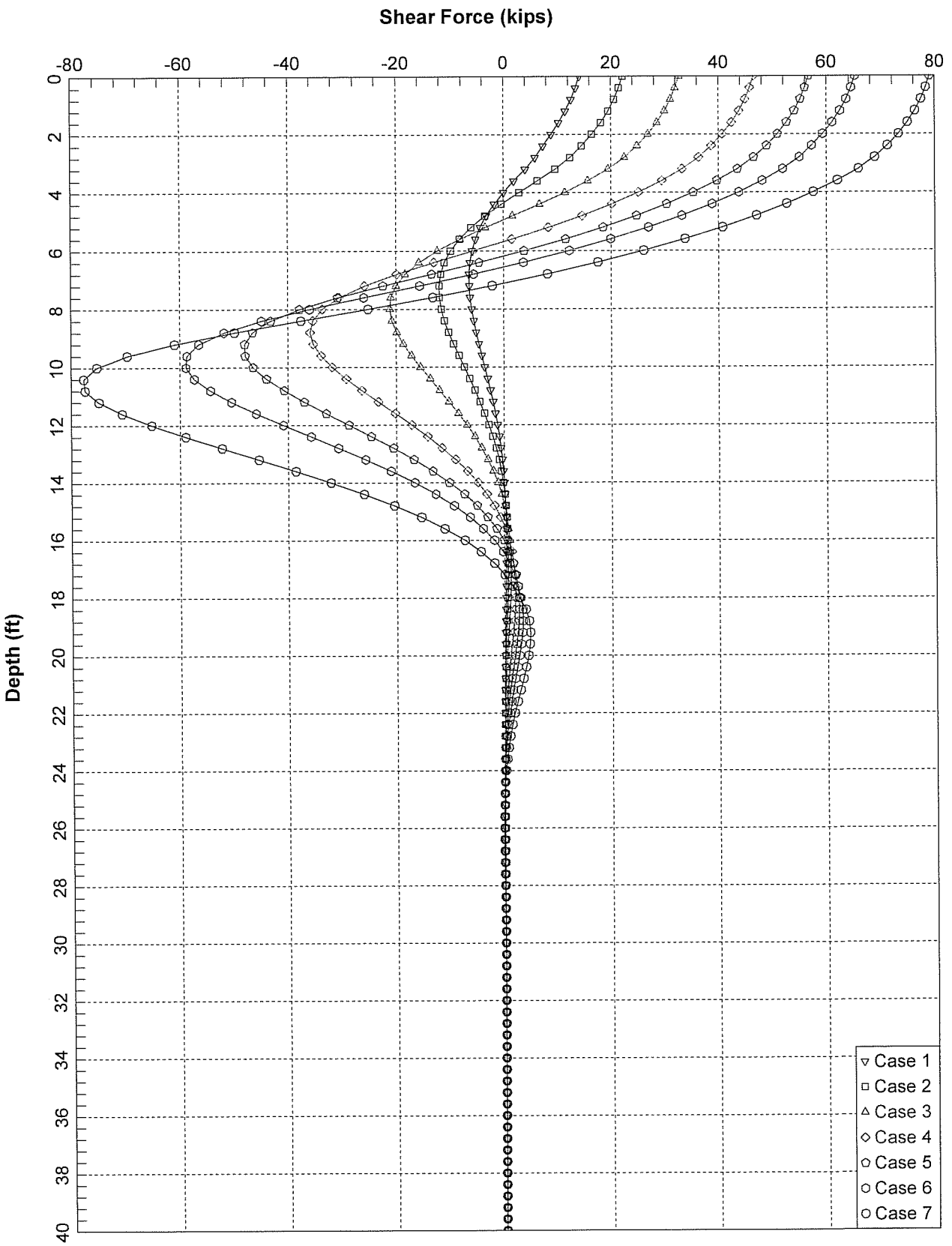
SOIL UNIT -	DEPTH (ft)	EFF. STRESS (ksf)	UNIT SKIN FRICT COMPR. (ksf)	UPLIFT (ksf)	UNIT END BEARING (ksf)	CUM.FR. COMPR. (kips)	END BEARING (kips)	CAPACITY COMPRESS (kips)	UPLIFT (kips)
1	.00	.00	.00	.00	.0	.0	.0	.0	.0
1	2.00	.24	.12	.06	.0	.4	.0	.4	.2
1	3.00	.36	.18	.09	.0	.9	.0	.9	.4
2	3.00	.36	.20	.10	22.3	.9	1.9	2.8	.4
2	5.00	.61	.34	.17	37.6	2.7	3.2	5.9	1.3
2	7.00	.85	.47	.24	52.8	5.4	4.5	9.9	2.7
2	9.00	1.10	.61	.30	68.1	9.0	5.9	14.8	4.5
2	11.00	1.34	.74	.37	83.3	13.5	7.2	20.6	6.7
2	13.00	1.59	.88	.44	98.6	18.9	8.5	27.4	9.4
2	15.00	1.84	1.02	.51	113.8	25.2	9.8	35.0	12.6
2	17.00	2.08	1.15	.58	129.1	32.4	11.1	43.5	16.2
2	18.00	2.20	1.22	.61	136.7	36.4	11.8	48.1	18.2
3	18.00	2.20	1.43	.72	319.7	36.4	27.5	63.9	18.2
3	20.00	2.46	1.60	.80	356.8	46.5	30.7	77.2	23.2
3	22.00	2.72	1.76	.88	394.0	57.7	33.9	91.6	28.8
3	24.00	2.97	1.93	.97	431.1	70.0	37.1	107.1	35.0
3	26.00	3.23	2.10	1.05	468.2	83.4	40.3	123.7	41.7
3	28.00	3.48	2.26	1.13	505.3	97.9	43.5	141.4	49.0
3	30.00	3.74	2.43	1.21	542.4	113.5	46.7	160.2	56.8
3	32.00	4.00	2.60	1.30	579.6	130.3	49.8	180.1	65.1
3	34.00	4.25	2.76	1.38	616.7	148.1	53.0	201.1	74.1
3	36.00	4.51	2.93	1.46	653.8	167.1	56.2	223.3	83.5
3	38.00	4.76	3.09	1.55	690.9	187.1	59.4	246.5	93.6
3	40.00	5.02	3.26	1.63	728.0	208.3	62.6	270.9	104.1
3	42.00	5.28	3.43	1.71	765.2	230.5	65.8	296.4	115.3
3	44.00	5.53	3.59	1.80	802.3	253.9	69.0	322.9	127.0
3	46.00	5.79	3.76	1.88	839.4	278.4	72.2	350.6	139.2
3	48.00	6.04	3.93	1.96	876.5	304.0	75.4	379.4	152.0
3	50.00	6.30	4.09	2.05	913.6	330.7	78.6	409.3	165.3
3	52.00	6.56	4.26	2.13	950.8	358.5	81.8	440.3	179.3
3	54.00	6.81	4.42	2.21	987.9	387.4	85.0	472.4	193.7
3	56.00	7.07	4.59	2.30	1025.0	417.4	88.2	505.6	208.7
3	58.00	7.32	4.76	2.38	1062.1	448.6	91.3	539.9	224.3
3	60.00	7.58	4.92	2.46	1099.2	480.8	94.5	575.3	240.4
0	60.00	7.58	.00	.00	.0	480.8	.0	480.8	240.4

191-34 = 157'

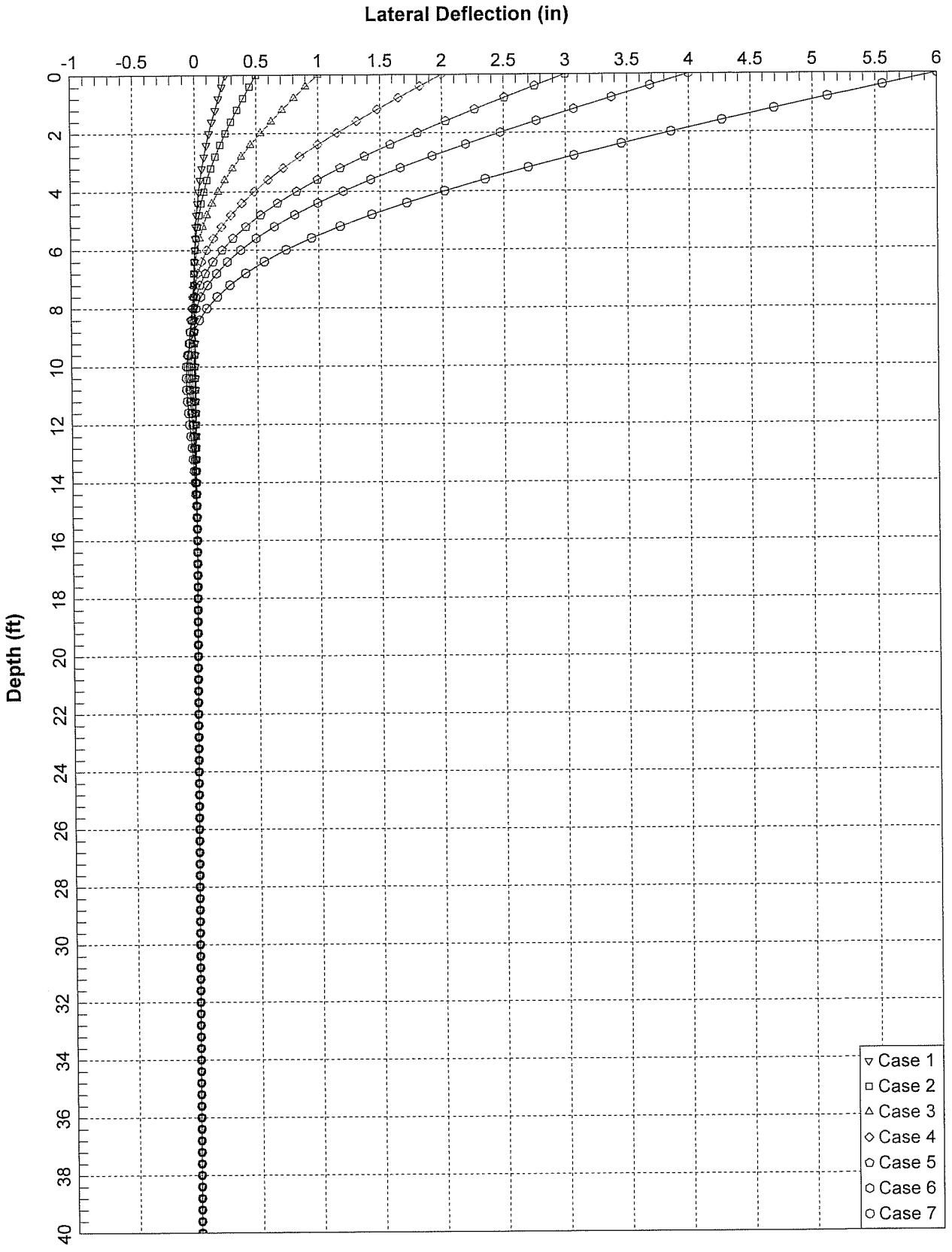

Lateral Deflection (in)
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Lateral Solutions (Strong Axis) for RW 462 - H=16' SW on RW



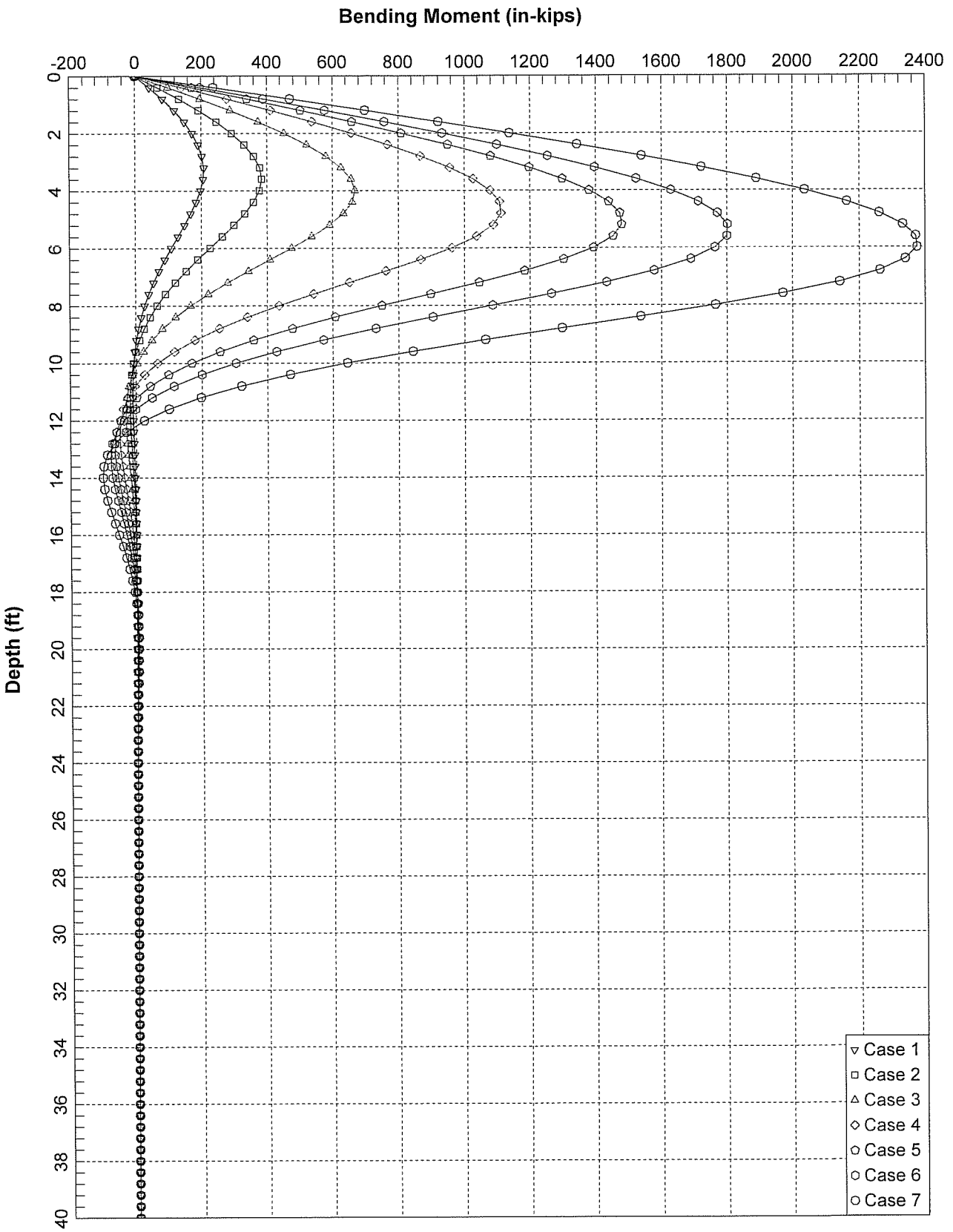
Lateral Solutions (Strong Axis) for RW 462 - H=16' SW on RW

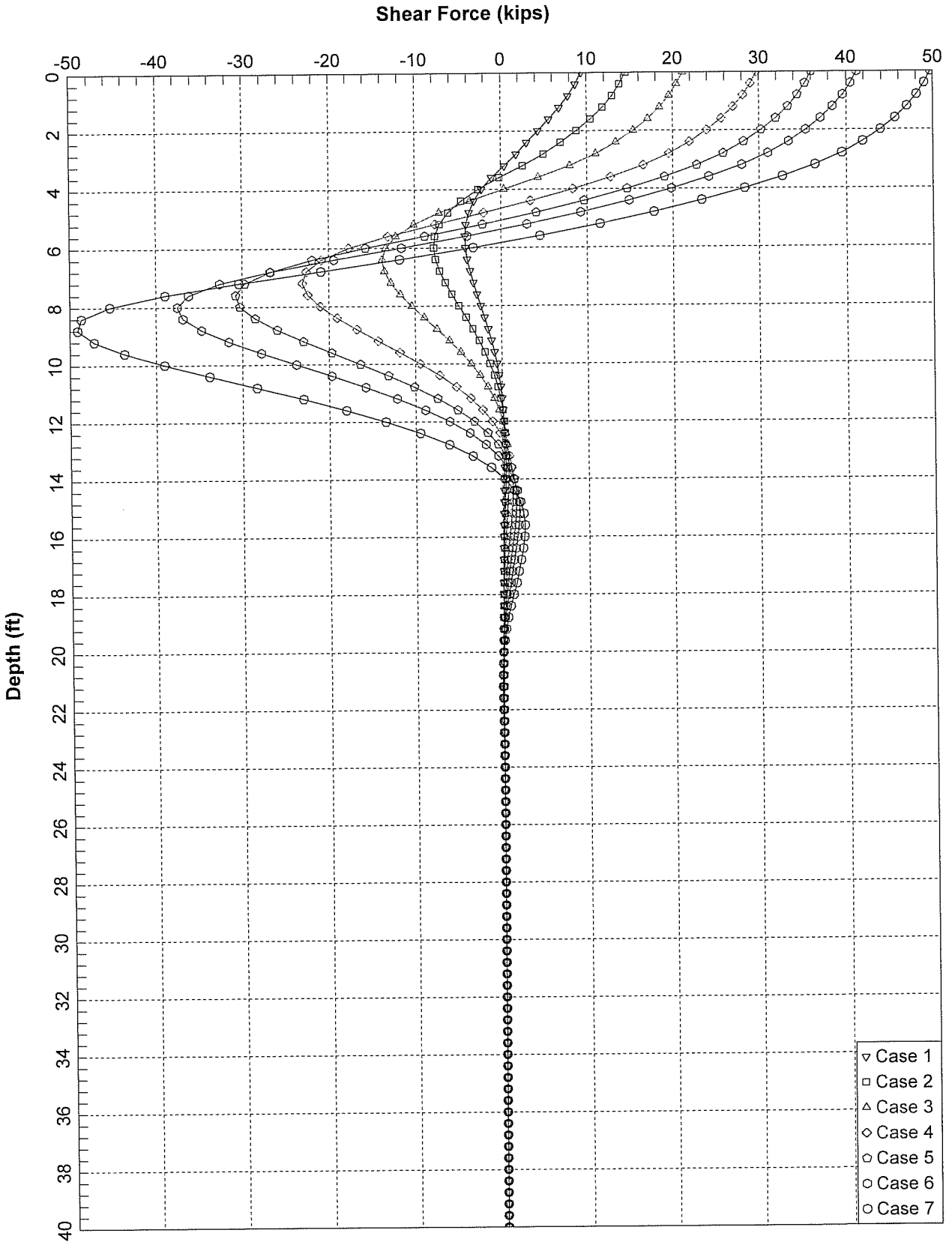


Lateral Solutions (Strong Axis) for RW 462 - H=16' SW on RW



Lateral Solutions (Weak Axis) for RW 462 - H=16' SW on RW


Bending Moment (in-kips)
-200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Lateral Solutions (Weak Axis) for RW 462 - H=16' SW on RW



Lateral Solutions (Weak Axis) for RW 462 - H=16' SW on RW

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project RW492 Project No. _____

By CCY Date 2/25/08 Checked By _____ Date _____ Sheet ___ of ___

12 PCC

H=18 Type 1 RW

El 224' — depth 0
γ=120 pcf
C=1.4 ksf
ε_{50}=0.008

205 — 16
γ=123 pcf
C=2 ksf
ε_{50}=0.005

180 — 41
γ=125 pcf
ϕ=36°
K=150 pci

H=16 SW on RW

El 224' — depth 0'
γ=120 pcf
C=1.4 ksf
ε_{50}=0.008

(58)' — 42'
γ=123 pcf
C=2 ksf
ε_{50}=0.005

$A = 144\ in^2 = 1\ ft^2$

$I = \frac{1}{12} 12^4 = 1728$ $\quad I_{cr} = \frac{1}{2} I$

$E_c = 57000\sqrt{4000} = 3600$ ksi

```
**********************************************************************************
2/25/2009  YCT
RW492-H=18' Type I RW - 12"PCC
**********************************************************************************

SOIL DATA
---------------------------------
NUMBER OF SOIL UNITS =      3
DEPTH TO WATER TABLE =    60.00'
UNIT WEIGHT OF WATER =    .0624 kcf

SOIL      DEPTH      UNIT WT.  CLAY:  c  (ksf)    Nc     Cac    Cat
UNIT   (ft)     (ft)   (kcf)     SAND: PHI (deg)   Nq     Khc    Kht    delta (deg)
-------------------------------------------------------------------------------
  1     .0 -  16.0    .120     CLAY     1.40        9.    .50    .50
  1   16.0 -  41.0    .120     CLAY     2.00        9.    .50    .50
  1   41.0 -  62.0    .120     SAND    36.00       62.   1.00    .50    31.00


PILE DATA                 PILE TOP    PILE TIP
-----------------------------------------------
DEPTH                  =       .00      62.00'
CIRCUMFERENCE          =     4.000      4.000'
CROSS-SECTIONAL AREA =     1.0000     1.0000 ft2

PILE STIFFNESS                                AE/L =      99999. kips/ft
DISPLACEMENT TO MOBILIZE FULL SKIN FRICTION =  1.670E-02' (= 2.004E-01")
DISPLACEMENT TO MOBILIZE FULL END BEARING   =  5.800E-02' (= 6.960E-01")
DEPTH INCREMENT FOR CAPACITY CALCULATIONS   =  2.00'
FACTOR OF SAFETY FOR SKIN FRICTION          =  1.00
FACTOR OF SAFETY FOR END-BEARING            =  1.00

-------------------------------------------------------------------------------
SOIL  DEPTH  EFF.  UNIT SKIN FRICT  UNIT END  CUM.FR.   END      CAPACITY
UNIT         STRESS COMPR. UPLIFT   BEARING   COMPR.  BEARING  COMPRESS  UPLIFT
  -   (ft)   (ksf)  (ksf)  (ksf)    (ksf)    (kips)  (kips)   (kips)    (kips)
-------------------------------------------------------------------------------
  1    .00    .00    .70     .70      12.6       .0     12.6     12.6       .0
  1   2.00    .24    .70     .70      12.6      5.6     12.6     18.2       5.6
  1   4.00    .48    .70     .70      12.6     11.2     12.6     23.8      11.2
  1   6.00    .72    .70     .70      12.6     16.8     12.6     29.4      16.8
  1   8.00    .96    .70     .70      12.6     22.4     12.6     35.0      22.4
  1  10.00   1.20    .70     .70      12.6     28.0     12.6     40.6      28.0
  1  12.00   1.44    .70     .70      12.6     33.6     12.6     46.2      33.6
  1  14.00   1.68    .70     .70      12.6     39.2     12.6     51.8      39.2
  1  16.00   1.92    .70     .70      12.6     44.8     12.6     57.4      44.8
  2  16.00   1.92   1.00    1.00      18.0     44.8     18.0     62.8      44.8
  2  18.00   2.16   1.00    1.00      18.0     52.8     18.0     70.8      52.8
  2  20.00   2.40   1.00    1.00      18.0     60.8     18.0     78.8      60.8
  2  22.00   2.64   1.00    1.00      18.0     68.8     18.0     86.8      68.8
  2  24.00   2.88   1.00    1.00      18.0     76.8     18.0     94.8      76.8
  2  26.00   3.12   1.00    1.00      18.0     84.8     18.0    102.8      84.8
  2  28.00   3.36   1.00    1.00      18.0     92.8     18.0    110.8      92.8
  2  30.00   3.60   1.00    1.00      18.0    100.8     18.0    118.8     100.8
  2  32.00   3.84   1.00    1.00      18.0    108.8     18.0    126.8     108.8
  2  34.00   4.08   1.00    1.00      18.0    116.8     18.0    134.8     116.8
  2  36.00   4.32   1.00    1.00      18.0    124.8     18.0    142.8     124.8
  2  38.00   4.56   1.00    1.00      18.0    132.8     18.0    150.8     132.8
  2  40.00   4.80   1.00    1.00      18.0    140.8     18.0    158.8     140.8
  2  41.00   4.92   1.00    1.00      18.0    144.8     18.0    162.8     144.8
  3  41.00   4.92   2.96    1.48     305.0    144.8    305.0    449.8     144.8   221-43=178'
  3  43.00   5.16   3.10    1.55     319.9    169.0    319.9    488.9     156.9  =>
  3  45.00   5.40   3.24    1.62     334.8    194.4    334.8    529.2     169.6
  3  47.00   5.64   3.39    1.69     349.7    220.9    349.7    570.6     182.9
  3  49.00   5.88   3.53    1.77     364.6    248.6    364.6    613.2     196.7
  3  51.00   6.12   3.68    1.84     379.4    277.5    379.4    656.9     211.1
  3  53.00   6.36   3.82    1.91     394.3    307.5    394.3    701.8     226.1
  3  55.00   6.60   3.97    1.98     409.2    338.6    409.2    747.8     241.7
  3  57.00   6.84   4.11    2.05     424.1    370.9    424.1    795.0     257.9
  3  59.00   7.08   4.25    2.13     439.0    404.4    439.0    843.3     274.6
  3  60.00   7.20   4.33    2.16     446.4    421.5    446.4    867.9     283.2
  3  62.00   7.32   4.40    2.20     453.5    456.4    453.5    910.0     300.6
  0  62.00   7.32    .00     .00       .0     456.4      .0     456.4     300.6
-------------------------------------------------------------------------------
```

****

2/25/2009 YCT
RW492-H=16' SW on RW - 12"PCC

****

SOIL DATA

NUMBER OF SOIL UNITS = 2
DEPTH TO WATER TABLE = 60.00'
UNIT WEIGHT OF WATER = .0624 kcf

SOIL UNIT	DEPTH (ft)		(ft)	UNIT WT. (kcf)	CLAY: SAND:	c (ksf) PHI (deg)	Nc Nq	Cac Khc	Cat Kht	delta (deg)
1	.0	-	42.0	.120	CLAY	1.40	9.	.50	.50	
1	42.0	-	62.0	.120	CLAY	2.00	15.	.50	.50	

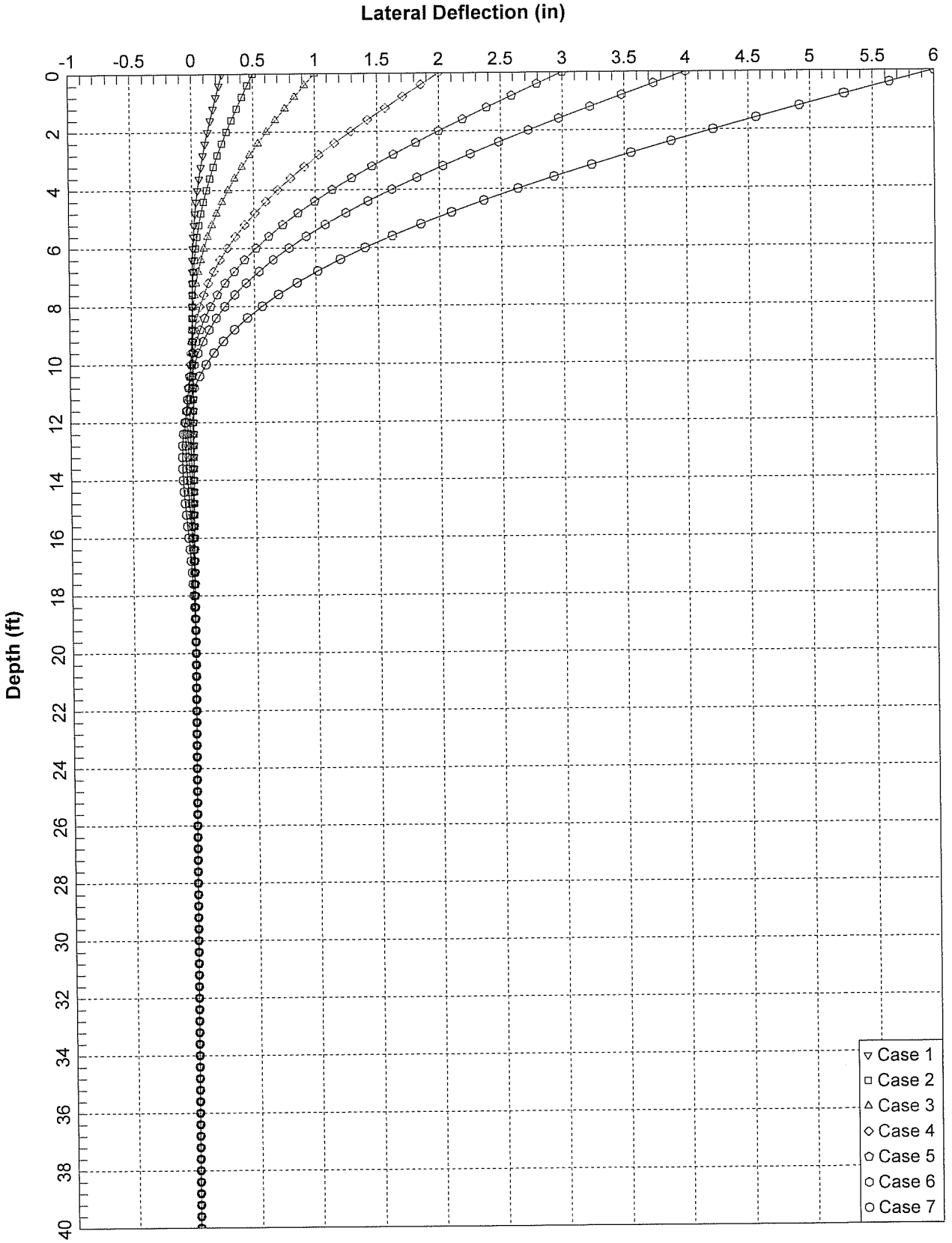
PILE DATA

	PILE TOP	PILE TIP
DEPTH =	.00	62.00'
CIRCUMFERENCE =	4.000	4.000'
CROSS-SECTIONAL AREA =	1.0000	1.0000 ft2

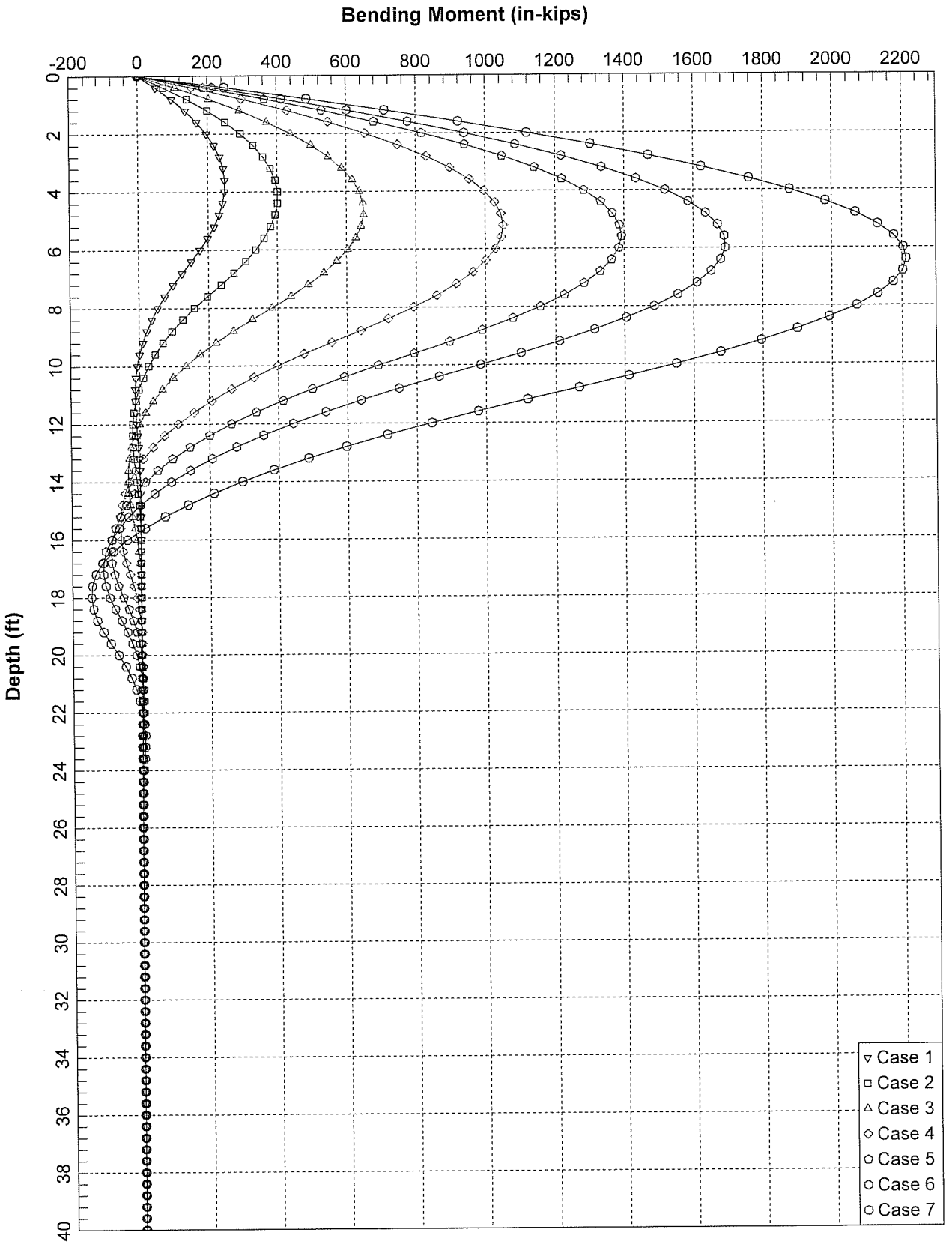
PILE STIFFNESS AE/L = 99999. kips/ft
DISPLACEMENT TO MOBILIZE FULL SKIN FRICTION = 1.670E-02' (= 2.004E-01")
DISPLACEMENT TO MOBILIZE FULL END BEARING = 5.800E-02' (= 6.960E-01")
DEPTH INCREMENT FOR CAPACITY CALCULATIONS = 2.00'
FACTOR OF SAFETY FOR SKIN FRICTION = 1.00
FACTOR OF SAFETY FOR END-BEARING = 1.00

SOIL UNIT -	DEPTH (ft)	EFF. STRESS (ksf)	UNIT SKIN FRICT COMPR. (ksf)	UPLIFT (ksf)	UNIT END BEARING (ksf)	CUM.FR. COMPR. (kips)	END BEARING (kips)	CAPACITY COMPRESS (kips)	UPLIFT (kips)
1	.00	.00	.70	.70	12.6	.0	12.6	12.6	.0
1	2.00	.24	.70	.70	12.6	5.6	12.6	18.2	5.6
1	4.00	.48	.70	.70	12.6	11.2	12.6	23.8	11.2
1	6.00	.72	.70	.70	12.6	16.8	12.6	29.4	16.8
1	8.00	.96	.70	.70	12.6	22.4	12.6	35.0	22.4
1	10.00	1.20	.70	.70	12.6	28.0	12.6	40.6	28.0
1	12.00	1.44	.70	.70	12.6	33.6	12.6	46.2	33.6
1	14.00	1.68	.70	.70	12.6	39.2	12.6	51.8	39.2
1	16.00	1.92	.70	.70	12.6	44.8	12.6	57.4	44.8
1	18.00	2.16	.70	.70	12.6	50.4	12.6	63.0	50.4
1	20.00	2.40	.70	.70	12.6	56.0	12.6	68.6	56.0
1	22.00	2.64	.70	.70	12.6	61.6	12.6	74.2	61.6
1	24.00	2.88	.70	.70	12.6	67.2	12.6	79.8	67.2
1	26.00	3.12	.70	.70	12.6	72.8	12.6	85.4	72.8
1	28.00	3.36	.70	.70	12.6	78.4	12.6	91.0	78.4
1	30.00	3.60	.70	.70	12.6	84.0	12.6	96.6	84.0
1	32.00	3.84	.70	.70	12.6	89.6	12.6	102.2	89.6
1	34.00	4.08	.70	.70	12.6	95.2	12.6	107.8	95.2
1	36.00	4.32	.70	.70	12.6	100.8	12.6	113.4	100.8
1	38.00	4.56	.70	.70	12.6	106.4	12.6	119.0	106.4
1	40.00	4.80	.70	.70	12.6	112.0	12.6	124.6	112.0
1	42.00	5.04	.70	.70	12.6	117.6	12.6	130.2	117.6
2	42.00	5.04	1.00	1.00	30.0	117.6	30.0	147.6	117.6
2	44.00	5.28	1.00	1.00	30.0	125.6	30.0	155.6	125.6
2	46.00	5.52	1.00	1.00	30.0	133.6	30.0	163.6	133.6
2	48.00	5.76	1.00	1.00	30.0	141.6	30.0	171.6	141.6
2	50.00	6.00	1.00	1.00	30.0	149.6	30.0	179.6	149.6
2	52.00	6.24	1.00	1.00	30.0	157.6	30.0	187.6	157.6
2	54.00	6.48	1.00	1.00	30.0	165.6	30.0	195.6	165.6
2	56.00	6.72	1.00	1.00	30.0	173.6	30.0	203.6	173.6
2	58.00	6.96	1.00	1.00	30.0	181.6	30.0	211.6	181.6
2	60.00	7.20	1.00	1.00	30.0	189.6	30.0	219.6	189.6
2	62.00	7.32	1.00	1.00	30.0	197.6	30.0	227.6	197.6
0	62.00	7.32	.00	.00	.0	197.6	.0	197.6	197.6

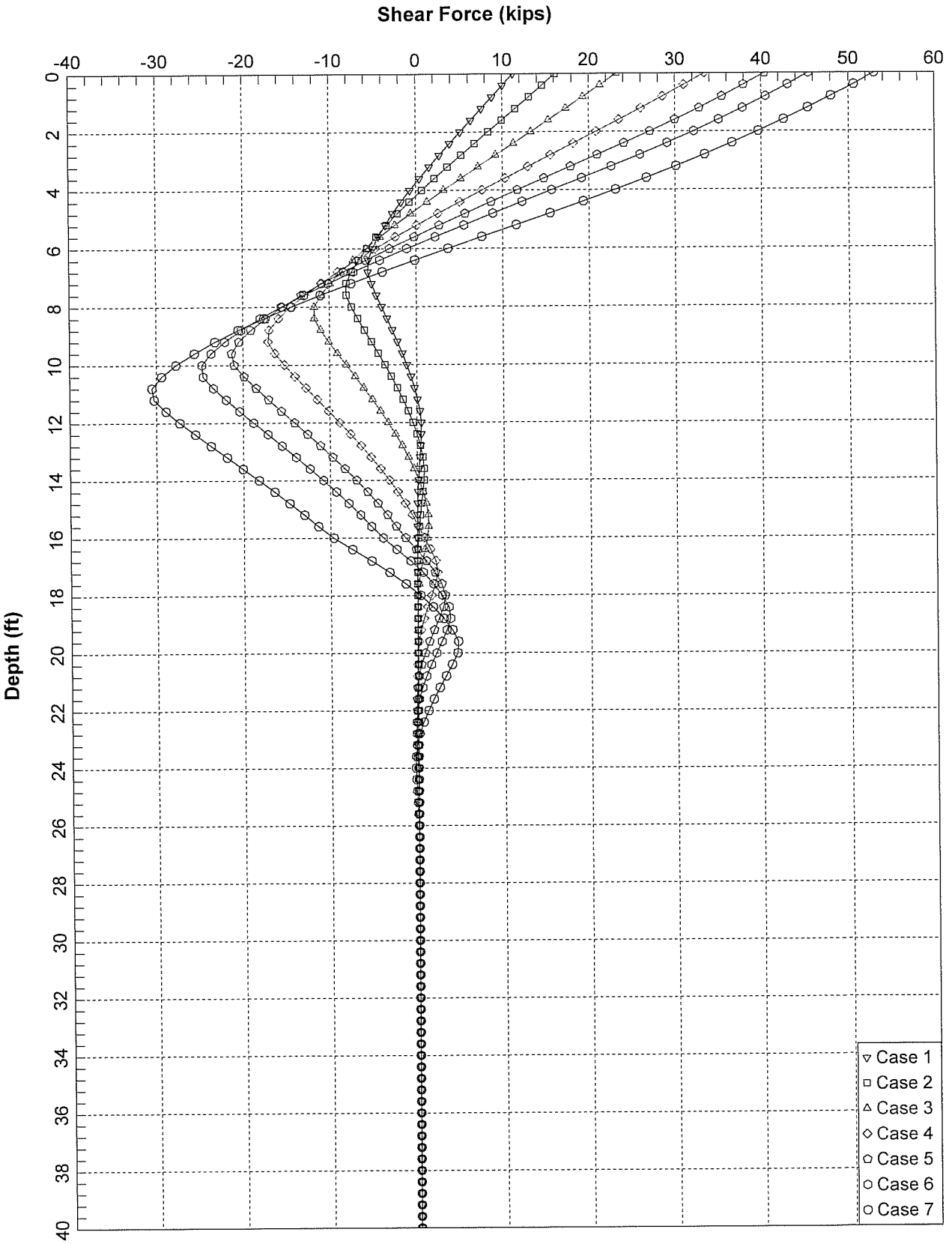
224-51=173'



Lateral Solutions for RW 492 - H=16' Type 1 RW and H=18' SW on RW



Lateral Solutions for RW 492 - H=16' Type 1 RW and H=18' SW on RW



Lateral Solutions for RW 492 - H=16' Type 1 RW and H=18' SW on RW

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project RW 496 Project No. _____

By ETY Date 2/22/09 Checked By _____ Date _____ Sheet ____ of ____

HP 10X42

EL

214 — $c = 2$ ksf
$\gamma = 130$ pcf
$\varepsilon_{50} = 0.005$

depth 0

204 — $c = 3$ ksf
$\gamma = 130$ pcf
$\varepsilon_{50} = 0.005$

10

199 — $\phi = 38°$
$\gamma = 128$ pcf
$k = 200$ pci

15

****

2/25/2009 YCT
RW496 - H=26' SW on RW - HP10x42

****

SOIL DATA

NUMBER OF SOIL UNITS = 3
DEPTH TO WATER TABLE = 60.00'
UNIT WEIGHT OF WATER = .0624 kcf

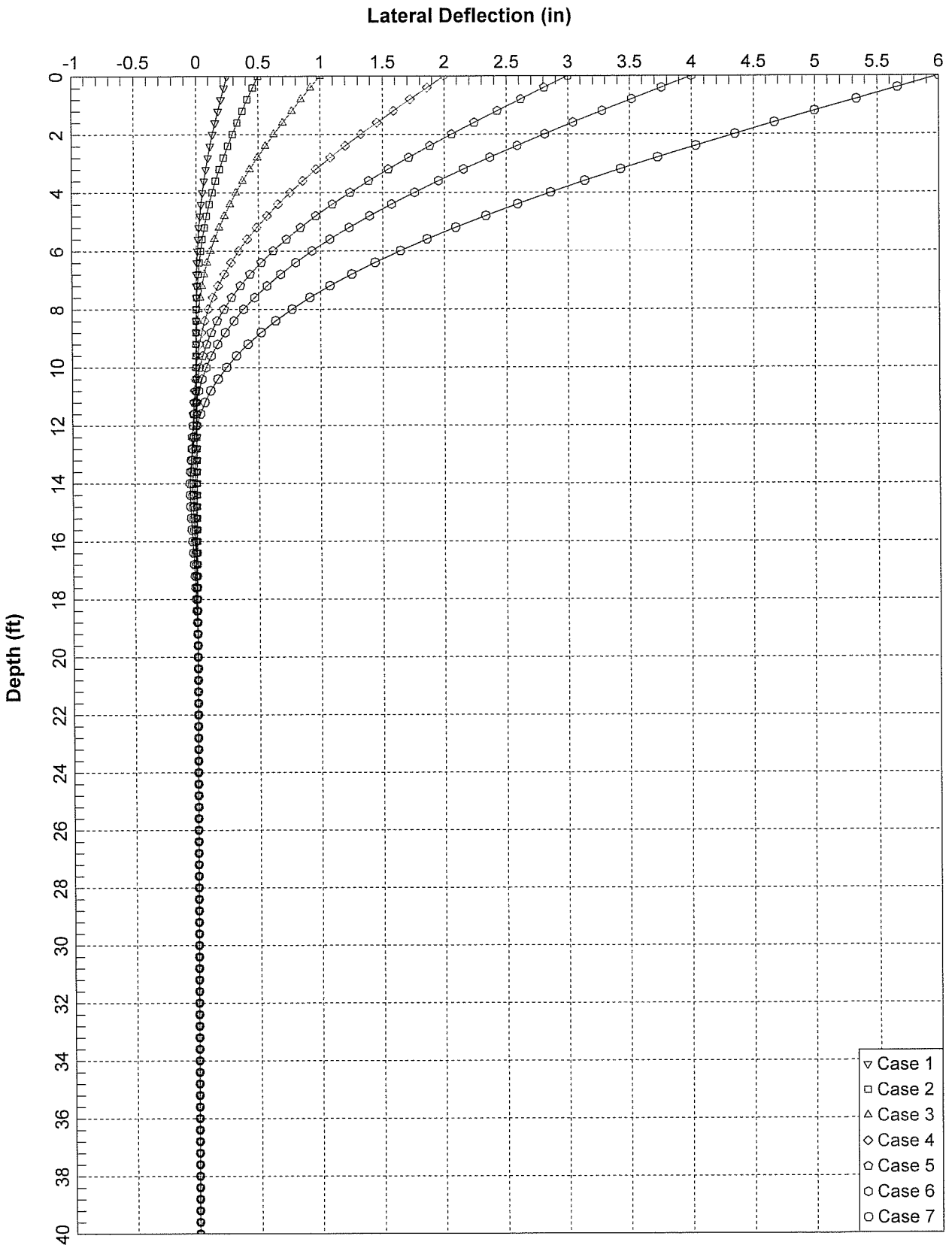
SOIL UNIT	DEPTH (ft)		UNIT WT. (kcf)	CLAY: SAND:	c (ksf) PHI (deg)	Nc Nq	Cac Khc	Cat Kht	delta (deg)
1	.0 -	10.0	.123	CLAY	2.00	0.	.50	.50	
1	10.0 -	15.0	.125	CLAY	3.00	0.	.50	.50	
1	15.0 -	60.0	.128	SAND	38.00	145.	1.00	.50	33.00

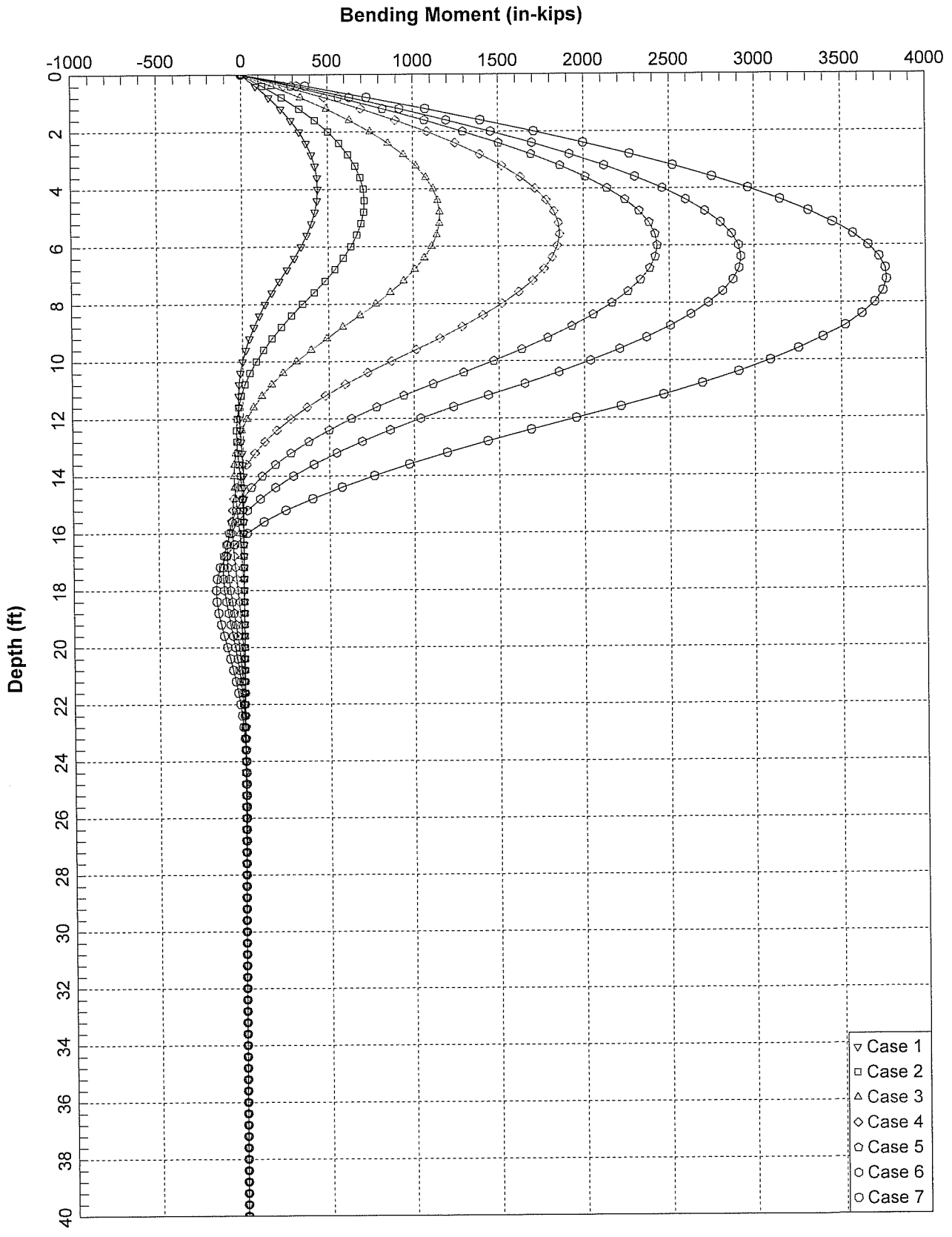
PILE DATA	PILE TOP	PILE TIP
DEPTH =	.00	60.00'
CIRCUMFERENCE =	3.330	3.330'
CROSS-SECTIONAL AREA =	.0860	.0860 ft2

PILE STIFFNESS AE/L = 99999. kips/ft
DISPLACEMENT TO MOBILIZE FULL SKIN FRICTION = 1.670E-02' (= 2.004E-01")
DISPLACEMENT TO MOBILIZE FULL END BEARING = 5.800E-02' (= 6.960E-01")
DEPTH INCREMENT FOR CAPACITY CALCULATIONS = 2.00'
FACTOR OF SAFETY FOR SKIN FRICTION = 1.00
FACTOR OF SAFETY FOR END-BEARING = 1.00

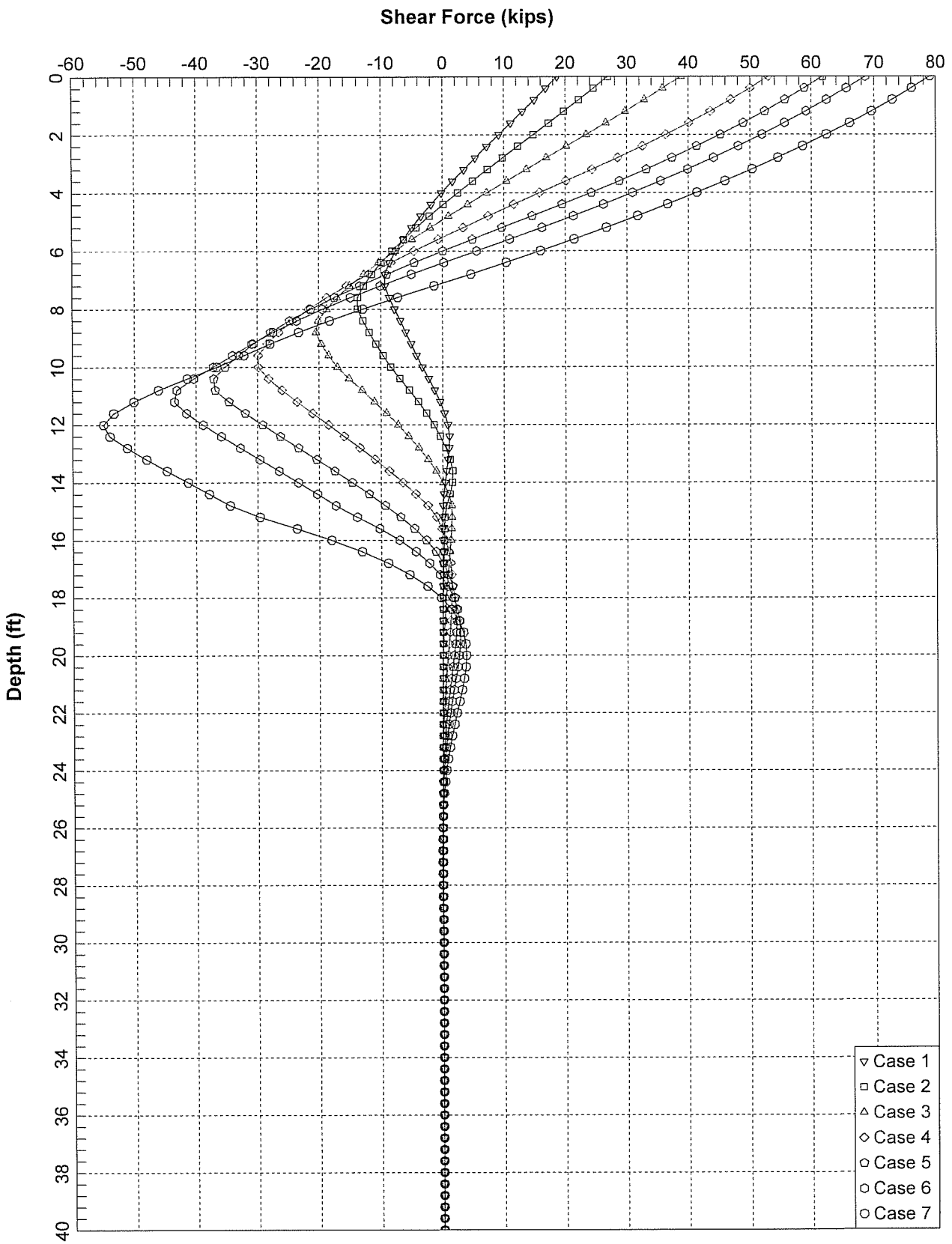
SOIL UNIT -	DEPTH (ft)	EFF. STRESS (ksf)	UNIT SKIN FRICT COMPR. (ksf)	UPLIFT (ksf)	UNIT END BEARING (ksf)	CUM.FR. COMPR. (kips)	END BEARING (kips)	CAPACITY COMPRESS (kips)	UPLIFT (kips)
1	.00	.00	1.00	1.00	.0	.0	.0	.0	.0
1	2.00	.25	1.00	1.00	.0	6.7	.0	6.7	6.7
1	4.00	.49	1.00	1.00	.0	13.3	.0	13.3	13.3
1	6.00	.74	1.00	1.00	.0	20.0	.0	20.0	20.0
1	8.00	.98	1.00	1.00	.0	26.6	.0	26.6	26.6
1	10.00	1.23	1.00	1.00	.0	33.3	.0	33.3	33.3
2	10.00	1.23	1.50	1.50	.0	33.3	.0	33.3	33.3
2	12.00	1.48	1.50	1.50	.0	43.3	.0	43.3	43.3
2	14.00	1.73	1.50	1.50	.0	53.3	.0	53.3	53.3
2	15.00	1.85	1.50	1.50	.0	58.3	.0	58.3	58.3
3	15.00	1.85	1.20	.60	269.0	58.3	23.1	81.4	58.3
3	17.00	2.11	1.37	.69	306.1	66.9	26.3	93.2	62.6
3	19.00	2.37	1.54	.77	343.2	76.5	29.5	106.1	67.4
3	21.00	2.62	1.70	.85	380.3	87.3	32.7	120.0	72.8
3	23.00	2.88	1.87	.93	417.5	99.2	35.9	135.1	78.7
3	25.00	3.13	2.04	1.02	454.6	112.2	39.1	151.3	85.3
3	27.00	3.39	2.20	1.10	491.7	126.3	42.3	168.6	92.3
3	29.00	3.65	2.37	1.18	528.8	141.6	45.5	187.0	99.9
3	31.00	3.90	2.53	1.27	565.9	157.9	48.7	206.6	108.1
3	33.00	4.16	2.70	1.35	603.1	175.3	51.9	227.2	116.8
3	35.00	4.41	2.87	1.43	640.2	193.9	55.1	248.9	126.1
3	37.00	4.67	3.03	1.52	677.3	213.5	58.2	271.8	135.9
3	39.00	4.93	3.20	1.60	714.4	234.3	61.4	295.7	146.3
3	41.00	5.18	3.37	1.68	751.5	256.1	64.6	320.8	157.2
3	43.00	5.44	3.53	1.77	788.7	279.1	67.8	346.9	168.7
3	45.00	5.69	3.70	1.85	825.8	303.2	71.0	374.2	180.7
3	47.00	5.95	3.86	1.93	862.9	328.4	74.2	402.6	193.3
3	49.00	6.21	4.03	2.02	900.0	354.7	77.4	432.1	206.5
3	51.00	6.46	4.20	2.10	937.1	382.1	80.6	462.7	220.2
3	53.00	6.72	4.36	2.18	974.3	410.6	83.8	494.4	234.4
3	55.00	6.97	4.53	2.26	1011.4	440.2	87.0	527.2	249.2
3	57.00	7.23	4.70	2.35	1048.5	470.9	90.2	561.1	264.6
3	59.00	7.49	4.86	2.43	1085.6	502.7	93.4	596.1	280.5
3	60.00	7.61	4.95	2.47	1104.2	519.1	95.0	614.0	288.7
0	60.00	7.61	.00	.00	.0	519.1	.0	519.1	288.7

214 - 31' = 183'

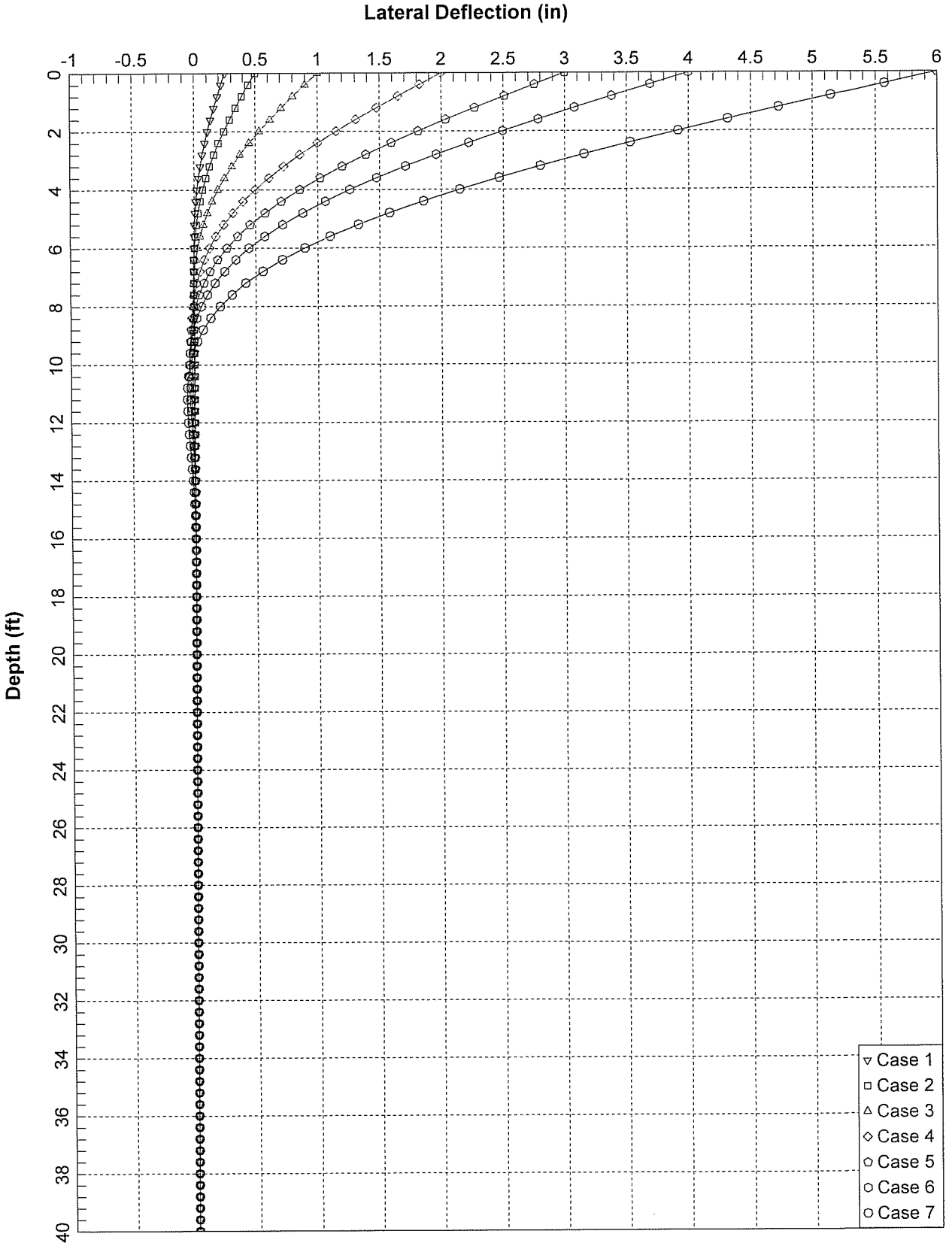

Lateral Deflection (in)
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Lateral Solutions (Strong Axis) for RW 496 - H=26' SW on RW

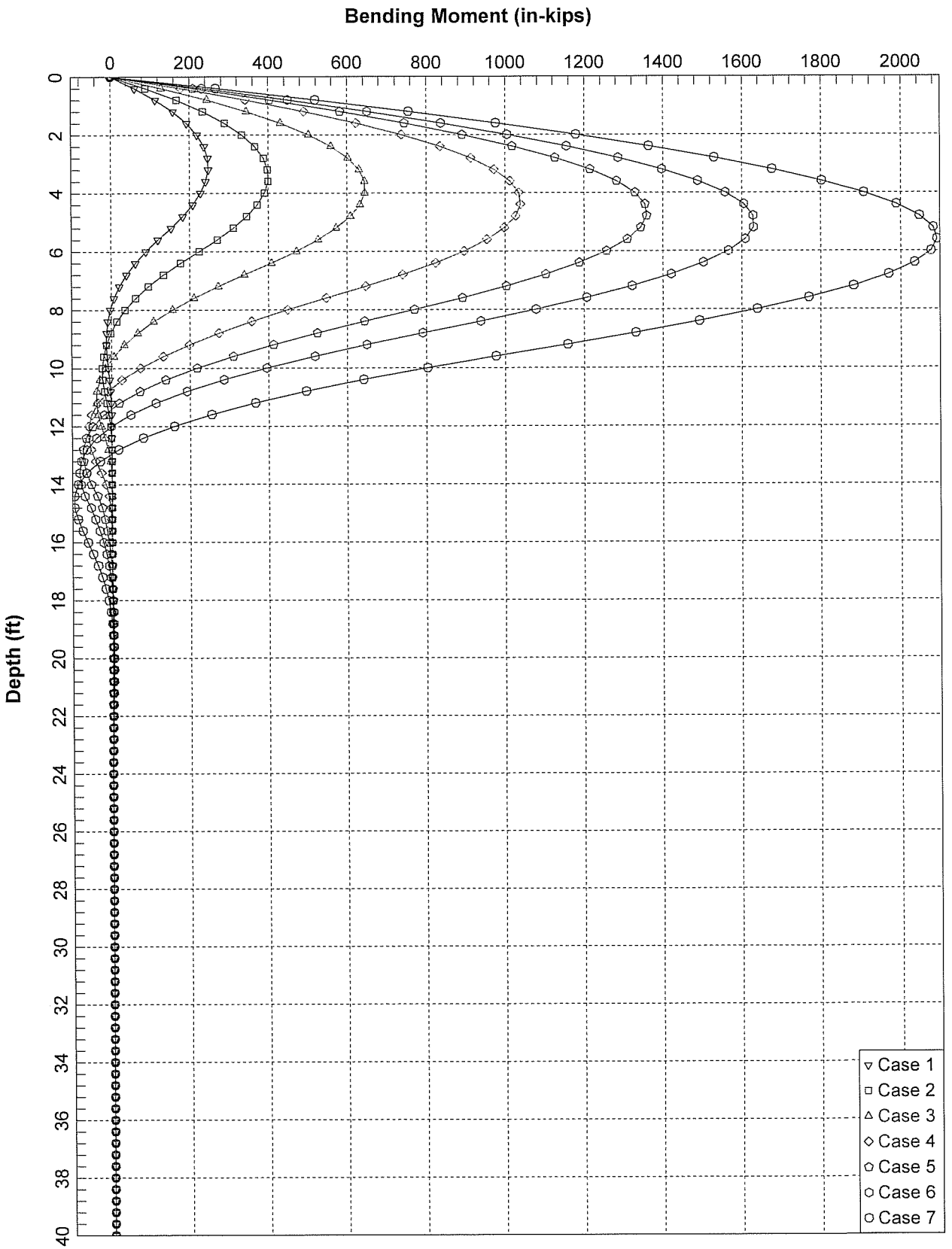


Lateral Solutions (Strong Axis) for RW 496 - H=26' SW on RW

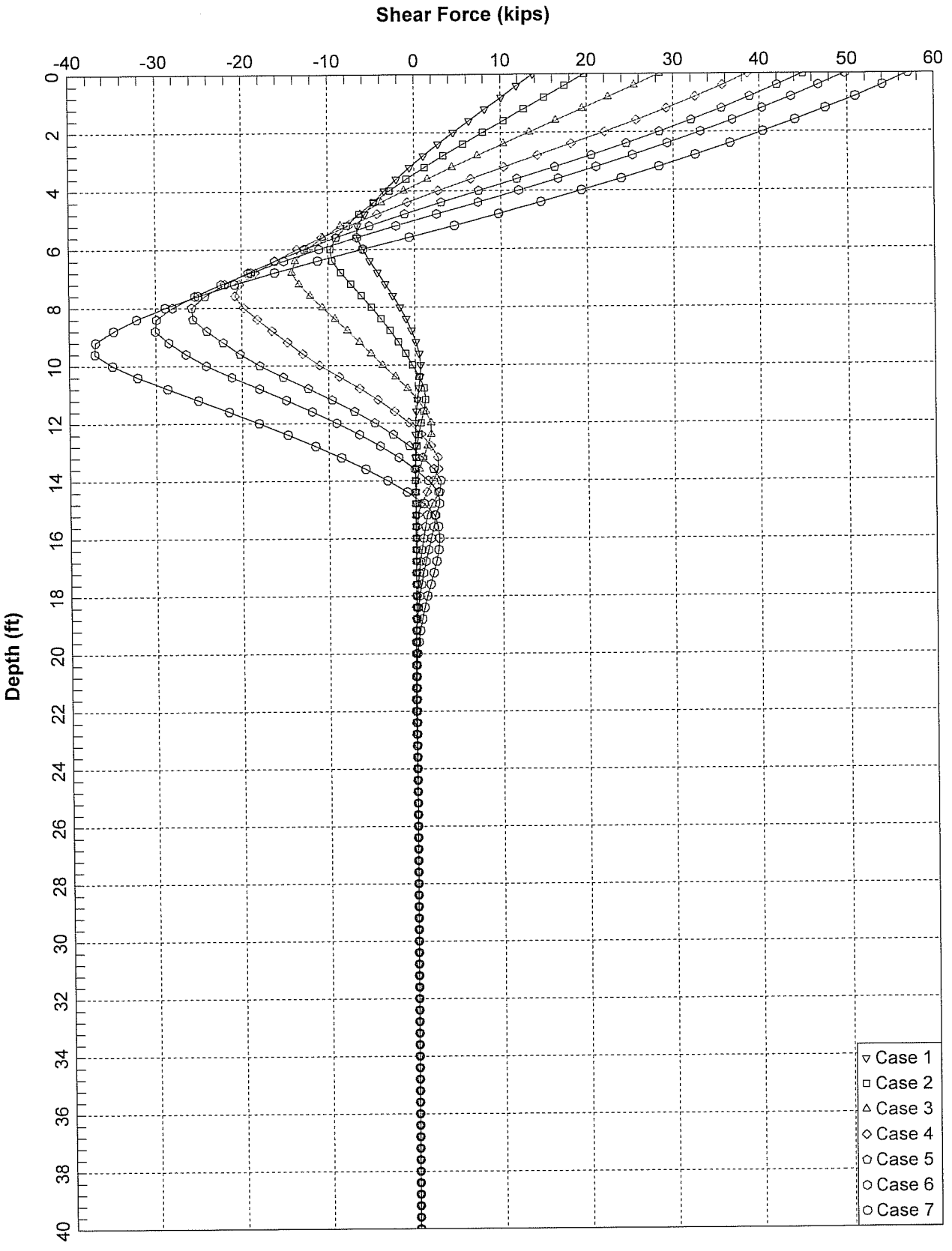


Lateral Solutions (Strong Axis) for RW 496 - H=26' SW on RW


Lateral Deflection (in)
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Lateral Solutions (Weak Axis) for RW 496 - H=26' SW on RW



Lateral Solutions (Weak Axis) for RW 496 - H=26' SW on RW



Lateral Solutions (Weak Axis) for RW 496 - H=26' SW on RW

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Duncomer Y. Har
REGISTERED CIVIL ENGINEER

May 1, 2006
PLANS APPROVAL DATE

Duncomer Y. Har, No. C45803, Exp. 12-31-06, CIVIL, REGISTERED PROFESSIONAL ENGINEER, STATE OF CALIFORNIA

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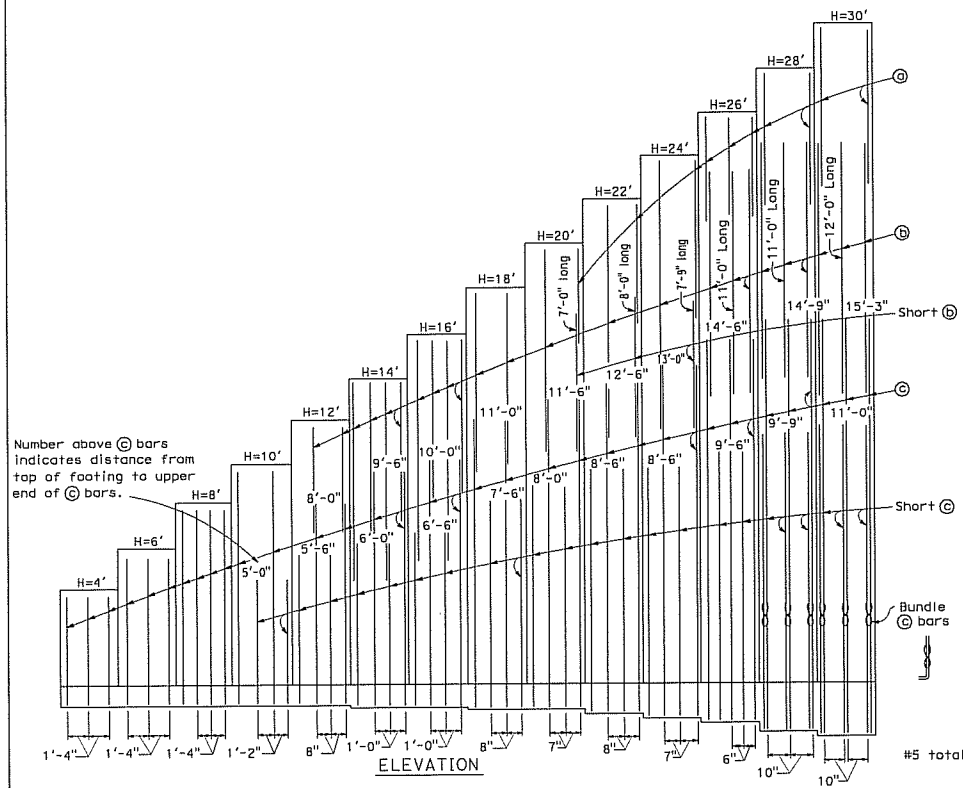
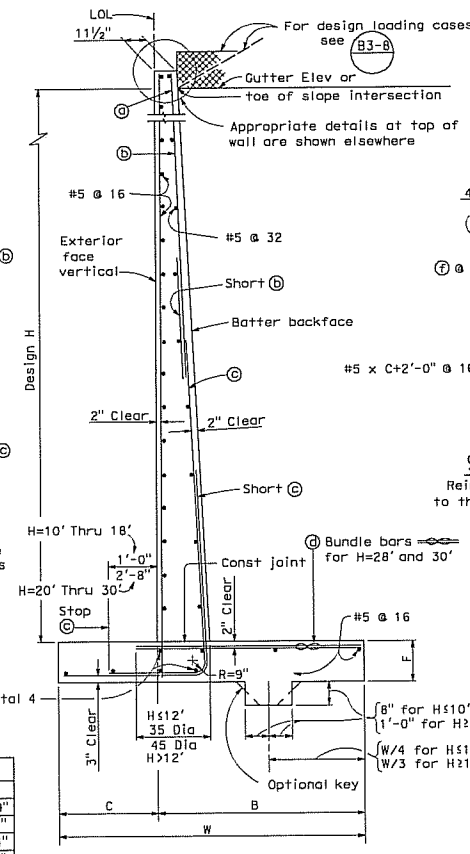
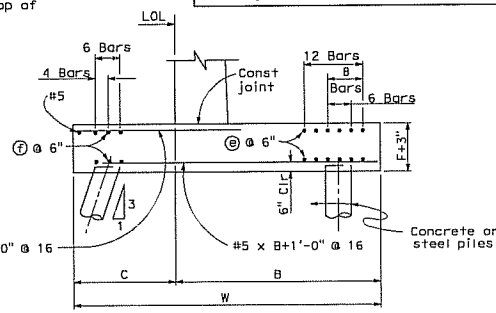


ELEVATION



SPREAD FOOTING SECTION



90 KIP PILE FOOTING SECTION

Reinforcement detailed is to be placed in addition to that shown for spread footing. All piles not shown, see pile layout on other sheets.

TABLE OF REINFORCING STEEL DIMENSIONS AND DATA

Design H		4'	6'	8'	10'	12'	14'	16'	18'	20'	22'	24'	26'	28'	30'
W		3'-3"	4'-3"	5'-3"	6'-3"	7'-3"	8'-0"	9'-0"	10'-0"	11'-0"	12'-1"	13'-3"	14'-3"	15'-3"	16'-9"
C		1'-0"	1'-4"	1'-8"	2'-0"	2'-4"	2'-7"	2'-11"	3'-3"	3'-7"	3'-11"	4'-5"	4'-9"	5'-1"	5'-5"
B		2'-3"	2'-11"	3'-7"	4'-3"	4'-11"	5'-5"	6'-1"	6'-9"	7'-5"	8'-2"	8'-10"	9'-6"	10'-2"	11'-4"
F		1'-4"	1'-4"	1'-4"	1'-4"	1'-4"	1'-6"	1'-6"	1'-6"	1'-6"	1'-8"	1'-10"	2'-2"	2'-6"	2'-9"
Batter		1/2:12	1/2:12	1/2:12	1/2:12	1/2:12	1/2:12	1/2:12	1/2:12	1/2:12	1/2:12	5/8:12	3/4:12	3/4:12	7/8:12
ⓐ	bars	—	—	—	—	—	—	—	—	#5 @ 28	#5 @ 32	#5 @ 28	#5 @ 12	#5 @ 20	#8 @ 20
ⓑ	bars	—	—	—	—	#5 @ 16	#5 @ 12	#5 @ 12	#6 @ 16	#8 @ 14	#8 @ 16	#8 @ 14	#8 @ 12	#8 @ 10	#9 @ 10
ⓒ	bars	#5 @ 16	#5 @ 16	#5 @ 16	#6 @ 14	#6 @ 8	#8 @ 12	#9 @ 12	#9 @ 8	#9 @ 7	#11 @ 8	#11 @ 7	#11 @ 6	#11 @ 10⅋	#11 @ 10⅋
ⓓ	bars	#5 @ 16	#5 @ 16	#5 @ 16	#5 @ 14	#5 @ 8	#8 @ 12	#9 @ 12	#9 @ 8	#9 @ 7	#11 @ 8	#11 @ 7	#11 @ 6	#11 @ 10⅋	#11 @ 10⅋
Total ⓔ	bars	6-#6	6-#6	6-#6	12-#6	12-#6	12-#6	12-#6	8-#6	8-#6	8-#6	6-#6	6-#6	6-#6	6-#6
Total ⓕ	bars	—	—	—	6-#6	6-#6	6-#6	6-#6	6-#6	6-#6	6-#6	4-#5	4-#5	4-#5	4-#5
Loading Case I	Toe Pressure ksf	1.7	1.9	2.2	2.5	2.8	3.3	3.5	4.0	4.3	4.6	4.9	5.3	5.7	6.3
Loading Case II	Toe Pressure ksf	1.1	1.5	2.0	2.3	2.7	3.3	3.7	4.2	4.7	5.5	6.0	6.5	7.1	7.5
Loading Case III	Toe Pressure Ksf	1.4	1.7	2.1	2.5	2.9	3.4	3.8	4.3	4.8	5.4	5.8	6.5	7.2	7.5

⅋ Denotes a bundle of 2 bars

NOTES:

1. For details not shown and drainage notes see B3-8
2. For wall stem joint details see B0-3 3-3 and B0-3 3-4
3. For pile footing for design H=4' use same footing dimensions as for design H=6'.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

RETAINING WALL TYPE 1 H=4' THROUGH 30'

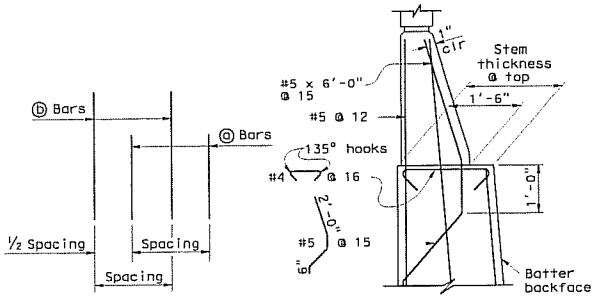
NO SCALE

B3-1

8-1-05

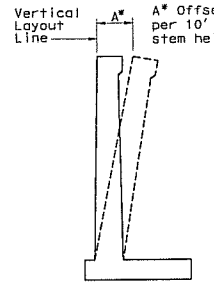
GENERAL NOTES

1. For soundwall and retaining wall architectural finish or texture, see details elsewhere in project plans.
2. For details not shown and drainage notes, see B3-8
3. Footing cover, 1'-6" minimum.
4. Limit of no splicing rebars = 3 times the bottom thickness of the stem.
5. Placement of reinforcements :
   - ⓑ & ⓒ bars are spliced together.
   - ✳ ⓐ & ⓑ bars are bundled together.
   - ✳✳ Alternate ⓐ & ⓑ bars are shown in "Detail B".
   - Cont = Continuous.
6. For Soundwall & Barrier reinforcement, see "Soundwall Masonry Block on Barriers" sheets in Standard Plans.



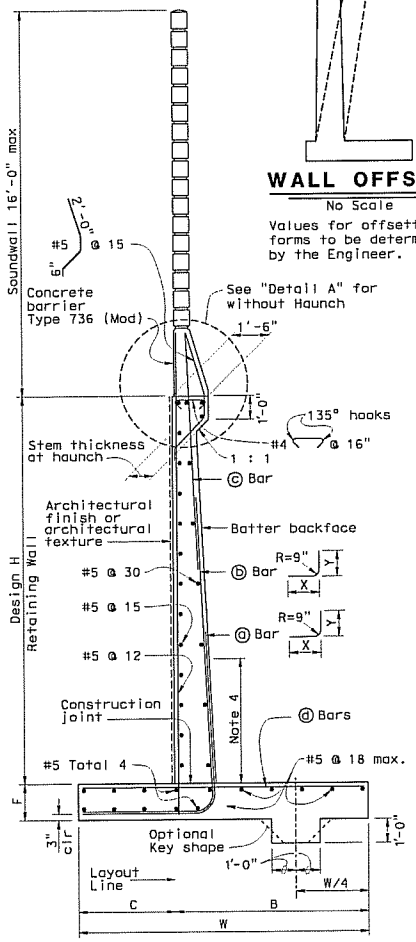
DETAIL B
No Scale

DETAIL A WITHOUT HAUNCH
No Scale



WALL OFFSET
No Scale

Values for offsetting forms to be determined by the Engineer.



SPREAD FOOTING SECTION
No Scale

DESIGN DATA

DESIGN: Load Factor Design (LFD)

CONCRETE: Reinforced Concrete, f'c = 3600 psi
fy = 60,000 psi

LOADING CASE:
Level ground with 240 psf surcharge and 16' Soundwall

Seismic Load	= 0.3 Dead Load
Wind Load	= 30 psf
Dead Load of Soundwall	= 1414 lb/ft
Dead Load of Barrier	= 372 lb/ft

SEISMIC LOAD: SOIL
Kh = 0.3g
Kv = 0.0
Kae : Mononobe-Okabe Method

SOIL: ø = 34° γ = 120 pcf
Equivalent fluid pressure:
= 36 pcf for determination of toe pressure
= 27 pcf for determination of heel pressure

EXTERNAL STABILITY:
Group 1 : D + E + SC
Group 2 : D + E + SC + W
Group 3 : D + PYM

INTERNAL STABILITY (LFD):
Group A : βD + 1.7E + 1.7SC
Group B : βD + 1.7E + 1.3W
Group C (stem) : 1.0D + 1.0E + 1.0EQD + 1.0EQE
Group C (footing) : D + PYM

Where : β = 1.0 or 1.3 whichever controls design
D = Dead Load
E = Lateral Earth Pressure
SC = Surcharge
W = Wind load
EQD = Seismic Dead Load
EQE = Seismic Lateral Earth Pressure
PYM = Probable Yield Moment (1.3 x Nominal Yield Moment of Stem)

TABLE 1: TABLE OF REINFORCING STEEL DIMENSIONS AND DATA

	Stem With Haunch													
Design H	6'	8'	10'	12'	14'	16'	18'	20'	22'	24'	26'	28'	30'	32'
W	7'-9"	8'-0"	8'-9"	9'-9"	10'-9"	12'-0"	13'-0"	14'-3"	15'-3"	16'-6"	18'-6"	19'-9"	21'-3"	22'-6"
C	2'-9"	2'-9"	3'-0"	3'-3"	3'-6"	4'-0"	4'-3"	4'-9"	5'-0"	5'-6"	6'-3"	6'-9"	7'-3"	7'-9"
B	5'-0"	5'-3"	5'-9"	6'-6"	7'-3"	8'-0"	8'-9"	9'-6"	10'-3"	11'-0"	12'-3"	13'-0"	14'-0"	14'-9"
F Spread footing	1'-3"	1'-3"	1'-3"	1'-3"	1'-3"	1'-6"	1'-6"	1'-9"	2'-0"	2'-3"	2'-9"	3'-0"	3'-3"	3'-9"
Batter	0	1/2 :12	1/2 :12	1/2 :12	1/2 :12	1/2 :12	1/2 :12	1/2 :12	1/2 :12	5/8 :12	3/4 :12	7/8 :12	1 :12	1 :12
Stem thickn. @ Haunch	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
ⓐ Bars				#6 @18**	#7 @18**	#8 @18**	#9 @18**	#10 @16**	#8 @ 9*	#8 @ 9*	#7 @ 6*	#10 @12**	#9 @ 9*	#11@12**
X				Cont	Cont	Cont	Cont	Cont	Cont	Cont	Cont	Cont	Cont	Cont
Y				8'-0"	6'-6"	7'-6"	8'-6"	9'-6"	9'-6"	11'-0"	11'-0"	13'-0"	14'-0"	15'-6"
ⓑ Bars	#5 @12	#5 @12	#5 @ 9	#6 @18**	#7 @18**	#8 @18**	#9 @18**	#10 @16**	#8 @ 9*	#8 @ 9*	#7 @ 6*	#10 @12**	#9 @ 9*	#11@12**
X	Cont	Cont	Cont	Cont	Cont	Cont	Cont	Cont	Cont	5'-6"	6'-6"	7'-0"	8'-0"	8'-6"
Y	Cont	Cont	Cont	Cont	10'-6"	13'-0"	15'-0"	17'-6"	19'-6"	21'-0"	18'-6"	19'-0"	25'-6"	23'-6"
ⓒ Bars					#6 @18	#6 @18	#6 @18	#6 @18	#6 @18	#6 @18	#6 @12	#7 @12	#7 @18	#7 @12
ⓓ Bars	#5 @12	#5 @12	#5 @12	#5 @ 9	#6 @ 9	#6 @ 9	#6 @ 6	#8 @ 9	#8 @ 9	#8 @ 9	#7 @ 6	#7 @ 6	#9 @ 9	#9 @ 9
Ultimate Bearing Capacity Req'd k/sf	~~4.6~~	~~5.5~~	~~6.1~~	~~6.6~~	~~7.3~~	~~8.1~~	~~9.0~~	~~9.9~~	~~11.3~~	~~12.2~~	~~12.5~~	~~13.4~~	~~14.1~~	~~15.4~~

TABLE 2: TABLE OF REINFORCING STEEL DIMENSIONS AND DATA

	Stem With Haunch						Stem Without Haunch						
Design H	8'	10'	12'	14'	16'	18'	20'	22'	24'	26'	28'	30'	32'
W	8'-0"	8'-6"	9'-3"	10'-3"	11'-3"	13'-0"	13'-9"	16'-0"	16'-6"	18'-6"	20'-0"	20'-6"	21'-9"
C	2'-9"	2'-9"	3'-0"	3'-6"	3'-9"	4'-3"	4'-6"	5'-3"	5'-6"	6'-3"	6'-9"	6'-9"	7'-6"
B	5'-3"	5'-9"	6'-3"	6'-9"	7'-6"	8'-9"	9'-3"	10'-9"	11'-0"	12'-3"	13'-3"	13'-9"	14'-3"
F Spread footing	1'-3"	1'-3"	1'-3"	1'-3"	1'-6"	1'-6"	1'-9"	2'-0"	2'-3"	2'-9"	3'-0"	3'-3"	3'-6"
Batter	0	0	0	0	0	0	0	0	0	1/4 :12	1/2 :12	1/2 :12	1/2 :12
Stem thickn. @ Haunch	1'-0"	1'-0"	1'-0"	1'-0"	1'-3"	1'-3"							
Stem thickn. @ top							1'-6"	2'-0"	2'-0"	2'-0"	2'-0"	2'-0"	2'-0"
ⓐ Bars			#6 @12**	#5 @ 6*	#9 @18**	#9 @12**	#9 @12**	#9 @12**	#7 @ 6*	#7 @ 6*	#7 @ 6*	#9 @ 9*	#11@12**
X			Cont	Cont	Cont	Cont	Cont	Cont	Cont	Cont	Cont	Cont	Cont
Y			5'-6"	5'-6"	8'-6"	8'-6"	8'-6"	8'-6"	9'-6"	11'-0"	12'-6"	13'-6"	14'-6"
ⓑ Bars	#5 @ 9	#6 @ 9	#6 @12**	#5 @ 6*	#9 @18**	#9 @12**	#9 @12**	#9 @12**	#7 @ 6*	#7 @ 6*	#7 @ 6*	#9 @ 9*	#11@12**
X	Cont	Cont	Cont	Cont	Cont	Cont	Cont	Cont	5'-6"	6'-0"	7'-6"	7'-6"	8'-0"
Y	Cont	Cont	Cont	Cont	11'-6"	11'-6"	12'-0"	12'-0"	17'-6"	20'-0"	21'-6"	24'-0"	24'-0"
ⓒ Bars					#7 @18	#7 @12	#7 @12	#7 @12	#6 @ 12	#6 @ 12	#6 @12	#7 @18	#7 @12
ⓓ Bars	#5 @12	#5 @ 9	#5 @9	#6 @ 9	#6 @ 9	#9 @12	#9 @12	#7 @#7	6 @ 6	#7 @ 6	#7 @ 6	#9 @ 9	#9 @ 9
Ultimate Bearing Capacity Req'd k/sf	~~5.5~~	~~6.5~~	~~7.3~~	~~7.6~~	~~9.0~~	~~9.0~~	~~10.6~~	~~10.5~~	~~12.2~~	~~12.6~~	~~13.3~~	~~15.4~~	~~16.0~~

DIST.	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

REGISTERED ENGINEER - CIVIL

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STANDARD DRAWING

FILE NO. xs14-220e

APPROVED BY G. WANG — RESPONSIBLE TECHNICAL SPECIALIST
APPROVAL DATE 5-19-08

RELEASED BY ROBERTO LACALLE — RESPONSIBLE OFFICE CHIEF
RELEASE DATE 5-19-08

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF ENGINEERING SERVICES

CU
EA

BRIDGE NO.
POST MILE

RETAINING WALL TYPE 1SWB

SHEET OF

REVISION DATES (PRELIMINARY STAGE ONLY)

DISREGARD PRINTS BEARING EARLIER REVISION DATES

USERNAME = rwil

xs14-220e.dgn

DS DSD 21474 ENGLISH STANDARD DRAWING "XS" BORDER REV. 01/11/08)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

SUMMARY OF DESIGN BEARING PRESSURES
RETAINING WALL TYPE 1SWB (XS SHEET)

	WORKING LEVEL:		FACTORED:		
	q_{toe}	q_{heel}	q_{toe}	q_{heel}	
H = 22 FT	3.972	2.169	15.587	0.000	
H = 20 FT	3.574	2.063	12.152	0.000	
H = 18 FT	3.361	1.891	10.135	0.000	
H = 16 FT	3.100	1.768	9.955	0.000	
H = 14 FT	2.915	1.592	11.752	0.000	
H = 12 FT	2.683	1.465	9.921	0.000	
H = 10 FT	2.475	1.345	8.766	0.000	
H = 8 FT	2.222	1.271	6.444	0.000	
H = 6 FT	1.880	1.227	4.373	0.000	

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Douglas J. Dunrud
REGISTERED CIVIL ENGINEER

May 1, 2006
PLANS APPROVAL DATE

Douglas J. Dunrud No. C47240 Exp. 12-31-07 CIVIL STATE OF CALIFORNIA

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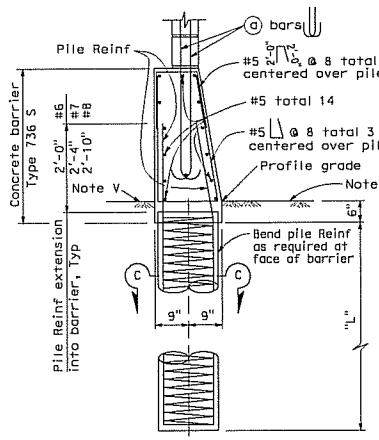
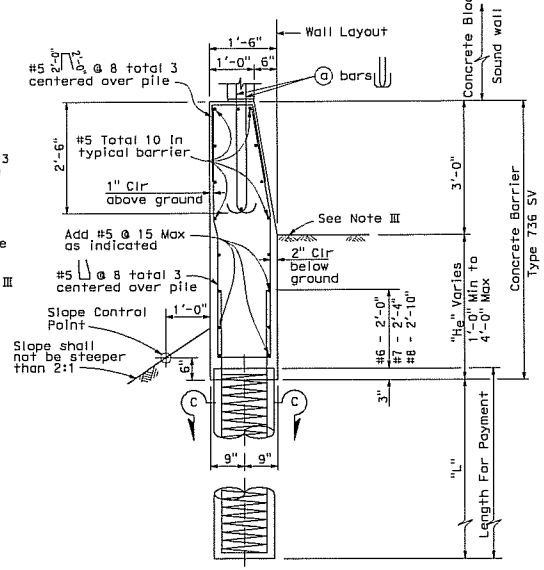


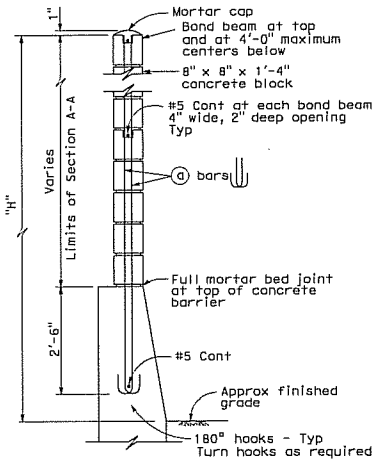
CASE 1

For details not shown, See Case 2.
Level ground ±10% on both sides of barrier.

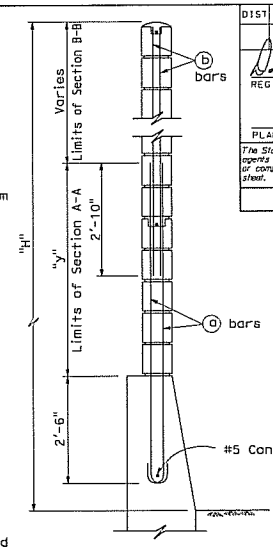


CASE 2

For details not shown, See Case 1.
Level ground ±10% at the traffic side of barrier and sloping ground on the opposite side.



H=6'-4" THRU H=10'-4"



H=12'-4" THRU H=16'-4"

For details not shown, see H=6'-4" thru H=10'-4".

TYPICAL SECTIONS

See Standard Plan B15-8 for pile details.

SOUND WALL REINFORCEMENT TABLE

Maximum H	ⓐ bars @ 1'-4" Max	ⓑ bars @ 1'-4" Max	"y"	f'm (psi)	Compressive Strength of CMU (psi)	H
6'-4"	#4	---	---	1500	1900	6'-4"
8'-4"	#4	---	---	1500	1900	8'-4"
10'-4"	#4	---	---	1500	1900	10'-4"
12'-4"	#5	#4	5'-0"	1500	1900	12'-4"
14'-4"	#6	#4	7'-0"	1500	1900	14'-4"
16'-4"	#6	#4	9'-0"	2500	3750	16'-4"

NOTES I THROUGH VI:

I. Details shown are primarily to conform design of sound walls to Type 736S and Type 736 SV Concrete Barriers. For sound wall details conforming with barriers see Standard Plans B15-7 and B15-8.

II. For details and sections not shown, see Standard Plans B15-7 and B15-8.

III. Slope ground at traffic side of barrier to drain. Maximum slope ±10%. See Std Plan B11-56, Note D.

IV. Pile spacing may be varied, but shall not exceed the tabular values. See Standard Plan B15-8.

V. For Case 1 - ground line to be at the same elevation on both sides of the barrier. Barrier shall not be used to retain earth.

VI. See Standard Plan B15-9 for other details.

NOTES A THROUGH G:

A. For type of block, type of block bond, and joint finish, see other sheets.

B. When blocks are laid in stacked bond, ladder type, galvanized joint reinforcement shall be provided. A minimum of 2-12 gauge wires continuous at 4'-0" maximum to be used. Locate reinforcement in joints that are at the approximate midpoint between bond beams.

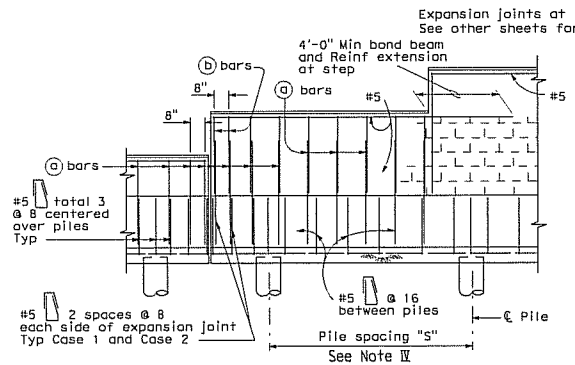
C. Horizontal joints shall be tooled concave or may be weathered. Vertical joints shall be tooled concave or may be raked.

D. For intermediate wall heights (H), or barrier depths (H_e), that are between the values given, use the tabular information for the next higher (H) or (H_e).

E. Class 2 concrete to be used for the barrier.

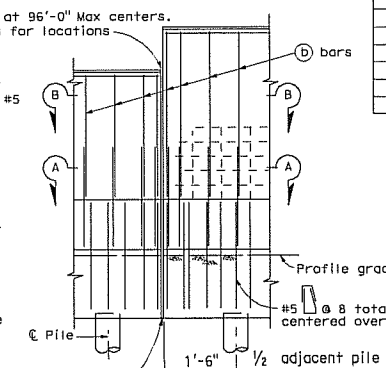
F. Masonry strengths are listed in the "SOUND WALL REINFORCEMENT TABLE".

BARRIER SECTIONS



CASE 1

For details not shown, See Case 2.



CASE 2

For details not shown, See Case 1.

PARTIAL ELEVATIONS

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

SOUND WALL MASONRY BLOCK ON TYPE 736S/SV BARRIER DETAILS (1)

NO SCALE

B15-6

2-14-06

Return to Table of Contents

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Douglas J. Dunrud
REGISTERED CIVIL ENGINEER

May 1, 2006
PLANS APPROVAL DATE

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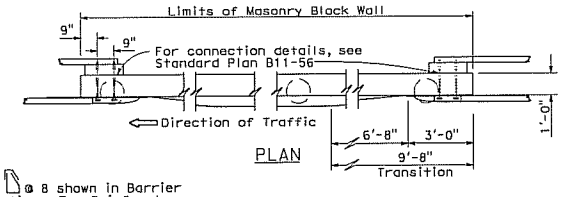
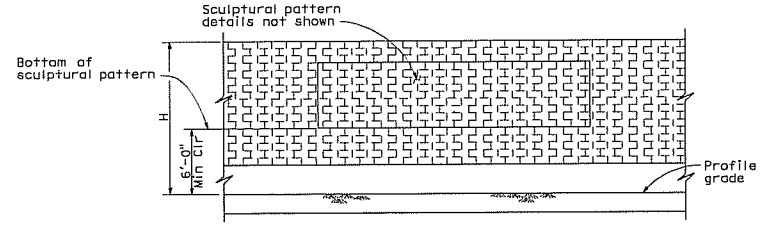
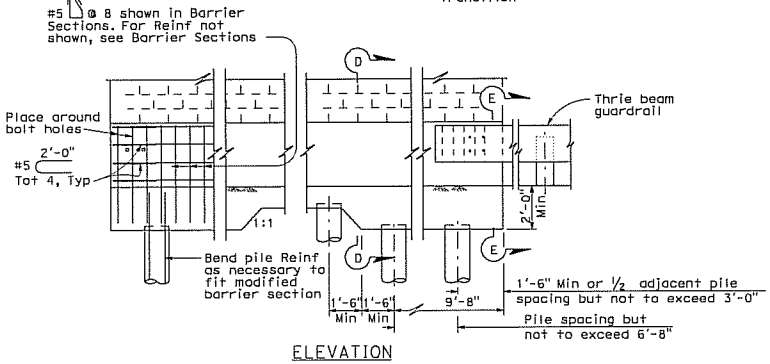


PLAN



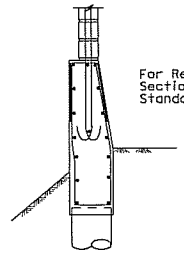
CLEARANCE DETAIL



ELEVATION

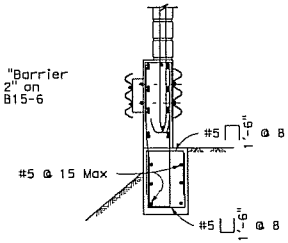
METAL BEAM GUARDRAIL ANCHORAGE

For details not shown, see Standard Plan B11-56.

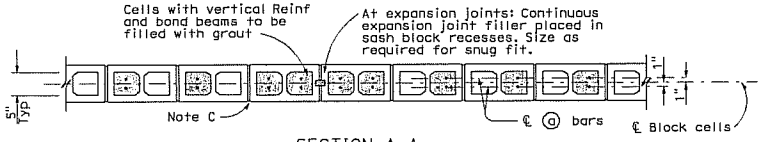


SECTION D-D

For Reinf, see "Barrier Sections Case 2" on Standard plan B15-6



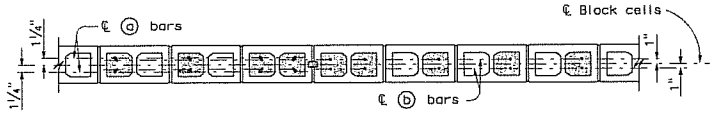
SECTION E-E



SECTION A-A

For details not shown, see other details.

H=6'-4" THRU H=10-4"



SECTION A-A SECTION B-B

For details not shown, see other details.

H=12'-4" THRU H=16'-4"

DESIGN NOTES:

DESIGN

Uniform Building Code, 1997 Edition and the Bridge Design Specifications.

DESIGN WIND LOAD

27 psf

DESIGN SEISMIC LOAD

0.57 Dead load

REINFORCED CONCRETE

f'c = 3.6 ksi
fy = 60 ksi

CONCRETE MASONRY

REGULAR STRENGTH	HIGH STRENGTH	
f'm = 1500 psi	f'm = 2000 psi	f'm = 2500 psi
fb = 495 psi	fb = 660 psi	fb = 830 psi
fs = 24,000 psi	fs = 24,000 psi	fs = 24,000 psi
n = 25.8	n = 19.3	n = 15.5

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

SOUND WALL MASONRY BLOCK ON TYPE 736S/SV BARRIER DETAILS (2)

NO SCALE

B15-7

2-14-06

Return to Table of Contents

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS

Douglas J. Durrud
REGISTERED CIVIL ENGINEER

May 1, 2006
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
Douglas J. Durrud
No. C47240
Exp. 12-31-07
CIVIL
STATE OF CALIFORNIA

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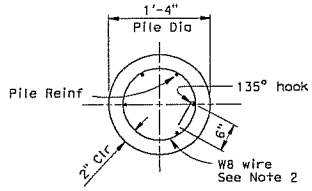
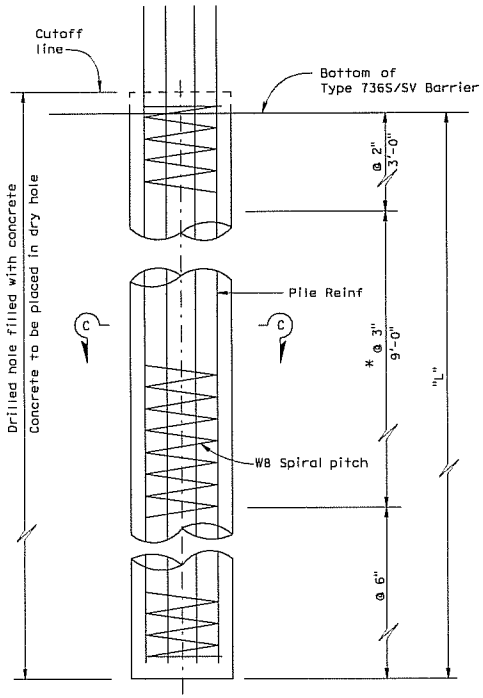


SECTION C-C



ELEVATION

* @ 2" at option of Contractor.

CASE 1: PILE DATA TABLE

Maximum H	θ = 25 Min S	θ = 25 Min L	θ = 25 Min Pile Reinf	θ = 30 Min S	θ = 30 Min L	θ = 30 Min Pile Reinf	θ = 35 Min S	θ = 35 Min L	θ = 35 Min Pile Reinf	Maximum H
6'-4"	10'-0"	8'-6"	#6 Tol 6	10'-0"	7'-0"	#6 Tol 6	10'-0"	6'-0"	#6 Tol 6	6'-4"
8'-4"	10'-0"	9'-6"	#6 Tol 6	10'-0"	8'-0"	#6 Tol 6	10'-0"	7'-0"	#6 Tol 6	8'-4"
10'-4"	10'-0"	10'-6"	#6 Tol 6	10'-0"	9'-0"	#6 Tol 6	10'-0"	7'-6"	#6 Tol 6	10'-4"
12'-4"	10'-0"	11'-6"	#7 Tol 6	10'-0"	9'-6"	#7 Tol 6	10'-0"	8'-6"	#6 Tol 6	12'-4"
14'-4"	10'-0"	12'-6"	#7 Tol 7	10'-0"	10'-6"	#7 Tol 7	10'-0"	9'-0"	#7 Tol 7	14'-4"
16'-4"	10'-0"	13'-0"	#8 Tol 7	10'-0"	11'-6"	#8 Tol 7	10'-0"	9'-6"	#7 Tol 7	16'-4"

CASE 2: PILE DATA TABLE

H_e	Maximum H	θ = 30 Min S	θ = 30 Min L	θ = 30 Min Pile Reinf	θ = 35 Min S	θ = 35 Min L	θ = 35 Min Pile Reinf	Maximum H
1'-0"	6'-4"	10'-0"	15'-0"	#7 Tol 6	10'-0"	12'-0"	#6 Tol 6	6'-4"
	8'-4"	9'-9"	16'-0'	#7 Tol 6	10'-0"	13'-0"	#7 Tol 6	8'-4"
	10'-4"	8'-0"	16'-0"	#7 Tol 6	10'-0"	14'-0"	#7 Tol 6	10'-4"
	12'-4"	6'-9"	16'-0"	#7 Tol 6	10'-0"	15'-0"	#8 Tol 7	12'-4"
	14'-4"	5'-9"	16'-0"	#7 Tol 6	9'-6"	15'-6'	#8 Tol 7	14'-4"
	16'-4"	5'-0"	16'-0"	#7 Tol 6	8'-9"	16'-0"	#8 Tol 7	16'-4"
2'-0"	6'-4"	8'-3"	16'-0"	#7 Tol 6	10'-0"	13'-6"	#7 Tol 6	6'-4"
	8'-4"	7'-0"	16'-0"	#7 Tol 6	10'-0"	14'-6"	#7 Tol 7	8'-4"
	10'-4"	6'-0"	16'-0"	#7 Tol 6	10'-0"	15'-3'	#8 Tol 7	10'-4"
	12'-4"	5'-3"	16'-0"	#7 Tol 6	9'-9"	16'-0"	#8 Tol 7	12'-4"
	14'-4"	4'-6"	16'-0"	#7 Tol 6	8'-4"	16'-0"	#8 Tol 7	14'-4"
	16'-4"	4'-0"	16'-0"	#7 Tol 6	7'-4"	16'-0"	#8 Tol 7	16'-4"
3'-0"	6'-4"	6'-0"	16'-0"	#7 Tol 6	10'-0"	15'-3"	#8 Tol 7	6'-4"
	8'-4"	5'-3"	16'-0"	#7 Tol 6	10'-0"	16'-0"	#8 Tol 7	8'-4"
	10'-4"	4'-6"	16'-0"	#7 Tol 6	8'-10"	16'-0"	#8 Tol 7	10'-4"
	12'-4"	4'-0"	16'-0"	#7 Tol 6	7'-10"	16'-0"	#8 Tol 7	12'-4"
	14'-4"	3'-6'	16'-0"	#7 Tol 6	6'-10"	16'-0"	#8 Tol 7	14'-4"
	16'-4"	3'-3"	16'-0"	#7 Tol 6	6'-2"	16'-0"	#8 Tol 7	16'-4"
4'-0"	6'-4"	4'-3"	16'-0"	#7 Tol 6	8'-0"	15'-6"	#8 Tol 7	6'-4"
	8'-4"	3'-10"	16'-0"	#7 Tol 6	7'-4"	15'-9"	#8 Tol 7	8'-4"
	10'-4"	3'-6"	16'-0"	#7 Tol 6	6'-10"	16'-0"	#8 Tol 7	10'-4"
	12'-4"	3'-2"	16'-0"	#7 Tol 6	6'-3"	16'-0"	#8 Tol 7	12'-4"
	14'-4"	3'-0"	16'-3"	#7 Tol 6	5'-8"	16'-0"	#8 Tol 7	14'-4"
	16'-4"	2'-10"	16'-6"	#7 Tol 6	5'-0"	16'-0"	#8 Tol 7	16'-4"

NOTES:

1. For details not shown, see Standard plans B15-6 and B15-7.
2. Lapped splices in spiral reinforcement shall be lapped at least 80 wire diameters. Spiral reinforcement at splices and at ends shall be terminated with a 135° hook with a 6" tail hooked around a longitudinal bar.

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

SOUND WALL MASONRY BLOCK ON TYPE 736S/SV BARRIER DETAILS (3)

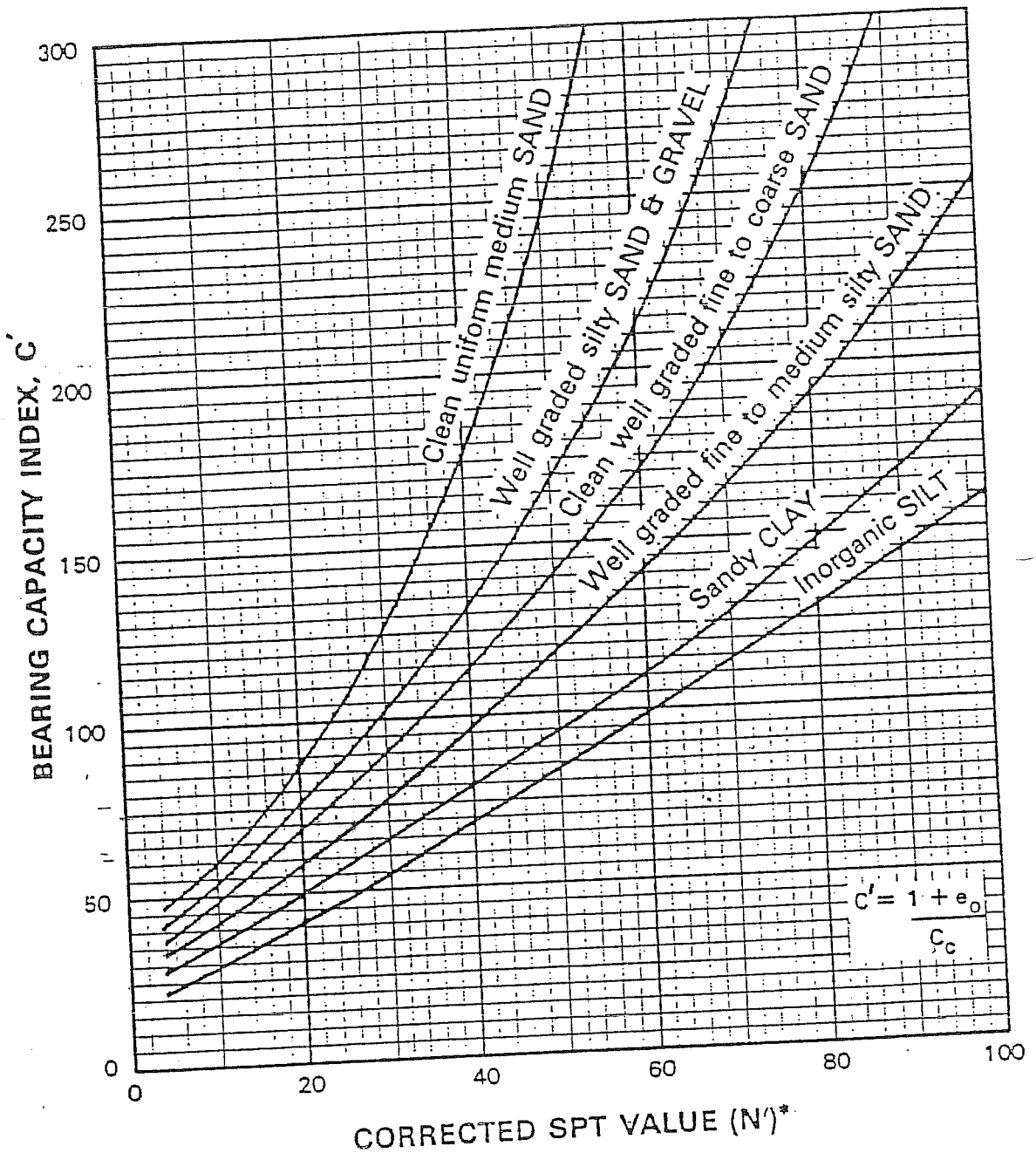
NO SCALE

B15-8

7-14-06

Return to Table of Contents

FHWA,
Nat'l Hwy Institute Soil & Foundations Workshop
Nov. 1982



*N'—SPT (N) Value Corrected for Overburden Pressure.

Reference: Hough, "Compressibility as a Basis for Soil Bearing Value" ASCE 1959

FIGURE 13

BEARING CAPACITY INDEX (C') VALUES FOR GRANULAR SOILS

Correction of SPT Blow Counts

In recent years much attention has focused on the validity of field SPT blow counts (N). Numerous factors which influence SPT counts with increasing depth were investigated by field testing. The conclusion of that testing showed that physical factors such as increasing drill rod weight or rod flexibility had a minor overall effect on N counts. However, the increasing overburden pressure resulted in N values at increasing depths which indicated larger relative densities than actually existed. Conversely, at very shallow depths, where overburden and pressure are low, N values indicated lower relative densities than actually existed. Therefore, N values from field operations must be corrected by the designer to reflect overburden pressure changes. Figure 12 should be used to obtain corrected SPT values, N'.

Settlement Computation For Cohesionless Soils

1. Determine corrected SPT value (N') from Figure 12.
2. Determine bearing capacity index (C') by entering Figure 13 with N' value.
3. Compute settlement in 10' ± increments of depth from

$$\Delta H = H \left(\frac{1}{C'}\right) \log \frac{Po + \Delta P}{Po}$$

where

ΔH = Settlement
H = Thickness of soil layer considered
C' = Bearing capacity index
Po = Existing effective overburden pressure (psf) at center of considered layer. For shallow surface deposits, a minimum value of 200 psf must be used to prevent unrealistic computation of settlement.
ΔP = Distributed embankment pressure (psf) at center of considered layer
PF = Final pressure felt by foundation subsoil

Note: $PF = Po + \Delta P$

Time for Settlement

Time rate of settlement is not a concern for cohesionless soils. Cohesionless soils, being highly permeable, will settle instantaneously as they are loaded.

Earth Mechanics, Inc.
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Project: **SR-57 NB Widening - RW 462** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 462 (6 feet high)

Retaining Wall Type 1SWB Wall - Sta 10+00 to 11+68

Max H= 6 ft Toe pressure, q_{toe}= 1.88 ksf
W= 7.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-101, A-08-102, C-08-103

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	62.5	205.0				0.0	0.0
0	61.0	200.0	(N')= 15	N_{used}=14, 11, 13,	SM γ= 120 pcf	1.5	5.0
I-OverEX	60.8	199.5	c'= 50	23	γ= 120 pcf	1.7	5.5
II	59.1	194.0				3.4	11.0
III	57.3	188.0	(N')= 23	N_{used}=12, 28	SP	5.2	17.0
IV	55.5	182.0	c'= 75		γ= 120 pcf	7.0	23.0
V	53.3	175.0				9.1	30.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	5	2.5		0.30							
I-OverEX	0.5	5.25	0.25	0.63	0.03	1.00	1.88	2.51	50	0.07	Overex (0.5 ft)
II	6	8.25	3.25	0.99	0.42	0.86	1.62	2.61	50	0.56	0.56
III	6	14	9	1.68	1.16	0.53	0.99	2.67	50	0.29	0.29
IV	6	20	15	2.40	1.94	0.33	0.61	3.01	75	0.09	0.09
V	7	26.5	21.5	3.18	2.77	0.22	0.41	3.59	75	0.06	0.06
									total=	*1.07*	**1.00**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x7.75x15.7-0.12x3 = 12.10 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.1 / 3 = 4.03 ksf > q_{toe} = 1.88 kPa

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Project: **SR-57 NB Widening - RW 462** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 462 (10 feet high)

Retaining Wall Type 1SWB Wall - Sta 11+68 to 11+78 and Sta 12+26 to 12+34

Max H= 10 ft Toe pressure, q_{toe}= 2.475 ksf
W= 8.50 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-101, A-08-102, C-08-103

Layer	Elev. (m)	Elev. (ft)			depth (m)	depth (ft)
	61.6	202.0			0.0	0.0
0	59.4	195.0	(N')= 12	N_{used}=14, 11, 13	2.1	7.0
I-OverEX	59.1	194.0	c'= 45	SM γ= 120 pcf	2.4	8.0
II	58.2	191.0			3.4	11.0
III	57.3	188.0	(N')= 23	N_{used}=12, 28	4.3	14.0
IV	54.9	180.0	c'= 75	SP γ= 120 pcf	6.7	22.0
V	51.8	170.0			9.8	32.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I-OverEX	1	7.5	0.5	0.90	0.06	1.00	2.48	3.38	45	0.15	Overex (1 ft)
II	3	9.5	2.5	1.14	0.29	0.95	2.35	3.49	45	0.39	0.39
III	3	12.5	5.5	1.50	0.65	0.76	1.89	3.39	45	0.28	0.28
IV	8	18	11	2.16	1.29	0.48	1.19	3.35	75	0.24	0.24
V	10	27	20	3.24	2.35	0.27	0.67	3.91	75	0.13	0.13
									total=	*1.20*	**1.05**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x8.5x15.7-0.12x3 = 12.67 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.67 / 3 = 4.22 ksf > q_{toe} = 2.475 kPa

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Project: **SR-57 NB Widening - RW 462** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 462 (16 feet high)

Retaining Wall Type 1SWB Wall - Sta 11+77 to 12+26

Max H= 16 ft Toe pressure, q_{toe}= 3.1 ksf
W= 12.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-101, A-08-102, C-08-103

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	61.0	200.0				0.0	0.0
0	58.5	192.0			γ= 120 pcf	2.4	8.0
I-OverEX	58.1	190.5	(N')= 12 c'= 45	N_{used}=14, 11, 13	**SM** γ= 120 pcf	2.9	9.5
II	57.3	188.0	(N')= 23 c'= 75	N_{used}=12, 28	**SP** γ= 120 pcf	3.7	12.0
III	51.8	170.0				9.1	30.0
IV	48.8	160.0				12.2	40.0
V	45.7	150.0				15.2	50.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I-OverEX	1.5	8.75	0.75	1.05	0.06	1.00	3.10	4.15	45	0.24	Overex (1.5 ft)
II	3	10.75	2.75	1.29	0.23	0.97	3.00	4.29	45	0.35	0.35
III	18	21	13	2.52	1.08	0.53	1.63	4.15	75	0.62	0.62
IV	10	35	27	4.20	2.25	0.28	0.87	5.07	75	0.13	0.13
V	10	45	37	5.40	3.08	0.19	0.60	6.00	75	0.07	0.07
									total=	*1.41*	**1.18**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x12x15.7-0.12x3 = 15.31 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 15.31 / 3 = 5.1 ksf > q_{toe} = 3.1 kPa

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Project: **SR-57 NB Widening - RW 462** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 462 (8 feet high)

Retaining Wall Type 1SWB Wall - Sta 12+34 to 13+60

Max H= 8 ft Toe pressure, q_{toe}= 2.222 ksf
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-101, A-08-102, C-08-103

Layer	Elev. (m)	Elev. (ft)			depth (m)	depth (ft)
	62.8	206.0			0.0	0.0
0	61.0	200.0		γ= 120 pcf	1.8	6.0
I-OverEX			(N')= 15 c'= 50	N_{used}=14, 11, 13, 23 SM		
	60.8	199.5		γ= 120 pcf	2.0	6.5
II	59.1	194.0			3.7	12.0
III	57.3	188.0			5.5	18.0
IV			(N')= 23 c'= 75	N_{used}=12, 28 SP		
	55.5	182.0		γ= 120 pcf	7.3	24.0
V	53.3	175.0			9.4	31.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I-OverEX	0.5	6.25	0.25	0.75	0.03	1.00	2.22	2.97	50	0.07	Overex (0.5 ft)
II	6	9.25	3.25	1.11	0.41	0.91	2.01	3.12	50	0.59	0.59
III	6	15	9	1.80	1.13	0.53	1.17	2.97	50	0.31	0.31
IV	6	21	15	2.52	1.88	0.34	0.76	3.28	75	0.11	0.11
V	7	27.5	21.5	3.30	2.69	0.23	0.51	3.81	75	0.07	0.07
									total=	*1.16*	**1.09**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x8x15.7-0.12x3 = 12.29 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.29 / 3 = 4.1 ksf > q_{toe} = 2.222 kPa

Earth Mechanics, Inc.
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Project: **SR-57 NB Widening - RW 462** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 462 (8 feet high)

Retaining Wall Type 1SWB Wall - Sta 13+60 to 16+16

Max H= 8 ft Toe pressure, q_{toe}= 2.222 ksf
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-105, A-08-106

Layer	Elev. (m)	Elev. (ft)			depth (m)	depth (ft)
	63.1	207.0			0.0	0.0
0	61.3	201.0		γ= 120 pcf	1.8	6.0
I-OverEX	61.0	200.0	(N')= 12, c'= 45; N_{used}=8, 15, 20, 7, 13, 5	SM γ= 120 pcf	2.1	7.0
II	59.4	195.0			3.7	12.0
III	57.6	189.0			5.5	18.0
IV	54.6	179.0	(N')= 17, c'= 62; N_{used}=13, 25/5", 19, 19	SP γ= 120 pcf	8.5	28.0
V	51.5	169.0	(N')= 40, c'= 114; N_{used}=25/5", 32, 49, 40	SP γ= 120 pcf	11.6	38.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I-OverEX	1	6.5	0.5	0.78	0.06	1.00	2.22	3.00	45	0.16	Overex (1 ft)
II	5	9.5	3.5	1.14	0.44	0.86	1.92	3.06	45	0.57	0.57
III	6	15	9	1.80	1.13	0.53	1.17	2.97	45	0.35	0.35
IV	10	23	17	2.76	2.13	0.30	0.67	3.43	62	0.18	0.18
V	10	33	27	3.96	3.38	0.18	0.39	4.35	114	0.04	0.04
									total=	*1.30*	**1.14**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x8x15.7-0.12x3 = 12.29 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.29 / 3 = 4.1 ksf > q_{toe} = 2.222 kPa

Earth Mechanics, Inc.
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Project: **SR-57 NB Widening - RW 462** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 462 (6 feet high)

Retaining Wall Type 1SWB Wall - Sta 16+16 to 16+32

Max H= 6 ft Toe pressure, q_{toe}= 1.88 ksf
W= 7.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-105, A-08-106

Layer	Elev. (m)	Elev. (ft)			depth (m)	depth (ft)
	63.4	208.0			0.0	0.0
0	61.9	203.0		γ= 120 pcf	1.5	5.0
I-OverEX	61.7	202.5	(N')= 15 c'= 50	N_{used}=8, 15, 20, 7, 13 SM γ= 120 pcf	1.7	5.5
II	59.4	195.0			4.0	13.0
III	57.6	189.0			5.8	19.0
IV	54.6	179.0	(N')= 17 c'= 62	N_{used}=13, 25/5", 19, 19 SP γ= 120 pcf	8.8	29.0
V	51.5	169.0	(N')= 40 c'= 114	N_{used}=25/5", 32, 49, 40 SP γ= 120 pcf	11.9	39.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	5	2.5		0.30							
I-OverEX	0.5	5.25	0.25	0.63	0.03	1.00	1.88	2.51	50	0.07	Overex (0.5 ft)
II	8	9.25	4.25	1.11	0.55	0.82	1.54	2.65	50	0.68	0.68
III	6	16	11	1.92	1.42	0.43	0.80	2.72	50	0.22	0.22
IV	10	24	19	2.88	2.45	0.26	0.49	3.37	62	0.13	0.13
V	10	34	29	4.08	3.74	0.15	0.29	4.37	114	0.03	0.03
									total=	*1.13*	**1.06**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x7.75x15.7-0.12x3 = 12.10 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.1 / 3 = 4.03 ksf > q_{toe} = 1.88 kPa

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Project: **SR-57 NB Widening - RW 466** Project No. **08-115**
By CTY Date 1/5/09 Check by Date Sheet

RW No. 466 (6 feet high)

Retaining Wall Type 1SWB Wall - Sta 10+80 to 11+40

Max H= 6 ft Toe pressure, q_{toe}= 1.88 ksf
W= 7.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-105, A-08-106, A-08-01

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	65.1	213.5				0.0	0.0
0	63.6	208.5			γ= 120 pcf	1.5	5.0
I-OverEX	63.2	207.5	(N')= 20 c'= 58	N_{used}=35, 11, 12, 24	SM γ= 120 pcf	1.8	6.0
II	62.5	205.0				2.6	8.5
III	59.4	195.0	(N')= 8 c'= 39	N_{used}=7, 8	SM γ= 120 pcf	5.6	18.5
IV	54.3	178.0	(N')= 13 c'= 54	N_{used}=20, 7, 5, 14, 19	SP γ= 120 pcf	10.8	35.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	5	2.5		0.30							
I-OverEX	1	5.5	0.5	0.66	0.06	100.0%	1.88	2.54	58	0.12	Overex (1 ft)
II	3	7.25	2.25	0.87	0.29	95.0%	1.79	2.66	58	0.25	0.25
III	10	13.5	8.5	1.62	1.10	52.7%	0.99	2.61	39	0.64	0.64
IV	17	27	22	3.24	2.84	21.3%	0.40	3.64	54	0.19	0.19
									total=	*1.20*	*1.08*

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf
ϕ= 30 ° = 0.524 rad => Nq= 18.4
c= 0 ksf Nr= 15.7
Overburn: D= 3 feet Nc= 30.1

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x7.75x15.7-0.12x3 = 12.10 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.1 / 3 = 4.03 ksf > q_{toe} = 1.88 kPa

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Project: **SR-57 NB Widening - RW 466** Project No. **08-115**
By CTY Date 1/5/09 Check by Date Sheet

RW No. 466 (8 feet high)

Retaining Wall Type 1SWB Wall - Sta 11+40 to 13+28
Max H= 8 ft Toe pressure, q_{toe}= 2.222 ksf
W= 8.00 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-105, A-08-106, A-08-01

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	65.4	214.5				0.0	0.0
0	63.6	208.5			γ= 120 pcf	1.8	6.0
I-OverEX	63.1	207.0	(N')= 20 c'= 58	N_{used}=35, 11, 12, 24	SM γ= 120 pcf	2.3	7.5
II	62.5	205.0	(N')= 8 c'= 39	N_{used}=7, 8	SM γ= 120 pcf	2.9	9.5
III	59.4	195.0	(N')= 13 c'= 54	N_{used}=20, 7, 5, 14, 19	SP γ= 120 pcf	5.9	19.5
IV	54.3	178.0				11.1	36.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I-OverEX	1.5	6.75	0.75	0.81	0.09	98.3%	2.19	3.00	58	0.18	Overex (1.5 ft)
II	2	8.5	2.5	1.02	0.31	95.0%	2.11	3.13	58	0.20	0.20
III	10	14.5	8.5	1.74	1.06	55.0%	1.22	2.96	39	0.71	0.71
IV	17	28	22	3.36	2.75	22.0%	0.49	3.85	54	0.22	0.22
									total=	*1.31*	*1.14*

Check Bearing Capacity
Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf
ϕ= 30 ° = 0.524 rad => Nq= 18.4
c= 0 ksf Nr= 15.7
Overburn: D= 3 feet Nc= 30.1

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x8x15.7-0.12x3 = 12.29 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.29 / 3 = 4.1 ksf > q_{toe} = 2.222 kPa

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Project: **SR-57 NB Widening - RW 466** Project No. **08-115**
By CTY Date 1/5/09 Check by Date Sheet

RW No. 466 (8 feet high)

Retaining Wall Type 1SWB Wall - Sta 14+56 to 15+36
Max H= 8 ft Toe pressure, q_{toe}= 2.222 ksf
W= 8.00 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-106, A-08-01

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	67.8	222.5				0.0	0.0
0	66.0	216.5			γ= 120 pcf	1.8	6.0
I-OverEX	65.7	215.5	(N')= 20 c'= 58	N_{used}=35, 11, 12, 24	SM γ= 120 pcf	2.1	7.0
II	62.5	205.0	(N')= 8 c'= 39	N_{used}=7, 8	SM γ= 120 pcf	5.3	17.5
III	59.4	195.0	(N')= 13 c'= 54	N_{used}=20, 7, 5, 14, 19	SP γ= 120 pcf	8.4	27.5
IV	54.3	178.0				13.6	44.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I-OverEX	1	6.5	0.5	0.78	0.06	100.0%	2.22	3.00	58	0.12	Overex (1 ft)
II	11	12.25	6.25	1.47	0.78	65.0%	1.44	2.91	58	0.65	0.65
III	10	22.5	16.5	2.70	2.06	31.0%	0.69	3.39	39	0.30	0.30
IV	17	36	30	4.32	3.75	15.0%	0.33	4.65	54	0.12	0.12
									total=	*1.19*	*1.07*

Check Bearing Capacity
Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D$ = 0*30.1+0.12x3x18.4+0.4x0.12x8x15.7-0.12x3 = 12.29 ksf

$q_{allow(net)} = q_{ult(net)} / 3$ = 12.29 / 3 = 4.1 ksf > q_{toe} = 2.222 kPa

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Project: **SR-57 NB Widening - RW 466** Project No. **08-115**
By CTY Date 1/5/09 Check by Date Sheet

RW No. 466 (10 feet high)

Retaining Wall Type 1SWB Wall

Max H= 10 ft Toe pressure, q_{toe}= 2.475 ksf
W= 8.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-106, A-08-01

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	67.1	220.3				0.0	0.0
0	65.0	213.3			γ= 120 pcf	2.1	7.0
I-OverEX			(N')= 16	N_{used}=12, 24, 13	SM		
	64.4	211.3	c'= 52		γ= 120 pcf	2.7	9.0
II	63.4	208.0				3.7	12.3
III			(N')= 7	N_{used}=7	SM		
	61.0	200.0	c'= 38		γ= 120 pcf	6.2	20.3
IV			(N')= 17	N_{used}=14, 19	SP		
	57.9	190.0	c'= 62		γ= 120 pcf	9.2	30.3
V			(N')= 34	N_{used}=33, 28, 41	SM		
	54.3	178.0	c'= 84		γ= 125 pcf	12.9	42.3

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I-OverEX	2	8	1	0.96	0.11	98.3%	2.43	3.39	52	0.25	Overex (2 ft)
II	3	10.65	3.65	1.28	0.42	86.3%	2.14	3.41	52	0.33	0.33
III	8	16.3	9.3	1.96	1.06	55.0%	1.36	3.32	38	0.58	0.58
IV	10	25.3	18.3	3.04	2.09	30.0%	0.74	3.78	62	0.18	0.18
V	12	36.3	29.3	4.39	3.35	17.5%	0.43	4.82	84	0.07	0.07
									total=	*1.41*	**1.16**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x8.75x15.7-0.12x3 = 12.86 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.86 / 3 = 4.29 ksf > q_{toe} = 2.475 kPa

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Project: **SR-57 NB Widening - RW 466** Project No. **08-115**
By CTY Date 1/5/09 Check by Date Sheet _____

RW No. 466 (14 feet high)

Retaining Wall Type 1SWB Wall

Max H= 14 ft Toe pressure, q_{toe}= 2.915 ksf
W= 10.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-106, A-08-01

Layer	Elev. (m)	Elev. (ft)					depth (m)	depth (ft)
	66.1	217.0					0.0	0.0
0	63.7	209.0			γ= 120	pcf	2.4	8.0
I-OverEX	63.4	208.0	(N')= 16 c'= 52	N_{used}=12, 24, 13	SM γ= 120	pcf	2.7	9.0
II-OverEX	62.8	206.0	(N')= 7 c'= 38	N_{used}=7	SM γ= 120	pcf	3.4	11.0
III	61.0	200.0					5.2	17.0
IV	57.9	190.0	(N')= 17 c'= 62	N_{used}=14, 19	SP γ= 120	pcf	8.2	27.0
V	54.3	178.0	(N')= 34 c'= 84	N_{used}=33, 28, 41	SM γ= 125	pcf	11.9	39.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I-OverEX	1	8.5	0.5	1.02	0.05	100.0%	2.92	3.94	52	0.14	
II-OverEX	2	10	2	1.20	0.19	96.7%	2.82	4.02	38	0.33	Overex (3 ft)
III	6	14	6	1.68	0.56	82.0%	2.39	4.07	38	0.73	0.73
IV	10	22	14	2.64	1.30	48.0%	1.40	4.04	62	0.36	0.36
V	12	33	25	3.99	2.33	28.0%	0.82	4.81	84	0.14	0.14
									total=	*1.69*	**1.22**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf
ϕ= 30 ° = 0.524 rad => Nq= 18.4
c= 0 ksf Nr= 15.7
Overburn: D= 3 feet Nc= 30.1

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x10.75x15.7-0.12x3 = 14.37 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 14.37 / 3 = 4.79 ksf > q_{toe} = 2.915 kPa

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Project: **SR-57 NB Widening - RW 474** Project No. **08-115**
By CTY Date 1/13/09 Check by Date Sheet

RW No. 474 (12 feet high)

Retaining Wall Type 1SWB Wall - Sta 10+00 to 10+08

Max H= 12 ft Toe pressure, q_{toe}= 2.683 ksf
W= 9.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-03, A-08-108

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	67.5	221.5				0.0	0.0
0	65.1	213.5			γ= 120 pcf	2.4	8.0
I	63.4	208.0	(N')= 21 c'= 60	N_{used}=26, 26, 20, 16, 18	**SC** γ= 120 pcf	4.1	13.5
II	62.5	205.0				5.0	16.5
III	61.0	200.0	(N')= 11 c'= 44	N_{used}=12, 28	**SC** γ= 120 pcf	6.6	21.5
IV	57.9	190.0	(N')= 30 c'= 90	N_{used}=12, 28	**SP** γ= 120 pcf	9.6	31.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I	5.5	10.75	2.75	1.29	0.28	0.95	2.55	3.84	60	0.52	
II	3	15	7	1.80	0.72	0.71	1.90	3.70	60	0.19	
III	5	19	11	2.28	1.13	0.53	1.41	3.69	44	0.29	
IV	10	26.5	18.5	3.18	1.90	0.34	0.92	4.10	90	0.15	
									total=	*1.14*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf
ϕ= 30 ° = 0.524 rad => Nq= 18.4
Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 2 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x2x18.4+0.4x0.12x9.75x15.7-0.12x2 = 11.52 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 11.52 / 3 = 3.84 ksf > q_{toe} = 2.683 kPa

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Project: **SR-57 NB Widening - RW 474** Project No. **08-115**
By CTY Date 1/13/09 Check by Date Sheet

RW No. 474 (8 feet high)

Retaining Wall Type 1SWB Wall - Sta 10+08 to 10+24

Max H= 8 ft Toe pressure, q_{toe}= 2.222 ksf
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-105, A-08-106

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	68.3	224.0				0.0	0.0
0	66.4	218.0			γ= 120 pcf	1.8	6.0
I	64.9	213.0	(N')= 21 c'= 60	N_{used}=26, 26, 20, 16, 18	**SC** γ= 120 pcf	3.4	11.0
II	62.5	205.0	(N')= 11 c'= 44	N_{used}=12, 28	**SC** γ= 120 pcf	5.8	19.0
III	61.0	200.0	(N')= 30 c'= 90	N_{used}=12, 28	**SP** γ= 120 pcf	7.3	24.0
IV	57.9	190.0				10.4	34.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I	5	8.5	2.5	1.02	0.31	0.95	2.11	3.13	60	0.49	
II	8	15	9	1.80	1.13	0.53	1.17	2.97	60	0.35	
III	5	21.5	15.5	2.58	1.94	0.33	0.73	3.31	44	0.15	
IV	10	29	23	3.48	2.88	0.21	0.47	3.95	90	0.07	
									total=	*1.06*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 2 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D$ = 0*30.1+0.12x2x18.4+0.4x0.12x8x15.7-0.12x2 = 10.20 ksf

$q_{allow(net)} = q_{ult(net)} / 3$ = 10.2 / 3 = 3.4 ksf > q_{toe} = 2.222 kPa

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Project: **SR-57 NB Widening - RW 474** Project No. **08-115**
By CTY Date 1/13/09 Check by Date Sheet

RW No. 474 (6 feet high)

Retaining Wall Type 1SWB Wall - Sta 10+24 to 10+48 and Sta 12+32 to 12+64

Max H= 6 ft Toe pressure, q_{toe}= 1.88 ksf
W= 7.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-03, A-08-108

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	68.6	225.0				0.0	0.0
0	67.1	220.0			γ= 120 pcf	1.5	5.0
I	64.9	213.0	(N')= 21 c'= 60	N_{used}=26, 26, 20, 16, 18	**SC** γ= 120 pcf	3.7	12.0
II	62.5	205.0				6.1	20.0
III	61.0	200.0	(N')= 11 c'= 44	N_{used}=12, 28	**SC** γ= 120 pcf	7.6	25.0
IV	57.9	190.0	(N')= 30 c'= 90	N_{used}=12, 28	**SP** γ= 120 pcf	10.7	35.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	5	2.5		0.30							
I	7	8.5	3.5	1.02	0.45	0.86	1.62	2.64	60	0.58	
II	8	16	11	1.92	1.42	0.43	0.80	2.72	60	0.24	
III	5	22.5	17.5	2.70	2.26	0.28	0.53	3.23	44	0.11	
IV	10	30	25	3.60	3.23	0.19	0.35	3.95	90	0.05	
									total=	*0.98*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 2 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x2x18.4+0.4x0.12x7.75x15.7-0.12x2 = 10.02 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.02 / 3 = 3.34 ksf > q_{toe} = 1.88 kPa

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Project: **SR-57 NB Widening - RW 474** Project No. **08-115**
By CTY Date 1/13/09 Check by Date Sheet

RW No. 474 (8 feet high)

Retaining Wall Type 1SWB Wall - Sta 10+48 to 12+32

Max H= 8 ft Toe pressure, q_{toe}= 2.222 ksf
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-03, A-08-108

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	68.6	225.0				0.0	0.0
0	66.8	219.0			γ= 120 pcf	1.8	6.0
I	64.9	213.0	(N')= 21 c'= 60	N_{used}=26, 26, 20, 16, 18	**SC** γ= 120 pcf	3.7	12.0
II	62.5	205.0	(N')= 11 c'= 44	N_{used}=12, 28	**SC** γ= 120 pcf	6.1	20.0
III	61.0	200.0	(N')= 30 c'= 90	N_{used}=12, 28	**SP** γ= 120 pcf	7.6	25.0
IV	57.9	190.0				10.7	35.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I	6	9	3	1.08	0.38	0.91	2.01	3.09	60	0.55	
II	8	16	10	1.92	1.25	0.48	1.07	2.99	60	0.31	
III	5	22.5	16.5	2.70	2.06	0.31	0.69	3.39	44	0.13	
IV	10	30	24	3.60	3.00	0.20	0.44	4.04	90	0.07	
									total=	*1.06*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 2 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x2x18.4+0.4x0.12x8x15.7-0.12x2 = 10.20 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.2 / 3 = 3.4 ksf > q_{toe} = 2.222 kPa

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Project: **SR-57 NB Widening - RW 474** Project No. **08-115**
By CTY Date 1/13/09 Check by Date Sheet

RW No. 474 (6 feet high)

Retaining Wall Type 1SWB Wall - Sta 12+64 to 13+20

Max H= 6 ft Toe pressure, q_{toe}= 1.88 ksf
W= 7.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-03, A-08-108

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	68.9	226.0				0.0	0.0
0	67.4	221.0			γ= 120 pcf	1.5	5.0
I	64.9	213.0	(N')= 21 c'= 60	N_{used}=26, 26, 20, 16, 18	**SC** γ= 120 pcf	4.0	13.0
II	62.5	205.0	(N')= 11 c'= 44	N_{used}=12, 28	**SC** γ= 120 pcf	6.4	21.0
III	61.0	200.0	(N')= 30 c'= 90	N_{used}=12, 28	**SP** γ= 120 pcf	7.9	26.0
IV	57.9	190.0				11.0	36.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	5	2.5		0.30							
I	8	9	4	1.08	0.52	0.82	1.54	2.62	60	0.62	
II	8	17	12	2.04	1.55	0.40	0.75	2.79	60	0.22	
III	5	23.5	18.5	2.82	2.39	0.27	0.51	3.33	44	0.10	
IV	10	31	26	3.72	3.35	0.18	0.33	4.05	90	0.05	
									total=	*0.98*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf
ϕ= 30 ° = 0.524 rad => Nq= 18.4
c= 0 ksf Nr= 15.7
Overburn: D= 2 feet Nc= 30.1

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x2x18.4+0.4x0.12x7.75x15.7-0.12x2 = 10.02 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.02 / 3 = 3.34 ksf > q_{toe} = 1.88 kPa

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Project: **SR-57 NB Widening - RW 476** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 476 (8 feet high)

Standard Caltrans Type 1 Wall - Sta 10+00 to 10+48

Max H= 8 ft Toe pressure, q_{toe}= 2.2 ksf (for Load Case I)
W= 5.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-06

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	63.1	207				0.0	0
0	61.6	202			γ= 120 pcf	1.5	5
I	61.0	200	(N')= 10 c'= 42	N_{used}=8, 13	SM γ= 120 pcf	2.1	7
II	59.4	195	(N')= 22 c'= 62	N_{used}=13, 34, 26, 18, 23	SM γ= 120 pcf	3.7	12
III	57.9	190				5.2	17
IV	54.9	180	(N')= 11 c'= 37	N_{used}=15, 10, 10, 11, 11	CL γ= 120 pcf	8.2	27
V	51.8	170	(N')= 29 c'= 74		SM γ= 120 pcf	11.3	37

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	5	2.5		0.30							
I	2	6	1	0.72	0.19	0.97	2.13	2.85	42	0.34	
II	5	9.5	4.5	1.14	0.86	0.62	1.36	2.50	62	0.33	
III	5	14.5	9.5	1.74	1.81	0.36	0.79	2.53	62	0.16	
IV	10	22	17	2.64	3.24	0.19	0.41	3.05	37	0.20	
V	10	32	27	2.64	5.14	0.11	0.25	2.89	74	0.06	
									total=	*1.09*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x5.25x15.7-0.12x3 = 10.22 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.22 / 3 = 3.41 ksf > q_{toe} = 2.2 kPa

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Project: **SR-57 NB Widening - RW 476** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 476 (10 feet high)

Standard Caltrans Type 1 Wall - Sta 10+48 to 10+80

Max H= 10 ft Toe pressure, q_{toe}= 2.5 ksf (for Load Case I)
W= 6.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-06

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	63.4	208				0.0	0
0	61.3	201			γ= 120 pcf	2.1	7
I	61.0	200	(N')= 10 c'= 42	N_{used}=8, 13	SM γ= 120 pcf	2.4	8
II	59.4	195	(N')= 22 c'= 62	N_{used}=13, 34, 26, 18, 23	SM γ= 120 pcf	4.0	13
III	57.9	190				5.5	18
IV	54.9	180	(N')= 11 c'= 37	N_{used}=15, 10, 10, 11, 11	CL γ= 120 pcf	8.5	28
V	51.8	170	(N')= 29 c'= 74		SM γ= 120 pcf	11.6	38

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I	1	7.5	0.5	0.90	0.08	1.00	2.50	3.40	42	0.16	
II	5	10.5	3.5	1.26	0.56	0.82	2.05	3.31	62	0.41	
III	5	15.5	8.5	1.86	1.36	0.45	1.13	2.99	62	0.20	
IV	10	23	16	2.76	2.56	0.25	0.63	3.39	37	0.29	
V	10	33	26	2.76	4.16	0.14	0.34	3.10	74	0.08	
									total=	*1.14*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x6.25x15.7-0.12x3 = 10.97 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.97 / 3 = 3.66 ksf > q_{toe} = 2.5 kPa

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Project: **SR-57 NB Widening - RW 476** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 476 (12 feet high)

Standard Caltrans Type 1 Wall - Sta 10+80 to 11+12
Max H= 12 ft Toe pressure, q_{toe}= 2.9 ksf (for Load Case I)
W= 7.25 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-06

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	63.7	209				0.0	0
0	61.3	201			γ= 120 pcf	2.4	8
I-OE	61.0	200	(N')= 10 c'= 42	N_{used}=8, 13	SM γ= 120 pcf	2.7	9
II	59.4	195	(N')= 22 c'= 62	N_{used}=13, 34, 26, 18, 23	SM γ= 120 pcf	4.3	14
III	57.9	190				5.8	19
IV	54.9	180	(N')= 11 c'= 37	N_{used}=15, 10, 10, 11, 11	CL γ= 120 pcf	8.8	29
V	51.8	170	(N')= 29 c'= 74		SM γ= 120 pcf	11.9	39

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I-OE	1	8.5	0.5	1.02	0.07	1.00	2.90	3.92	42	0.17	Overex (1 ft)
II	5	11.5	3.5	1.38	0.48	0.86	2.50	3.88	62	0.43	0.43
III	5	16.5	8.5	1.98	1.17	0.50	1.46	3.44	62	0.23	0.23
IV	10	24	16	2.88	2.21	0.29	0.84	3.72	37	0.36	0.36
V	10	34	26	2.88	3.59	0.16	0.46	3.34	74	0.11	0.11
									total=	*1.30*	*1.13*

Check Bearing Capacity
Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x7.25x15.7-0.12x3 = 11.73 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 11.73 / 3 = 3.91 ksf > q_{toe} = 2.9 kPa

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Project: **SR-57 NB Widening - RW 476** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 476 (14 feet high)

Standard Caltrans Type 1 Wall - Sta 11+12 to 11+27

Max H= 14 ft Toe pressure, q_{toe}= 3.4 ksf (for Load Case I)
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Borings A-08-05 and C-08-111

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	64.0	210				0.0	0
0	61.3	201			γ= 120 pcf	2.7	9
I-OE	61.0	200	(N')= 10 c'= 42	N_{used}=8, 13	SM γ= 120 pcf	3.0	10
II	59.4	195	(N')= 22 c'= 62	N_{used}=13, 34, 26, 18, 23	SM γ= 120 pcf	4.6	15
III	57.9	190				6.1	20
IV	54.9	180	(N')= 11 c'= 37	N_{used}=15, 10, 10, 11, 11	CL γ= 120 pcf	9.1	30
V	51.8	170	(N')= 29 c'= 74		SM γ= 120 pcf	12.2	40

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	Δσ_v' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	9	4.5		0.54							
I-OE	1	9.5	0.5	1.14	0.06	1.00	3.40	4.54	42	0.17	Overex (1 ft)
II	5	12.5	3.5	1.50	0.44	0.86	2.94	4.44	62	0.46	0.46
III	5	17.5	8.5	2.10	1.06	0.55	1.87	3.97	62	0.27	0.27
IV	10	25	16	3.00	2.00	0.31	1.05	4.05	37	0.42	0.42
V	10	35	26	3.00	3.25	0.18	0.61	3.61	74	0.13	0.13
									total=	*1.45*	*1.28*

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x8x15.7-0.12x3 = 12.29 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.29 / 3 = 4.1 ksf > q_{toe} = 3.4 kPa

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Project: **SR-57 NB Widening - RW 476** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet _____

RW No. 476

MSE - 20' high
Max H= 20 ft Toe pressure, q_{toe}= 3.79 ksf
W= 14.00 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-108, A-08-109

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	64.6	212				0.0	0
0	61.6	202			γ= 120 pcf	3.0	10
I	60.4	198	(N')= 22 c'= 62	N_{used}=13, 34, 26, 18, 23	**SM** γ= 120 pcf	4.3	14
II	59.1	194				5.5	18
III	57.9	190	(N')= 12 c'= 39	N_{used}=15, 10, 10, 11, 11	**CL** γ= 120 pcf	6.7	22
IV	54.9	180	(N')= 29 c'= 74		**SM** γ= 120 pcf	9.8	32
V	51.8	170				12.8	42

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	10	5		0.60							
I	4	12	2	1.44	0.14	0.98	3.73	5.17	62	0.43	
II	4	16	6	1.92	0.43	0.86	3.27	5.19	62	0.33	
III	4	20	10	2.40	0.71	0.71	2.68	5.08	62	0.25	
IV	10	27	17	3.24	1.21	0.50	1.91	5.15	39	0.62	
V	10	37	27	3.24	1.93	0.33	1.24	4.48	74	0.23	
									total=	*1.86*	

Check Bearing Capacity
Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x14x15.7-0.12x3 = 16.81 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 16.81 / 3 = 5.6 ksf > q_{toe} = 3.79 kPa

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Project: **SR-57 NB Widening - RW 476** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 476

MSE - 22'-8" high
Max H= 22'-8" Toe pressure, q_{toe}= 4.1 ksf
W= 16.00 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-108, A-08-109

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	65.8	216				0.0	0
0	62.5	205			γ= 120 pcf	3.4	11
I	61.0	200	(N')= 22 c'= 62	N_{used}=13, 34, 26, 18, 23	**SM** γ= 120 pcf	4.9	16
II	59.4	195	(N')= 22 c'= 62		**SM** γ= 120 pcf	6.4	21
III	57.9	190	(N')= 22 c'= 62		**SM** γ= 120 pcf	7.9	26
IV	54.9	180	(N')= 12 c'= 39	N_{used}=15, 10, 10, 11, 11	**CL** γ= 120 pcf	11.0	36
V	51.8	170	(N')= 29 c'= 74		**SM** γ= 120 pcf	14.0	46

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	11	5.5		0.66							
I	5	13.5	2.5	1.62	0.16	0.98	4.03	5.65	62	0.53	
II	5	18.5	7.5	2.22	0.47	0.86	3.54	5.76	62	0.40	
III	5	23.5	12.5	2.82	0.78	0.65	2.67	5.49	62	0.28	
IV	10	31	20	3.72	1.25	0.48	1.97	5.69	39	0.57	
V	10	41	30	3.72	1.88	0.34	1.41	5.13	74	0.23	
									total=	*2.00*	

Check Bearing Capacity
Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x16x15.7-0.12x3 = 18.32 ksf
$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 18.32 / 3 = 6.11 ksf > q_{toe} = 4.1 kPa

Earth Mechanics, Inc.
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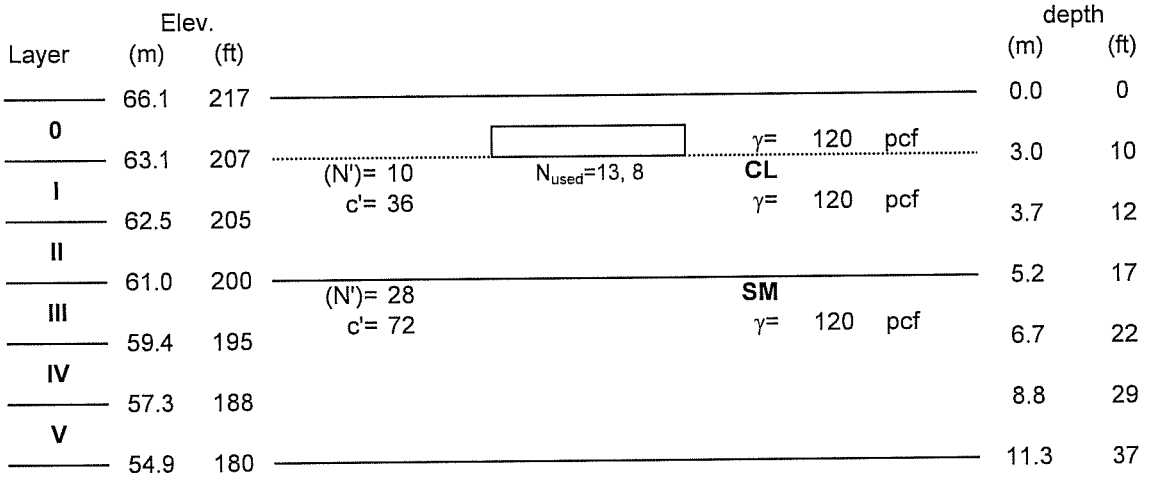
Project: **SR-57 NB Widening - RW 476** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 476

MSE - 22'-8" high
Max H= 22'-8" Toe pressure, q_{toe}= 4.1 ksf
W= 16.00 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-108, A-08-109



Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	10	5		0.60							
I	1	11	1	1.26	0.06	1.00	4.10	5.36	36	0.21	
II	6	14.5	4.5	1.68	0.28	0.95	3.90	5.58	36	1.04	
III	5	19.5	9.5	2.34	0.59	0.76	3.13	5.47	72	0.31	
IV	7	25.5	15.5	3.06	0.97	0.58	2.39	5.45	72	0.29	
V	8	33	23	3.06	1.44	0.43	1.75	4.81	72	0.26	
									total=	*2.11*	

Check Bearing Capacity
Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 2.5
ϕ= 10 ° = 0.175 rad Nr= 0.4
c= 1.2 ksf Nc= 8.5
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 1.2*8.5+0.12x3x2.5+0.4x0.12x16x0.4-0.12x3 =$ 11.05 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 11.05 / 3 = 3.68 ksf > $q_{toe} =$ 4.1 kPa

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Project: **SR-57 NB Widening - RW 476** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 476

MSE - 20' high

Max H= 20 ft Toe pressure, q_{toe}= 3.79 ksf
W= 14.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-108, A-08-109

Layer	Elev. (m)	Elev. (ft)		depth (m)	depth (ft)
	66.1	217		0.0	0
0					
	63.1	207	γ= 120 pcf	3.0	10
			(N')= 10 N_{used}=13, 8 **CL**		
I			c'= 36 γ= 120 pcf		
	62.5	205		3.7	12
II					
	61.0	200		5.2	17
			(N')= 28 **SM**		
III			c'= 72 γ= 120 pcf		
	59.4	195		6.7	22
IV					
	57.3	188		8.8	29
V					
	54.9	180		11.3	37

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	10	5		0.60							
I	2	11	1	1.32	0.07	1.00	3.79	5.11	36	0.39	
II	5	14.5	4.5	1.74	0.32	0.95	3.60	5.34	36	0.81	
III	5	19.5	9.5	2.34	0.68	0.71	2.68	5.02	72	0.28	
IV	7	25.5	15.5	3.06	1.11	0.53	2.00	5.06	72	0.25	
V	8	33	23	3.06	1.64	0.39	1.47	4.53	72	0.23	
									total=	*1.96*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 2.5
ϕ= 10 ° = 0.175 rad Nr= 0.4
c= 1.2 ksf Nc= 8.5
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.2*8.5+0.12x3x2.5+0.4x0.12x14x0.4-0.12x3 = 11.01 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 11.01 / 3 = 3.67 ksf > q_{toe} = 3.79 kPa

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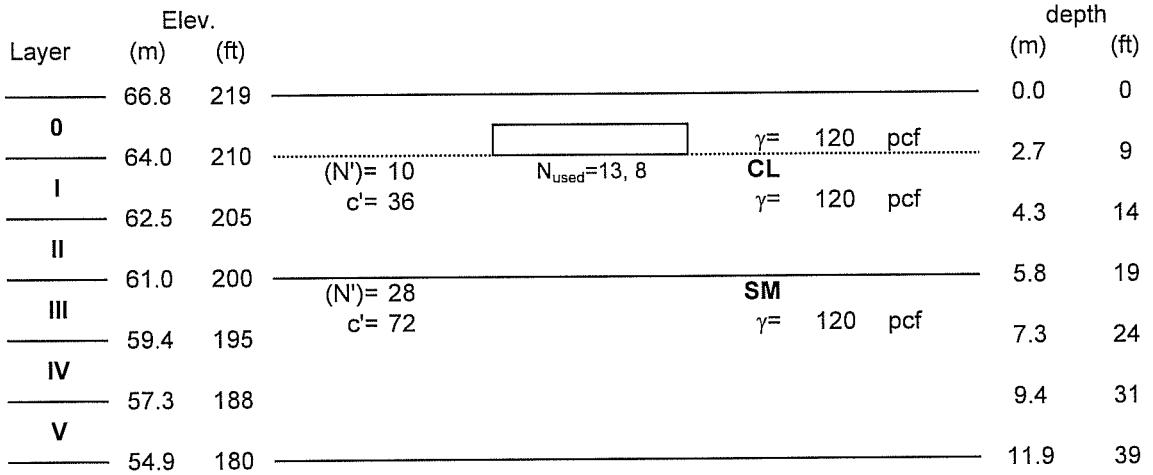
Project: **SR-57 NB Widening - RW 476** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 476

MSE - 17'-6" high
Max H= 17.5 ft Toe pressure, q_{toe}= 3.48 ksf
W= 12.00 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-108, A-08-109



Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	9	4.5		0.54							
I	5	11.5	2.5	1.38	0.21	0.97	3.36	4.74	36	0.89	
II	5	16.5	7.5	1.98	0.63	0.76	2.66	4.64	36	0.62	
III	5	21.5	12.5	2.58	1.04	0.55	1.91	4.49	72	0.20	
IV	7	27.5	18.5	3.30	1.54	0.40	1.39	4.69	72	0.18	
V	8	35	26	3.30	2.17	0.30	1.04	4.34	72	0.16	
									total=	*2.05*	

Check Bearing Capacity
Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 2.5
ϕ= 10 ° = 0.175 rad Nr= 0.4
c= 1.2 ksf Nc= 8.5
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.2*8.5+0.12x3x2.5+0.4x0.12x12x0.4-0.12x3 = 10.97 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.97 / 3 = 3.66 ksf > q_{toe} = 3.48 kPa

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Project: **SR-57 NB Widening - RW 476** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 476

MSE - 17'-6" high

Max H= 17.5 ft Toe pressure, q_{toe}= 3.48 ksf
W= 12.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-108, A-08-109

Layer	Elev. (m)	Elev. (ft)			depth (m)	depth (ft)
	68.3	224			0.0	0
0	65.5	215		γ= 120 pcf	2.7	9
I	64.0	210	(N')= 18 c'= 55	SM γ= 120 pcf	4.3	14
II	62.5	205	(N')= 10 c'= 36	CL γ= 120 pcf	5.8	19
III	61.0	200			7.3	24
IV	57.9	190	(N')= 28 c'= 72	SM γ= 120 pcf	10.4	34
V	54.9	180			13.4	44

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	9	4.5		0.54							
I	5	11.5	2.5	1.38	0.21	0.97	3.36	4.74	55	0.59	
II	5	16.5	7.5	1.98	0.63	0.76	2.66	4.64	36	0.62	
III	5	21.5	12.5	2.58	1.04	0.55	1.91	4.49	36	0.40	
IV	10	29	20	3.48	1.67	0.39	1.35	4.83	72	0.24	
V	10	39	30	3.48	2.50	0.25	0.87	4.35	72	0.16	
									total=	*2.00*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x12x15.7-0.12x3 = 15.31 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 15.31 / 3 = 5.1 ksf > q_{toe} = 3.48 kPa

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Project: **SR-57 NB Widening - RW 486** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 486 (14 feet high)

Standard Caltrans Type 1 Wall - Sta 10+00 to 10+08

Max H= 14 ft Toe pressure, q_{toe}= 3.4 ksf (for Load Case III)
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Borings A-08-05 and C-08-111

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	68.8	225.8				0.0	0
0	66.1	216.8			γ= 120 pcf	2.7	9
I-OverEX			(N')= 21	N_{used}=16,27	CL		
	65.5	214.8	c'= 52		γ= 120 pcf	3.4	11
II			(N')= 21	N_{used}=16,27	CL		
	62.5	205	c'= 52		γ= 120 pcf	6.3	20.75
III			(N')= 10	N_{used}=13, 9	CL		
	59.4	195	c'= 36		γ= 120 pcf	9.4	30.75
IV			(N')= 30	N_{used}=24, 39, 42	SM		
	54.9	180	c'= 76		γ= 125 pcf	13.9	45.75

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	9	4.5		0.54							
I-OverEX	2	10	1	1.20	0.13	0.98	3.34	4.54	52	0.27	Overex (2 ft)
II	9.75	15.88	6.875	1.91	0.86	0.62	2.10	4.00	52	0.73	0.73
III	10	25.75	16.75	3.09	2.09	0.30	1.02	4.11	36	0.41	0.41
IV	15	38.25	29.25	4.63	3.66	0.16	0.54	5.17	76	0.11	0.11
									total=	*1.52*	**1.25**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2.5 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 2.5*5.14+0.12x3x1+0.4x0.12x8x0-0.12x3 =$ 12.85 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 12.85 / 3 = 4.28 ksf > $q_{toe} =$ 3.4 kPa

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Project: **SR-57 NB Widening - RW 486** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 486 (12 feet high)

Standard Caltrans Type 1 Wall - Sta 10+08 to 11+14

Max H= 12 ft Toe pressure, q_{toe}= 2.9 ksf (for Load Case III)
W= 7.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Borings A-08-05 and C-08-111

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	69.3	227.5				0.0	0
0	66.9	219.5			γ= 120 pcf	2.4	8
I-OverEX			(N')= 14	N_{used}=14	CL		
	66.6	218.5	c'= 42		γ= 120 pcf	2.7	9
II			(N')= 21	N_{used}=16,27	CL		
	62.5	205	c'= 52		γ= 120 pcf	6.9	22.5
III			(N')= 10	N_{used}=13, 9	CL		
	59.4	195	c'= 36		γ= 120 pcf	9.9	32.5
IV			(N')= 30	N_{used}=24, 39, 42	SM		
	54.9	180	c'= 76		γ= 125 pcf	14.5	47.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I-OverEX	1	8.5	0.5	1.02	0.07	1.00	2.90	3.92	42	0.17	Overex (1 ft)
II	13.5	15.75	7.75	1.89	1.07	0.55	1.60	3.49	52	0.83	0.83
III	10	27.5	19.5	3.30	2.69	0.23	0.67	3.97	36	0.27	0.27
IV	15	40	32	4.84	4.41	0.13	0.37	5.20	76	0.08	0.08
									total=	*1.34*	**1.17**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2.5 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2.5*5.14+0.12x3x1+0.4x0.12x7.25x0-0.12x3 12.85 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.85 / 3 = 4.28 ksf > q_{toe} = 2.9 kPa

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Project: **SR-57 NB Widening - RW 486** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 486 (14 feet high)

Standard Caltrans Type 1 Wall - Sta 11+14 to 12+56

Max H= 14 ft Toe pressure, q_{toe}= 3.4 ksf (for Load Case III)
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Borings A-08-05 and C-08-111

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	69.6	228.5				0.0	0
0	66.9	219.5			γ= 120 pcf	2.7	9
I-OverEX			(N')= 14	N_{used}=14	CL		
	66.3	217.5	c'= 42		γ= 120 pcf	3.4	11
II			(N')= 21	N_{used}=16,27	CL		
	62.5	205	c'= 52		γ= 120 pcf	7.2	23.5
III			(N')= 11	N_{used}=13, 9	CL		
	59.4	195	c'= 37		γ= 120 pcf	10.2	33.5
IV			(N')= 30	N_{used}=24, 39, 42	SM		
	54.9	180	c'= 76		γ= 125 pcf	14.8	48.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	9	4.5		0.54							
I	2	10	1	1.20	0.13	0.98	3.34	4.54	42	0.33	Overex (2 ft)
II	12.5	17.25	8.25	2.07	1.03	0.55	1.87	3.94	52	0.81	0.81
III	10	28.5	19.5	3.42	2.44	0.26	0.88	4.30	37	0.32	0.32
IV	15	41	32	4.96	4.00	0.14	0.48	5.43	76	0.09	0.09
									total=	*1.55*	**1.22**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2*5.14+0.12x3x1+0.4x0.12x8x0-0.12x3 = 10.28 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.28 / 3 = 3.43 ksf > q_{toe} = 3.4 kPa

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Project: **SR-57 NB Widening - RW 486** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 486 (14 feet high)

Standard Caltrans Type 1 Wall - Sta 12+88 to 13+52

Max H= 14 ft Toe pressure, q_{toe}= 3.4 ksf (for Load Case III)
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Borings A-08-05 and C-08-111

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	70.3	230.5				0.0	0
0					γ= 120 pcf		
	67.5	221.5	(N')= 14	N_{used}=14	CL	2.7	9
I-OverEX			c'= 42		γ= 120 pcf		
	67.1	220	(N')= 21	N_{used}=16,27	CL	3.2	10.5
II			c'= 52		γ= 120 pcf		
	62.5	205	(N')= 11	N_{used}=13, 9	CL	7.8	25.5
III			c'= 37		γ= 120 pcf		
	59.4	195	(N')= 30	N_{used}=24, 39, 42	SM	10.8	35.5
IV			c'= 76		γ= 125 pcf		
	54.9	180				15.4	50.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	9	4.5		0.54							
I-OverEX	1.5	9.75	0.75	1.17	0.09	0.98	3.34	4.51	42	0.25	Overex (1.5 ft)
II	15	18	9	2.16	1.13	0.53	1.79	3.95	52	0.91	0.91
III	10	30.5	21.5	3.66	2.69	0.23	0.78	4.44	37	0.27	0.27
IV	15	43	34	5.20	4.25	0.13	0.44	5.64	76	0.08	0.08
									total=	*1.52*	**1.26**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 2*5.14+0.12x3x1+0.4x0.12x8x0-0.12x3 =$ 10.28 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 10.28 / 3 = 3.43 ksf > q_{toe} = 3.4 kPa

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Project: **SR-57 NB Widening - RW 486** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 486 (16 feet high)

Standard Caltrans Type 1 Wall - Sta 14+72 to 14+80

Max H= 16 ft Toe pressure, q_{toe}= 3.8 ksf (for Load Case III)
W= 9.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-06

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	70.1	230				0.0	0
0	67.1	220			γ= 120 pcf	3.0	10
I-OverEX	66.3	217.5	(N')= 22 c'= 53	N_{used}=15, 29	CL γ= 120 pcf	3.8	12.5
II	64.9	213	(N')= 22 c'= 53	N_{used}=15, 29	CL γ= 120 pcf	5.2	17
III	63.4	208	(N')= 10 c'= 36	N_{used}=10	CL γ= 120 pcf	6.7	22
IV	54.9	180	(N')= 25 c'= 67	N_{used}=18, 34, 39, 26, 34, 33	SM γ= 125 pcf	15.2	50

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	10	5		0.60							
I-OverEX	2.5	11.25	1.25	1.35	0.14	0.98	3.74	5.09	53	0.33	Overex (2.5 ft)
II	4.5	14.75	4.75	1.77	0.53	0.82	3.12	4.89	53	0.45	0.45
III	5	19.5	9.5	2.34	1.06	0.55	2.09	4.43	36	0.46	0.46
IV	28	36	26	4.39	2.89	0.21	0.81	5.20	67	0.37	0.37
									total=	*1.61*	**1.28**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2.5 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2.5*5.14+0.12x3x1+0.4x0.12x9x0-0.12x3 = 12.85 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.85 / 3 = 4.28 ksf > q_{toe} = 3.8 kPa

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Project: **SR-57 NB Widening - RW 492** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 492 (18 feet high)

Standard Caltrans Type 1 Wall - Sta 10+00 to 10+10

Max H= 18 ft Toe pressure, q_{toe}= 4.3 ksf (for Load Case III)
W= 10.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-07, A-08-08

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	70.7	231.8				0.0	0.0
0	67.3	220.8			γ= 120 pcf	3.4	11.0
I-OverEX	65.8	215.8	(N')= 14 c'= 42	N_{used}=16, 13, 20, 10, 11, 16, 9, 12, 15	CL γ= 120 pcf	4.9	16.0
II	63.4	208.0				7.3	23.8
III	61.0	200.0				9.7	31.8
IV	56.4	185.0	(N')= 17 c'= 46	N_{used}=10, 15, 14, 8, 22, 25, 23, 14	CL γ= 123 pcf	14.3	46.8
V	54.9	180.0	(N')= 24 c'= 65	N_{used}=29, 20	SM γ= 125 pcf	15.8	51.8

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	11	5.5		0.66							
I-OverEX	5	13.5	2.5	1.62	0.25	0.95	4.09	5.71	42	0.78	Overex (5 ft)
II	8	19.9	8.9	2.39	0.89	0.62	2.65	5.04	42	0.72	0.72
III	8	27.8	16.8	3.34	1.68	0.37	1.61	4.94	42	0.39	0.39
IV	15	39.3	28.3	4.74	2.83	0.22	0.95	5.68	46	0.31	0.31
V	5	49.3	38.3	5.97	3.83	0.15	0.65	6.62	65	0.04	0.04
									total=	*2.24*	**1.46**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1.6
ϕ= 5 ° = 0.087 rad Nr= 0.1
c= 1.5 ksf Nc= 6.9
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.5*6.9+0.12x3x1.6+0.4x0.12x10x0.1-0.12x3 = 10.61 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.61 / 3 = 3.54 ksf < q_{toe} = 4.3 kPa

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Project: **SR-57 NB Widening - RW 492** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 492 (14 feet high)

Standard Caltrans Type 1 Wall - Sta 10+10 to 10+56

Max H= 14 ft Toe pressure, q_{toe}= 3.4 ksf (for Load Case III)
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-07, A-08-08

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	71.2	233.5				0.0	0.0
0	68.4	224.5			γ= 120 pcf	2.7	9.0
I-OverEX	67.2	220.5	(N')= 14 c'= 42	N_{used}=16, 13, 20, 10, 11, 16, 9, 12, 15	CL γ= 120 pcf	4.0	13.0
II	64.0	210.0				7.2	23.5
III	61.0	200.0	(N')= 17 c'= 46	N_{used}=10, 15, 14, 8, 22, 25, 23, 14	CL γ= 123 pcf	10.2	33.5
IV	56.4	185.0	(N')= 24 c'= 65	N_{used}=29, 20	SM γ= 125 pcf	14.8	48.5
V	54.9	180.0				16.3	53.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	9	4.5		0.54							
I-OverEX	4	11	2	1.32	0.25	0.95	3.23	4.55	42	0.61	Overex (4 ft)
II	11	18.25	9.25	2.19	1.16	0.53	1.79	3.98	42	0.78	0.78
III	10	28.5	19.5	3.42	2.44	0.26	0.88	4.30	42	0.29	0.29
IV	15	41	32	4.94	4.00	0.14	0.48	5.42	46	0.16	0.16
V	5	51	42	6.18	5.25	0.11	0.38	6.56	65	0.02	0.02
									total=	*1.86*	**1.24**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1.6
ϕ= 5 ° = 0.087 rad Nr= 0.1
c= 1.5 ksf Nc= 6.9
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.5*6.9+0.12x3x1.6+0.4x0.12x8x0.1-0.12x3 = 10.60 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.6 / 3 = 3.53 ksf > q_{toe} = 3.4 kPa

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Project: **SR-57 NB Widening - RW 492** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet _____

RW No. 492 (12 feet high)

Standard Caltrans Type 1 Wall - Sta 10+56 to 12+24

Max H= 12 ft Toe pressure, q_{toe}= 2.9 ksf (for Load Case III)
W= 7.25 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-07, A-08-08

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	71.2	233.5				0.0	0.0
0	68.7	225.5			γ= 120 pcf	2.4	8.0
I-OverEX	67.8	222.5	(N')= 14 c'= 42	N_{used}=16, 13, 20, 10, 11, 16, 9, 12, 15	CL γ= 120 pcf	3.4	11.0
II	65.2	214.0				5.9	19.5
III	61.0	200.0	(N')= 17 c'= 46	N_{used}=10, 15, 14, 8, 22, 25, 23, 14	CL γ= 123 pcf	10.2	33.5
IV	56.4	185.0	(N')= 24 c'= 65	N_{used}=29, 20	SM γ= 125 pcf	14.8	48.5
V	54.9	180.0				16.3	53.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I-OverEX	3	9.5	1.5	1.14	0.21	0.97	2.80	3.94	42	0.46	Overex (3 ft)
II	9	15.25	7.25	1.83	1.00	0.55	1.60	3.43	42	0.66	0.66
III	14	26.5	18.5	3.18	2.55	0.25	0.73	3.91	42	0.36	0.36
IV	15	41	33	4.94	4.55	0.12	0.35	5.29	46	0.12	0.12
V	5	51	43	6.18	5.93	0.11	0.32	6.50	65	0.02	0.02
									total=	*1.62*	**1.15**

Check Bearing Capacity
Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1.6
ϕ= 5 ° = 0.087 rad Nr= 0.1
c= 1.5 ksf Nc= 6.9
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.5*6.9+0.12x3x1.6+0.4x0.12x7.25x0.1-0.12x3 = 10.60 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.6 / 3 = 3.53 ksf > q_{toe} = 2.9 kPa

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Project: **SR-57 NB Widening - RW 492** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 492 (12 feet high)

Standard Caltrans Type 1 Wall - Sta 12+24 to 12+80

Max H= 12 ft Toe pressure, q_{toe}= 2.9 ksf (for Load Case III)
W= 7.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-07, A-08-08

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	71.8	235.5				0.0	0.0
0	69.3	227.5			γ= 120 pcf	2.4	8.0
I-OverEX			(N')= 14	N_{used}=16, 13, 20, 10,	CL		
	68.4	224.5	c'= 42	11, 16, 9, 12, 15	γ= 120 pcf	3.4	11.0
II	65.2	214.0				6.6	21.5
III	61.0	200.0				10.8	35.5
			(N')= 17	N_{used}=10, 15, 14, 8,	CL		
IV	56.4	185.0	c'= 46	22, 25, 23, 14	γ= 123 pcf	15.4	50.5
			(N')= 24	N_{used}=29, 20	SM		
V	54.9	180.0	c'= 65		γ= 125 pcf	16.9	55.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I-OverEX	3	9.5	1.5	1.14	0.21	0.97	2.80	3.94	42	0.46	Overex (3 ft)
II	11	16.25	8.25	1.95	1.14	0.53	1.53	3.48	42	0.75	0.75
III	14	28.5	20.5	3.42	2.83	0.22	0.64	4.06	42	0.30	0.30
IV	15	43	35	5.18	4.83	0.12	0.33	5.52	46	0.11	0.11
V	5	53	45	6.42	6.21	0.11	0.32	6.74	65	0.02	0.02
									total=	*1.64*	**1.18**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1.6
ϕ= 5 ° = 0.087 rad Nr= 0.1
c= 1.5 ksf Nc= 6.9
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.5*6.9+0.12x3x1.6+0.4x0.12x7.25x0.1-0.12x3 = 10.60 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.6 / 3 = 3.53 ksf > q_{toe} = 2.9 kPa

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Project: **SR-57 NB Widening - RW 492** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 492 (12 feet high)

Retaining Wall Type 1SWB Wall - Sta 12+80 to 13+13

Max H= 12 ft Toe pressure, q_{toe}= 2.683 ksf
W= 9.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-07, A-08-08

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	72.0	236.3				0.0	0.0
0	69.3	227.3			γ= 120 pcf	2.7	9.0
I-OverEX	68.1	223.3	(N')= 14 c'= 42	N_{used}=16, 13, 20, 10, 11, 16, 9, 12, 15	CL γ= 120 pcf	4.0	13.0
II	64.6	212.0				7.4	24.3
III	61.0	200.0	(N')= 17 c'= 46	N_{used}=10, 15, 14, 8, 22, 25, 23, 14	CL γ= 123 pcf	11.1	36.3
IV	56.4	185.0	(N')= 24 c'= 65	N_{used}=29, 20	SM γ= 125 pcf	15.6	51.3
V	54.9	180.0				17.2	56.3

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	9	4.5		0.54							
I-OverEX	4	11	2	1.32	0.21	0.97	2.59	3.91	42	0.54	Overex (4 ft)
II	11	18.65	9.65	2.24	0.99	0.58	1.56	3.80	42	0.74	0.74
III	12	30.3	21.3	3.64	2.18	0.29	0.78	4.41	42	0.29	0.29
IV	15	43.8	34.8	5.28	3.57	0.17	0.44	5.72	46	0.14	0.14
V	5	53.8	44.8	6.51	4.59	0.12	0.32	6.83	65	0.02	0.02
									total=	*1.73*	**1.19**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf
ϕ= 5 ° = 0.087 rad => Nq= 1.6
c= 1.5 ksf Nr= 0.1
Overburn: D= 3 feet Nc= 6.9

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.5*6.9+0.12x3x1.6+0.4x0.12x9.75x0.1-0.12 10.61 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.61 / 3 = 3.54 ksf > q_{toe} = 2.683 kPa

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Project: **SR-57 NB Widening - RW 492** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 492 (16 feet high)

Retaining Wall Type 1SWB Wall - Sta 13+13 to 13+20

Max H= 16 ft Toe pressure, q_{toe}= 3.1 ksf
W= 12.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-07, A-08-08

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	71.0	233.0				0.0	0.0
0	68.3	224.0			γ= 120 pcf	2.7	9.0
I-OverEX	66.8	219.0	(N')= 14 c'= 42	N_{used}=16, 13, 20, 10, 11, 16, 9, 12, 15	CL γ= 120 pcf	4.3	14.0
II	64.0	210.0				7.0	23.0
III	61.0	200.0				10.1	33.0
IV	56.4	185.0	(N')= 17 c'= 46	N_{used}=10, 15, 14, 8, 22, 25, 23, 14	CL γ= 123 pcf	14.6	48.0
V	54.9	180.0	(N')= 24 c'= 65	N_{used}=29, 20	SM γ= 125 pcf	16.2	53.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	9	4.5		0.54							
I-OverEX	5	11.5	2.5	1.38	0.21	0.97	3.00	4.38	42	0.72	Overex (5 ft)
II	9	18.5	9.5	2.22	0.79	0.65	2.02	4.24	42	0.72	0.72
III	10	28	19	3.36	1.58	0.39	1.20	4.56	42	0.38	0.38
IV	15	40.5	31.5	4.88	2.63	0.24	0.74	5.63	46	0.24	0.24
V	5	50.5	41.5	6.12	3.46	0.17	0.53	6.64	65	0.03	0.03
									total=	*2.09*	**1.37**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1.6
ϕ= 5 ° = 0.087 rad Nr= 0.1
c= 1.5 ksf Nc= 6.9
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.5*6.9+0.12x3x1.6+0.4x0.12x12x0.1-0.12x: 10.62 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.62 / 3 = 3.54 ksf > q_{toe} = 3.1 kPa

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Project: **SR-57 NB Widening - RW 496** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 496

Retaining Wall Type 1SWB Wall - Sta 10+00 to 10+28

Max H= 16 ft Toe pressure, q_{toe}= 3.1 ksf
W= 12.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-15, A-08-119

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	71.6	235				0.0	0
0	68.6	225			γ= 120 pcf	3.0	10
I	67.1	220	(N')= 14 c'= 42	N_{used}=7, 17, 11, 8, 20, 17, 18, 17	**CL** γ= 120 pcf	4.6	15
II	64.6	212				7.0	23
III	62.5	205				9.1	30
IV	59.4	195	(N')= 22 c'= 53	N_{used}=31, 26, 29, 12	**CL** γ= 120 pcf	12.2	40
V	53.3	175	(N')= 40 c'= 96		**SM** γ= 120 pcf	18.3	60

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	10	5		0.60							
I	5	12.5	2.5	1.50	0.21	0.97	3.00	4.50	42	0.68	Overex (5 ft)
II	8	19	9	2.28	0.75	0.65	2.02	4.30	42	0.63	0.63
III	7	26.5	16.5	3.18	1.38	0.45	1.41	4.59	42	0.32	0.32
IV	10	35	25	4.20	2.08	0.30	0.93	5.13	53	0.20	0.20
V	20	50	40	4.20	3.33	0.18	0.54	4.74	96	0.13	0.13
									total=	*1.96*	**1.28**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 2.5
ϕ= 10 ° = 0.175 rad Nr= 0.4
c= 1.5 ksf Nc= 8.5
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.5*8.5+0.12x3x2.5+0.4x0.12x12x0.4-0.12x3 = 13.52 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 13.52 / 3 = 4.51 ksf > q_{toe} = 3.1 kPa

Earth Mechanics, Inc.
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Project: **SR-57 NB Widening - RW 496** Project No. **08-115**
By CTY Date 1/27/09 Check by Date Sheet

RW No. 496

MSE - 17'-5" high

Max H= 17.5 Toe pressure, q_{toe}= 3.722 ksf
W= 16.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-15, A-08-119

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	70.4	231				0.0	0
0	67.4	221			γ= 120 pcf	3.0	10
I	66.8	219	(N')= 14 c'= 42	N_{used}=7, 17, 11, 8, 20, 17, 18, 17	CL γ= 120 pcf	3.7	12
II	64.0	210				6.4	21
III	62.5	205	(N')= 22	N_{used}=31, 26, 29,	SM	7.9	26
IV	59.4	195	c'= 62	12	γ= 120 pcf	11.0	36
V	56.4	185	(N')= 40 c'= 96		SM γ= 120 pcf	14.0	46

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	10	5		0.60							
I	2	11	1	1.32	0.06	1.00	3.72	5.04	42	0.33	Overex (2 ft)
II	9	16.5	6.5	1.98	0.41	0.91	3.37	5.35	42	1.11	1.11
III	5	23.5	13.5	2.82	0.84	0.62	2.30	5.12	42	0.37	0.37
IV	10	31	21	3.72	1.31	0.48	1.79	5.51	62	0.33	0.33
V	10	41	31	3.72	1.94	0.33	1.22	4.94	96	0.15	0.15
									total=	*2.30*	**1.96**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 2.5
ϕ= 10 ° = 0.175 rad Nr= 0.4
c= 1.5 ksf Nc= 8.5
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 1.5*8.5+0.12x3x2.5+0.4x0.12x16x0.4-0.12x3 =$ 13.60 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 13.6 / 3 = 4.53 ksf > $q_{toe} =$ 3.722 kPa

Earth Mechanics, Inc.
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Project: **SR-57 NB Widening - RW 496** Project No. **08-115**
By CTY Date 1/27/09 Check by Date Sheet

RW No. 496

MSE - 22'-8" high
Max H= 22'-8" Toe pressure, q_{toe}= 4.394 ksf
W= 21.00 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-15, A-08-119

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	70.4	231				0.0	0
0	67.4	221			γ= 120 pcf	3.0	10
I	66.0	216.5	(N')= 14 c'= 42	N_{used}=7, 17, 11, 8, 20, 17, 18, 17	**CL** γ= 120 pcf	4.4	14.5
II	64.0	210				6.4	21
III	62.5	205	(N')= 22 c'= 62	N_{used}=31, 26, 29, 12	**SM** γ= 120 pcf	7.9	26
IV	59.4	195	(N')= 40 c'= 96		**SM** γ= 120 pcf	11.0	36
V	56.4	185				14.0	46

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	10	5		0.60							
I	4.5	12.25	2.25	1.47	0.11	0.98	4.32	5.79	42	0.77	Overex (4.5 ft)
II	6.5	17.75	7.75	2.13	0.37	0.91	3.98	6.11	42	0.85	0.85
III	5	23.5	13.5	2.82	0.64	0.76	3.35	6.17	42	0.49	0.49
IV	10	31	21	3.72	1.00	0.55	2.42	6.14	62	0.42	0.42
V	10	41	31	3.72	1.48	0.43	1.87	5.59	96	0.22	0.22
									total=	*2.74*	**1.98**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 2.5
ϕ= 10 ° = 0.175 rad Nr= 0.4
c= 1.5 ksf Nc= 8.5
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 1.5*8.5+0.12x3x2.5+0.4x0.12x21x0.4-0.12x3 =$ 13.69 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 13.69 / 3 = 4.56 ksf > $q_{toe} =$ 4.394 kPa

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Project: **SR-57 NB Widening - RW 496** Project No. **08-115**
By CTY Date 1/27/09 Check by Date Sheet

RW No. 496

MSE - 20' high
Max H= 20' Toe pressure, q_{toe}= 4.101 ksf
W= 18.00 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-15, A-08-119

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	70.4	231				0.0	0
0	67.4	221			γ= 120 pcf	3.0	10
I	66.4	218	(N')= 14 c'= 42	N_{used}=7, 17, 11, 8, 20, 17, 18, 17	**CL** γ= 120 pcf	4.0	13
II	64.0	210				6.4	21
III	62.5	205	(N')= 22 c'= 62	N_{used}=31, 26, 29, 12	**SM** γ= 120 pcf	7.9 11.0	26 36
IV	59.4	195	(N')= 40 c'= 96		**SM** γ= 120 pcf	14.0	46
V	56.4	185					

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	Δσ$_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	10	5		0.60							
I	3	11.5	1.5	1.38	0.08	0.98	4.03	5.41	42	0.51	Overex (3 ft)
II	8	17	7	2.04	0.39	0.91	3.72	5.76	42	1.03	1.03
III	5	23.5	13.5	2.82	0.75	0.65	2.67	5.49	42	0.41	0.41
IV	10	31	21	3.72	1.17	0.53	2.16	5.88	62	0.38	0.38
V	10	41	31	3.72	1.72	0.37	1.53	5.25	96	0.19	0.19
									total=	*2.52*	**2.01**

Check Bearing Capacity
Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 2.5
ϕ= 10 ° = 0.175 rad Nr= 0.4
c= 1.5 ksf Nc= 8.5
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.5*8.5+0.12x3x2.5+0.4x0.12x18x0.4-0.12x3 = 13.64 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 13.64 / 3 = 4.55 ksf > q_{toe} = 4.101 kPa

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Project: **SR-57 NB Widening - RW 496** Project No. **08-115**
By CTY Date 1/27/09 Check by Date Sheet

RW No. 496

MSE - 22'-8" high
Max H= 22'-8" Toe pressure, q_{toe}= 4.394 ksf
W= 21.00 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-119, A-08-16

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	70.4	231				0.0	0
0	67.4	221			γ= 120 pcf	3.0	10
I	66.0	216.5	(N')= 18 c'= 47	N_{used}=12, 30, 12	CL γ= 120 pcf	4.4	14.5
II	64.0	210				6.4	21
III	61.0	200	(N')= 40 c'= 96	N_{used}=40	SC γ= 120 pcf	9.4	31
IV	59.4	195	(N')= 18 c'= 47	N_{used}=10, 17, 31, 18	CL γ= 120 pcf	11.0	36
V	56.4	185				14.0	46

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	10	5		0.60							
I	4.5	12.25	2.25	1.47	0.11	0.98	4.32	5.79	47	0.68	Overex (4.5 ft)
II	6.5	17.75	7.75	2.13	0.37	0.91	3.98	6.11	47	0.76	0.76
III	10	26	16	3.12	0.76	0.65	2.86	5.98	47	0.72	0.72
IV	5	33.5	23.5	4.02	1.12	0.53	2.31	6.33	96	0.12	0.12
V	10	41	31	4.02	1.48	0.43	1.87	5.89	47	0.42	0.42
									total=	*2.71*	**2.03**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 2.5
ϕ= 10 ° = 0.175 rad Nr= 0.4
c= 1.8 ksf Nc= 8.5
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 1.8*8.5+0.12x3x2.5+0.4x0.12x21x0.4-0.12x3 =$ 16.24 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 16.24 / 3 = 5.41 ksf > $q_{toe} =$ 4.394 kPa

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Project: **SR-57 NB Widening - RW 496** Project No. **08-115**
By CTY Date 1/27/09 Check by Date Sheet _____

RW No. 496

MSE - 24'-6" high
Max H= 24.5' Toe pressure, q_{toe}= 4.75 ksf
W= 22.00 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-119, A-08-16

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	70.7	232				0.0	0
0	67.4	221			γ= 120 pcf	3.4	11
I	65.8	216	(N')= 18 c'= 47	N_{used}=12, 30, 12	CL γ= 120 pcf	4.9	16
II	64.0	210				6.7	22
III	61.0	200	(N')= 40	N_{used}=40	SC	9.8	32
IV	59.4	195	c'= 96		γ= 120 pcf	11.3	37
V	56.4	185	(N')= 18 c'= 47	N_{used}=10, 17, 31, 18	CL γ= 120 pcf	14.3	47

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	Δσ$_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	11	5.5		0.66							
I	5	13.5	2.5	1.62	0.11	0.98	4.67	6.29	47	0.75	Overex (5 ft)
II	6	19	8	2.28	0.36	0.91	4.31	6.59	47	0.71	0.71
III	10	27	16	3.24	0.73	0.71	3.36	6.60	47	0.79	0.79
IV	5	34.5	23.5	4.14	1.07	0.55	2.61	6.75	96	0.13	0.13
V	10	42	31	4.14	1.41	0.45	2.15	6.29	47	0.46	0.46
									total=	*2.84*	**2.09**

Check Bearing Capacity
Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 2.5
ϕ= 10 ° = 0.175 rad Nr= 0.4
c= 1.8 ksf Nc= 8.5
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.8*8.5+0.12x3x2.5+0.4x0.12x22x0.4-0.12x3 = 16.26 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 16.26 / 3 = 5.42 ksf > q_{toe} = 4.75 kPa

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Project: **SR-57 NB Widening - RW 496** Project No. **08-115**
By CTY Date 1/27/09 Check by Date Sheet

RW No. 496

MSE - 26'-8" high
Max H= 26.67' Toe pressure, q_{toe}= 5.07 ksf
W= 24.00 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-119, A-08-16

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	71.0	233				0.0	0
0	67.4	221			γ= 120 pcf	3.7	12
I	65.8	216	(N')= 18 c'= 47	N_{used}=12, 30, 12	CL γ= 120 pcf	5.2	17
II	64.0	210				7.0	23
III	61.0	200				10.1	33
IV	59.4	195	(N')= 40 c'= 96	N_{used}=40	SC γ= 120 pcf	11.6	38
V	56.4	185	(N')= 18 c'= 47	N_{used}=10, 17, 31, 18	CL γ= 120 pcf	14.6	48

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	12	6		0.72							
I	5	14.5	2.5	1.74	0.10	0.98	4.99	6.73	47	0.75	Overex (5 ft)
II	6	20	8	2.40	0.33	0.91	4.60	7.00	47	0.71	0.71
III	10	28	16	3.36	0.67	0.76	3.87	7.23	47	0.85	0.85
IV	5	35.5	23.5	4.26	0.98	0.58	2.96	7.22	96	0.14	0.14
V	10	43	31	4.26	1.29	0.48	2.43	6.69	47	0.50	0.50
									total=	*2.96*	**2.21**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf
ϕ= 10 ° = 0.175 rad => Nq= 2.5
c= 1.8 ksf Nr= 0.4
Overburn: D= 3 feet Nc= 8.5

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 1.8*8.5+0.12x3x2.5+0.4x0.12x24x0.4-0.12x3 =$ 16.30 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 16.3 / 3 = 5.43 ksf > q_{toe} = 5.07 kPa

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Project: **SR-57 NB Widening - RW 512** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 512 (18 feet high)

Standard Caltrans Type 1 Wall - Sta 10+00 to 10+96

Max H= 18 ft Toe pressure, q_{toe}= 4 ksf (for Load Case III)
W= 10.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-13

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	70.1	230.0				0.0	0.0
0	67.1	220.0			γ= 120 pcf	3.0	10.0
I-OverEX			(N')= 21	N_{used}=23, 18, 21	CL		
	66.4	218.0	c'= 52		γ= 120 pcf	3.7	12.0
II	64.0	210.0				6.1	20.0
III	62.2	204.0				7.9	26.0
IV			(N')= 38	N_{used}=38	CL		
	59.4	195.0	c'= 77		γ= 123 pcf	10.7	35.0
V			(N')= 38	N_{used}=46, 28, 40	SM		
	56.4	185.0	c'= 92		γ= 125 pcf	13.7	45.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	10	5		0.60							
I-OverEX	2	11	1	1.32	0.10	0.98	3.93	5.25	52	0.28	Overex (2 ft)
II	8	16	6	1.92	0.60	0.76	3.05	4.97	52	0.76	0.76
III	6	23	13	2.76	1.30	0.48	1.92	4.68	52	0.32	0.32
IV	9	30.5	20.5	3.67	2.05	0.31	1.24	4.91	77	0.18	0.18
V	10	40	30	4.85	3.00	0.20	0.80	5.65	92	0.09	0.09
									total=	*1.62*	**1.34**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2.5 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2.5*5.14+0.12x3x1+0.4x0.12x10x0-0.12x3 = 12.85 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.85 / 3 = 4.28 ksf > q_{toe} = 4 kPa

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Project: **SR-57 NB Widening - RW 512** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 512 (16 feet high)

Standard Caltrans Type 1 Wall - Sta 10+96 to 11+68

Max H= 16 ft Toe pressure, q_{toe}= 3.8 ksf (for Load Case III)
W= 9.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-13

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	70.4	231.0				0.0	0.0
0	67.4	221.0			γ= 120 pcf	3.0	10.0
I-OverEX			(N')= 21	N_{used}=23, 18, 21	CL		
	66.9	219.5	c'= 52		γ= 120 pcf	3.5	11.5
II	64.0	210.0				6.4	21.0
III	62.2	204.0				8.2	27.0
IV			(N')= 38	N_{used}=38	CL		
	59.4	195.0	c'= 77		γ= 123 pcf	11.0	36.0
V			(N')= 38	N_{used}=46, 28, 40	SM		
	56.4	185.0	c'= 92		γ= 125 pcf	14.0	46.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	10	5		0.60							
I-OverEX	1.5	10.75	0.75	1.29	0.08	0.98	3.74	5.03	52	0.20	Overex (1.5 ft)
II	10	16.25	6.25	1.95	0.69	0.71	2.69	4.64	52	0.82	0.82
III	6	24	14	2.88	1.56	0.40	1.52	4.40	52	0.25	0.25
IV	9	31.5	21.5	3.79	2.39	0.27	1.03	4.82	77	0.15	0.15
V	10	41	31	4.97	3.44	0.17	0.65	5.62	92	0.07	0.07
									total=	*1.50*	**1.29**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2.5 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D$ = 2.5*5.14+0.12x3x1+0.4x0.12x9x0-0.12x3 = 12.85 ksf

$q_{allow(net)} = q_{ult(net)} / 3$ = 12.85 / 3 = 4.28 ksf > q_{toe} = 3.8 kPa

Earth Mechanics, Inc.
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Project: **SR-57 NB Widening - RW 512** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 512 (14 feet high)

Standard Caltrans Type 1 Wall - Sta 11+68 to 12+08

Max H= 14 ft Toe pressure, q_{toe}= 3.4 ksf (for Load Case III)
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-13

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	70.7	232.0				0.0	0.0
0	68.0	223.0			γ= 120 pcf	2.7	9.0
I-OverEX			(N')= 21	N_{used}=23, 18, 21	CL		
	67.5	221.5	c'= 52		γ= 120 pcf	3.2	10.5
II	64.6	212.0				6.1	20.0
III	62.2	204.0				8.5	28.0
IV			(N')= 38	N_{used}=38	CL		
	59.4	195.0	c'= 77		γ= 123 pcf	11.3	37.0
V			(N')= 38	N_{used}=46, 28, 40	SM		
	56.4	185.0	c'= 92		γ= 125 pcf	14.3	47.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	Δσ_v' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	9	4.5		0.54							
I-OverEX	1.5	9.75	0.75	1.17	0.09	0.98	3.34	4.51	52	0.20	Overex (1.5 ft)
II	10	15.25	6.25	1.83	0.78	0.65	2.21	4.04	52	0.75	0.75
III	8	24	15	2.88	1.88	0.34	1.17	4.05	52	0.27	0.27
IV	9	32.5	23.5	3.91	2.94	0.21	0.70	4.62	77	0.10	0.10
V	10	42	33	5.09	4.13	0.14	0.46	5.56	92	0.05	0.05
									total=	*1.38*	**1.18**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2.5 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2.5*5.14+0.12x3x1+0.4x0.12x8x0-0.12x3 = 12.85 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.85 / 3 = 4.28 ksf > q_{toe} = 3.4 kPa

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Project: **SR-57 NB Widening - RW 512** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 512 (12 feet high)

Standard Caltrans Type 1 Wall - Sta 12+08 to 12+24

Max H= 12 ft Toe pressure, q_{toe}= 2.9 ksf (for Load Case III)
W= 7.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-13

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	70.7	232.0				0.0	0.0
0	68.3	224.0			γ= 120 pcf	2.4	8.0
I-OverEX			(N')= 21	N_{used}=23, 18, 21	CL		
	68.0	223.0	c'= 52		γ= 120 pcf	2.7	9.0
II	64.9	213.0				5.8	19.0
III	62.2	204.0				8.5	28.0
IV			(N')= 38	N_{used}=38	CL		
	59.4	195.0	c'= 77		γ= 123 pcf	11.3	37.0
V			(N')= 38	N_{used}=46, 28, 40	SM		
	56.4	185.0	c'= 92		γ= 125 pcf	14.3	47.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I-OverEX	1	8.5	0.5	1.02	0.07	1.00	2.90	3.92	52	0.13	Overex (1 ft)
II	10	14	6	1.68	0.83	0.65	1.89	3.57	52	0.75	0.75
III	9	23.5	15.5	2.82	2.14	0.30	0.87	3.69	52	0.24	0.24
IV	9	32.5	24.5	3.91	3.38	0.18	0.51	4.42	77	0.07	0.07
V	10	42	34	5.09	4.69	0.12	0.34	5.43	92	0.04	0.04
									total=	*1.24*	**1.11**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2.5 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 2.5*5.14+0.12x3x1+0.4x0.12x7.25x0-0.12x3$ 12.85 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 12.85 / 3 = 4.28 ksf > q_{toe} = 2.9 kPa

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Project: **SR-57 NB Widening - RW 512** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 512 (10 feet high)

Standard Caltrans Type 1 Wall - Sta 12+24 to 12+88

Max H= 10 ft Toe pressure, q_{toe}= 2.5 ksf (for Load Case III)
W= 6.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-13

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	71.0	233.0				0.0	0.0
0	68.9	226.0			γ= 120 pcf	2.1	7.0
I-OverEX	68.7	225.5	(N')= 21 c'= 52	N_{used}=23, 18, 21	CL γ= 120 pcf	2.3	7.5
II	65.5	215.0				5.5	18.0
III	62.2	204.0	(N')= 38 c'= 77	N_{used}=38	CL γ= 123 pcf	8.8	29.0
IV	59.4	195.0	(N')= 38 c'= 92	N_{used}=46, 28, 40	SM γ= 125 pcf	11.6	38.0
V	56.4	185.0				14.6	48.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I-OverEX	0.5	7.25	0.25	0.87	0.04	1.00	2.50	3.37	52	0.07	Overex (0.5 ft)
II	11	12.75	5.75	1.53	0.92	0.58	1.46	2.99	52	0.70	0.70
III	11	23.5	16.5	2.82	2.64	0.24	0.60	3.42	52	0.21	0.21
IV	9	33.5	26.5	4.03	4.24	0.13	0.33	4.37	77	0.05	0.05
V	10	43	36	5.21	5.76	0.11	0.28	5.49	92	0.03	0.03
									total=	*1.06*	**1.00**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2.5 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 2.5*5.14+0.12x3x1+0.4x0.12x6.25x0-0.12x3$ 12.85 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 12.85 / 3 = 4.28 ksf > q_{toe} = 2.5 kPa

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Project: **SR-57 NB Widening - RW 512** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 512 (8 feet high)

Standard Caltrans Type 1 Wall - Sta 12+88 to 13+28

Max H= 8 ft Toe pressure, q_{toe}= 2.2 ksf (for Load Case III)
W= 5.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-13

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	71.0	233.0				0.0	0.0
0	69.2	227.0			γ= 120 pcf	1.8	6.0
I	67.7	222.0	(N')= 21 c'= 52	N_{used}=23, 18, 21	**CL** γ= 120 pcf	3.4	11.0
II	64.9	213.0				6.1	20.0
III	62.2	204.0				8.8	29.0
IV	59.4	195.0	(N')= 38 c'= 77	N_{used}=38	**CL** γ= 123 pcf	11.6	38.0
V	56.4	185.0	(N')= 38 c'= 92	N_{used}=46, 28, 40	**SM** γ= 125 pcf	14.6	48.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I	5	8.5	2.5	1.02	0.48	0.86	1.90	2.92	52	0.53	
II	9	15.5	9.5	1.86	1.81	0.36	0.79	2.65	52	0.32	
III	9	24.5	18.5	2.94	3.52	0.17	0.36	3.30	52	0.11	
IV	9	33.5	27.5	4.03	5.24	0.11	0.25	4.28	77	0.04	
V	10	43	37	5.21	7.05	0.08	0.18	5.39	92	0.02	
									total=	*1.01*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2.5 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2.5*5.14+0.12x3x1+0.4x0.12x5.25x0-0.12x3 12.85 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.85 / 3 = 4.28 ksf > q_{toe} = 2.2 kPa

Earth Mechanics, Inc.
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Project: **SR-57 NB Widening - RW 514** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet _____

RW No. 514 (6 feet high)

Standard Caltrans Type 1 Wall - Sta 12+10 to 12+80

Max H= 6 ft Toe pressure, q_{toe}= 1.9 ksf (for Load Case I)
W= 4.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-13, A-08-14

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	73.8	242.0				0.0	0.0
0	72.2	237.0			γ= 120 pcf	1.5	5.0
I	71.8	235.5	(N')= 16 c'= 44	N_{used}=16, 12, 12, 12, 13, 15, 13, 19, 24, 21	CL γ= 120 pcf	2.0	6.5
II	68.9	226.0				4.9	16.0
III	66.1	217.0	(N')= 10 c'= 36	N_{used}=10, 13, 7	CL γ= 120 pcf	7.6	25.0
IV	63.1	207.0	(N')= 22 c'= 53	N_{used}=23, 18, 21, 38, 20, 35, 20, 23, 14, 19, 16	CL γ= 120 pcf	10.7	35.0
V	60.0	197.0				13.7	45.0
VI	56.4	185.0				17.4	57.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	5	2.5		0.30							
I	1.5	5.75	0.75	0.69	0.18	0.97	1.84	2.53	44	0.23	
II	10	11.25	6.25	1.35	1.47	0.43	0.81	2.16	44	0.53	
III	9	20.5	15.5	2.46	3.65	0.16	0.30	2.76	36	0.15	
IV	10	30	25	3.60	5.88	0.11	0.21	3.81	53	0.06	
V	10	40	35	4.80	8.24	0.08	0.15	4.95	53	0.03	
VI	12.0	51	46	6.12	10.82	0.02	0.04	6.16	53	0.01	
									total=	*1.01*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2*5.14+0.12x3x1+0.4x0.12x4.25x0-0.12x3 = 10.28 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.28 / 3 = 3.43 ksf > q_{toe} = 1.9 kPa

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Project: **SR-57 NB Widening - RW 514** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 514 (8 feet high)

Standard Caltrans Type 1 Wall - Sta 12+80 to 13+95

Max H= 8 ft Toe pressure, q_{toe}= 2.2 ksf (for Load Case I)
W= 5.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-13, A-08-14

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	73.8	242.0				0.0	0.0
0	71.9	236.0			γ= 120 pcf	1.8	6.0
I-OverEX	71.6	235.0	(N')= 16 c'= 44	N_{used}=16, 12, 12, 12, 13, 15, 13, 19, 24, 21	CL γ= 120 pcf	2.1	7.0
II	68.9	226.0	(N')= 10 c'= 36	N_{used}=10, 13, 7	CL γ= 120 pcf	4.9	16.0
III	66.1	217.0	(N')= 22 c'= 53	N_{used}=23, 18, 21, 38, 20, 35, 20, 23, 14, 19, 16	CL γ= 120 pcf	7.6	25.0
IV	63.1	207.0				10.7	35.0
V	60.0	197.0				13.7	45.0
VI	56.4	185.0				17.4	57.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I-OverEX	1	6.5	0.5	0.78	0.10	0.98	2.16	2.94	44	0.16	Overex (1 ft)
II	9	11.5	5.5	1.38	1.05	0.55	1.21	2.59	44	0.67	0.67
III	9	20.5	14.5	2.46	2.76	0.22	0.48	2.94	36	0.23	0.23
IV	10	30	24	3.60	4.57	0.12	0.26	3.86	53	0.07	0.07
V	10	40	34	4.80	6.48	0.11	0.25	5.05	53	0.05	0.05
VI	12.0	51	45	6.12	8.57	0.05	0.11	6.23	53	0.02	0.02
									total=	*1.20*	**1.05**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2*5.14+0.12x3x1+0.4x0.12x5.25x0-0.12x3 = 10.28 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.28 / 3 = 3.43 ksf > q_{toe} = 2.2 kPa

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Project: **SR-57 NB Widening - RW 514** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 514 (10 feet high)

Standard Caltrans Type 1 Wall - Sta 13+95 to 14+32

Max H= 10 ft Toe pressure, q_{toe}= 2.5 ksf (for Load Case I)
W= 6.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-13, A-08-14

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	74.1	243.0				0.0	0.0
0	71.9	236.0			γ= 120 pcf	2.1	7.0
I-OverEX	71.3	234.0	(N')= 16 c'= 44	N_{used}=16, 12, 12, 12, 13, 15, 13, 19, 24, 21	CL γ= 120 pcf	2.7	9.0
II	68.9	226.0	(N')= 10 c'= 36	N_{used}=10, 13, 7	CL γ= 120 pcf	5.2	17.0
III	66.1	217.0	(N')= 22 c'= 53	N_{used}=23, 18, 21, 38, 20, 35, 20, 23, 14, 19, 16	CL γ= 120 pcf	7.9	26.0
IV	63.1	207.0				11.0	36.0
V	60.0	197.0				14.0	46.0
VI	56.4	185.0				17.7	58.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I-OverEX	2	8	1	0.96	0.16	0.98	2.46	3.42	44	0.30	Overex (2 ft)
II	8	13	6	1.56	0.96	0.58	1.46	3.02	44	0.63	0.63
III	9	21.5	14.5	2.58	2.32	0.28	0.70	3.28	36	0.31	0.31
IV	10	31	24	3.72	3.84	0.15	0.37	4.09	53	0.09	0.09
V	10	41	34	4.92	5.44	0.11	0.28	5.20	53	0.05	0.05
VI	12.0	52	45	6.24	7.20	0.08	0.20	6.44	53	0.04	0.04
									total=	*1.42*	**1.12**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2*5.14+0.12x3x1+0.4x0.12x6.25x0-0.12x3 = 10.28 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.28 / 3 = 3.43 ksf > q_{toe} = 2.5 kPa

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Project: **SR-57 NB Widening - RW 514** Project No. **08-115**
By CTY Date 2/23/09 Check by Date Sheet

RW No. 514 (10 feet high)

Standard Caltrans Type 1 Wall - Sta 15+20 to 16+16

Max H= 10 ft Toe pressure, q_{toe}= 2.5 ksf (for Load Case I)
W= 6.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-13, A-08-14

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	75.0	246.0				0.0	0.0
0	72.8	239.0			γ= 120 pcf	2.1	7.0
I-OverEX	72.2	237.0	(N')= 16 c'= 44	N_{used}=16, 12, 12, 12, 13, 15, 13, 19, 24, 21	CL γ= 120 pcf	2.7	9.0
II	68.9	226.0				6.1	20.0
III	66.1	217.0	(N')= 10 c'= 36	N_{used}=10, 13, 7	CL γ= 120 pcf	8.8	29.0
IV	63.1	207.0	(N')= 22 c'= 53	N_{used}=23, 18, 21, 38, 20, 35, 20, 23, 14, 19, 16	CL γ= 120 pcf	11.9	39.0
V	60.0	197.0				14.9	49.0
VI	56.4	185.0				18.6	61.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I-OverEX	2	8	1	0.96	0.16	0.98	2.46	3.42	44	0.30	Overex (2 ft)
II	11	14.5	7.5	1.74	1.20	0.50	1.26	3.00	44	0.71	0.71
III	9	24.5	17.5	2.94	2.80	0.22	0.55	3.49	36	0.22	0.22
IV	10	34	27	4.08	4.32	0.13	0.33	4.41	53	0.08	0.08
V	10	44	37	5.28	5.92	0.11	0.28	5.56	53	0.05	0.05
VI	12.0	55	48	6.60	7.68	0.08	0.20	6.80	53	0.04	0.04
									total=	*1.40*	**1.09**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2*5.14+0.12x3x1+0.4x0.12x6.25x0-0.12x3 = 10.28 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.28 / 3 = 3.43 ksf > q_{toe} = 2.5 kPa

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Project: SR-57 NB Widening - RW 514 Project No. 08-115
By CTY Date 2/23/09 Check by Date Sheet

RW No. 514 (14 feet high)

Standard Caltrans Type 1 Wall - Sta 16+16 to 16+24

Max H= 14 ft Toe pressure, q_{toe}= 3.3 ksf (for Load Case III)
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-13, A-08-14

Layer	Elev. (m)	Elev. (ft)					depth (m)	depth (ft)
	74.2	243.5					0.0	0.0
0	71.5	234.5			γ= 120	pcf	2.7	9.0
I-OverEX	70.4	231.0	(N')= 16 c'= 44	N_{used}=16, 12, 12, 12, 13, 15, 13, 19, 24, 21	CL γ= 120	pcf	3.8	12.5
II	68.9	226.0	(N')= 10 c'= 36	N_{used}=10, 13, 7	CL γ= 120	pcf	5.3	17.5
III	66.1	217.0	(N')= 22 c'= 53	N_{used}=23, 18, 21, 38, 20, 35, 20, 23, 14, 19, 16	CL γ= 120	pcf	8.1	26.5
IV	63.1	207.0					11.1	36.5
V	60.0	197.0					14.2	46.5
VI	56.4	185.0					17.8	58.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	9	4.5		0.54							
I-OverEX	3.5	10.75	1.75	1.29	0.22	0.97	3.19	4.48	44	0.52	Overex (3.5 ft)
II	5	15	6	1.80	0.75	0.65	2.15	3.95	44	0.46	0.46
III	9	22	13	2.64	1.63	0.39	1.28	3.92	36	0.51	0.51
IV	10	31.5	22.5	3.78	2.81	0.22	0.73	4.51	53	0.17	0.17
V	10	41.5	32.5	4.98	4.06	0.14	0.46	5.44	53	0.09	0.09
VI	12.0	52.5	43.5	6.30	5.44	0.11	0.37	6.67	53	0.07	0.07
									total=	*1.82*	**1.31**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2*5.14+0.12x3x1+0.4x0.12x8x0-0.12x3 = 10.28 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.28 / 3 = 3.43 ksf > q_{toe} = 3.3 kPa

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Project: **SR-57 NB Widening - RW 522** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 522 (14 feet high)

Standard Caltrans Type 1 Wall - Sta 10+00 to 10+08

Max H= 14 ft Toe pressure, q_{toe}= 3.3 ksf (for Load Case I)
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-15, C-08-117

Layer	Elev. (m)	Elev. (ft)					depth (m)	depth (ft)
	74.2	243.5					0.0	0.0
0	71.8	235.5			γ= 120	pcf	2.4	8.0
I-OverEX			(N')= 21	N_{used}=21	CL			
	70.7	232.0	c'= 52		γ= 120	pcf	3.5	11.5
II-OverEX			(N')= 11	N_{used}=8, 13, 7	CL			
	70.6	231.5	c'= 37		γ= 120	pcf	3.7	12.0
III			(N')= 11	N_{used}=8, 13, 7	CL			
	68.0	223.0	c'= 37		γ= 120	pcf	6.2	20.5
IV			(N')= 7	N_{used}=7	SM			
	65.8	216.0	c'= 38		γ= 120	pcf	8.4	27.5
V			(N')= 12	N_{used}=17, 11, 8	CL			
	61.9	203.0	c'= 39		γ= 120	pcf	12.3	40.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I-OverEX	3.5	9.75	1.75	1.17	0.22	0.97	3.19	4.36	52	0.46	
II-OverEX	1	11.75	3.75	1.41	0.47	0.86	2.85	4.26	37	0.08	Overex (4 ft)
III	9	16.25	8.25	1.95	1.03	0.55	1.82	3.77	37	0.79	0.79
IV	7	24	16	2.88	2.00	0.31	1.02	3.90	38	0.29	0.29
V	13	34	26	4.08	3.25	0.18	0.59	4.67	39	0.24	0.24
									total=	*1.85*	**1.32**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D$ = 2*5.14+0.12x3x1+0.4x0.12x8x0-0.12x3 = 10.28 ksf

$q_{allow(net)} = q_{ult(net)} / 3$ = 10.28 / 3 = 3.43 ksf > q_{toe} = 3.3 kPa

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Project: **SR-57 NB Widening - RW 522** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 522 (10 feet high)

Standard Caltrans Type 1 Wall - Sta 10+08 to 10+16

Max H= 10 ft Toe pressure, q_{toe}= 2.5 ksf (for Load Case I)
W= 6.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-15, C-08-117

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	75.6	248.0				0.0	0.0
0	73.5	241.0			γ= 120 pcf	2.1	7.0
I-OverEX			(N')= 21 c'= 52	N_{used}=21	CL γ= 120 pcf		
II	72.5	238.0				3.0	10.0
III	70.7	232.0	(N')= 11 c'= 37	N_{used}=8, 13, 7	CL γ= 120 pcf	4.9	16.0
IV	68.0	223.0	(N')= 7 c'= 38	N_{used}=7	SM γ= 120 pcf	7.6	25.0
V	65.8	216.0	(N')= 12 c'= 39	N_{used}=17, 11, 8	CL γ= 120 pcf	9.8	32.0
	61.9	203.0				13.7	45.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	Δσ$_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I-OverEX	3	8.5	1.5	1.02	0.24	0.97	2.42	3.44	52	0.37	Overex (3 ft)
II	6	13	6	1.56	0.96	0.58	1.46	3.02	52	0.40	0.40
III	9	20.5	13.5	2.46	2.16	0.30	0.75	3.21	37	0.34	0.34
IV	7	28.5	21.5	3.42	3.44	0.17	0.42	3.84	38	0.11	0.11
V	13	38.5	31.5	4.62	5.04	0.11	0.28	4.90	39	0.10	0.10
									total=	*1.31*	**0.95**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2*5.14+0.12x3x1+0.4x0.12x6.25x0-0.12x3 = 10.28 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.28 / 3 = 3.43 ksf > q_{toe} = 2.5 kPa

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Project: **SR-57 NB Widening - RW 522** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 522 (8 feet high)

Standard Caltrans Type 1 Wall - Sta 10+16 to 11+20

Max H= 8 ft Toe pressure, q_{toe}= 2.2 ksf (for Load Case I)
W= 5.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-15, C-08-117

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	75.3	247.0				0.0	0.0
0	73.5	241.0			γ= 120 pcf	1.8	6.0
I-OverEX			(N')= 21	N_{used}=21	CL		
	73.3	240.5	c'= 52		γ= 120 pcf	2.0	6.5
II	70.7	232.0	(N')= 11	N_{used}=8, 13, 7	CL	4.6	15.0
III	68.0	223.0	c'= 37		γ= 120 pcf	7.3	24.0
IV	65.8	216.0	(N')= 7 c'= 38	N_{used}=7	SM γ= 120 pcf	9.4	31.0
V	61.9	203.0	(N')= 12 c'= 39	N_{used}=17, 11, 8	CL γ= 120 pcf	13.4	44.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I-OverEX	0.5	6.25	0.25	0.75	0.05	1.00	2.20	2.95	52	0.07	Overex (0.5 ft)
II	9	10.75	4.75	1.29	0.90	0.62	1.36	2.65	52	0.61	0.61
III	9	19.5	13.5	2.34	2.57	0.25	0.55	2.89	37	0.27	0.27
IV	7	27.5	21.5	3.30	4.10	0.14	0.30	3.60	38	0.08	0.08
V	13	37.5	31.5	4.50	6.00	0.11	0.25	4.75	39	0.09	0.09
									total=	*1.12*	**1.06**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 2*5.14+0.12x3x1+0.4x0.12x5.25x0-0.12x3 =$ 10.28 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 10.28 / 3 = 3.43 ksf > $q_{toe} =$ 2.2 kPa

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Project: **SR-57 NB Widening - RW 522** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet _____

RW No. 522 (10 feet high)

Standard Caltrans Type 1 Wall - Sta 11+84 to 14+24

Max H= 10 ft Toe pressure, q_{toe}= 2.5 ksf (for Load Case I)
W= 6.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-15, C-08-117

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	75.6	248.0				0.0	0.0
0	73.5	241.0			γ= 120 pcf	2.1	7.0
			(N')= 21	N_{used}=21	CL		
I-OverEX	73.0	239.5	c'= 52		γ= 120 pcf	2.6	8.5
II	70.7	232.0				4.9	16.0
			(N')= 11	N_{used}=8, 13, 7	CL		
III	68.0	223.0	c'= 37		γ= 120 pcf	7.6	25.0
			(N')= 7	N_{used}=7	SM		
IV	65.8	216.0	c'= 38		γ= 120 pcf	9.8	32.0
			(N')= 12	N_{used}=17, 11, 8	CL		
V	61.9	203.0	c'= 39		γ= 120 pcf	13.7	45.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I-OverEX	1.5	7.75	0.75	0.93	0.12	0.98	2.46	3.39	52	0.19	Overex (1.5 ft)
II	8	12.25	5.25	1.47	0.84	0.62	1.54	3.01	52	0.54	0.54
III	9	20.5	13.5	2.46	2.16	0.30	0.75	3.21	37	0.34	0.34
IV	7	28.5	21.5	3.42	3.44	0.17	0.42	3.84	38	0.11	0.11
V	13	38.5	31.5	4.62	5.04	0.11	0.28	4.90	39	0.10	0.10
									total=	*1.29*	**1.09**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 2*5.14+0.12x3x1+0.4x0.12x6.25x0-0.12x3 =$ 10.28 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 10.28 / 3 = 3.43 ksf > $q_{toe} =$ 2.5 kPa

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Project: **SR-57 NB Widening - RW 522** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 522 (12 feet high)

Standard Caltrans Type 1 Wall - Sta 14+24 to 15+60

Max H= 12 ft Toe pressure, q_{toe}= 2.8 ksf (for Load Case I)
W= 7.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-15, C-08-117

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	75.3	247.0				0.0	0.0
0	72.8	239.0	(N')= 21	N_{used}=21	CL γ= 120 pcf	2.4	8.0
I-OverEX	71.9	236.0	c'= 52		γ= 120 pcf	3.4	11.0
II	70.7	232.0	(N')= 6	N_{used}=6	CL	4.6	15.0
III	68.9	226.0	c'= 31		γ= 120 pcf	6.4	21.0
IV	67.4	221.0	(N')= 6	N_{used}=6	SM	7.9	26.0
			c'= 37		γ= 120 pcf		
V	61.9	203.0	(N')= 18 c'= 47	N_{used}=20, 17, 18, 17	CL γ= 120 pcf	13.4	44.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I-OverEX	3	9.5	1.5	1.14	0.21	0.97	2.71	3.85	52	0.37	Overex (3 ft)
II	4	13	5	1.56	0.69	0.71	1.98	3.54	52	0.33	0.33
III	6	18	10	2.16	1.38	0.45	1.27	3.43	31	0.47	0.47
IV	5	23.5	15.5	2.82	2.14	0.30	0.84	3.66	37	0.18	0.18
V	18	35	27	4.20	3.72	0.15	0.43	4.63	47	0.20	0.20
									total=	*1.54*	**1.17**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2*5.14+0.12x3x1+0.4x0.12x7.25x0-0.12x3 = 10.28 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.28 / 3 = 3.43 ksf > q_{toe} = 2.8 kPa

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Project: **SR-57 NB Widening - RW 522** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 522 (12 feet high)

Standard Caltrans Type 1 Wall - Sta 15+60 to 16+00

Max H= 12 ft Toe pressure, q_{toe}= 2.8 ksf (for Load Case I)
W= 7.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-15, C-08-117

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	74.4	244.0				0.0	0.0
0	71.9	236.0			γ= 120 pcf	2.4	8.0
I-OverEX			(N')= 21 c'= 52	N_{used}=21	CL γ= 120 pcf		
	70.9	232.5				3.5	11.5
II	70.7	232.0	(N')= 6 c'= 31	N_{used}=6	CL γ= 120 pcf	3.7	12.0
III	68.9	226.0	(N')= 6 c'= 37	N_{used}=6	SM γ= 120 pcf	5.5	18.0
IV	67.4	221.0	(N')= 18 c'= 47	N_{used}=20, 17, 18, 17	CL γ= 120 pcf	7.0	23.0
V	61.9	203.0				12.5	41.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I-OverEX	3.5	9.75	1.75	1.17	0.24	0.97	2.71	3.88	52	0.42	Overex (3.5 ft)
II	1	11.75	3.75	1.41	0.52	0.82	2.30	3.71	52	0.05	0.05
III	6	15	7	1.80	0.97	0.58	1.63	3.43	31	0.65	0.65
IV	5	20.5	12.5	2.46	1.72	0.37	1.05	3.51	37	0.25	0.25
V	18	32	24	3.84	3.31	0.18	0.50	4.34	47	0.25	0.25
									total=	*1.62*	**1.20**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2*5.14+0.12x3x1+0.4x0.12x7.25x0-0.12x3 = 10.28 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.28 / 3 = 3.43 ksf > q_{toe} = 2.8 kPa

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Project: **SR-57 NB Widening - RW 522** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet _____

RW No. 522 (14 feet high)

Standard Caltrans Type 1 Wall - Sta 16+00 to 16+48

Max H= 14 ft Toe pressure, q_{toe}= 3.3 ksf (for Load Case I)
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring C-08-117, C-08-118, A-08-119

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	74.1	243				0.0	0
0	71.3	234			γ= 120 pcf	2.7	9
I-OverEX	70.71	232	(N')= 21 c'= 52	N_{used}=21	CL γ= 120 pcf	3.35	11
II-OverEX	70.10	230.0	(N')= 6 c'= 31	N_{used}=8, 13, 7	CL γ= 120 pcf	3.96	13
III	68.9	226				5.2	17
IV	67.4	221	(N')= 6 c'= 37	N_{used}=6	SM γ= 120 pcf	6.7	22
V	61.9	203	(N')= 18 c'= 47	N_{used}=20, 17, 18, 17	CL γ= 120 pcf	12.2	40

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	9	4.5		0.54							
I-OverEX	2	10	1	1.20	0.13	0.98	3.25	4.45	52	0.26	
II-OverEX	2	12	3	1.44	0.38	0.91	2.99	4.43	31	0.38	Overex (4 ft)
III	4	15	6	1.80	0.75	0.65	2.15	3.95	31	0.53	0.53
IV	5	19.5	10.5	2.34	1.31	0.48	1.58	3.92	37	0.36	0.36
V	18	31	22	3.72	2.75	0.22	0.73	4.45	47	0.36	0.36
									total=	*1.89*	**1.25**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2*5.14+0.12x3x1+0.4x0.12x8x0-0.12x3 = 10.28 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.28 / 3 = 3.43 ksf > q_{toe} = 3.3 kPa

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Project: **SR-57 NB Widening - RW 522** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 522 (12 feet high)

Standard Caltrans Type 1 Wall - Sta 16+48 to 16+95

Max H= 12 ft Toe pressure, q_{toe}= 2.8 ksf (for Load Case I)
W= 7.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring C-08-117, C-08-118, A-08-119

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	73.5	241.0				0.0	0.0
0							
	71.0	233.0			γ= 120 pcf	2.4	8.0
I-OverEX			(N')= 6	N_{used}=8, 13, 7	CL		
	69.8	229.0	c'= 31		γ= 120 pcf	3.7	12.0
II							
	69.5	228.0	(N')= 6	N_{used}=6	SM	4.0	13.0
III			c'= 37		γ= 120 pcf		
	68.0	223.0	(N')= 18	N_{used}=20, 17, 18,	CL	5.5	18.0
IV			c'= 47	17	γ= 120 pcf		
	64.9	213.0	(N')= 18	N_{used}=20, 17, 18,	CL	8.5	28.0
V			c'= 47	17	γ= 120 pcf		
	61.9	203.0				11.6	38.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I-OverEX	4	10	2	1.20	0.28	0.95	2.66	3.86	31	0.79	Overex (4 ft)
II	1	12.5	4.5	1.50	0.62	0.76	2.14	3.64	31	0.15	0.15
III	5	15.5	7.5	1.86	1.03	0.55	1.54	3.40	37	0.42	0.42
IV	10	23	15	2.76	2.07	0.31	0.87	3.63	47	0.30	0.30
V	10	33	25	3.96	3.45	0.17	0.48	4.44	47	0.13	0.13
									total=	*1.79*	**1.00**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 10.7
ϕ= 25 ° = 0.436 rad Nr= 6.8
c= 0.2 ksf Nc= 20.8
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0.2*20.8+0.12x3x10.7+0.4x0.12x7.25x6.8-0.12x3 = 10.02 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.02 / 3 = 3.34 ksf > q_{toe} = 2.8 kPa

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Project: **SR-57 NB Widening - RW 522** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 522 (10 feet high)

Standard Caltrans Type 1 Wall - Sta 16+95 to 17+43

Max H= 10 ft Toe pressure, q_{toe}= 2.5 ksf (for Load Case I)
W= 6.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring C-08-117, C-08-118, A-08-119

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	73.2	240.0				0.0	0.0
0	71.0	233.0			γ= 120 pcf	2.1	7.0
I-OverEX			(N')= 6	N_{used}=8, 13, 7	CL		
	70.4	231.0	c'= 31		γ= 120 pcf	2.7	9.0
II	69.5	228.0	(N')= 6	N_{used}=6	SM	3.7	12.0
III			c'= 37		γ= 120 pcf		
	68.0	223.0	(N')= 18	N_{used}=20, 17, 18,	CL	5.2	17.0
IV			c'= 47	17	γ= 120 pcf		
	64.9	213.0	(N')= 18	N_{used}=20, 17, 18,	CL	8.2	27.0
V			c'= 47	17	γ= 120 pcf		
	61.9	203.0				11.3	37.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I-OverEX	2	8	1	0.96	0.16	0.98	2.46	3.42	31	0.43	Overex (2 ft)
II	3	10.5	3.5	1.26	0.56	0.82	2.05	3.31	31	0.49	0.49
III	5	14.5	7.5	1.74	1.20	0.50	1.26	3.00	37	0.38	0.38
IV	10	22	15	2.64	2.40	0.27	0.68	3.32	47	0.25	0.25
V	10	32	25	3.84	4.00	0.14	0.35	4.19	47	0.10	0.10
									total=	*1.65*	**1.22**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 10.7
ϕ= 25 ° = 0.436 rad Nr= 6.8
c= 0.2 ksf Nc= 20.8
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0.2*20.8+0.12x3x10.7+0.4x0.12x6.25x6.8-0.12x3 = 9.69 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 9.69 / 3 = 3.23 ksf > q_{toe} = 2.5 kPa

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Project: **SR-57 NB Widening - RW 522** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 522 (8 feet high)

Standard Caltrans Type 1 Wall - Sta 17+43 to 17+78

Max H= 8 ft Toe pressure, q_{toe}= 2.2 ksf (for Load Case I)
W= 5.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring C-08-117, C-08-118, A-08-119

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	72.5	238.0				0.0	0.0
0	70.7	232.0			γ= 120 pcf	1.8	6.0
I-OverEX			(N')= 6 c'= 31	N_{used}=8, 13, 7	**CL** γ= 120 pcf		
	70.3	230.5				2.3	7.5
II	69.5	228.0	(N')= 6	N_{used}=6	**SM**	3.0	10.0
III	68.0	223.0	c'= 37		γ= 120 pcf	4.6	15.0
IV	64.9	213.0	(N')= 18 c'= 47	N_{used}=20, 17, 18, 17	**CL** γ= 120 pcf	7.6	25.0
V	61.9	203.0	(N')= 18 c'= 47	N_{used}=20, 17, 18, 17	**CL** γ= 120 pcf	10.7	35.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I-OverEX	1.5	6.75	0.75	0.81	0.14	0.98	2.16	2.97	31	0.33	Overex (1.5 ft)
II	3	8.75	2.75	1.05	0.52	0.82	1.80	2.85	31	0.42	0.42
III	5	12.5	6.5	1.50	1.24	0.50	1.11	2.61	37	0.39	0.39
IV	10	20	14	2.40	2.67	0.24	0.53	2.93	47	0.22	0.22
V	10	30	24	3.60	4.57	0.12	0.26	3.86	47	0.08	0.08
									total=	*1.44*	**1.11**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf
ϕ= 10 ° = 0.175 rad => Nq= 2.5
c= 0.8 ksf Nr= 0.4
Overburn: D= 3 feet Nc= 8.5

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0.8*8.5+0.12x3x2.5+0.4x0.12x5.25x0.4-0.12x3 = 7.44 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 7.44 / 3 = 2.48 ksf > q_{toe} = 2.2 kPa

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Project: **SR-57 NB Widening - RW 522** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet _____

RW No. 522 (6 feet high)

Standard Caltrans Type 1 Wall - Sta 17+78 to 17+86

Max H= 6 ft Toe pressure, q_{toe}= 1.9 ksf (for Load Case I)
W= 4.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring C-08-117, C-08-118, A-08-119

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	72.5	238.0				0.0	0.0
0	70.7	232.0			γ= 120 pcf	1.8	6.0
I-OverEX			(N')= 6 c'= 31	N_{used}=8, 13, 7	**CL** γ= 120 pcf		
	70.6	231.5				2.0	6.5
II	69.5	228.0	(N')= 6 c'= 37	N_{used}=6	**SM** γ= 120 pcf	3.0	10.0
III	68.0	223.0	(N')= 18 c'= 47	N_{used}=20, 17, 18, 17	**CL** γ= 120 pcf	4.6	15.0
IV	64.9	213.0	(N')= 18 c'= 47	N_{used}=20, 17, 18, 17	**CL** γ= 120 pcf	7.6	25.0
V	61.9	203.0				10.7	35.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I-OverEX	0.5	6.25	0.25	0.75	0.06	1.00	1.90	2.65	31	0.11	Overex (0.5 ft)
II	4	8.25	2.25	0.99	0.53	0.82	1.56	2.55	31	0.56	0.56
III	5	12.5	6.5	1.50	1.53	0.40	0.76	2.26	37	0.29	0.29
IV	10	20	14	2.40	3.29	0.18	0.34	2.74	47	0.15	0.15
V	10	30	24	3.60	5.65	0.11	0.21	3.81	47	0.06	0.06
									total=	*1.16*	**1.06**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf
ϕ= 5 ° = 0.087 rad => Nq= 1.6
c= 0.8 ksf Nr= 0.1
Overburn: D= 3 feet Nc= 6.9

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0.8*6.9+0.12x3x1.6+0.4x0.12x4.25x0.1-0.12x3 = 5.76 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 5.76 / 3 = 1.92 ksf > q_{toe} = 1.9 kPa

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Project: **SR-57 NB Widening - RW 526** Project No. **08-115**
By CTY Date 1/14/09 Check by Date Sheet

RW No. 526 (6 feet high)

Retaining Wall Type 1SWB Wall - Sta 10+00 to 12+12
Max H= 6 ft Toe pressure, q_{toe}= 1.88 ksf
W= 7.75 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring C-08-118, A-08-119, C-08-120

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	76.7	251.5				0.0	0.0
0	75.1	246.5			γ= 120 pcf	1.5	5.0
I-OverEX	74.4	244.0	(N')= 18 c'= 47	N_{used}=14, 18, 20, 21	**CL** γ= 120 pcf	2.3	7.5
II	72.1	236.5	(N')= 9 c'= 35	N_{used}=6, 6, 6, 10, 12, 10	**CL** γ= 120 pcf	4.6	15.0
III	68.9	226.0	(N')= 18 c'= 47	N_{used}=20, 17, 18. 17	**CL** γ= 120 pcf	7.8	25.5
IV	62.5	205.0	(N')= 22 c'= 62	N_{used}=29, 12, 38	**SM** γ= 120 pcf	14.2	46.5
V	57.9	190.0				18.7	61.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	Δσ$_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	5	2.5		0.30							
I-OverEX	2.5	6.25	1.25	0.75	0.16	0.98	1.85	2.60	47	0.34	Overex (2.5 ft)
II	8	11.25	6.25	1.35	0.81	0.65	1.22	2.57	47	0.54	0.54
III	11	20.25	15.25	2.43	1.97	0.33	0.61	3.04	35	0.35	0.35
IV	21	36	31	4.32	4.00	0.14	0.26	4.58	47	0.14	0.14
V	15.0	54	49	6.48	6.32	0.11	0.21	6.69	62	0.04	0.04
									total=	*1.41*	*1.07*

Check Bearing Capacity
Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 1.6 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.6*5.14+0.12x3x1+0.4x0.12x7.75x0-0.12x3 = 8.22 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 8.22 / 3 = 2.74 ksf > q_{toe} = 1.88 kPa

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Project: **SR-57 NB Widening - RW 526** Project No. **08-115**
By CTY Date 1/14/09 Check by Date Sheet

RW No. 526 (8 feet high)

Retaining Wall Type 1SWB Wall - Sta 12+12 to 12+44

Max H= 8 ft Toe pressure, q_{toe}= 2.222 ksf
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring C-08-118, A-08-119, C-08-120

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	76.4	250.5				0.0	0.0
0	74.5	244.5			γ= 120 pcf	1.8	6.0
I-OverEX			(N')= 18 c'= 47	N_{used}=14, 18, 20, 21	CL γ= 120 pcf	2.9	9.5
II	73.5	241.0				4.3	14.0
III	72.1	236.5	(N')= 9 c'= 35	N_{used}=6, 6, 6, 10, 12, 10	CL γ= 120 pcf	7.5	24.5
IV	68.9	226.0	(N')= 18 c'= 47	N_{used}=20, 17, 18. 17	CL γ= 120 pcf	13.9	45.5
V	62.5	205.0	(N')= 22 c'= 62	N_{used}=29, 12, 38	SM γ= 120 pcf	18.4	60.5
	57.9	190.0					

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I-OverEX	3.5	7.75	1.75	0.93	0.22	0.97	2.15	3.08	47	0.46	Overex (3.5 ft)
II	5	11.75	5.75	1.41	0.72	0.71	1.57	2.98	47	0.37	0.37
III	11	19.25	13.25	2.31	1.66	0.39	0.86	3.17	35	0.49	0.49
IV	21	35	29	4.20	3.63	0.16	0.36	4.56	47	0.19	0.19
V	15.0	53	47	6.36	5.88	0.11	0.25	6.61	62	0.05	0.05
									total=	*1.57*	*1.11*

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 1.6 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.6*5.14+0.12x3x1+0.4x0.12x8x0-0.12x3 = 8.22 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 8.22 / 3 = 2.74 ksf > q_{toe} = 2.222 kPa

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Project: **SR-57 NB Widening - RW 526** Project No. **08-115**
By CTY Date 1/14/09 Check by Date Sheet

RW No. 526 (10 feet high)

Retaining Wall Type 1SWB Wall - Sta 12+44 to 12+76

Max H= 10 ft Toe pressure, q_{toe}= 2.475 ksf
W= 8.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring C-08-118, A-08-119, C-08-120

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	76.0	249.5				0.0	0.0
0	73.9	242.5			γ= 120 pcf	2.1	7.0
I-OverEX	72.7	238.5	(N')= 18 c'= 47	N_{used}=14, 18, 20, 21	**CL** γ= 120 pcf	3.4	11.0
II	72.1	236.5				4.0	13.0
III	68.9	226.0	(N')= 9 c'= 35	N_{used}=6, 6, 6, 10, 12, 10	**CL** γ= 120 pcf	7.2	23.5
IV	62.5	205.0	(N')= 18 c'= 47	N_{used}=20, 17, 18. 17	**CL** γ= 120 pcf	13.6	44.5
V	57.9	190.0	(N')= 22 c'= 62	N_{used}=29, 12, 38	**SM** γ= 120 pcf	18.1	59.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I-OverEX	4	9	2	1.08	0.23	0.97	2.39	3.47	47	0.52	Overex (4 ft)
II	2	12	5	1.44	0.57	0.82	2.03	3.47	47	0.20	0.20
III	11	18.25	11.25	2.19	1.29	0.48	1.19	3.38	35	0.68	0.68
IV	21	34	27	4.08	3.09	0.19	0.48	4.56	47	0.26	0.26
V	15.0	52	45	6.24	5.14	0.11	0.28	6.52	62	0.05	0.05
									total=	*1.70*	*1.19*

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
φ= 0 ° = 0.000 rad Nr= 0
c= 1.6 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.6*5.14+0.12x3x1+0.4x0.12x8.75x0-0.12x3 = 8.22 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 8.22 / 3 = 2.74 ksf > q_{toe} = 2.475 kPa

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Project: **SR-57 NB Widening - RW 526** Project No. **08-115**
By CTY Date 1/14/09 Check by Date Sheet

RW No. 526 (12 feet high)

Retaining Wall Type 1SWB Wall - Sta 12+76 to 13+60
Max H= 12 ft Toe pressure, q_{toe}= 2.683 ksf
W= 9.75 ft

Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring C-08-118, A-08-119, C-08-120

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	76.0	249.5				0.0	0.0
0	73.6	241.5			γ= 120 pcf	2.4	8.0
I-OverEX	72.1	236.5	(N')= 18 c'= 47	N_{used}=14, 18, 20, 21	CL γ= 120 pcf	4.0	13.0
II	68.9	226.0	(N')= 9 c'= 35	N_{used}=6, 6, 6, 10, 12, 10	CL γ= 120 pcf	7.2	23.5
III	65.8	216.0	(N')= 18 c'= 47	N_{used}=20, 17, 18. 17	CL γ= 120 pcf	10.2	33.5
IV	62.5	205.0				13.6	44.5
V	57.9	190.0	(N')= 22 c'= 62	N_{used}=29, 12, 38	SM γ= 120 pcf	18.1	59.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I-OverEX	5	10.5	2.5	1.26	0.26	0.95	2.55	3.81	47	0.61	Overex (5 ft)
II	11	18.25	10.25	2.19	1.05	0.55	1.48	3.67	35	0.81	0.81
III	10	28.5	20.5	3.42	2.10	0.30	0.80	4.22	47	0.23	0.23
IV	11	39	31	4.68	3.18	0.19	0.50	5.18	47	0.12	0.12
V	15.0	52	44	6.24	4.51	0.12	0.32	6.56	62	0.06	0.06
									total=	*1.84*	*1.23*

Check Bearing Capacity
Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 1.6 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.6*5.14+0.12x3x1+0.4x0.12x9.75x0-0.12x3 = 8.22 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 8.22 / 3 = 2.74 ksf > q_{toe} = 2.683 kPa

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Project: **SR-57 NB Widening - RW 526** Project No. **08-115**
By CTY Date 1/14/09 Check by Date Sheet

RW No. 526 (10 feet high)

Retaining Wall Type 1SWB Wall - Sta 13+60 to 14+08

Max H= 10 ft Toe pressure, q_{toe}= 2.475 ksf
W= 8.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring C-08-118, A-08-119, C-08-120

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	76.8	252.0				0.0	0.0
0	74.7	245.0			γ= 120 pcf	2.1	7.0
I-OverEX	73.5	241.0	(N')= 18 c'= 47	N_{used}=14, 18, 20, 21	CL γ= 120 pcf	3.4	11.0
II	72.1	236.5				4.7	15.5
III	68.9	226.0	(N')= 9 c'= 35	N_{used}=6, 6, 6, 10, 12, 10	CL γ= 120 pcf	7.9	26.0
IV	62.5	205.0	(N')= 18 c'= 47	N_{used}=20, 17, 18. 17	CL γ= 120 pcf	14.3	47.0
V	57.9	190.0	(N')= 22 c'= 62	N_{used}=29, 12, 38	SM γ= 120 pcf	18.9	62.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I-OverEX	4	9	2	1.08	0.23	0.97	2.39	3.47	47	0.52	Overex (4 ft)
II	5	13.25	6.25	1.59	0.71	0.71	1.75	3.34	47	0.37	0.37
III	11	20.75	13.75	2.49	1.57	0.40	0.99	3.48	35	0.52	0.52
IV	21	36.5	29.5	4.38	3.37	0.18	0.43	4.81	47	0.22	0.22
V	15.0	54.5	47.5	6.54	5.43	0.11	0.28	6.82	62	0.05	0.05
									total=	*1.68*	*1.17*

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 1.6 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.6*5.14+0.12x3x1+0.4x0.12x8.75x0-0.12x3 = 8.22 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 8.22 / 3 = 2.74 ksf > q_{toe} = 2.475 kPa

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Project: **SR-57 NB Widening - RW 526** Project No. **08-115**
By CTY Date 1/14/09 Check by Date Sheet

RW No. 526 (8 feet high)

Retaining Wall Type 1SWB Wall - Sta 14+08 to 14+40

Max H= 8 ft Toe pressure, q_{toe}= 2.222 ksf
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring C-08-118, A-08-119, C-08-120

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	77.1	253.0				0.0	0.0
0	75.3	247.0			γ= 120 pcf	1.8	6.0
I-OverEX	74.4	244.0	(N')= 18 c'= 47	N_{used}=14, 18, 20, 21	**CL** γ= 120 pcf	2.7	9.0
II	72.1	236.5	(N')= 9 c'= 35	N_{used}=6, 6, 6, 10, 12, 10	**CL** γ= 120 pcf	5.0	16.5
III	68.9	226.0	(N')= 18 c'= 47	N_{used}=20, 17, 18. 17	**CL** γ= 120 pcf	8.2	27.0
IV	62.5	205.0	(N')= 22 c'= 62	N_{used}=29, 12, 38	**SM** γ= 120 pcf	14.6	48.0
V	57.9	190.0				19.2	63.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I-OverEX	3	7.5	1.5	0.90	0.19	0.97	2.15	3.05	47	0.41	Overex (3 ft)
II	8	12.75	6.75	1.53	0.84	0.62	1.37	2.90	47	0.53	0.53
III	11	21.75	15.75	2.61	1.97	0.33	0.73	3.34	35	0.38	0.38
IV	21	37.5	31.5	4.50	3.94	0.14	0.32	4.82	47	0.16	0.16
V	15.0	55.5	49.5	6.66	6.19	0.11	0.25	6.91	62	0.05	0.05
									total=	*1.53*	*1.12*

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 1.6 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.6*5.14+0.12x3x1+0.4x0.12x8x0-0.12x3 = 8.22 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 8.22 / 3 = 2.74 ksf > q_{toe} = 2.222 kPa

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Project: **SR-57 NB Widening - RW 526** Project No. **08-115**
By CTY Date 1/14/09 Check by Date Sheet

RW No. 526 (6 feet high)

Retaining Wall Type 1SWB Wall - Sta 14+40 to 15+00

Max H= 6 ft Toe pressure, q_{toe}= 1.88 ksf
W= 7.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring C-08-118, A-08-119, C-08-120

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	77.7	255.0				0.0	0.0
0	76.2	250.0			γ= 120 pcf	1.5	5.0
I-OverEX			(N')= 18 c'= 47	N_{used}=14, 18, 20, 21	CL γ= 120 pcf		
	75.4	247.5				2.3	7.5
II	72.1	236.5				5.6	18.5
III			(N')= 9 c'= 35	N_{used}=6, 6, 6, 10, 12, 10	CL γ= 120 pcf		
	68.9	226.0				8.8	29.0
IV			(N')= 18 c'= 47	N_{used}=20, 17, 18. 17	CL γ= 120 pcf		
	62.5	205.0				15.2	50.0
V			(N')= 22 c'= 62	N_{used}=29, 12, 38	SM γ= 120 pcf		
	57.9	190.0				19.8	65.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	5	2.5		0.30							
I-OverEX	2.5	6.25	1.25	0.75	0.16	0.98	1.85	2.60	47	0.34	Overex (2.5 ft)
II	11	13	8	1.56	1.03	0.55	1.03	2.59	47	0.62	0.62
III	11	23.75	18.75	2.85	2.42	0.26	0.49	3.34	35	0.25	0.25
IV	21	39.5	34.5	4.74	4.45	0.12	0.23	4.97	47	0.11	0.11
V	15.0	57.5	52.5	6.90	6.77	0.08	0.15	7.05	62	0.03	0.03
									total=	*1.35*	*1.01*

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 1.6 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 1.6*5.14+0.12x3x1+0.4x0.12x7.75x0-0.12x3 = 8.22 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 8.22 / 3 = 2.74 ksf > q_{toe} = 1.88 kPa

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Project: **SR-57 NB Widening - RW 536** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 536 (14 feet high)

Retaining Wall Type 1SWB Wall - Sta 10+00 to 10+10

Max H= 14 ft Toe pressure, q_{toe}= 2.915 ksf
W= 10.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-17

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	77.0	252.5				0.0	0.0
0	74.2	243.5			γ= 120 pcf	2.7	9.0
I-OverEX	73.3	240.5	(N')= 20 c'= 50	N_{used}=20, 18, 29, 38, 14, 25, 35	CL γ= 120 pcf	3.7	12.0
II	70.1	230.0				6.9	22.5
III	65.5	215.0				11.4	37.5
IV	61.0	200.0				16.0	52.5
V	56.4	185.0	(N')= 18 c'= 47	N_{used}=29, 12, 38	CL γ= 120 pcf	20.6	67.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	9	4.5		0.54							
I-OverEX	3	10.5	1.5	1.26	0.14	0.98	2.87	4.13	50	0.37	Overex (3 ft)
II	11	17.25	8.25	2.07	0.77	0.65	1.89	3.96	50	0.71	0.71
III	15	30	21	3.60	1.95	0.33	0.95	4.55	50	0.37	0.37
IV	15	45	36	5.40	3.35	0.18	0.51	5.91	50	0.14	0.14
V	15.0	60	51	7.20	4.74	0.12	0.34	7.54	47	0.08	0.08
									total=	*1.67*	*1.30*

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2*5.14+0.12x3x1+0.4x0.12x10.75x0-0.12x3 = 10.28 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.28 / 3 = 3.43 ksf > q_{toe} = 2.915 kPa

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Project: **SR-57 NB Widening - RW 536** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 536 (10 feet high)

Retaining Wall Type 1SWB Wall - Sta 10+10 to 10+18

Max H= 10 ft Toe pressure, q_{toe}= 2.475 ksf
W= 8.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-17

Layer	Elev. (m)	Elev. (ft)					depth (m)	depth (ft)
	77.6	254.5					0.0	0.0
0	75.4	247.5			γ= 120	pcf	2.1	7.0
I-OverEX	75.0	246.0	(N')= 20 c'= 50	N_{used}=20, 18, 29, 38, 14, 25, 35	CL γ= 120	pcf	2.6	8.5
II	70.1	230.0					7.5	24.5
III	65.5	215.0					12.0	39.5
IV	61.0	200.0					16.6	54.5
V	56.4	185.0	(N')= 18 c'= 47	N_{used}=29, 12, 38	CL γ= 120	pcf	21.2	69.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I-OverEX	1.5	7.75	0.75	0.93	0.09	0.98	2.43	3.36	50	0.20	Overex (1.5 ft)
II	16	16.5	9.5	1.98	1.09	0.53	1.30	3.28	50	0.84	0.84
III	15	32	25	3.84	2.86	0.21	0.53	4.37	50	0.20	0.20
IV	15	47	40	5.64	4.57	0.12	0.30	5.94	50	0.08	0.08
V	15.0	62	55	7.44	6.29	0.11	0.28	7.72	47	0.06	0.06
									total=	*1.39*	*1.19*

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 2 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 2*5.14+0.12x3x1+0.4x0.12x8.75x0-0.12x3 = 10.28 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.28 / 3 = 3.43 ksf > q_{toe} = 2.475 kPa

Earth Mechanics, Inc.
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Project: **SR-57 NB Widening - RW 538** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 538 (6 feet high)

Retaining Wall Type 1SWB Wall

Max H= 6 ft Toe pressure, q_{toe}= 1.88 ksf
W= 7.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-123, A-08-124, C-08-125

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	76.2	250.0				0.0	0.0
0	74.7	245.0	(N')= 23	N_{used}=30, 16	SM γ= 120 pcf	1.5	5.0
I-OverEX	74.1	243.0	c'= 63		γ= 120 pcf	2.1	7.0
II	73.2	240.0				3.0	10.0
III	71.0	233.0	(N')= 6 c'= 31	N_{used}=3, 6, 7, 6, 2,8	CL γ= 120 pcf	5.2	17.0
IV	68.3	224.0	(N')= 15 c'= 43	N_{used}=19, 16, 7, 7, 18	CL γ= 120 pcf	7.9	26.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	5	2.5		0.30							
I-OverEX	2	6	1	0.72	0.13	98%	1.85	2.57	63	0.21	Overex (2 ft)
II	3	8.5	3.5	1.02	0.45	86%	1.62	2.64	63	0.24	0.24
III	7	13.5	8.5	1.62	1.10	53%	0.99	2.61	31	0.56	0.56
IV	9	21.5	16.5	2.58	2.13	30%	0.56	3.14	43	0.22	0.22
									total=	*1.22*	*1.01*

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 3.9
ϕ= 15 ° = 0.262 rad Nr= 1.1
c= 0.5 ksf Nc= 10.8
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D$ = 0.5*10.8+0.12x3x3.9+0.4x0.12x7.75x1.1-0.12x3 = 6.85 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 6.85 / 3 = 2.28 ksf > $q_{toe} =$ 1.88 kPa

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Project: **SR-57 NB Widening - RW 538** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 538 (8 feet high)

Retaining Wall Type 1SWB Wall

Max H= 8 ft Toe pressure, q_{toe}= 2.222 ksf
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-123, A-08-124, C-08-125

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	76.2	250.0				0.0	0.0
0	74.4	244.0	(N')= 23	N_{used}=30, 16	SM γ= 120 pcf	1.8	6.0
I-OverEX	73.6	241.5	c'= 63		γ= 120 pcf	2.6	8.5
II	73.2	240.0				3.0	10.0
III	71.0	233.0	(N')= 6 c'= 31	N_{used}=3, 6, 7, 6, 2,8	CL γ= 120 pcf	5.2	17.0
IV	68.3	224.0	(N')= 15 c'= 43	N_{used}=19, 16, 7, 7, 18	CL γ= 120 pcf	7.9	26.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I-OverEX	2.5	7.25	1.25	0.87	0.16	98%	2.19	3.06	63	0.26	Overex (2.5 ft)
II	2	9.25	3.25	1.11	0.41	91%	2.01	3.12	63	0.13	0.13
III	7	13.5	7.5	1.62	0.94	58%	1.30	2.92	31	0.69	0.69
IV	9	21.5	15.5	2.58	1.94	33%	0.73	3.31	43	0.27	0.27
									total=	*1.35*	*1.09*

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 3.9
ϕ= 15 ° = 0.262 rad Nr= 1.1
c= 0.5 ksf Nc= 10.8
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 0.5*10.8+0.12x3x3.9+0.4x0.12x8x1.1-0.12x3 =$ 6.87 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 6.87 / 3 = 2.29 ksf > $q_{toe} =$ 2.222 kPa

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Project: **SR-57 NB Widening - RW 538** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 538 (8 feet high)

Retaining Wall Type 1SWB Wall

Max H= 8 ft Toe pressure, q_{toe}= 2.222 ksf
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-124, A-08-126

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	75.4	247.5				0.0	0.0
0	73.6	241.5			γ= 120 pcf	1.8	6.0
I-OverEX	73.2	240.0	(N')= 23 c'= 63	N_{used}=30, 16	SM γ= 120 pcf	2.3	7.5
II-OverEX	72.8	239.0	(N')= 6 c'= 31	N_{used}=3, 6, 7, 6, 2,8	CL γ= 120 pcf	2.6	8.5
III	71.0	233.0				4.4	14.5
IV	68.3	224.0	(N')= 15 c'= 43	N_{used}=19, 16, 7, 7, 18	CL γ= 120 pcf	7.2	23.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I-OverEX	1.5	6.75	0.75	0.81	0.09	98%	2.19	3.00	63	0.16	
II-OverEX	1	8	2	0.96	0.25	95%	2.11	3.07	31	0.20	Overex (2.5 ft)
III	6	11.5	5.5	1.38	0.69	71%	1.57	2.95	31	0.77	0.77
IV	9	19	13	2.28	1.63	39%	0.86	3.14	43	0.35	0.35
									total=	*1.47*	*1.12*

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf
ϕ= 15 ° = 0.262 rad => Nq= 3.9
c= 0.5 ksf Nr= 1.1
Overburn: D= 3 feet Nc= 10.8

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0.5*10.8+0.12x3x3.9+0.4x0.12x8x1.1-0.12x3 = 6.87 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 6.87 / 3 = 2.29 ksf > q_{toe} = 2.222 kPa

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Project: **SR-57 NB Widening - RW 538** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 538 (6 feet high)

Retaining Wall Type 1SWB Wall

Max H= 6 ft Toe pressure, q_{toe}= 1.88 ksf
W= 7.75 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-123, A-08-124, C-08-125

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	75.4	247.5				0.0	0.0
0	73.9	242.5			γ= 120 pcf	1.5	5.0
I-OverEX	73.2	240.0	(N')= 23 c'= 63	N_{used}=30, 16	SM γ= 120 pcf	2.3	7.5
II-OverEX	73.0	239.5	(N')= 6 c'= 31	N_{used}=3, 6, 7, 6, 2,8	CL γ= 120 pcf	2.4	8.0
III	71.0	233.0				4.4	14.5
IV	68.3	224.0	(N')= 15 c'= 43	N_{used}=19, 16, 7, 7, 18	CL γ= 120 pcf	7.2	23.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	5.0	2.5		0.30							
I-OverEX	2.5	6.25	1.25	0.75	0.16	98%	1.85	2.60	63	0.26	
II-OverEX	0.5	7.75	2.75	0.93	0.35	91%	1.70	2.63	31	0.09	Overex (3 ft)
III	6.5	11.25	6.25	1.35	0.81	65%	1.22	2.57	31	0.70	0.70
IV	9.0	19	14	2.28	1.81	36%	0.68	2.96	43	0.28	0.28
									total=	*1.33*	*0.99*

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 3.9
ϕ= 15 ° = 0.262 rad Nr= 1.1
c= 0.5 ksf Nc= 10.8
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0.5*10.8+0.12x3x3.9+0.4x0.12x7.75x1.1-0.12x3 = 6.85 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 6.85 / 3 = 2.28 ksf > q_{toe} = 1.88 kPa

Earth Mechanics, Inc.
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Project: **SR-57 NB Widening - RW 576** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 576 (6 feet high)

Standard Caltrans Type 1 Wall - Sta 10+00 to 10+32

Max H= 6 ft Toe pressure, q_{toe}= 1.9 ksf (for Load Case I)
W= 4.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-137, A-08-138

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	87.8	288				0.0	0
0	86.3	283			γ= 120 pcf	1.5	5
I	85.34	280	(N')= 13 c'= 40	N_{used}=16, 10	**CL** γ= 120 pcf	2.44	8
II	84.43	277	(N')= 17	N_{used}=21, 12, 17,	**SM**	3.35	11
III	81.4	267	c'= 53 (N')= 40	19 N_{used}=40, 25/5"	γ= 120 pcf **CL**	6.4	21
IV	79.6	261	c'= 80 (N')= 20	N_{used}=12, 28	γ= 120 pcf **CL**	8.2	27
V	74.7	245	c'= 50		γ= 120 pcf	13.1	43

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	5	2.5		0.30							
I	3	6.5	1.5	0.78	0.35	0.91	1.72	2.50	40	0.46	
II	3	9.5	4.5	1.14	1.06	0.55	1.05	2.19	40	0.25	
III	10	16	11	1.92	2.59	0.24	0.46	2.38	53	0.21	
IV	6	24	19	2.88	4.47	0.12	0.23	3.11	80	0.03	
V	16	35	30	4.20	7.06	0.08	0.15	4.35	50	0.06	
									total=	*1.01*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 1.5 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 1.5*5.14+0.12x3x1+0.4x0.12x4.25x0-0.12x3 =$ 7.71 ksf

$q_{allow(net)} = q_{ult(net)} / 3 = 7.71 / 3 = 2.57$ ksf > q_{toe} = 1.9 kPa

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Project: **SR-57 NB Widening - RW 576** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 576 (10 feet high)

Standard Caltrans Type 1 Wall - Sta 10+32 to 10+48

Max H= 10 ft Toe pressure, q_{toe}= 2.5 ksf (for Load Case I)
W= 6.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-137, A-08-138

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	86.9	285.0				0.0	0.0
0	84.7	278.0			γ= 120 pcf	2.1	7.0
I	84.4	277.0	(N')= 13 c'= 40	N_{used}=16, 10	CL γ= 120 pcf	2.4	8.0
II	82.9	272.0	(N')= 17 c'= 53	N_{used}=21, 12, 17, 19	SM γ= 120 pcf	4.0	13.0
III	81.4	267.0				5.5	18.0
IV	79.6	261.0	(N')= 40 c'= 80	N_{used}=40, 25/5"	CL γ= 120 pcf	7.3	24.0
V	74.7	245.0	(N')= 20 c'= 50	N_{used}=12, 28	CL γ= 120 pcf	12.2	40.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I	1	7.5	0.5	0.90	0.08	1.00	2.50	3.40	40	0.17	
II	5	10.5	3.5	1.26	0.56	0.82	2.05	3.31	53	0.47	
III	5	15.5	8.5	1.86	1.36	0.45	1.13	2.99	53	0.23	
IV	6	21	14	2.52	2.24	0.29	0.72	3.24	80	0.10	
V	16	32	25	3.84	4.00	0.14	0.35	4.19	50	0.15	
									total=	*1.13*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 1
ϕ= 0 ° = 0.000 rad Nr= 0
c= 1.5 ksf Nc= 5.14
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D$ = 1.5*5.14+0.12x3x1+0.4x0.12x6.25x0-0.12x3 = 7.71 ksf

$q_{allow(net)} = q_{ult(net)} / 3$ = 7.71 / 3 = 2.57 ksf > q_{toe} = 2.5 kPa

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Project: **SR-57 NB Widening - RW 576** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 576 (12 feet high)

Standard Caltrans Type 1 Wall - Sta 10+48 to 10+56

Max H= 12 ft Toe pressure, q_{toe}= 2.9 ksf (for Load Case III)
W= 7.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-137, A-08-138

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	86.0	282.0				0.0	0.0
0	83.8	275.0			γ= 120 pcf	2.1	7.0
I-OverEX	83.5	274.0	(N')= 17 c'= 53	N_{used}=21, 12, 17, 19	SM γ= 120 pcf	2.4	8.0
II	81.4	267.0	(N')= 40 c'= 80	N_{used}=40, 25/5"	CL γ= 120 pcf	4.6	15.0
III	79.6	261.0	(N')= 20 c'= 50	N_{used}=12, 28	CL γ= 120 pcf	6.4	21.0
IV	77.7	255.0	(N')= 18 c'= 55	N_{used}=21, 17, 19	SM γ= 120 pcf	8.2	27.0
V	71.6	235.0				14.3	47.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I-OverEX	1	7.5	0.5	0.90	0.07	1.00	2.90	3.80	53	0.14	Overex (1 ft)
II	7	11.5	4.5	1.38	0.62	0.76	2.21	3.59	53	0.66	0.66
III	6	18	11	2.16	1.52	0.40	1.16	3.32	80	0.17	0.17
IV	6	24	17	2.88	2.34	0.27	0.78	3.66	50	0.15	0.15
V	20	37	30	4.44	4.14	0.14	0.40	4.84	55	0.16	0.16
									total=	*1.28*	**1.14**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x7.25x15.7-0.12x3 = 11.73 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 11.73 / 3 = 3.91 ksf > q_{toe} = 2.9 kPa

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Project: **SR-57 NB Widening - RW 576** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 576 (14 feet high)

Standard Caltrans Type 1 Wall - Sta 10+56 to 10+84

Max H= 14 ft Toe pressure, q_{toe}= 3.4 ksf (for Load Case III)
W= 8.00 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-137, A-08-138

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	85.8	281.5				0.0	0.0
0	83.4	273.5			γ= 120 pcf	2.4	8.0
I-OverEX	83.1	272.5	(N')= 17 c'= 53	N_{used}=21, 12, 17, 19	SM γ= 120 pcf	2.7	9.0
II	81.4	267.0	(N')= 40 c'= 80	N_{used}=40, 25/5"	CL γ= 120 pcf	4.4	14.5
III	79.6	261.0	(N')= 20 c'= 50	N_{used}=12, 28	CL γ= 120 pcf	6.2	20.5
IV	77.7	255.0	(N')= 20 c'= 58	N_{used}=21, 17, 19	SM γ= 120 pcf	8.1	26.5
V	71.6	235.0				14.2	46.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	Δσ$_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	8	4		0.48							
I-OverEX	1	8.5	0.5	1.02	0.06	1.00	3.40	4.42	53	0.14	Overex (1 ft)
II	6	11.75	3.75	1.41	0.47	0.86	2.94	4.35	53	0.61	0.61
III	6	17.5	9.5	2.10	1.19	0.50	1.71	3.81	80	0.23	0.23
IV	6	23.5	15.5	2.82	1.94	0.33	1.11	3.93	50	0.21	0.21
V	20	36.5	28.5	4.38	3.56	0.17	0.56	4.94	58	0.22	0.22
									total=	*1.41*	**1.27**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x8x15.7-0.12x3 = 12.29 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 12.29 / 3 = 4.1 ksf > q_{toe} = 3.4 kPa

Earth Mechanics, Inc.
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Project: **SR-57 NB Widening - RW 576** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 576 (12 feet high)

Standard Caltrans Type 1 Wall - Sta 10+84 to 11+75

Max H= 12 ft Toe pressure, q_{toe}= 2.9 ksf (for Load Case III)
W= 7.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-137, A-08-138

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	85.5	280.5				0.0	0.0
0	83.4	273.5			γ= 120 pcf	2.1	7.0
			(N')= 17	N_{used}=21, 12, 17,	**SM**		
I-OverEX	83.1	272.5	c'= 53	19	γ= 120 pcf	2.4	8.0
II	81.4	267.0				4.1	13.5
			(N')= 40	N_{used}=40, 25/5"	**CL**		
III	79.6	261.0	c'= 80		γ= 120 pcf	5.9	19.5
			(N')= 20	N_{used}=12, 28	**CL**		
IV	77.7	255.0	c'= 50		γ= 120 pcf	7.8	25.5
			(N')= 18	N_{used}=21, 17, 19	**SM**		
V	71.6	235.0	c'= 55		γ= 120 pcf	13.9	45.5

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount
3. The overexcavation in Layer I is recommended to remove weak material. Since the back fill in the overexcavation zone will be well-compacted, the settlement in this zone is negligible.

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	7	3.5		0.42							
I-OverEX	1	7.5	0.5	0.90	0.07	1.00	2.90	3.80	53	0.14	Overex (1 ft)
II	6	10.75	3.75	1.29	0.52	0.82	2.38	3.67	53	0.57	0.57
III	6	16.5	9.5	1.98	1.31	0.48	1.39	3.37	80	0.21	0.21
IV	6	22.5	15.5	2.70	2.14	0.30	0.87	3.57	50	0.17	0.17
V	20	35.5	28.5	4.26	3.93	0.14	0.42	4.68	55	0.18	0.18
									total=	*1.27*	**1.12**

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x7.25x15.7-0.12x3 = 11.73 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 11.73 / 3 = 3.91 ksf > q_{toe} = 2.9 kPa

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Project: **SR-57 NB Widening - RW 576** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 576 (10 feet high)

Standard Caltrans Type 1 Wall - Sta 11+75 to 12+56

Max H= 10 ft Toe pressure, q_{toe}= 2.5 ksf (for Load Case I)
W= 6.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-137, A-08-138

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	85.3	280.0				0.0	0.0
0							
	83.5	274.0			γ= 120 pcf	1.8	6.0
I			(N')= 17	N_{used}=21, 12, 17,	**SM**		
	82.6	271.0	c'= 53	19	γ= 120 pcf	2.7	9.0
II							
	81.4	267.0				4.0	13.0
III			(N')= 40	N_{used}=40, 25/5"	**CL**		
	79.6	261.0	c'= 80		γ= 120 pcf	5.8	19.0
IV			(N')= 20	N_{used}=12, 28	**CL**		
	74.7	245.0	c'= 50		γ= 120 pcf	10.7	35.0
V							

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	6	3		0.36							
I	3	7.5	1.5	0.90	0.24	0.97	2.42	3.32	53	0.38	
II	4	11	5	1.32	0.80	0.65	1.63	2.95	53	0.32	
III	6	16	10	1.92	1.60	0.39	0.97	2.89	80	0.16	
IV	16	27	21	3.24	3.36	0.18	0.44	3.68	50	0.21	
									total=	*1.07*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)} = cNc + \gamma DNq + 0.4\gamma BNr - \gamma D = 0*30.1+0.12x3x18.4+0.4x0.12x6.25x15.7-0.12x3 =$ 10.97 ksf

$q_{allow(net)} = q_{ult(net)} / 3 =$ 10.97 / 3 = 3.66 ksf > $q_{toe} =$ 2.5 kPa

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Project: **SR-57 NB Widening - RW 576** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 576 (8 feet high)

Standard Caltrans Type 1 Wall - Sta 12+56 to 13+52

Max H= 8 ft Toe pressure, q_{toe}= 2.2 ksf (for Load Case I)
W= 5.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-137, A-08-138

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	85.3	280.0				0.0	0.0
0					γ= 120 pcf		
	83.8	275.0	(N')= 17	N_{used}=21, 12, 17,	**SM**	1.5	5.0
I			c'= 53	19	γ= 120 pcf		
	83.5	274.0				1.8	6.0
II							
	81.4	267.0	(N')= 40	N_{used}=40, 25/5"	**CL**	4.0	13.0
III			c'= 80		γ= 120 pcf		
	79.6	261.0	(N')= 20	N_{used}=12, 28	**CL**	5.8	19.0
IV			c'= 50		γ= 120 pcf		
	74.7	245.0				10.7	35.0
V							

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	5	2.5		0.30							
I	1	5.5	0.5	0.66	0.10	0.98	2.16	2.82	53	0.14	
II	7	9.5	4.5	1.14	0.86	0.62	1.36	2.50	53	0.54	
III	6	16	11	1.92	2.10	0.30	0.66	2.58	80	0.12	
IV	16	27	22	3.24	4.19	0.13	0.29	3.53	50	0.14	
									total=	*0.94*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x5.25x15.7-0.12x3 = 10.22 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 10.22 / 3 = 3.41 ksf > q_{toe} = 2.2 kPa

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Project: **SR-57 NB Widening - RW 576** Project No. **08-115**
By CTY Date 2/24/09 Check by Date Sheet

RW No. 576 (6 feet high)

Standard Caltrans Type 1 Wall - Sta 13+52 to 16+56

Max H= 6 ft Toe pressure, q_{toe}= 1.9 ksf (for Load Case I)
W= 4.25 ft

Check Settlement:

Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-137, A-08-138

Layer	Elev. (m)	Elev. (ft)				depth (m)	depth (ft)
	84.7	278.0				0.0	0.0
0	83.8	275.0			γ= 120 pcf	0.9	3.0
I	82.6	271.0	(N')= 17 c'= 53	N_{used}=21, 12, 17, 19	**SM** γ= 120 pcf	2.1	7.0
II	81.4	267.0				3.4	11.0
III	79.6	261.0	(N')= 40 c'= 80	N_{used}=40, 25/5"	**CL** γ= 120 pcf	5.2	17.0
IV	74.7	245.0	(N')= 20 c'= 50	N_{used}=12, 28	**CL** γ= 120 pcf	10.1	33.0
V							

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	Δσ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔH w/o overex (in)	ΔH w overex (in)
0	3	1.5		0.18							
I	4	5	2	0.60	0.47	0.86	1.64	2.24	53	0.52	
II	4	9	6	1.08	1.41	0.45	0.86	1.94	53	0.23	
III	6	14	11	1.68	2.59	0.24	0.46	2.14	80	0.09	
IV	16	25	22	3.00	5.18	0.11	0.21	3.21	50	0.11	
									total=	*0.96*	

Check Bearing Capacity

Method: Terzaghi Ultimate Capacity from NAVFAC DM 7.2

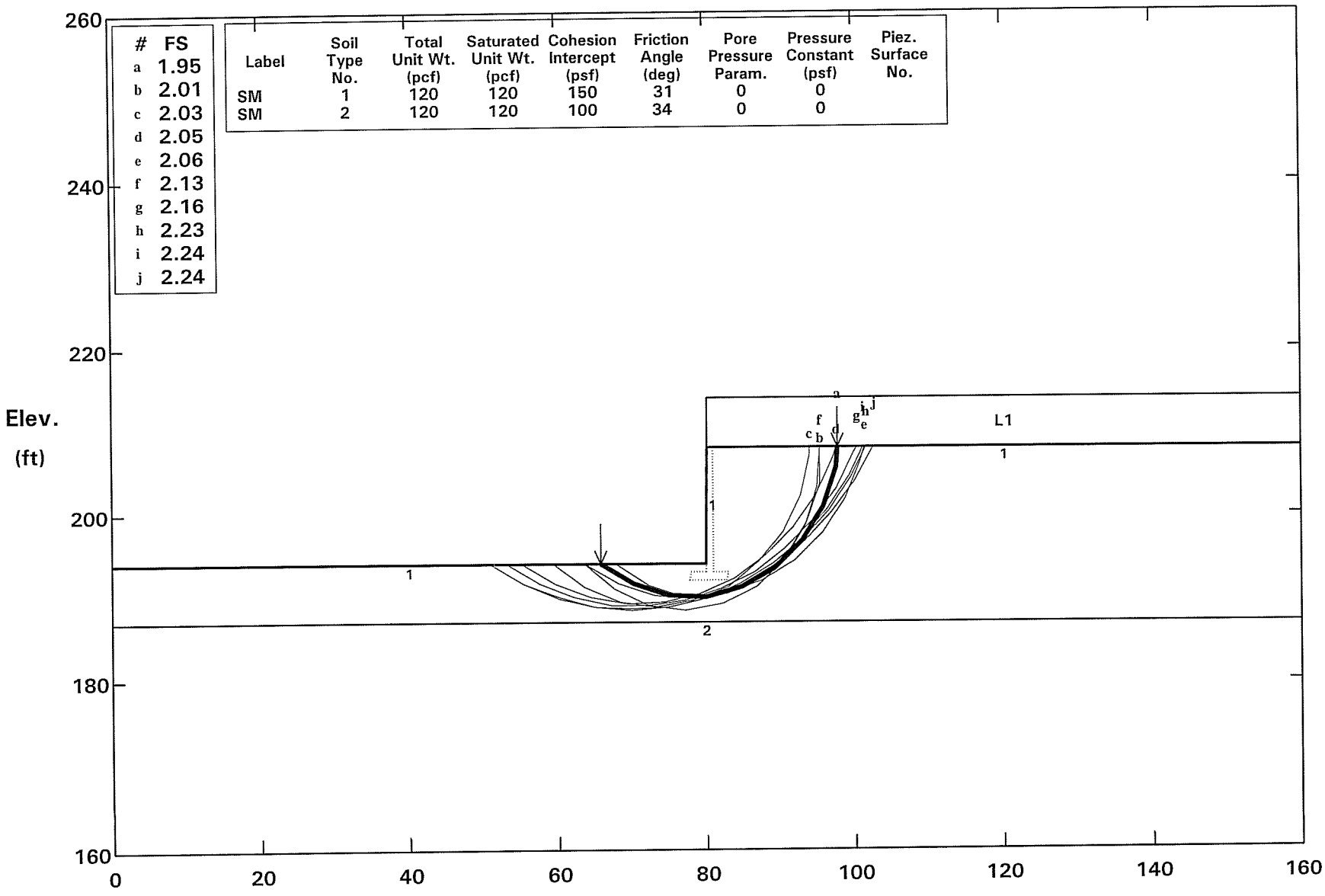
Base material propertires: γ= 0.12 ksf => Nq= 18.4
ϕ= 30 ° = 0.524 rad Nr= 15.7
c= 0 ksf Nc= 30.1
Overburn: D= 3 feet

$q_{ult(net)}$ = cNc+ γDNq + 0.4γBNr - γD = 0*30.1+0.12x3x18.4+0.4x0.12x4.25x15.7-0.12x3 = 9.47 ksf

$q_{allow(net)}$ = $q_{ult(net)}$ / 3 = 9.47 / 3 = 3.16 ksf > q_{toe} = 1.9 kPa

RW462 (16' high type 1 RW) @ Sta 463+40 Static Condition

Ten Most Critical. D:RW462S.PLT 02-26-09 11:41am



#	FS
a	1.95
b	2.01
c	2.03
d	2.05
e	2.06
f	2.13
g	2.16
h	2.23
i	2.24
j	2.24

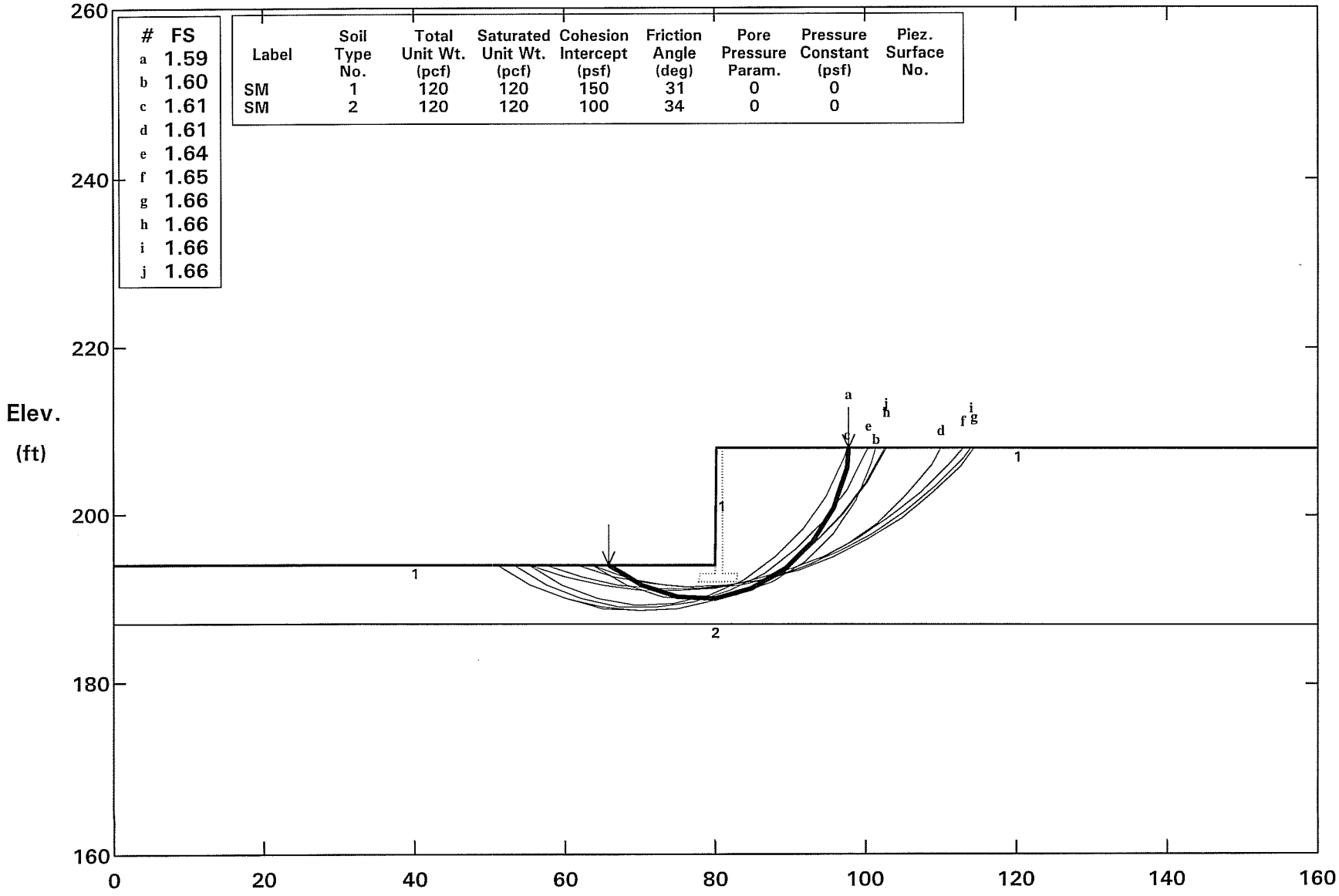
Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SM	1	120	120	150	31	0	0	
SM	2	120	120	100	34	0	0	

STABL6H FSmin = 1.95 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW462 (16'-high type 1 RW) @ Sta 463+40 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW462D.PLT 02-26-09 11:46am

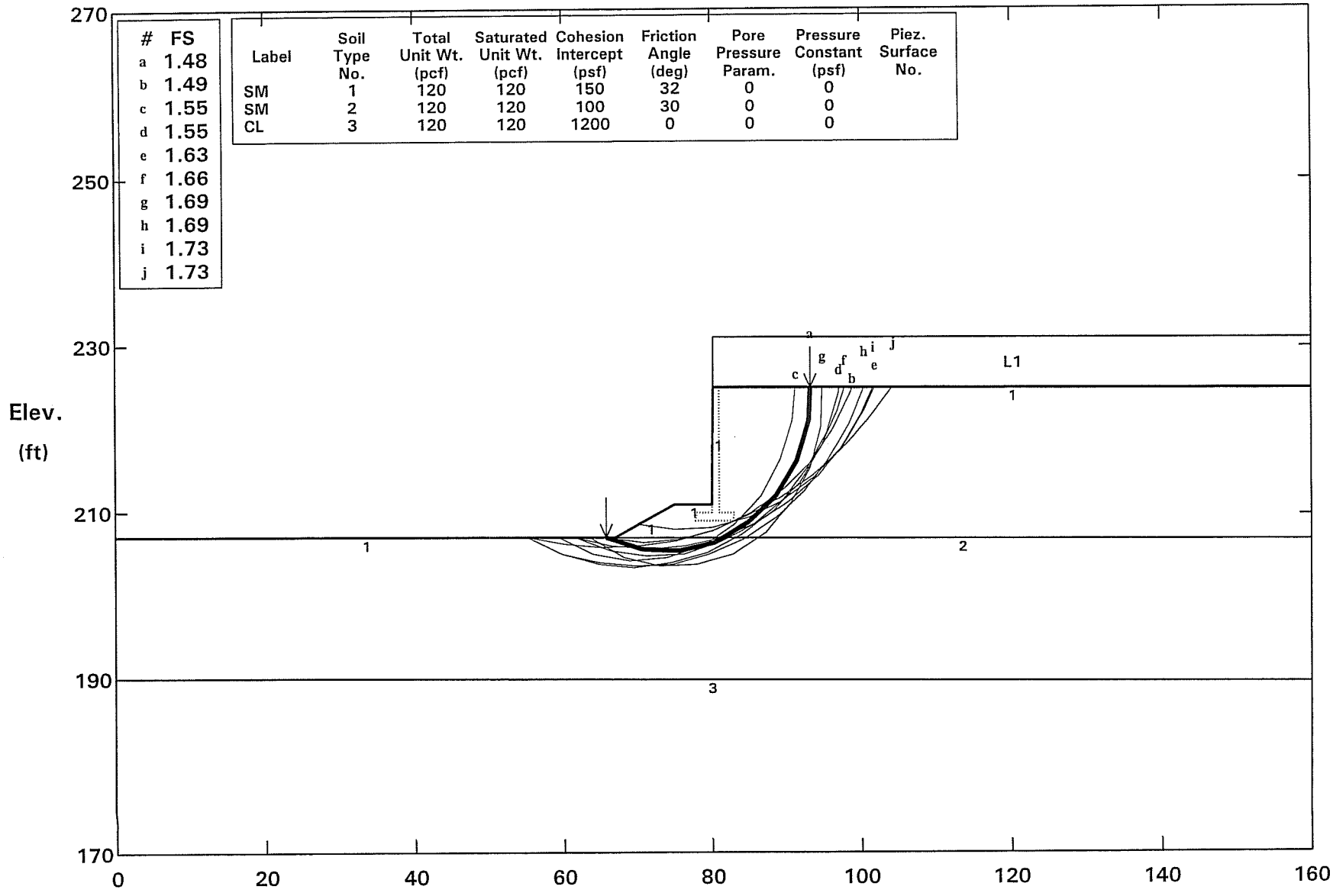


STABL6H FSmin=1.59 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW466 (14'-high Type 1 RW) @ Sta 471+20 Static Condition

Ten Most Critical. D:RW466S.PLT 01-24-09 10:56am



#	FS
a	1.48
b	1.49
c	1.55
d	1.55
e	1.63
f	1.66
g	1.69
h	1.69
i	1.73
j	1.73

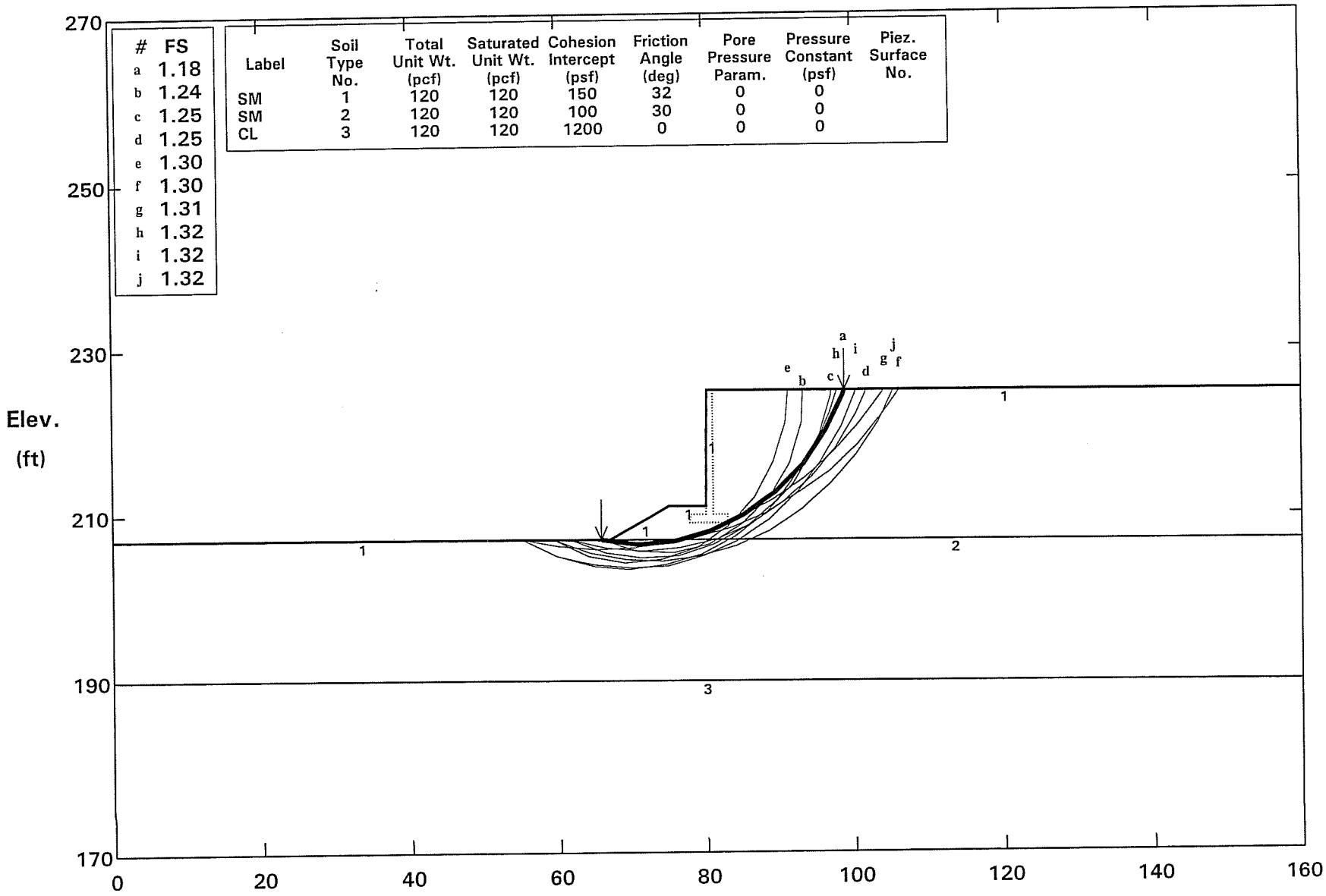
Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SM	1	120	120	150	32	0	0	
SM	2	120	120	100	30	0	0	
CL	3	120	120	1200	0	0	0	

STABL6H FSmin = 1.48 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW466 (14'-high Type 1 RW) @ Sta 471 + 20 Pseudostatic Condition (kh = 0.2)

Ten Most Critical. D:RW466D.PLT 01-24-09 10:56am

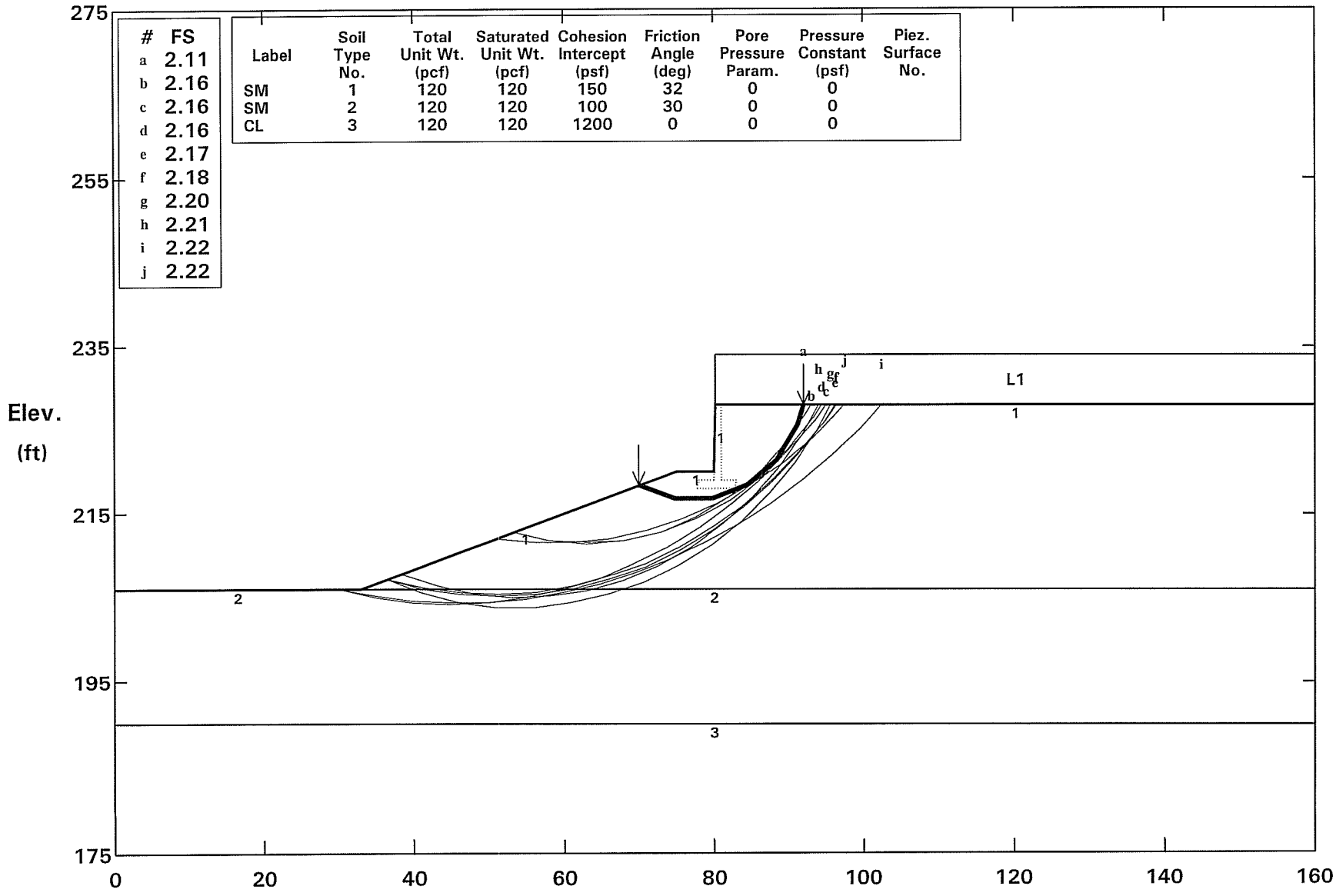


STABL6H FSmin = 1.18 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW474 (SW on 12'-high RW) @ Sta 473+25 Static Condition

Ten Most Critical. D:RW474S.PLT 02-26-09 12:21pm

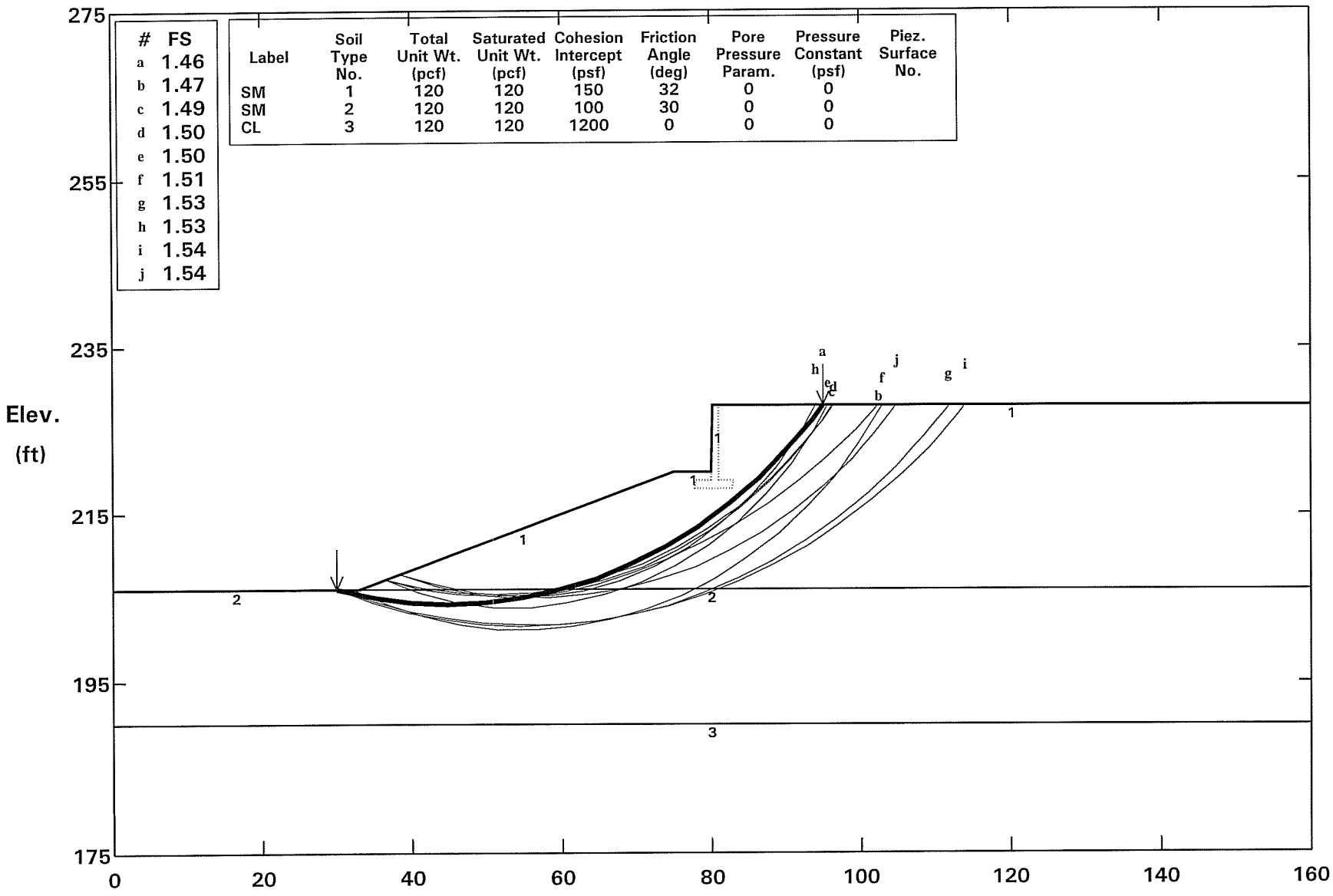


STABL6H FSmin = 2.11 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW474 (SW on 12'-high RW) @ Sta 473+25 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW474D.PLT 02-26-09 11:50am

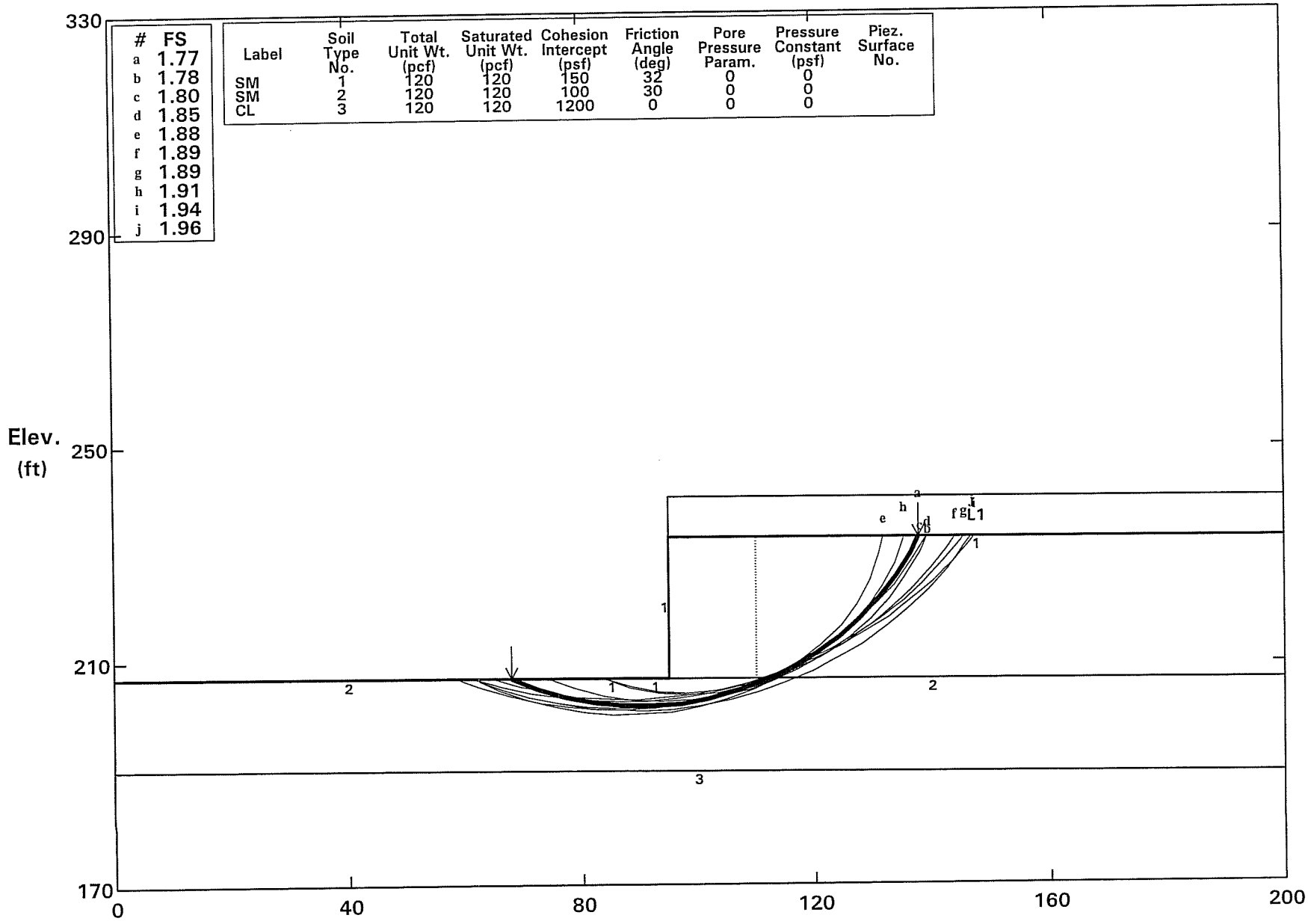


STABL6H FSmin = 1.46 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW476 (22'-high MSE wall) @ Sta 478+00 Static Condition

Ten Most Critical. D:RW480S.PLT 01-24-09 11:11am

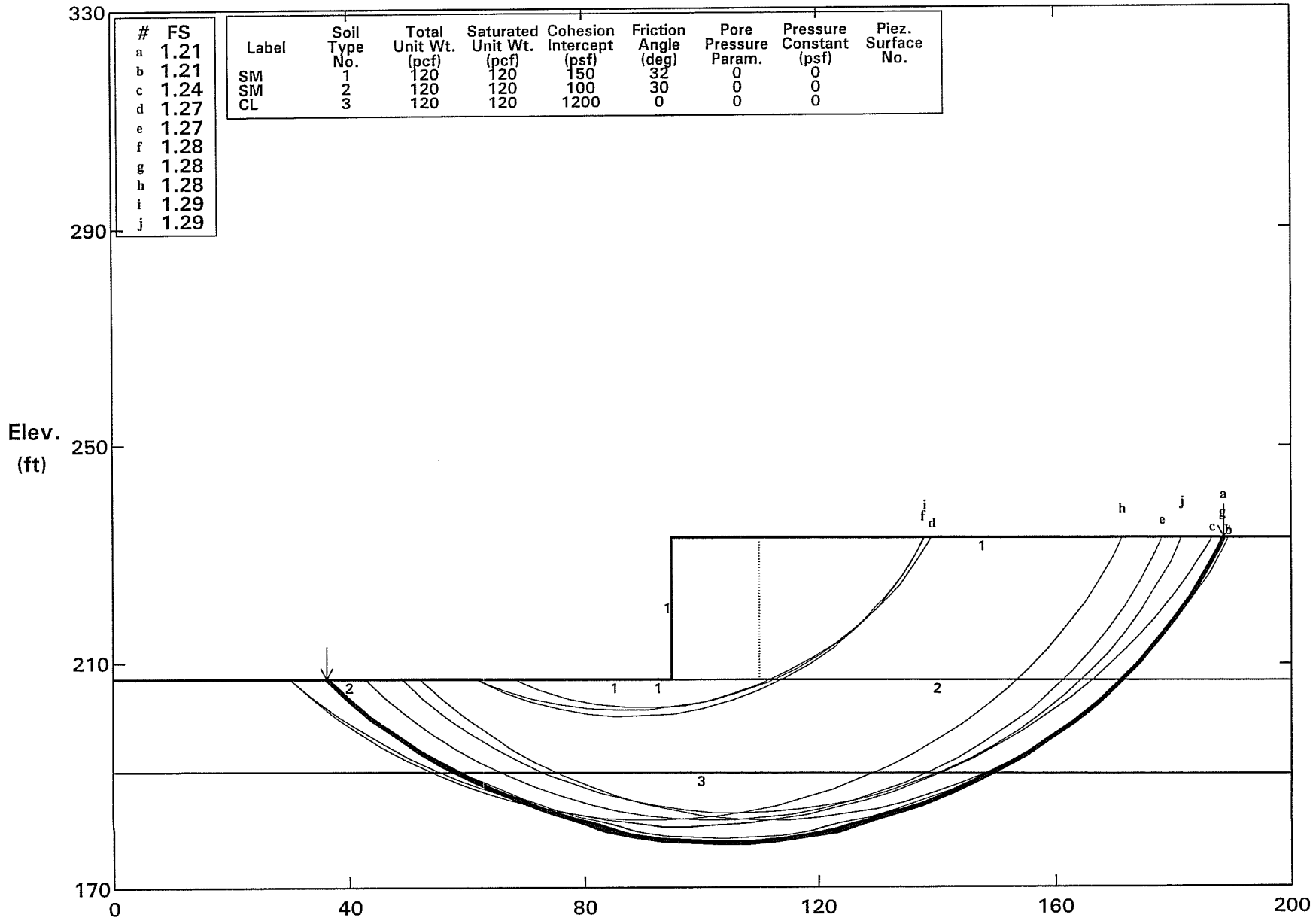


STABL6H FSmin = 1.77 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW476 (22'-high MSE wall) @ Sta 478+00 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW480D.PLT 01-24-09 11:11am

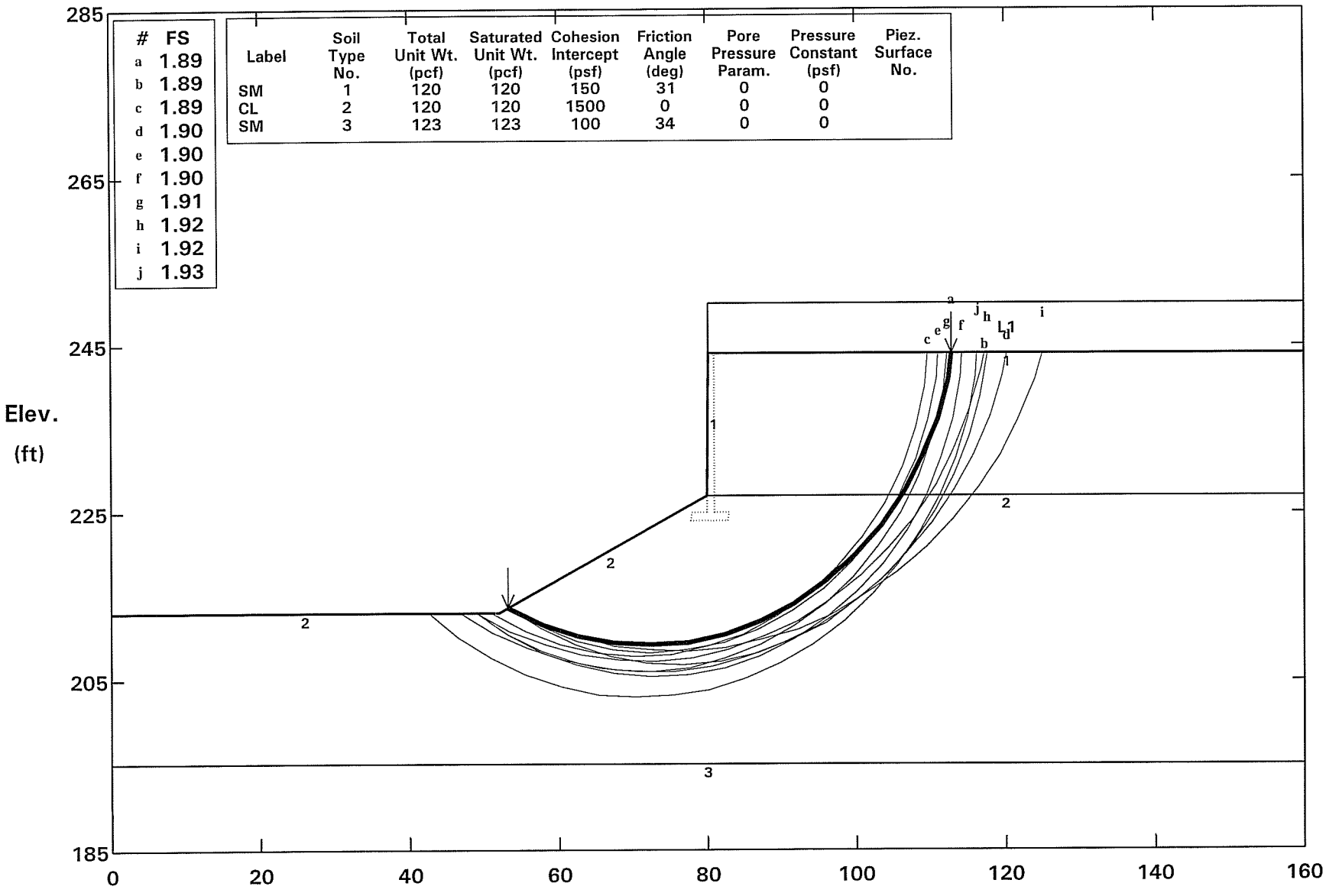


STABL6H FSmin = 1.21 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW486 (16'-high type 1 RW) @ Sta 489+80 Static Condition

Ten Most Critical. D:RW486S.PLT 02-26-09 11:53am

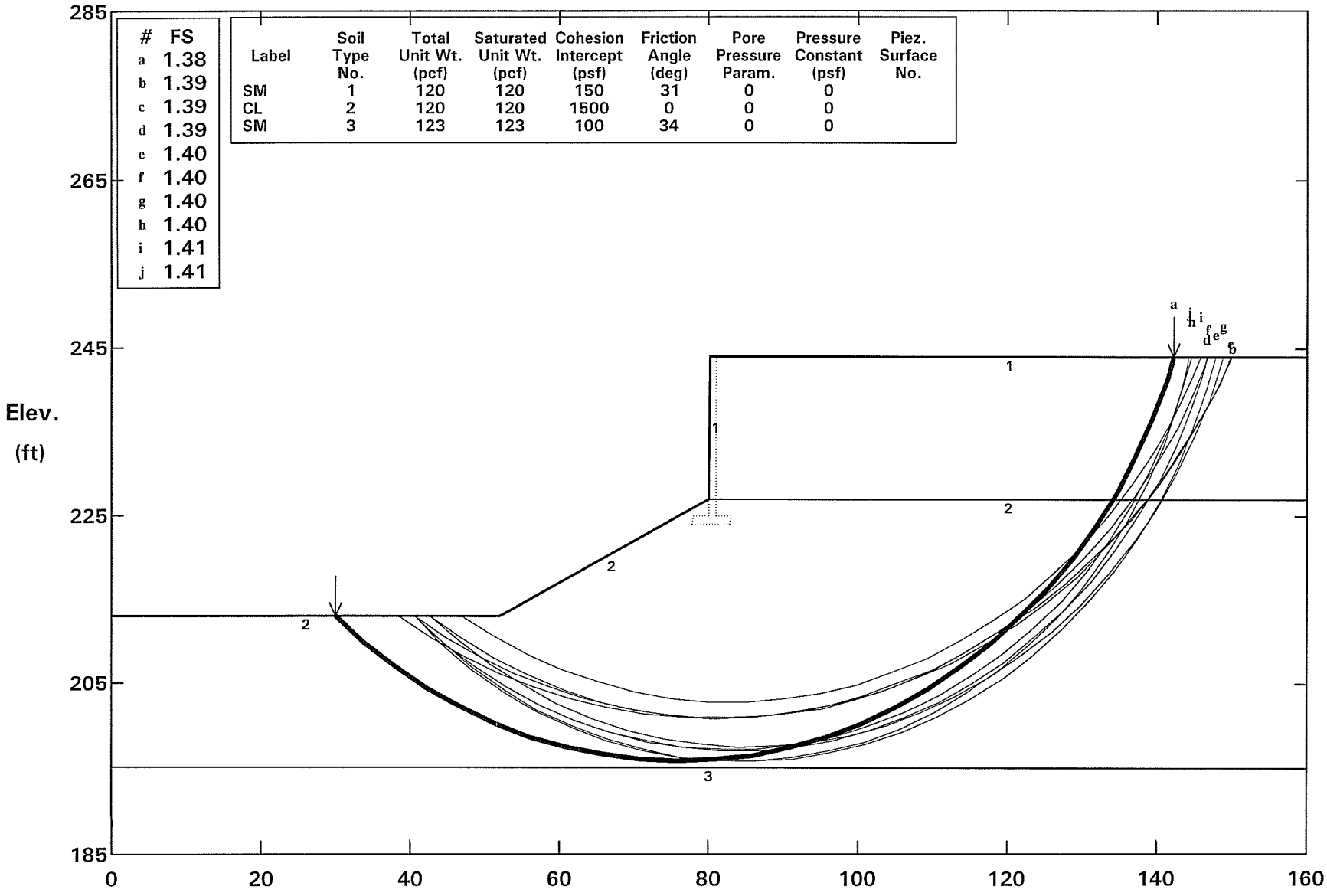


STABL6H FSmin = 1.89 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW486 (16'-high type 1 RW) @ Sta 489+80 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW486D.PLT 02-26-09 11:54am



#	FS
a	1.38
b	1.39
c	1.39
d	1.39
e	1.40
f	1.40
g	1.40
h	1.40
i	1.41
j	1.41

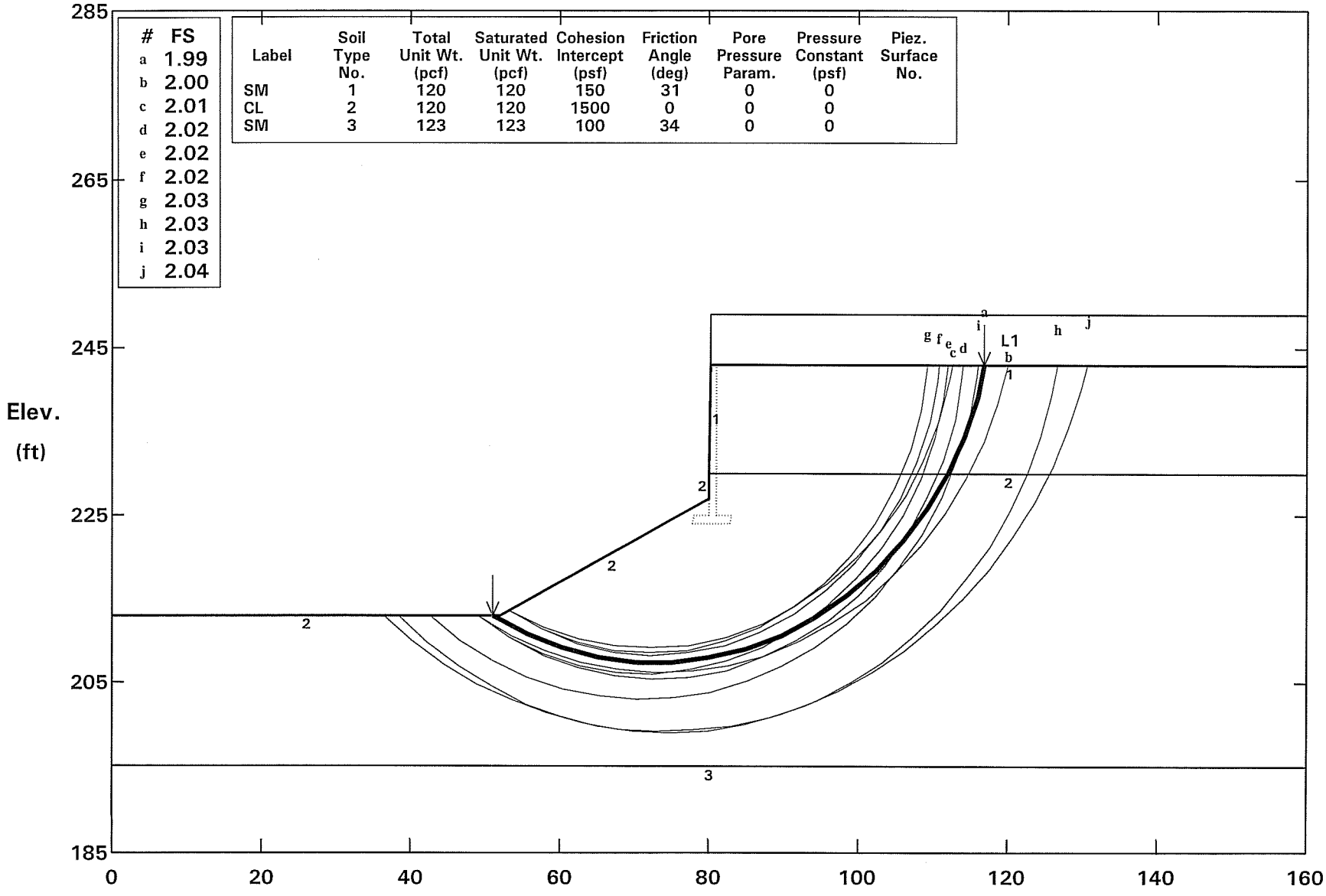
Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SM	1	120	120	150	31	0	0	
CL	2	120	120	1500	0	0	0	
SM	3	123	123	100	34	0	0	

STABL6H FSmin = 1.38 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW492 (18'-high type 1 RW) @ Sta 491+50 Static Condition

Ten Most Critical. D:RW492S.PLT 02-26-09 11:57am

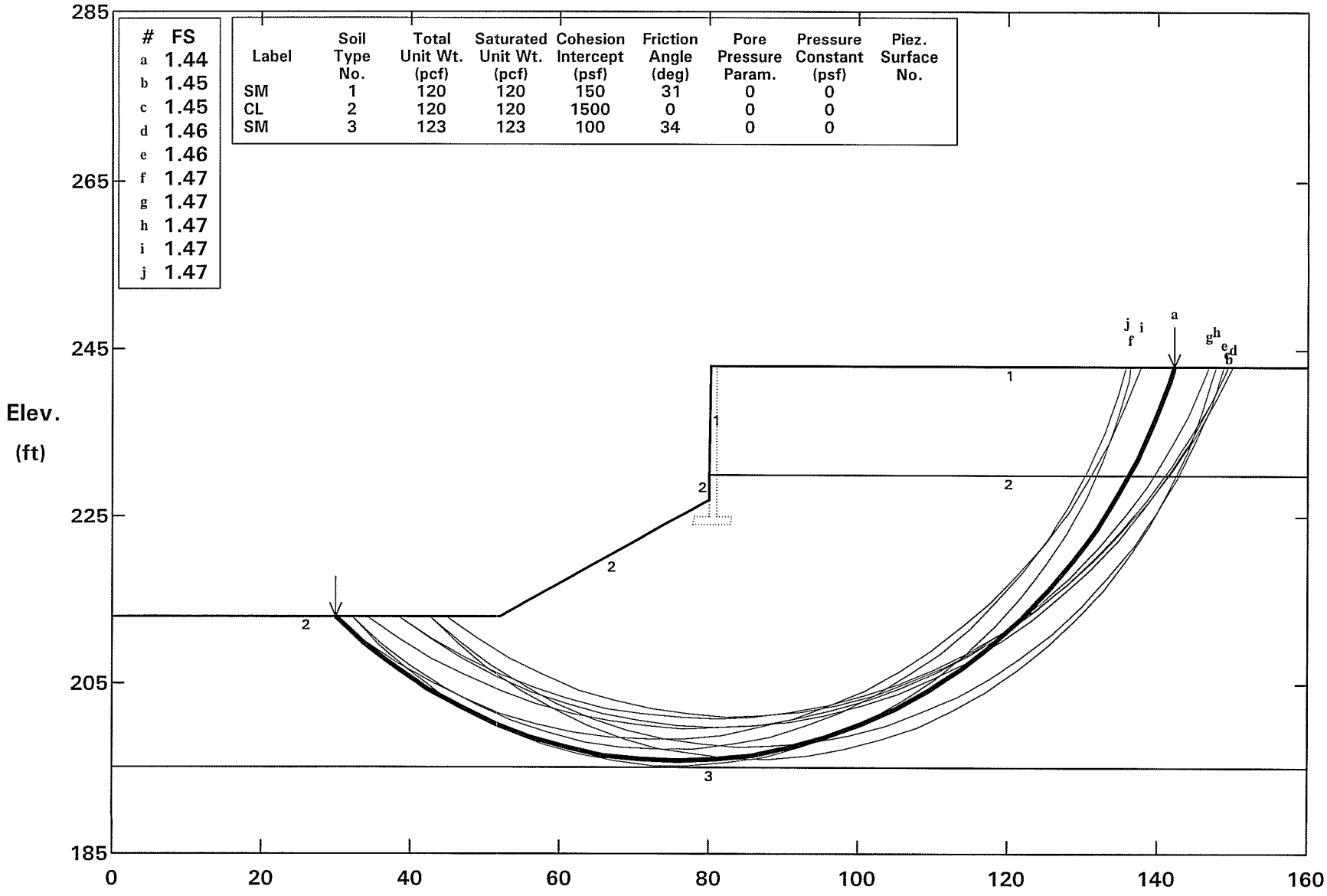


STABL6H FSmin = 1.99 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW492 (18'-high type 1 RW) @ Sta 491+50 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW492D.PLT 02-26-09 11:57am

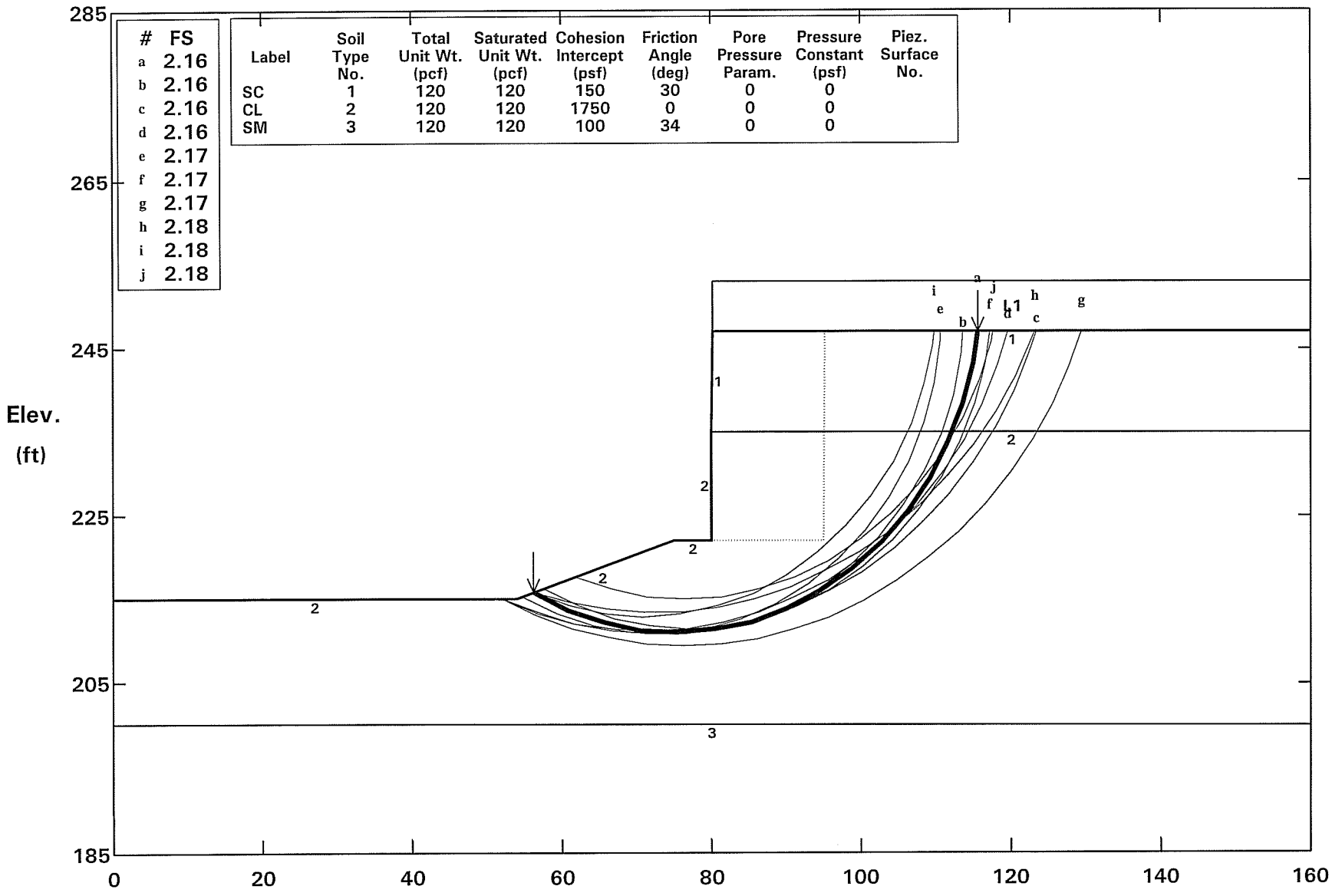


STABL6H FSmin = 1.44 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW496 (26'-high MSE wall) @ Sta 505+60 Static Condition

Ten Most Critical. D:RW496S.PLT 02-26-09 12:07pm

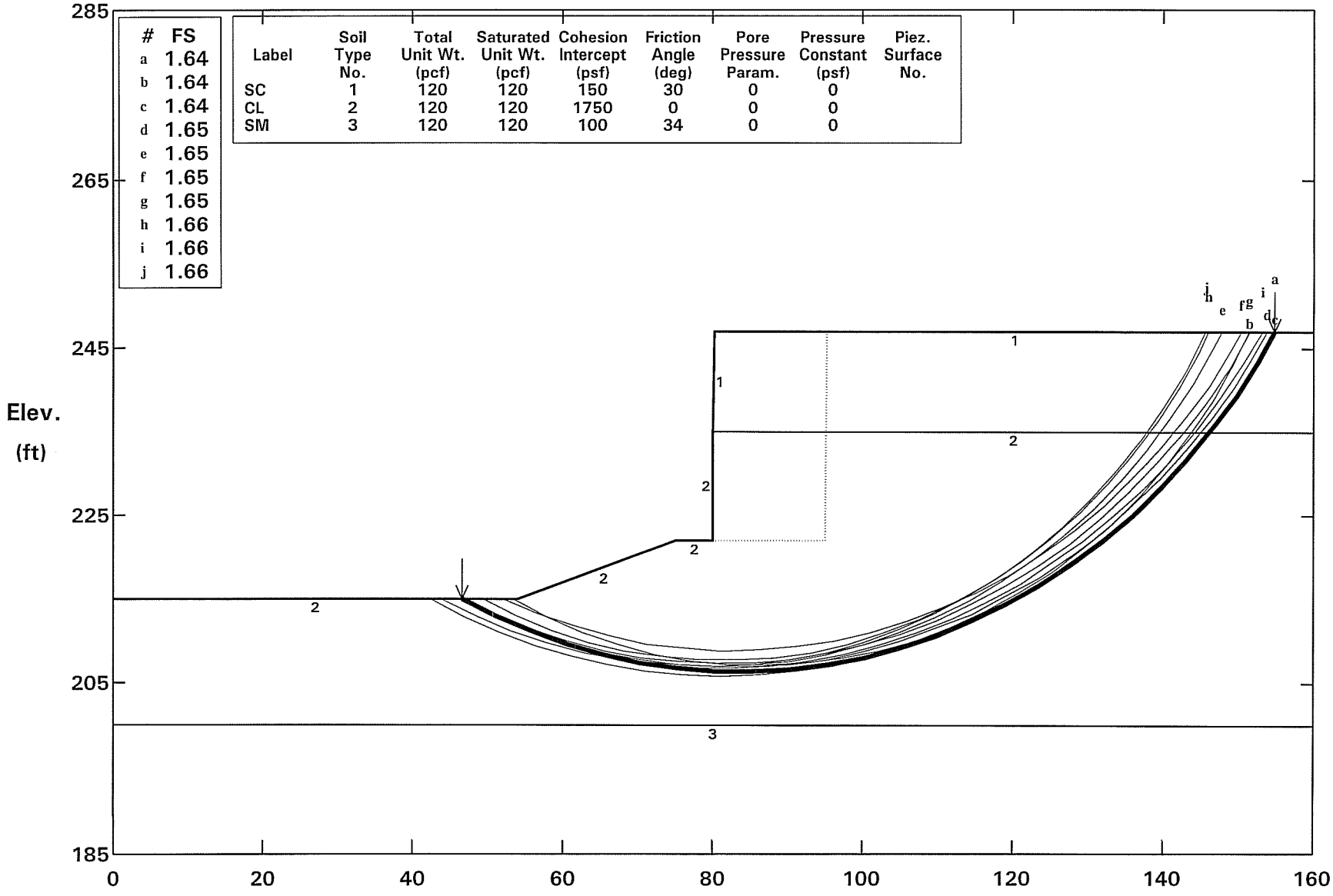


STABL6H FSmin = 2.16 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

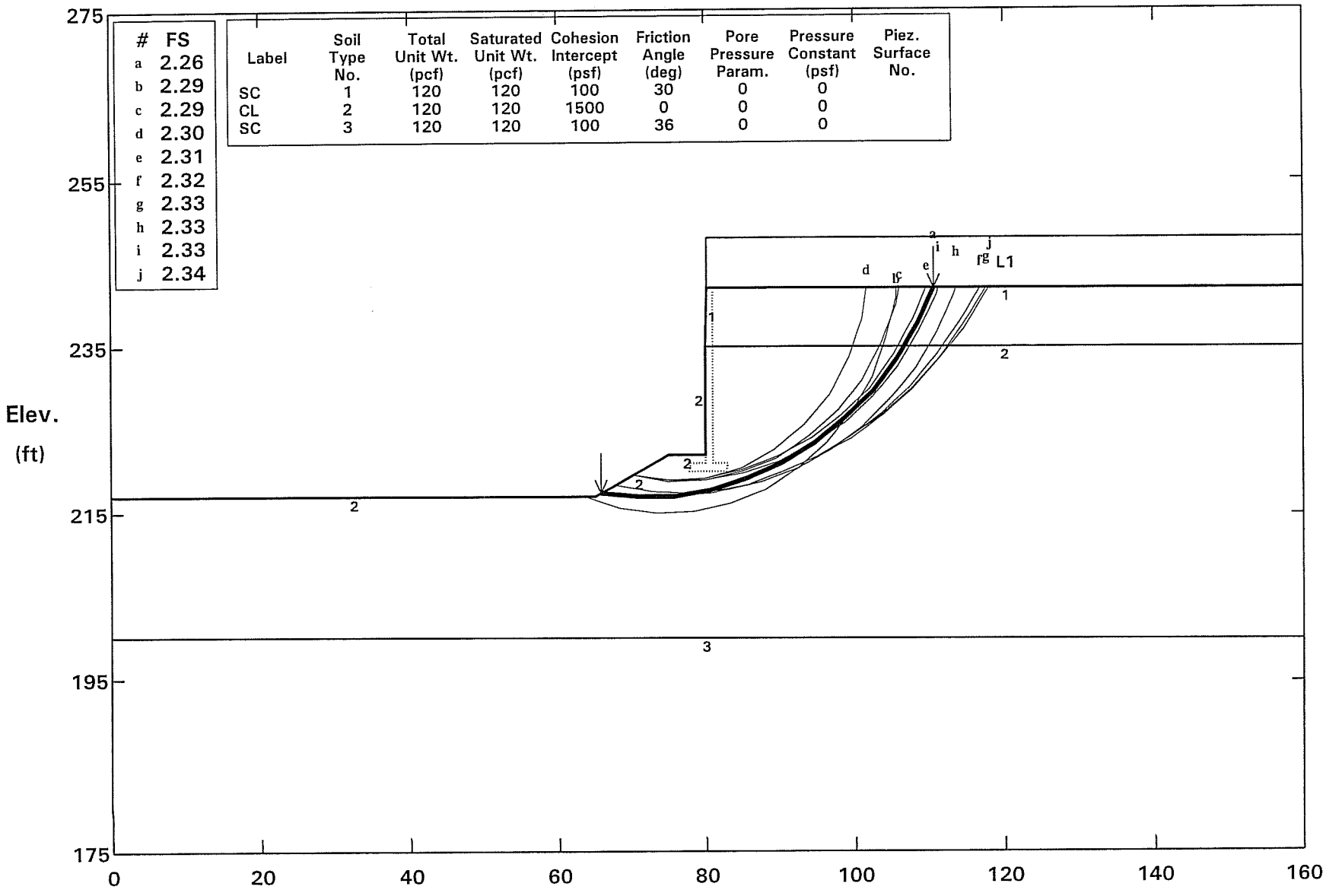
RW496 (26'-high MSE wall) @ Sta 505+60 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW496D.PLT 02-26-09 12:07pm



RW512 (18'-high type 1 wall) Sta 511+60 Static Condition

Ten Most Critical. D:RW512S.PLT 01-26-09 8:45am

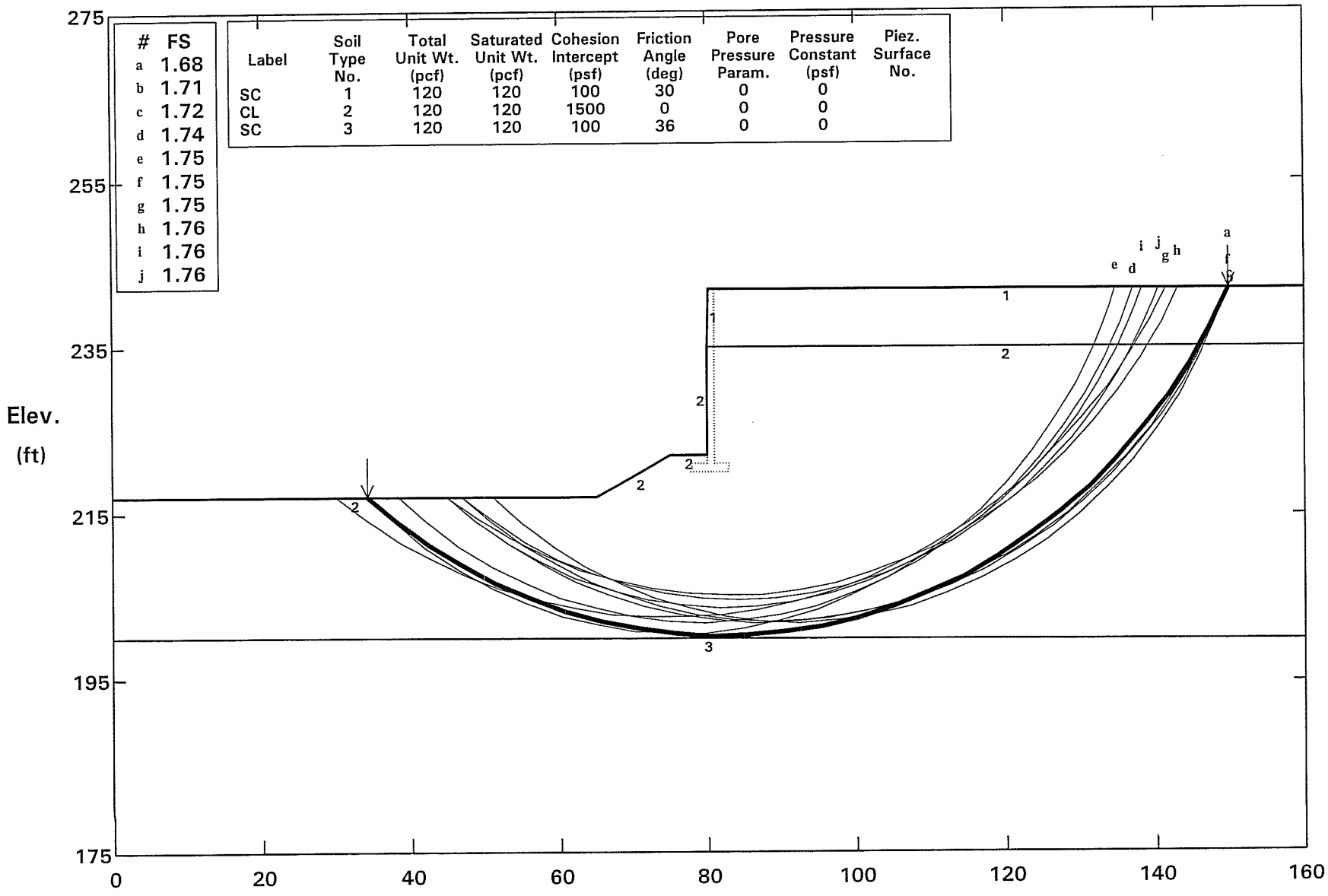


STABL6H FSmin = 2.26 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW512 (18'-high type 1 wall) Sta 511+60 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW512D.PLT 01-26-09 8:46am

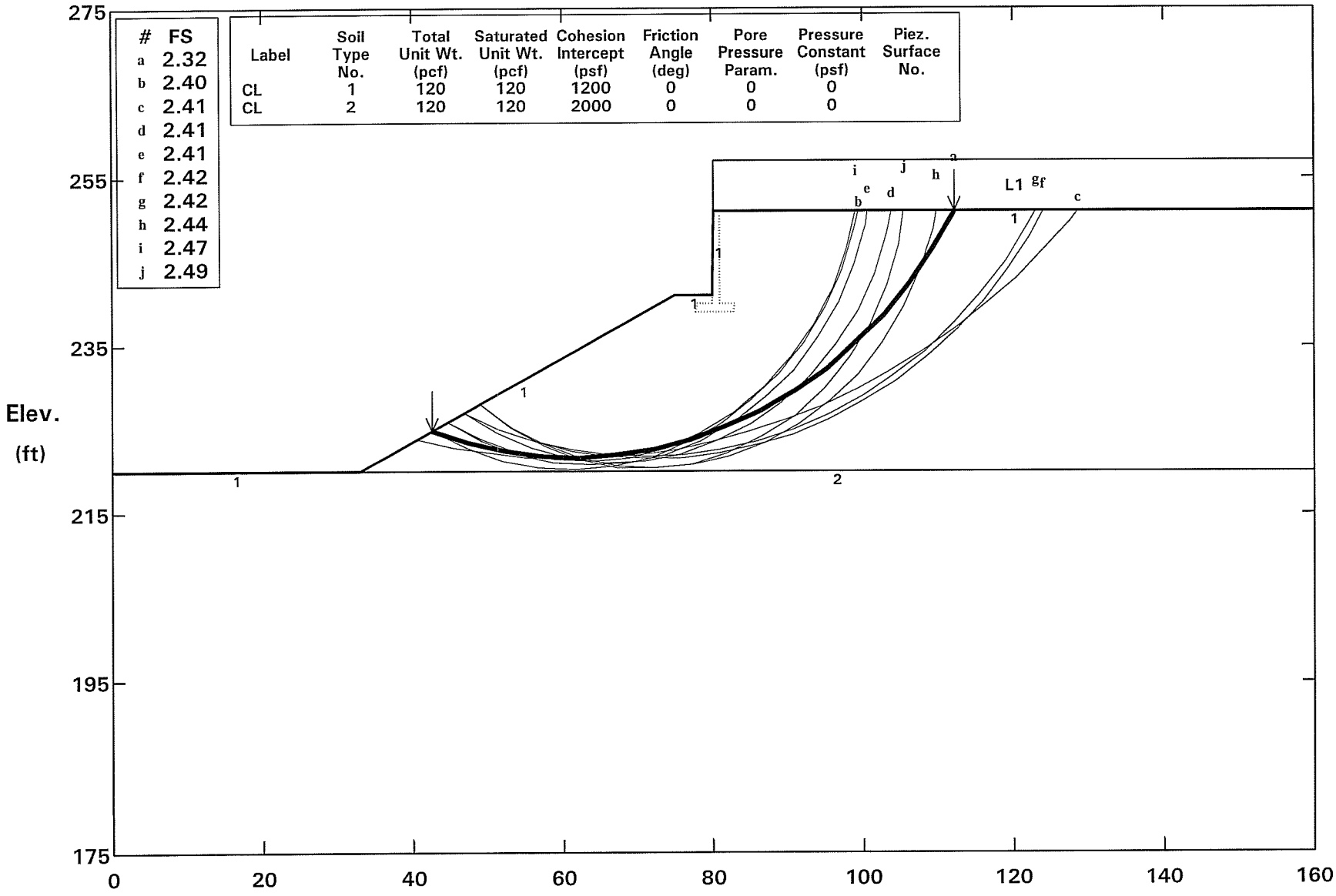


STABL6H FSmin=1.68 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW514 (14'-high Type 1 wall) Sta 519+15 Static Condition

Ten Most Critical. D:RW514S.PLT 02-26-09 12:09pm

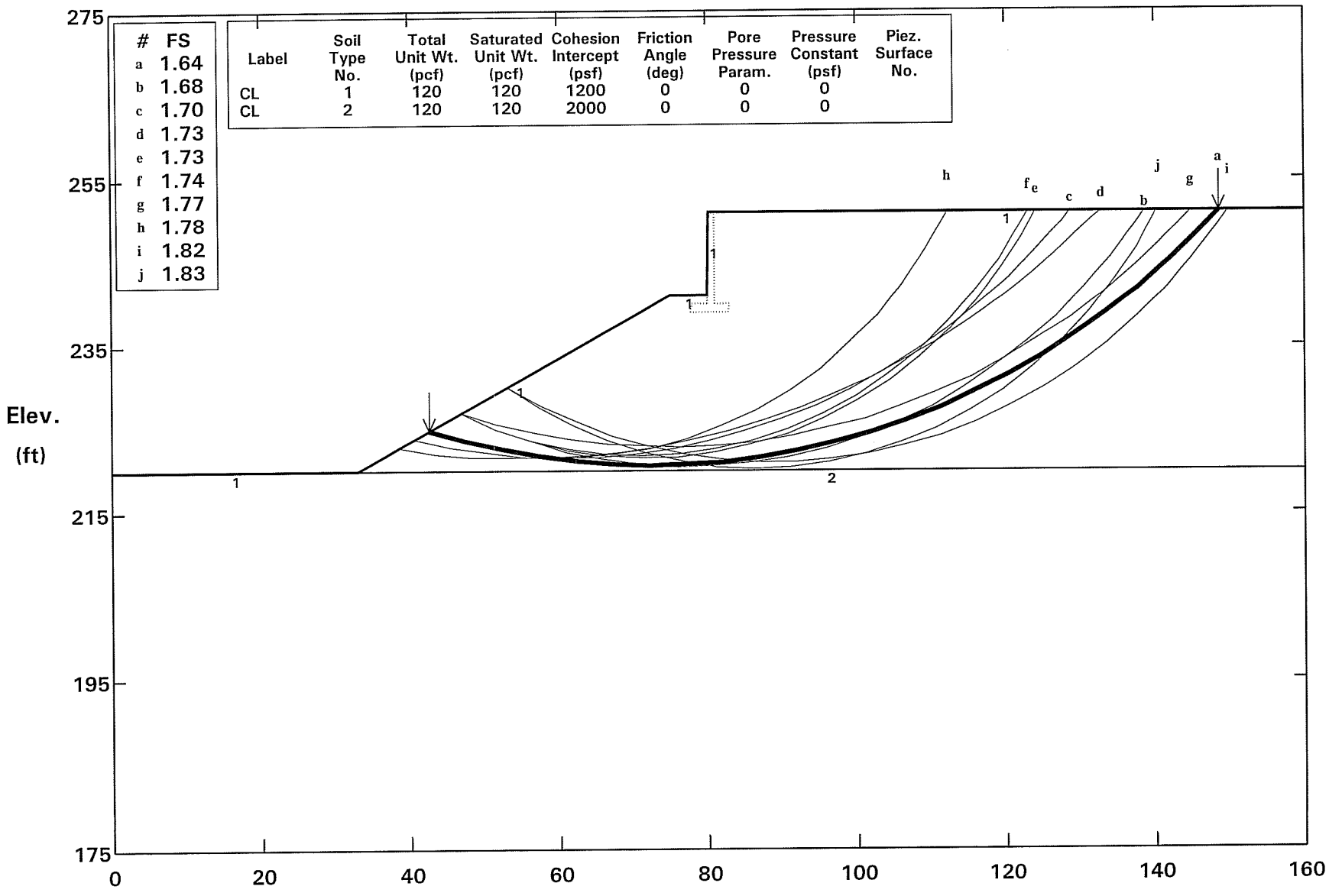


STABL6H FSmin = 2.32 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW514 (14'-high Type 1 wall) Sta 519+15 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW514D.PLT 02-26-09 12:09pm

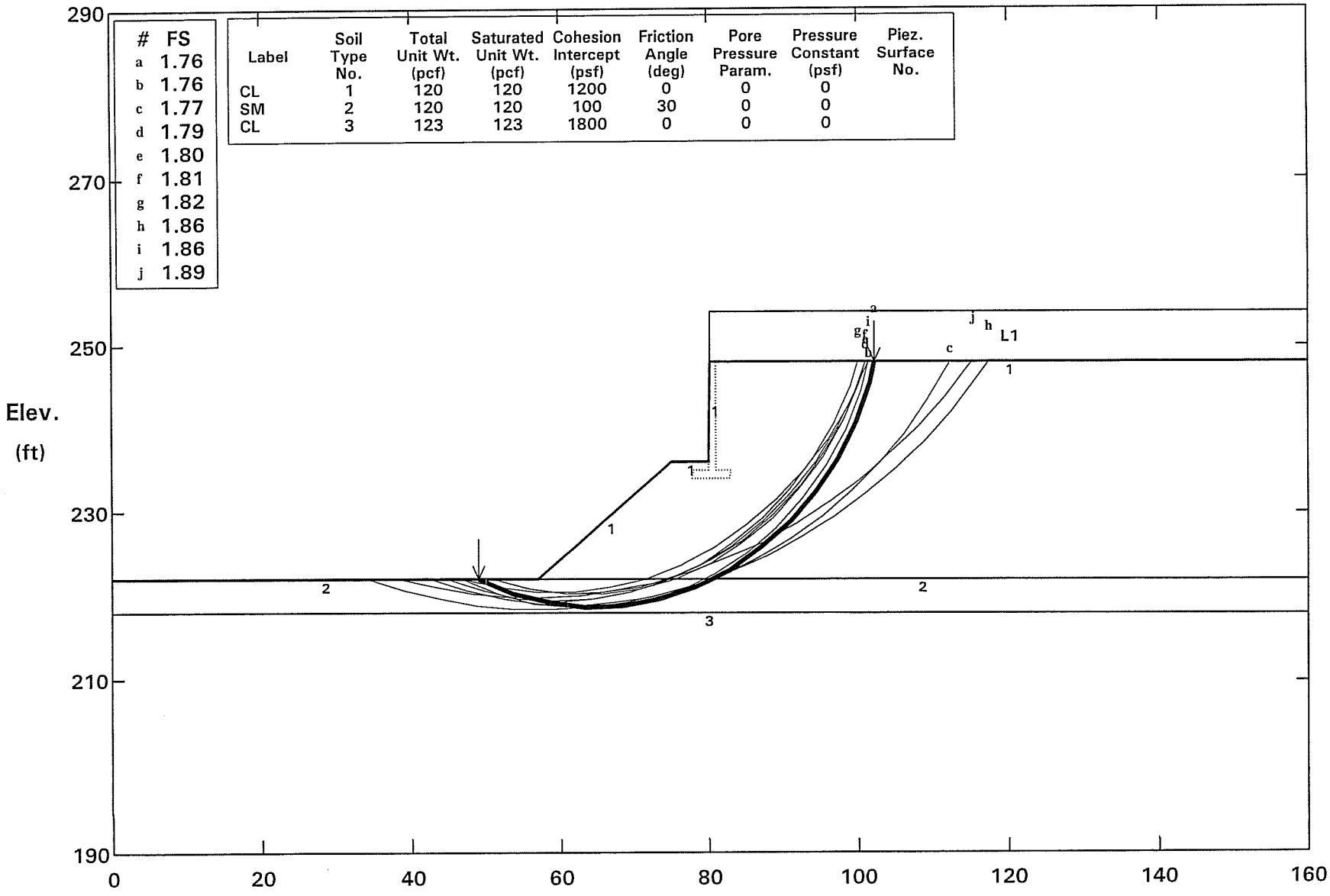


STABL6H FSmin = 1.64 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW522 (14'-high type 1 wall) Sta 527+00 Static Condition

Ten Most Critical. D:RW522S.PLT 01-26-09 8:50am

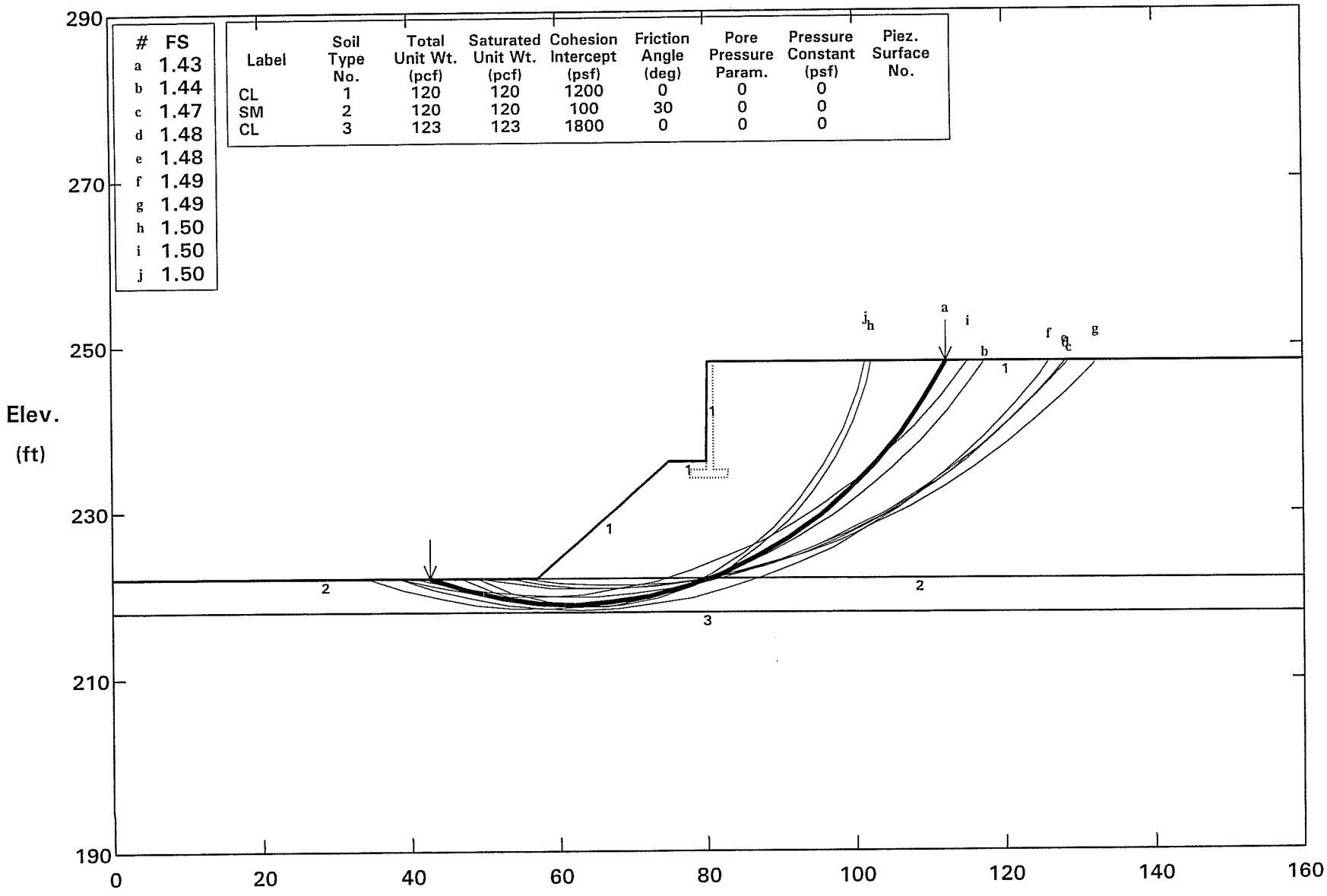


STABL6H FSmin = 1.76 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW522 (14'-high type 1 wall) Sta 527+00 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW522D.PLT 01-26-09 8:50am

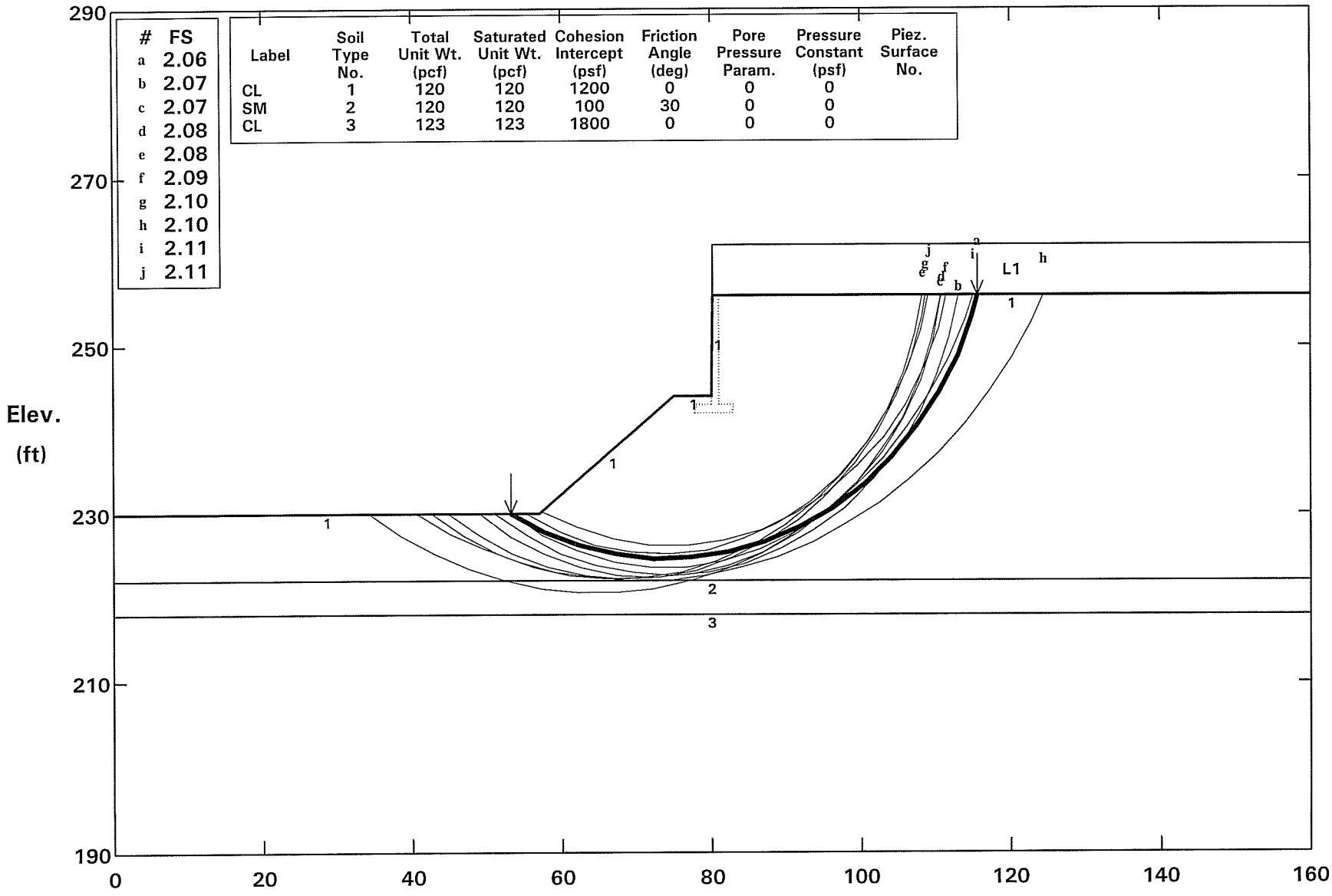


STABL6H FSmin=1.43 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW526 (SW on 14'-high RW) @ Sta 535+35 Static Condition

Ten Most Critical. D:RW536S.PLT 02-26-09 12:12pm

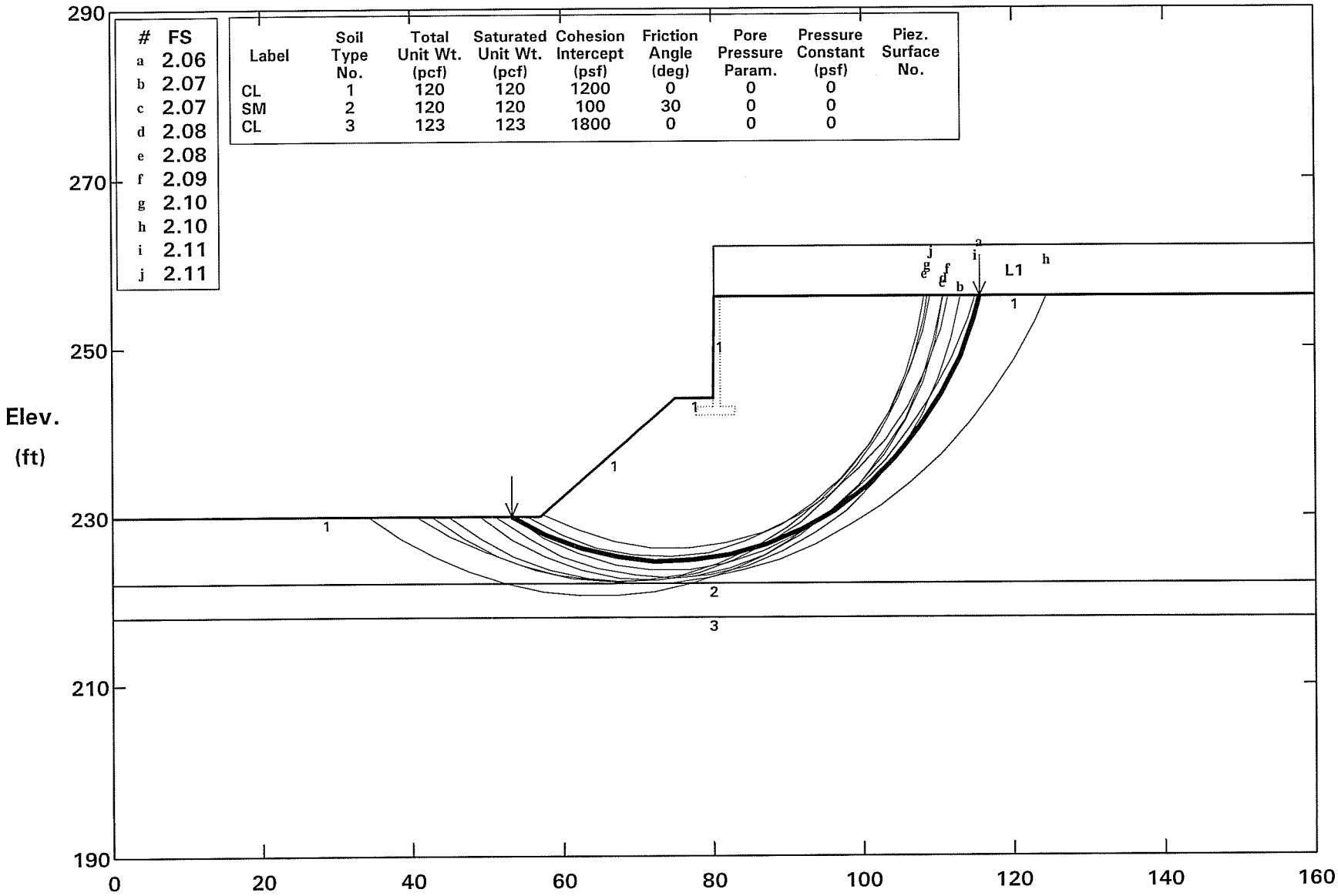


STABL6H FSmin = 2.06 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW536 (SW on 14'-high RW) @ Sta 535+35 Static Condition

Ten Most Critical. D:RW536S.PLT 02-26-09 12:12pm

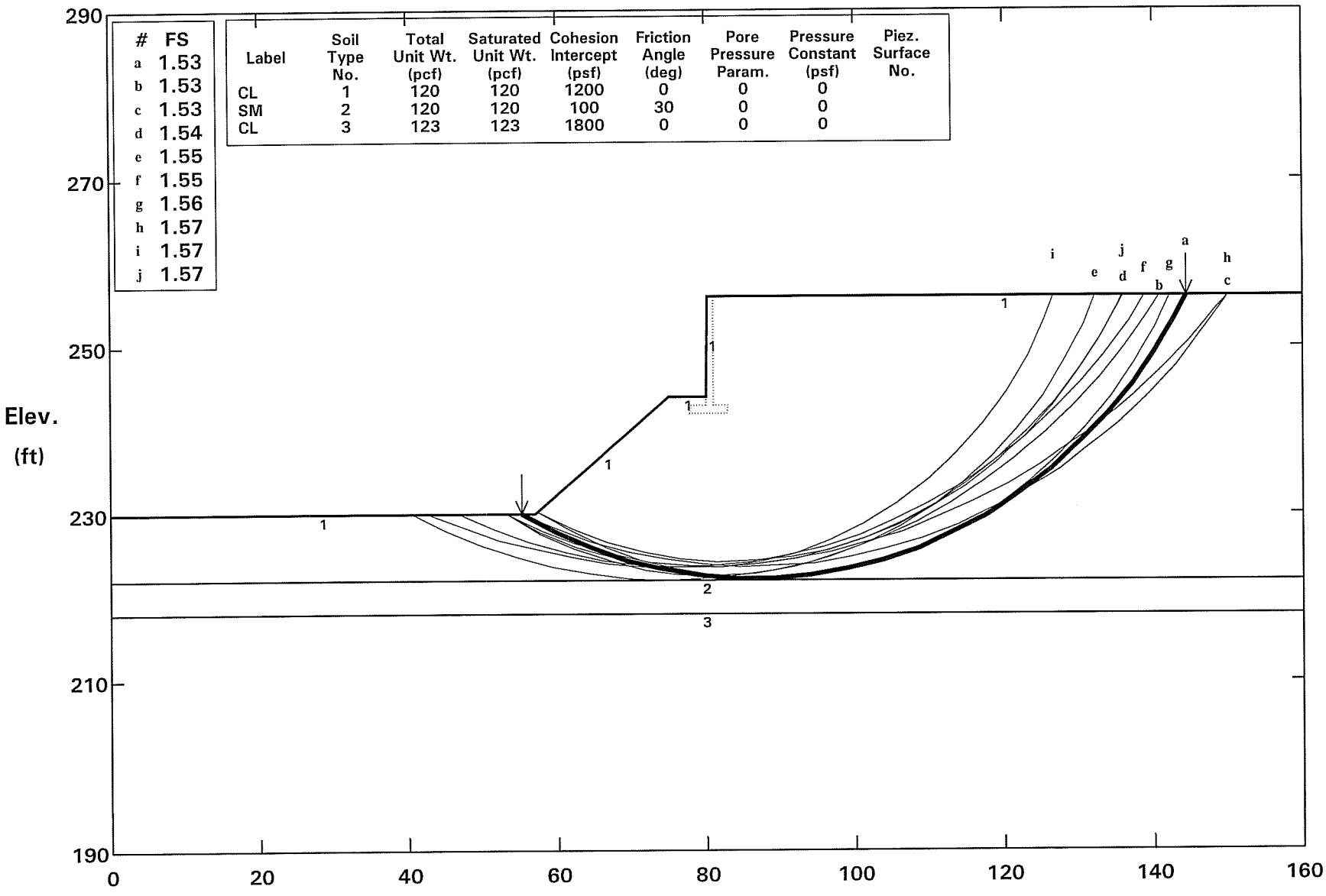


STABL6H FSmin = 2.06 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW536 (SW on 14'-high RW) @ Sta 535+35 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW536D.PLT 02-26-09 12:13pm



STABL6H FSmin = 1.53 X-Axis (ft)

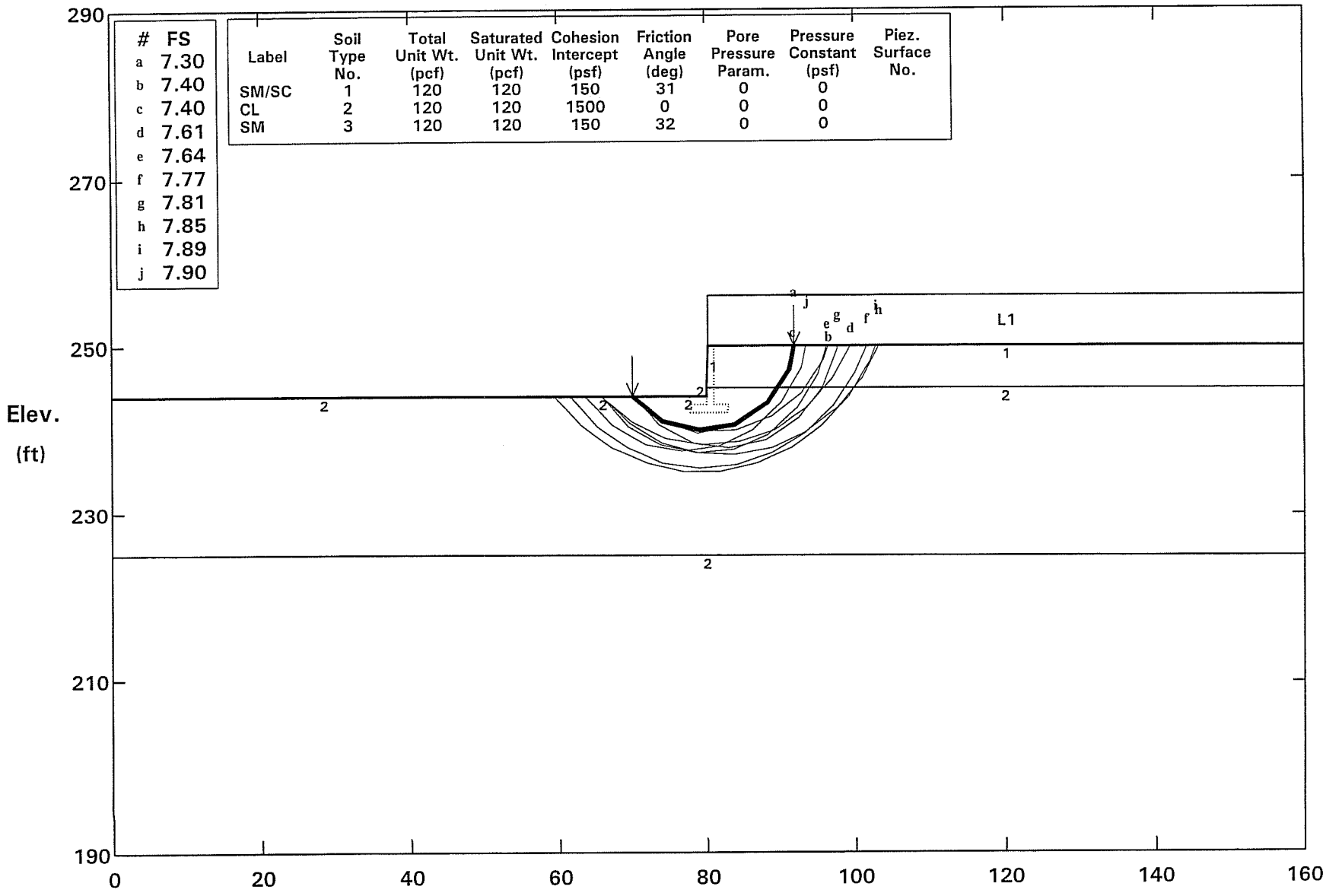
Factors Of Safety Calculated By The Modified Bishop Method

RW538/542 (12'-high SW on 8'-high RW) @ Sta 541+00 Static Condition

Ten Most Critical. D:RW538S.PLT 01-26-09 9:01am

#	FS
a	7.30
b	7.40
c	7.40
d	7.61
e	7.64
f	7.77
g	7.81
h	7.85
i	7.89
j	7.90

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SM/SC	1	120	120	150	31	0	0	
CL	2	120	120	1500	0	0	0	
SM	3	120	120	150	32	0	0	

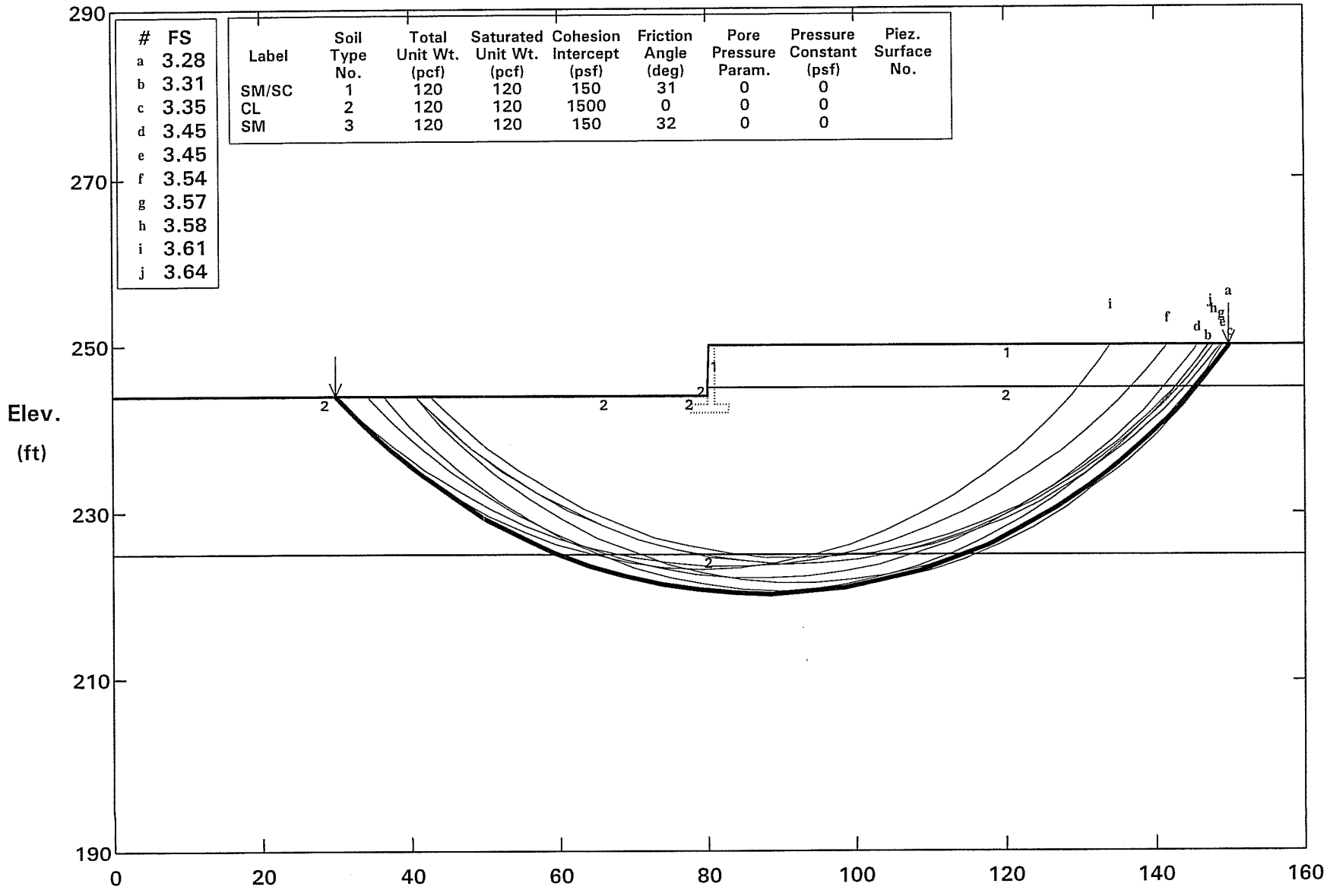


STABL6H FSmin = 7.30 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW538/542 (12'-high SW on 8'-high RW) @ Sta 541+00 Pseudostatic Cond. (kh=0.2)

Ten Most Critical. D:RW538D.PLT 01-26-09 9:02am

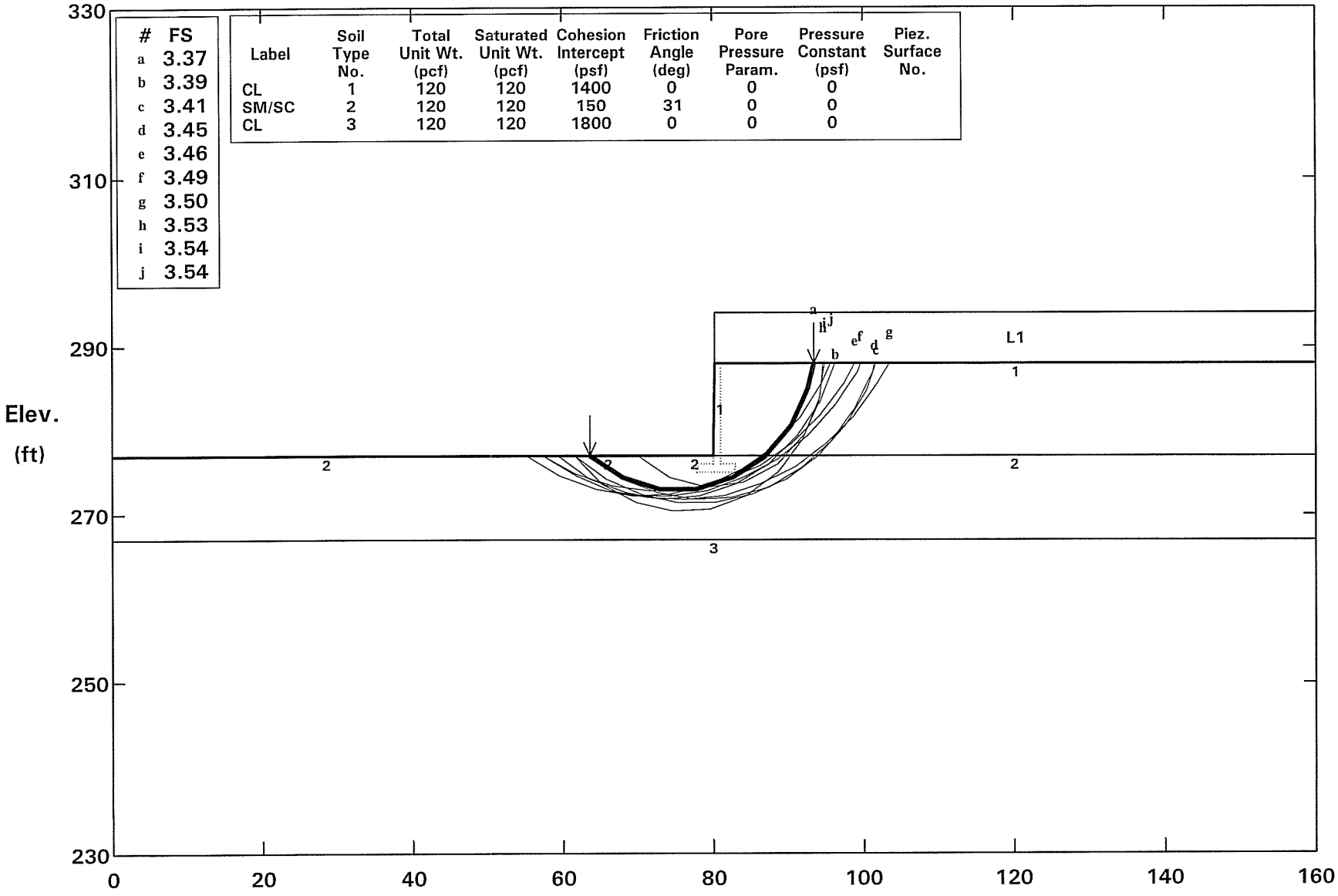


STABL6H FSmin=3.28 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW576 (14'-high type 1 wall) @ 575+00 Static Condition

Ten Most Critical. D:RW576S.PLT 02-26-09 12:15pm



#	FS
a	3.37
b	3.39
c	3.41
d	3.45
e	3.46
f	3.49
g	3.50
h	3.53
i	3.54
j	3.54

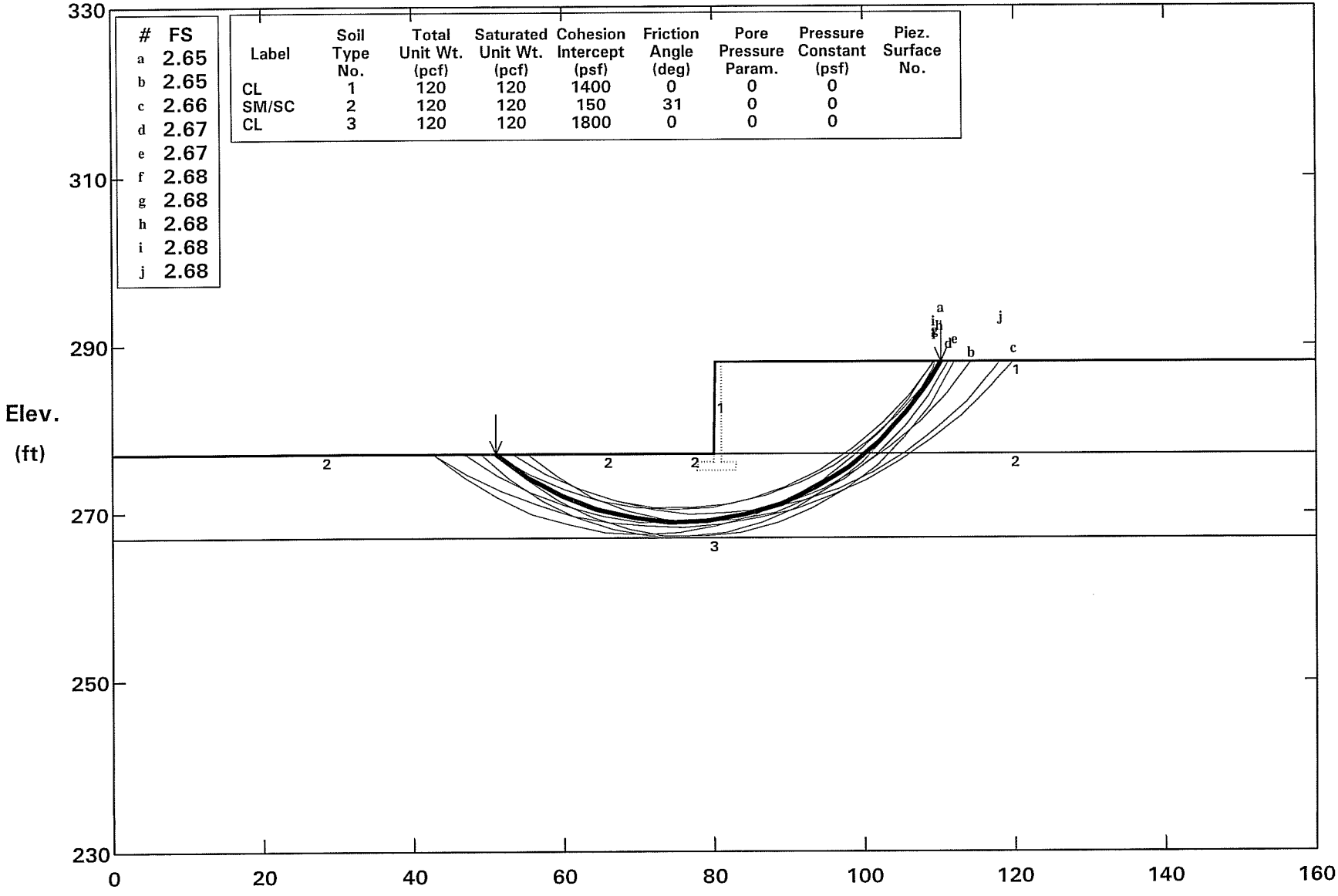
Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
CL	1	120	120	1400	0	0	0	
SM/SC	2	120	120	150	31	0	0	
CL	3	120	120	1800	0	0	0	

STABL6H FSmin = 3.37 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

RW576 (14'-high type 1 wall) @ 575+00 Pseudostatic Condition (kh=0.2)

Ten Most Critical. D:RW576D.PLT 02-26-09 12:15pm



#	FS
a	2.65
b	2.65
c	2.66
d	2.67
e	2.67
f	2.68
g	2.68
h	2.68
i	2.68
j	2.68

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
CL	1	120	120	1400	0	0	0	
SM/SC	2	120	120	150	31	0	0	
CL	3	120	120	1800	0	0	0	

STABL6H FSmin = 2.65 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

APPENDIX D

CALTRANS REVIEW COMMENTS AND EMI RESPONSES

State of California — Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Branch Chief, Design A

Date: June 2, 2009
File: 12-ORA-57-PM 16.2/18.6
12-0F0311

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Retaining Wall Nos. 486, 512 514, 522, 576, Sound Wall on Retaining Wall Nos. 462, 466, 474, 492, 526, 536, 538 and MSE Wall Nos. 476 & 496

Subject: Review of Response to Caltrans Comments on the Foundation Report

On June 1, 2009, we received a response and revised portions of the Foundation Report for the retaining walls, sound walls and MSE walls within SR-57 Northbound improvement. The project limits are between 0.2 miles south of Orangethorpe Ave. and 0.2 miles north of Yorba Linda Blvd. The following comments are based on the response and revised part of the report dated May 26, 2009, prepared by Earth Mechanics, Inc.

- Since similar heights of H = 12 & 16 are listed for Wall 492 in Tables 5-4 and 5-7, the wall heights in Table 5-7 should be distinguished with stationing to avoid confusion.

  EMI: Stationing was added to Table 5-7 to avoid confusion.

- Horizontal limits of over-excavation as stated in Sections 5.4.1 and 5.5.1 could remain the same as long as a minimum horizontal distance of four (4) feet measured at the top of footing between the near face of the footing and the face of the finished slope is provided (Caltrans Bridge Design Specifications 4.4.5.1).

  EMI: The above minimum horizontal distance was already stated in the report.

- Per phone conversation with Mr. Leno Cheang, LOTB of all walls including standard walls on spread footing should comply with Caltrans Soil and Rock Manual. Therefore, LOTB of wall Nos. 486, 512, 514, 522 & 576 should be revised accordingly.

  EMI: We will comply.

- The word "downward" in statement for horizontal limits of over-excavation should be modified to down and out to avoid confusion.

  EMI: All "downward" terms have been replaced with "down and out".

Report by:

FARAMARZ GERAMI, P.G., C.E.G.
Engineering Geologist
Office of Geotechnical Design - South 1
Branch C

Reviewed by: Date: 6/2/09

CHI-TSENG TED LIU, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design – South 1
Branch C

REGISTERED PROFESSIONAL ENGINEER CHI-TSENG TED LIU No. 2069 Exp. 6-30-2010 GEOTECHNICAL STATE OF CALIFORNIA

c: OGDS1 - LA. File
OGDS1 - Sac. File
GS – Sac. File

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

May 26, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Attention: Mr. Steve Huff

Subject: Response to Caltrans Foundation Review Comments on "Foundation Report for Sound Walls, Retaining Walls and MSE Walls, SR-57 Northbound Widening" 12-Ora-57, PM 16.2/18.6, EA 12-0F0311

Dear Mr. Huff:

Caltrans issued a Foundation Review sheet dated April 15, 2009 for the subject project. A copy of this review sheet is attached at the end. The following are our responses to those comments. Many of these responses require revisions of the foundation report. We have included those revised pages from the foundation report as attachments, and the actual revisions are also identified by a vertical line placed on the right side of the text.

1.2 Project Description

- Figures 1-1 and 1-2 should be placed at the end of Section 1.0, so that the sequence of project description is not split.

Response: We will comply in the final report.

- For combination walls, please specify each wall limits by stationing and also begin and end stationing of entire wall.

Response: Table 1-1 has been added to specify the wall limits (see attached Page 2).

Wall Location Plan Figure 1-2

- The symbol for Wall 492 should be shown as sound/retaining wall. Also the symbol for Wall 496 is not included in the legend.

Response: Wall symbols in the attached Figure 1-2 have been revised to present the correct wall type. Retaining Wall No. (RW) 492 is a combination of cantilevered retaining walls and sound walls on retaining walls (SW on RW). RW 496 consists of SW on RW and sound walls on MSE walls.

2.1 Field Investigation

- MSE portion of the Wall Nos. 476 and 496 should be given a different wall no. or designation to avoid confusion.

Response: According to the structural designers, Caltrans Division of Structures has already assigned wall numbers to each wall, and accepts the use of a single wall number for the entire wall.

- In Table 2-1 and also Log of Test borings (LOTB), stationing and off set of all borings should be referenced to centerline Route 57 "B" line. The location of those borings that are based on other lines could be kept in parenthesis or as equivalent to centerline 57 stationing (in Table 2-1); however, boring locations on LOTB should only be referred to centerline Route 57 "B" line.

Response: All boring locations have been revised to refer to the centerline Route 57 "B" line. Revised Table 2-1 (Pages 6 and 7) and LOTB sheets are attached.

- Para. 2, 5th sentence: (2.4 inches ID) and (3.25 inches ID) should be changed to (2.4 inches OD) and (3.25 inches OD).

Response: "ID" has been changed to "OD" (see attached Page 8).

4.1 Soil Conditions

- It would be useful to add a column for expansion potential of different soils.

Response: A column for expansion potential has been added to Table 4-1 (see attached Pages 14, 15 and 16).

- Expansion potential and remedial solution at affected wall location whether supported by spread footing or pile should be discussed. Geotechnical Design Report stated that lean clays could be low to medium expansive and fat clays in several borings could be highly expansive.

Response: There are overexcavation requirements for spread footing foundations supporting walls. The overexcavation depths range from 0.5 to 5 feet below the footing bottom. We also recommended backfilling with Structure Backfill; that is, onsite soils are not allowed to be re-used below the spread footings. Since Structure Backfill is used below the footing, there is no design concern for expansive soils. There is one exception: onsite soils are allowed to be re-used as backfill below the two MSE walls (Wall Nos. 476 and 496) only because MSE walls can withstand larger ground movements and the soil types below the two MSE walls consist of silty sand, clayey sand, sandy clay and lean clay with sand with expansion potential ranging from very low to medium. With the significant overburden exerted by the MSE backfill and no highly expansive materials (such as fat clays) are anticipated to be encountered below the MSE wall, we believe there is also no design concerns for expansive soils below the two MSE walls.

For walls supported on piles, the pile foundation is able to resist the uplift forces from expansive soils. Expansive soils should not be a design issue for pile foundation.

5.4 Foundation Design For Type 1 Walls

- Last sentence of 1st para.: in Section 5.5 pile foundation is recommended for RW 492 with height of 16 feet (instead of 18 feet in Section 5.4). However, pile foundation is shown at wall heights of 12 and 16 feet in General Plan of RW 492. Retaining Wall Nos. 462 with height of 16 feet and 496 with height of 26 feet should be added.

Response: The structural engineers redesigned RW 492 and the wall height of 18 feet is now reduced to 16 feet; after this change, a spread footing foundation is feasible. Therefore, pile foundation for RW 492 in Section 5.4.2 will be deleted from the final report and spread footing recommendations for the 16-foot high wall has been included in Table 5-4 (see attached Page 20).

As noted by the Caltrans Reviewer, the General Plan of RW 492 (which is a SW on RW) shows pile foundation for wall heights of 12 and 16 feet at the north end. Previously, we recommended only pile foundation for a height of 16 feet only; however, for ease of construction and the 12-foot high wall is only 33 feet long, the structural designers decided to support both the 12 and 16-foot wall heights on piles. Section 5.5.2 and Table 5-7 (see attached Pages 22 and 23) have been revised to include pile foundations for both the 12 and 16-foot wall heights.

RW 462 with a height of 16 feet and RW 496 with a height of 26 feet are actually SW on RW on piles. Foundation recommendations for these two walls were presented in Section 5.5.2 and Table 5-9 of the draft report.

5.4.1 Spread Footing

- Instead of specifying horizontal limits of overexcavation, the horizontal limits of structure backfill in compliance with Section 19-5.03 of Caltrans Standard Specifications should be specified. This statement also applies to spread footing in Section 5.5.1. However, if overexcavation statement is not changed, then the horizontal limits of structure backfill as mentioned above should be added.

Response: Section 19-5.03 is feasible for retaining wall on new embankment. For this project, we have a sliver widening and the spread footings supporting the retaining walls are founded mostly on existing embankment fill. For this reason, the existing roadway embankment will need to be re-constructed to accommodate the requirements of Section 19-5.03. More importantly, Section 19-5 of the Standard Specifications is not applicable for Structure Backfill (See Section 19-5.01). The horizontal limits specified in the foundation report pertain to Structure Backfill, therefore, we believe the retaining wall portion of Section 19-5.03 is not applicable in this case.

5.4.2 Pile Foundation

- Based on AASHTO LRFD Bridge Design specifications (Section 10.7.3.9), group effects of driven piles in clay should be considered if center to center spacing is less than 6 pile diameters and less than 4 for CIDH piles in cohesionless soils (Section 10.8.3.6.3). This statement should also apply to Section 5.5.2 (1st para.).

Response: Section 5.4.2 (Type-1 RW on pile foundation) has been deleted due to recent change in design. In Section 5.5.2 (SW on RW on pile foundation), piles supporting RW 462 are embedded in cohesionless soils with center to center spacing equal to or greater than 3 pile diameters; therefore, consideration of group effect is not required (per Section 9.8.1.1 Design and Construction of Driven Pile Foundations, FHWA 2006). For RW 492 and RW 496, piles are embedded within interbedded cohesionless and cohesive soils. Since the pile cap for both walls will be in firm contact with the ground, a group efficiency of 1.0 can be used (per Section 9.8.1.2 Design and Construction of Driven Pile Foundations, FHWA 2006).

- In Table 5-5 (also Table 5-9 and Pile Data Tables in structure Plans), letters should be used instead of numbers for footnote indicators of design tip elevations.

Response: Table 5-5 has been deleted. Old Table 5-9 becomes Table 5-7 in the revised report and letters are used instead of numbers (see attached Page 23).

- A nominal driving resistant column should be added to the end of Tables 5-5 and 5-9 and Pile Data Tables in Structure Plans.

Response: Table 5-5 has been deleted. Old Table 5-9 becomes Table 5-7 in the revised report and "nominal driving resistant" column has been added (see attached Page 23).

- While only wall height of 18 feet is indicated in Table 5-5 for pile support, the General Plan shows wall heights of 12 and 16 feet to be pile supported.

Response: The structural engineers redesigned RW 492 and the wall height of 18 feet is now reduced to 16 feet; after this change, a spread footing foundation is feasible. Therefore, pile foundation for RW 492 in Table 5-5 will be deleted from the final report and spread footing recommendations for the 16-foot high wall has been included in Table 5-4 (see attached Page 20).

The wall heights of 12 and 16 feet are SW on RW supported on piles; the pile data table is presented in Table 5-7 (see attached Page 23).

- The reason for using driven piles at the end of wall 492. This portion of the wall is not too high for Type 1 footing to be used similar to the remainder of the wall.

Response: On the south end, the 18-foot high Type 1 Wall on pile foundation has been deleted after the structural engineers reduced the wall height to 16 feet. At 16 feet high, this wall can be supported on spread footing (see attached Table 5-4 on Page 20). On the north end, pile

foundation is used for SW on RW (not Type 1 Wall). The reason for using pile foundation is because spread footing is not feasible due to excessive settlement.

5.5.2 Pile Foundation

- Please explain the anticipated hard driving below elevation 175 at RW 462. Closest boring to the pile location is A-08-102 which is not deep enough and CPT-08-103 does not indicate such a condition. Borings A-08-105 & A-08-106 are too far for extrapolation.

Response: As we designed this wall, we delineated the stratigraphy using all the borings drilled for this wall, which are Borings A-08-101 through A-08-106 (including C-08-103 and C-08-104). A relatively stronger soil layer was observed below El. +175 feet in CPT-08-104 and A-08-105 and steel HP-piles were conservatively chosen to support this portion of the wall. The reviewer is correct that Boring A-08-102 and CPT C-08-103 are closest to the pile foundation. The interpreted SPT blowcount (from C-08-103) shows 40 to 50 blows per foot of sand to silty sand below El. +175 feet. We believe there is justification to include the precautionary note of hard driving in our report.

- The reason for using Type 1 wall at the beginning and piles at the end of wall 496 while the rest of the wall is built as MSE wall. Usually MSE wall is more economical than other type of wall.

Response: Per Jon Hamaguchi, Caltrans Division of Structures, MSE walls should not be used to support a bridge approach slab. Therefore, at Wall 496, a concrete wall is used adjacent to the approach slab.

5.6 Foundation Design For MSE Walls

- In Table 5-13 foot note, footing bottom should be changed to bottom of leveling pad.

Response: The footnote has been revised to "Overexcavation depth is measured from the bottom of leveling pad." (see attached Page 25).

- Leveling Pad: the leveling pad does not have any bearing capacity.

Response: The leveling pad is used to support the MSE wall panels. We provided the bearing capacity so that the structural designers can compare the bearing capacity of the soils to the bearing pressure exerted by the total weight of the MSE wall panels.

- Overexcavation depth for the Type 1 portions of the walls 476 and 496 should be added to Table 5-13.

Response: RW 476 consists of a combination of Type 1 wall and MSE wall. RW 496 consists of a combination of sound wall on retaining wall and sound wall on MSE wall. Table 5-13 provides recommendations for the MSE wall only. The Type 1 Wall portion of RW 476 has been listed in

Table 5-4 (see attached Page 20), and the SW on RW portion of RW 496 was listed in Table 5-6 (old Table 5-8) (see attached Page 22).

- The limits of overexcavation and backfill should extend to the entire base width tc prevent differential settlement and future roadway distress.

Response: The sentence has been revised as "The minimum horizontal limits of the overexcavation should begin 1 foot from the outside edge of the leveling pad and the inner edge of the MSE wall backfill, and extend downward at a 45-degree imaginary plane until the plane intersects the recommended excavation depths." (see attached Page 26)

- The limits of overexcavation and backfill should also be shown on the General Plans of both walls 476 and 496 in Section B-B. A table of overexcavation depth similar tc Section A-A should be added under Section B-B also.

Response: RBF will comply.

- The reason for using Type 1 wall at the beginning and end of wall 476 and beginning of wall 496. It might be prudent to use the same wall type (MSE) for aesthetics and possible differential settlements.

Response: According to the structural designers, at the beginning of Wall 476, there are two driving factors for the use of a Type 1 wall. First, it would not be possible to construct an MSE Wall at the beginning of the ramp and also keep one lane of traffic open. Second, the Type 1 wall can be constructed at a lower cost for shorter walls as compared to MSE wall.

Also per Jon Hamaguchi, Caltrans Division of Structures, MSE walls should not be used to support a bridge approach slab. Therefore, a concrete wall is used adjacent to the approach slab at the end of wall 476 and the beginning/end of wall 496.

Appendix A - Log of Test Borings (LOTB)

- Correction/multiplication factor for conversion of 2.4" sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.

- When ground water was not encountered or measured, a note to that effect should be placed under each boring (i.e. ground water was not encountered or not measured during field investigation).

- Pocket penetrometer (pp) values should be shown at the end of each cohesive soil layer description and consistency should be based on those values rather than blow counts.

- Apparent density of cohesion less soils should be based on corrected blow count for hammer efficiency: however, the actual blow counts (raw field blow counts) as currently shown on LOTB should not be changed.

- When soil group name is changed a solid separation line should be drawn through boring graphic column.

- The name and directions (in arrow) of nearest cities should be placed on plan view.

- Control line "B" line should be shown on plan view as equal to cent line Rte 57.

- Identify the vertical datum used to determine the benchmark elevations.

- Include a conversion factor on As Built LOTB for converting As Built elevations (i.e. NGVD29 datum) to current NAVD88 datum elevations.

- Bottom Title Block from left to right on LOTB and Soil Legend sheets (in Foundation Report) should comply with Section 5.2.3.2 of Caltrans Soil and Rock Logging Manual, June 2007.

- The LOTB and Soil Legend sheets of Wall Nos. 486, 512, 514, 522 & 576 in Structure Plans should have Title Blocks on the bottom of the sheet not on the left margin (Section 5.2.3.2 of Caltrans Soil and Rock Logging Manual, June 2007).

- The LOTB of all walls except walls 476 & 496 in Structure Plans should have separate Soil Legend sheets (similar to walls 476 & 496). The Soil Legend sheets of all walls should be at the end of each wall's LOTB sheets sequence.

- When there is an existing bridge or retaining/sound wall adjacent to or between a proposed retaining/sound wall, the As-Built LOTB of those structures in compliance with Section 5.2.4 of Caltrans Soil and Rock Manual should be part of LOTB sheets in Foundation Report and Structure Plans.

- Dual wall numbers should not be used on a same LOTB sheet, when borings are shared between two walls repeat those boring with separate wall number.

Response: The attached LOTB sheets incorporated the following revisions per Caltrans review:

- Conversion factor from 2.4" California Modified Ring sampler blowcount to 1.4" Standard Penetration Test sampler blowcount is added to the "Notes"
- "Groundwater Not Encountered During Drilling" is added under each boring.

- Pocket penetrometer test results are added and used for classifying cohesive soils.
- Apparent density was revised based on the blowcount and hammer efficiency.
- Separation lines are drawn where group symbols changes.
- Directions to the nearest cities are added.
- "B-Line" in parenthesis was added to the plan next to the existing SR-57 Centerline mark.
- We added Vertical Datum is NAVD 88.
- The following sentence has been added to Section 2.1 Field Investigation: "About 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV88)."
- An appropriate bottom title block was used in the attached LOTB sheets.
- RW Nos. 486, 512, 514, 522 and 576 are Caltrans Standard Type-1 on spread footings. Based on our past project experience, LOTB sheets for Caltrans Standard Type-1 walls on spread footings are drafted inside a "Roadway" border rather than the border specified in the Caltrans Soil and Rock Logging Manual.
- The LOTB legend sheets will be prepared for each wall in contract plans. We will put the Soil Legend sheets at the end of each wall LOTB sheets in the revised report.
- As-built LOTB sheets will be attached in the final report.
- The LOTB sheets were revised to avoid dual wall numbers on a same LOTB sheet.

Sincerely,
EARTH MECHANICS, INC.

Chien-Tai Yang, GE 2827
Project Engineer

Attachments

Attachment 1:
-Revised Report Pages 1 and 2 for **Table 1-1**
-Revised Report Pages 6 and 7 for **Table 2-1**
-Revised Report Page 8 for **OD – outside diameter**
-Revised Report Pages 14 thru 16 for **Table 4-1**
-Revised Report Page 20 for **RW 492 (H=16') in Table 5-4**
-Revised Report Page 23 for **Table 5-7**
-Revised Report Page 25 for **Table 5-11**
-Revised Report Page 26 for **Limit of Overexcavation**
-Revised Report **Figure 1-2**
-Revised LOTB Sheets

– deleted (see revised report)

Attachment 2:
-Caltrans Foundation Review Comment Sheets dated April 15, 2009

Attachment 1

Portions of Revised Reports Related to the Review Comments and Revised LOTB Sheets

deleted
(see revised report)

Attachment 2

Caltrans Foundation Review Comment Sheets dated April 15, 2009

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Branch Chief, Design A

Date: April 15, 2009
File: 12-ORA-57-PM 16.2/18.6
12-0F0311

Retaining Wall Nos. 486, 512 514, 522, 576, Sound Wall on Retaining Wall Nos. 462, 466, 474, 492, 526, 536, 538 and MSE Wall Nos. 476 & 496

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of the Foundation Report

On March 17, 2009, we received a Foundation Report and unchecked plans for the retaining walls, sound walls and MSE walls within SR-57 Northbound improvement. The project limits are between 0.2 miles south of Orangethorpe Ave. and 0.2 miles north of Yorba Linda Blvd. The following comments are based on the subject report dated March 3, 2009 and plans, prepared by Earth Mechanics, Inc. for RBF Consulting.

1.2 Project Description

- Figures 1-1 and 1-2 should be placed at the end of Section 1.0, so that the sequence of project description is not split.

- For combination walls, please specify each wall limits by stationing and also begin and end stationing of entire wall.

Wall Location Plan Figure 1-2

- The symbol for Wall 492 should be shown as sound/retaining wall. Also the symbol for Wall 496 is not included in the legend.

2.1 Field Investigation

- MSE portion of the Wall Nos. 476 and 496 should be given a different wall no. or designation to avoid confusion.

- In Table 2-1 and also Log of Test borings (LOTB), stationing and off set of all borings should be referenced to centerline Route 57 "B" line. The location of those borings that are based on other lines could be kept in parenthesis or as equivalent to centerline 57 stationing (in Table 2-1); however, boring locations on LOTB should only be referred to centerline Route 57 "B" line.

- Para. 2, 5th sentence: (2.4 inches ID) and (3.25 inches ID) should be changed to (2.4 inches OD) and (3.25 inches OD).

4.1 Soil Conditions

- It would be useful to add a column for expansion potential of different soils.

- Expansion potential and remedial solution at affected wall location whether supported by spread footing or pile should be discussed. Geotechnical Design Report stated that lean clays could be low to medium expansive and fat clays in several borings could be highly expansive.

5.4 Foundation Design For Type 1 Walls

- Last sentence of 1st para.: in Section 5.5 pile foundation is recommended for RW 492 with height of 16 feet (instead of 18 feet in Section 5.4). However, pile foundation is shown at wall heights of 12 and 16 feet in General Plan of RW 492. Retaining Wall Nos. 462 with height of 16 feet and 496 with height of 26 feet should be added.

5.4.1 Spread Footing

- Instead of specifying horizontal limits of overexcavation, the horizontal limits of structure backfill in compliance with Section 19-5.03 of Caltrans Standard Specifications should be specified. This statement also applies to spread footing in Section 5.5.1. However, if overexcavation statement is not changed, then the horizontal limits of structure backfill as mentioned above should be added.

5.4.2 Pile Foundation

- Based on AASHTO LRFD Bridge Design specifications (Section 10.7.3.9), group effects of driven piles in clay should be considered if center to center spacing is less than 6 pile diameters and less than 4 for CIDH piles in cohesionless soils (Section 10.8.3.6.3). This statement should also apply to Section 5.5.2 (1st para.).

- In Table 5-5 (also Table 5-9 and Pile Data Tables in structure Plans), letters should be used instead of numbers for footnote indicators of design tip elevations.

- A nominal driving resistant column should be added to the end of Tables 5-5 and 5-9 and Pile Data Tables in Structure Plans.

- While only wall height of 18 feet is indicated in Table 5-5 for pile support, the General Plan shows wall heights of 12 and 16 feet to be pile supported.

- The reason for using driven piles at the end of wall 492. This portion of the wall is not too high for Type 1 footing to be used similar to the remainder of the wall.

5.5.2 Pile Foundation

- Please explain the anticipated hard driving below elevation 175 at RW 462. Closest boring to the pile location is A-08-102 which is not deep enough and CPT-08-103 does not indicate such a condition. Borings A-08-105 & A-08-106 are too far for extrapolation.

- The reason for using Type 1 wall at the beginning and piles at the end of wall 496 while the rest of the wall is built as MSE wall. Usually MSE wall is more economical than other type of wall.

5.6 Foundation Design For MSE Walls

- In Table 5-13 foot note, footing bottom should be changed to bottom of leveling pad.

- Leveling Pad: the leveling pad does not have any bearing capacity.

- Overexcavation depth for the Type 1 portions of the walls 476 and 496 should be added to Table 5-13.

- The limits of overexcavation and backfill should extend to the entire base width to prevent differential settlement and future roadway distress.

- The limits of overexcavation and backfill should also be shown on the General Plans of both walls 476 and 496 in Section B-B. A table of overexcavation depth similar to Section A-A should be added under Section B-B also.

- The reason for using Type 1 wall at the beginning and end of wall 476 and beginning of wall 496. It might be prudent to use the same wall type (MSE) for aesthetics and possible differential settlements.

Appendix A - Log of Test Borings (LOTB)

- Correction/multiplication factor for conversion of 2.4" sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.

- When ground water was not encountered or measured, a note to that effect should be placed under each boring (i.e. ground water was not encountered or not measured during field investigation).

- Pocket penetrometer (pp) values should be shown at the end of each cohesive soil layer description and consistency should be based on those values rather than blow counts.

- Apparent density of cohesion less soils should be based on corrected blow count for hammer efficiency: however, the actual blow counts (raw field blow counts) as currently shown on LOTB should not be changed.

- When soil group name is changed a solid separation line should be drawn through boring graphic column.

- The name and directions (in arrow) of nearest cities should be placed on plan view.

- Control line "B" line should be shown on plan view as equal to cent line Rte 57.

- Identify the vertical datum used to determine the benchmark elevations.

- Include a conversion factor on As Built LOTB for converting As Built elevations (i.e. NGVD29 datum) to current NAVD88 datum elevations.

- Bottom Title Block from left to right on LOTB and Soil Legend sheets (in Foundation Report) should comply with Section 5.2.3.2 of Caltrans Soil and Rock Logging Manual, June 2007.

- The LOTB and Soil Legend sheets of Wall Nos. 486, 512, 514, 522 & 576 in Structure Plans should have Title Blocks on the bottom of the sheet not on the left margin (Section 5.2.3.2 of Caltrans Soil and Rock Logging Manual, June 2007).

- The LOTB of all walls except walls 476 & 496 in Structure Plans should have separate Soil Legend sheets (similar to walls 476 & 496). The Soil Legend sheets of all walls should be at the end of each wall's LOTB sheets sequence.

- When there is an existing bridge or retaining/sound wall adjacent to or between a proposed retaining/sound wall, the As-Built LOTB of those structures in compliance with Section 5.2.4 of Caltrans Soil and Rock Manual should be part of LOTB sheets in Foundation Report and Structure Plans.

- Dual wall numbers should not be used on a same LOTB sheet, when borings are shared between two walls repeat those boring with separate wall number.

Any questions regarding the above comments should be directed to Faramarz Gerami at (213) 620-2149 or Ted Liu at (213) 620-2136.

Report by:

FARAMARZ GERAMI, P.G., C.E.G.
Engineering Geologist
Office of Geotechnical Design - South 1
Branch C

Reviewed by:

Date: 4/15/09

CHI-TSENG TED LIU, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design - South 1
Branch C

c: OGDS1 - LA. File
OGDS1 - Sac. File
GS – Sac. File

FINAL FOUNDATION REPORT

Orangethorpe Avenue UC (WIDEN)
Bridge No. 55-0459
SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 16.4
EA 12-0F0311

EMI Project No. 08-115
Date: June 17, 2009

EARTH MECHANICS, INC.

Geotechnical and Earthquake Engineering

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

June 17, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Attention: Mr. Steve Huff, P.E.

Subject: **Final Foundation Report for Orangethorpe Avenue Undercrossing (WIDEN),**
Bridge No. 55-0459
SR-57 Northbound Improvement Project, Orange County, California
12-Ora-57, PM 16.4, EA 12-0F0311

Dear Mr. Huff:

Attached please find the final Foundation Report for the subject bridge widening project. This report contains the findings and conclusions of our field investigation and laboratory testing program. This report also contains our recommendations for the design and construction of the bridge foundation.

A draft version of this report dated February 4, 2009 was submitted to Caltrans for their review. Review comments and our responses are included in Appendix D. Our responses are all incorporated into this final report.

We appreciate the opportunity to provide geotechnical design services for this project. If you have any questions, please call us.

Sincerely,
EARTH MECHANICS, INC.

Lino Cheang, GE 2345
Project Manager

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

FINAL FOUNDATION REPORT

ORANGETHORPE AVENUE UNDERCROSSING (WIDEN)
BRIDGE NO. 55-459
SR-57 NORTHBOUND IMPROVEMENT PROJECT
ORANGE COUNTY, CALIFORNIA
12-Ora-57, PM 16.4
EA 12-0F0311

Prepared for:

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Prepared By:

Earth Mechanics, Inc.
17660 Newhope Street, Suite E
Fountain Valley, California 92708

EMI Project No. 08-115

June 17, 2009

TABLE OF CONTENTS

Section	Page
1.0 INTRODUCTION	**1**
1.1 Purpose and Scope of Study	1
1.2 Project Description	1
2.0 FIELD INVESTIGATION AND LABORATORY TESTING	**4**
2.1 Field Investigation	4
2.2 Laboratory Testing	5
3.0 GEOLOGY AND SEISMICITY	**6**
3.1 Topography and Drainage	6
3.2 Physiography	6
3.3 Geologic Structure	6
3.4 Geologic Hazards	8
3.5 Stratigraphy	8
3.6 Seismicity	10
4.0 SUBSURFACE CONDITIONS	**11**
4.1 Soil Conditions	11
4.2 Groundwater Conditions	11
5.0 CONCLUSIONS AND RECOMMENDATIONS	**12**
5.1 Seismic Design Criteria	12
5.2 Liquefaction	14
5.3 Soil Corrosivity	14
5.4 Pile Foundation Design	14
5.4.1 Foundation Type	14
5.4.2 Foundation Data Provided by Structural Designers	14
5.4.3 Axial Capacity	15
5.4.4 Lateral Resistance	16
5.5 Embankments and Settlement	17
5.6 Bridge Abutment Wall Design	18
6.0 CONSTRUCTION RECOMMENDATIONS	**19**
6.1 Earthwork	19
6.2 Pile Construction	19
6.3 Backdrain and Backfill Requirements For Abutment Walls	20
6.4 Review of Construction Plans	20
6.5 Geotechnical Observation and Testing	20
7.0 LIMITATIONS	**22**
8.0 REFERENCES	**23**

List of Tables Page

Table 2-1. Geotechnical Exploration Information 4
Table 4-1. Idealized Soil Profile and Strength Parameters 11
Table 5-1. Local Seismic Sources 12
Table 5-2. Soil Corrosion Test Results 14
Table 5-3. Foundation Design Data Sheet 15
Table 5-4. Foundation Design Loads 15
Table 5-5. Abutment Foundations Design Recommendations 15
Table 5-6. Bent Foundation Design Recommendations 16
Table 5-7. Pile Data Table 16
Table 5-8. Lateral Pile Solutions 17

List of Figures Page

Figure 1-1. Site Location Map 2
Figure 3-1. Regional Fault and Physiographic Map 7
Figure 3-2. Geological Map 9
Figure 5-1. Design ARS Curve 13
Figure 6-1. Low Expansion Material in Bridge Embankment 21

APPENDICES

Appendix A. Log of Test Borings Sheets and As-built Log of Test Borings Sheet
Appendix B. Laboratory Test Results
Appendix C. Design Calculations
Appendix D. Caltrans Review Comments and EMI Responses

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF STUDY

This Foundation Report presents the findings and conclusions of a geotechnical investigation conducted by Earth Mechanics, Inc. (EMI). It presents foundation design and construction recommendations for proposed widening of the Orangethorpe Avenue Undercrossing (UC) in Orange County, California. A site location map is presented in Figure 1-1.

This work was performed for the Orange County Transportation Authority (OCTA) and EMI is a subconsultant to RBF Consulting (RBF). The geotechnical services provided for this project included the following tasks:

- Collection and review of existing geotechnical information;
- Field exploration consisting of drilling and logging exploratory borings;
- Laboratory testing of selected bulk and relatively undisturbed soil samples;
- Engineering calculations (see Appendix C) and analysis to develop foundation design and construction recommendations; and
- Preparation of this report presenting our findings, conclusions, and recommendations.

1.2 PROJECT DESCRIPTION

The Department of Tansportation (Caltrans) – District 12, in cooperation with the Orange County Transportation Authority (OCTA), proposed to widen northbound State Route 57 (SR-57) by adding one northbound through lane. The project limits are between 0.2 mile south of Orangethorpe Avenue and 0.2 mile north of Yorba Linda Boulevard along northbound SR-57. Within the project limits, there are interchanges located at Orangethorpe Avenue, Chapman Avenue, Nutwood Avenue and Yorba Linda Boulevard. The entire project involves widening seven existing bridges and a tieback wall at Yorba Linda Boulevard:

- Orangethorpe Avenue Undercrossing (Bridge No. 55-0459)
- South Placentia Overhead (Bridge No. 55-0450)
- Crowther Avenue Undercrossing (Bridge No. 55-0457)
- Placentia Overhead (Bridge No. 55-0449)
- Placentia Avenue Undercrossing (Bridge No. 55-0460)
- Chapman Avenue Undercrossing (Bridge No. 55-0456)
- Nutwood Avenue Undercrossing (Bridge No. 55-04649)
- Tieback Wall at Yorba Linda Boulevard (Bridge No. 55-0468)

This report pertains to Orangethorpe Avenue UC only; separate foundation reports are prepared for each of the above seven remaining structures.

The Orangethorpe Avenue UC is located in the City of Placentia north of the SR-57/SR-91 interchange. SR-57 in the project area trends in a north-south direction and carries traffic from the "Orange Crush" (I-5/SR-22/SR-57 Interchange) in Orange County to Interstate 210 in Los Angeles County (See Figure 1-1).

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SITE LOCATION MAP

Figure 1-1

ORANGETHORPE AVENUE UC (WIDEN)

Project No. 08-115

Date: 01-30-09

The existing Orangethorpe Avenue UC is a two span structure that carries SR-57 northbound and southbound traffic over Orangethorpe Avenue. The structure was originally constructed in 1969. The structure has two spans with a total span length of 173'-10"+/-. The structure is a Cast-In-Place reinforced concrete box girder with a depth of 5'-3". Total width of the structure is 188'-0" maximum and varies and it consists of two box girders, one for the northbound and one for the southbound of SR-57. The two box girders are separated with 1-inch wide longitudinal expansion joint filler. The box girders are supported on diaphragm abutment walls connected directly to 16-inch diameter (45 ton) CIDH concrete piles.

This structure was widened in 2000, approximately 15'-3"+/- maximum and varies on the northbound side to provide an additional 12-foot lane on that direction. The widening is a continuous 2 span precast prestressed reinforced concrete girder bridge on a single column bent and open end reinforced concrete diaphragm abutments. All widening foundations are supported on (70 ton) 16-inch diameter CIDH concrete piles.

This project will widen Orangethorpe Avenue UC by approximately 13'-8 1/2" on the northbound side to provide an additional 12-foot lane on that direction.

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 FIELD INVESTIGATION

Copies of the As-Built Log-of-Test-Borings (LOTB) sheets are included in Appendix A; about 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV 88). According to these As-Built LOTB sheets, four penetration borings and one rotary-wash boring were performed in November 1965. One hollow stem auger boring (B-601) was performed in February 1993; soil boring (B-1) shown adjacent to B-601 was duplicated from the 1965 investigation. During the exploration in 1965, the rotary boring was the deepest boring and was advanced to about El. +161 feet. The boring drilled in 1993 was about 70 feet deep and was advanced to about El. +133 feet. Existing grade at the borehole location at the time of the investigation in 1965 and 1993 was approximately El. +204 feet. Groundwater was not encountered during drilling in November 1965 and February 1993 down to El. +161 feet and +133 feet, respectively.

To supplement the existing subsurface data, three soil borings were drilled (one at each abutment and the third near the center bent). These borings were drilled on August 27 and September 25, 2008. Boring information, including exploration number, stations, offsets, ground surface elevations, bottom of hole elevations and water level measurements are summarized in Table 2-1. Locations of the exploratory boring are shown on the LOTB sheets provided in Appendix A.

TABLE 2-1. GEOTECHNICAL EXPLORATION INFORMATION

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-001	SR-57 (B-Line)	471+05	97 RT	+225.4	+133.9	None Encountered During Drilling
A-08-002		472+27	115 RT	+206.1	+134.6	
A-08-003		473+35	90 RT	+227.8	+136.3	

Exploratory borings were drilled using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. Relatively undisturbed drive samples were obtained using a 3.25-inch outer diameter California split-spoon sampler lined with brass rings. Each of these brass rings is 1-inch long with a 2.5-inch outside diameter. The California Drive sampler was driven into the ground using successive blows of a 140-lb hammer falling a distance of 30 inches. The numbers of blow for the final 12 inches or shorter of driving are shown on the LOTB sheets.

The Standard Penetration Test (SPT) sampler (1.4-inch inside diameter) was also used to obtain soil samples. The sampler was driven into the ground using a 140-lb hammer free falling from a height of 30 inches. The numbers of blow to advance the sampler each 6 inches of penetration or less was recorded. The blow counts required to drive the sampler for the last 12 inches or less was recorded as the Standard Penetration Resistance (N-value) on the LOTB sheets.

Charts published by Winterkorn and Fang (1975) can be used to determine a reduction factor used to convert blowcounts recorded using the California Drive sampler into SPT blowcounts. Using those charts, we obtained a reduction factor of 0.5 and this one-half reduction factor was used for this project.

The sampling interval is usually 5 feet. Sampling was performed by alternating the California Drive sampler and SPT sampler.

2.2 LABORATORY TESTING

Soil samples considered representative of the subsurface conditions were tested to obtain or derive relevant physical and engineering soil properties. The following laboratory tests were conducted to supplement the observations recorded during the field investigation:

- In-situ Moisture Content and Unit Weight
- Percent Passing No. 200 Sieve
- Direct Shear
- Compaction and R-Value
- Minimum Resistivity, pH, Sulfate Content and Chloride Content

The laboratory tests were conducted in general accordance with California Test Methods or American Society for Testing and Materials (ASTM) Standards. Laboratory test results are included in Appendix B.

3.0 GEOLOGY AND SEISMICITY

3.1 TOPOGRAPHY AND DRAINAGE

The project corridor is in the eastern part of the Los Angeles Basin along the southern margin of the Coyote Hills and the Puente Hills (Figure 3-1). Just north of the project corridor, the Puente Hills rise to an elevation of about 1,400 feet. The southwestern edge of the Puente Hills is paralleled by a series of low-elevation plains and hills; the Santa Fe Plain and the Coyote Hills are to the west of the project corridor, and the Richfield and Kraemer Hills are to the east. The elevations of these hills range from about 500 feet just west of the project to about 300 feet in the east. The ground upon which the project is located slopes gently to the south. Elevations along the project corridor range from about 280 feet in the north to about 200 feet on the south.

The project corridor traverses the ancient flood plains and alluvial fans of Fullerton Creek and the Santa Ana River. The major drainage in the area is the Santa Ana River which flows westerly south of the site. Fullerton Creek, a tributary to the Santa Ana River, drains southwesterly from the Puente Hills just west of the project corridor.

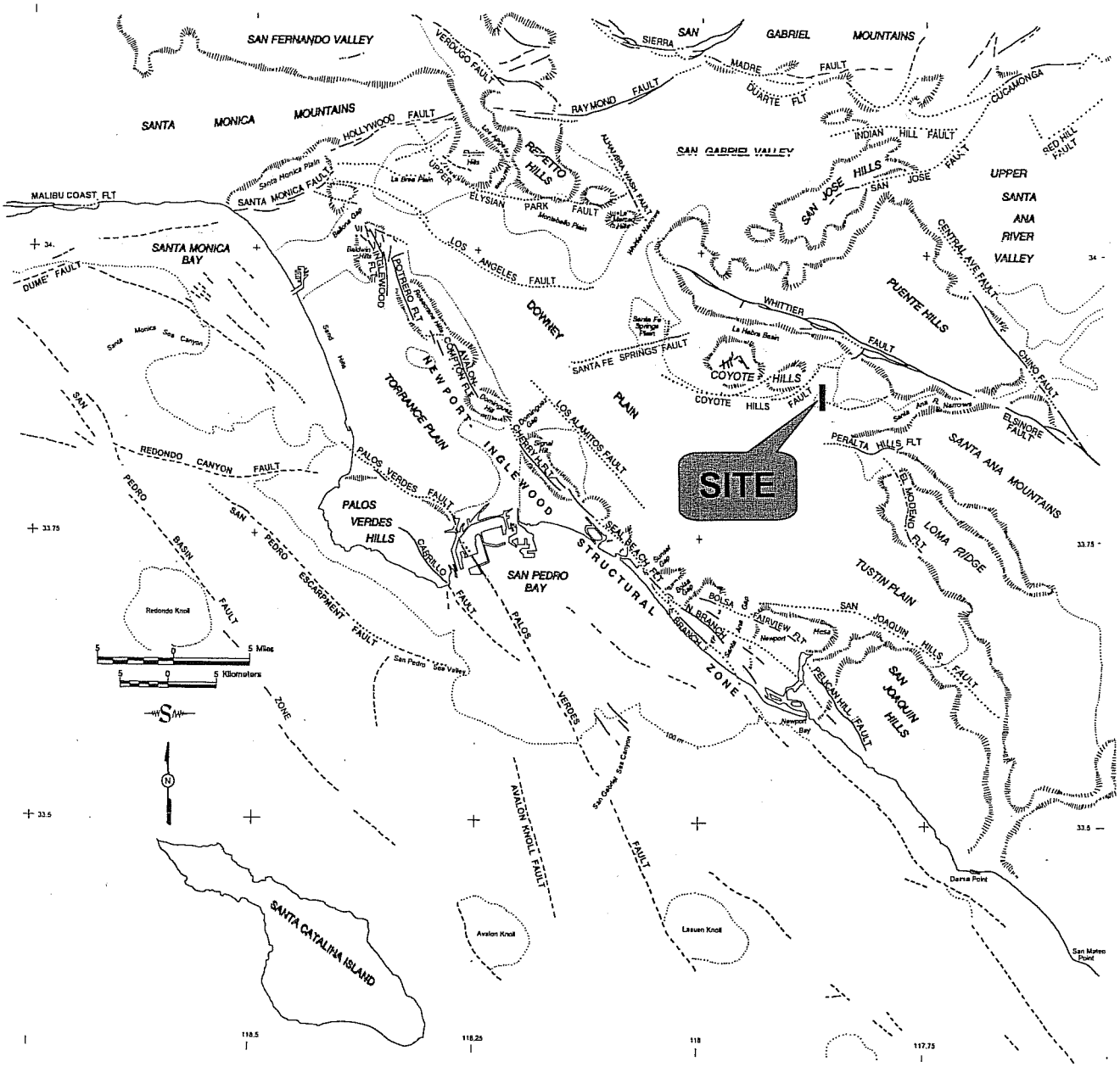
3.2 PHYSIOGRAPHY

The site area is at the eastern edge of the Los Angeles physiographic basin, a large, relatively flat, low-lying, coastal plain surrounded by mountains on the north, east, and southeast (Figure 3-1). The floor of the Los Angeles Basin is relatively flat but slopes gradually southwesterly from an elevated marginal apron to sea level along the coastline. The western margin of the Los Angeles Basin is bordered by the sea and the Palos Verdes Hills. The eastern margin is bordered by the Puente Hills and Santa Ana Mountains. The Coyote Hills, Santa Fe Springs Plain, Richfield Hills, and Kramer Hills are low elevation uplifts along the southern margin of the Puente Hills.

3.3 GEOLOGIC STRUCTURE

The geologic structure at the site is quite simple and is characterized by flat-lying Quaternary sediments overlying gently folded Tertiary sedimentary rocks. These strata rise gently to the Coyote Hills, Richfield Hills, and Kraemer Hills where they are arched upward to form anticlinal folds. The site is on the south limb of these anticlines with the early Pleistocene and Tertiary age strata dipping gently to the south and overlain by younger flat-lying Quaternary sediments.

The nearest active or potentially active surface faults are the Peralta Hills and Whittier faults (Figure 3-1). The low-elevation plains and hills along the eastern margin of the Los Angeles Basin are underlain by a series of east-west trending, en echelon, faults and folds in the subsurface; the major faults within this trend are, from north to south, the Los Angeles (Las Cienegas), Santa Fe Springs, and Coyote Hills faults (Figure 3-1). This group of faults is known as the Puente Hills fault system. Other poorly known segments of this thrust fault system underlie the Richfield and Kramer hills. All of these faults are blind thrust or reverse faults that approach within about a mile or so of the ground surface. They are identified on seismic reflection geophysical data only and are below the depths of oil wells.



ORANGETHORPE AVENUE UC (WIDEN)

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REGIONAL FAULT AND PHYSIOGRAPHIC MAP

Figure 3-1

Project No. 08-115 | Date: 12-11-08

The Peralta Hills fault may be related to the Puente Hills fault system. The Peralta Hills fault is exposed along the south flank of the Peralta Hills where it displaces Tertiary-age rocks upward and over younger Quaternary alluvium. The fault extends westerly below the Santa Ana River channel where it creates barriers to ground-water flow (Figure 3-2). The barriers extend about to the SR 57 freeway just north of the Lincoln Avenue (Morton and Miller, 1981). The location of the Peralta Hills fault is well up on the flank of the hills rather than at the base of the hills indicating that it is not the only fault responsible for uplift and folding of the Peralta Hills. There must be a deeper unknown blind thrust fault below the Peralta Hills thrust fault but this feature has never been directly identified.

The Whittier fault is a major strike slip fault that extends northwesterly along the southwest flank of the Puente Hills northeast of the site (Figure 3-1). The Whittier fault is associated with the Chino fault and the Elsinore fault and together these faults form a major fault system that extends from the Los Angeles Basin into northern Mexico.

The El Modeno fault is a north-south trending feature within Loma Ridge, one of the foothills of the Santa Ana Mountains, southeast of the site. The feature is poorly known but is known to displace Holocene soil in Loma Ridge. Although the fault is grouped with the Peralta Hills fault on the Caltrans seismic hazard map (Mualchin 1996), it appears to be a discrete normal or strike-slip fault unrelated to the thrust faults of the Peralta Hills. Although the fault must be considered active because it displaces Holocene soil, the feature has a very long (thousands of years) recurrence interval.

3.4 GEOLOGIC HAZARDS

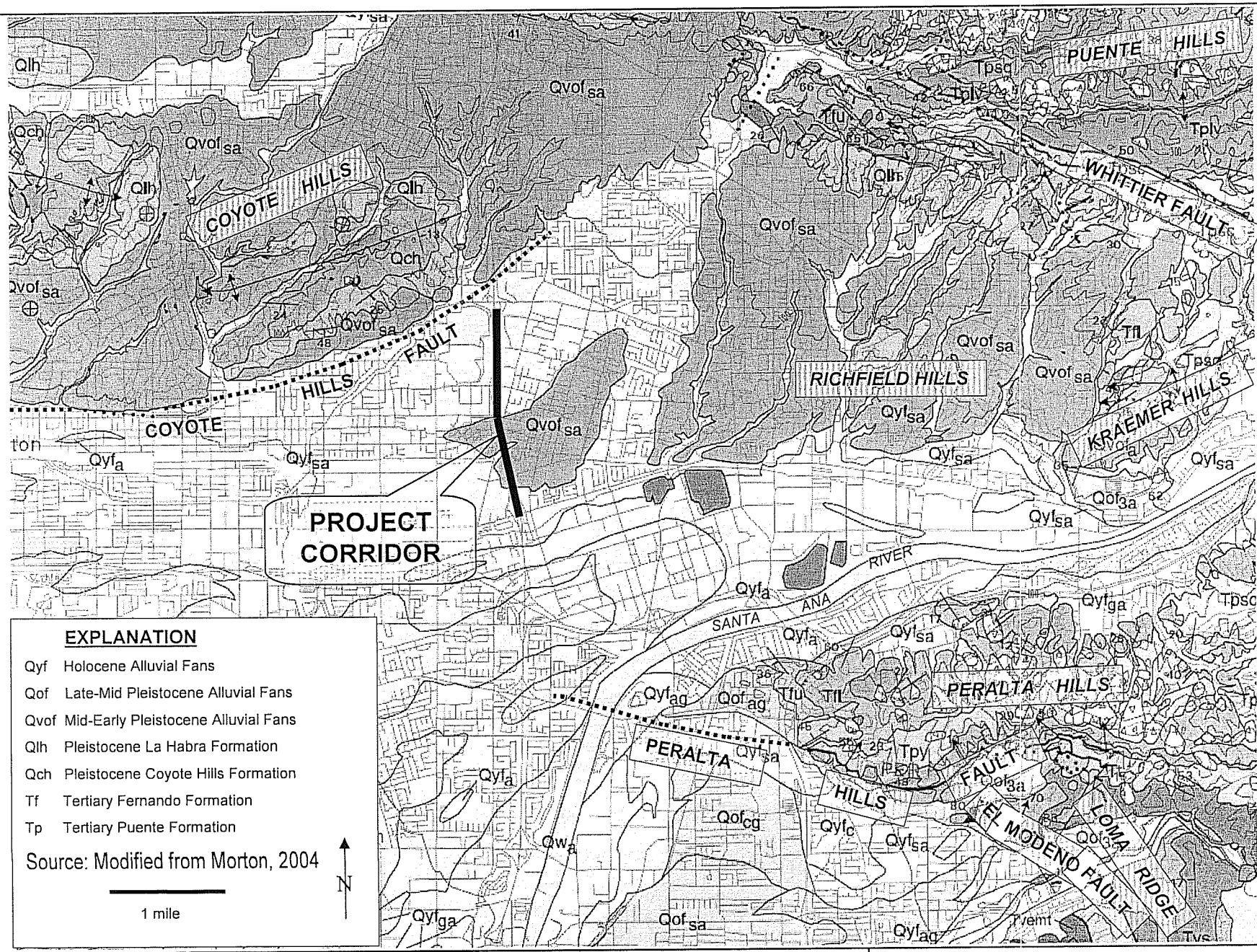
There are no steep slopes within the corridor so landsliding is not likely. There are no active faults so surface fault rupture is not likely. There are no known volcanos in the site region. The site is far from the sea on elevated land so Tsunamis are not a hazard.

The site is not identified on the State seismic hazard maps of the Anaheim and Newport Beach quadrangle as being susceptible to liquefaction (California Geological Survey/Division of Mines and Geology, 1997). This is due primarily to the depth of historically highest ground water being greater than 50 feet.

3.5 STRATIGRAPHY

Regional studies (e.g. Morton, 2004; Morton and Miller, 1981; Durham and Yerkes, 1964; California Department of Water Resources, 1961) indicate that the site area is underlain by Quaternary sediments overlying older Quaternary and Tertiary sediments and sedimentary rocks.

The surficial deposits are primarily Holocene and Pleistocene alluvial fan deposits (Figure 3-2). Older formations exposed in the hills and underlying the corridor are, in descending order, the Pleistocene-age La Habra and Coyote Hills, the Pliocene Fernando, and Pliocene-Miocene-age Puente formations. Along the corridor, the La Habra Formation is at an elevation of about sea level and therefore these older units are well below the level of interest for this project.



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

ORANGETHORPE AVENUE UC (WIDEN)

Project No. 08-115 | Date: 12-11-08

GEOLOGICAL MAP

Figure 3-2

3.6 SEISMICITY

The largest historical earthquake within the Los Angeles Basin was the 1933 Long Beach earthquake of M_W=6.4 (M_L = 6.3) which is generally believed to have been associated with the Newport-Inglewood Structural Zone. The association of the 1933 event with the NISZ was based on abundant ground failures along the NISZ trend, but no unequivocal surface rupture was identified. Hauksson and Gross (1991) reevaluated the seismicity data and relocated the 1933 earthquake hypocenter to a depth of about 6 miles below the Huntington Beach-Newport Beach city boundary.

Other damaging earthquakes in the Los Angeles region include the 1971 San Fernando, the 1987 Whittier, and the 1994 Northridge events. The 1971 San Fernando (M_L= 6.4, M_W=6.7) earthquake occurred along the northern margin of the San Fernando Valley and produced a surface rupture which coincided partly with a zone of mapped surface faults along the mountain-valley margin. The more-recent 1987 Whittier earthquake (M_L=5.9, M_W=5.9) and the 1994 Northridge (M_L=6.4, M_W = 6.7) earthquake were not associated with surface faulting. Such events indicate that seismic hazards analysis must consider subsurface faulting as well as surface faulting. The Whittier event occurred at a depth of about 10 miles on a northerly dipping thrust fault dipping from the Coyote Hills area, under the Repetto and Puente Hills, to below the San Gabriel Valley. The Northridge event occurred at a depth of about 12 miles on a south-dipping reverse fault below the San Fernando Valley.

Another significant earthquake in the region was the 1812 earthquake which caused damage at the San Juan Capistrano Mission. The location and magnitude of the 1812 earthquake are unknown but geological studies (Jacoby et al., 1988; Fumal et al., 1993; Weldon et al., 2004) postulated that it did not occur in the Capistrano area, but rather was a large (M> 7.0) distant event on the San Andreas fault in the Wrightwood area of the San Gabriel Mountains.

A recent magnitude 5.4 (M_W) earthquake occurred on 29 July 2008 below the Puente Hills northeast of the site at a depth of about 10 miles. This event was a reverse type fault with a left- lateral component of slip. The causative fault is unknown. The epicenter is between the Whittier and Chino faults. The orientation of the preferred focal plane of the focal mechanism solution is somewhat compatible with the Whittier fault. The Whittier fault may have a reverse component of slip but is believed to be primarily a right-lateral fault. Furthermore dip of the preferred focal plane and the distribution of aftershocks are not very compatible with the Whittier fault. The northerly dipping buried thrust faults under the Peralta Hills, Richfield Hills, or Kraemer Hills could have been source because the preferred focal plane dips northeasterly similar to the northerly dipping faults. However, the distribution of the aftershocks does not seem compatible with the orientations of these faults.

4.0 SUBSURFACE CONDITIONS

4.1 SOIL CONDITIONS

Based on the recent field exploration and the as-built LOTB sheets in Appendix A, the subsurface materials at the site consist primarily of coarse-grained soils composing of clayey sand, silty silt, sand with silt and sand; consistency of the soil generally increases with depth. The idealized soil profile and design strength parameters for foundation design are presented in Table 4-1.

TABLE 4-1. IDEALIZED SOIL PROFILE AND STRENGTH PARAMETERS

Approx. Elevation (ft)	Predominant Soil Type	Range of Measured and Converted SPT Blowcount; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion (psf)
+227.8 to +207	Clayey Sand (Fill)	(11) to 26 Average = 20	120	32	150
+207 to +195	Silty Sand and Sand	6 to 24 Average = 14	120	30	100
+195 to +173	Sand with Silt and Sand	27 to (47) Average = 34	123	36	50
+173 to +134	Sand with Silt and Sand	25 to 57 Average = 45	125	38	50

Notes:
(1) SPT = Standard Penetration Test.
(2) Values in ( ) are converted SPT blowcounts corrected for sampler size; correction factor from California sampler blowcounts to SPT blowcounts is 0.5.

The above soil strength parameters are primarily based on published correlations with SPT blowcounts (Lam and Martin, 1986). A comparison of the above soil strength parameters with direct shear test results included in Appendix B indicates they are slightly higher than the ultimate values but significantly lower that the peak values obtained from the laboratory test results. We believe the strength values obtained using the SPT correlation are more reliable and should be used for foundation design because the laboratory test results are affected by soil disturbance during sampling.

4.2 GROUNDWATER CONDITIONS

During the recent field investigation conducted on August 27 and September 25, 2008, groundwater was not encountered down to El. +134 feet which is more than 90 feet from the freeway surface. As shown on the as-built LOTB sheets in Appendix A, groundwater was not encountered during drilling in November 1965 and February 1993 down to El. +161 feet and +133 feet, respectively.

The relatively deep water depth is confirmed by the historical groundwater map published by the California Geological Survey (Seismic Hazard Zones Map - Anaheim and Newport Beach Quadrangle) (CGS, 1997). This map shows the depth to groundwater to be greater than 50 feet.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SEISMIC DESIGN CRITERIA

According to the 1996 Caltrans Seismic Hazard map, the most significant faults relative to the project area are listed in Table 5-1 along with their style of fault, maximum earthquake magnitude, distance to the bridge site and resulting peak bedrock acceleration (PBA).

TABLE 5-1. LOCAL SEISMIC SOURCES

Fault or Fault Zone	Style of Faulting	Maximum Credible Earthquake (MCE) Magnitude	Distance to Site[2] (miles)	Peak Bedrock Acceleration[3] (g)
El Modeno-Peralta Hills (EMP)	Reverse-Thrust[1]	6.50	0.6	0.8
Puente Hills Blind Thrust	Reverse-Thrust	7.25	4.6	0.6
Whittier-Elsinore (WEE)	Strike-Slip	7.50	5.2	0.5

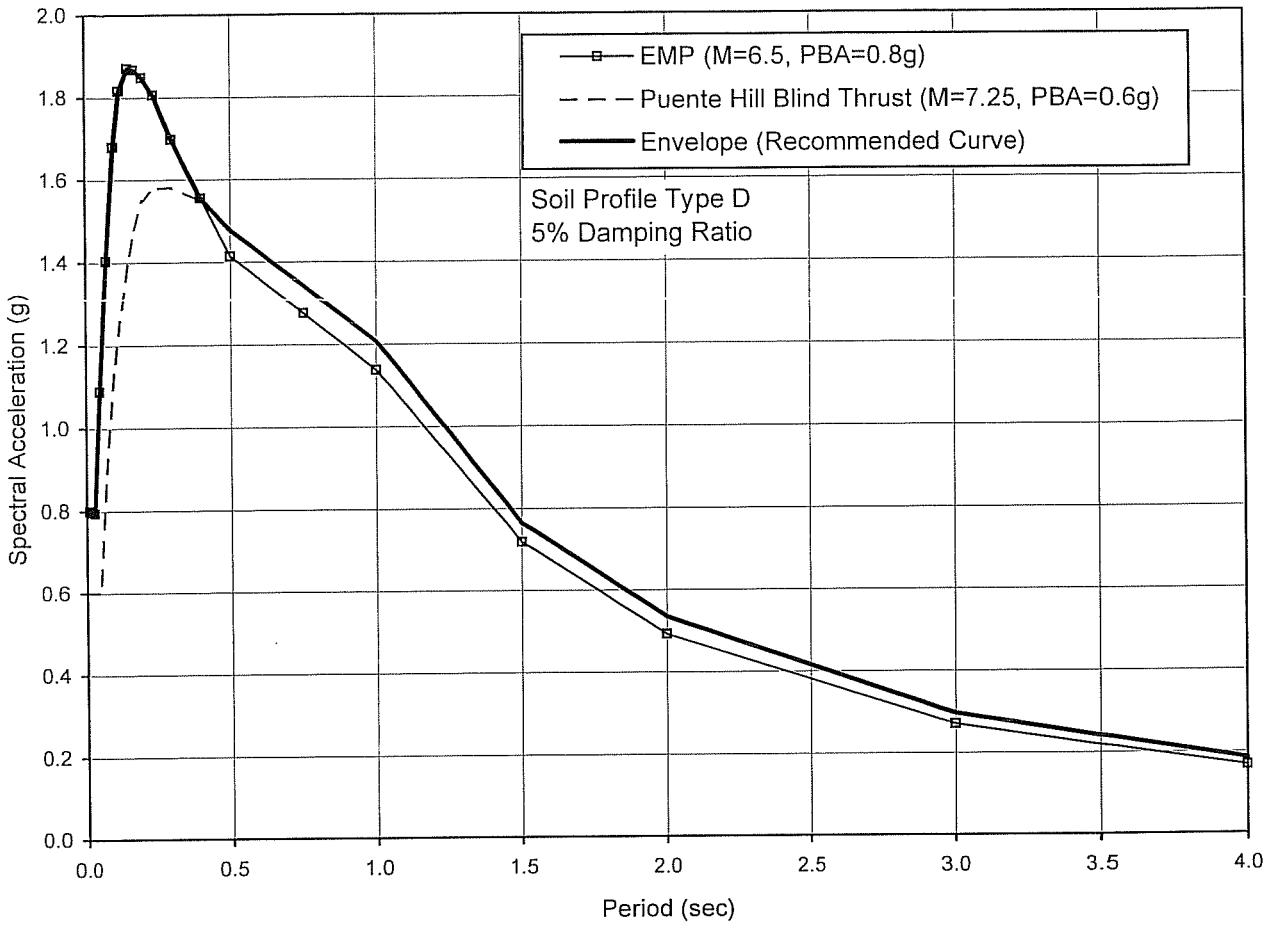
Notes:
(1) Caltrans designates the style of fault for EMP to be "unknown"; we assume a reverse-thrust fault (most conservative).
(2) For the EMP and WEE faults, the distances of each bridge site to these seismic sources were scaled from the 1996 Caltrans Seismic Hazard Map. Distances of each bridge site to the Puente Hills Blind Thrust were obtained from the seismic source model contained within the FRISKSP4.0 computer program (Blake, 2000 and 2004).
(3) The PBA is the larger of the two PBA's obtained from the attenuation relations of Sadigh (1997) and Mualchin (1996).

The ARS curves published in the Caltrans SDC (2006b) for Soil Profile Type "D" are applicable; this applies to Figures B.7 and B.8 for MCE Magnitudes (M) of 6.5±0.25 and 7.5±0.25, respectively. However, ARS curves for M of 6.5±0.25 with PBA's greater than 0.6g are not included in Figure B.7 of the Caltrans SDC (2006b). As a result, we generated an ARS curve for M=6.5±0.25 and a PBA of 0.8g by scaling the 0.6-g curve in Figure B.7 of the Caltrans SDC (2006b).

The design ARS curve envelopes the scaled ARS curve for M=6.5±0.25 and PBA=0.8g, and Figure B.8 for PBA=0.6g. According to Caltrans, this curve must also be modified to account for near-fault effects. For the near-fault effects, Caltrans Seismic Design Criteria (SDC, 2006b) Section 6.1.2.1 recommends the following modifications in the spectral accelerations:

- For periods less than 0.50 second, no change;
- For periods greater than 1.0 second, an increase of 20%;
- For periods between 0.50 and 1.0 second, a linear interpolation between the values at 0.50 and 1.0 second.

The resulting design ARS curve and the digitized coordinates are presented in Figure 5-1.



Spectral Coordinates of Recommended Curve

Period (sec)	Acc. (g)
0.010	0.800
0.020	0.797
0.030	0.795
0.050	1.089
0.075	1.403
0.100	1.680
0.120	1.817
0.150	1.871
0.170	1.867
0.200	1.848

Period (sec)	Acc. (g)
0.240	1.806
0.300	1.698
0.400	1.555
0.500	1.477
0.750	1.342
1.000	1.207
1.500	0.765
2.000	0.536
3.000	0.296
4.000	0.186

5.2 LIQUEFACTION

Based on the available boring information, the subject site has a low liquefaction potential due to absence of groundwater within the depths of interest.

5.3 SOIL CORROSIVITY

Two soil samples were tested for pH, minimum resistivity, soluble chloride content and soluble sulfate content. The test results are summarized in Table 5-2. Minimum resistivities are 1,100 and 2,000 ohm-cm and pH values are 8.4 and 8.6. The soluble sulfate contents are 300 and 450 parts per million (ppm), and the soluble chloride contents are 153 and 216 ppm.

TABLE 5-2. SOIL CORROSION TEST RESULTS

Boring	Station (Offset) / "Station Line"	Sample Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Soluble Sulfate Content (ppm)	Soluble Chloride Content (ppm)
A-08-01	471+05 (97 RT) / "B-Line"	10	SC	2000	8.6	450	153
A-08-03	473+35 (90 RT) / "B-Line"	10	CL	1100	8.4	300	216

Based on the Caltrans Corrosion Guidelines (2003), soils are considered corrosive if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm or greater. Based on the test results and the Caltrans criteria, the on-site soils are not considered to be corrosive to bare metals and concrete.

5.4 PILE FOUNDATION DESIGN

5.4.1 Foundation Type

The existing bridge is supported on 16-inch diameter Cast-In-Drilled-Hole (CIDH) piles. We recommend using the same pile type for the proposed widening except the diameter is 24 inches.

5.4.2 Foundation Data Provided by Structural Designers

Per Caltrans policy, the Load and Resistant Factor Design (LRFD) method is used for bent piles and the Working Stress Design (WSD) is used for abutment piles. The foundation design data sheet and factored foundation loads were provided by the structural designers following the latest Caltrans Memo To Designers (Caltrans, 2008), and are shown in Tables 5-3 and 5-4, respectively.

TABLE 5-3. FOUNDATION DESIGN DATA SHEET

Location	Design Method	Pile Type	Finished Grade El. (ft)	Pile Cut-off El. (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (inch)	Number of Piles per Support
					B	L		
Abutment 1	WSD	24" CIDH	218.55	209.55	8.5	17.5	1	4
Bent 2	LRFD		206.10	199.75	14	16		9
Abutment 3	WSD		221.13	211.58	8.5	17.5		4

TABLE 5-4. FOUNDATION DESIGN LOADS

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Perma-nent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abut 1	800	200	550	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bent 2	1130	N/A	820	1560	230	-	-	820	400	0	200
Abut 3	800	200	550	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5.4.3 Axial Capacity

The abutment and bent foundations design recommendations are presented in Tables 5-5 and 5-6, respectively. The Pile Data Table for the contract plans is presented in Table 5-7. The design pile tip elevation for the compression load case was based on skin friction only. The pile capacities are also based on soil resistance only and may be further limited by the pile-head connection details. Pile group efficiency factors were calculated using the guidelines published in AASHTO LRFD Bridge Design Specifications (2007).

TABLE 5-5. ABUTMENT FOUNDATIONS DESIGN RECOMMENDATIONS

Support	Pile Type	Cut-Off Elev. (feet)	LRFD Service-I Limit State Load (kips) per Support		LRFD Service-I Limit State Total Load (kips) per Pile (Compression)	Nominal Resistance (kips)	Design Tip Elev. (feet)[1]	Specified Tip Elev. (feet)[2]
			Total	Permanent				
Abut 1	24" CIDH	209.55	800	550	200	400	+168 (a) +172 (c) +180 (d)	+168
Abut 3	24" CIDH	211.58	800	550	200	400	+168 (a) +172 (c) +180 (d)	+168

Notes:
1. Design tip elevation is controlled by the following demands: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for lateral and settlement.

TABLE 5-6. BENT FOUNDATION DESIGN RECOMMENDATIONS

Support Location	Pile Type	Cut-off El. (ft)	Service-I Limit State Load (kips) Per Support	Total Permissible Support Settlement (inches)	Required Factored Nominal Resistance (kips)				Design Tip El. (ft)[1]	Specified Tip El. (ft)[2]
					Strength Limit		Extreme Event			
					Comp. ($\phi = 0.7$)	Tension ($\phi = 0.7$)	Comp. ($\phi = 1$)	Tension ($\phi = 1$)		
Bent 2	24" CIDH	199.75	1130	1	230	0	400	200	+168 (a-I) +160 (a-II) +171 (b-II) +168 (c) +170 (d)	+160

Notes:
1. Design tip elevation is controlled by the following demands: (a-I) Compression (Strength Limit), (a-II) Compression (Extreme Event), (b-II) Tension (Extreme Event), (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for tension, lateral and tolerable settlement.

TABLE 5-7. PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)	Specified Tip El. (ft)
		Compression	Tension		
Abutment 1	24" CIDH	400	0	+168 (a) +172 (c) +180 (d)	+168
Bent 2		400	200	+160 (a) +171 (b) +168 (c) +170 (d)	+160
Abutment 3		400	0	+168 (a) +172 (c) +180 (d)	+168

Notes:
1. Design tip elevations for Abutments are controlled by: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. Design tip elevations for Bent are controlled by: (a) Compression, (b) Tension, (c) Settlement, and (d) Lateral Load.

5.4.4 Lateral Resistance

Results of lateral pile analysis in terms of pile-head shear and lateral deflection for a free-head condition are presented in Table 5-8. The maximum bending moment and the location of maximum moment are also presented. The solutions presented in Table 5-8 are entirely based on soil resistance and linear pile properties. Therefore, these values may be limited by the flexural strength (plastic moment) of the piles and other connection details. Linear interpolation can be used for solutions between pile-head deflections of 0.25 and 5 inches.

TABLE 5-8. LATERAL PILE SOLUTIONS

Location	Lateral Displacement at Top of Pile (in)	Lateral Load at Top of Pile (kips)	Maximum Moment (kip-in)	Depth from Pile Head to Max. Moment (ft)
Abutments	¼	26	785	5
	½	43	1465	6
	1	63	2629	6
	3	107	6274	8
	5	135	9133	9
Bent	¼	25	925	6
	½	45	1809	6
	1	73	3388	6
	3	134	7943	7
	5	170	11368	8

New CIDH piles will be installed close to an existing 36-inch diameter gas pipeline at Bent 2 and these new piles could induce lateral loads on the gas pipeline. Bridge designers have been in discussions with Southern California Gas Co. (SCG) with regards to this existing high pressure gas transmission line. They have reached a consensus on how we will handle the construction of the bridge widening. Here is a summary of the key decisions that were made:

(1) The existing lines will not be encased.
(2) Portions of existing lines will be exposed by vacuum extraction prior to beginning work on the column foundations.
(3) The locations for the CIDH piles next to the gas lines will be vacuum extracted to a depth below the existing gas line prior to allowing a drill rig to complete the excavation.
(4) Any excavation work done within two feet of the existing gas lines will be done by vacuum extraction.
(5) SCG representatives will be invited to attend the pre-construction meeting. They will be given time to review the final plans prior to construction and will be notified about all scheduled work near their lines so they can be present and monitor the activities.
(6) The contractor will notify dig alert to have SCG mark the location of the lines prior to construction.

In addition according to the bridge designers, in order to protect the existing gas pipeline from any soil pressure due to any seismic movement of the new pilecap at Bent 2, an isolation material will be provided between the pilecap and the gas pipeline.

5.5 EMBANKMENTS AND SETTLEMENT

Settlement. About 23 feet of sliver fill will be placed to construct the approach embankments. Based on the onsite soil type, ground subsidence is estimated to be on the order of 2 inches. We recommend a settlement period of at least 5 calendar days for pile installation at the abutments only.

Slope Stability. Global stability analyses were conducted using the computer program SLIDE (RocScience, 2007) for both static and pseudostatic conditions for the bridge end slopes. Results of this analysis are presented in Appendix C.

The factor of safety for a deep-seated failure is greater than 1.5 under static condition for the 1V:1.5H end slope with a 2-foot soil surcharge to represent traffic loading. Slope stability analysis under pseudostatic condition was performed using a seismic coefficient equal to 0.2g (which is the smaller of either one-third the horizontal peak ground acceleration or 0.2g) in accordance with guidelines provided in Section 3.12 of the Caltrans Guidelines for Foundation Investigations and Reports (Caltrans, 2006a). Analysis indicates that the factor of safety is greater than 1.1 under pseudostatic condition. The 1V:1.5H end slope has proposed concrete slope paving, therefore surficial stability is not a design issue.

5.6 BRIDGE ABUTMENT WALL DESIGN

Abutment Earth Pressures. If abutment walls are free to move laterally at the top, a static active lateral earth pressure of 36 psf per foot of depth is recommended for a free draining, level and compacted backfill. If lateral movement at the top of abutment walls is restrained, the lateral earth pressure for a free draining, level and compacted backfill should follow Section 5.5.5.11 of the Caltrans BDS dated August 2004. For this condition, we recommend a coefficient of active lateral earth pressure of 0.3, a coefficient of at-rest lateral earth pressure of 0.47 and a soil unit weight of 120 lb/ft^3. If applicable, a uniform lateral pressure of at least 72 psf due to vehicle loads, equivalent to a vertical pressure produced by at least 2 feet of earth, should be added to the above lateral earth pressure.

Passive Resistance of Abutment Backfill. Under seismic loading, an ultimate passive earth pressure of 5 ksf may be used for the approach backfill and abutment walls with a height equal to or greater than 5.5 feet. For abutment walls with heights less than 5.5 feet, the passive pressure may be calculated proportionally (e.g., for a 4-foot high wall, the passive pressure is [4/5.5]x 5 ksf = 3.64 ksf. The horizontal movement at which the maximum passive pressure is expected to be fully mobilized can be determined following the procedure outlined in Section 7.8.1 of the Caltrans SDC (2006b).

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 EARTHWORK

Earthwork should be performed in accordance with Caltrans Standard Specifications, Section 19 (Caltrans, 2006c). Appropriate measures should be taken to prevent damage to adjacent structures and utilities. Any design and construction of temporary sloping, sheeting, or shoring should be made the contractor's responsibility. It should be noted that it is the responsibility of the contractor to oversee the safety of the workers in the field during construction. The contractor shall conform to all applicable occupational and health standards, rules, regulations, and orders established by the State of California. In addition, other State, County, or Municipal regulations may supersede the recommendations presented in this section. If a trench shoring design and safety plan is required, the geotechnical consultant should review the plan to confirm that recommendations presented in this report have been applied to the design.

During the recent field investigation conducted on August 27 and September 25, 2008, groundwater was not encountered down to about El. +134 feet which is more than 90 feet from the freeway surface. As shown on the as-built LOTB sheets in Appendix A, groundwater was not encountered during drilling in November 1965 and February 1993 down to El. +161 feet and +133 feet, respectively. Therefore, groundwater is not expected to be encountered during footing construction. However, groundwater level can fluctuate due to seasonal rainfall amount, local irrigation and groundwater recharge program and other man-made conditions. If groundwater is encountered, it should be controlled in accordance with Section 19-3.04 of the Caltrans Standard Specifications (2006c).

6.2 PILE CONSTRUCTION

For on-center pile spacings less than six times the pile diameter, no two adjacent piles can be constructed concurrently.

Loose soils should be cleaned from the bottom of the borings. Pile borings should be inspected and approved by the geotechnical engineer prior to the installation of reinforcement. Extreme care in drilling, placement of steel, and the pouring of concrete is essential to avoid excessive disturbance of pile boring walls. Concrete placement by pumping or tremie tube to the bottom of the pile borings is recommended. Specifications should require that sufficient space be provided in the pile reinforcing cage during fabrication to allow the insertion of a tremie tube for concrete placement. The pile reinforcing cage should be installed and the concrete pumped immediately after drilling is completed.

Sand was encountered in our soil borings and these materials are susceptible to caving. If caving occurs, a temporary casing may be required during construction. Casings should have an outer diameter equal to or exceeding the pile diameter. Temporary casing should be placed tight-in-hole. Vibratory or impact hammer with or without center-relief drilling can be used to install the temporary casing provided the existing structure is monitored for potential movement due to ground vibration; casing installation using this method should be suspended if excessive movement is detected. The temporary casing should be pulled as the concrete is being poured while always maintaining at least a 5-foot head of concrete inside the casing.

6.3 BACKDRAIN AND BACKFILL REQUIREMENTS FOR ABUTMENT WALLS

Per Caltrans requirements, expansive soils should not be placed as part of the embankment within the limits of a bridge abutment as shown in Figure 6-1. Materials placed behind abutment wall should be low-expansive soil with an Expansion Index (EI) less than 50 and Sand Equivalent (SE) of more than 20. The low-expansive material requirement should be supplemental to the abutment structure and pervious backfill requirement as described in Caltrans Standard Plans (2006d) and Caltrans Standard Specifications (2006c) under Sections 19-3.06 and 19-3.065, respectively.

Backfill should be compacted in accordance with Section 19-5 of the Caltrans Standard Specifications (2006c). Backfill should be placed in loose lifts not exceeding 8 inches in thickness, moisture-conditioned to near optimum moisture content, and compacted to at least 95 percent relative compaction. The relative compaction should be based on the maximum density determined by California Test 216. Jetting or flooding to compact backfill is not recommended. Heavy compaction equipment, such as vibratory rollers, dozers, or loaders, should not be used adjacent to the abutment walls in order to avoid damaging the walls due to large lateral earth pressures.

Backdrains should be installed behind abutment walls to relieve hydrostatic pressure. Backdrains should be constructed in accordance with Bridge Detail 3-1 on Sheet BO-3 per Caltrans Standard Plans (2006d) or the geocomposite drain alternative per Section 6 of the Caltrans Bridge Design Aids (1992).

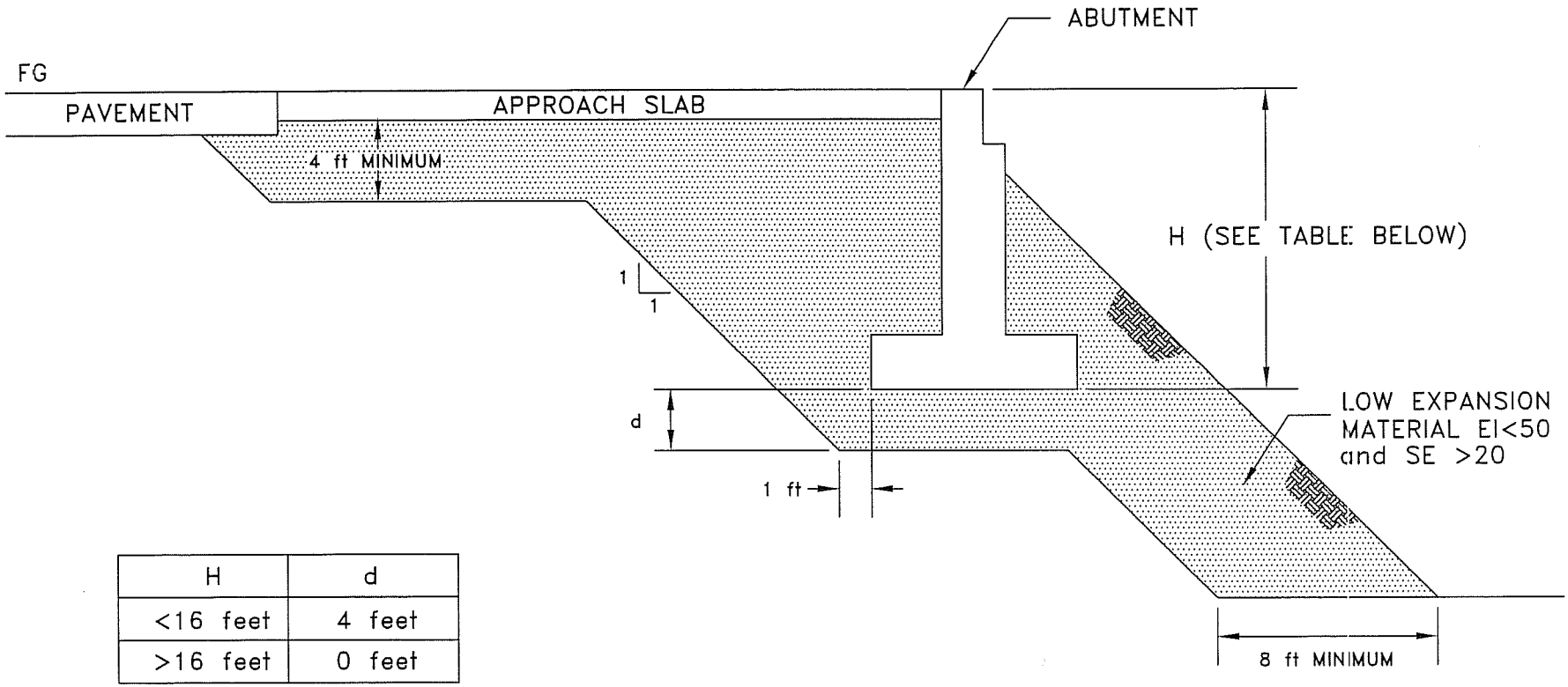
6.4 REVIEW OF CONSTRUCTION PLANS

Recommendations contained in this report are based on preliminary plans. The geotechnical consultant should review the final construction plans and specifications in order to confirm that the general intent of the recommendations contained in this report have been incorporated into the final construction documents. Recommendations contained in this report may require modification or additional recommendations may be necessary based on the final design.

6.5 GEOTECHNICAL OBSERVATION AND TESTING

It is recommended that inspections and testing be performed by the geotechnical consultant during the following stages of construction:

- Grading operations, including excavations and placement of compacted fill
- Shoring installation
- Footing excavations
- Pile installation
- Backdrain installation and backfilling of bridge abutment walls.
- Removal or installation of support of buried utilities or structures
- When any unusual subsurface conditions are encountered



H	d
<16 feet	4 feet
>16 feet	0 feet

EXPANSION INDEX TO BE DETERMINED BY ASTM D4829
SAND EQUIVALENT TO BE DETERMINED
BY CALIFORNIA TEST METHOD 217

NO SCALE

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

ORANGETHORPE AVENUE UC (WIDEN)

EMI Project No. 08-115 | Date: 12-12-2008

LOW EXPANSION MATERIAL
IN BRIDGE EMBANKMENT

FIGURE 6-1

7.0 LIMITATIONS

This report is intended for the use of RBF Consulting, Orange County Transportation Authority and Caltrans for the widening of Orangethorpe Avenue Undercrossing. This report is based on the project as described and the information obtained from the exploratory borings at the approximate locations indicated on the attached plans. The findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses. In addition, soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project site. However, subsurface conditions and characteristics of soils between exploratory borings can vary. The findings reflect an interpretation of the direct evidence obtained. The recommendations presented in this report are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained in this report are applicable to the specific design element(s) and location(s) which is (are) the subject of this report. They have no applicability to any other design elements or to any other locations and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

EMI has no responsibility for construction means, methods, techniques, sequences, or procedures; for safety precautions or programs in connection with the construction; for the acts or omissions of the CONTRACTOR or any other person performing any of the construction; or for the failure of any worker to carry out the construction in accordance with the Final Construction Drawings and Specifications.

Services performed by EMI have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

8.0 REFERENCES

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APPENDIX A

LOG OF TEST BORINGS SHEETS AND AS-BUILT LOG OF TEST BORINGS SHEETS

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Tina Cheang
REGISTERED ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

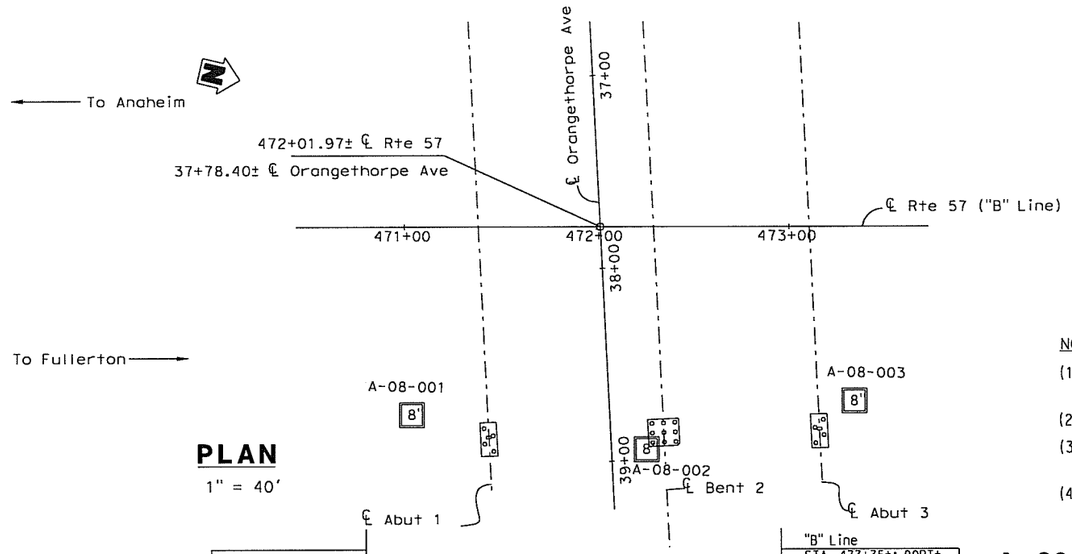
EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 40'

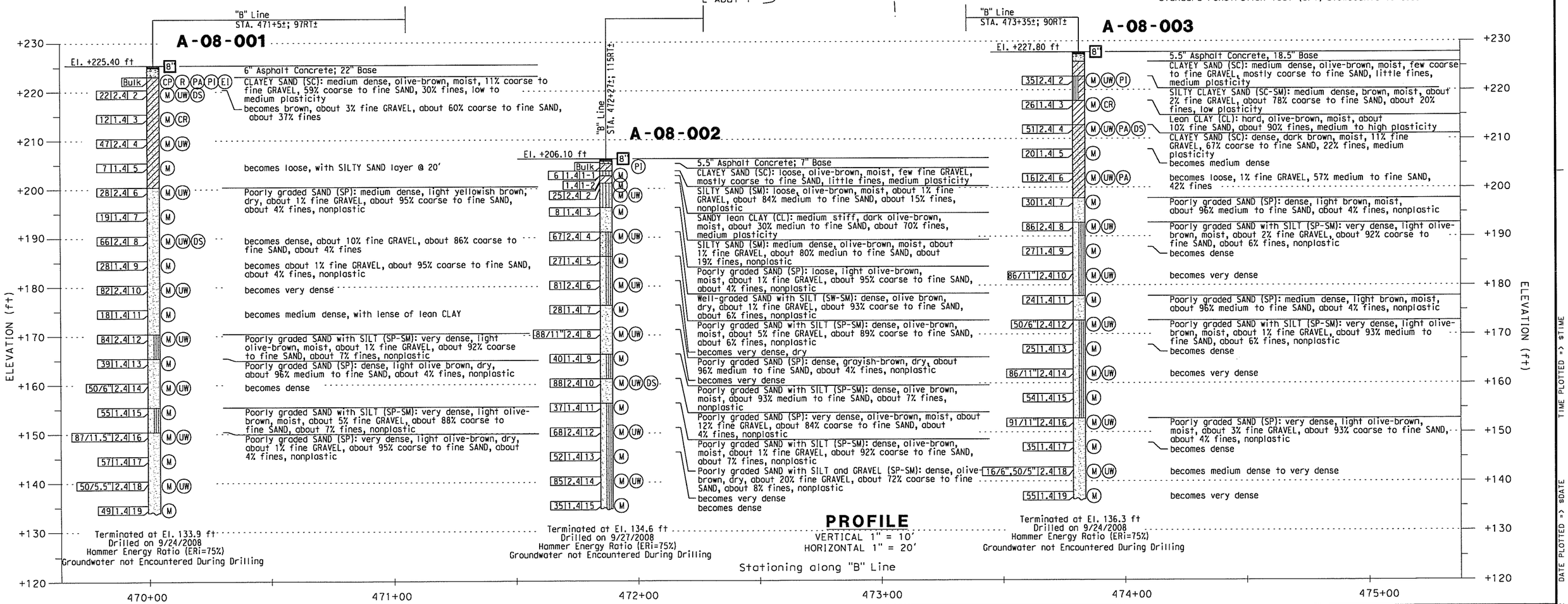
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

L. Cheang
PROJECT ENGINEER

BRIDGE NO. 55-0459
POST MILES 16.4

ORANGETHORPE AVENUE UC (WIDEN)
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY): 4/30/09

SHEET OF

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
USERNAME => $USER

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lim Cheang
REGISTERED ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

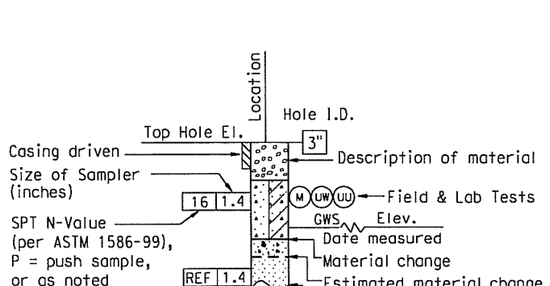
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

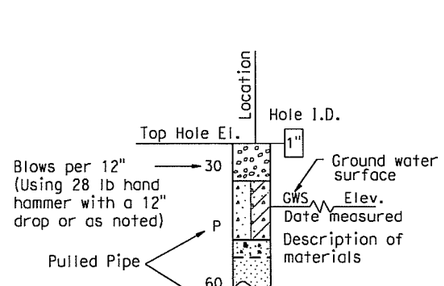
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

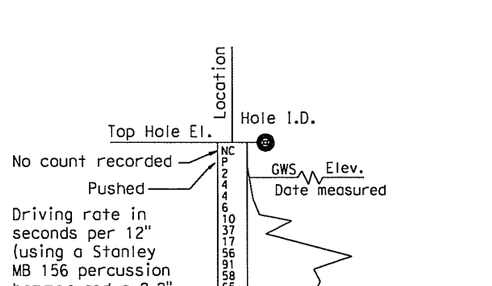
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



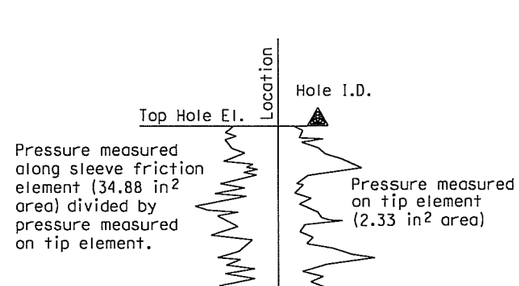
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0459	ORANGETHORPE AVENUE UC (WIDEN)
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.4	LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) | SHEET | OF

USERNAME -> $USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names	Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND		
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)		
GM	SILTY GRAVEL SILTY GRAVEL with SAND	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND		
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL		
SP	Poorly graded SAND Poorly graded SAND with GRAVEL	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL		
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL		
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
SM	SILTY SAND SILTY SAND with GRAVEL		
SC	CLAYEY SAND CLAYEY SAND with GRAVEL	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL		
PT	PEAT	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND
	COBBLES COBBLES and BOULDERS BOULDERS		

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lina Cheang
REGISTERED ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

L. Cheang
PROJECT ENGINEER

BRIDGE NO. 55-0459
POST MILES 16.4

ORANGETHORPE AVENUE UC (WIDEN)
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER
DATE PLOTTED => $DATE
TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57, 91	15.6/16.6, 5.0/6.7	726	852

REGISTERED PROFESSIONAL ENGINEER — LINO CHEANG No. C 41401 Exp. 09-30-99 CIVIL STATE OF CALIFORNIA

8-26-96
PLANS APPROVAL DATE

EARTH MECHANICS, INC.
Geotechnical & Earthquake Engineering
17660 NEWHOPE STREET, SUITE E ● FOUNTAIN VALLEY, CA. 92708
Phone (714) 751-3826

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DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

Lino Cheang
REGISTERED CIVIL ENGINEER — DATE

ORANGETHORPE AVENUE UC (WIDEN)

AS-BUILT LOG OF TEST BORINGS NO. 1

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 EA: 0F0311

BRIDGE No. 55-0459

Sheet ___ of ___

REGISTERED PROFESSIONAL ENGINEER — LINO C. CHEANG — NO. GE 2345 — EXP. 9/30/99 — GEOTECHNICAL — STATE OF CALIFORNIA

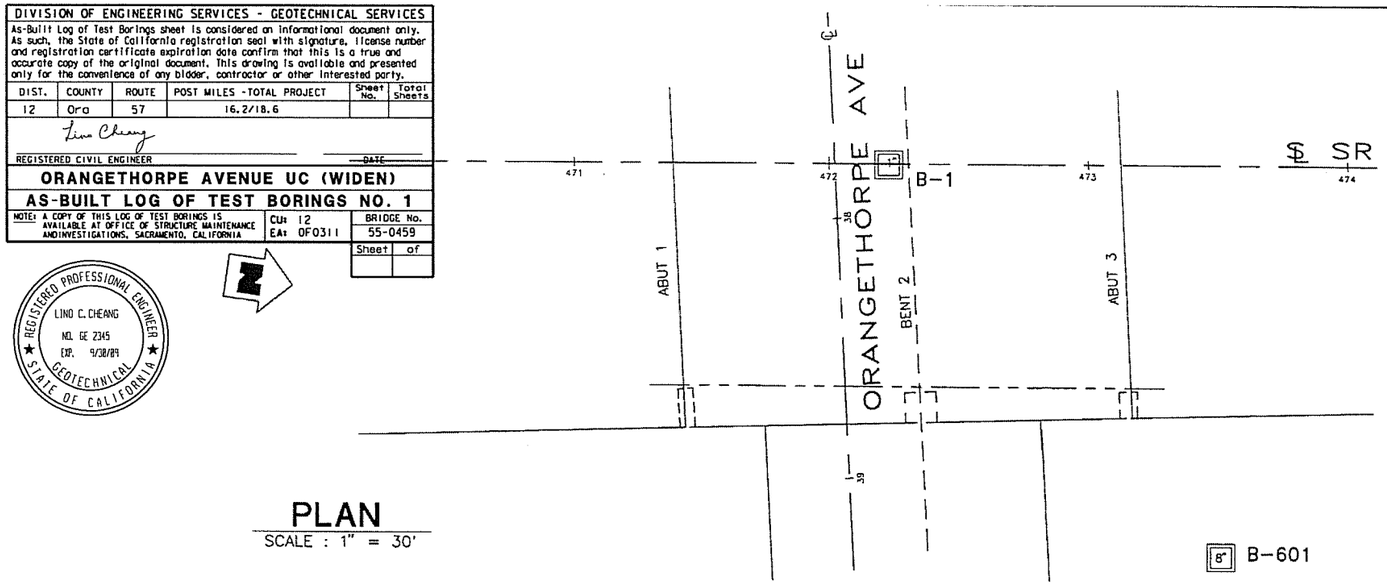
NO AS-BUILT CHANGES

AS BUILT
CORRECTIONS BY AM ALAHMAD
CONTRACT NO. 12-012544
DATE 04-25-00

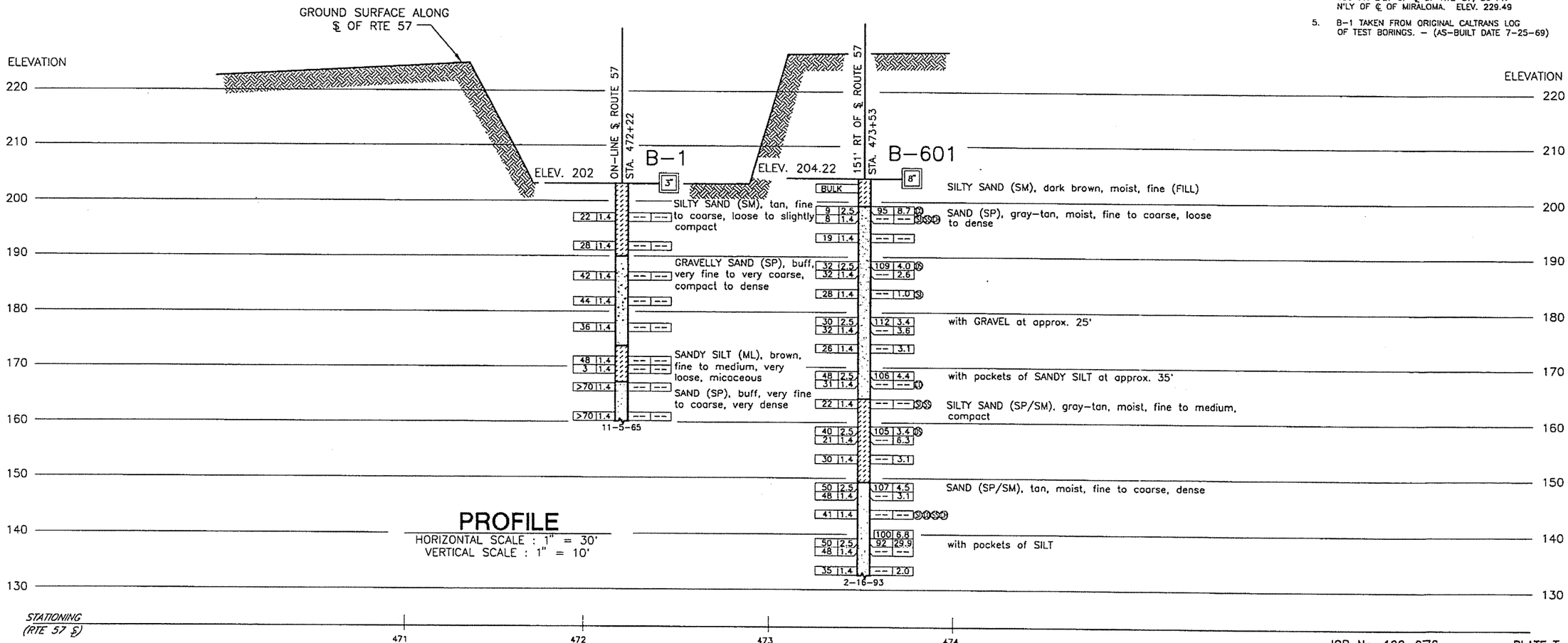
NOTES:

1. NO GROUNDWATER ENCOUNTERED.
2. ELEVATIONS BASED ON SURVEY BY COAST SURVEYING, INC.
3. BORING B-601 LOGGED BY ENRIQUE RIUTORT, STAFF ENGINEER.
4. BENCHMARK – 57/91-B-88(PM 15.9) –3.5 IN. DIA. CADT STA. MARK DISK SET IN EPOXY ON TOP OF PCC SIDEWALK ON THE NE'LY CORNER OF THE MIRALOMA AVE. BRIDGE OVER RTE-57 FWY, ABOUT 150 FT. E'LY OF ℄ OF RTE-57, 36 FT. N'LY OF ℄ OF MIRALOMA. ELEV. 229.49
5. B-1 TAKEN FROM ORIGINAL CALTRANS LOG OF TEST BORINGS. – (AS-BUILT DATE 7-25-69)

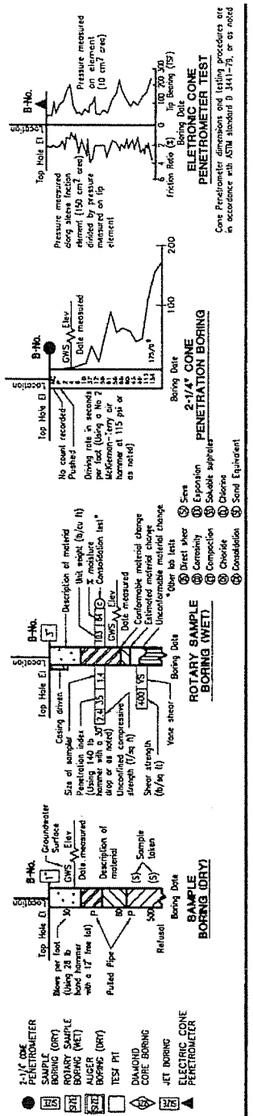
PLAN
SCALE : 1" = 30'



PROFILE
HORIZONTAL SCALE : 1" = 30'
VERTICAL SCALE : 1" = 10'



LEGEND OF BORING OPERATIONS



LEGEND OF EARTH MATERIALS

GRAVEL · SAND · SILT · CLAY · SANDY CLAY or CLAYEY SAND · SANDY SILT or SILTY SAND · SILTY CLAY · CLAYEY SILT · PEAT and/or ORGANIC MATTER · FILL MATERIAL · IGNEOUS ROCK · SEDIMENTARY ROCK · METAMORPHIC ROCK

CONSISTENCY CLASSIFICATION FOR SOILS
According to the Standard Penetration Test

Penetration Index (blows/ft)	Granular	Cohesive
0-4	Very loose	Very soft
5-9	Loose	Soft
10-19	Slightly compact	Stiff
20-34	Compact	Very stiff
35-69	Dense	Hard
>70	Very dense	Very hard

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BE NGUYEN — DESIGN OVERSIGHT — SIGN OFF DATE 3-13-96

DRAWN BY: JOE MAGLIATO
CHECK BY: E.A. RIUTORT

E.A. RIUTORT — FIELD INVESTIGATOR — DATE 2-16-93

M&T AGRA — Geotechnical and Environmental Services

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

Y. NIEN WANG — PROJECT ENGINEER

CU 12209

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

DISREGARD PRINTS BEARING EARLIER PREVIOUS DATES

REVISION DATES (PRELIMINARY STAGE ONLY) — SHEET OF

BRIDGE NO. 55-0459
POST MILE 16.4

JOB No. 192-076

PLATE I

ORANGETHORPE AVE UC (WIDEN)
LOG OF TEST BORINGS

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

8-26-96
TO ACCOMPANY PLANS DATED

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57, 91	15.6/16.6, 5.0/6.7	727	852

DIST	COUNTY	ROUTE	SECTION	SHEET	TOTAL SHEETS
07	Ora.	57	16.2/18.6	247	247

October 17, 1996

BENCH MARK
BM "YZR-EE" Elev 203.41
Set P/S in S. curb Orangethorpe Ave. 134' E. of ℄ Orange Fwy. 100' W of ℄ Nebraska Ave.

B-1 N 620,443.821 E 504,258.755

℄ CONST. RTE 57

℄ SURVEY ℄ STA. LINE ORANGETHORPE AVE.

PLAN
Scale: 1" = 20'

NO AS-BUILT CHANGES

AS BUILT
CORRECTIONS BY AM ALAHMAD
CONTRACT NO. 12-0125 U4
DATE 04-25-00

AS-BUILT PLANS
Contract No. 07-032114
Date Completed
Document No. 700005?

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

Lino Cheang
REGISTERED CIVIL ENGINEER — DATE

ORANGETHORPE AVENUE UC (WIDEN)

AS-BUILT LOG OF TEST BORINGS NO. 2

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 EA: 0F0311

BRIDGE No. 55-0459

Sheet ____ of ____

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

LEGEND OF BORING OPERATIONS

Penetrometer; 2½" Core Penetrometer; Sampler Boring (SPT); Rotary Boring (RCT); Auger Boring (DH); Jet Boring; Core Boring; Test Pit

LEGEND OF EARTH MATERIALS

Gravel; Sand; Silt; Clay; Sandy Clay or Clayey Sand; Silty Clay or Clayey Silt; Sandy Silt or Silty Sand; Organic Material; Fill Material; Igneous Rock; Sedimentary Rock; Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

PROFILE
Scale: Vert. 1" = 10'
Horiz. 1" = 20'

approx. existing ground line along ℄ CONST. RTE 57

B-2 — 11+14 Sta. 471+80 ℄ CONST. RTE 57 — 80.3' Lt. — 20.4' Rt. — 11-8-65
B-3 — 11+14 Sta. 471+80 ℄ CONST. RTE 57 — On line — 11-8-65
B-1 — On line Sta. 472+22 ℄ CONST. RTE 57 — 60.2' Lt. — 11-8-65
B-4 — 68.1' Rt. Sta. 472+71 ℄ CONST. RTE 57 — 20.3' Rt. — 11-8-65
B-5 — 105.1' Rt. Sta. 472+71 ℄ CONST. RTE 57 — 20.3' Rt. — 11-8-65

Loose to slightly compact, fine silty, fine to coarse sand.
Compact to dense, buff, gravelly, very fine to very coarse sand.
Very loose, brown, micaceous, sandy silt
Very dense, buff very fine to coarse sand.

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE 11-65

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
10 10

ORANGETHORPE AVENUE OVERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-459 | FILE | DRAWING 55459-10

BE NGUYEN
DESIGN OVERSIGHT
3-13-96
SIGNOFF DATE

NOTE:
ADDITIONAL AS-BUILT FOUNDATION DATA MAY BE AVAILABLE AT THE OFFICE OF TRANSPORTATION MATERIALS AND RESEARCH 5900 FOLSOM BOULEVARD, SACRAMENTO, CALIFORNIA 95819

	BY		CHECKED
DESIGN	J. Hueser		D. Kuang
DETAILS	T. Elofson		D. Novak
QUANTITIES	J. Hueser		L. Woo

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Y. Nien Wang
PROJECT ENGINEER

CU 12209
EA 0125U1

BRIDGE No.	ORANGETHORPE AVE UC (WIDEN)
55-0459	AS-BUILT LOG OF TEST BORINGS
POST MILE 16.4	

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 5/9/94

SHEET 15 OF 15

USER: fthompson Date/Time: 05/17/96 08:30:00 File: C:\projects\55459\10.dgn Generated by MicroStation 5.0

APPENDIX B

LABORATORY TEST RESULTS

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-001	BULK	2.5 - 4	SC							26/15/11				
A-08-001	D-2	5	SC	13.6	133.7						2000	8.6	450	153
A-08-001	S-3	10	SC	8.7										
A-08-001	D-4	15	SC	12.9	138.1									
A-08-001	S-5	20	SM/SC	13.9										
A-08-001	D-6	25	SP	2.7	106.8									
A-08-001	S-7	30	SP	3.4										
A-08-001	D-8	35	SP	3.0	123.8									
A-08-001	S-9	40	SP	2.7										
A-08-001	D-10	45	SP	3.6	115.2									
A-08-001	S-11	50	SP	6.3										
A-08-001	D-12	55	SP-SM	5.1	125.4									
A-08-001	S-13	60	SP	5.5										
A-08-001	D-14	65	SP	3.6	108.7									
A-08-001	S-15	70	SP-SM	3.6										
A-08-001	D-16	75	SP	2.9	112.9									
A-08-001	S-17	80	SP	3.2										
A-08-001	D-18	85	SP	3.8	107.1									
A-08-001	S-19	90	SP	2.9										
A-08-002	BULK	1.0 - 5	SC							31/18/13				
A-08-002	S-1-1	2.5	SM	8.6										
A-08-002	S-1-2	3.5	CL	16.5										
A-08-002	D-2	5	SM	14.5	122.9									
A-08-002	S-3	10	SP	3.3										
A-08-002	D-4	15	SW-SM	2.6	121.0									
A-08-002	S-5	20	SP-SM	3.3										
A-08-002	D-6	25	SP-SM	2.9	111.7									
A-08-002	S-7	30	SP	2.6										
A-08-002	D-8	35	SP-SM	2.2	110.1									
A-08-002	S-9	40	SP-SM	2.9										
A-08-002	D-10	45	SP	3.4	110.7									
A-08-002	S-11	50	SP-SM	4.3										
A-08-002	D-12	55	SP-SM	2.0	115.8									
A-08-002	S-13	60	SP-SM	3.4										
A-08-002	D-14	65	SP-SM	2.7	108.8									
A-08-002	S-15	70	SP-SM	2.8										
A-08-003	D-2	5	SC-SM	8.5	141.2					22/17/5				
A-08-003	S-3	10	CL	16.8							1100	8.4	300	216
A-08-003	D-4	15	SC	6.9	140.9			11:67:22						
A-08-003	S-5	20	SC	15.2										
A-08-003	D-6	25	SC	16.9	124.3			1:57:42						
A-08-003	S-7	30	SP	2.7										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-003	D-8	35	SP-SM	2.7	115.1									
A-08-003	S-9	40	SP-SM	2.9										
A-08-003	D-10	45	SP-SM	2.9	112.8									
A-08-003	S-11	50	SP	3.2										
A-08-003	D-12	55	SP-SM	3.7	107.1									
A-08-003	S-13	60	SP-SM	7.1										
A-08-003	D-14	65	SP-SM	3.5	109.6									
A-08-003	S-15	70	SP-SM	3.6										
A-08-003	D-16	75	SP	2.0	106.3									
A-08-003	S-17	80	SP	3.4										
A-08-003	D-18	85	SP	2.3	111.8									
A-08-003	S-19	90	SP	2.6										

TABLE 2 SUMMARY OF LABORATORY RESULTS FOR BULK SAMPLE

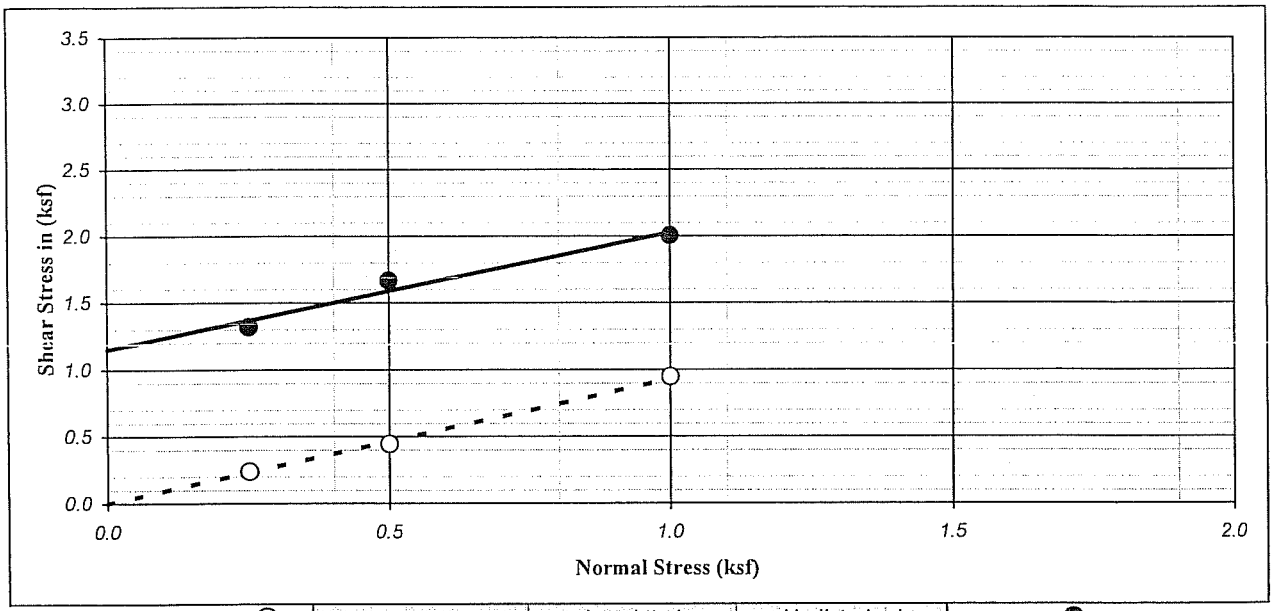
Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth	Soil Identification (group symbol) ASTM D2488/D2487	Compaction (CT-216)		R-Value	Expansion Index	Grain Size Distribution
				Optimum Moisture	Maximum Dry Density			GR:SA:FI
		(ft)		(%)	(pcf)			(%)
A-08-001	*Bulk*	2.5 to 4	SC	8.5	132	33	10	11:59:30

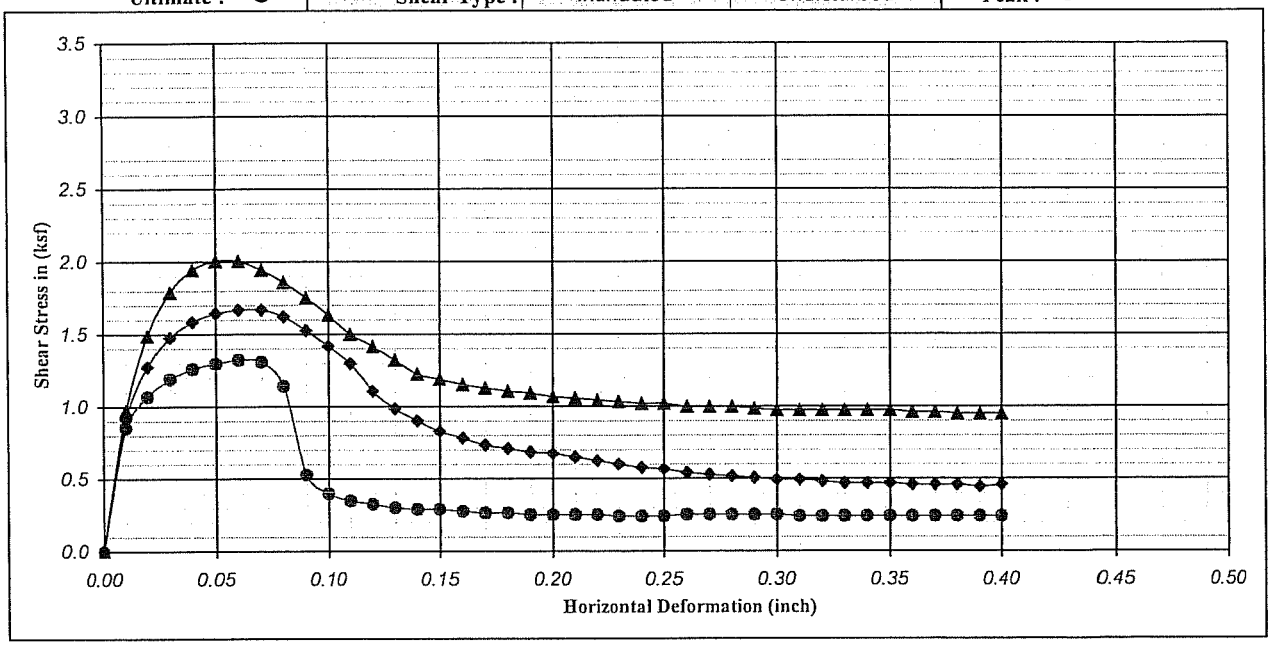
TABLE 3 SUMMARY OF LABORATORY STRENGTH TEST RESULTS

Project No. : *08-115* **Project Name :** RBF/SR-57 Northbound

Boring No .	Sample No.	Sample Depth	Soil Identification (group symbol) ASTM D2488/D2487	Unconsolidated Undrained Triaxial Test (ASTM D2850)				Direct Shear Test (ASTM D3080)			
								Peak		Residual	
				Peak Strength S_u	Strain at Peak S_u	Shear Strength at 10% Strain S_u	Confining Pressure	ϕ	C	ϕ	C
		(ft)		(ksf)	(%)	(ksf)	(ksf)	(deg)	(ksf)	(deg)	(ksf)
A-08-001	*D-2*	5	SC					41.27	1.15	43.14	0
A-08-001	*D-7*	35	SP					42.4	0.34	30.09	0.13
A-08-002	*D-10*	45	SP					38.7	0	33.03	0
A-08-003	*D-4*	15	SC					35.43	0.91	32.42	0.08



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-001		Strength Intercept (C) :	1.15	(ksf)	Peak	0.00	(ksf)	Ultimate
Sample No. : D-2			55.16	(kPa)		0.00	(kPa)	
Depth (ft/m) : 5.0	0.00	Friction Angle (ϕ) :	41.27	Degree		43.14	Degree	
Description : Brown, CLAYEY SAND (SC)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	17.43	116.28	18.30	0.45	0.25	11.97	1.32	63.20	0.24	11.49
◆	18.47	113.44	17.86	0.49	0.50	23.94	1.67	79.86	0.44	21.26
▲	17.65	114.83	18.07	0.47	1.00	47.88	2.00	95.95	0.95	45.39

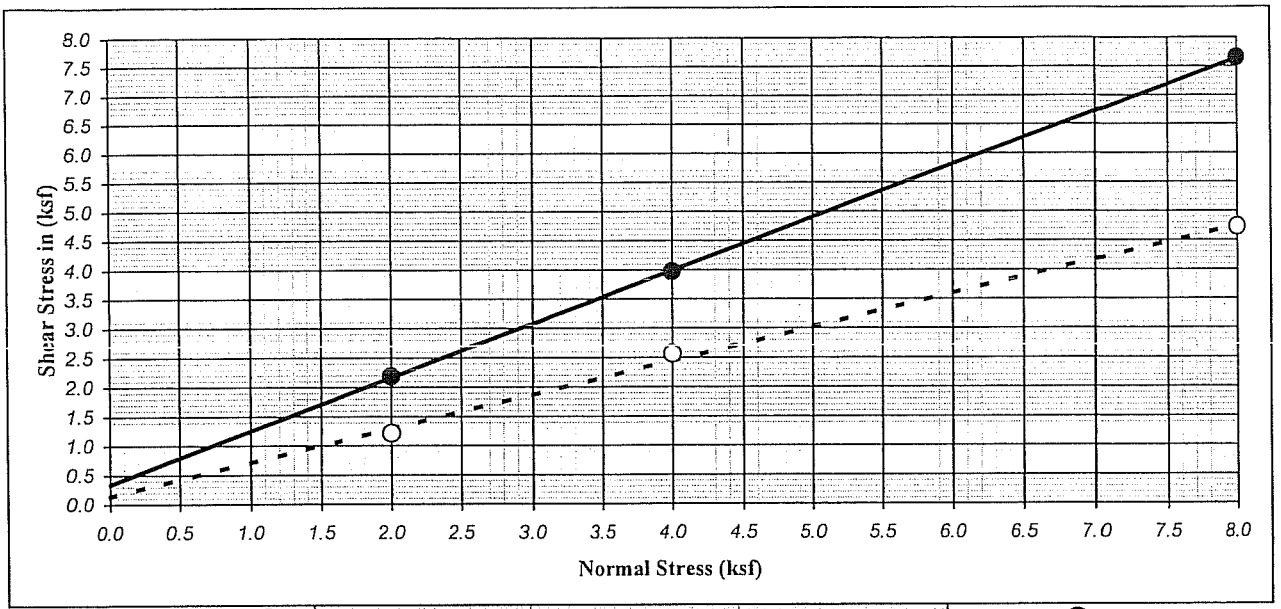
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

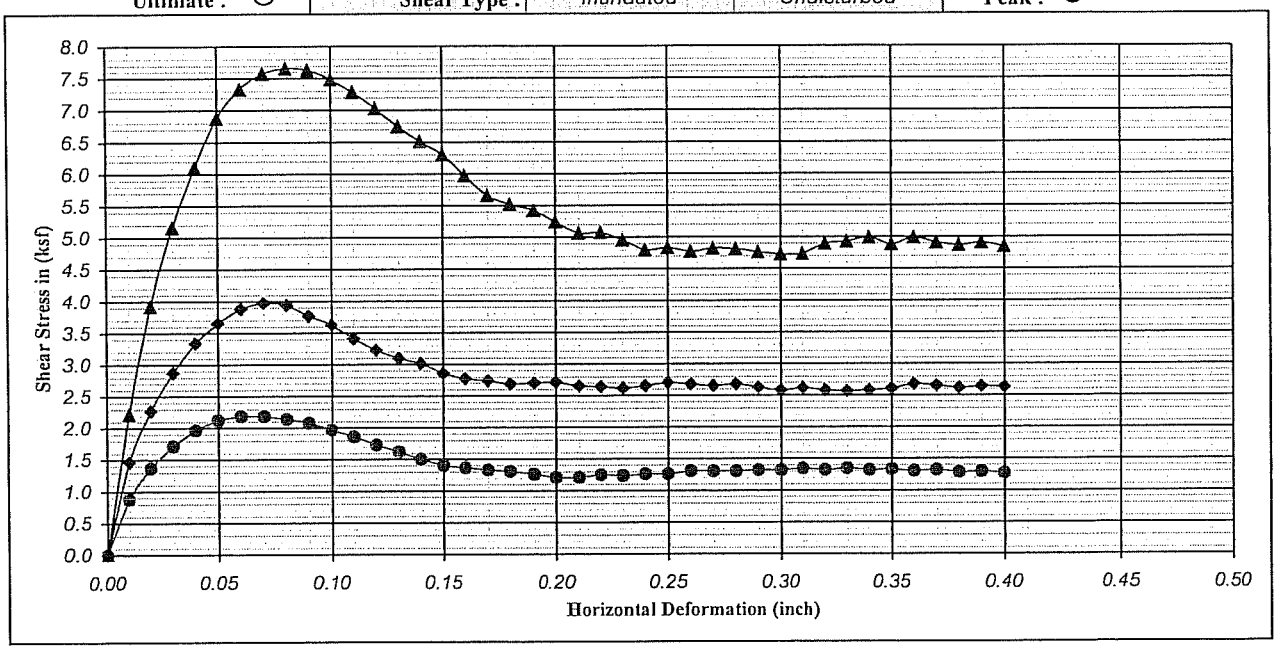
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-001		Strength Intercept (C) :	0.34	(ksf)	Peak	0.13	(ksf)	Ultimate
Sample No. : D-7			16.40	(kPa)		6.32	(kPa)	
Depth (ft/m) : 35.0	0.00	Friction Angle (ϕ) :	42.40	Degree		30.09	Degree	
Description : Light olive brown, Poorly graded SAND (SP)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	16.61	105.01	16.53	0.61	2.00	95.76	2.18	104.57	1.21	58.03
◆	15.39	101.62	16.00	0.66	4.00	191.52	3.97	190.18	2.57	122.96
▲	14.73	104.76	16.49	0.61	8.00	383.04	7.66	366.52	4.73	226.38

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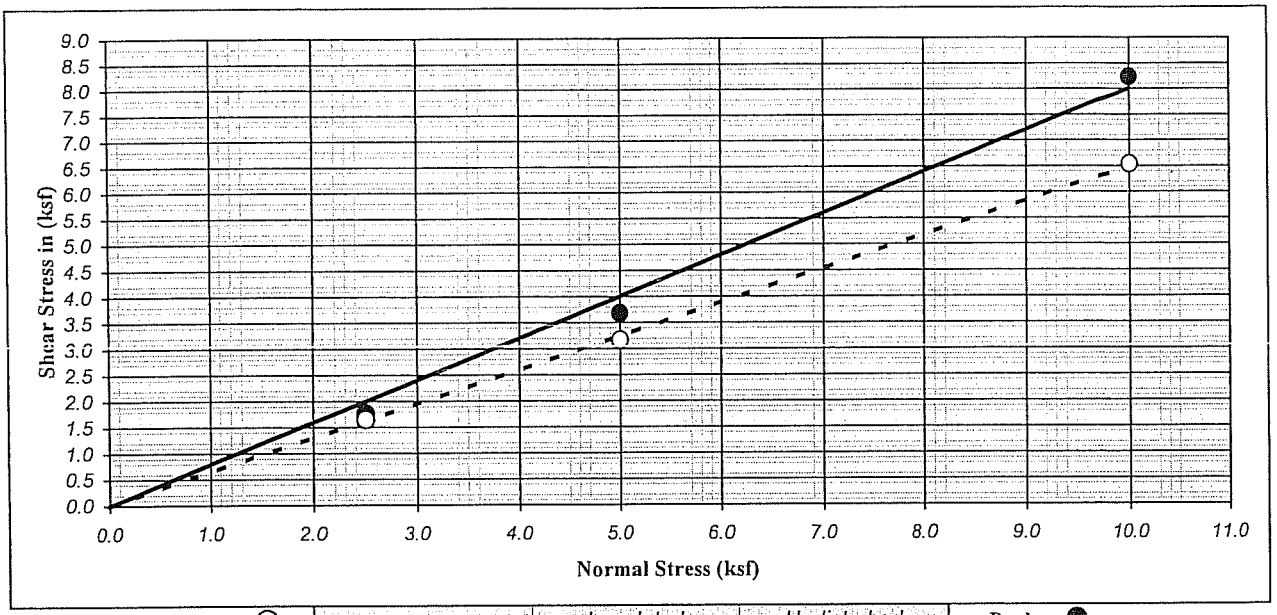
Geotechnical and Earthquake Engineering

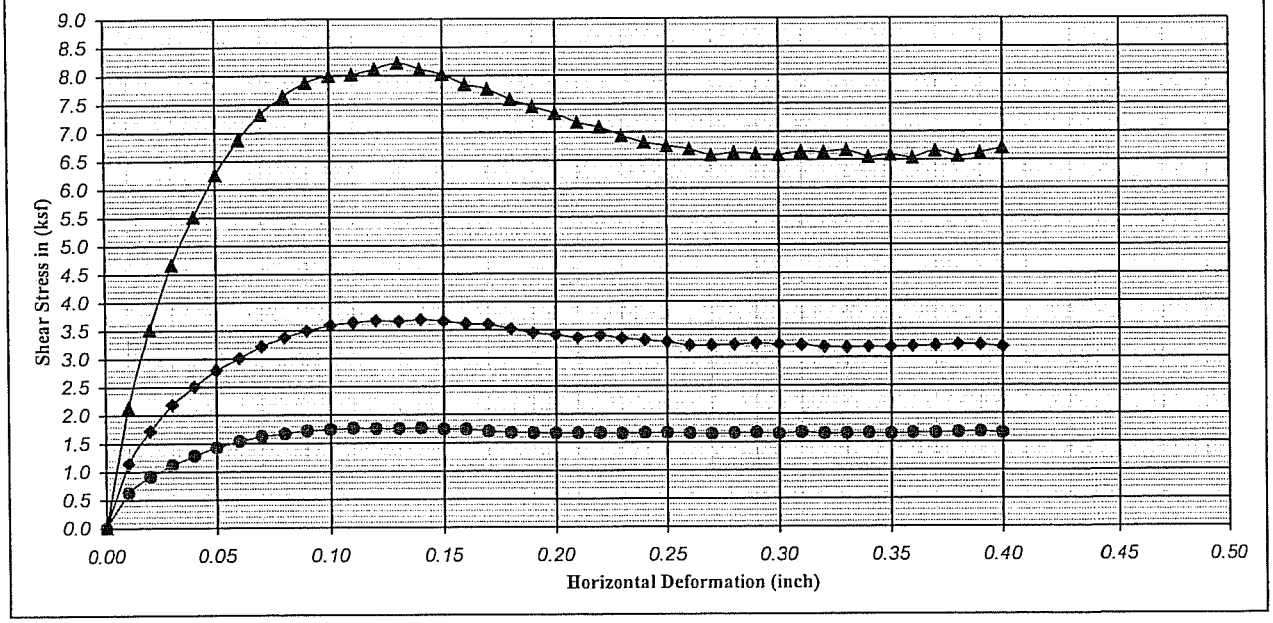
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08 | Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-002		Strength Intercept (C) :	0.00	(ksf)	Peak	0.00	(ksf)	Ultimate
Sample No. : D-10			0.00	(kPa)		0.00	(kPa)	
Depth (ft/m) : 45.0	0.00	Friction Angle (ϕ) :	38.70	Degree		33.03	Degree	
Description : Olive brown, Poorly graded SAND (SP)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	21.34	87.98	13.85	0.92	2.50	119.70	1.76	84.46	1.64	78.71
◆	19.99	91.15	14.35	0.85	5.00	239.40	3.68	176.39	3.17	151.68
▲	18.60	94.70	14.91	0.78	10.00	478.80	8.23	394.10	6.54	313.09

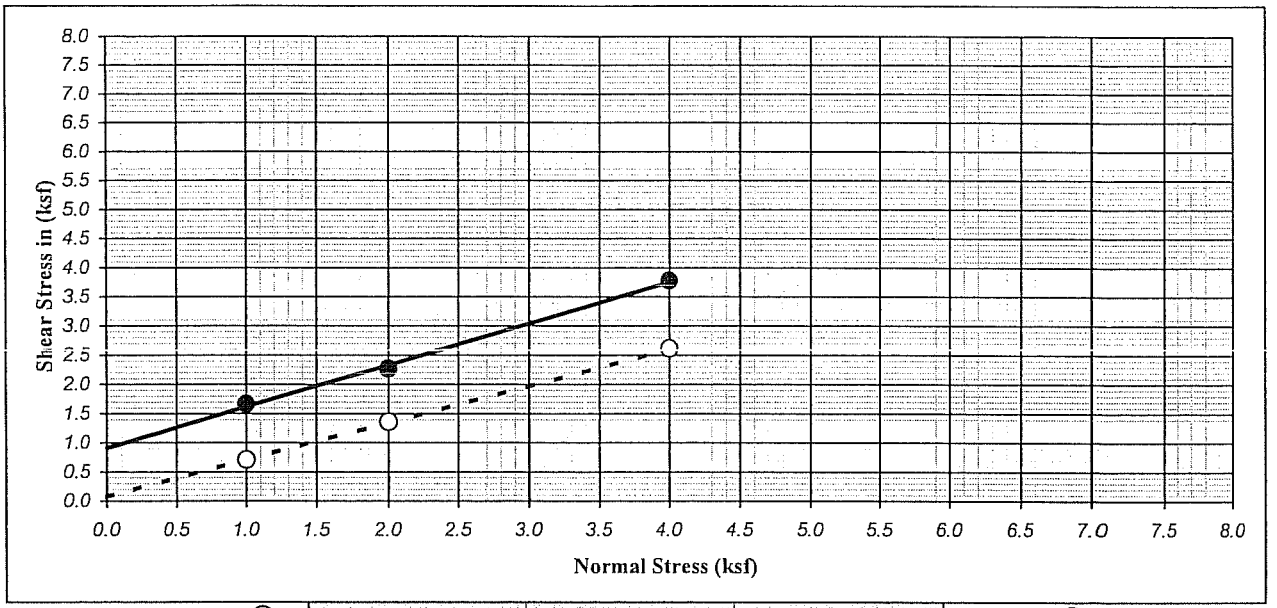
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

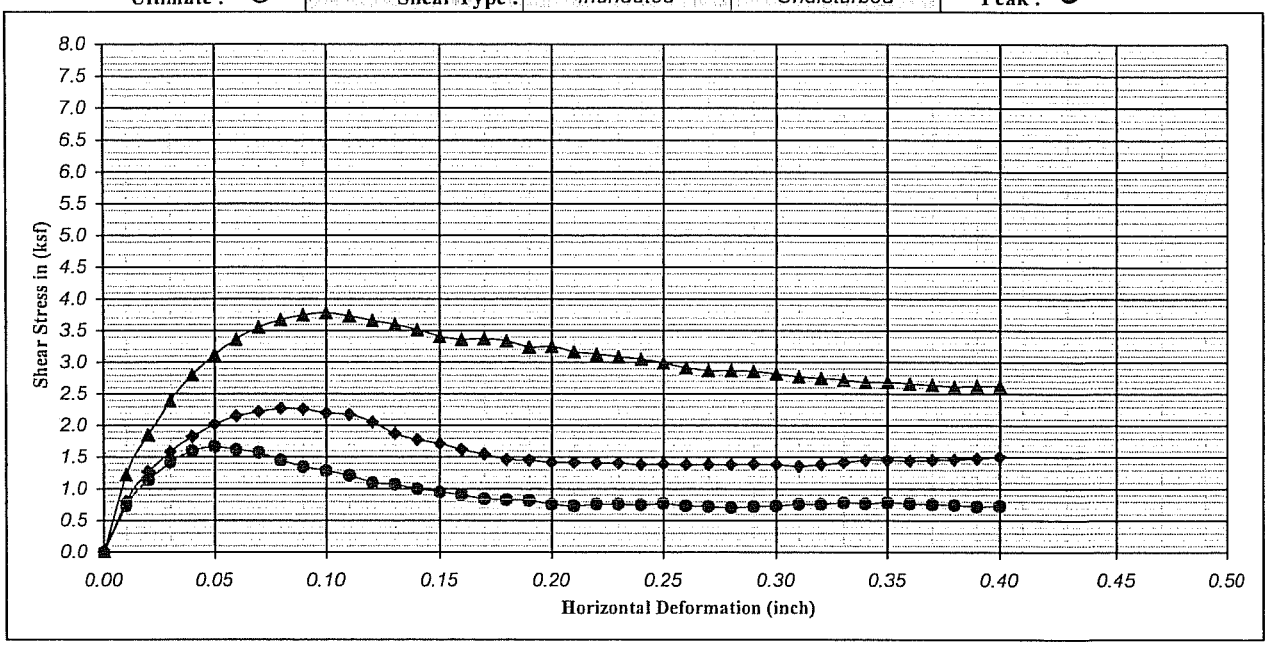
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-003		Strength Intercept (C) :	0.91	(ksf)	Peak	0.08	(ksf)	Ultimate
Sample No. : D-4			43.67	(kPa)		3.73	(kPa)	
Depth (ft/m) : 15.0	0.00	Friction Angle (ϕ) :	35.43	Degree		32.42	Degree	
Description : Brown, CLAYEY SAND (SC)							Shear Rate (inch/minute) :	0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.17	119.87	18.87	0.41	1.00	47.88	1.67	79.86	0.71	33.90
◆	13.80	121.41	19.11	0.39	2.00	95.76	2.27	108.59	1.36	64.93
▲	7.79	128.82	20.28	0.31	4.00	191.52	3.78	180.99	2.62	125.25

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08

Figure No. :

APPENDIX C

DESIGN CALCULATIONS

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project SR-57NB Orangethorpe Ave UC (Widen) Project No. 08-115

By LLC Date 12/10/08 Checked By _____ Date _____ Sheet 1 of 5

Pile Properties 24" ϕ CIDH

$\pi D = \pi(2') = 6.283$ ft

$\frac{\pi}{4} D^2 = \frac{\pi}{4}(2)^2 = 3.14$ ft^2 $= 452$ in^2

$I = \frac{\pi}{64}(24)^4 = 16{,}286$ in^4

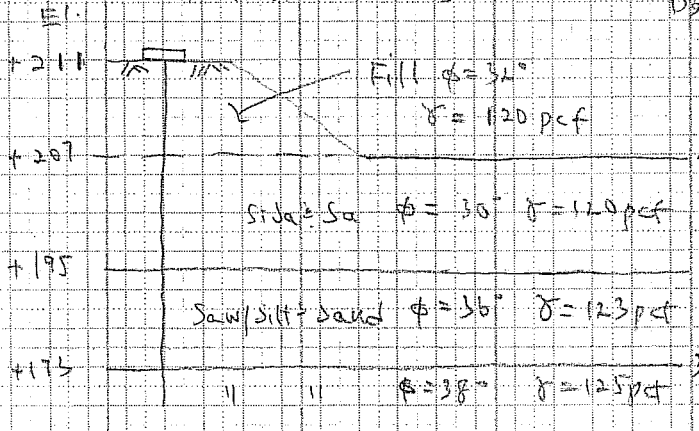
$E_c = 57000\sqrt{f'_c} = 57000\sqrt{3250} = 3.25 \times 10^6$ lb/in^2

EI-Grouted $= 5.29 \times 10^{10}$ lb-in^2

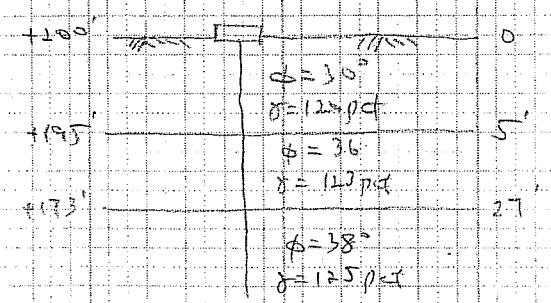
$\frac{1}{2}$ EI-Grouted $= 2.65 \times 10^{10}$ lb-in^2

Axial Capacity

Abutments 1 and 3:



Abut 2:



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
17660 Newhope Street, Suite E, Fountain Valley, CA 92708
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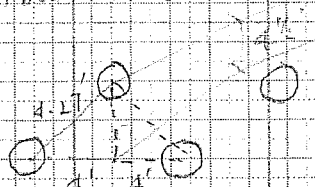
Project Orangethorpe Ave UC (Widen) Project No. 08-115

By LLC Date 5/15/09 Checked By _____ Date _____ Sheet 2 of 5

Group Efficiency Factor (η)

Abutments:

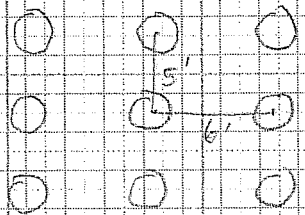


$\frac{\text{Spacing}}{\text{Dia}} = \frac{4.27}{2} = 2.1 \quad \eta = 0.56$

$= \frac{8}{2} = 4 \quad \eta = 1.0$

Average $\eta = \frac{0.56 + 0.56 + 1}{3} = 0.71$

Bent:



$\frac{\text{Spacing}}{\text{Dia}} = \frac{5}{2} = 2.5$ and $\frac{6}{2} = 3.0$

$\eta = 0.65 \qquad \eta = 0.77$

Average $\eta = 0.71$

Abutment to Pile Length

Single Pile: Demand = 200^K Nom. Resistance = 400^K

Req'd Pile Length = 35 feet

Pile Group: Demand = 800^K Nom. Resistance = 1600^K

Available from each pile = (0.71)(4)(400) = 1136^K < 1600^K

Req'd from each pile = $\frac{1600}{(0.71)(4)} = 563^K$

Req'd Pile Length = 43 feet

Pile Tip El. = 211 − 43 = **+168 feet**

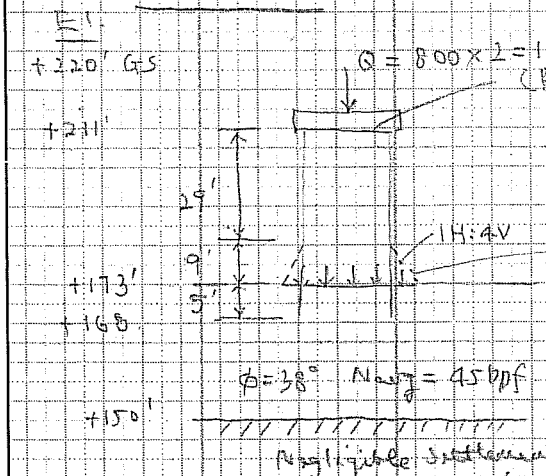
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project SR-57 NB Orangethorpe Ave LC (Widen) Project No. 08-115

By LCC Date 5/15/09 Checked By _____ Date _____ Sheet 3 of _____

Settlement



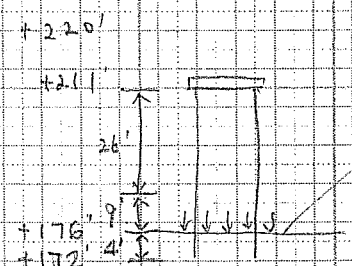
$(B')(L') = (14 + 2.25 + 2.25)(6\frac{1}{2} + 2.25 + 2.25)$

$= (18.5')(11')$

$\frac{Q}{(B')(L')} = \frac{1600^k}{(18.5)(11)} = 7.86$ ksf

El.	Thickness	σ_o	$\Delta\sigma$	σ_c	C'	Settlement
173		5.64	7.84	13.5		
	23'	(7.02)		(14.9)	105	0.86" < 1"
150'		8.4	7.86	16.26		

Raise Pile Tip 4'



$(B')(L') = (18.5')(11')$

$\frac{Q}{B'L'} = 7.86$ ksf

El.	Thickness	σ_o	$\Delta\sigma$	σ_c	C'	Settlement
176		5.28	7.86	13.14		
	26'	(6.84)		(14.7)	105	0.77" ≈ 1"
150		8.4	7.86	16.26		

Tip for settlement = **+172'**

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project SR-57 NB Orangethorpe Ave UC (Widen) Project No. 08-715

By LLC Date 5/15/09 Checked By _____ Date _____ Sheet 4 of _____

Bent Pile Length

Strength Limit Single Pile Nom. Resistance = $\frac{230}{0.7}$ = 329 K

Pile Length = 31 feet

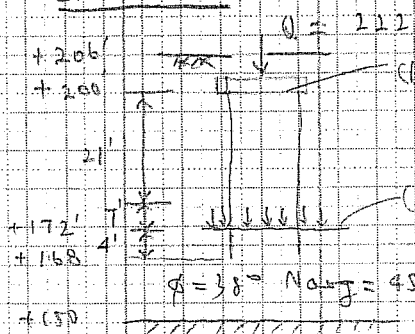
Pile Group Demand = $\frac{1560\,K}{0.7}$ = 2229 K

Σ Single Pile = (329)(9)(0.71) = 2102 K < 2229

Reqd Capacity = $\frac{2229\,K}{(9)(0.71)}$ = 349 K

Pile Length = 32 feet Tip = 200 − 32 = **+168'**

Settlement



(B)(L) = (14')(12')

(B')(L') = (14 + 1.75 + 1.75) + (12 + 1.75 + 1.75)
= (17.5)(15.5)

$\frac{Q}{B'L'} = \frac{2229}{(17.5)(15.5)}$ = 8.22 ksf

El.	Thickness	σ_o	$\Delta\sigma$	σ_f	ϵ'	Settlement
172	22'	4.08 (5.14) 6.72	8.22	(13.64)	105	1.01" ≈ 1.0"
150'			8.22			

Use same Tip **+168'**

Extreme Event Single Pile Nom. Resistance = 400 K Compression

Pile Length = 36' Tip = 200 − 36 = **+164'**

Pile Group Demand = 820 K

Σ Single Pile = (400)(9)(0.7) = 2556 K >> 820 K Use +160' same as Draft FR

Earth Mechanics, Inc.
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Project SR-57 NB Orangethorpe Ave UC (Widen) Project No. 08-115

By LLC Date 5/18/09 Checked By _____ Date _____ Sheet 5 of _____

Settlement

No need to check for Ex-frame ∴ Strength Limit controls pile tip (deeper).

Tension

Single Pile Nom. Resistance = 200^K * $\frac{0.7}{0.5}$

= 280^K

Req'd Pile Length = 29' Pile Tip = 200 − 29 = **+171'**

No need to check group capacity ∴ Demand per footprint is ∅

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

ITEM: 2-FT DIAMETER CIDH PILE

Abutments

PROJECT: Orangethorpe
PROJECT NO.: 08-115
DONE BY: lcc DATE: 04/22/09
CHECKED BY: DATE:

D_s => 2 ft Hw => 100.0 ft Hg => 0.0 ft
p = 6.2832 ft Ho => 0.0 ft Hf => 0.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	10	120	57.6	0.00	32
(2)	10	16	120	57.6	0.00	30
(3)	16	38	123	60.6	0.00	36
(4)	38	80	125	62.6	0.00	38
(5)	80	150	125	62.6	0.00	38
(6)	80	150	125	62.6	0.00	38
(7)	80	150	125	62.6	0.00	38
(8)	80	150	125	62.6	0.00	38

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)	(kips)
0	0.0	0.0	0.0	120.0	0									
1	0.0	0.0	0.0	120.0	0	0				0.0			0.0	0.0
2	1.0	0.5	0.5	120.0	60	0	1.2000	0.0720	0.5	0.5	0.0000	0.0	0.0	0.5
3	2.0	1.5	1.5	120.0	180	0	1.2000	0.2160	1.4	1.8	0.0000	0.0	0.0	1.8
4	3.0	2.5	2.5	120.0	300	0	1.2000	0.3600	2.3	4.1	0.0000	0.0	0.0	4.1
5	4.0	3.5	3.5	120.0	420	0	1.2000	0.5040	3.2	7.2	0.0000	0.0	0.0	7.2
6	5.0	4.5	4.5	120.0	540	0	1.2000	0.6480	4.1	11.3	0.0000	0.0	0.0	11.3
7	6.0	5.5	5.5	120.0	660	0	1.1834	0.7810	4.9	16.2	0.0000	0.0	0.0	16.2
8	7.0	6.5	6.5	120.0	780	0	1.1558	0.9015	5.7	21.9	0.0000	0.0	0.0	21.9
9	8.0	7.5	7.5	120.0	900	0	1.1303	1.0173	6.4	28.3	0.0000	0.0	0.0	28.3
10	9.0	8.5	8.5	120.0	1020	0	1.1064	1.1285	7.1	35.4	0.0000	0.0	0.0	35.4
11	10.0	9.5	9.5	120.0	1140	0	1.0839	1.2356	7.8	43.1	0.0000	0.0	0.0	43.1
12	12.0	11.0	11.0	120.0	1320	0	1.0523	1.3890	17.5	60.6	0.0000	0.0	0.0	60.6
13	14.0	13.0	13.0	120.0	1560	0	1.0133	1.5807	19.9	80.4	0.0000	0.0	0.0	80.4
14	16.0	15.0	15.0	120.0	1800	0	0.9771	1.7589	22.1	102.5	0.0000	0.0	0.0	102.5
15	18.0	17.0	17.0	123.0	2046	0	0.9434	1.9302	24.3	126.8	0.0000	0.0	0.0	126.8
16	20.0	19.0	19.0	123.0	2292	0	0.9115	2.0893	26.3	153.1	0.0000	0.0	0.0	153.1
17	22.0	21.0	21.0	123.0	2538	0	0.8814	2.2369	28.1	181.2	0.0000	0.0	0.0	181.2
18	24.0	23.0	23.0	123.0	2784	0	0.8526	2.3735	29.8	211.0	0.0000	0.0	0.0	211.0
19	26.0	25.0	25.0	123.0	3030	0	0.8250	2.4998	31.4	242.4	0.0000	0.0	0.0	242.4
20	28.0	27.0	27.0	123.0	3276	0	0.7985	2.6159	32.9	275.3	0.0000	0.0	0.0	275.3
21	30.0	29.0	29.0	123.0	3522	0	0.7730	2.7225	34.2	309.5	0.0000	0.0	0.0	309.5
22	32.0	31.0	31.0	123.0	3768	0	0.7484	2.8198	35.4	344.9	0.0000	0.0	0.0	344.9
23	34.0	33.0	33.0	123.0	4014	0	0.7245	2.9081	36.5	381.5	0.0000	0.0	0.0	381.5
24	36.0	35.0	35.0	123.0	4260	0	0.7013	2.9877	37.5	419.0	0.0000	0.0	0.0	419.0
25	38.0	37.0	37.0	123.0	4506	0	0.6788	3.0588	38.4	457.5	0.0000	0.0	0.0	457.5
26	40.0	39.0	39.0	125.0	4756	0	0.6569	3.1243	39.3	496.7	0.0000	0.0	0.0	496.7
27	42.0	41.0	41.0	125.0	5006	0	0.6356	3.1817	40.0	536.7	0.0000	0.0	0.0	536.7
28	44.0	43.0	43.0	125.0	5256	0	0.6147	3.2311	40.6	577.3	0.0000	0.0	0.0	577.3
29	46.0	45.0	45.0	125.0	5506	0	0.5944	3.2727	41.1	618.4	0.0000	0.0	0.0	618.4
30	48.0	47.0	47.0	125.0	5756	0	0.5745	3.3067	41.6	660.0	0.0000	0.0	0.0	660.0
31	50.0	49.0	49.0	125.0	6006	0	0.5550	3.3333	41.9	701.9	0.0000	0.0	0.0	701.9
32	52.0	51.0	51.0	125.0	6256	0	0.5359	3.3526	42.1	744.0	0.0000	0.0	0.0	744.0
33	54.0	53.0	53.0	125.0	6506	0	0.5172	3.3648	42.3	786.3	0.0000	0.0	0.0	786.3
34	56.0	55.0	55.0	125.0	6756	0	0.4988	3.3700	42.3	828.6	0.0000	0.0	0.0	828.6
35	58.0	57.0	57.0	125.0	7006	0	0.4808	3.3683	42.3	871.0	0.0000	0.0	0.0	871.0
36	60.0	59.0	59.0	125.0	7256	0	0.4630	3.3599	42.2	913.2	0.0000	0.0	0.0	913.2
37	62.0	61.0	61.0	125.0	7506	0	0.4456	3.3448	42.0	955.2	0.0000	0.0	0.0	955.2

Shaft 6 of 7

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Orangethorpe
ITEM: 2-FT DIAMETER CIDH PILE

Bent 2

PROJECT NO.: 08-115
DONE BY: lcc DATE: 04/22/09
CHECKED BY: DATE:

D_s => 2 ft Hw => 100.0 ft Hg => 0.0 ft
p = 6.2832 ft Ho => 0.0 ft Hf => 0.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	5	120	57.6	0.00	30
(2)	5	27	123	60.6	0.00	36
(3)	27	38	125	62.6	0.00	38
(4)	38	80	125	62.6	0.00	38
(5)	80	150	125	62.6	0.00	38
(6)	80	150	125	62.6	0.00	38
(7)	80	150	125	62.6	0.00	38
(8)	80	150	125	62.6	0.00	38

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)	(kips)
0	0.0	0.0	0.0	120.0	0									
1	0.0	0.0	0.0	120.0	0	0				0.0			0.0	0.0
2	1.0	0.5	0.5	120.0	60	0	1.2000	0.0720	0.5	0.5	0.0000	0.0	0.0	0.5
3	2.0	1.5	1.5	120.0	180	0	1.2000	0.2160	1.4	1.8	0.0000	0.0	0.0	1.8
4	3.0	2.5	2.5	120.0	300	0	1.2000	0.3600	2.3	4.1	0.0000	0.0	0.0	4.1
5	4.0	3.5	3.5	120.0	420	0	1.2000	0.5040	3.2	7.2	0.0000	0.0	0.0	7.2
6	5.0	4.5	4.5	120.0	540	0	1.2000	0.6480	4.1	11.3	0.0000	0.0	0.0	11.3
7	6.0	5.5	5.5	123.0	663	0	1.1834	0.7846	4.9	16.2	0.0000	0.0	0.0	16.2
8	7.0	6.5	6.5	123.0	786	0	1.1558	0.9085	5.7	21.9	0.0000	0.0	0.0	21.9
9	8.0	7.5	7.5	123.0	909	0	1.1303	1.0274	6.5	28.4	0.0000	0.0	0.0	28.4
10	9.0	8.5	8.5	123.0	1032	0	1.1064	1.1418	7.2	35.6	0.0000	0.0	0.0	35.6
11	10.0	9.5	9.5	123.0	1155	0	1.0839	1.2519	7.9	43.4	0.0000	0.0	0.0	43.4
12	12.0	11.0	11.0	123.0	1340	0	1.0523	1.4095	17.7	61.2	0.0000	0.0	0.0	61.2
13	14.0	13.0	13.0	123.0	1586	0	1.0133	1.6065	20.2	81.3	0.0000	0.0	0.0	81.3
14	16.0	15.0	15.0	123.0	1832	0	0.9771	1.7896	22.5	103.8	0.0000	0.0	0.0	103.8
15	18.0	17.0	17.0	123.0	2078	0	0.9434	1.9599	24.6	128.5	0.0000	0.0	0.0	128.5
16	20.0	19.0	19.0	123.0	2324	0	0.9115	2.1180	26.6	155.1	0.0000	0.0	0.0	155.1
17	22.0	21.0	21.0	123.0	2570	0	0.8814	2.2646	28.5	183.5	0.0000	0.0	0.0	183.5
18	24.0	23.0	23.0	123.0	2816	0	0.8526	2.4004	30.2	213.7	0.0000	0.0	0.0	213.7
19	26.0	25.0	25.0	123.0	3062	0	0.8250	2.5257	31.7	245.4	0.0000	0.0	0.0	245.4
20	28.0	27.0	27.0	125.0	3312	0	0.7985	2.6443	33.2	278.7	0.0000	0.0	0.0	278.7
21	30.0	29.0	29.0	125.0	3562	0	0.7730	2.7530	34.6	313.3	0.0000	0.0	0.0	313.3
22	32.0	31.0	31.0	125.0	3812	0	0.7484	2.8523	35.8	349.1	0.0000	0.0	0.0	349.1
23	34.0	33.0	33.0	125.0	4062	0	0.7245	2.9425	37.0	386.1	0.0000	0.0	0.0	386.1
24	36.0	35.0	35.0	125.0	4312	0	0.7013	3.0238	38.0	424.1	0.0000	0.0	0.0	424.1
25	38.0	37.0	37.0	125.0	4562	0	0.6788	3.0965	38.9	463.0	0.0000	0.0	0.0	463.0
26	40.0	39.0	39.0	125.0	4812	0	0.6569	3.1608	39.7	502.7	0.0000	0.0	0.0	502.7
27	42.0	41.0	41.0	125.0	5062	0	0.6356	3.2170	40.4	543.1	0.0000	0.0	0.0	543.1
28	44.0	43.0	43.0	125.0	5312	0	0.6147	3.2652	41.0	584.2	0.0000	0.0	0.0	584.2
29	46.0	45.0	45.0	125.0	5562	0	0.5944	3.3057	41.5	625.7	0.0000	0.0	0.0	625.7
30	48.0	47.0	47.0	125.0	5812	0	0.5745	3.3386	42.0	667.7	0.0000	0.0	0.0	667.7
31	50.0	49.0	49.0	125.0	6062	0	0.5550	3.3641	42.3	709.9	0.0000	0.0	0.0	709.9
32	52.0	51.0	51.0	125.0	6312	0	0.5359	3.3824	42.5	752.4	0.0000	0.0	0.0	752.4
33	54.0	53.0	53.0	125.0	6562	0	0.5172	3.3935	42.6	795.1	0.0000	0.0	0.0	795.1
34	56.0	55.0	55.0	125.0	6812	0	0.4988	3.3977	42.7	837.8	0.0000	0.0	0.0	837.8
35	58.0	57.0	57.0	125.0	7062	0	0.4808	3.3950	42.7	880.4	0.0000	0.0	0.0	880.4
36	60.0	59.0	59.0	125.0	7312	0	0.4630	3.3856	42.5	923.0	0.0000	0.0	0.0	923.0
37	62.0	61.0	61.0	125.0	7562	0	0.4456	3.3695	42.3	965.3	0.0000	0.0	0.0	965.3

Sheet 7 of 7

Earth Mechanics, Inc.
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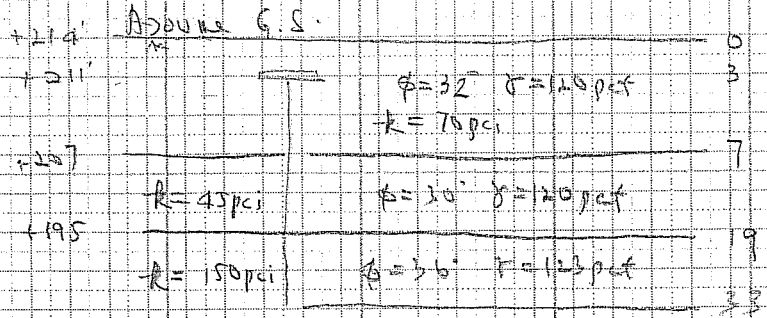
Project Orangethorpe Ave UC (Widen) Project No. 08-115

By LCC Date 12/10/08 Checked By _____ Date _____ Sheet 5 of _____

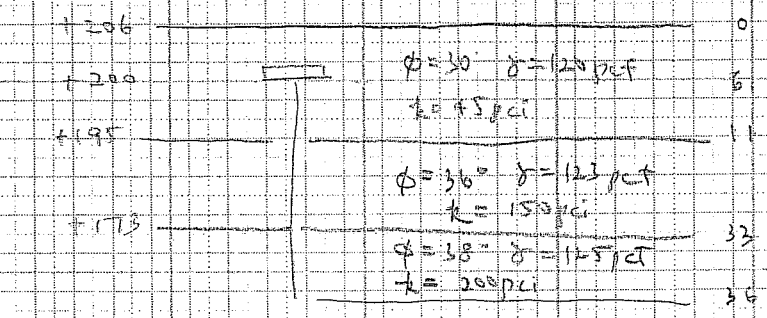
Lateral Pile Solutions

Abutments:



Group Efficiency Factor
$\eta_{EFF} = 0.8$

Bent:



$\eta_{EFF} = 0.52$

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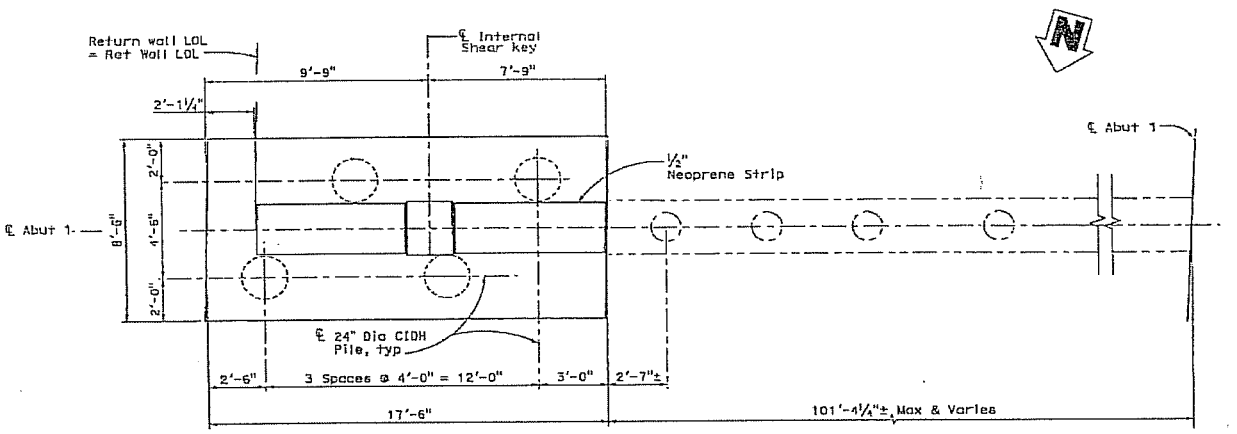
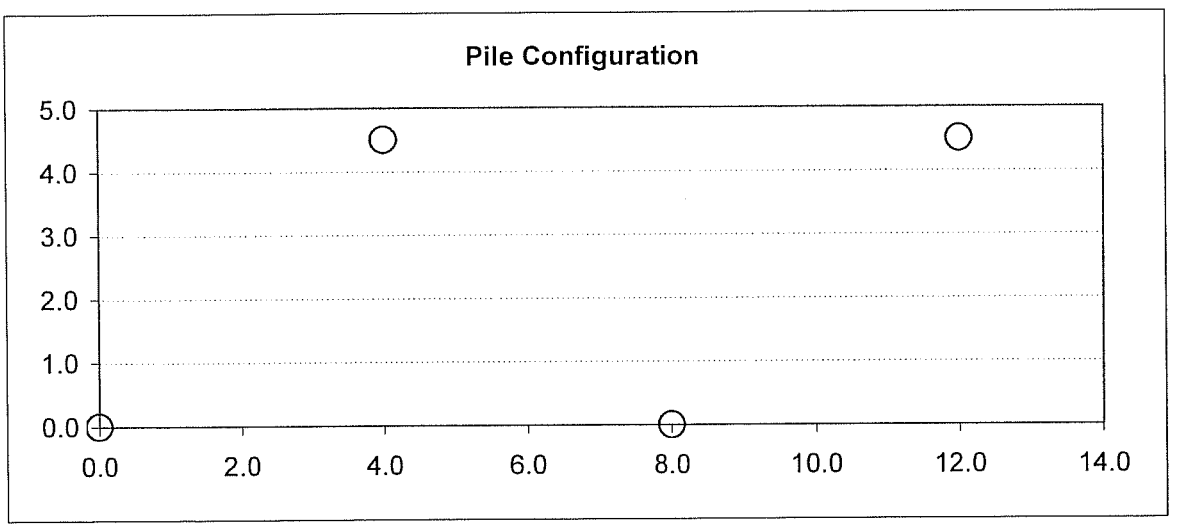
Project: **Orangethorpe Avenue UC (WIDEN)** Project No. **08-115**
By CTY Date 12/10/08 Check by Date Sheet 6

Proposed Pile Layout



Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia. (feet): 2
No. of Piles: 4

Group Efficiency	X-Dir	Y-Dir
	0.759	0.825

Avg = 0.8

Pile No.	X	Y
1	0.000	0.00
2	8.000	0.00
3	4.000	4.50
4	12.000	4.50

Reduction Factors in X-dir	Reduction Factors in Y-dir
0.673	0.822
0.790	0.680
0.642	0.868
0.932	0.932

Fx1 = 0.673 = 0.813 (lbl-21) x 0.848 (skew-31) x 0.976 (skew-41)
skew-31 = 0.848 = SQRT((0.73*Cos(0.844))^2 + 0.931*Sin(0.844))^2)
skew-41 = 0.976 = SQRT((0.972*Cos(0.359))^2 + 1*Sin(0.359))^2)

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Project: **Orangethorpe Avenue UC (WIDEN)** Project No. **08-115**
By CTY Date 12/10/08 Check by Date Sheet 7

Fx2 = 0.79 = 1 (lbl-12) x 0.932 (skew-32) x 0.848 (skew-42)
skew-32 = 0.932 = SQRT((0.932*Cos(0.844))^2 + 0.931*Sin(0.844))^2)
skew-42 = 0.848 = SQRT((0.73*Cos(0.844))^2 + 0.931*Sin(0.844))^2)

Fx3 = 0.642 = 0.932 (skew-13) x 0.848 (skew-23) x 0.813 (lbl-43)
skew-13 = 0.932 = SQRT((0.932*Cos(0.844))^2 + 0.931*Sin(0.844))^2)
skew-23 = 0.848 = SQRT((0.73*Cos(0.844))^2 + 0.931*Sin(0.844))^2)

Fx4 = 0.932 = 1 (skew-14) x 0.932 (skew-24) x 1 (lbl-34)
skew-14 = 1 = SQRT((1*Cos(0.359))^2 + 1*Sin(0.359))^2)
skew-24 = 0.932 = SQRT((0.932*Cos(0.844))^2 + 0.931*Sin(0.844))^2)

Fy1 = 0.673 = 1 (sbs-21) x 0.825 (skew-31) x 0.997 (skew-41)
skew-31 = 0.825 = SQRT((0.73*Cos(0.727))^2 + 0.931*Sin(0.727))^2)
skew-41 = 0.997 = SQRT((0.972*Cos(1.212))^2 + 1*Sin(1.212))^2)

Fy2 = 0.79 = 1 (sbs-12) x 0.825 (skew-32) x 0.825 (skew-42)
skew-32 = 0.825 = SQRT((0.73*Cos(0.727))^2 + 0.931*Sin(0.727))^2)
skew-42 = 0.825 = SQRT((0.73*Cos(0.727))^2 + 0.931*Sin(0.727))^2)

Fy3 = 0.642 = 0.932 (skew-13) x 0.932 (skew-23) x 1 (sbs-43)
skew-13 = 0.932 = SQRT((0.932*Cos(0.727))^2 + 0.931*Sin(0.727))^2)
skew-23 = 0.932 = SQRT((0.932*Cos(0.727))^2 + 0.931*Sin(0.727))^2)

Fy4 = 0.932 = 1 (skew-14) x 0.932 (skew-24) x 1 (sbs-34)
skew-14 = 1 = SQRT((1*Cos(1.212))^2 + 1*Sin(1.212))^2)
skew-24 = 0.932 = SQRT((0.932*Cos(0.727))^2 + 0.931*Sin(0.727))^2)

where
lbl: line-by-line effect
sbs: side-by-side effect
skew: skew effect

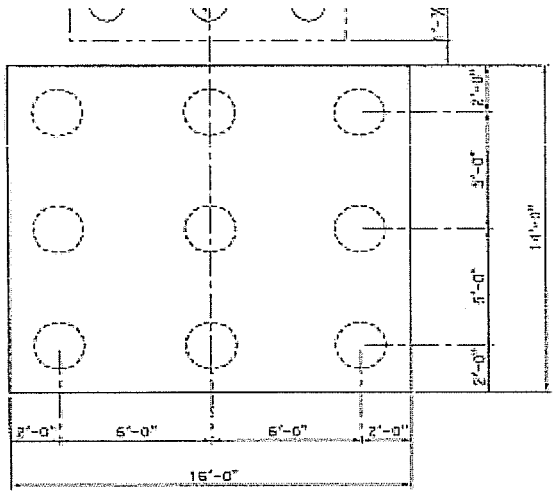
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
phone: (714)751-3826, Fax (714)751-3928

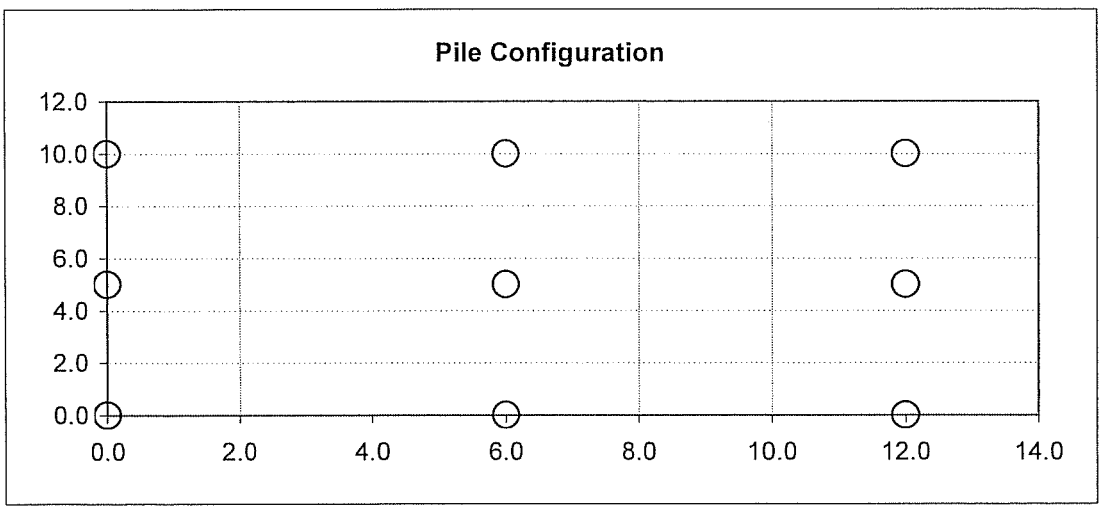
Project: **Orangethorpe Avenue UC (WIDEN)** Project No. **08-115**

By CTY Date 12/10/08 Check by Date Sheet 7

Proposed Bent Pile Layout



Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia. (feet): 2
No. of Piles: 9

Group Efficiency	X-Dir	Y-Dir
	0.563	0.477

Average = 0.52

Pile No.	X	Y
1	0.000	0.00
2	6.000	0.00
3	12.000	0.00
4	0.000	5.00
5	6.000	5.00
6	12.000	5.00
7	0.000	10.00
8	6.000	10.00
9	12.000	10.00

Reduction Factors in X-dir	Reduction Factors in Y-dir
0.519	0.493
0.519	0.406
0.813	0.493
0.403	0.517
0.410	0.446
0.709	0.517
0.519	0.825
0.519	0.766
0.813	0.825

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Project: **Orangethorpe Avenue UC (WIDEN)** Project No. **08-115**
By CTY Date 12/10/08 Check by Date Sheet 9

Fx1 = 0.519 = 0.729 (lbl-21) x 0.948 (lbl-31) x 0.874 (sbs-41) x 0.89 (skew-51) x 0.981 (skew-61) x 1 (sbs-71) x 0.984 (skew-81) x 1 (skew-91)

skew-51 = 0.89 = SQRT((0.805*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-61 = 0.981 = SQRT((0.978*Cos(0.395))^2 + 1*Sin(0.395))^2)
skew-81 = 0.984 = SQRT((0.938*Cos(1.03))^2 + 1*Sin(1.03))^2)
skew-91 = 1 = SQRT((1*Cos(0.695))^2 + 1*Sin(0.695))^2)

Fx2 = 0.519 = 0.931 (lbl-12) x 0.729 (lbl-32) x 0.999 (skew-42) x 0.874 (sbs-52) x 0.89 (skew-62) x 1 (skew-72) x 1 (sbs-82) x 0.984 (skew-92)

skew-42 = 0.999 = SQRT((0.998*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-62 = 0.89 = SQRT((0.805*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-72 = 1 = SQRT((1*Cos(1.03))^2 + 1*Sin(1.03))^2)
skew-92 = 0.984 = SQRT((0.938*Cos(1.03))^2 + 1*Sin(1.03))^2)

Fx3 = 0.813 = 1 (lbl-13) x 0.931 (lbl-23) x 1 (skew-43) x 0.999 (skew-53) x 0.874 (sbs-63) x 1 (skew-73) x 1 (skew-83) x 1 (sbs-93)

skew-43 = 1 = SQRT((1*Cos(0.395))^2 + 1*Sin(0.395))^2)
skew-53 = 0.999 = SQRT((0.998*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-73 = 1 = SQRT((1*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-83 = 1 = SQRT((1*Cos(1.03))^2 + 1*Sin(1.03))^2)

Fx4 = 0.403 = 0.874 (sbs-14) x 0.89 (skew-24) x 0.981 (skew-34) x 0.729 (lbl-54) x 0.948 (lbl-64) x 0.874 (sbs-74) x 0.89 (skew-84) x 0.981 (skew-94)

skew-24 = 0.89 = SQRT((0.805*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-34 = 0.981 = SQRT((0.978*Cos(0.395))^2 + 1*Sin(0.395))^2)
skew-84 = 0.89 = SQRT((0.805*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-94 = 0.981 = SQRT((0.978*Cos(0.395))^2 + 1*Sin(0.395))^2)

Fx5 = 0.41 = 0.999 (skew-15) x 0.874 (sbs-25) x 0.89 (skew-35) x 0.931 (lbl-45) x 0.729 (lbl-65) x 0.999 (skew-75) x 0.874 (sbs-85) x 0.89 (skew-95)

skew-15 = 0.999 = SQRT((0.998*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-35 = 0.89 = SQRT((0.805*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-75 = 0.999 = SQRT((0.998*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-95 = 0.89 = SQRT((0.805*Cos(0.695))^2 + 1*Sin(0.695))^2)

Fx6 = 0.709 = 1 (skew-16) x 0.999 (skew-26) x 0.874 (sbs-36) x 1 (lbl-46) x 0.931 (lbl-56) x 1 (skew-76) x 0.999 (skew-86) x 0.874 (sbs-96)

skew-16 = 1 = SQRT((1*Cos(0.395))^2 + 1*Sin(0.395))^2)
skew-26 = 0.999 = SQRT((0.998*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-76 = 1 = SQRT((1*Cos(0.395))^2 + 1*Sin(0.395))^2)
skew-86 = 0.999 = SQRT((0.998*Cos(0.695))^2 + 1*Sin(0.695))^2)

Fx7 = 0.519 = 1 (sbs-17) x 0.984 (skew-27) x 1 (skew-37) x 0.874 (sbs-47) x 0.89 (skew-57) x 0.981 (skew-67) x 0.729 (lbl-87) x 0.948 (lbl-97)

skew-27 = 0.984 = SQRT((0.938*Cos(1.03))^2 + 1*Sin(1.03))^2)
skew-37 = 1 = SQRT((1*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-57 = 0.89 = SQRT((0.805*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-67 = 0.981 = SQRT((0.978*Cos(0.395))^2 + 1*Sin(0.395))^2)

Fx8 = 0.519 = 1 (skew-18) x 1 (sbs-28) x 0.984 (skew-38) x 0.999 (skew-48) x 0.874 (sbs-58) x 0.89 (skew-68) x 0.931 (lbl-78) x 0.729 (lbl-98)

skew-18 = 1 = SQRT((1*Cos(1.03))^2 + 1*Sin(1.03))^2)
skew-38 = 0.984 = SQRT((0.938*Cos(1.03))^2 + 1*Sin(1.03))^2)
skew-48 = 0.999 = SQRT((0.998*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-68 = 0.89 = SQRT((0.805*Cos(0.695))^2 + 1*Sin(0.695))^2)

Fx9 = 0.813 = 1 (skew-19) x 1 (skew-29) x 1 (sbs-39) x 1 (skew-49) x 0.999 (skew-59) x 0.874 (sbs-69) x 1 (lbl-79) x 0.931 (lbl-89)

skew-19 = 1 = SQRT((1*Cos(0.695))^2 + 1*Sin(0.695))^2)
skew-29 = 1 = SQRT((1*Cos(1.03))^2 + 1*Sin(1.03))^2)
skew-49 = 1 = SQRT((1*Cos(0.395))^2 + 1*Sin(0.395))^2)
skew-59 = 0.999 = SQRT((0.998*Cos(0.695))^2 + 1*Sin(0.695))^2)

Fy1 = 0.519 = 0.93 (sbs-21) x 1 (sbs-31) x 0.68 (lbl-41) x 0.925 (skew-51) x 0.997 (skew-61) x 0.885 (lbl-71) x 0.955 (skew-81) x 1 (skew-91)

skew-51 = 0.925 = SQRT((0.805*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-61 = 0.997 = SQRT((0.978*Cos(1.176))^2 + 1*Sin(1.176))^2)
skew-81 = 0.955 = SQRT((0.938*Cos(0.54))^2 + 1*Sin(0.54))^2)
skew-91 = 1 = SQRT((1*Cos(0.876))^2 + 1*Sin(0.876))^2)

Fy2 = 0.519 = 0.93 (sbs-12) x 0.93 (sbs-32) x 0.925 (skew-42) x 0.68 (lbl-52) x 0.925 (skew-62) x 0.955 (skew-72) x 0.885 (lbl-82) x 0.955 (skew-92)

skew-42 = 0.925 = SQRT((0.805*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-62 = 0.925 = SQRT((0.805*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-72 = 0.955 = SQRT((0.938*Cos(0.54))^2 + 1*Sin(0.54))^2)
skew-92 = 0.955 = SQRT((0.938*Cos(0.54))^2 + 1*Sin(0.54))^2)

Fy3 = 0.813 = 1 (sbs-13) x 0.93 (sbs-23) x 0.997 (skew-43) x 0.925 (skew-53) x 0.68 (lbl-63) x 1 (skew-73) x 0.955 (skew-83) x 0.885 (lbl-93)

skew-43 = 0.997 = SQRT((0.978*Cos(1.176))^2 + 1*Sin(1.176))^2)
skew-53 = 0.925 = SQRT((0.805*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-73 = 1 = SQRT((1*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-83 = 0.955 = SQRT((0.938*Cos(0.54))^2 + 1*Sin(0.54))^2)

Fy4 = 0.403 = 0.888 (lbl-14) x 0.999 (skew-24) x 1 (skew-34) x 0.93 (sbs-54) x 1 (sbs-64) x 0.68 (lbl-74) x 0.925 (skew-84) x 0.997 (skew-94)

skew-24 = 0.999 = SQRT((0.998*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-34 = 1 = SQRT((1*Cos(1.176))^2 + 1*Sin(1.176))^2)
skew-84 = 0.925 = SQRT((0.805*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-94 = 0.997 = SQRT((0.978*Cos(1.176))^2 + 1*Sin(1.176))^2)

Fy5 = 0.41 = 0.999 (skew-15) x 0.888 (lbl-25) x 0.999 (skew-35) x 0.93 (sbs-45) x 0.93 (sbs-65) x 0.925 (skew-75) x 0.68 (lbl-85) x 0.925 (skew-95)

skew-15 = 0.999 = SQRT((0.998*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-35 = 0.999 = SQRT((0.998*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-75 = 0.925 = SQRT((0.805*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-95 = 0.925 = SQRT((0.805*Cos(0.876))^2 + 1*Sin(0.876))^2)

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Project: **Orangethorpe Avenue UC (WIDEN)** Project No. **08-115**
By CTY Date 12/10/08 Check by Date Sheet 11

Fy6 = 0.709 = 1 (skew-16) x 0.999 (skew-26) x 0.888 (lbl-36) x 1 (sbs-46) x 0.93 (sbs-56) x 0.997 (skew-76) x 0.925 (skew-86) x 0.68 (lbl-96)

skew-16 = 1 = SQRT((1*Cos(1.176))^2 + 1*Sin(1.176))^2)
skew-26 = 0.999 = SQRT((0.998*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-76 = 0.997 = SQRT((0.978*Cos(1.176))^2 + 1*Sin(1.176))^2)
skew-86 = 0.925 = SQRT((0.805*Cos(0.876))^2 + 1*Sin(0.876))^2)

Fy7 = 0.519 = 1 (lbl-17) x 1 (skew-27) x 1 (skew-37) x 0.888 (lbl-47) x 0.999 (skew-57) x 1 (skew-67) x 0.93 (sbs-87) x 1 (sbs-97)

skew-27 = 1 = SQRT((1*Cos(0.54))^2 + 1*Sin(0.54))^2)
skew-37 = 1 = SQRT((1*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-57 = 0.999 = SQRT((0.998*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-67 = 1 = SQRT((1*Cos(1.176))^2 + 1*Sin(1.176))^2)

Fy8 = 0.519 = 1 (skew-18) x 1 (lbl-28) x 1 (skew-38) x 0.999 (skew-48) x 0.888 (lbl-58) x 0.999 (skew-68) x 0.93 (sbs-78) x 0.93 (sbs-98)

skew-18 = 1 = SQRT((1*Cos(0.54))^2 + 1*Sin(0.54))^2)
skew-38 = 1 = SQRT((1*Cos(0.54))^2 + 1*Sin(0.54))^2)
skew-48 = 0.999 = SQRT((0.998*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-68 = 0.999 = SQRT((0.998*Cos(0.876))^2 + 1*Sin(0.876))^2)

Fy9 = 0.813 = 1 (skew-19) x 1 (skew-29) x 1 (lbl-39) x 1 (skew-49) x 0.999 (skew-59) x 0.888 (lbl-69) x 1 (sbs-79) x 0.93 (sbs-89)

skew-19 = 1 = SQRT((1*Cos(0.876))^2 + 1*Sin(0.876))^2)
skew-29 = 1 = SQRT((1*Cos(0.54))^2 + 1*Sin(0.54))^2)
skew-49 = 1 = SQRT((1*Cos(1.176))^2 + 1*Sin(1.176))^2)
skew-59 = 0.999 = SQRT((0.998*Cos(0.876))^2 + 1*Sin(0.876))^2)

where
lbl: line-by-line effect
sbs: side-by-side effect
skew: skew effect

Orangethorpe, 24" CIDH, 12/10/2008 lCC
ABUTMENTS

Pile-Head Deflection (in)	Max. Moment (lb-in)	Pile-Head (lb)	Depth to Max Moment (ft)
0.000000E+00	0.000000E+00	0.000000E+00	
2.500000E-01	7.846295E+05	2.627594E+04	5
5.000000E-01	1.464952E+06	4.286509E+04	6
1.000000E+00	2.628662E+06	6.282572E+04	6
3.000000E+00	6.274110E+06	1.070376E+05	8
5.000000E+00	9.133194E+06	1.353258E+05	9

BENT

0.000000E+00	0.000000E+00	0.000000E+00	
2.500000E-01	9.249115E+05	2.521147E+04	6
5.000000E-01	1.808719E+06	4.504395E+04	6
1.000000E+00	3.387642E+06	7.322866E+04	6
3.000000E+00	7.942552E+06	1.337088E+05	7
5.000000E+00	1.136807E+07	1.697507E+05	8

ABUT.PYO

```
**************************
* PROGRAM PYCURVE        *
* CODED BY PO LAM        *
* EARTH MECHANICS, INC.  *
* USING 1987 API CRIT.   *
* PROGRAM DATE: 3/20/89  *
**************************
```

Orangethorpe, Abutments, 24" CIDH 12/10/2008 LCC

NO. OF SOIL LAYERS	=	3
NO. OF P-Y CURVES	=	10
STATION NO. AT M.L.	=	-3
STATIC (0) OR CYCLIC (1) CRITERION	=	0

PILE DIAMETER (IN.)	=	24.0
INCREMENT LENGTH (IN.)	=	12.0
MULTIPLICATION FACTOR ON P	=	8.000E-01
MULTIPLICATION FACTOR ON Y	=	1.000E+00

DEPTH OF P-Y CURVES (FT) :

3.00 5.00 7.00 7.01 10.00 15.00 19.00 19.01 25.00 33.00

DEPTH (FT) TOP	BOTTOM	SOIL TYPE	DENSITY (PCF)	C (PSF)	J-COEFF	E-50	PHI (DEG)	INIT. MOD (LB/C. IN)
.0	7.0	1	120.00	.00	.0000	.0000	32.0	70.0
7.0	19.0	1	120.00	.00	.0000	.0000	30.0	45.0
19.0	35.0	1	123.00	.00	.0000	.0000	36.0	150.0

Orangethorpe, Abutments, 24" CIDH 12/10/2008 LCC

P-Y CURVES FOR 24.0 -IN. DIAMETER PILES

DEPTH (IN)	CURVE NO.	COORDINATES OF CURVE POINTS (P IN LB ; Y IN IN) P1	Y1	P2	Y2	P3	Y3	P4	Y4	P5	Y5	P6	Y6	P7	Y7	P8	Y8	P9	Y9
36.0	1	0.	.0	55	.028	257	.139	424	.277	508	.416	559	.832	559	1.387				
60.0	2	0.	.0	70	.021	324	.105	535	.210	641	.314	704	.629	704	1.048				
84.0	3	0.	.0	112	.024	516	.119	853	.239	1021	.358	1122	.716	1122	1.193				
84.1	4	0.	.0	94	.031	434	.156	718	.312	860	.468	945	.936	945	1.561				
120.0	5	0.	.0	175	.041	809	.204	1337	.407	1601	.611	1759	1.222	1759	2.037				
180.0	6	0.	.0	367	.057	1688	.283	2789	.567	3340	.850	3670	1.699	3670	2.832				
228.0	7	0.	.0	569	.069	2619	.347	4328	.694	5182	1.041	5694	2.082	5694	3.469				

ABUT.PYO

228.1 8 0. .0 957 .035 4404 .175 7277 .350 8713 .525 9575
1.049 9575 1.749
300.0 9 0. .0 1624 .045 7473 .226 12347 .451 14784 .677 16247
1.354 16247 2.257
396.0 10 0. .0 2788 .059 12826 .293 21191 .587 25374 .880 27883
1.760 27883 2.934

Orangethorpe, Abutments, 24" CIDH 12/10/2008 LCC

Q-W CURVES FOR BMCOL DATA FILE

P-Y CURVES FOR 24.0 -IN. DIAMETER PILES

0 1 -.671E+02 .832E-02 7 1
0 10 46 75 91 100 100
0 3 16 33 50 100 166

2 1 -.845E+02 .629E-02 7 1
0 9 46 76 91 100 100
0 3 16 33 50 100 166

4 0 -.135E+03 .716E-02 7 1
0 10 45 75 90 100 100
0 3 16 33 50 100 166

4 1 -.113E+03 .936E-02 7 1
0 10 45 76 91 100 100
0 3 16 33 50 100 166

7 1 -.211E+03 .122E-01 7 1
0 10 46 75 91 100 100
0 3 16 33 50 100 166

12 1 -.441E+03 .170E-01 7 1
0 10 46 75 90 100 100
0 3 16 33 50 100 166

16 0 -.683E+03 .208E-01 7 1
0 9 46 76 91 100 100
0 3 16 33 50 100 166

16 1 -.115E+04 .105E-01 7 1
0 10 46 75 91 100 100
0 3 16 33 50 100 166

22 1 -.195E+04 .135E-01 7 1
0 9 45 75 90 100 100
0 3 16 33 50 100 166

30 0 -.335E+04 .176E-01 7 1
0 9 45 75 90 100 100
0 3 16 33 50 100 166

12/11/08 LCC

Sheet 15

BENT.PYO

```
**************************
* PROGRAM PYCURVE        *
* CODED BY PO LAM        *
* EARTH MECHANICS, INC.  *
* USING 1987 API CRIT.   *
* PROGRAM DATE: 3/20/89  *
**************************
```

Orangethorpe, Bent 2, 24" CIDH 12/10/2008 LCC

NO. OF SOIL LAYERS	=	3
NO. OF P-Y CURVES	=	10
STATION NO. AT M.L.	=	-6 ✓
STATIC (0) OR CYCLIC (1) CRITERION	=	0

PILE DIAMETER (IN.)	=	24.0
INCREMENT LENGTH (IN.)	=	12.0
MULTIPLICATION FACTOR ON P	=	5.200E-01 ✓
MULTIPLICATION FACTOR ON Y	=	1.000E+00

DEPTH OF P-Y CURVES (FT) :

6.00 8.00 11.00 11.01 15.00 20.00 25.00 33.00 33.01 36.00

DEPTH (FT) TOP	BOTTOM	SOIL TYPE	DENSITY (PCF)	C (PSF)	J-COEFF	E-50	PHI (DEG)	INIT. MOD (LB/C. IN)
.0	11.0 ✓	1	120.00	.00	.0000	.0000	30.0 ✓	45.0
11.0	33.0 ✓	1	120.00	.00	.0000	.0000	36.0 ✓	150.0
33.0	37.0	1	123.00	.00	.0000	.0000	38.0 ✓	200.0

Orangethorpe, Bent 2, 24" CIDH 12/10/2008 LCC

P-Y CURVES FOR 24.0 -IN. DIAMETER PILES

DEPTH (IN)	CURVE NO.	COORDINATES OF CURVE POINTS (P IN LB ; Y IN IN) P1	Y1	P2	Y2	P3	Y3	P4	Y4	P5	Y5	P6
		Y6	P7	Y7	P8	Y8	P9	Y9				
72.0	1	0.	.0	47	.028	217	.140	358	.280	429	.420	471
.840	471	1.400										
96.0	2	0.	.0	77	.034	355	.172	586	.344	702	.516	772
1.031	772	1.718										
132.0	3	0.	.0	135	.044	623	.220	1030	.439	1234	.659	1356
1.317	1356	2.196										
132.1	4	0.	.0	224	.022	1032	.109	1705	.218	2042	.327	2244
.653	2244	1.089										
180.0	5	0.	.0	398	.028	1831	.142	3026	.284	3623	.425	3982
.851	3982	1.418										
240.0	6	0.	.0	685	.037	3152	.183	5208	.366	6236	.549	6853
1.098	6853	1.831										
300.0	7	0.	.0	1049	.045	4828	.224	7978	.449	9552	.673	10497
1.346	10497	2.243										

BENT.PYO

```
396.0    8      0.     .0   1793  .058   8249  .290  13629  .581  16320  .871  17934
1.742  17934  2.903
396.1    9      0.     .0   2142  .052   9857  .260  16286  .520  19500  .780  21429
1.561  21429  2.601
432.0   10      0.     .0   2541  .057  11692  .283  19317  .566  23130  .849  25417
1.697  25417  2.829
```

Orangethorpe, Bent 2, 24" CIDH 12/10/2008 LCC

Q-W CURVES FOR BMCOL DATA FILE

```
P-Y CURVES FOR  24.0 -IN. DIAMETER PILES
       0        1 -.566E+02  .840E-02    7    1
                              0   10     46   76   91  100  100
                              0    3     16   33   50  100  166
               2  1 -.926E+02  .103E-01    7    1
                              0   10     46   76   91  100  100
                              0    3     16   33   50  100  166
               5  0 -.163E+03  .132E-01    7    1
                              0   10     46   76   91  100  100
                              0    3     16   33   50  100  166
       5       1 -.269E+03  .653E-02    7    1
                              0    9     45   75   90  100  100
                              0    3     16   33   50  100  166
               9  1 -.478E+03  .851E-02    7    1
                              0   10     46   76   91  100  100
                              0    3     16   33   50  100  166
              14  1 -.822E+03  .110E-01    7    1
                              0   10     45   75   91  100  100
                              0    3     16   33   50  100  166
              19  1 -.126E+04  .135E-01    7    1
                              0    9     45   75   90  100  100
                              0    3     16   33   50  100  166
              27  0 -.215E+04  .174E-01    7    1
                              0   10     46   76   91  100  100
                              0    3     16   33   50  100  166
       27      1 -.257E+04  .156E-01    7    1
                              0   10     46   76   91  100  100
                              0    3     16   33   50  100  166
              30  0 -.305E+04  .170E-01    7    1
                              0   10     46   75   91  100  100
                              0    3     16   33   50  100  166
```

Abut.bc

```
Orangethorpe, Abutments, 24" CIDH, 12/10/2008 lCC
UNIT=lb,in
    1      0.25" Deflection
         2          1                                    30       12.0
        20          0    0    0    0          1    1   30
                100.00    0.001          0   10
         0          1    0.25
         0   30     0 2.650E+10      0.00        0.00
         0          1 -.671E+02  .832E-02     7    1
                                    0   10   46   75   91  100  100
                                    0    3   16   33   50  100  166
                2     1 -.845E+02  .629E-02     7    1
                                    0    9   46   76   91  100  100
                                    0    3   16   33   50  100  166
                4     0 -.135E+03  .716E-02     7    1
                                    0   10   45   75   90  100  100
                                    0    3   16   33   50  100  166
         4          1 -.113E+03  .936E-02     7    1
                                    0   10   45   76   91  100  100
                                    0    3   16   33   50  100  166
                7     1 -.211E+03  .122E-01     7    1
                                    0   10   46   75   91  100  100
                                    0    3   16   33   50  100  166
               12     1 -.441E+03  .170E-01     7    1
                                    0   10   46   75   90  100  100
                                    0    3   16   33   50  100  166
               16     0 -.683E+03  .208E-01     7    1
                                    0    9   46   76   91  100  100
                                    0    3   16   33   50  100  166
        16          1 -.115E+04  .105E-01     7    1
                                    0   10   46   75   91  100  100
                                    0    3   16   33   50  100  166
               22     1 -.195E+04  .135E-01     7    1
                                    0    9   45   75   90  100  100
                                    0    3   16   33   50  100  166
               30     0 -.335E+04  .176E-01     7    1
                                    0    9   45   75   90  100  100
                                    0    3   16   33   50  100  166
    2      0.5" Deflection
         2          1                                    30       12.0
        20          1    0    1    1          1    0    0
                100.00    0.001          0   10
         0          1    0.5
    3      1.0" Deflection
         2          1                                    30       12.0
        20          1    0    1    1          1    0    0
                100.00    0.001          0   10
         0          1    1.0
    4      3.0" Deflection
         2          1                                    30       12.0
        20          1    0    1    1          1    0    0
                100.00    0.001          0   10
         0          1    3.0
    5      5.0" Deflection
         2          1                                    30       12.0
        20          1    0    1    1          1    0    0
                100.00    0.001          0   10
         0          1    5.0
STOP
```

Bent.bc

```
Orangethorpe, Bent 2, 24" CIDH, 12/10/2008 lCC
UNIT=lb,in
    1      0.25" Deflection
         2          1                                        30       12.0
        20          0    0    0    0          1    1    30
               100.00    0.001          0   10
         0          1    0.25
         0   30     0 2.650E+10       0.00       0.00
         0          1 -.566E+02  .840E-02     7    1
                                    0   10   46   76   91  100  100
                                    0    3   16   33   50  100  166
               2    1 -.926E+02  .103E-01     7    1
                                    0   10   46   76   91  100  100
                                    0    3   16   33   50  100  166
               5    0 -.163E+03  .132E-01     7    1
                                    0   10   46   76   91  100  100
                                    0    3   16   33   50  100  166
         5          1 -.269E+03  .653E-02     7    1
                                    0    9   45   75   90  100  100
                                    0    3   16   33   50  100  166
               9    1 -.478E+03  .851E-02     7    1
                                    0   10   46   76   91  100  100
                                    0    3   16   33   50  100  166
              14    1 -.822E+03  .110E-01     7    1
                                    0   10   45   75   91  100  100
                                    0    3   16   33   50  100  166
              19    1 -.126E+04  .135E-01     7    1
                                    0    9   45   75   90  100  100
                                    0    3   16   33   50  100  166
              27    0 -.215E+04  .174E-01     7    1
                                    0   10   46   76   91  100  100
                                    0    3   16   33   50  100  166
        27          1 -.257E+04  .156E-01     7    1
                                    0   10   46   76   91  100  100
                                    0    3   16   33   50  100  166
              30    0 -.305E+04  .170E-01     7    1
                                    0   10   46   75   91  100  100
                                    0    3   16   33   50  100  166
    2      0.5" Deflection
         2          1                                        30       12.0
        20          1    0    1    1          1    0    0
               100.00    0.001          0   10
         0          1    0.5
    3      1.0" Deflection
         2          1                                        30       12.0
        20          1    0    1    1          1    0    0
               100.00    0.001          0   10
         0          1    1.0
    4      3.0" Deflection
         2          1                                        30       12.0
        20          1    0    1    1          1    0    0
               100.00    0.001          0   10
         0          1    3.0
    5      5.0" Deflection
         2          1                                        30       12.0
        20          1    0    1    1          1    0    0
               100.00    0.001          0   10
         0          1    5.0
STOP
```

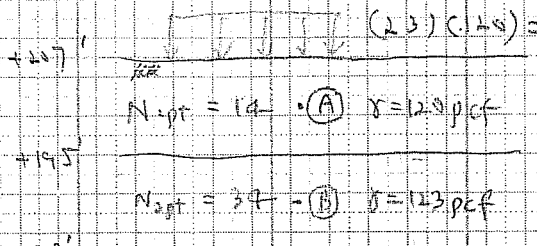
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project Orangethorpe Ave UC (Widen) Project No. 08-115

By LCC Date 12/11/08 Checked By _____ Date _____ Sheet 19 of ____

Settlement (23' sliver fill)



Point	Depth	σ_{vo} (ksf)	$\Delta\sigma$ (ksf)	σ_{vf} (ksf)	C'	Settlement
	0					
(A)		0.72	2.76	3.48	60	1.64"
	12					
(B)		2.79	2.76	5.55	85	0.93"
	34					2.57"

$$\text{Settlement} = H \frac{1}{C'} \log \frac{\sigma_{vf}}{\sigma_{vo}} \quad \text{(FHWA, 1982)}$$

Abutment Lateral Earth Pressures

$\phi = 32°$ (Compacted Fill)

$K_a = \tan^2(45 - \frac{\phi}{2}) = 0.30$

$K_a\gamma = (120)(0.3) = 36$ pcf

$K_o = 1 - \sin\phi = 1 - \sin 32° = 0.47$

Earth Mechanics, Inc.
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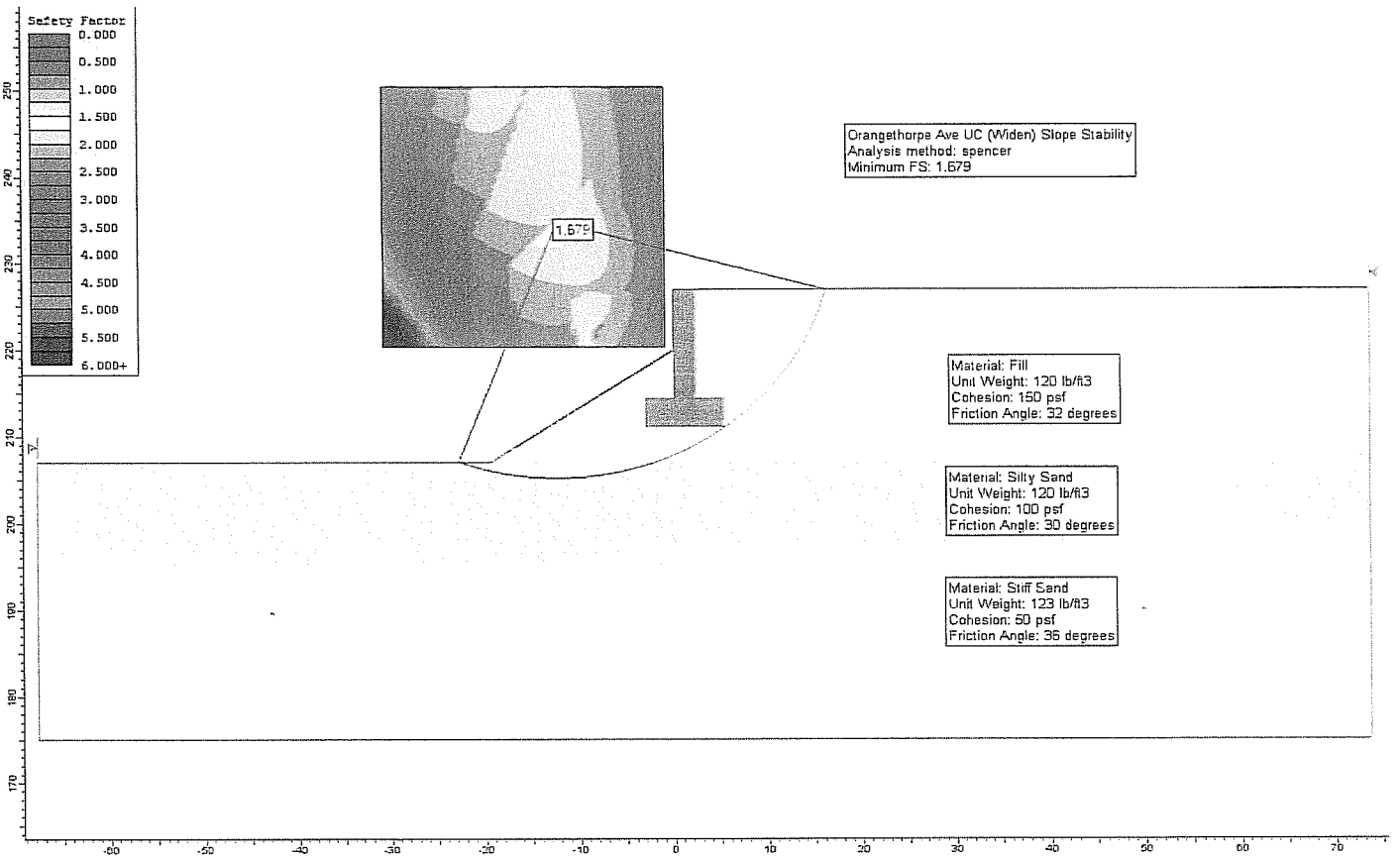
Project: **Orangethorpe Avenue UC (WIDEN)** Project No. **08-115**

By AZ Date 01/08/09 Check by Date Sheet

Static Slope Stability



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

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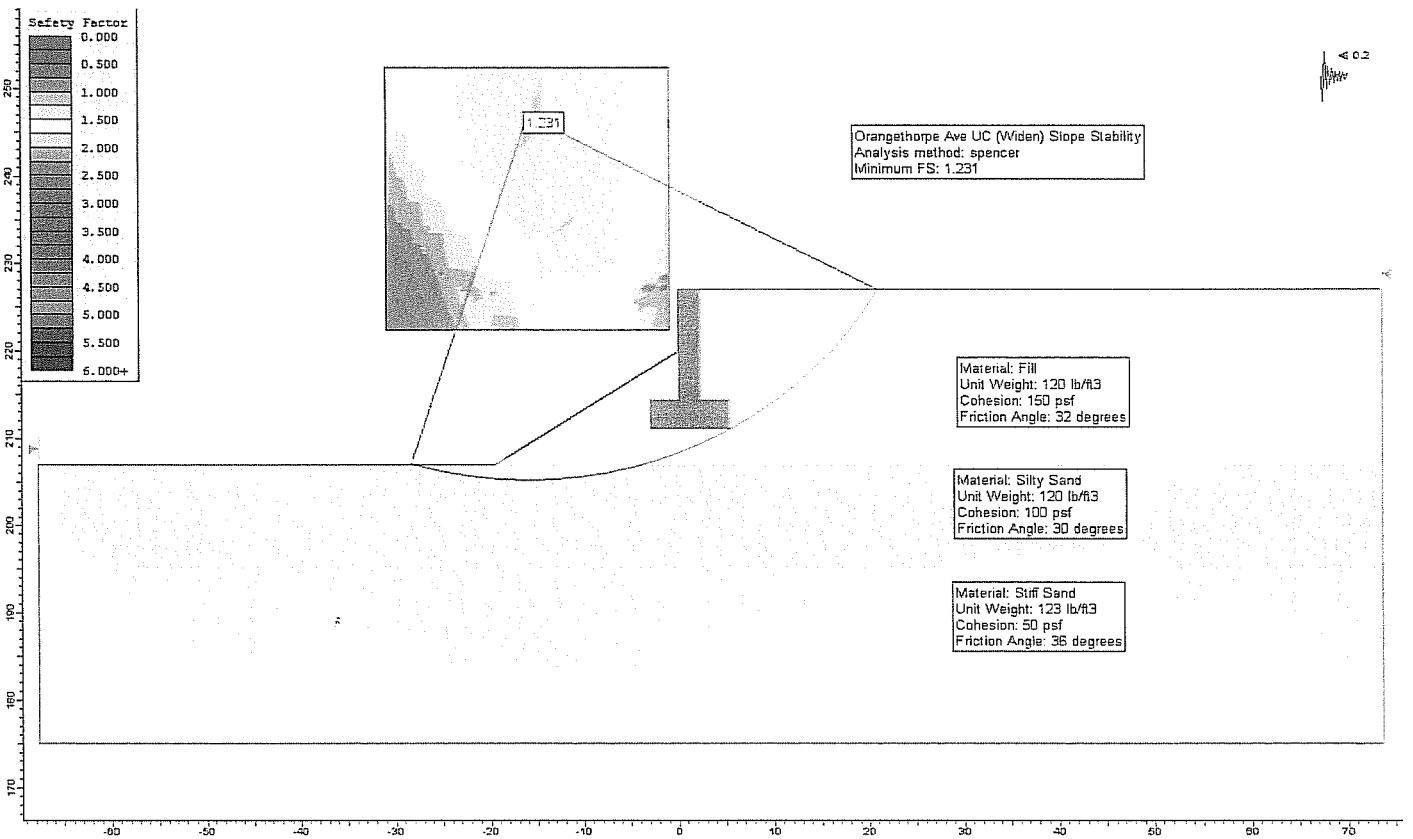
Project: **Orangethorpe Avenue UC (WIDEN)** Project No. **08-115**

By AZ Date 01/08/09 Check by Date Sheet

Seismic Slope Stability



APPENDIX D

CALTRANS REVIEW COMMENTS AND EMI RESPONSES

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: May 27, 2009
File: 12-ORA-57-PM 16.4
12-0F0311
Orangethorpe Ave UC
Bridge No. 55-0459
SR-57 Northbound Widening

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of response to our comments on Foundation Report

On May 20, 2009, the Office of Geotechnical Design-South 1 received the response to our review comments on the Foundation Report prepared by Earth Mechanics Inc. for Orangethorpe Avenue Undercrossing, Br. No. 55-0459. The response has been examined thoroughly and it is our opinion that the Foundation Report could be finalized after addressing additional comment as below:

- Please correct the typing error in Section 5.5 (sliver fill, not silver fill).

If you have any questions please call Chungkeun Lee at (213) 620-2148 or Chi-Tseng Ted Liu at (213) 620-2136.

Prepared by: Date: 5/27/09

REGISTERED PROFESSIONAL ENGINEER
CHUNGKEUN LEE
C69450
Exp. 6/30/10
CIVIL
STATE OF CALIFORNIA

Chungkeun Lee, P.E.
Transportation Engineer
Office of Geotechnical Design South 1
Branch C

Reviewed by: Date: 5/27/09

REGISTERED PROFESSIONAL ENGINEER
CHI-TSENG TED LIU
No. 2669
Exp. 6/30/2010
GEOTECHNICAL
STATE OF CALIFORNIA

Chi-Tseng Ted Liu, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design South 1
Branch C

c: OGDS1 - LA. File (2)
OGDS1-SAC. File (1)
GS-SAC, File (1)

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

May 20, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Attention: Mr. Steve Huff

Subject: Response to Caltrans Foundation Review Comments on "Foundation Report (dated 2/04/09) Orangethorpe Avenue UC (Widen), Bridge No. 55-0459, SR-57 Northbound Widening"
12-ORA-57, PM 16.4, EA 12-0F0311

Dear Mr. Huff:

Caltrans issued a Foundation Review sheet dated April 2, 2009 for the subject project. A copy of this review sheet is attached. The following are our responses to those comments:

Section 2.1, Field Investigation

Response: See attached revised LOTB sheet.

The revised Table 2-1 is presented below:

Table 2-1. Geotechnical Exploration Information

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-001	SR-57 (B-Line)	471+05	97 RT	+225.4	+133.9	None Encountered During Drilling
A-08-002		472+27	115 RT	+206.1	+134.6	
A-08-003		473+35	90 RT	+227.8	+136.3	

Section 5.4, Pile Foundation Design

Response: Bridge designers have been in discussions with Southern California Gas Co. (SCG) with regards to this existing high pressure gas transmission line. They have reached a consensus on how we will handle the construction of the bridge widening. Here is a summary of the key decisions that were made (we can provide supporting emails, if needed):

(1) The existing lines will not be encased.
(2) Portions of existing lines will be exposed by vacuum extraction prior to beginning work on the column foundations.

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

(3) The locations for the CIDH piles next to the gas lines will be vacuum extracted to a depth below the existing gas line prior to allowing a drill rig to complete the excavation.
(4) Any excavation work done within two feet of the existing gas lines will be done by vacuum extraction.
(5) SCG representatives will be invited to attend the pre-construction meeting. They will be given time to review the final plans prior to construction and will be notified about all scheduled work near their lines so they can be present and monitor the activities.
(6) The contractor will notify dig alert to have SCG mark the location of the lines prior to construction.

In addition according to the bridge designers, in order to protect the existing 36" High Pressure Gas pipe line from any soil pressure due to any seismic movement of the new pilecap at Bent 2, an isolation material will be provided between the pilecap and the gas pipe. This detail will be included in the 100% Submittal Plan Set.

Section 5.4.2, Foundation Data Provided by Structural Designers

Response: The revised Table 5-3 is presented below:

Table 5-3. Foundation Design Data Sheet

Location	Design Method	Pile Type	Finished Grade El. (ft)	Pile Cut-off El. (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (inch)	Number of Piles per Support
					B	L		
Abutment 1	WSD	24" CIDH	218.55	209.55	8.5	17.5	1	4
Bent 2	LRFD		206.10	199.75	14	16		9
Abutment 3	WSD		221.13	211.58	8.5	17.5		4

Section 5.4.3, Axial Capacity

Response: We incorporated the group efficiency factors per AASHTO LRFD Bridge Design Specification. Our calculation sheets are attached. As shown, specified pile tip elevations were deepened by up to 7 feet as compared to our previous recommendation.

There were significant changes in the foundation loads. The revised Table 5-4 (as given by the bridge designers) is presented below:

Table 5-4. Foundation Design Loads

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Perma -nent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abut 1	800	200	550	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bent 2	1130	N/A	820	1560	230	-	-	820	400	0	200
Abut 3	800	200	550	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

The revised Table 5-5 is presented below:

Table 5-5. Abutment Foundations Design Recommendations

Support	Pile Type	Cut-Off Elev. (feet)	LRFD Service-I Limit State Load (kips) per Support		LRFD Service-I Limit State Total Load (kips) per Pile (Compression)	Nominal Resistance (kips)	Design Tip Elev. (feet)[1]	Specified Tip Elev. (feet)[2]
			Total	Permanent				
Abut 1	24" CIDH	209.55	800	550	200	400	+168 (a) +172 (c) +180 (d)	+168
Abut 3	24" CIDH	211.58	800	550	200	400	+168 (a) +172 (c) +180 (d)	+168

Notes:
1. Design tip elevation is controlled by the following demands: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for lateral and settlement.

The revised Table 5-6 is presented below:

Table 5-6. Bent Foundation Design Recommendations

Support Location	Pile Type	Cut-off El. (ft)	Service-I Limit State Load (kips) Per Support	Total Permissible Support Settlement (inches)	Required Factored Nominal Resistance (kips)				Design Tip El. (ft)[1]	Specified Tip El. (ft)[2]
					Strength Limit		Extreme Event			
					Comp. ($\phi = 0.7$)	Tension ($\phi = 0.7$)	Comp. ($\phi = 1$)	Tension ($\phi = 1$)		
Bent 2	24" CIDH	199.75	1130	1	230	0	400	200	+168 (a-I) +160 (a-II) +171 (b-II) +168 (c) +170 (d)	+160

Notes:
1. Design tip elevation is controlled by the following demands: (a-I) Compression (Strength Limit), (a-II) Compression (Extreme Event), (b-II) Tension (Extreme Event), (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for tension, lateral and tolerable settlement.

The revised Table 5-7 is presented below:

Table 5-7. Pile Data Table

Location	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)	Specified Tip El. (ft)
		Compression	Tension		
Abutment 1	24" CIDH	400	0	+168 (a) +172 (c) +180 (d)	+168
Bent 2		400	200	+160 (a) +171 (b) +168 (c) +170 (d)	+160
Abutment 3		400	0	+168 (a) +172 (c) +180 (d)	+168

Notes:
1. Design tip elevations for ***Abutments*** are controlled by: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. Design tip elevations for ***Bent*** are controlled by: (a) Compression, (b) Tension, (c) Settlement, and (d) Lateral Load.

Appendix A-Log of Test Borings (LOTB) Sheets and As-Built Log of Test Borings Sheets

Response: The attached LOTB sheets incorporated the following revisions per Caltrans review:

- An appropriate border is used in the attached LOTB sheets.
- Groundwater Not Encountered during drilling is added under each boring.
- Conversion factor from 2.4" California Modified Ring sampler blowcount to 1.4" Standard Penetration Test sampler blowcount is added to the "Notes"
- We added Vertical Datum is NAVD 88.
- Apparent densities are revised to correspond to SPT blowcounts corrected with energy ratio
- Apparent densities have been included in the top description of A-08-001, A-08-002 and A-08-003.
- We corrected the "layer presentation" for 5' below top of A-08-001 and 60' below top of A-08-002.
- Proper title block is now included.
- The following sentence will be added to Section 2.1 Field Investigation:
  "About 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV 88)."

Appendix B-Laboratory Test Results

Response: Table 1 in Appendix B is quite congested already. We will add the attached Table 2 (bulk samples test results) and Table 3 (Strength test results) in Appendix B.

We will also add the following sentence at the beginning of Section 6.2 Pile Construction:

"For on-center pile spacings less than six times the pile diameter, no two adjacent piles can be constructed concurrently."

Sincerely,
EARTH MECHANICS, INC.

Lino Cheang

Lino Cheang, GE 2345
Project Manager

Attachments
-Caltrans Foundation Review sheet dated April 2, 2009
-Axial Pile Capacity Calculation Sheets
-Table 2 and Table 3, Appendix B
- Revised LOTB Sheets

in foundation report

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: April 2, 2009
File: 12-ORA-57-PM 16.4
12-0F0311
Orangethorpe Ave UC
Bridge No. 55-0459
SR-57 Northbound Widening

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of the Draft Foundation Report

On February 26, 2009, the Office of Geotechnical Design-South 1, Branch C received the Foundation Report (FR) prepared by Earth Mechanics Inc, dated February 4, 2009, and 65% Unchecked Details Plans for the Northbound widening of Orangethorpe Avenue Undercrossing, Bride No. 55-0459. We reviewed the report and plan sheets, and our comments are as follows.

2.1 Field Investigation

- The station line (B-Line) is not defined clearly in this section of the report and Log of Test Boring (LOTB) Sheets.
- Please correct the boring numbers in Table 2-1 of this section (e.g. A-08-001, not A-08-01).

5.4 Pile Foundation Design

- Since new cast-in-drilled-hole (CIDH) piles will be installed close to the pile for existing bridge and gas pipeline at Bent 2, it should be addressed how to minimize the impact of new pile installation on the bridge and pipeline in foundation design.

5.4.2 Foundation Data Provided by Structural Designers

- The pile cut-off elevations and pile cap sizes for Abutment 1 and 3 in Table 5-3 do not match the plans.

5.4.3 Axial Capacity

- According to AASHTO LRFD BRIDGE DESIGN SPECIFICATION (p 10-142), group effect of CIDH pile should be considered if center-to-center spacing of drilled shafts is less than 4.0 times pile diameters, not 3.0 times pile diameters as mentioned in this report.
- There should be compression and tension load demand per support in Extreme Event Limit State in Table 5-4 of this report.

- According to Table 5 in Caltrans Memo To Designers 3-1 (July 2008), LRFD Service-1 Limit State Total Load and Permanent Load per Support should be included in Table 5-5 of this report and Nominal Resistance should be rounded-up to the nearest 10 kips. Also, Design Tip Elevations for load demands should be determined under the consideration of pile group effect if group efficiency should be applied.
- According to Table 8 in Caltrans Memo To Designers 3-1 (July 2008), Required Factored Nominal Resistance in Table 5-6 and LRFD Service-1 Limit State Loads in Table 5-5 of this report should not be rounded
- According to Table 9 in Caltrans Memo To Designers 3-1 (July 2008), Nominal Resistance in Table 5-7 of this report should be rounded up.

Appendix A-Log of Test Boring (LOTB) Sheets and As-Built Log of Test Borings Sheets

- Please refer to the Caltrans Soil and Rock Logging Manual (June 2007), and use an appropriate LOTB border.
- When groundwater is not shown on the borings, explain in a sentence under each boring such as groundwater was not encountered or measured during field investigation.
- Correction/multiplication factor for conversion of 2.4" California Modified ring sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.
- It is required to note datum used for surveying boreholes in LOTB (NGVD 29 or NAVD88).
- The descriptions for apparent density of cohesionless soil in LOTB are not corresponding with SPT blow counts corrected with energy ratio.
  - A-08-001: 40, 45, 55 and 60 feet below top of borehole
  - A-08-002: 10, 45 feet below top of borehole
  - A-08-003: 15, 20, 30, 40, 60, 85 feet below top of borehole
- Please estimate apparent density and include it in the top description of A-08-001, A-08-002 and A-08-003.
- The "layer presentation" method should be applied to the descriptions for 5.0 feet below top of borehole in A-08-001 and 60 feet below top of borehole in A-08-002.
- As-Built Log of Test Borings containing proper title block conforming to Caltrans Soil and Rock Loggin Manual should be included in the project plan.
- If As-Built Log of Test Borings was surveyed with different datum, it is required to include conversion factor of the datum to NAVD 88.

Appendix B-Laboratoy Test Results

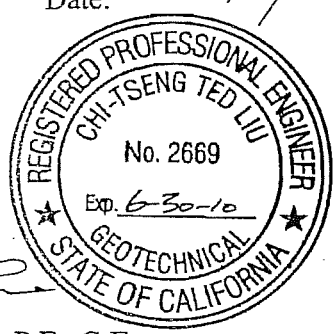
- It is recommended to include all testing results (Direct shear and bulk samples) in Table 1.

If you have any questions, please contact Chungkeun Lee at (213) 620-2148 or Ted Liu at (213) 620-2136.

Prepared by: Date: 04/02/09

Chungkeun Lee, P.E.
Transportation Engineer
Office of Geotechnical Design South 1
Branch C

Reviewed by: Date: 4/2/09



Chi-Tseng Ted Liu, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design South 1
Branch C

Prepared by: Date:

FARAMARZ GERAMI, P.G., C.E.G.
Engineering Geologist
Office of Geotechnical Design South 1
Branch C

c: OGDS1 - LA. File (2)
OGDS1 - Sac. File (1)
GS – Sac. File (1)

FINAL FOUNDATION REPORT

South Placentia OH (WIDEN)
Bridge No. 55-0450
SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 16.7
EA 12-0F0311

EMI Project No. 08-115
Date: June 17, 2009

EARTH MECHANICS, INC.

Geotechnical and Earthquake Engineering

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

June 17, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Attention: Mr. Steve Huff, P.E.

Subject: **Final Foundation Report for South Placentia Overhead (WIDEN),**
Bridge No. 55-0450
SR-57 Northbound Improvement Project, Orange County, California
12-Ora-57, PM 16.7, EA 12-0F0311

Dear Mr. Huff:

Attached please find the final Foundation Report for the subject bridge widening project. This report contains the findings and conclusions of our field investigation and laboratory testing program. This report also contains our recommendations for the design and construction of the bridge foundation.

A draft version of this report dated February 4, 2009 was submitted to Caltrans for their review. Review comments and our responses are included in Appendix D. Our responses are all incorporated into this final report.

We appreciate the opportunity to provide geotechnical design services for this project. If you have any questions, please call us.

Sincerely,
EARTH MECHANICS, INC.

Amir Zand, RCE 73910
Staff Engineer

Lino Cheang, GE 2345
Project Manager

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FINAL FOUNDATION REPORT

SOUTH PLACENTIA OVERHEAD (WIDEN)
BRIDGE NO. 55-0450
SR-57 NORTHBOUND IMPROVEMENT PROJECT
ORANGE COUNTY, CALIFORNIA
12-Ora-57, PM 16.7
EA 12-0F0311

Prepared for:

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Prepared By:

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June 17, 2009

TABLE OF CONTENTS

Section	Page
1.0 INTRODUCTION	**1**
1.1 Purpose and Scope of Study	1
1.2 Project Description	1
2.0 FIELD INVESTIGATION AND LABORATORY TESTING	**4**
2.1 Field Investigation	4
2.2 Laboratory Testing	5
3.0 GEOLOGY AND SEISMICITY	**6**
3.1 Topography and Drainage	6
3.2 Physiography	6
3.3 Geologic Structure	6
3.4 Geologic Hazards	8
3.5 Stratigraphy	8
3.6 Seismicity	10
4.0 SUBSURFACE CONDITIONS	**11**
4.1 Soil Conditions	11
4.2 Groundwater Conditions	12
5.0 CONCLUSIONS AND RECOMMENDATIONS	**13**
5.1 Seismic Design Criteria	13
5.2 Liquefaction	15
5.3 Soil Corrosivity	15
5.4 Pile Foundation Design	15
5.4.1 Foundation Type	15
5.4.2 Foundation Data Provided by Structural Designers	15
5.4.3 Axial Capacity	16
5.4.4 Lateral Resistance	18
5.5 Embankments and Settlement	18
5.6 Bridge Abutment Wall Design	20
6.0 CONSTRUCTION RECOMMENDATIONS	**21**
6.1 Earthwork	21
6.2 Pile Construction	21
6.3 Backdrain and Backfill Requirements For Abutment Walls	22
6.4 Review of Construction Plans	22
6.5 Geotechnical Observation and Testing	24
7.0 LIMITATIONS	**25**
8.0 REFERENCES	**26**

List of Tables Page

Table 2-1. Geotechnical Exploration Information 4
Table 4-1. Idealized Soil Profile and Strength Parameters 11
Table 5-1. Local Seismic Sources 13
Table 5-2. Soil Corrosion Test Results 15
Table 5-3. Foundation Design Data Sheet 16
Table 5-4. Foundation Design Loads 16
Table 5-5. Abutment Foundations Design Recommendations 17
Table 5-6. Bent Foundation Design Recommendations 17
Table 5-7. Pile Data Table 18
Table 5-8. Lateral Pile Solutions 19

List of Figures Page

Figure 1-1. Site Location Map 2
Figure 3-1. Regional Fault and Physiographic Map 7
Figure 3-2. Geological Map 9
Figure 5-1. Design ARS Curve 14
Figure 6-1. Low Expansion Material in Bridge Embankment 23

APPENDICES

Appendix A. Log of Test Borings Sheets and As-built Log of Test Borings Sheet
Appendix B. Laboratory Test Results
Appendix C. Design Calculations
Appendix D. Caltrans Review Comments and EMI Responses

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF STUDY

This Foundation Report presents the findings and conclusions of a geotechnical investigation conducted by Earth Mechanics, Inc. (EMI). It presents foundation design and construction recommendations for proposed widening of the South Placentia Overhead (OH) in Orange County, California. A site location map is presented in Figure 1-1.

This work was performed for the Orange County Transportation Authority (OCTA) and EMI is a subconsultant to RBF Consulting (RBF). The geotechnical services provided for this project included the following tasks:

- Collection and review of existing geotechnical information;
- Field exploration consisting of drilling and logging exploratory borings;
- Laboratory testing of selected bulk and relatively undisturbed soil samples;
- Engineering calculations (see Appendix C) and analysis to develop foundation design and construction recommendations; and
- Preparation of this report presenting our findings, conclusions, and recommendations.

1.2 PROJECT DESCRIPTION

The Department of Transportation (Caltrans) – District 12, in cooperation with the Orange County Transportation Authority (OCTA), proposed to widen northbound State Route 57 (SR-57) by adding one northbound through lane. The project limits are between 0.2 mile south of Orangethorpe Avenue and 0.2 mile north of Yorba Linda Boulevard along northbound SR-57. Within the project limits, there are interchanges located at Orangethorpe Avenue, Chapman Avenue, Nutwood Avenue and Yorba Linda Boulevard. The entire project involves widening seven existing bridges and a tieback wall at Yorba Linda Boulevard:

- Orangethorpe Avenue Undercrossing (Bridge No. 55-0459)
- South Placentia Overhead (Bridge No. 55-0450)
- Crowther Avenue Undercrossing (Bridge No. 55-0457)
- Placentia Overhead (Bridge No. 55-0449)
- Placentia Avenue Undercrossing (Bridge No. 55-0460)
- Chapman Avenue Undercrossing (Bridge No. 55-0456)
- Nutwood Avenue Undercrossing (Bridge No. 55-04649)
- Tieback Wall at Yorba Linda Boulevard (Bridge No. 55-0468)

This report pertains to South Placentia OH only; separate foundation reports are prepared for each of the above seven remaining structures.

The South Placentia OH is located in the City of Placentia north of the SR-57/SR-91 interchange. SR-57 in the project area trends in a north-south direction and carries traffic from the "Orange Crush" (I-5/SR-22/SR-57 Interchange) in Orange County to Interstate 210 in Los Angeles County (See Figure 1-1).

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SITE LOCATION MAP

Figure 1-1

SOUTH PLACENTIA OVERHEAD (WIDEN)

Project No. 08-115

Date: 01-28-09

The existing South Placentia Overhead (Bridge No. 55-0450) is a three-span structure that carries SR-57 northbound and southbound traffic over BNSF R.R. Spur Track in the City of Placentia. BNSF R.R. Spur Track is a local city track. Parking and pedestrian are prohibited on both sides of track.

The structure was originally constructed in 1969 following the 1961 AASHTO design specifications with Caltrans supplements. The structure has three spans with a total span length of 101'-10"±. The structure is a Cast-In-Place Reinforced Concrete "T" Girder with a depth of 2'-6" ±. Total width of the bridge is 185'-0" ± max and varies, and it consists of two structures, one for the northbound and one for the southbound of SR-57. The two structures are separated with 1" wide longitudinal expansion joint filler. The superstructures are supported on two diaphragm abutment walls and two multicolumn bents. All existing foundations are supported on 16" (45 ton) CIDH concrete piles. The structures are joined at the centerline of SR-57 along the deck. The same expansion joints extend down to the bottom of the existing diaphragms abutments.

The structure was widened in 1991, by approximately 12'-8 ½"± on the northbound side to provide an additional 12-foot lane in that direction. The widening is a continuous three-span reinforced concrete "T" girder bridge on two single column bents and open end reinforced concrete diaphragm abutments. All widening foundations are supported on (45 ton) CIDH concrete piles. The existing bridge supports five lanes of northbound and five lanes of southbound traffic.

This project will widen South Placentia Overhead by approximately 23'-2 3/8" on the northbound side to provide an additional 12-foot lane in that direction.

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 FIELD INVESTIGATION

Copies of the As-Built Log-of-Test-Borings (LOTB) sheets are included in Appendix A; about 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV 88). According to these As-Built LOTB sheets, three penetration borings and one rotary-wash boring were performed in April 1966. Two hollow stem auger borings (B-1 and B-2) were performed in December 1988. During the exploration in 1966, the rotary boring was the deepest boring and was advanced to about El. +159 feet. The borings drilled in 1988 were about 60 feet deep and were advanced to about El. +169 feet. Existing grade at the borehole location at the time of the investigation in 1966 and 1988 was approximately El. +206 feet and El. +229 feet, respectively. Groundwater was not encountered during drilling in April 1966 and December 1988 down to El. +159 and +169 feet, respectively.

To supplement the existing subsurface data, two soil borings were drilled (one at each abutment). These borings were drilled on September 22, 2008. Boring information, including exploration number, stations, offsets, ground surface elevations, bottom of hole elevations and water level measurements are summarized in Table 2-1. Locations of the exploratory boring are shown on the LOTB sheet provided in Appendix A.

TABLE 2-1. GEOTECHNICAL EXPLORATION INFORMATION

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-004	SR-57 (B-Line)	483+85	90 RT	+231.9	+141.5	None Encountered During Drilling
A-08-005		485+12	90 RT	+233.5	+142.1	

Exploratory borings were drilled using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. Relatively undisturbed drive samples were obtained using a 3.25-inch outer diameter California split-spoon sampler lined with brass rings. Each of these brass rings is 1-inch long with a 2.5-inch outside diameter. The California Drive sampler was driven into the ground using successive blows of a 140-lb hammer falling a distance of 30 inches. The numbers of blow for the final 12 inches or shorter of driving are shown on the LOTB sheet.

The Standard Penetration Test (SPT) sampler (1.4-inch inside diameter) was also used to obtain soil samples. The sampler was driven into the ground using a 140-lb hammer free falling from a height of 30 inches. The numbers of blow to advance the sampler each 6 inches of penetration or less was recorded. The blow counts required to drive the sampler for the last 12 inches or less was recorded as the Standard Penetration Resistance (N-value) on the LOTB sheet.

Charts published by Winterkorn and Fang (1975) can be used to determine a reduction factor used to convert blowcounts recorded using the California Drive sampler into SPT blowcounts. Using those charts, we obtained a reduction factor of 0.5 and this one-half reduction factor was used for this project.

The sampling interval is usually 5 feet. Sampling was performed by alternating the California Drive sampler and SPT sampler.

2.2 LABORATORY TESTING

Soil samples considered representative of the subsurface conditions were tested to obtain or derive relevant physical and engineering soil properties. The following laboratory tests were conducted to supplement the observations recorded during the field investigation:

- In-situ Moisture Content and Unit Weight
- Plasticity Index
- Particle Size Analysis
- Direct Shear
- Consolidation
- Minimum Resistivity, pH, Sulfate Content and Chloride Content

The laboratory tests were conducted in general accordance with California Test Methods or American Society for Testing and Materials (ASTM) Standards. Laboratory test results are included in Appendix B.

3.0 GEOLOGY AND SEISMICITY

3.1 TOPOGRAPHY AND DRAINAGE

The project corridor is in the eastern part of the Los Angeles Basin along the southern margin of the Coyote Hills and the Puente Hills (Figure 3-1). Just north of the project corridor, the Puente Hills rise to an elevation of about 1,400 feet. The southwestern edge of the Puente Hills is paralleled by a series of low-elevation plains and hills; the Santa Fe Plain and the Coyote Hills are to the west of the project corridor, and the Richfield and Kraemer Hills are to the east. The elevations of these hills range from about 500 feet just west of the project to about 300 feet in the east. The ground upon which the project is located slopes gently to the south. Elevations along the project corridor range from about 280 feet in the north to about 200 feet on the south.

The project corridor traverses the ancient flood plains and alluvial fans of Fullerton Creek and the Santa Ana River. The major drainage in the area is the Santa Ana River which flows westerly south of the site. Fullerton Creek, a tributary to the Santa Ana River, drains southwesterly from the Puente Hills just west of the project corridor.

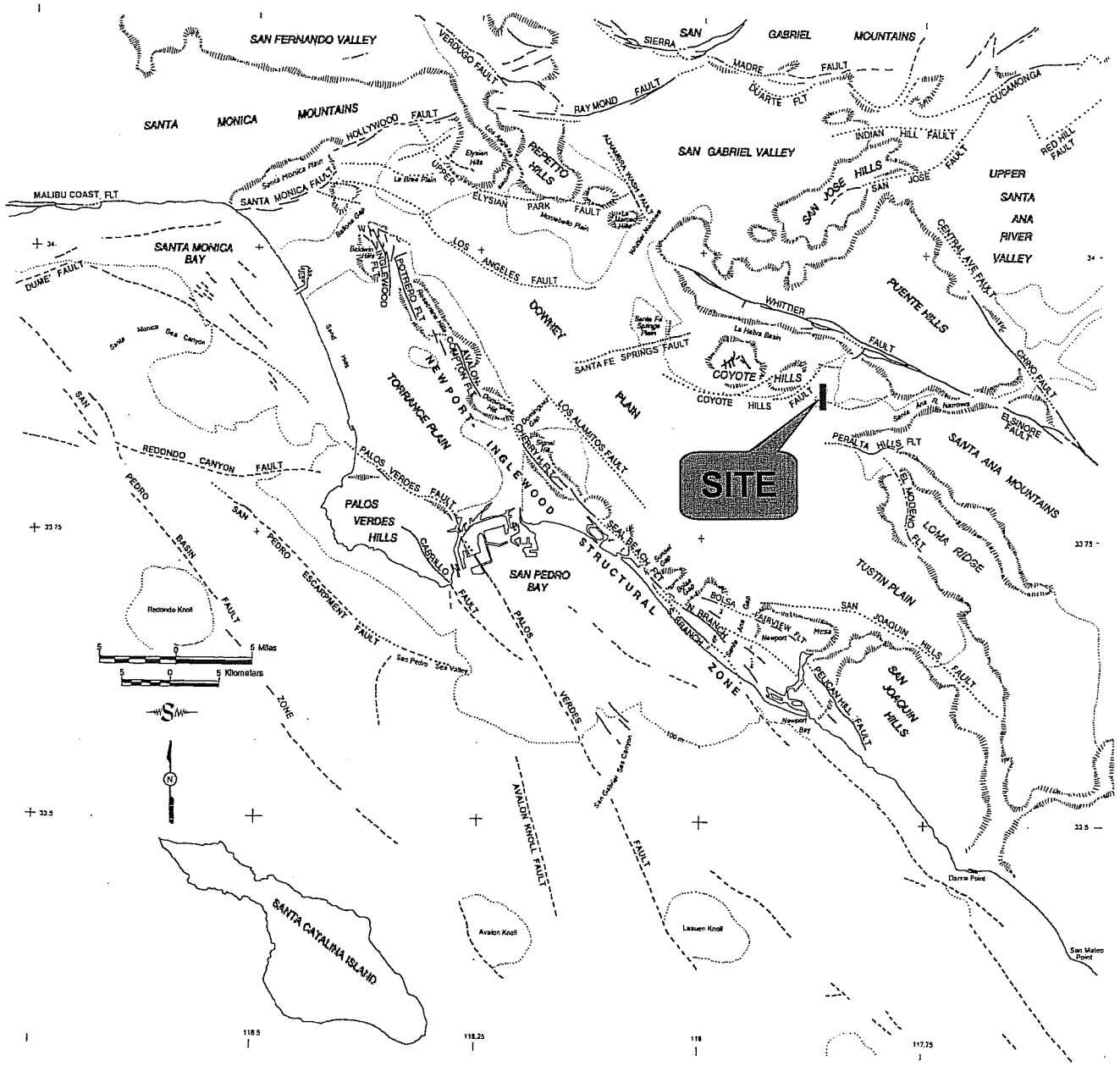
3.2 PHYSIOGRAPHY

The site area is at the eastern edge of the Los Angeles physiographic basin, a large, relatively flat, low-lying, coastal plain surrounded by mountains on the north, east, and southeast (Figure 3-1). The floor of the Los Angeles Basin is relatively flat but slopes gradually southwesterly from an elevated marginal apron to sea level along the coastline. The western margin of the Los Angeles Basin is bordered by the sea and the Palos Verdes Hills. The eastern margin is bordered by the Puente Hills and Santa Ana Mountains. The Coyote Hills, Santa Fe Springs Plain, Richfield Hills, and Kramer Hills are low elevation uplifts along the southern margin of the Puente Hills.

3.3 GEOLOGIC STRUCTURE

The geologic structure at the site is quite simple and is characterized by flat-lying Quaternary sediments overlying gently folded Tertiary sedimentary rocks. These strata rise gently to the Coyote Hills, Richfield Hills, and Kraemer Hills where they are arched upward to form anticlinal folds. The site is on the south limb of these anticlines with the early Pleistocene and Tertiary age strata dipping gently to the south and overlain by younger flat-lying Quaternary sediments.

The nearest active or potentially active surface faults are the Peralta Hills and Whittier faults (Figure 3-1). The low-elevation plains and hills along the eastern margin of the Los Angeles Basin are underlain by a series of east-west trending, en echelon, faults and folds in the subsurface; the major faults within this trend are, from north to south, the Los Angeles (Las Cienegas), Santa Fe Springs, and Coyote Hills faults (Figure 3-1). This group of faults is known as the Puente Hills fault system. Other poorly known segments of this thrust fault system underlie the Richfield and Kramer hills. All of these faults are blind thrust or reverse faults that approach within about a mile or so of the ground surface. They are identified on seismic reflection geophysical data only and are below the depths of oil wells.



SOUTH PLACENTIA OH (WIDEN)

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REGIONAL FAULT AND PHYSIOGRAPHIC MAP

Figure 3-1

Project No. 08-115

Date: 01-28-09

The Peralta Hills fault may be related to the Puente Hills fault system. The Peralta Hills fault is exposed along the south flank of the Peralta Hills where it displaces Tertiary-age rocks upward and over younger Quaternary alluvium. The fault extends westerly below the Santa Ana River channel where it creates barriers to ground-water flow (Figure 3-2). The barriers extend about to the SR 57 freeway just north of the Lincoln Avenue (Morton and Miller, 1981). The location of the Peralta Hills fault is well up on the flank of the hills rather than at the base of the hills indicating that it is not the only fault responsible for uplift and folding of the Peralta Hills. There must be a deeper unknown blind thrust fault below the Peralta Hills thrust fault but this feature has never been directly identified.

The Whittier fault is a major strike slip fault that extends northwesterly along the southwest flank of the Puente Hills northeast of the site (Figure 3-1). The Whittier fault is associated with the Chino fault and the Elsinore fault and together these faults form a major fault system that extends from the Los Angeles Basin into northern Mexico.

The El Modeno fault is a north-south trending feature within Loma Ridge, one of the foothills of the Santa Ana Mountains, southeast of the site. The feature is poorly known but is known to displace Holocene soil in Loma Ridge. Although the fault is grouped with the Peralta Hills fault on the Caltrans seismic hazard map (Mualchin 1996), it appears to be a discrete normal or strike-slip fault unrelated to the thrust faults of the Peralta Hills. Although the fault must be considered active because it displaces Holocene soil, the feature has a very long (thousands of years) recurrence interval.

3.4 GEOLOGIC HAZARDS

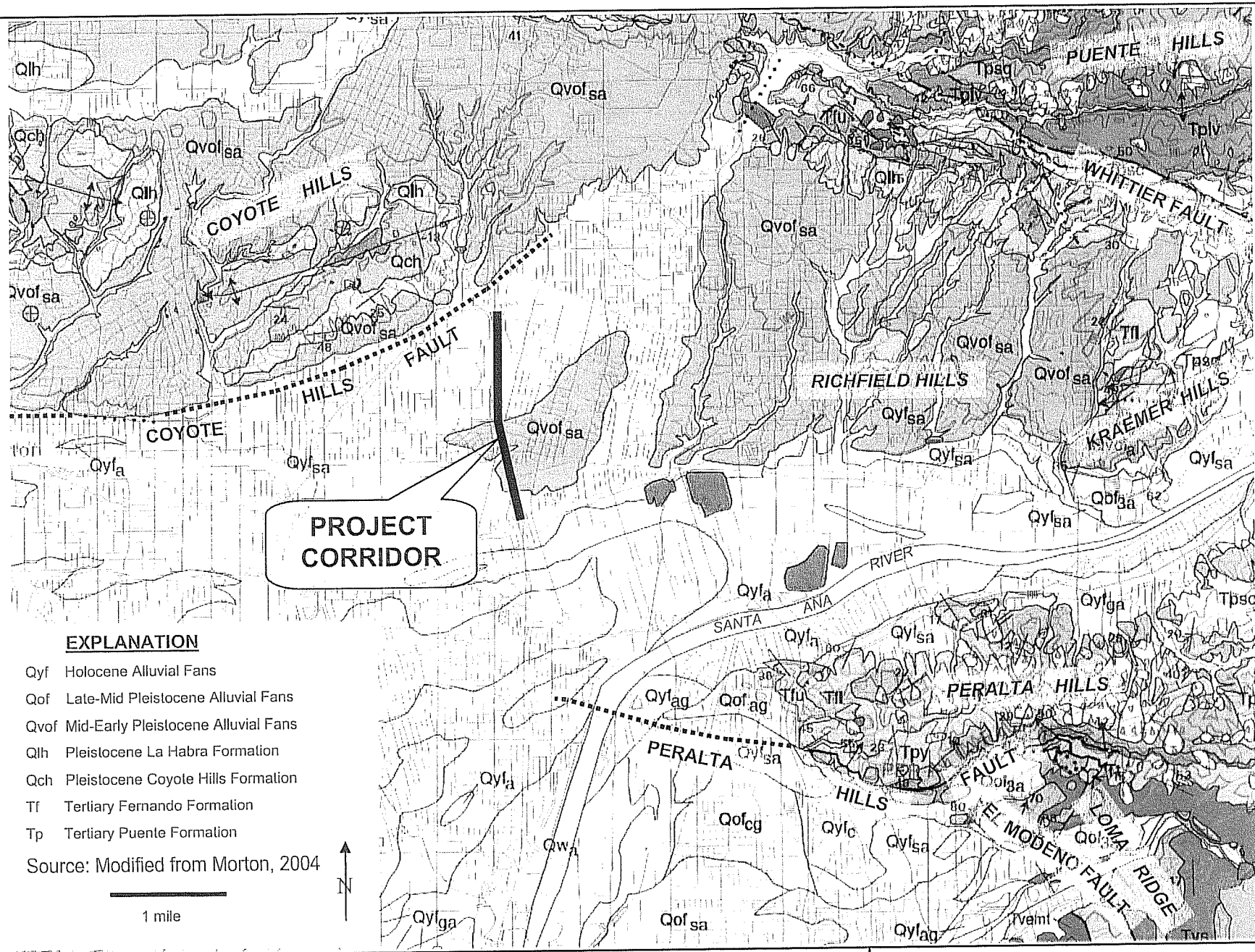
There are no steep slopes within the corridor so landsliding is not likely. There are no active faults so surface fault rupture is not likely. There are no known volcanos in the site region. The site is far from the sea on elevated land so Tsunamis are not a hazard.

The site is not identified on the State seismic hazard maps of the Anaheim and Newport Beach quadrangle as being susceptible to liquefaction (California Geological Survey/Division of Mines and Geology, 1997). This is due primarily to the depth of historically highest ground water being greater than 50 feet.

3.5 STRATIGRAPHY

Regional studies (e.g. Morton, 2004; Morton and Miller, 1981; Durham and Yerkes, 1964; California Department of Water Resources, 1961) indicate that the site area is underlain by Quaternary sediments overlying older Quaternary and Tertiary sediments and sedimentary rocks.

The surficial deposits are primarily Holocene and Pleistocene alluvial fan deposits (Figure 3-2). Older formations exposed in the hills and underlying the corridor are, in descending order, the Pleistocene-age La Habra and Coyote Hills, the Pliocene Fernando, and Pliocene-Miocene-age Puente formations. Along the corridor, the La Habra Formation is at an elevation of about sea level and therefore these older units are well below the level of interest for this project.



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SOUTH PLACENTIA OH (WIDEN)

Project No. 08-115 | Date: 01-28-09

GEOLOGICAL MAP

Figure 3-2

3.6 SEISMICITY

The largest historical earthquake within the Los Angeles Basin was the 1933 Long Beach earthquake of M_W=6.4 (M_L = 6.3) which is generally believed to have been associated with the Newport-Inglewood Structural Zone. The association of the 1933 event with the NISZ was based on abundant ground failures along the NISZ trend, but no unequivocal surface rupture was identified. Hauksson and Gross (1991) reevaluated the seismicity data and relocated the 1933 earthquake hypocenter to a depth of about 6 miles below the Huntington Beach-Newport Beach city boundary.

Other damaging earthquakes in the Los Angeles region include the 1971 San Fernando, the 1987 Whittier, and the 1994 Northridge events. The 1971 San Fernando (M_L= 6.4, M_W=6.7) earthquake occurred along the northern margin of the San Fernando Valley and produced a surface rupture which coincided partly with a zone of mapped surface faults along the mountain-valley margin. The more-recent 1987 Whittier earthquake (M_L=5.9, M_W=5.9) and the 1994 Northridge (M_L=6.4, M_W = 6.7) earthquake were not associated with surface faulting. Such events indicate that seismic hazards analysis must consider subsurface faulting as well as surface faulting. The Whittier event occurred at a depth of about 10 miles on a northerly dipping thrust fault dipping from the Coyote Hills area, under the Repetto and Puente Hills, to below the San Gabriel Valley. The Northridge event occurred at a depth of about 12 miles on a south-dipping reverse fault below the San Fernando Valley.

Another significant earthquake in the region was the 1812 earthquake which caused damage at the San Juan Capistrano Mission. The location and magnitude of the 1812 earthquake are unknown but geological studies (Jacoby et al., 1988; Fumal et al., 1993; Weldon et al., 2004) postulated that it did not occur in the Capistrano area, but rather was a large (M> 7.0) distant event on the San Andreas fault in the Wrightwood area of the San Gabriel Mountains.

A recent magnitude 5.4 (M_W) earthquake occurred on 29 July 2008 below the Puente Hills northeast of the site at a depth of about 10 miles. This event was a reverse type fault with a left- lateral component of slip. The causative fault is unknown. The epicenter is between the Whittier and Chino faults. The orientation of the preferred focal plane of the focal mechanism solution is somewhat compatible with the Whittier fault. The Whittier fault may have a reverse component of slip but is believed to be primarily a right-lateral fault. Furthermore dip of the preferred focal plane and the distribution of aftershocks are not very compatible with the Whittier fault. The northerly dipping buried thrust faults under the Peralta Hills, Richfield Hills, or Kraemer Hills could have been source because the preferred focal plane dips northeasterly similar to the northerly dipping faults. However, the distribution of the aftershocks does not seem compatible with the orientations of these faults.

4.0 SUBSURFACE CONDITIONS

4.1 SOIL CONDITIONS

Based on the recent field exploration and the as-built LOTB sheets in Appendix A, the subsurface materials at the site consist primarily of alternating layers of coarse-grained soils composing of clayey sand, silty sand, sand with silt, and fine grained soils composing of lean clay and lean clay with sand. Consistency of the soil is generally uniform above El. +195 feet, and increases with depth below that elevation. The idealized soil profile and design strength parameters for foundation design are presented in Table 4-1.

TABLE 4-1. IDEALIZED SOIL PROFILE AND STRENGTH PARAMETERS

Approx. Elevation (ft)	Predominant Soil Type	Range of Measured and Converted SPT Blowcount; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion/ Undrained Shear Strength (psf)
+234 to +217	Clayey Sand (Fill)	(10) to 41 Average = 20	125	28	200
+217 to +212	Sandy Lean Clay (Fill)	16 to 17 Average = 16	125	0	2000
+212 to +204	Clayey Sand (Fill)	4 to (27) Average = 16	125	32	50
+204 to +195	Sandy Lean Clay	(9) to 13 Average = 11	125	0	1200
+195 to +185	Clayey Sand, Sand with Silt and Clay	24 to (25/6") Average = 34	120	36	50
+185 to +170	Sand with Silt and Clay	47 to (> 70) Average > 70	120	39	50
+170 to +165	Sandy Lean Clay	20 to (21) Average = 20	125	0	2500
+165 to +141	Sand with Silt and Clay	> 70	117	40	50

Notes:
(1) SPT = Standard Penetration Test.
(2) Values in ( ) are converted SPT blowcounts corrected for sampler size; correction factor from California sampler blowcounts to SPT blowcounts is 0.5.

The above soil strength parameters are primarily based on published correlations with SPT blowcounts (Lam and Martin, 1986). A comparison of the above soil strength parameters with direct shear test results included in Appendix B indicates they are slightly higher than the ultimate values but significantly lower that the peak values obtained from the laboratory test results. We believe the strength values obtained using the SPT correlation are more reliable and should be used for foundation design because the laboratory test results are affected by soil disturbance during sampling.

4.2 GROUNDWATER CONDITIONS

During the recent field investigation conducted on September 22, 2008, groundwater was not encountered down to El. +141 feet which is more than 90 feet from the freeway surface. As shown on the as-built LOTB sheets in Appendix A, groundwater was not encountered during drilling in April 1966 and December 1988 down to El. +159 and +169 feet, respectively.

The relatively deep water depth is confirmed by the historical groundwater map published by the California Geological Survey (Seismic Hazard Zones Map - Anaheim and Newport Beach Quadrangle) (CGS, 1997). This map shows the depth to groundwater to be greater than 50 feet.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SEISMIC DESIGN CRITERIA

According to the 1996 Caltrans Seismic Hazard map, the most significant faults relative to the project area are listed in Table 5-1 along with their style of fault, maximum earthquake magnitude, distance to the bridge site and resulting peak bedrock acceleration (PBA).

TABLE 5-1. LOCAL SEISMIC SOURCES

Fault or Fault Zone	Style of Faulting	Maximum Credible Earthquake (MCE) Magnitude	Distance to Site[2] (miles)	Peak Bedrock Acceleration[3] (g)
El Modeno-Peralta Hills (EMP)	Reverse-Thrust[1]	6.50	0.8	0.8
Puente Hills Blind Thrust	Reverse-Thrust	7.25	4.3	0.6
Whittier-Elsinore (WEE)	Strike-Slip	7.50	5.0	0.5

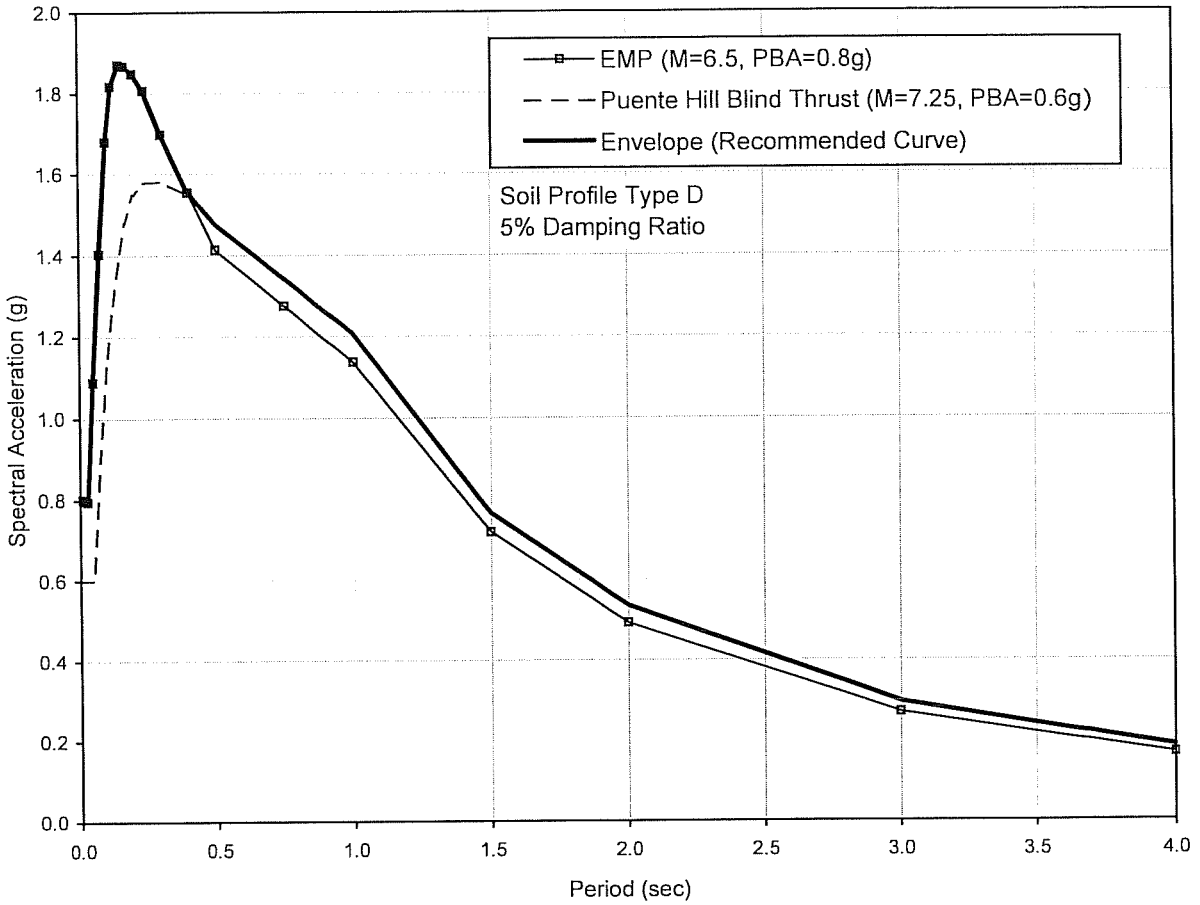
Notes:
(1) Caltrans designates the style of fault for EMP to be "unknown"; we assume a reverse-thrust fault (most conservative).
(2) For the EMP and WEE faults, the distances of each bridge site to these seismic sources were scaled from the 1996 Caltrans Seismic Hazard Map. Distances of each bridge site to the Puente Hills Blind Thrust were obtained from the seismic source model contained within the FRISKSP4.0 computer program (Blake, 2000 and 2004).
(3) The PBA is the larger of the two PBA's obtained from the attenuation relations of Sadigh (1997) and Mualchin (1996).

The ARS curves published in the Caltrans SDC (2006b) for Soil Profile Type "D" are applicable; this applies to Figures B.7 and B.8 for MCE Magnitudes (M) of 6.5±0.25 and 7.5±0.25, respectively. However, ARS curves for M of 6.5±0.25 with PBA's greater than 0.6g are not included in Figure B.7 of the Caltrans SDC (2006b). As a result, we generated an ARS curve for M=6.5±0.25 and a PBA of 0.8g by scaling the 0.6-g curve in Figure B.7 of the Caltrans SDC (2006b).

The design ARS curve envelopes the scaled ARS curve for M=6.5±0.25 and PBA=0.8g, and Figure B.8 for PBA=0.6g. According to Caltrans, this curve must also be modified to account for near-fault effects. For the near-fault effects, Caltrans Seismic Design Criteria (SDC, 2006b) Section 6.1.2.1 recommends the following modifications in the spectral accelerations:

- For periods less than 0.50 second, no change;
- For periods greater than 1.0 second, an increase of 20%;
- For periods between 0.50 and 1.0 second, a linear interpolation between the values at 0.50 and 1.0 second.

The resulting design ARS curve and the digitized coordinates are presented in Figure 5-1.



Spectral Coordinates of Recommended Curve

Period (sec)	Acc. (g)
0.010	0.800
0.020	0.797
0.030	0.795
0.050	1.089
0.075	1.403
0.100	1.680
0.120	1.817
0.150	1.871
0.170	1.867
0.200	1.848

Period (sec)	Acc. (g)
0.240	1.806
0.300	1.698
0.400	1.555
0.500	1.477
0.750	1.342
1.000	1.207
1.500	0.765
2.000	0.536
3.000	0.296
4.000	0.186

5.2 LIQUEFACTION

Based on the available boring information, the subject site has a low liquefaction potential due to absence of groundwater within the depths of interest.

5.3 SOIL CORROSIVITY

Two soil samples were tested for pH, minimum resistivity, soluble chloride content and soluble sulfate content. The test results are summarized in Table 5-2. Minimum resistivities were 750 and 2,000 ohm-cm. The pH values were 7.5 and 8.4. The soluble sulfate measurements were 120 and 700 parts per million (ppm), and the soluble chloride measurements were 173 and 185 ppm.

TABLE 5-2. SOIL CORROSION TEST RESULTS

Boring	Station (Offset) / "Station Line"	Sample Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Soluble Sulfate Content (ppm)	Soluble Chloride Content (ppm)
A-08-004	483+85 (90 RT) / "SR-57 (B-Line)"	15	CL	750	7.5	700	185
A-08-005	485+12 (90 RT) / "SR-57 (B-Line)"	15	SC	2000	8.4	120	173

Based on the Caltrans Corrosion Guidelines (2003), soils are considered corrosive if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm or greater. Based on the test results and the Caltrans criteria, the on-site soils are not considered to be corrosive to bare metals and concrete.

5.4 PILE FOUNDATION DESIGN

5.4.1 Foundation Type

The original bridge is supported on 16-inch diameter CIDH piles. The 1991 widened section is also supported on 16-inch diameter CIDH piles. According to the bridge engineer, abutment foundation design requires large lateral resistance. As a result, CIDH piles are not feasible because this pile type cannot be easily battered. Therefore, driven piles are recommended for abutments. Based on the soil boring data, hard driving is anticipated within localized dense layers; therefore steel HP-piles are preferred over precast concrete piles. In order to maximize the available lateral pile resistance, a heavier 14HP section was selected over the standard 10HP section for Service-I demand of 45 tons or less. For proposed widening bents, we recommend using 24-inch diameter CIDH piles.

5.4.2 Foundation Data Provided by Structural Designers

Per Caltrans policy, the Load and Resistant Factor Design (LRFD) method is used for bent piles and the Working Stress Design (WSD) is used for abutment piles. The foundation design data sheet and

foundation loads were provided by the structural designers following the latest Caltrans Memo To Designers (Caltrans, 2008), and are shown in Table 5-3 and Table 5-4, respectively.

TABLE 5-3. FOUNDATION DESIGN DATA SHEET

Location	Design Method	Pile Type	Finished Grade El. (ft)	Pile Cut-off El. (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (inch)	Number of Piles per Support
					B	L		
Abutment 1	WSD	HP 14x89	223.66	213.41	10	20.10	1	6
Bent 2	LRFD	24" CIDH	211.00	202.25	10	10	1	4
Bent 3	LRFD	24" CIDH	213.20	202.25	10	10	1	4
Abutment 4	WSD	HP 14x89	225.14	217.00	10	20.10	1	6

TABLE 5-4. FOUNDATION DESIGN LOADS

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Perm-anent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abutment 1	620	90	480	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bent 2	510	N/A	410	720	180	-	-	650	400	10	200
Bent 3	510	N/A	410	720	180	-	-	650	400	10	200
Abutment 4	620	90	480	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5.4.3 Axial Capacity

The abutment and bent foundations design recommendations are presented in Table 5-5 and Table 5-6, respectively. The Pile Data Table for the contract plans is presented in Table 5-7. The HP piles are designed using both skin friction and end-bearing resistances. For CIDH piles, the design pile tip elevation for the compression load case was based on skin friction only. The pile capacities are based on soil resistance only and may be further limited by the pile-head connection details. Pile group effects based on the layout provided by the structural engineers and the guidelines published in the AASHTO LRFD Bridge Design Specifications (2007) were included in these results.

TABLE 5-5. ABUTMENT FOUNDATIONS DESIGN RECOMMENDATIONS

Support	Pile Type	Cut-Off Elev. (feet)	LRFD Service-I Limit State Load per Support (kips)		LRFD Service-I Limit State Total Load per Pile (kips)	Nominal Resist-ance (kips)	Design Tip Elev. (feet)[1]	Specified Tip Elev. (feet)[2]	Nominal Driving Resistance Required (kips)
			Total	Perma-nent					
Abut 1	HP 14x89	213.58	620	480	90	180	+176 (a) +188 (d)	+176	180
Abut 4		217.17	620	480	90	180	+180 (a) +192 (d)	+180	180

Notes:
1. Design tip elevation is controlled by the following demands: (a) Compression and (d) Lateral Load. There is no design tip elevation for settlement at Abutments 1 and 4
2. The specified tip elevation shall not be raised above the design tip elevations for lateral.

TABLE 5-6. BENT FOUNDATION DESIGN RECOMMENDATIONS

Support Location	Pile Type	Cut-off El. (ft)	Service-I Limit State Load per Support (kips)	Total Perm-issible Support Settle-ment (in)	Required Factored Nominal Resistance (kips)				Design Tip El. (ft)	Specified Tip El. (ft)
					Strength Limit		Extreme Event			
					Comp. (ϕ=0.7)	Tension (ϕ=0.7)	Comp. (ϕ=1)	Tension (ϕ=1)		
Bent 2	24" CIDH	202.25	510	1	180	0	400	200	+170 (a-I) +158 (a-II) +174 (b-II) +172 (d)	+158
Bent 3	24" CIDH	202.25	510	1	180	0	400	200	+170 (a-I) +158 (a-II) +174 (b-II) +172 (d)	+158

Notes:
1. Design tip elevation is controlled by the following demands: (a-I) Compression (Strength Limit), (a-II) Compression (Extreme Event), (b-II) Tension (Extreme Event), and (d) Lateral Load. There is no design tip elevation for settlement at Bents 2 and 3.
2. The specified tip elevation shall not be raised above the design tip elevations for tension and lateral.

TABLE 5-7. PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)[1]	Specified Tip El. (ft)	Nominal Driving Resistance (kips)
		Compression	Tension			
Abutment 1	HP 14x89	180	0	+176 (a) +188 (d)	+176	180
Bent 2	24" CIDH	400	200	+158 (a) +174 (b) +172 (d)	+158	N/A
Bent 3	24" CIDH	400	200	+158 (a) +174 (b) +172 (d)	+158	N/A
Abutment 4	HP 14x89	180	0	+180 (a) +192 (d)	+180	180

Notes:
1. Design tip elevations for Abutments are controlled by: (a) Compression and (d) Lateral Load. There is no design tip elevation for settlement at Abutments 1 and 4.
2. Design tip elevations for Bents are controlled by: (a) Compression, (b) Tension and (d) Lateral Load. There is no design tip elevation for settlement at Bents 2 and 3.

5.4.4 Lateral Resistance

Results of lateral pile analysis in terms of pile-head shear and lateral deflection for a free-head condition are presented in Table 5-8. The maximum bending moment and the location of maximum moment are also presented. The solutions presented in Table 5-8 are entirely based on soil resistance and linear pile properties. Therefore, these values may be limited by the flexural strength (plastic moment) of the piles and other connection details. Linear interpolation can be used for solutions between pile-head deflections of 0.25 and 5 inches.

5.5 EMBANKMENTS AND SETTLEMENT

Settlement. About 25 feet of sliver fill will be placed to construct the approach embankments. Based on the onsite soil type, ground subsidence is estimated to be on the order of 2 inches. We recommend a settlement period of at least 5 calendar days for pile installation at the abutments.

TABLE 5-8. LATERAL PILE SOLUTIONS

Location	Lateral Displacement at Top of Pile (in)	Lateral Load at Top of Pile (kips)	Maximum Moment (kip-in)	Depth from Pile Head to Max. Moment (ft)
Abutments 1 & 4 (Weak Axis)	¼	15	448	5
	½	23	794	5
	1	35	145	6
	3	64	342	7
	5	79	487	8
Abutments 1 & 4 (Strong Axis)	¼	21	802	6
	½	33	1476	6
	1	53	2686	7
	3	97	6343	8
	5	123	9221	9
Bents 2 & 3	¼	19	745	7
	½	29	1384	7
	1	45	2613	8
	3	92	6569	9
	5	123	9634	10

Slope Stability. Global stability analyses were conducted for both static and pseudostatic conditions for the bridge end slopes. Results of this analysis are presented in Appendix C.

The factor of safety for a deep-seated failure is greater than 1.5 under static condition for the 1V:1.5H end slope with a 2-foot soil surcharge to represent traffic loading. Slope stability analysis under pseudostatic condition was performed using a seismic coefficient equal to 0.2g (which is the smaller of either one-third the horizontal peak ground acceleration or 0.2g) in accordance with guidelines provided in Section 3.12 of the Caltrans Guidelines for Foundation Investigations and Reports (Caltrans, 2006a). Analysis indicates that the factor of safety is greater than 1.1 under pseudostatic condition. The 1V:1.5H end slope has proposed concrete slope paving, therefore surficial stability is not a design issue.

Per Caltrans Memo to Designers 5-3 dated December 1992 (Caltrans, 1992a), structure approach slabs are required for this project. Selection of the approach type will be performed by the structural designer following the flowchart in Caltrans Memo to Designers 5-3, Attachment A, dated May 1996 (Caltrans, 1996).

5.6 BRIDGE ABUTMENT WALL DESIGN

Abutment Earth Pressures. If abutment walls are free to move laterally at the top, a static active lateral earth pressure of 36 psf per foot of depth is recommended for a free draining, level and compacted backfill. If lateral movement at the top of abutment walls is restrained, the lateral earth pressure for a free draining, level and compacted backfill should follow Section 5.5.5.11 of the Caltrans BDS dated August 2004. For this condition, we recommend a coefficient of active lateral earth pressure of 0.3, a coefficient of at-rest lateral earth pressure of 0.47 and a soil unit weight of 120 lb/ft^3. If applicable, a uniform lateral pressure of at least 72 psf due to vehicle loads, equivalent to a vertical pressure produced by at least 2 feet of earth, should be added to the above lateral earth pressure.

Passive Resistance of Abutment Backfill. Under seismic loading, an ultimate passive earth pressure of 5 ksf may be used for the approach backfill and abutment walls with a height equal to or greater than 5.5 feet. For abutment walls with heights less than 5.5 feet, the passive pressure may be calculated proportionally (e.g., for a 4-foot high wall, the passive pressure is [4/5.5]x 5 ksf = 3.64 ksf. The horizontal movement at which the maximum passive pressure is expected to be fully mobilized can be determined following the procedure outlined in Section 7.8.1 of the Caltrans SDC (2006b).

There is no abutment wingwalls since both abutments are adjacent to RW 476 and 486. There is a small return wall connecting the abutment to the retaining walls. This return wall sits on the abutment pile cap as a part of the abutment design. Design of RW 476 and 486 is in the roadway plans.

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 EARTHWORK

Earthwork should be performed in accordance with Caltrans Standard Specifications, Section 19 (Caltrans, 2006c). Appropriate measures should be taken to prevent damage to adjacent structures and utilities. Any design and construction of temporary sloping, sheeting, or shoring should be made the contractor's responsibility. It should be noted that it is the responsibility of the contractor to oversee the safety of the workers in the field during construction. The contractor shall conform to all applicable occupational and health standards, rules, regulations, and orders established by the State of California. In addition, other State, County, or Municipal regulations may supersede the recommendations presented in this section. If a trench shoring design and safety plan is required, the geotechnical consultant should review the plan to confirm that recommendations presented in this report have been applied to the design.

During the recent field investigation conducted on September 22, 2008, groundwater was not encountered down to El. +141 feet which is more than 90 feet from the freeway surface. As shown on the as-built LOTB sheets in Appendix A, groundwater was not encountered during drilling in April 1966 and December 1988 down to El. +159 and +169 feet, respectively. Therefore, groundwater is not expected to be encountered during footing construction. However, groundwater level can fluctuate due to seasonal rainfall amount, local irrigation and groundwater recharge program and other man-made conditions. If groundwater is encountered, it should be controlled in accordance with Section 19-3.04 of the Caltrans Standard Specifications (2006c).

6.2 PILE CONSTRUCTION

Driven Piles. Piles should be driven at least to the specified tip elevation and the bearing value should be checked with the pile-driving formula given in Section 49-1.08 of the Caltrans Standard Specifications (2006c). However, if the specified tip elevation is reached without achieving the design load, pile driving should continue until bearing is attained. In this case, it may be prudent to allow the pile to "set up" before continuing the driving.

The selected pile-driving hammer such as diesel-type hammers should be able to deliver sufficient energy to drive the piles at a penetration rate of not less than 1/8 inch per blow at the required bearing value. Oversized predrilling through the embankment fill should conform to Section 49-1.06 of the Caltrans Standard Specifications (2006c). Vibratory hammers and undersized predrilling below the embankment fill are not allowed for pile installation.

Based on the available soil boring data, hard driving may be encountered below El. +190 feet. Contractor should be prepared for hard driving conditions.

CDIH Piles. For on-center pile spacing less than six times the pile diameter, no two adjacent piles can be constructed concurrently.

Loose soils should be cleaned from the bottom of the borings. Pile borings should be inspected and approved by the geotechnical engineer prior to the installation of reinforcement. Extreme care in drilling, placement of steel, and the pouring of concrete is essential to avoid excessive disturbance of

pile boring walls. Concrete placement by pumping or tremie tube to the bottom of the pile borings is recommended. Specifications should require that sufficient space be provided in the pile reinforcing cage during fabrication to allow the insertion of a tremie tube for concrete placement. The pile reinforcing cage should be installed and the concrete pumped immediately after drilling is completed.

Sandy soils were encountered in our soil borings and these materials are susceptible to caving. If caving occurs, a temporary casing may be required during construction. Casings should have an outer diameter equal to or exceeding the pile diameter. Temporary casing should be placed tight-in-hole. Vibratory or impact hammer with or without center-relief drilling can be used to install the temporary casing provided the existing structure is monitored for potential movement due to ground vibration; casing installation using this method should be suspended if excessive movement is detected. The temporary casing should be pulled as the concrete is being poured while always maintaining at least a 5-foot head of concrete inside the casing.

6.3 BACKDRAIN AND BACKFILL REQUIREMENTS FOR ABUTMENT WALLS

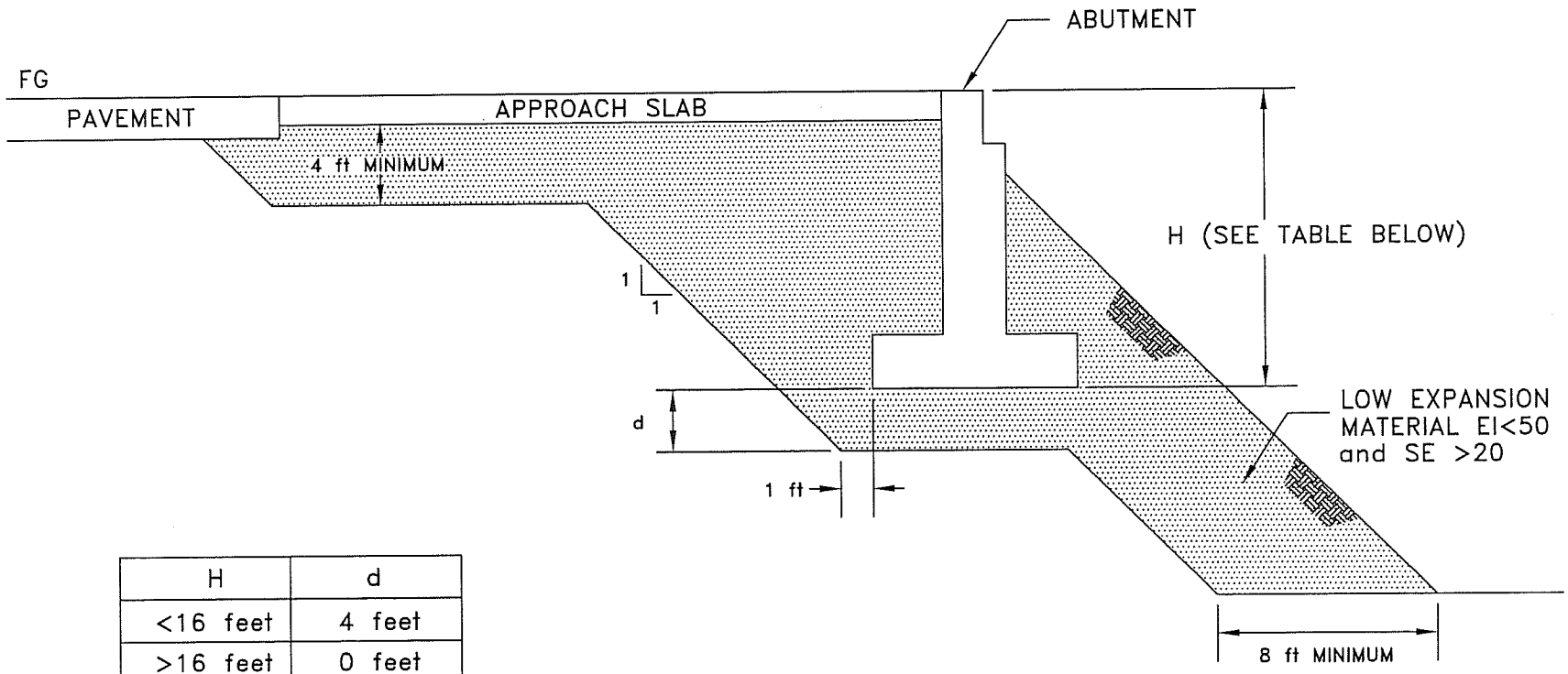
Per Caltrans requirements, expansive soils should not be placed as part of the embankment within the limits of a bridge abutment as shown in Figure 6-1. Materials placed behind abutment wall should be low-expansive soil with an Expansion Index (EI) less than 50 and Sand Equivalent (SE) of more than 20. The low-expansive material requirement should be supplemental to the abutment structure and pervious backfill requirement as described in Caltrans Standard Plans (2006d) and Caltrans Standard Specifications (2006c) under Sections 19-3.06 and 19-3.065, respectively.

Backfill should be compacted in accordance with Section 19-5 of the Caltrans Standard Specifications (2006c). Backfill should be placed in loose lifts not exceeding 8 inches in thickness, moisture-conditioned to near optimum moisture content, and compacted to at least 95 percent relative compaction. The relative compaction should be based on the maximum density determined by California Test 216. Jetting or flooding to compact backfill is not recommended. Heavy compaction equipment, such as vibratory rollers, dozers, or loaders, should not be used adjacent to the abutment walls in order to avoid damaging the walls due to large lateral earth pressures.

Backdrains should be installed behind abutment walls to relieve hydrostatic pressure. Backdrains should be constructed in accordance with Bridge Detail 3-1 on Sheet BO-3 per Caltrans Standard Plans (2006d) or the geocomposite drain alternative per Section 6 of the Caltrans Bridge Design Aids (1992b).

6.4 REVIEW OF CONSTRUCTION PLANS

Recommendations contained in this report are based on preliminary plans. The geotechnical consultant should review the final construction plans and specifications in order to confirm that the general intent of the recommendations contained in this report have been incorporated into the final construction documents. Recommendations contained in this report may require modification or additional recommendations may be necessary based on the final design.



H	d
<16 feet	4 feet
>16 feet	0 feet

EXPANSION INDEX TO BE DETERMINED BY ASTM D4829
SAND EQUIVALENT TO BE DETERMINED
BY CALIFORNIA TEST METHOD 217

NO SCALE

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

SOUTH PLACENTIA OVERHEAD (WIDEN)

EMI Project No. 08-115 | Date: 01-28-2009

LOW EXPANSION MATERIAL
IN BRIDGE EMBANKMENT

FIGURE 6-1

6.5 GEOTECHNICAL OBSERVATION AND TESTING

It is recommended that inspections and testing be performed by the geotechnical consultant during the following stages of construction:

- Grading operations, including excavations and placement of compacted fill
- Shoring installation
- Footing excavations
- Pile installation
- Backdrain installation and backfilling of bridge abutment walls.
- Removal or installation of support of buried utilities or structures
- When any unusual subsurface conditions are encountered

7.0 LIMITATIONS

This report is intended for the use of RBF Consulting, Orange County Transportation Authority and Caltrans for the widening of South Placentia Overhead. This report is based on the project as described and the information obtained from the exploratory borings at the approximate locations indicated on the attached plans. The findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses. In addition, soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project site. However, subsurface conditions and characteristics of soils between exploratory borings can vary. The findings reflect an interpretation of the direct evidence obtained. The recommendations presented in this report are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained in this report are applicable to the specific design element(s) and location(s) which is (are) the subject of this report. They have no applicability to any other design elements or to any other locations and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

EMI has no responsibility for construction means, methods, techniques, sequences, or procedures; for safety precautions or programs in connection with the construction; for the acts or omissions of the CONTRACTOR or any other person performing any of the construction; or for the failure of any worker to carry out the construction in accordance with the Final Construction Drawings and Specifications.

Services performed by EMI have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

8.0 REFERENCES

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APPENDIX A

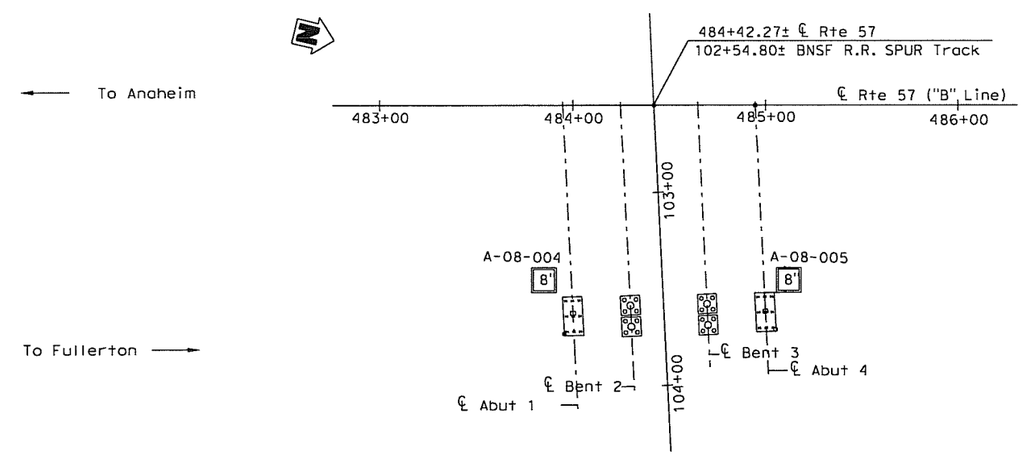
LOG OF TEST BORINGS SHEETS AND AS-BUILT LOG OF TEST BORINGS SHEETS

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 40'

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lina Cheang
REGISTERED ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER L. CHEANG NO. GE 2345 EXP. 9-30-09 GEOTECHNICAL STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

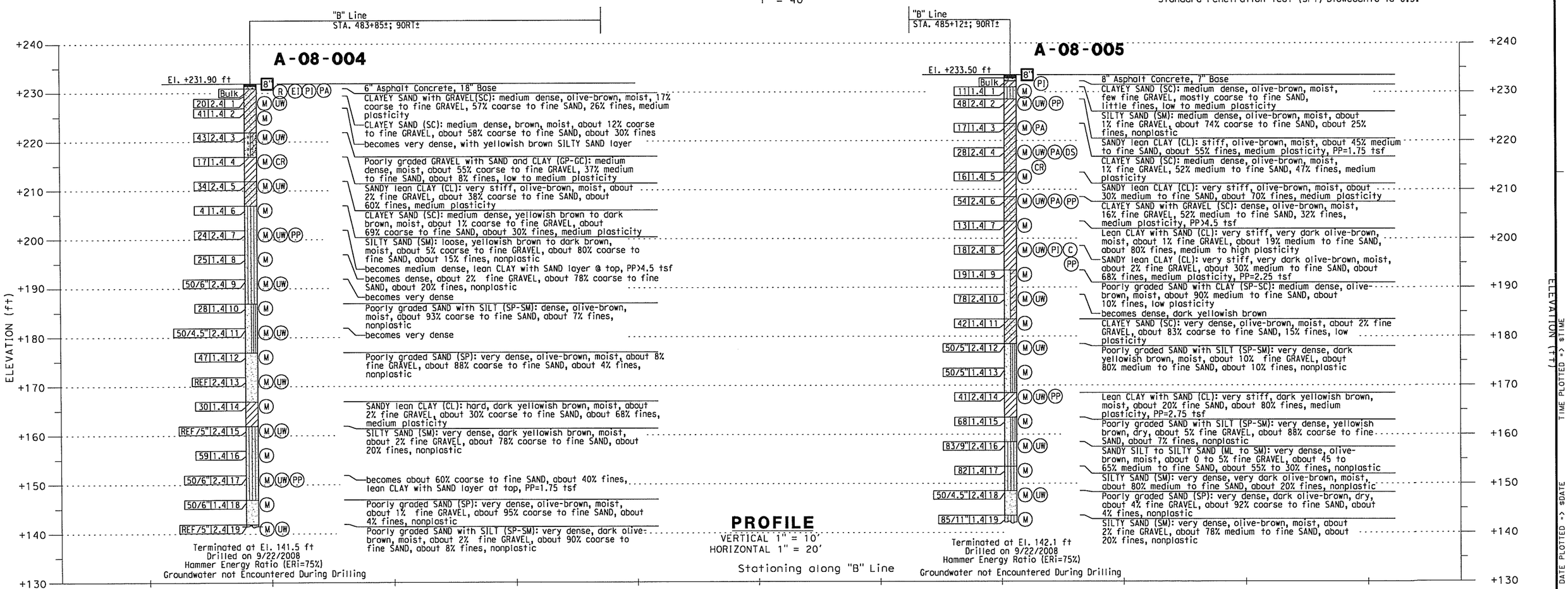
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0450
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.7

SOUTH PLACENTIA OH (WIDEN)
LOG OF TEST BORINGS 1 OF 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)										SHEET	OF
4/30/09											

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lino Cheang
REGISTERED ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
	D	Dynamic Cone Penetration Boring
	CPT	Cone Penetration Test (ASTM D 5778-95)
	O	Other

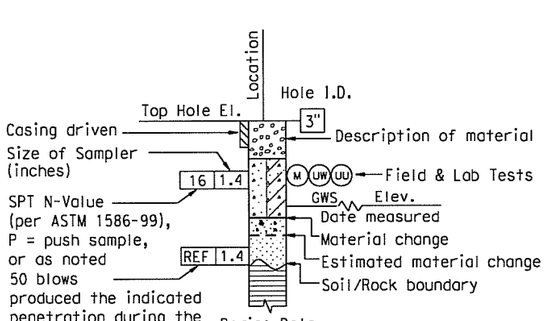
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

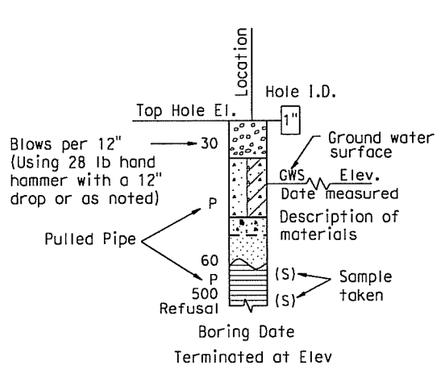
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

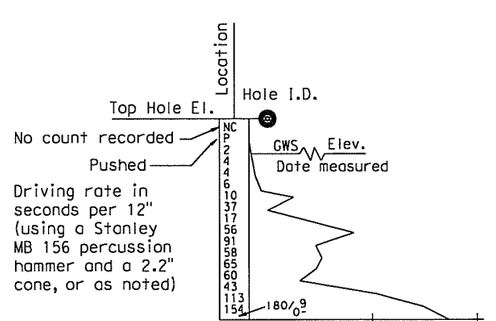
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



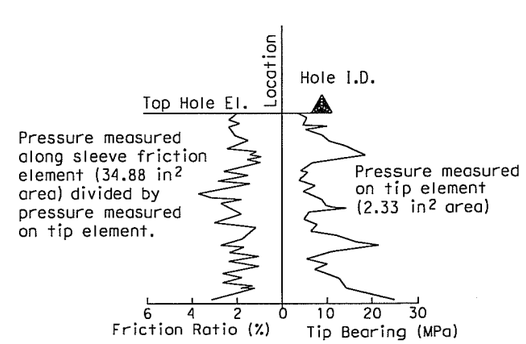
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0450 POST MILES 16.7	SOUTH PLACENTIA OH (WIDEN) LOG OF TEST BORINGS 2 OF 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) | SHEET | OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90)
Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166)
Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lina Cheang
REGISTERED ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0450 POST MILES 16.7

SOUTH PLACENTIA OH (WIDEN)
LOG OF TEST BORINGS 3 OF 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	467	491

Kul Bhushan 12/20/89
GEOTECHNICAL PROFESSIONAL

10-29-90
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — KUL BHUSHAN — No. GE 000144 — Exp. 12/31/1989 — GEOTECHNICAL — STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

Lino Cheang
REGISTERED CIVIL ENGINEER — DATE

SOUTH PLACENTIA OH (WIDEN)

LOG OF TEST BORINGS 4 OF 5

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

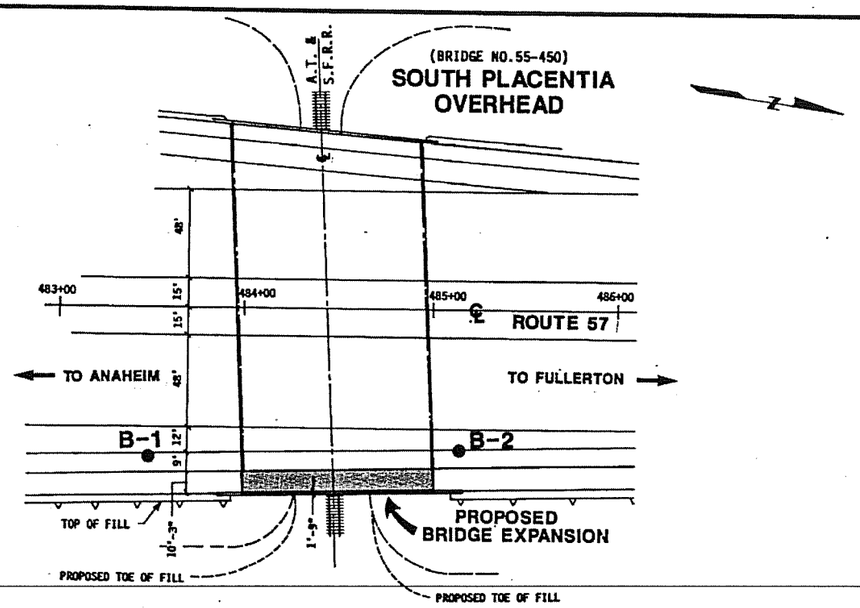
BRIDGE No. 55-0450

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER — LINO C. CHEANG — NO. GE 2345 — EXP. 9/30/89 — GEOTECHNICAL — STATE OF CALIFORNIA

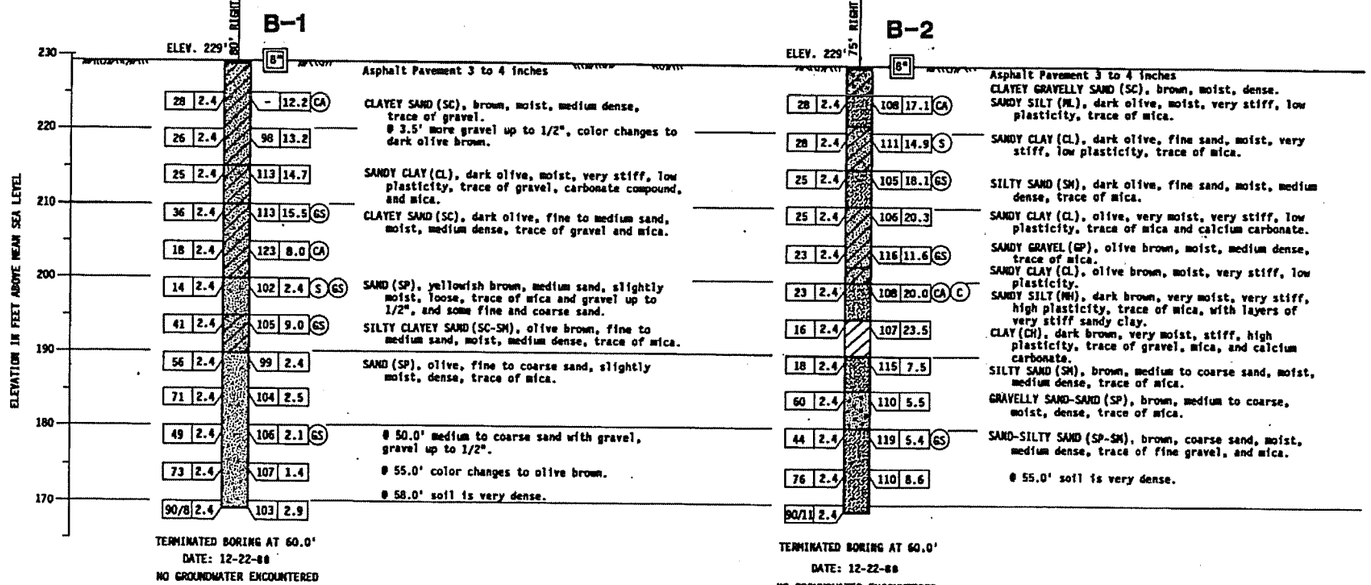
PLAN

SCALE: 1"=40'



PROFILE

VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'

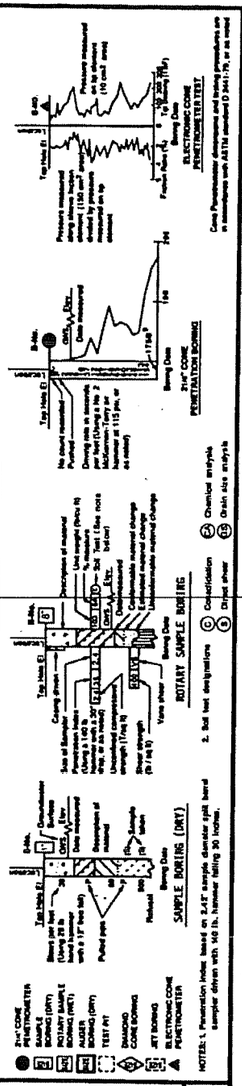


BM 535-D-70 — ELEVATION 257.37

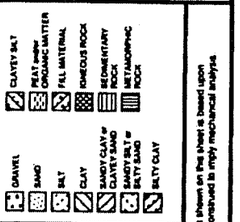
FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60 AND 105 FEET NORTHERLY OF THE CENTERLINE OF NUTWOOD AVE..

AS BUILT NO AS BUILT CHANGES
J. PINHEIRO
CORRECTIONS BY I. PANGLE
CONTRACT NO. 12-020184
DATE 11-24-92

LEGEND OF BORING OPERATIONS



LEGEND OF EARTH MATERIALS



CONSISTENCY CLASSIFICATION FOR SOILS

According to the Standard Penetration Test

Penetration Index (Blows / ft)	Granular	Cohesive
0-4	Very loose	Very soft
5-9	Loose	Soft
10-19	Slightly compact	Stiff
20-34	Compact	Very stiff
35-69	Dense	Hard
>70	Very dense	Very hard

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

DESIGN OVERSIGHT — SIGN OFF DATE 8-22-90

DRAWN BY	CHECKED BY
E. BASMADJIAN	H. ABDALLAH

S. MOHAMAD
FIELD INVESTIGATOR
DATE 12-28-89

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

Victor Lee
PROJECT ENGINEER

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12208
EA 020180

BRIDGE NO.	SOUTH PLACENTIA OVERHEAD (WIDEN)
55-450	
POST MILE 16.7	LOG OF TEST BORINGS

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 9 OF 10

FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	16.9/18.8	122	197

DATE APPROVED August 28, 1967

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

Lino Cheang
REGISTERED CIVIL ENGINEER — DATE

SOUTH PLACENTIA OH (WIDEN)

LOG OF TEST BORINGS 5 OF 5

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

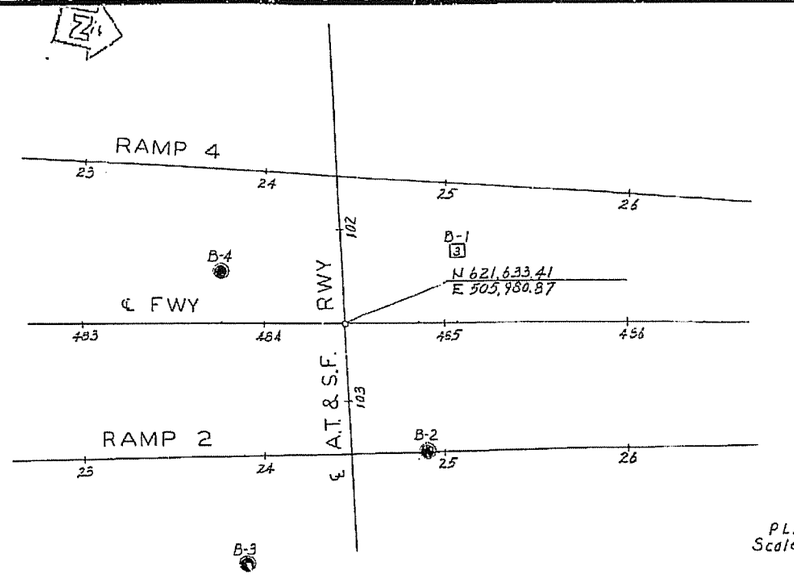
BRIDGE No. 55-0450

Sheet X of X

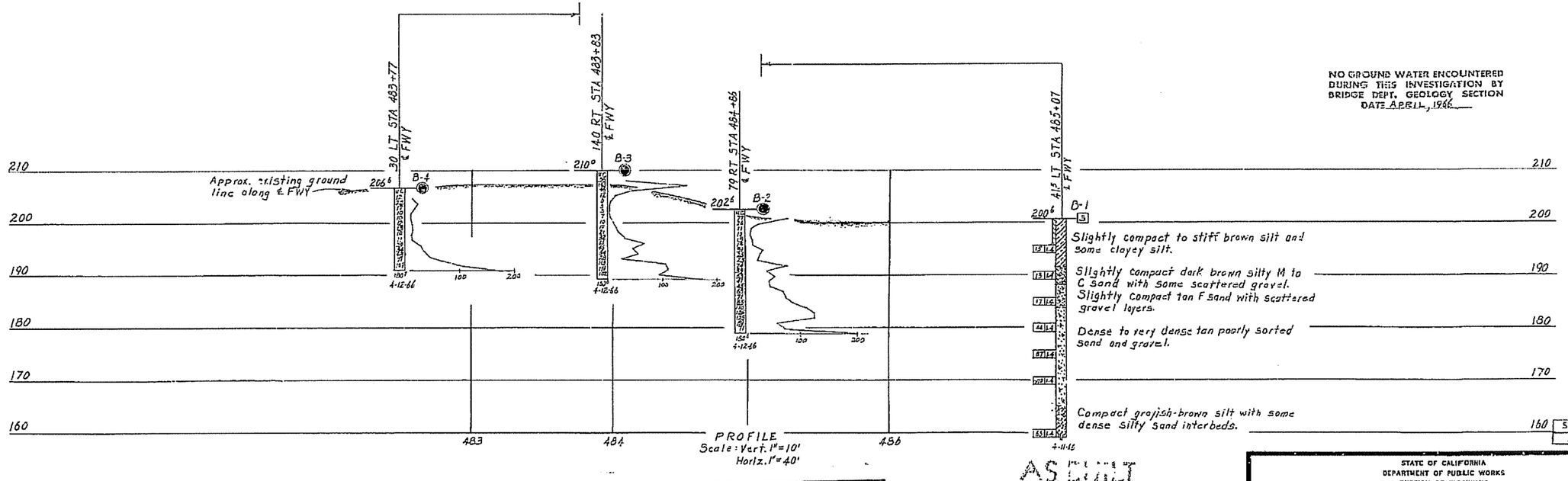
REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

BENCH MARK

B.M. 484-65 Elev. 205.336
Set R.R. spk. in N. side of P.P.# 102608 E 135 Ft. W. of ℄ intersection Frwy. ℄ A.T. & S.F. R.R. spurline 26 Ft. S. of ℄ Tracks 15 Ft. above O/G.

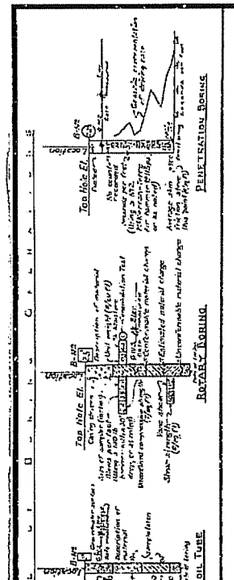


PLAN
Scale: 1" = 40'



PROFILE
Scale: Vert. 1" = 10'
Horiz. 1" = 40'

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE APRIL, 1966



PENETROMETER
2½" CONE PENETROMETER
SAMPLER SCREEN (DRY)
ROTARY BORING (WET)
FIXED ROTARY BORING (DRY)
JET BORING
CONE BORING
TEST PIT

LEGEND OF EARTH MATERIALS

GRAVEL — SILTY CLAY OR CLAYEY SILT
SAND — PEAT AND ORGANIC MATTER
SILT — FILL MATERIAL
CLAY — IGNEOUS ROCK
SANDY CLAY OR CLAYEY SAND — SEDIMENTARY ROCK
SANDY SILT OR SILTY SAND — METAMORPHIC ROCK

CLASSIFICATION OF MATERIAL BASED ON STANDARD UNIFIED SOIL LIMITS

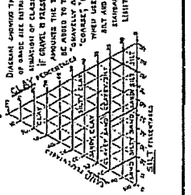


Diagram showing the basis for estimates of basic site information based on cohesion and friction. If fines is present in appreciable amounts the terms "gravelly" may be added to the clean sand, etc. Similarly, if sand is present, the terms "coarse", "medium" and "fine" may be used to describe sand, silt and gravel fines to the limits shown here.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY by D.F. Crawford 4-15-66
DRAWN by R.J. Ott & J.A. 4-26-66
CHECKED by R.C. Cooper 4-26-66
Approved: R. Clyde Sizemore Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

122

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000648

AS BUILT
CONDITIONS BY Hixson 7-23-09
CONTRACT NO. 07-032124
DATE 4-30-

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SOUTH PLACENTIA OVERHEAD

LOG OF TEST BORINGS

SCALE AS NOTED | BRIDGE 55-450 R/L | FILE | DRAWING 55450-13

SHEET 13 OF 18

Charge: 07208
W.A. 032121

Disregard prints bearing earlier numbers →

PREL. DRAWING No. PR-

APPENDIX B

LABORATORY TEST RESULTS

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

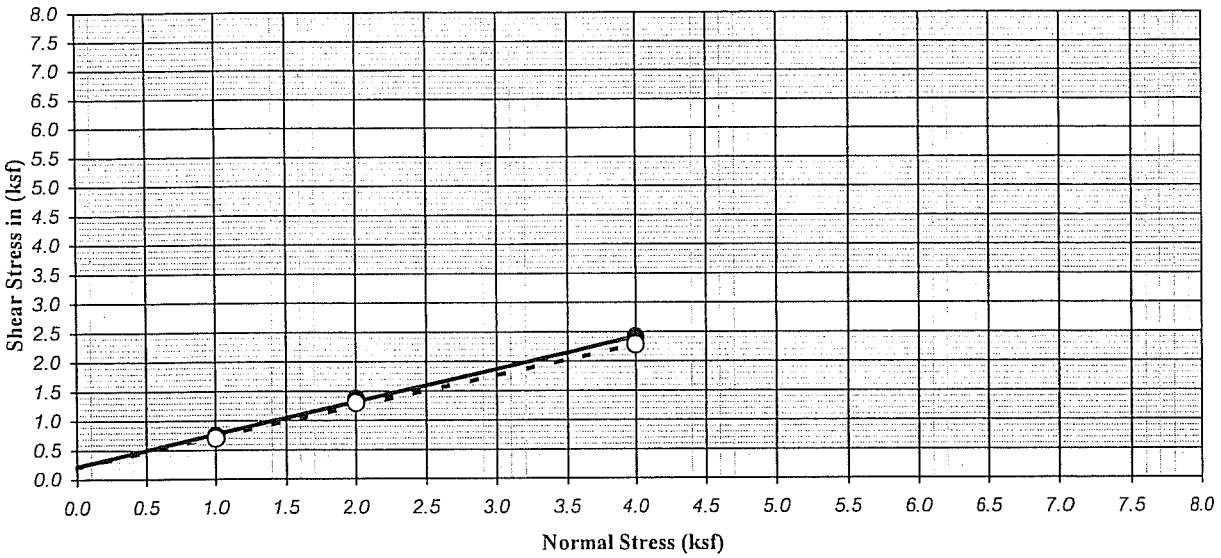
Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Expansion Index	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-004	BULK	2.5 - 5	SC						7	29/17/12				
A-08-004	D-1	2.5	SC	9.4	134.3									
A-08-004	S-2	5	SC	14.4										
A-08-004	D-3	10	GP-GC	11.6	132.3									
A-08-004	S-4	15	CL	13.1							750	7.5	700	185
A-08-004	D-5	20	SC	8.6	136.5									
A-08-004	S-6	25	SM	5.6										
A-08-004	D-7	30	CL to SM	17.3	128.2	>4.5								
A-08-004	S-8	35	SM	6.6										
A-08-004	D-9	40	SM	6.4	127.2									
A-08-004	S-10	45	SP-SM	4.2										
A-08-004	D-11	50	SP-SM	3.7	112.2									
A-08-004	S-12	55	SP	2.8										
A-08-004	D-13	60	SP	2.7	122.0									
A-08-004	S-14	65	CL	14.7										
A-08-004	D-15	70	SM	8.9	117.7									
A-08-004	S-16	75	SM	11.2										
A-08-004	D-17	80	CL to SM	18.4	124.3	1.75								
A-08-004	S-18	85	SP	3.3										
A-08-004	D-19	90	SP-SM	5.4	112.9									
A08-005	BULK	1.5 - 5	SC							27/19/8				
A-08-005	S-1	2.5	SM	7.1										
A-08-005	D-2	5	CL	10.8	104.1	1.75								
A-08-005	S-3	10	SC	13.0				1:52:47						
A-08-005	D-4	15	SC	13.5	117.9			1:51:48			2000	8.4	120	173
A-08-005	S-5	20	CL	18.6										
A-08-005	D-6	25	SC	12.5	132.2	>4.5		16:52:32						
A-08-005	S-7	30	CL	23.8										
A-08-005	D-8	35	CL	15.0	134.3	2.25				29/16/13				
A-08-005	S-9	40	SP-SC	7.6										
A-08-005	D-10	45	SP-SC	8.4	115.7									
A-08-005	S-11	50	SC	8.1										
A-08-005	D-12	55	SP-SM	7.4	120.4									
A-08-005	S-13	60	SP-SM	3.3										
A-08-005	D-14	65	CL	17.3	132.2	2.75								
A-08-005	S-15	70	SP-SM	2.7										
A-08-005	D-16	75	ML to SM	7.7	124.8									
A-08-005	S-17	80	SM	6.2										
A-08-005	D-18	85	SP	2.0	104.3									
A-08-005	S-19	90	SM	5.3										

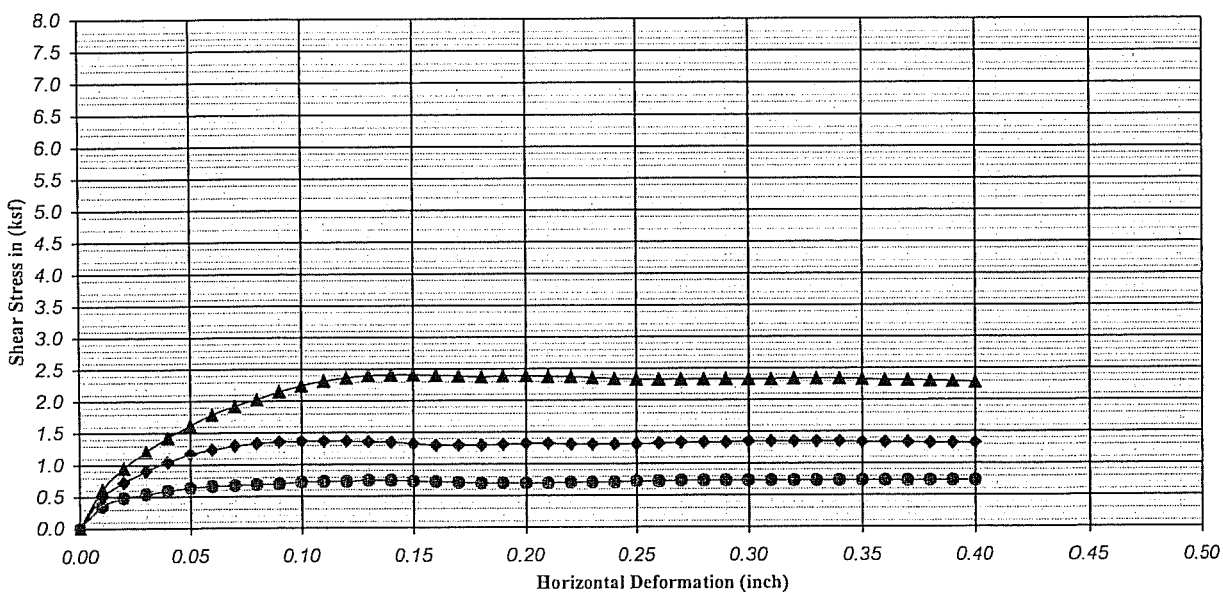
TABLE 2 SUMMARY OF LABORATORY STRENGTH TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No .	Sample No.	Sample Depth	Soil Identification (group symbol) ASTM D2488/D2487	Direct Shear Test (ASTM D3080)			
				Peak		Residual	
				ϕ	C	ϕ	C
		(ft)		(deg)	(ksf)	(deg)	(ksf)
A-08-005	D-4	15	SC	28.86	0.22	27.6	0.2



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No.	: A-08-005	Strength Intercept (C) :	0.22	(ksf)	Peak	0.20	(ksf)	Ultimate	
Sample No.	: D-4		10.63	(kPa)		9.77	(kPa)		
Depth (ft/m)	: 15.0 0.00	Friction Angle (ϕ) :	28.86	Degree		27.60	Degree		
Description	: Olive brown with olive gray, CLAYEY SAND (SC)						Shear Rate (inch/minute) :	0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	25.41	92.12	14.50	0.83	1.00	47.88	0.74	35.62	0.70	33.32
◆	25.89	93.42	14.70	0.80	2.00	95.76	1.37	65.50	1.30	62.05
▲	25.99	92.76	14.60	0.82	4.00	191.52	2.41	115.49	2.28	109.17

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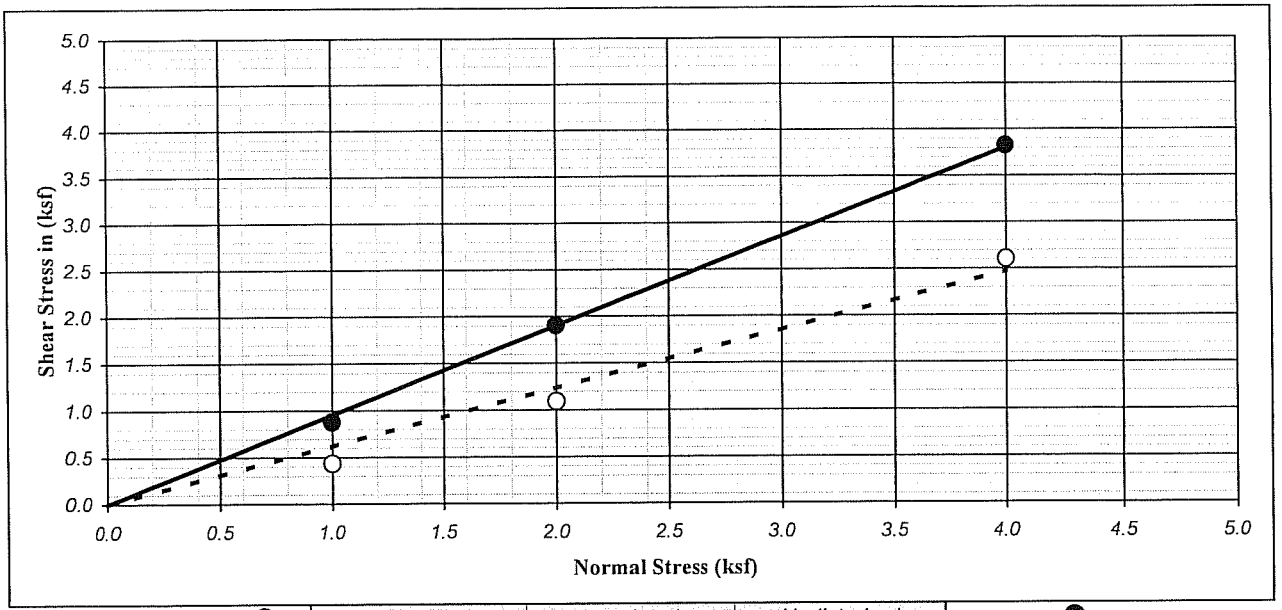
Geotechnical and Earthquake Engineering

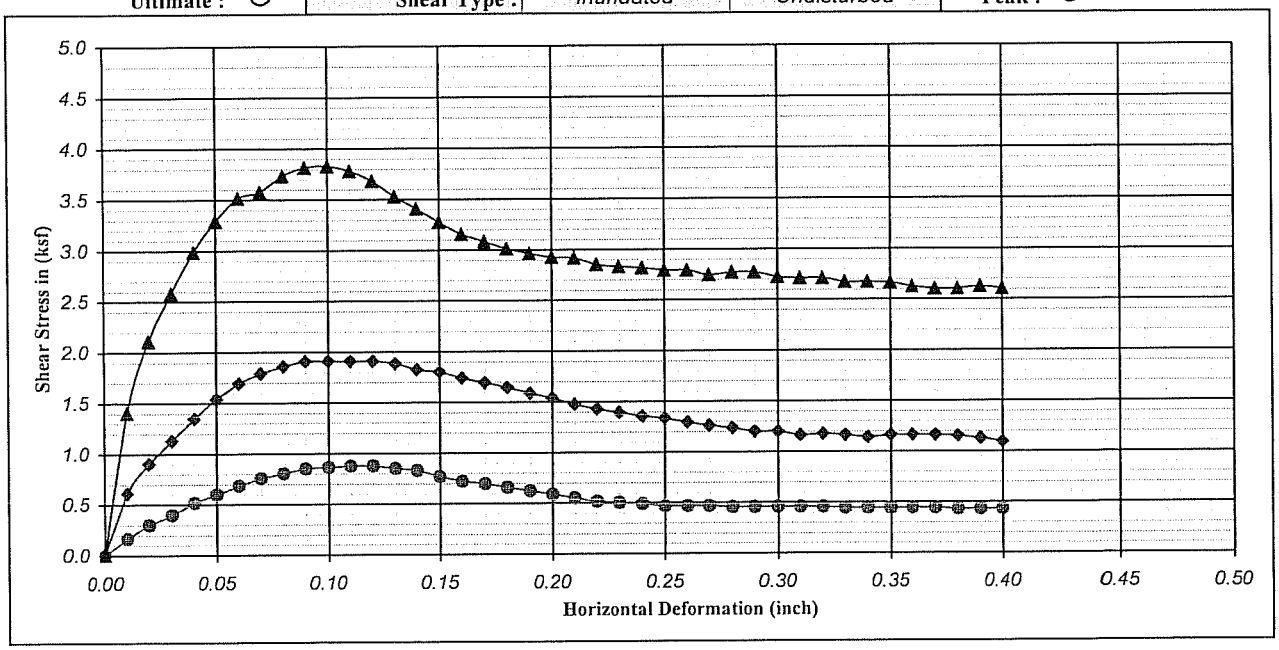
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/08/08 | Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No.	: A-08-004	Strength Intercept (C) :	0.00	(ksf)	Peak	0.00	(ksf)	Ultimate
Sample No.	: D-5		0.00	(kPa)		0.00	(kPa)	
Depth (ft/m)	: 20.0 | 0.00	Friction Angle (ϕ) :	43.61	Degree		31.82	Degree	
Description	: Brown, CLAYEY SAND (SC)						Shear Rate (inch/minute) :	0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.62	107.92	16.99	0.56	1.00	47.88	0.88	41.94	0.43	20.68
◆	15.71	117.05	18.42	0.44	2.00	95.76	1.91	91.36	1.09	52.28
▲	14.11	119.80	18.86	0.41	4.00	191.52	3.83	183.28	2.60	124.68

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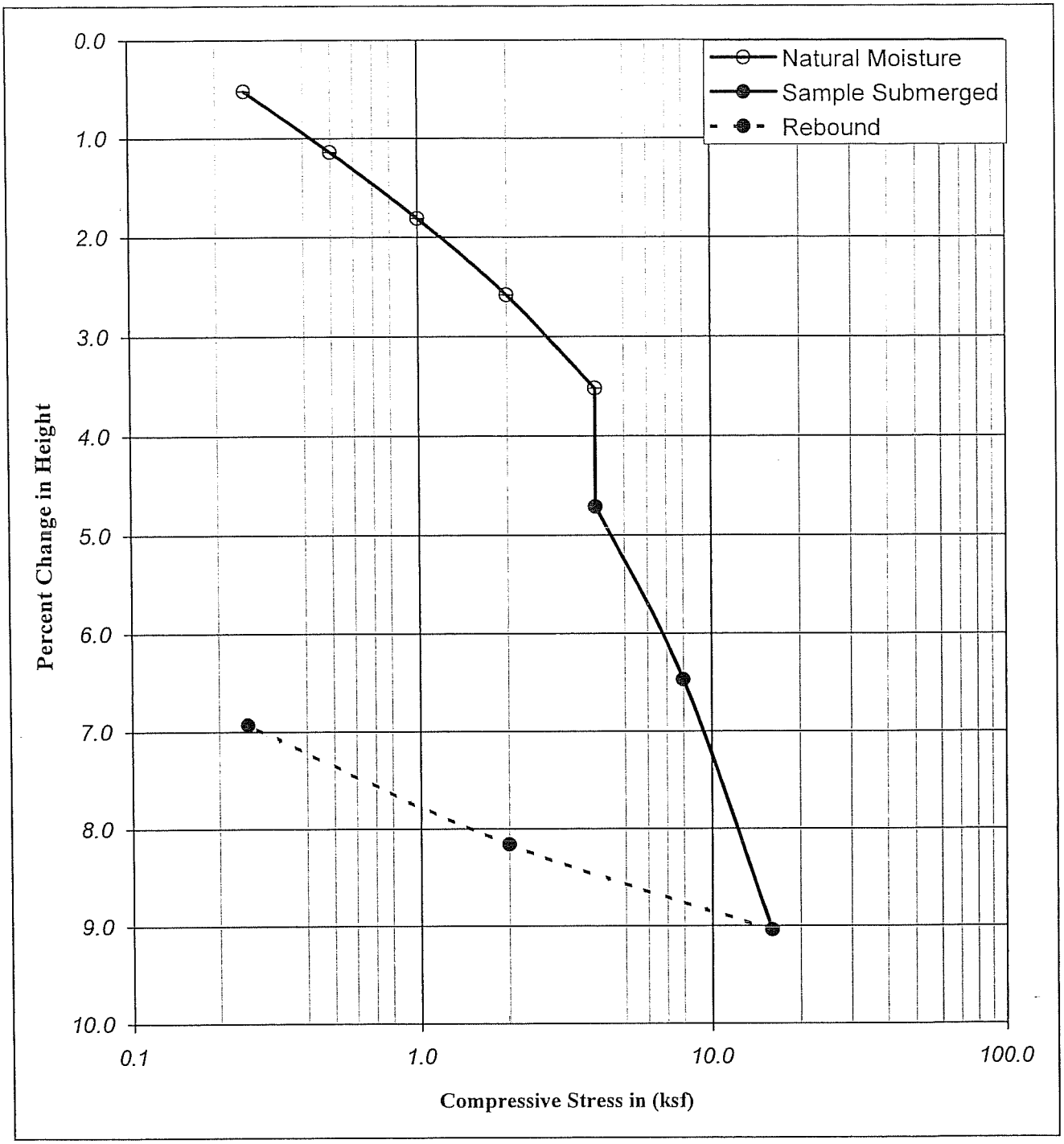
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115	Date : 01/30/09	Figure No. :



Boring No.	: A-08-005			Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-8			Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft) :	35.0	36.5	Plastic Index :	-	Initial	13.84	115.16	18.13	80.56	0.46
	(m) :	10.68	11.13	Specific Gravity :	2.70	Final	13.47	123.84	19.49	100.71	0.36
Description	: Dark yellowish brown, SANDY lean CLAY (CL)										

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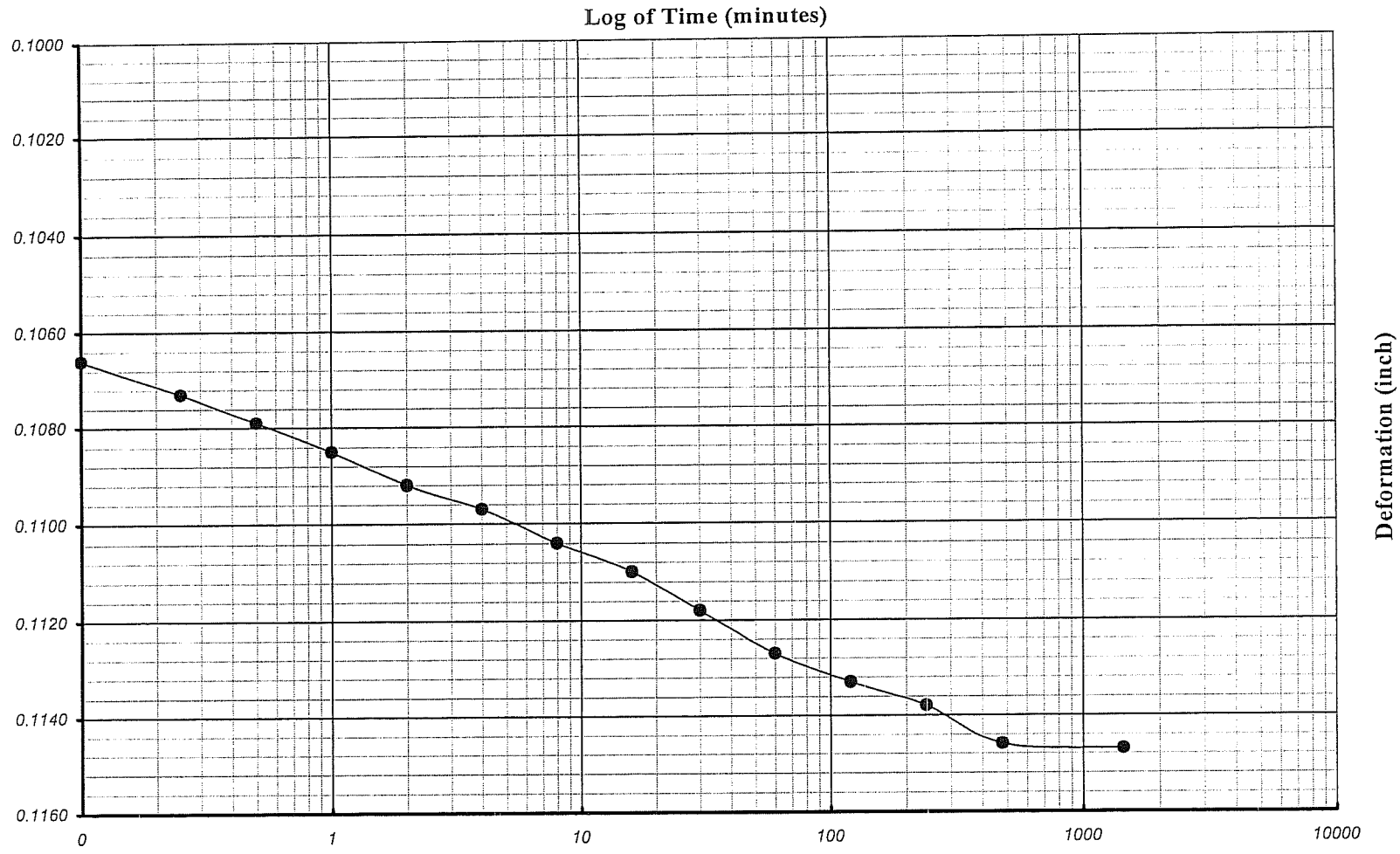
RBF/SR-57 Northbound

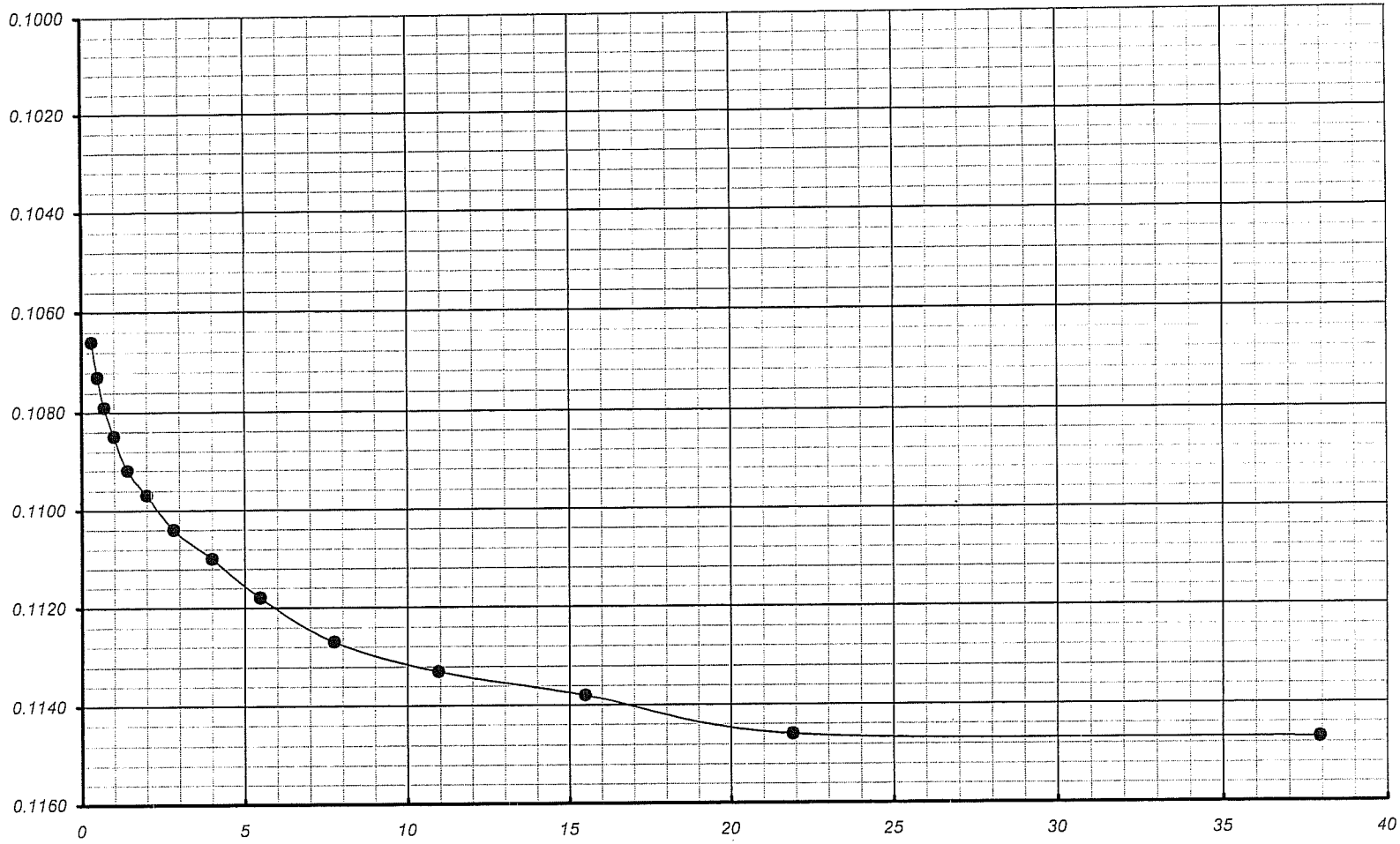
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

Project No. : *08-115* *12/05/08*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-005*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-8*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.00* *383.0*

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-005*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-8*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.0* *383.0*

APPENDIX C

DESIGN CALCULATIONS

Earth Mechanics, Inc.
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17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project SR-57 NB Placentia OH (widen) Project No. 02-115

By _____ Date _____ Checked By _____ Date _____ Sheet ____ of ____

Pile Properties 24" CIDH

$P = \pi D = \pi (2') = 6.283$ Ft

$A = \frac{\pi D^2}{4} = \frac{\pi}{4}(2)^2 = 3.14$ Ft^2 $= 452.16$ in^2

$I = \frac{\pi D^4}{64} = \frac{\pi}{64}(24)^4 = 16,286$ in^4

$E_c = 57000\sqrt{f'c} = 57000\sqrt{3250} = 3.25 \times 10^6$ $\frac{lb}{in^2}$

$EI = 5.29 \times 10^{10}$ lb-in^2

$\frac{1}{2}EI = 2.65 \times 10^{10}$ lb-in^2

HP 14x89

$P = 2 \times (13.83 + 14.695) = 57.05$ in

$A_{Gross} = 13.83 \times 14.695 = 203$ in^2

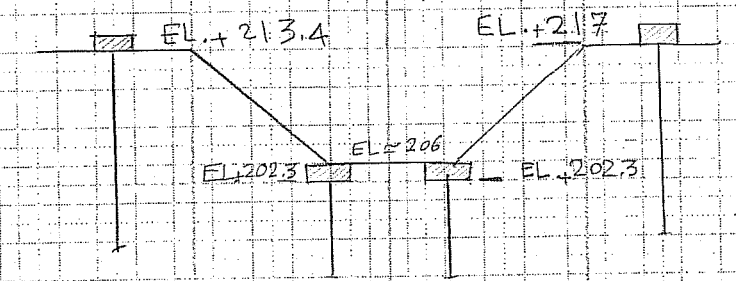
$A_{tip} = A_s = 26.1$ in^2

$EI_{xx} = 2.9E+7 \times 904 = 2.6E10$ lb-in^2

$EI_{yy} = 2.9E7 \times 326 = 9.45E9$ lb-in^2

$E_s = 29,000,000$ PSI

Idealized Soil Profile



Pile cutoff elevations

EL.		
+233.5	Clayey Sand	γ=125 Pcf, $\bar{N}$=14, Φ=28°
+217	Sandy Lean Clay, C = 2000 PSF	γ=125 Pcf, $\bar{N}$=15
+212	Clayey Sand	γ=125 Pcf, $\bar{N}$=15, Φ=32°
+204	Sandy Lean Clay	γ=125 Pcf, $\bar{N}$=10, C=1200 PSF
+195	clayey / Silty Sand	γ=120 Pcf, $\bar{N}$=30, Φ=36°
+185	Poorly-graded sand w/ Silt	γ=120 Pcf, $\bar{N}$=50, Φ=39°
+170	Sandy Lean Clay, C = 2500 PSF	γ=125 Pcf, $\bar{N}$=20
+165	Poorly-Graded/Silty Sand	γ=117 Pcf, $\bar{N}$>50, Φ=40°

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Project SR-57 NB S. Placentia OH (widen) Project No. 08-115

By AZ Date 5-14-09 Checked By _____ Date _____ Sheet ___ of ___

Axial Capacity of Abutment Piles

* Servic demand = 90x2 = 180 kips required nominal resistance

Pile spacing = 3'-6" = 3D

— axial group efficiency for sand layers: nominal axial resistance for pile group in sand is sum of axial resistance of individual piles, thus group efficiency in sand is 1.0.

— axial group efficiency for clay layers: nominal axial resistance for pile group in clay is lesser of:

I. Σ Nominal resistance of each pile

II. Nominal axial resistance of equivalent pier

equivalent pier dimensions: (subtract 1.5 ft for 14" pile)

$L = 15' + 2\times\frac{7}{12} - 1.5' = 14.67'$ $B = 7' + 2\times\frac{7}{12} - 1.5' = 6.67'$

Compare w/ Single Pile:	10 single piles	Equivalent Pier
Perimeter of HP 14x89 = 57.05 in	$10\times\frac{57.05}{12} = 47.5' <$	$2\times(14.67\times 6.67) = 195.7'$

Single pile nominal resistance is smaller. Group efficiency for clay is 1.0.

→ Pile length = 35' → Use 37' | See APile output in the following pages.

Note: Since the shear strength of the clay layer below the pile cap is 2000 psf, efficiency factor $\eta = 1$ can be used.

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Project SR-57 NB S. Placentia OH (widen) Project No. 08-115

By AZ Date 5-14-09 Checked By _____ Date _____ Sheet ____ of ____

Axial Capacity for Bents

- Strength limit state: 180 ÷ 0.7 = 257 kip
- Extreme event limit state: 400 kip

Group Efficiency Factor (η)

Min. Pile spacing = 5' (2.5d spacing)
Avg. Pile Spacing ≃ 5.67' (2.8d spacing)

η	For sand	For clay
	$0.65+\frac{0.3}{1.5}(1-0.65)$ = 0.72	Compare single pile vs. eq. pier

Equivalent Pier Perimeter:

No. of Piles = 8
Length (longitudinal direction) = 6'
Width (transverse direction) = 17'

Equivalent pier perimeter = 2(16+17) = 66 ft

Compare w/ Single Pile:

8 single Piles	Eq Pier
$10 \times \pi \times 2 = 62.8$ ft	< 66 ft

Use group efficiency factor $\eta = 1.0$ for clay layers.

required pile length = 44'

See next page table (based on SHAFT output) for axial capacity calculations.

Similarly required length for strength limit state is 32'.

- Axial Capacity in Tension
  - Extreme event limit state: 200 kip per pile resistance factor = 1.0
  - Single Pile axial resistance: use SHAFT output for tension.
    → required pile length = 28 ft ($\eta = 1.0$ for single pile in tension)
  - Pile group axial resistance in tension:
    Use vertical-side soil block for clay and sloped soil block for sand layers.

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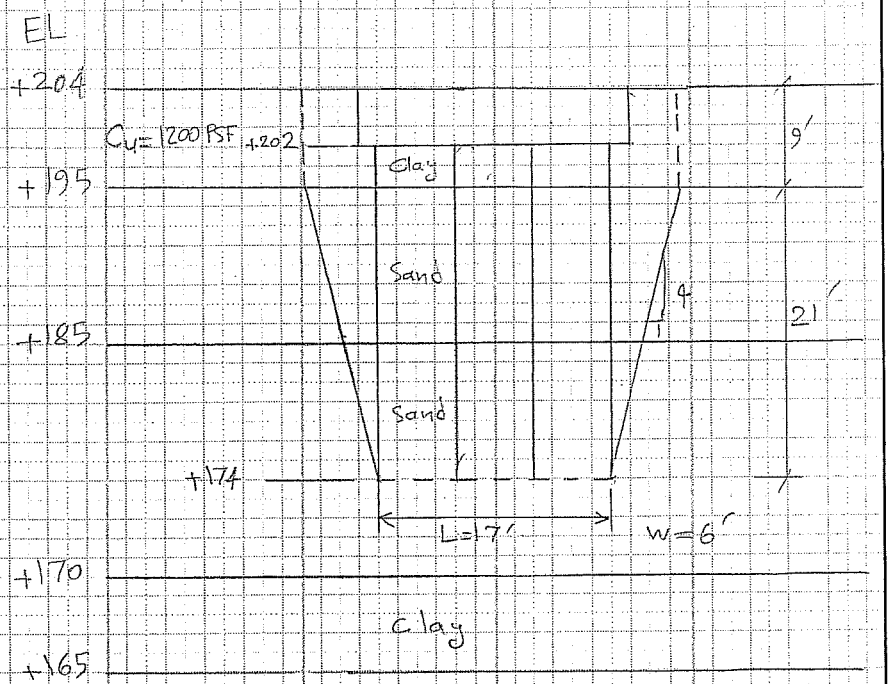
Project SR-57 NB S. Placentia OH (Widen) Project No. 08-115

By AZ Date 5-14-09 Checked By _____ Date _____ Sheet ____ of ____

- Assumed Piles and Pile Cap have the same density as soil.
- assumed density is 122 pcf for all layers.



Weight of rect. Prism ← → Weight of Partial Pyramid

Weight of Soil Block $W = W_1 + W_2$

$W_1 = 9 \times \left(\overbrace{17 + \frac{21}{2}}^{32.5'}\right) \times \left(\overbrace{6 + \frac{21}{2}}^{16.5'}\right) \times 0.122 = 589$ kip.

Volume of Partial prism: $V_2 = \frac{1}{3}(A_1 + A_2)h + \frac{1}{3}(\sqrt{A_1 A_2})h$

$V_2 = \frac{1}{3}(6 \times 17 + 32.5 \times 16.5) \times 21 + \frac{1}{3}\sqrt{(6 \times 17) \times (32.5 \times 16.5)} \times 21 = 6105$ ft^3

$W_2 = 6105 \times 0.122 = 745$ kip.

Shear strength along the clay layer $= 1.2 \times 9 \times 2 \times (32.5 + 16.5)$

$S = 1058$ kip

Total Tension Capacity $= 589 + 745 + 1058 = 2392$ kip

tension capacity per pile $= 2392 \div 8 = 299$ kips per pile

∴ Single pile tension capacity controls the length.

Specify 28 ft pile for tension.

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

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phone: (714)751-3826, Fax (714)751-3928

Project: **South Placentia OH (WIDEN)** Project No. **08-115**

By AZ Date 5/14/2009 Check by _____ Date _____ Sheet _____

Drilled shaft axial capacity with group reduction factor (η)

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)	η	QS(group) (TONS)
1	0.12	2.07	0	2.07	2.07	1.04	17.82	1.00	2.07
2	0.23	4.15	0	4.15	4.15	2.07	17.82	1.00	4.15
3	0.35	6.22	0	6.22	6.22	3.11	17.82	1.00	6.22
4	0.47	8.29	0	8.29	8.29	4.15	17.82	1.00	8.29
5	0.58	10.37	0	10.37	10.37	5.18	17.82	1.00	10.37
6	0.7	12.44	0	12.44	12.44	6.22	17.82	1.00	12.44
7	0.81	14.52	0	14.52	14.52	7.26	17.82	1.00	14.52
8	0.93	18.01	0	18.01	18.01	9.01	19.35	0.72	17.03
9	1.05	21.85	0	21.85	21.85	10.92	20.86	0.72	19.80
10	1.16	26.01	0	26.01	26.01	13.01	22.35	0.72	22.79
11	1.28	30.49	0	30.49	30.49	15.25	23.82	0.72	26.02
12	1.4	35.28	0	35.28	35.28	17.64	25.26	0.72	29.47
13	1.51	40.35	0	40.35	40.35	20.18	26.67	0.72	33.12
14	1.63	45.71	0	45.71	45.71	22.86	28.06	0.72	36.98
15	1.75	51.35	0	51.35	51.35	25.67	29.42	0.72	41.04
16	1.86	57.25	0	57.25	57.25	28.62	30.75	0.72	45.29
17	1.98	63.4	0	63.4	63.4	31.7	32.05	0.72	49.71
18	2.09	69.79	0	69.79	69.79	34.9	33.32	0.72	54.31
19	2.21	76.42	0	76.42	76.42	38.21	34.56	0.72	59.09
20	2.33	83.28	0	83.28	83.28	41.64	35.78	0.72	64.03
21	2.44	90.35	0	90.35	90.35	45.18	36.97	0.72	69.12
22	2.56	97.64	0	97.64	97.64	48.82	38.14	0.72	74.37
23	2.68	105.13	0	105.13	105.13	52.56	39.28	0.72	79.76
24	2.79	112.81	0	112.81	112.81	56.4	40.39	0.72	85.29
25	2.91	120.67	0	120.67	120.67	60.34	41.48	0.72	90.95
26	3.03	128.72	0	128.72	128.72	64.36	42.54	0.72	96.74
27	3.14	136.94	0	136.94	136.94	68.47	43.58	0.72	102.66
28	3.26	145.32	0	145.32	145.32	72.66	44.6	0.72	108.70
29	3.37	153.85	0	153.85	153.85	76.93	45.59	0.72	114.84
30	3.49	162.54	0	162.54	162.54	81.27	46.56	0.72	121.09
31	3.61	171.37	0	171.37	171.37	85.69	47.5	0.72	127.45
32	3.72	180.34	0	180.34	180.34	90.17	48.43	0.72	133.91
33	3.84	184.66	0	184.66	184.66	92.33	48.08	1.00	138.23
34	3.96	188.98	0	188.98	188.98	94.49	47.76	1.00	142.55
35	4.07	193.3	0	193.3	193.3	96.65	47.46	1.00	146.87
36	4.19	197.62	0	197.62	197.62	98.81	47.17	1.00	151.19
37	4.31	201.94	0	201.94	201.94	100.97	46.9	1.00	155.51
38	4.42	211.62	0	211.62	211.62	105.81	47.86	0.72	162.48
39	4.54	221.4	0	221.4	221.4	110.7	48.78	0.72	169.52
40	4.65	231.24	0	231.24	231.24	115.62	49.68	0.72	176.61
41	4.77	241.17	0	241.17	241.17	120.58	50.55	0.72	183.76
42	4.89	251.15	0	251.15	251.15	125.58	51.39	0.72	190.94
43	5	261.2	0	261.2	261.2	130.6	52.2	0.72	198.18
44	5.12	271.3	0	271.3	271.3	135.65	52.99	0.72	205.45
45	5.24	281.46	0	281.46	281.46	140.73	53.75	0.72	212.76
46	5.35	291.65	0	291.65	291.65	145.83	54.48	0.72	220.10
47	5.47	301.89	0	301.89	301.89	150.94	55.2	0.72	227.47
48	5.59	312.15	0	312.15	312.15	156.08	55.88	0.72	234.86
49	5.7	322.45	0	322.45	322.45	161.22	56.55	0.72	242.28
50	5.82	332.77	0	332.77	332.77	166.38	57.19	0.72	249.71

Axial Capacity for Abutment Piles

AXIALLY LOADING PILE ANALYSIS PROGRAM - APILEplus
VERSION 4.0 - (C) COPYRIGHT ENSOFT,INC.,1987-2004.

South Placentia Abutments - HP14x89 Piles

DESIGNER : AZ

DATE : 01-21-09

PILE PROPERTIES :

PERIMETER OF PILE WITH NONCIRCULAR SECTION=	57.05	IN.
TIP AREA OF PILE WITH NONCIRCULAR SECTION =	0.18	SQF
OUTSIDE DIAMETER OF CIRCULAR PILE =	0.00	IN.
INTERNAL DIAMETER OF CIRCULAR PILE =	0.00	IN.
PILE LENGTH =	40.00	FT.
MODULUS OF ELASTICITY =	0.290E+08	PSI

LENGTH OF SURFACE SECTION WITH ZERO SKIN FRICTION = 0.00 FT.
INCREMENT OF PILE LENGTH USED IN COMPUTATION = 1.00 FT.

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	CLAY	0.00	125.00	0.00	0.00
1.00	CLAY	0.00	125.00	0.00	0.00
1.00	SAND	0.80	125.00	27.00	24.00
9.00	SAND	0.80	125.00	27.00	24.00
9.00	CLAY	0.00	125.00	0.00	0.00
18.00	CLAY	0.00	125.00	0.00	0.00
18.00	SAND	0.80	120.00	31.00	40.00
28.00	SAND	0.80	120.00	31.00	40.00
28.00	SAND	0.80	120.00	34.00	100.00
43.00	SAND	0.80	120.00	34.00	100.00
43.00	CLAY	0.00	125.00	0.00	0.00
48.00	CLAY	0.00	125.00	0.00	0.00
48.00	SAND	0.80	117.00	35.00	120.00
60.00	SAND	0.80	117.00	35.00	120.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
9999.00	99999.00	2.00	1.00	0.00	0.00	0.00
9999.00	99999.00	2.00	1.00	0.00	0.00	0.00
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00
9999.00	99999.00	1.20	0.60	0.00	0.00	0.00
9999.00	99999.00	1.20	0.60	0.00	0.00	0.00
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00
9999.00	99999.00	2.50	1.25	0.00	0.00	0.00
9999.00	99999.00	2.50	1.25	0.00	0.00	0.00
9999.00	99999.00	0.00	0.00	0.00	0.00	0.00

9999.00 99999.00 0.00 0.00 0.00 0.00 0.00

1

****
* COMPUTATION RESULT *
****

1.798614	0.1812500	2	1
1.798614	0.1812500	3	1
1.798614	0.1812500	4	1
1.798614	0.1812500	5	1
1.798614	0.1812500	6	1
1.798614	0.1812500	7	1
1.798614	0.1812500	8	1
1.798614	0.1812500	9	1
1.798614	0.1812500	19	1
1.798614	0.1812500	20	1
1.798614	0.1812500	21	1
1.798614	0.1812500	22	1
1.798614	0.1812500	23	1
1.798614	0.1812500	24	1
1.798614	0.1812500	25	1
1.798614	0.1812500	26	1
1.798614	0.1812500	27	1
1.798614	0.1812500	28	1
1.798614	0.1812500	29	1
1.798614	0.1812500	30	1
1.798614	0.1812500	31	1
1.798614	0.1812500	32	1
1.798614	0.1812500	33	1
1.798614	0.1812500	34	1
1.798614	0.1812500	35	1
1.798614	0.1812500	36	1
1.798614	0.1812500	37	1
1.798614	0.1812500	38	1
1.798614	0.1812500	39	1
1.798614	0.1812500	40	1
1.798614	0.1812500	41	1
1.798614	0.1812500	42	0
1.798614	0.1812500	43	0
1.798614	0.1812500	49	0
1.798614	0.1812500	50	0
1.798614	0.1812500	51	0
1.798614	0.1812500	52	0
1.798614	0.1812500	53	0
1.798614	0.1812500	54	0
1.798614	0.1812500	55	0
1.798614	0.1812500	56	0
1.798614	0.1812500	57	0
1.798614	0.1812500	58	0
1.798614	0.1812500	59	0
1.798614	0.1812500	60	0

**********	**********	**********
* FED. HWY. METHOD *	* ARMY CORPS METHOD *	* LAMBDA 2 METHOD *
**********	**********	**********

PILE PENETR-ATION FT.	TOTAL SKIN FRIC KIP	END BEARING KIP	ULTIM CAPAC-ITY KIP	TOTAL SKIN FRIC KIP	END BEARING KIP	ULTIM CAPAC-ITY KIP	TOTAL SKIN FRIC KIP	END BEARING KIP	ULTIM CAPAC-ITY KIP
0.0	0.0	1.4	1.4	0.0	1.6	1.6	0.0	1.8	1.8
1.0	7.6	0.6	8.2	4.8	1.0	5.8	5.4	1.4	6.8
2.0	11.7	0.8	12.5	7.3	1.5	8.8	5.4	1.9	7.3
3.0	12.2	1.0	13.2	7.7	1.9	9.6	5.7	2.5	8.2
4.0	12.9	1.3	14.1	8.4	2.3	10.6	6.3	3.0	9.3
5.0	13.8	1.5	15.3	9.1	2.7	11.9	7.1	3.5	10.7
6.0	14.9	1.7	16.6	10.1	3.1	13.2	8.1	4.1	12.1
7.0	16.2	1.9	18.1	11.3	2.9	14.1	9.2	3.5	12.7
8.0	17.7	2.0	19.6	12.6	2.5	15.0	10.4	2.8	13.3
9.0	19.4	2.0	21.3	14.1	2.0	16.0	11.7	2.0	13.7

10.0	23.0	2.0	25.0	16.7	2.0	18.7	14.0	2.0	16.0
11.0	28.4	2.0	30.4	20.4	2.0	22.4	16.2	2.0	18.2
12.0	33.8	2.0	35.8	24.1	2.0	26.1	18.3	2.0	20.2
13.0	39.3	2.0	41.2	27.8	2.0	29.8	20.3	2.0	22.3
14.0	44.7	2.0	46.6	31.5	2.0	33.5	22.3	2.0	24.2
15.0	50.1	2.0	52.0	35.2	2.0	37.3	24.3	2.1	26.4
16.0	55.5	2.6	58.0	39.0	4.4	43.3	27.2	7.0	34.2
17.0	60.9	3.2	64.0	42.7	6.7	49.4	30.2	12.2	42.3
18.0	66.3	3.7	70.0	45.8	9.1	54.8	33.2	17.6	50.9
19.0	71.8	3.7	75.6	48.8	9.1	57.9	36.2	18.5	54.7
20.0	77.6	3.7	81.3	51.9	9.1	61.0	39.4	19.4	58.8
21.0	83.6	3.7	87.3	55.0	9.1	64.1	42.7	20.2	63.0
22.0	89.9	3.7	93.6	58.1	9.1	67.2	46.2	21.0	67.2
23.0	96.5	3.7	100.2	61.2	9.1	70.3	49.9	21.5	71.4
24.0	103.4	3.7	107.1	64.3	9.1	73.4	53.7	21.7	75.4
25.0	110.6	3.8	114.4	67.4	9.2	76.6	57.6	21.8	79.5
26.0	118.0	7.0	125.0	70.5	13.4	83.9	61.7	25.4	87.2
27.0	125.7	10.2	135.9	73.6	17.7	91.3	66.0	29.0	95.0
28.0	133.8	13.3	147.1	78.7	21.9	100.6	70.4	32.6	103.1
29.0	143.7	13.3	157.0	83.8	21.9	105.7	75.3	32.6	107.9
30.0	155.5	13.3	168.8	88.9	21.9	110.8	80.3	32.6	112.9
31.0	167.8	13.3	181.1	94.0	21.9	115.9	85.5	32.6	118.1
32.0	180.4	13.3	193.7	99.1	21.9	121.0	90.9	32.6	123.5
33.0	193.4	13.3	206.7	104.2	21.9	126.1	96.4	32.6	129.0
34.0	206.8	13.3	220.1	109.3	21.9	131.2	102.1	32.6	134.7
35.0	220.6	13.3	234.0	114.4	21.9	136.3	107.9	32.6	140.5
36.0	234.8	13.3	248.1	119.5	21.9	141.4	113.9	32.6	146.6
37.0	249.4	13.3	262.7	124.6	21.9	146.5	120.1	32.6	152.8
38.0	264.4	13.3	277.7	129.7	21.9	151.7	126.5	32.6	159.1
39.0	279.8	13.3	293.1	134.8	21.9	156.8	133.0	32.6	165.6
40.0	295.5	13.2	308.8	139.9	21.8	161.7	139.7	32.4	172.1

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* API RP-2A (1994) *
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PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	1.8	1.8
1.00	2.4	1.4	3.7
2.00	3.8	1.9	5.7
3.00	4.2	2.5	6.7
4.00	4.9	3.0	7.9
5.00	5.8	3.5	9.3
6.00	6.8	4.1	10.9
7.00	8.1	3.5	11.6
8.00	9.5	2.8	12.4
9.00	11.2	2.0	13.1
10.00	13.5	2.0	15.4
11.00	16.5	2.0	18.4
12.00	19.6	2.0	21.5
13.00	22.8	2.0	24.8
14.00	26.2	2.0	28.2
15.00	29.7	2.1	31.8
16.00	33.3	7.0	40.3
17.00	37.1	12.2	49.2
18.00	40.9	17.6	58.6
19.00	45.1	18.5	63.6
20.00	49.6	19.4	69.0
21.00	54.3	20.2	74.6
22.00	59.3	21.0	80.3
23.00	64.4	21.5	85.9
24.00	69.8	21.7	91.6
25.00	75.5	21.8	97.3
26.00	81.3	25.4	106.8
27.00	87.4	29.0	116.4
28.00	93.7	32.6	126.3
29.00	100.6	32.6	133.3
30.00	108.3	32.6	140.9
31.00	116.2	32.6	148.8
32.00	124.3	32.6	157.0

33.00	132.8	32.6	165.4
34.00	141.4	32.6	174.0
35.00	150.3	32.6	183.0
36.00	159.5	32.6	192.1
37.00	168.7	32.6	201.4
38.00	178.0	32.6	210.6
39.00	187.2	32.6	219.8
40.00	196.4	32.4	228.8

Output removed to reduce file size

LOAD VERSUS SETTLEMENT CURVE

****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.2649E+00	0.2076E-03	0.2228E-01	0.1000E-03
0.2649E+01	0.2076E-02	0.2228E+00	0.1000E-02
0.1325E+02	0.1038E-01	0.1114E+01	0.5000E-02
0.2664E+02	0.2080E-01	0.2228E+01	0.1000E-01
0.1240E+03	0.1012E+00	0.8648E+01	0.5000E-01
0.2046E+03	0.1884E+00	0.1067E+02	0.1000E+00
0.2139E+03	0.5944E+00	0.2024E+02	0.5000E+00
0.2200E+03	0.1098E+01	0.2633E+02	0.1000E+01
0.2260E+03	0.2102E+01	0.3237E+02	0.2000E+01

Axial Capacity
Bents Compression

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 5.0 (C) COPYRIGHT ENSOFT,INC. 1989,1995,1998,2001,2003

SR-57 NB South Placentia OH - Bents 2&3 (24-in CIDH)

PROPOSED DEPTH = 50.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 60.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 2.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 2.00

SOIL INFORMATION

LAYER NO 1----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.600E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.120E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.120E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.700E+01

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.114E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.700E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.943E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00

SOIL UNIT WEIGHT, LB/CU FT	= 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.170E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.943E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.390E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.170E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.736E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.390E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.320E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.250E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.320E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.250E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.370E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.679E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.400E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.117E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.370E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.454E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.400E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00

SOIL UNIT WEIGHT, LB/CU FT	= 0.117E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.600E+02

DRILLED SHAFT INFORMATION

DIAMETER OF STEM	=	2.000	FT.
DIAMETER OF BASE	=	2.000	FT.
END OF STEM TO BASE	=	0.000	FT.
ANGLE OF BELL	=	0.000	DEG.
IGNORED TOP PORTION	=	0.000	FT.
IGNORED BOTTOM PORTION	=	0.000	FT.
AREA OF ONE PERCENT STEEL	=	4.524	SQ.IN.
ELASTIC MODULUS, Ec	=	0.325E+07	LB/SQ IN
VOLUME OF UNDERREAM	=	0.000	CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
1.0	0.12	2.07	0.00	2.07	2.07	1.04	17.82
2.0	0.23	4.15	0.00	4.15	4.15	2.07	17.82
3.0	0.35	6.22	0.00	6.22	6.22	3.11	17.82
4.0	0.47	8.29	0.00	8.29	8.29	4.15	17.82
5.0	0.58	10.37	0.00	10.37	10.37	5.18	17.82
6.0	0.70	12.44	0.00	12.44	12.44	6.22	17.82
7.0	0.81	14.52	0.00	14.52	14.52	7.26	17.82
8.0	0.93	18.01	0.00	18.01	18.01	9.01	19.35
9.0	1.05	21.85	0.00	21.85	21.85	10.92	20.86
10.0	1.16	26.01	0.00	26.01	26.01	13.01	22.35
11.0	1.28	30.49	0.00	30.49	30.49	15.25	23.82
12.0	1.40	35.28	0.00	35.28	35.28	17.64	25.26
13.0	1.51	40.35	0.00	40.35	40.35	20.18	26.67
14.0	1.63	45.71	0.00	45.71	45.71	22.86	28.06
15.0	1.75	51.35	0.00	51.35	51.35	25.67	29.42
16.0	1.86	57.25	0.00	57.25	57.25	28.62	30.75
17.0	1.98	63.40	0.00	63.40	63.40	31.70	32.05
18.0	2.09	69.79	0.00	69.79	69.79	34.90	33.32
19.0	2.21	76.42	0.00	76.42	76.42	38.21	34.56
20.0	2.33	83.28	0.00	83.28	83.28	41.64	35.78
21.0	2.44	90.35	0.00	90.35	90.35	45.18	36.97
22.0	2.56	97.64	0.00	97.64	97.64	48.82	38.14
23.0	2.68	105.13	0.00	105.13	105.13	52.56	39.28
24.0	2.79	112.81	0.00	112.81	112.81	56.40	40.39
25.0	2.91	120.67	0.00	120.67	120.67	60.34	41.48
26.0	3.03	128.72	0.00	128.72	128.72	64.36	42.54
27.0	3.14	136.94	0.00	136.94	136.94	68.47	43.58
28.0	3.26	145.32	0.00	145.32	145.32	72.66	44.60
29.0	3.37	153.85	0.00	153.85	153.85	76.93	45.59
30.0	3.49	162.54	0.00	162.54	162.54	81.27	46.56
31.0	3.61	171.37	0.00	171.37	171.37	85.69	47.50
32.0	3.72	180.34	0.00	180.34	180.34	90.17	48.43
33.0	3.84	184.66	0.00	184.66	184.66	92.33	48.08
34.0	3.96	188.98	0.00	188.98	188.98	94.49	47.76
35.0	4.07	193.30	0.00	193.30	193.30	96.65	47.46
36.0	4.19	197.62	0.00	197.62	197.62	98.81	47.17

37.0	4.31	201.94	0.00	201.94	201.94	100.97	46.90
38.0	4.42	211.62	0.00	211.62	211.62	105.81	47.86
39.0	4.54	221.40	0.00	221.40	221.40	110.70	48.78
40.0	4.65	231.24	0.00	231.24	231.24	115.62	49.68
41.0	4.77	241.17	0.00	241.17	241.17	120.58	50.55
42.0	4.89	251.15	0.00	251.15	251.15	125.58	51.39
43.0	5.00	261.20	0.00	261.20	261.20	130.60	52.20
44.0	5.12	271.30	0.00	271.30	271.30	135.65	52.99
45.0	5.24	281.46	0.00	281.46	281.46	140.73	53.75
46.0	5.35	291.65	0.00	291.65	291.65	145.83	54.48
47.0	5.47	301.89	0.00	301.89	301.89	150.94	55.20
48.0	5.59	312.15	0.00	312.15	312.15	156.08	55.88
49.0	5.70	322.45	0.00	322.45	322.45	161.22	56.55
50.0	5.82	332.77	0.00	332.77	332.77	166.38	57.19

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.8141E+00	0.4215E-03	0.2291E-08	0.1000E-03
0.8141E+01	0.4215E-02	0.2291E-07	0.1000E-02
0.2051E+02	0.1056E-01	0.5728E-07	0.2500E-02
0.4129E+02	0.2122E-01	0.1146E-06	0.5000E-02
0.6135E+02	0.3187E-01	0.1718E-06	0.7500E-02
0.7979E+02	0.4232E-01	0.2291E-06	0.1000E-01
0.1649E+03	0.9698E-01	0.5728E-06	0.2500E-01
0.2344E+03	0.1594E+00	0.1146E-05	0.5000E-01
0.2673E+03	0.2026E+00	0.1718E-05	0.7500E-01
0.2858E+03	0.2379E+00	0.2291E-05	0.1000E+00
0.3132E+03	0.4052E+00	0.5603E-05	0.2500E+00
0.3094E+03	0.6537E+00	0.9040E-05	0.5000E+00
0.3091E+03	0.9035E+00	0.1176E-04	0.7500E+00
0.3087E+03	0.1153E+01	0.1418E-04	0.1000E+01
0.3068E+03	0.2552E+01	0.2294E-04	0.2400E+01

Axial Capacity for Bents in Tension

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 5.0 (C) COPYRIGHT ENSOFT,INC. 1989,1995,1998,2001,2003

SR-57 NB South Placentia OH - Bents 2&3 (24-in CIDH) - Tension Demand =

PROPOSED DEPTH = 50.0 FT

REDUCTION FACTOR APPLIED FOR UPLIFT FRICTION = 0.700

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 60.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 1.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 1.00

SOIL INFORMATION

LAYER NO 1----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.600E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.120E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.120E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.700E+01

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.114E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.700E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.943E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.170E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.943E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.390E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.170E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.736E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.390E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.320E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.250E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.320E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00
END BEARING COEFFICIENT-Nc = 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.250E+04
INTERNAL FRICTION ANGLE, DEG. = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.370E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.679E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.400E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT = 0.117E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.370E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.454E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.400E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.117E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.600E+02

DRILLED SHAFT INFORMATION

DIAMETER OF STEM	=	2.000	FT.
DIAMETER OF BASE	=	2.000	FT.
END OF STEM TO BASE	=	0.000	FT.
ANGLE OF BELL	=	0.000	DEG.
IGNORED TOP PORTION	=	0.000	FT.
IGNORED BOTTOM PORTION	=	0.000	FT.
AREA OF ONE PERCENT STEEL	=	4.524	SQ.IN.
ELASTIC MODULUS, Ec	=	0.325E+07	LB/SQ IN
VOLUME OF UNDERREAM	=	0.000	CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	WT (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
1.0	0.12	1.45	0.24	1.69	1.69	1.69	14.50
2.0	0.23	2.90	0.47	3.37	3.37	3.37	14.50
3.0	0.35	4.35	0.71	5.06	5.06	5.06	14.50
4.0	0.47	5.81	0.94	6.75	6.75	6.75	14.50
5.0	0.58	7.26	1.18	8.44	8.44	8.44	14.50
6.0	0.70	8.71	1.41	10.12	10.12	10.12	14.50
7.0	0.81	10.16	1.65	11.81	11.81	11.81	14.50
8.0	0.93	12.61	1.89	14.49	14.49	14.49	15.57
9.0	1.05	15.29	2.12	17.41	17.41	17.41	16.63
10.0	1.16	18.21	2.36	20.56	20.56	20.56	17.67
11.0	1.28	21.34	2.59	23.94	23.94	23.94	18.70
12.0	1.40	24.69	2.83	27.52	27.52	27.52	19.71
13.0	1.51	28.25	3.06	31.31	31.31	31.31	20.70
14.0	1.63	32.00	3.30	35.30	35.30	35.30	21.67
15.0	1.75	35.94	3.53	39.48	39.48	39.48	22.62
16.0	1.86	40.07	3.77	43.84	43.84	43.84	23.55
17.0	1.98	44.38	4.01	48.38	48.38	48.38	24.46
18.0	2.09	48.85	4.24	53.10	53.10	53.10	25.35
19.0	2.21	53.50	4.48	57.97	57.97	57.97	26.22
20.0	2.33	58.29	4.71	63.01	63.01	63.01	27.07
21.0	2.44	63.25	4.95	68.20	68.20	68.20	27.91
22.0	2.56	68.35	5.18	73.53	73.53	73.53	28.72
23.0	2.68	73.59	5.42	79.01	79.01	79.01	29.52
24.0	2.79	78.97	5.66	84.62	84.62	84.62	30.30
25.0	2.91	84.47	5.89	90.36	90.36	90.36	31.06
26.0	3.03	90.10	6.13	96.23	96.23	96.23	31.81
27.0	3.14	95.86	6.36	102.22	102.22	102.22	32.53
28.0	3.26	101.72	6.60	108.32	108.32	108.32	33.24
29.0	3.37	107.70	6.83	114.53	114.53	114.53	33.94
30.0	3.49	113.78	7.07	120.85	120.85	120.85	34.62
31.0	3.61	119.96	7.31	127.26	127.26	127.26	35.28
32.0	3.72	126.23	7.54	133.78	133.78	133.78	35.92

33.0	3.84	129.26	7.78	137.04	137.04	137.04	35.68
34.0	3.96	132.28	8.01	140.30	140.30	140.30	35.46
35.0	4.07	135.31	8.25	143.56	143.56	143.56	35.25
36.0	4.19	138.33	8.48	146.81	146.81	146.81	35.04
37.0	4.31	141.36	8.72	150.07	150.07	150.07	34.85
38.0	4.42	148.14	8.95	157.09	157.09	157.09	35.52
39.0	4.54	154.98	9.19	164.17	164.17	164.17	36.17
40.0	4.65	161.87	9.43	171.30	171.30	171.30	36.80
41.0	4.77	168.82	9.66	178.48	178.48	178.48	37.41
42.0	4.89	175.81	9.90	185.70	185.70	185.70	38.00
43.0	5.00	182.84	10.13	192.97	192.97	192.97	38.56
44.0	5.12	189.91	10.37	200.28	200.28	200.28	39.12
45.0	5.24	197.02	10.60	207.62	207.62	207.62	39.65
46.0	5.35	204.16	10.84	215.00	215.00	215.00	40.16
47.0	5.47	211.32	11.08	222.40	222.40	222.40	40.66
48.0	5.59	218.51	11.31	229.82	229.82	229.82	41.14
49.0	5.70	225.71	11.55	237.26	237.26	237.26	41.61
50.0	5.82	232.94	11.78	244.72	244.72	244.72	42.06

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD	TOP MOVEMENT	TIP LOAD	TIP MOVEMENT
ton	IN.	ton	IN.
0.4963E+00	0.3077E-03	0.1718E-02	0.1000E-03
0.4963E+01	0.3077E-02	0.1718E-01	0.1000E-02
0.1241E+02	0.7692E-02	0.4296E-01	0.2500E-02
0.2501E+02	0.1543E-01	0.8591E-01	0.5000E-02
0.3761E+02	0.2318E-01	0.1289E+00	0.7500E-02
0.4972E+02	0.3091E-01	0.1718E+00	0.1000E-01
0.1080E+03	0.7312E-01	0.4296E+00	0.2500E-01
0.1595E+03	0.1253E+00	0.8591E+00	0.5000E-01
0.1846E+03	0.1640E+00	0.1289E+01	0.7500E-01
0.1993E+03	0.1970E+00	0.1718E+01	0.1000E+00
0.2236E+03	0.3621E+00	0.4202E+01	0.2500E+00
0.2234E+03	0.6131E+00	0.6780E+01	0.5000E+00
0.2252E+03	0.8646E+00	0.8822E+01	0.7500E+00
0.2267E+03	0.1116E+01	0.1063E+02	0.1000E+01
0.2319E+03	0.2521E+01	0.1720E+02	0.2400E+01

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

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(714) 751-3826, Fax (714) 751-3928

Project SR-57 NB S. Placentia OH (widen) Project No. 08-115

By AZ Date 5-4-09 Checked By _____ Date _____ Sheet ____ of ____

Abutment Pile Group Settlement

Due to presence of a clay layer between El. +170' and El. +165', the pile group settlement is evaluated using equivalent pier method.

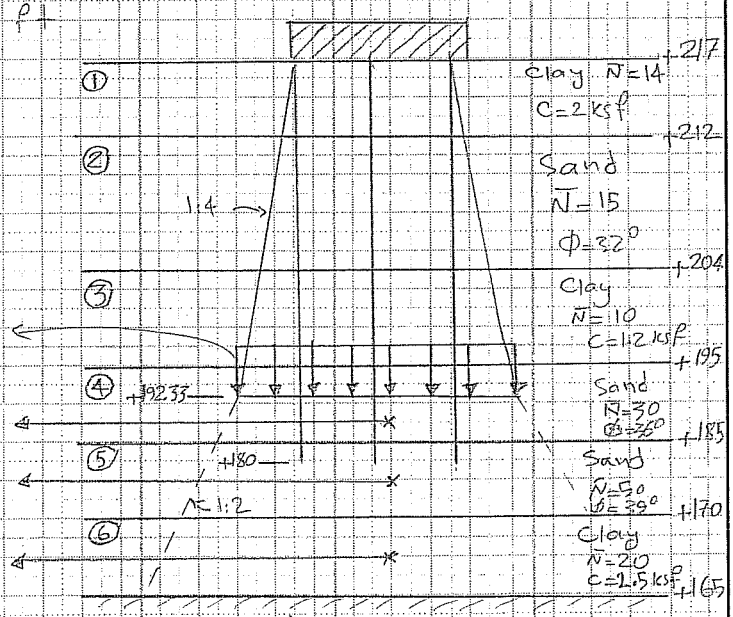
Soil Profile according to AASHTO Table 10.7.2.3.1-1 is Type d.

Equivalent pier is at depth $\frac{2}{3}D$: (D: pile length) $L = 14.67'$ $B = 6.67'$

$\rightarrow B_1 = 14.67 + \frac{1}{2} \times \frac{2}{3} \times 37 = 27'$ $\quad Y_1 = 6.67 + \frac{1}{2} \times \frac{2}{3} \times 37 = 19'$

Equivalent pressure $= \frac{Q}{B_1 Y_1} = \frac{480}{27 \times 19} = 0.94$ ksf.

Equivalent pier elevation $\simeq$ 192.33 ft



$q = 1.75$ ksf $(27' \times 19')$

$\Delta\sigma = \frac{480}{(27+3.67)(19+3.67)} = 0.688$ ksf

$\Delta\sigma = \frac{480}{(27+14.83)(19+14.83)} = 0.341$ ksf

$\Delta\sigma = \frac{480}{(27+24.83)(19+24.83)} = 0.213$ ksf

Point	EL (ft)	Layer H (ft)	σ'_{vo} (ksf)	$\Delta\sigma$ (ksf)	σ'_{vf} (ksf)	C'*	Settlement (in)
4	188.67	7.33	3.76	0.688	4.45	75	0.086
5	177.5	15	5.10	0.341	5.44	90	0.056
6	167.5	5	6.31	0.213	6.52	50	0.017

Layer Settlement $S = H \cdot \frac{1}{C'} \cdot \log \frac{\sigma'_{vf}}{\sigma'_o}$ $\quad S_{total} = 0.16$ in.

* See Fill settlement calculations for reference on C' values.

- Immediate settlement of clay is negligible due to limited thickness.
- Pile length corresponding to settlement of 1.0 in < 12'
  (Using similar calculations) There is no design tip EL. for settlement.

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Project SR-57 NB S. Placentia OH (widen) Project No. 08-115

By AZ Date 5-14-09 Checked By _____ Date _____ Sheet ____ of ____

Bent Pile Group Settlement

Bent Pile Group settlement for 44' piles is negligible since these piles tip into very dense sand layers below El. +165 ft. Minimum pile length corresponding to settlement of 1" was determined to be <12'. Calculations are presented as follows:

Soil Profile Type C (AASHTO Table 10.7.2.3.1-1)

Equivalent pier at depth $\frac{2}{9}D$ L = 17' & B = 6' (8 piles)

Calculations assuming D = 12':

$B_1 = 17 + \frac{1}{2} \times \frac{2}{9} D = 18.33'$

$Y_1 = 6 + \frac{1}{2} \times \frac{2}{9} D = 7.33'$

Equivalent pressure $= \frac{Q}{B_1 Y_1} = \frac{410}{18.33 \times 7.33} = 3.05$ ksf

Equivalent pier elevation = 191.33' Pile cap EL. = 202'

Soil Profile is same as previous page.

Point	EL. (ft)	Layer H (ft)	$\bar{\sigma}_{vo}$ (ksf)	$\Delta\bar{\sigma}$ (ksf)	$\bar{\sigma}_{vf}$ (ksf)	C'	Settlement (in)
4	188.17	6.33	2.195	1.816	4.01	75	0.265
5	177.5	15	3.475	0.602	4.077	90	0.139
6	167.5	5	4.688	0.312	5.00	50	0.034

$S_{total} = 0.44$ in

There is no design tip EL. for settlement at bents.

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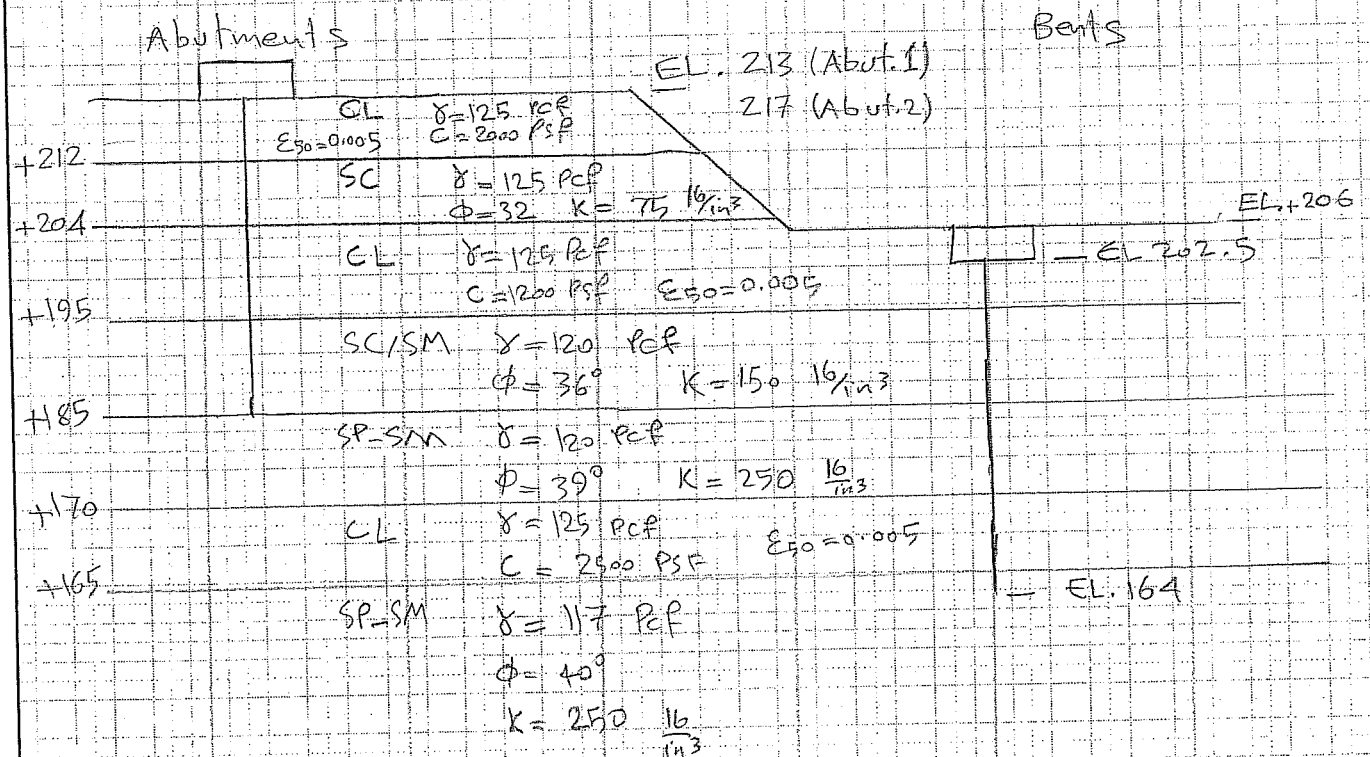
Project SR-57 NB Placentia OH (widen) Project No. 08-115

By AZ Date _____ Checked By _____ Date _____ Sheet ____ of ____

Lateral Pile Solutions



Group Efficiency Factors

Abuts.

GEF = 0.78

Bents.

GEF = 0.64

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.31)

              Analysis of Individual Piles and Drilled Shafts
            Subjected to Lateral Loading Using the p-y Method

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                             All Rights Reserved

================================================================================

This program is licensed to:

AZ
Earth Mechanics, Inc.

Path to file locations:       C:\Amir Files\Projects\Lino\SR-57\Placentia\lpile\
Name of input data file:      Abutments-strong.lpd
Name of output file:          Abutments-strong.lpo
Name of plot output file:     Abutments-strong.lpp
Name of runtime file:         Abutments-strong.lpr

--------------------------------------------------------------------------------
                          Time and Date of Analysis
--------------------------------------------------------------------------------

              Date:  January 28, 2009     Time:  15:43:11

--------------------------------------------------------------------------------
                               Problem Title
--------------------------------------------------------------------------------

Placentia Overhead Abutment - HP18x89 (strong axis, Abut. 4 modeled)

--------------------------------------------------------------------------------
                               Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments              =         100
- Maximum number of iterations allowed   =         100
- Deflection tolerance for convergence   =  1.0000E-05 in
- Maximum allowable deflection           =  1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1

--------------------------------------------------------------------------------
                    Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                                 =     408.00 in
Depth of ground surface below top of pile   =        .00 in
Slope angle of ground surface               =        .00 deg.

Structural properties of pile defined using  2 points

Point     Depth        Pile       Moment of       Pile       Modulus of
            X        Diameter      Inertia        Area       Elasticity
           in           in          in**4        Sq.in       lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   14.00000000      904.0000      26.1000     29000000.
  2     408.0000   14.00000000      904.0000      26.1000     29000000.
```

Soil and Rock Layering Information

The soil profile is modelled using 7 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = .000 in
Distance from top of pile to bottom of layer = 60.000 in

Layer 2 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 60.000 in
Distance from top of pile to bottom of layer = 156.000 in
p-y subgrade modulus k for top of soil layer = 75.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 75.000 lbs/in**3

Layer 3 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 156.000 in
Distance from top of pile to bottom of layer = 264.000 in

Layer 4 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 264.000 in
Distance from top of pile to bottom of layer = 384.000 in
p-y subgrade modulus k for top of soil layer = 150.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 150.000 lbs/in**3

Layer 5 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 384.000 in
Distance from top of pile to bottom of layer = 564.000 in
p-y subgrade modulus k for top of soil layer = 250.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 250.000 lbs/in**3

Layer 6 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 564.000 in
Distance from top of pile to bottom of layer = 624.000 in

Layer 7 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 624.000 in
Distance from top of pile to bottom of layer = 804.000 in
p-y subgrade modulus k for top of soil layer = 250.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 250.000 lbs/in**3

(Depth of lowest layer extends 396.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 14 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	.00	.07230
2	60.00	.07230
3	60.00	.07230
4	156.00	.07230
5	156.00	.07230
6	264.00	.07230
7	264.00	.06940
8	384.00	.06940
9	384.00	.06940
10	564.00	.06940
11	564.00	.07230
12	624.00	.07230
13	624.00	.06770
14	804.00	.06770

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 14 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	13.89000	.00	.00500	.0
2	60.000	13.89000	.00	.00500	.0
3	60.000	.00000	32.00	------	------
4	156.000	.00000	32.00	------	------
5	156.000	8.33000	.00	.00700	.0
6	264.000	8.33000	.00	.00700	.0
7	264.000	.00000	36.00	------	------

8	384.000	.00000	36.00	------	------
9	384.000	.00000	39.00	------	------
10	564.000	.00000	39.00	------	------
11	564.000	17.36000	.00	.00500	.0
12	624.000	17.36000	.00	.00500	.0
13	624.000	.00000	40.00	------	------
14	804.000	.00000	40.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	.000	.7800	1.0000
2	408.000	.7800	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves

---

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 5

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .250 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .500 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 3.000 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 5.000 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Pages Removed to Reduce Output Size

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .250000	M= 0.000	130000.	.2500000	801930.	21436.2721
4	y= .500000	M= 0.000	130000.	.5000000	1476299.	33599.0415
4	y= 1.000000	M= 0.000	130000.	1.0000000	2686258.	52994.9564
4	y= 3.000	M= 0.000	130000.	3.0000	6343030.	97598.2336
4	y= 5.000	M= 0.000	130000.	5.0000	9220632.	123472.

The analysis ended normally.

Summary of Warning Messages

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.31)

              Analysis of Individual Piles and Drilled Shafts
            Subjected to Lateral Loading Using the p-y Method

                        (c) 1985-2007 by Ensoft, Inc.
                            All Rights Reserved

================================================================================

This program is licensed to:

AZ
Earth Mechanics, Inc.

Path to file locations:       C:\Amir Files\Projects\Lino\SR-57\Placentia\lpile\
Name of input data file:      Abutments.lpd
Name of output file:          Abutments.lpo
Name of plot output file:     Abutments.lpp
Name of runtime file:         Abutments.lpr

--------------------------------------------------------------------------------
                          Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  January 28, 2009     Time:  15:42:40

--------------------------------------------------------------------------------
                                 Problem Title
--------------------------------------------------------------------------------

Placentia Overhead Abutment - HP18x89 (weak axis, Abut. 4 modeled)

--------------------------------------------------------------------------------
                                 Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multipliers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments              =         100
- Maximum number of iterations allowed   =         100
- Deflection tolerance for convergence   =  1.0000E-05 in
- Maximum allowable deflection           =  1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1

--------------------------------------------------------------------------------
                    Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                                 =     408.00 in
Depth of ground surface below top of pile   =        .00 in
Slope angle of ground surface               =        .00 deg.

Structural properties of pile defined using  2 points

Point     Depth        Pile        Moment of       Pile        Modulus of
            X        Diameter      Inertia         Area        Elasticity
           in           in          in**4         Sq.in       lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   14.00000000     326.0000      26.1000     29000000.
  2     408.0000   14.00000000     326.0000      26.1000     29000000.
```

Soil and Rock Layering Information

The soil profile is modelled using 7 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = .000 in
Distance from top of pile to bottom of layer = 60.000 in

Layer 2 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 60.000 in
Distance from top of pile to bottom of layer = 156.000 in
p-y subgrade modulus k for top of soil layer = 75.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 75.000 lbs/in**3

Layer 3 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 156.000 in
Distance from top of pile to bottom of layer = 264.000 in

Layer 4 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 264.000 in
Distance from top of pile to bottom of layer = 384.000 in
p-y subgrade modulus k for top of soil layer = 150.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 150.000 lbs/in**3

Layer 5 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 384.000 in
Distance from top of pile to bottom of layer = 564.000 in
p-y subgrade modulus k for top of soil layer = 250.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 250.000 lbs/in**3

Layer 6 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 564.000 in
Distance from top of pile to bottom of layer = 624.000 in

Layer 7 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 624.000 in
Distance from top of pile to bottom of layer = 804.000 in
p-y subgrade modulus k for top of soil layer = 250.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 250.000 lbs/in**3

(Depth of lowest layer extends 396.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 14 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	.00	.07230
2	60.00	.07230
3	60.00	.07230
4	156.00	.07230
5	156.00	.07230
6	264.00	.07230
7	264.00	.06940
8	384.00	.06940
9	384.00	.06940
10	564.00	.06940
11	564.00	.07230
12	624.00	.07230
13	624.00	.06770
14	804.00	.06770

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 14 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	13.89000	.00	.00500	.0
2	60.000	13.89000	.00	.00500	.0
3	60.000	.00000	32.00	------	------
4	156.000	.00000	32.00	------	------
5	156.000	8.33000	.00	.00700	.0
6	264.000	8.33000	.00	.00700	.0
7	264.000	.00000	36.00	------	------

8	384.000	.00000	36.00	------	------
9	384.000	.00000	39.00	------	------
10	564.000	.00000	39.00	------	------
11	564.000	17.36000	.00	.00500	.0
12	624.000	17.36000	.00	.00500	.0
13	624.000	.00000	40.00	------	------
14	804.000	.00000	40.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	.000	.7800	1.0000
2	408.000	.7800	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves

---

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 5

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .250 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .500 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 3.000 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 5.000 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Pages Removed to Reduce Output Size

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,
Type 2 = Shear and Slope,
Type 3 = Shear and Rot. Stiffness,
Type 4 = Deflection and Moment,
Type 5 = Deflection and Slope,

y = pile-head displacment in
M = Pile-head Moment lbs-in
V = Pile-head Shear Force lbs
S = Pile-head Slope, radians
R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1		Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .250000	M=	0.000	130000.	.2500000	448465.	15414.3257
4	y= .500000	M=	0.000	130000.	.5000000	794451.	23116.0243
4	y= 1.000000	M=	0.000	130000.	1.0000000	1445191.	35542.2846
4	y= 3.000	M=	0.000	130000.	3.0000	3424442.	64479.0372
4	y= 5.000	M=	0.000	130000.	5.0000	4872902.	79336.8235

The analysis ended normally.

Summary of Warning Messages

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.31)

              Analysis of Individual Piles and Drilled Shafts
            Subjected to Lateral Loading Using the p-y Method

                        (c) 1985-2007 by Ensoft, Inc.
                            All Rights Reserved

================================================================================

This program is licensed to:

AZ
Earth Mechanics, Inc.

Path to file locations:      C:\Amir Files\Projects\Lino\SR-57\Placentia\lpile\
Name of input data file:     Bents.lpd
Name of output file:         Bents.lpo
Name of plot output file:    Bents.lpp
Name of runtime file:        Bents.lpr

--------------------------------------------------------------------------------
                          Time and Date of Analysis
--------------------------------------------------------------------------------

             Date:  January 28, 2009     Time:  16: 5:33

--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

Placentia Overhead Bent - 24in CIDH

--------------------------------------------------------------------------------
                                Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multipliers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments             =          100
- Maximum number of iterations allowed  =          100
- Deflection tolerance for convergence  =   1.0000E-05 in
- Maximum allowable deflection          =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1

--------------------------------------------------------------------------------
                    Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                                 =     456.00 in
Depth of ground surface below top of pile   =     -48.00 in
Slope angle of ground surface               =        .00 deg.

Structural properties of pile defined using  2 points

Point     Depth        Pile        Moment of       Pile        Modulus of
            X        Diameter      Inertia         Area        Elasticity
           in           in          in**4         Sq.in       lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   24.00000000    8153.0000     452.0000      3250000.
  2     456.0000   24.00000000    8153.0000     452.0000      3250000.
```

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = -48.000 in
Distance from top of pile to bottom of layer = 84.000 in

Layer 2 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 84.000 in
Distance from top of pile to bottom of layer = 204.000 in
p-y subgrade modulus k for top of soil layer = 150.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 150.000 lbs/in**3

Layer 3 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 204.000 in
Distance from top of pile to bottom of layer = 384.000 in
p-y subgrade modulus k for top of soil layer = 250.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 250.000 lbs/in**3

Layer 4 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 384.000 in
Distance from top of pile to bottom of layer = 444.000 in

Layer 5 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 444.000 in
Distance from top of pile to bottom of layer = 624.000 in
p-y subgrade modulus k for top of soil layer = 250.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 250.000 lbs/in**3

(Depth of lowest layer extends 168.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 10 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-48.00	.07230
2	84.00	.07230
3	84.00	.06940
4	204.00	.06940
5	204.00	.06940
6	384.00	.06940
7	384.00	.07230
8	444.00	.07230
9	444.00	.06770
10	624.00	.06770

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 10 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-48.000	8.33000	.00	.00700	.0
2	84.000	8.33000	.00	.00700	.0
3	84.000	.00000	36.00	------	------
4	204.000	.00000	36.00	------	------
5	204.000	.00000	39.00	------	------
6	384.000	.00000	39.00	------	------
7	384.000	17.36000	.00	.00500	.0
8	444.000	17.36000	.00	.00500	.0
9	444.000	.00000	40.00	------	------
10	624.000	.00000	40.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	.000	.6400	1.0000
2	456.000	.6400	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 5

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .250 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .500 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 3.000 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 5.000 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 130000.000 lbs

Pages Removed to Reduce Output Size

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .250000	M= 0.000	130000.	.2500000	745177.	18649.2760
4	y= .500000	M= 0.000	130000.	.5000000	1384404.	28637.0842
4	y= 1.000000	M= 0.000	130000.	1.0000000	2613247.	45413.9603
4	y= 3.000	M= 0.000	130000.	3.0000	6568533.	92177.8824
4	y= 5.000	M= 0.000	130000.	5.0000	9634493.	122571.

The analysis ended normally.

Summary of Warning Messages

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

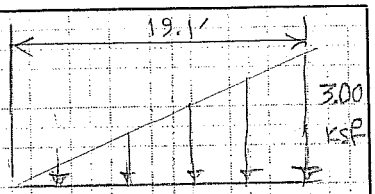
17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project SR-57 NB Placentia OH (Widen) Project No. 08-115

By AZ Date 1-28-09 Checked By _____ Date _____ Sheet ____ of ____

Settlement

Loading: 25' of silver Fill, the loading is triangular.



(25)x(0.120) = 3.00 ksf

+206 / +204 ① SC γ=125 pcf N=15 N'=3.36 N=50

② CL γ=125 pcf N=10 N'=1.53 N=15

+195 / +185 ③ SC/SM γ=120 pcf N=30 N'=0.94 N=28

④ SP-SM γ=120 pcf N=50 N'=0.78 N=39

+170 / +165 ⑤ CL γ=125 pcf N=20 N'=0.71 N=14

SP-SM Φ=40° γ=117 pcf N>50

Stress distribution was calculated from elastic solution.

Point	Depth (ft)	Layer H (ft)	σ'_{vo} (ksf)	$\Delta\sigma_v$ (ksf)	σ'_{vf} (ksf)	C*	Settlement (in)
1	1	2	0.125	2.693	2.82	115	0.3
2	6.5	9	0.813	1.772	2.58	40	1.4
3	16	10	1.975	1.009	2.98	75	0.3
4	28.5	15	3.475	0.613	4.09	90	0.1
5	38.5	5	4.688	0.465	5.15	50	0.0

Stotal = 2.1 in

Layer settlement: $S = H \frac{1}{C'} \log \frac{\sigma'_{vf}}{\sigma'_{vo}}$

* Note: Bearing capacity index (C') for clay layers was estimated from consolidation test, For sand layers from Fig. 13 in FHWA (1982).

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project SR57 NB Placentia OH (widen) Project No. 08-115

By AZ Date 1-28-09 Checked By _____ Date _____ Sheet ___ of ___

Abutment Lateral Earth Pressures

$\phi = 32^\circ$ (Compacted Fill)

$K_a = \tan^2(45 - \phi/2) = 0.30$

$K_a \cdot \gamma = (0.30)(120) = 36$ pcf

$K_o = 1 - \sin\phi = 1 - \sin 32^\circ = 0.47$

APPENDIX D

CALTRANS REVIEW COMMENTS AND EMI RESPONSES

Subject: Re: EA 12-0F031I_South Placentia Overhead (Bridge No. 55-0450)
From: Amir Zand <A.Zand@earthmech.com>
Date: Mon, 1 Jun 2009 16:11:45 -0400
To: Deepa Wathugala <deepa_wathugala@dot.ca.gov>
CC: Lino Cheang <l.cheang@earthmech.com>

Deepa:

Thank you very much for your comments. Regarding the first three comments, we will include the following responses along with the revised foundation report:

1. Input for APILE v4.0 program: The maximum Nq value of 50 in APILE manual is usually used with a rectangular box formed between flanges (See "Tip Area for Noncircular Section" on Page 5-17, APile Plus 4 Manual). We use the steel section area only. Nq is usually higher than 50 for this case. Our Nq value was chosen based on NAVFAC recommendations. See "Table Figure 1 continued" on Page 7.2-193 in NAVFAC Design Manual 7.02.

2. Dense sand layer unit weight: Unit weight is based on laboratory test results. It might be higher than our assumed value but our value is conservative. Please review density test results in Table 1; e.g. Sample D15 (A-08-004) at El. +160 feet, Sample D19 (A-08-004) at El. +140 feet, and Sample D18 (A-08-005) at El. +147 feet.

3. Settlement Calculations: We have used higher loads which result in more conservative lengths for settlement. We will revise the loads for updated foundation report.

Please let us know if you think we need to provide further information or take further actions regarding these comments.

Best regards,

--
Amir Zand, P.E.

Project Engineer

EARTH MECHANICS, INC. (www.earthmech.com)

17660 Newhope Street, Suite E
Fountain Valley, CA 92708
Tel (714) 751-3826, Fax (714) 751-3928

Deepa Wathugala wrote:

> Hi Lino,
>
> I finished the 2nd review and gave it to others in our office for review and signature. Until I send you the signed copy, here is the draft so that you may start working on that.
> Thank you.
> (See attached file: South Placentia OH_ FR_2 nd review.doc)
>
> ---
>
> Deepa Wathugala, Ph.D., P.E., G.E.
> Transportation Engineer
> Geotechnical Design -South 1,Branch C
> Office Phone: 213-620-2134
> Cell Phone: 562-760-8985

.

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: May 28, 2009
File: 12-ORA-57-PM16.63
12-0F0311

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design-South 1, Branch C

South Placentia Overhead (widen)
Bridge No. 55-0450
SR-57 Northbound Widening
(Southern Segment)

Subject: Review of Response to Caltrans Comments on the Foundation Report

On May 20, 2009, the Office of Geotechnical Design-South 1 (OGDS1), Branch C received the Response to Caltrans Comments on the Foundation Report (dated February 4, 2009) for the Northbound widening of South Placentia Overhead, Bridge No. 55-0450. We reviewed the responses, and our comments are as follows.

1. Input for APILE v4.0 program: The maximum value of Nq is 50 (page 5-25 of APILE v4.0 manual); input values 100 and 120 have been used. Please explain.

2. Input for APILE v4.0 program: For the last dense sand layer (phi =35 deg.), effective unit weight is given as 117 pcf which is too low.

3. Settlement calculations:
   For settlement calculations at abutments why did you use 900 kips? Use 620 kips for immediate settlements, and use 480 kips for consolidation settlements. Add all settlements to calculate total settlements.

   If you reach pile length equal to 12 feet before you get 1" settlement, stop your calculations. In Foundation Design Recommendation Table and in Pile Data Table, add a note stating "There is no design tip elevation for settlement at Abutment Nos. 1 and 2".

   For settlement calculations at bents why did you use 2000 kips? Use 510 kips for immediate settlements, and use 410 kips for consolidation settlements. Add all settlements to calculate total settlements.

   If you reach pile length equal to 12 feet before you get 1" settlement, stop your calculations. In Foundation Design Recommendation Table and in Pile Data Table, add a note stating "There is no design tip elevation for settlement at Bent Nos. 2 and 3".

   See email dated 6/1/09

4. Why did you include two similar as-built LOTB sheets? There will be only five LOTB sheets. Title Block of current LOTB sheet should read LOG OF TEST BORINGS 1 OF 5.

We have revised based on comments

Title Block of Legend sheets should read LOG OF TEST BORINGS 2 OF 5 and LOG OF TEST BORINGS 3 OF 5. Title Block of As-built should read LOG OF TEST BORINGS 4 OF 5 and LOG OF TEST BORINGS 5 OF 5.

5. In current LOTB sheet, still there are two values for ERi.

6. Pocket Penetrometer (PP) values are added only to boring A-08-005; PP values need to be added to boring A-08-004 also. No PP was performed for A-08-004.

7. Delete (b-I) Tension (Strength Limit State) in footnotes of Table 5-6.

8. Please include the note "Add 2 feet to the As-Built elevation to match Vertical Datum NAVD 88" in the report.

9. A new Table 2 has been included for results of Direct Shear tests and Triaxial UU test; you still need to remove columns in Table 1 for tests not performed for this project (for example Sand Equivalent and Torvane Shear).

If you have any questions, please contact Deepa Wathugala at (213) 620-2134 or Faramarz Gerami at (213) 620-2149.

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c.c. OGDS-1-Los Angeles File
OGDS-1-Sacramento File
GS - Sacramento File

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

May 14, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Attention: Mr. Steve Huff

Subject: Response to Caltrans Foundation Review Comments on "Foundation Report (dated 2/04/09) South Placentia Overhead (Widen), Bridge No. 55-0450, SR-57 Northbound Widening"
12-Ora-57, PM 16.7, EA 12-0F0311

Dear Mr. Huff:

Caltrans issued a Foundation Review sheet dated April 15, 2009 for the subject project. A copy of this review sheet is attached. The following are our responses to those comments:

Section 2.1, Field Investigation

Response: Boring numbers have been corrected per review comment. The revised Table 2-1 is presented below:

TABLE 2-1. GEOTECHNICAL EXPLORATION INFORMATION

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-004	Rte 57 ("B-Line")	483+85	90 RT	+231.9	+141.5	None Encountered During Drilling
A-08-005	Rte 57 ("B-Line")	485+12	90 RT	+233.5	+142.1	

Section 5.4.1, Foundation Type

Response: The foundation type was approved in the Type Selection meeting. We have provided the lateral capacity of the existing CIDH piles in our PFR. We talked to the structural designers regarding this comment. The response was that it was already checked that the existing abutment doesn't need retrofit. Due to the requirement of no-grading of the slopes surrounding the existing abutmnets, the new bridge bottom of footing is much lower than the existing (see Elevation on Plan Sheet No. 6 for comparison). Therefore lateral earth pressure on the widen abutment is much higher than the existing abutment and battered piles are needed in order to reduce the number of piles.

Section 5.4.2, Foundation Data Provided by Structural Designers

Response: The revised Table 5-4 is presented below:

TABLE 5-4. FOUNDATION DESIGN LOADS

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Perm-anent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abutment 1	620	90	480	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bent 2	510	N/A	410	720	180	-	-	650	400	10	200
Bent 3	510	N/A	410	720	180	-	-	650	400	10	200
Abutment 4	620	90	480	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Section 5.4.3 - Axial Capacity

Response: we incorporated group efficiency factors per AASHTO LRFD Bridge Design Specification. Our calculation sheets are attached. As shown, pile lengths for abutments and bents were increased by 3 feet and 6 feet as compared to our previous recommendation. Since all piles are mostly within sand layers and tip into dense sand layers, the block failure mechanism to check for group failure per AASHTO C10.7.3.9 is not applicable to the pile groups. However, group capacity and settlement are included in the attached calculations.

Section 5.4.3 – Table 5-5

Due to presence of a clay layer between El. +170 and El. +165 feet, equivalent Pier method was used to estimate the settlement of pile groups. The calculations are attached. For abutment pile groups the settlement of equivalent pier under service load was 0.29 inch for pile length of 37 feet and 1.0 inch for pile length of 20 feet. Pile group settlement for bents was negligible since bent piles tip into very dense sand layer below El. +165 feet. Bent pile group settlement was about 1 inch for a pile length of 17 ft.

Two columns for "Service I Limit State Load per Support (Total and Permanent)" were added to Table 5-5. "Tension" was removed from the footnote of Table 5-5.

Two columns for "Service I Limit State Load per Support" and "Total Permissible Support Settlement" were added to Table 5-6. The revised Table 5-5 and Table 5-6 are presented as follows:

TABLE 5-5. ABUTMENT FOUNDATIONS DESIGN RECOMMENDATIONS

Support	Pile Type	Cut-Off Elev. (feet)	LRFD Service-I Limit State Load per Support (kips)		LRFD Service-I Limit State Total Load per Pile (kips)	Nominal Resist-ance (kips)	Design Tip Elev. (feet)[1]	Specified Tip Elev. (feet)[2]	Nominal Driving Resistance Required (kips)
			Total	Perma-nent					
Abut 1	HP 14x89	213.58	620	480	90	180	+176 (a) +193 (c) +188 (d)	+176	180
Abut 4		217.17	620	480	90	180	+180 (a) +197 (c) +192 (d)	+180	180

Notes:
1. Design tip elevation is controlled by the following demands: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for lateral and settlement.

TABLE 5-6. BENT FOUNDATION DESIGN RECOMMENDATIONS

Support Location	Pile Type	Cut-off El. (ft)	Service-I Limit State Load per Support (kips)	Total Perm-issible Support Settle-ment (in)	Required Factored Nominal Resistance (kips)				Design Tip El. (ft)	Specified Tip El. (ft)
					Strength Limit		Extreme Event			
					Comp. (ϕ=0.7)	Tension (ϕ=0.7)	Comp. (ϕ=1)	Tension (ϕ=1)		
Bent 2	24" CIDH	202.25	510	1	180	0	400	200	+170 (a-I) +158 (a-II) +174 (b-II) +185 (c) +172 (d)	+158
Bent 3	24" CIDH	202.25	510	1	180	0	400	200	+170 (a-I) +158 (a-II) +174 (b-II) +185 (c) +172 (d)	+158

Notes:
1. Design tip elevation is controlled by the following demands: (a-I) Compression (Strength Limit), (b-I) Tension (Strength Limit), (a-II) Compression (Extreme Event), (b-II) Tension (Extreme Event), (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for tension, lateral and tolerable settlement.

Specified tip elevations were revised to reflect change in pile length. Nominal resistance was rounded up to nearest 10 kips. The revised Table 5-7 is presented below:

TABLE 5-7. PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)[1]	Specified Tip El. (ft)	Nominal Driving Resistance (kips)
		Compression	Tension			
Abutment 1	HP 14x89	180	0	+176 (a) +193 (c) +188 (d)	+176	180
Bent 2	24" CIDH	400	200	+158 (a) +174 (b) +185 (c) +172 (d)	+158	N/A
Bent 3	24" CIDH	400	200	+158 (a) +174 (b) +185 (c) +172 (d)	+158	N/A
Abutment 4	HP 14x89	180	0	+180 (a) +197 (c) +192 (d)	+180	180

Notes:
1. Design tip elevations for ***Abutments*** are controlled by: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. Design tip elevations for ***Bent*** are controlled by: (a) Compression, (b) Tension, (c) Settlement, and (d) Lateral Load.

Section 5.6, Embankment and Settlement

Response: We will add the following paragraph in Section 5.5, Embankment and Settlement: "Per Caltrans Memo to Designers 5-3 dated December 1992, structure approach slabs are required for this project. Selection of the approach type will be performed by the structurral designer following the flowchart in Caltrans Memo to Designers 5-3, Attachment A, dated May 1996."

There is no abutment wingwalls since both abutments are adjacent to RW 476 and 486. There is a small return wall connecting the abutment to the retaining walls. This return wall sits on the abutment pile cap as a part of the abutment design. Design of RW 476 and 486 is in the roadway plans.

Section 6.2, Pile Construction

Response: We will remove wet method recommendations from this section.

Appendix A-Log of Test Borings (LOTB) Sheets and As-Built Log of Test Borings Sheets

Response: LOTB sheets will be replaced with revised versions.

Appendix B-Laboratory Test Results

Response: Table 1 in Appendix B is quite congested already. We will add the attached Table 2 (Strength test results) in Appendix B.

Unchecked Detail Plans

Foundation Plan

Nominal driving resistance will be added to the Pile Data Table.

LOTB Sheets

Response: LOTB sheets will be replaced with the following revisions per Caltrans review:

- It was a typo on LOTB sheet. Hammer Energy Ratios are corrected on LOTBs.
- Groundwater Not Encountered during drilling is added under each boring.
- Pocket penetrometer results added to description of layers wherever applicable.
- Note Rte 57 ("B-Line") was added to LOTBs.
- Proper title block is now included.
- Word about is removed wherever the percentage of constitutes is based on the lab tests, for other cases the percentages are rounded to nearest 5%.
- Apparent densities are revised to correspond to SPT blowcounts corrected with energy ratio.
- Conversion factor from 2.4" California Modified Ring sampler blowcount to 1.4" Standard Penetration Test sampler blowcount is added to the "Notes"
- Proper title block for As-Built Log of Test Borings is now included.
- We added Vertical Datum is NAVD 88.
- The note "Add 2.00 feet to the As-Built elevation to match Vertical Datum NAVD 88" is included below the title block.
- Appropriate font is used for Benchmark notes.
- "Boring Records" is removed in the Benchmark notes.
- Name and direction of nearest cities are added to plan views in LOTBs.
- Soil legend sheets will be placed at the end of current LOTB sheets.

We will add the following sentence at the beginning of Section 6.2, Pile Construction:
"For on-center pile spacing less than six times the pile diameter, no two adjacent piles can be constructed concurrently."

Sincerely,
EARTH MECHANICS, INC.

Lino Cheang

Lino Cheang, GE 2345
Project Manager

Attachments
-Caltrans Foundation Review sheet dated April 2, 2009

-Axial Pile Capacity Calculation Sheets
-Equivalent Pier Settlement Calculation Sheet
-Revised LOTB Sheets
-Table 2, Appendix B

← in foundation report

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: April 15, 2009
File: 12-ORA-57-PM16.63
12-0F0311

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design-South 1, Branch C

South Placentia Overhead (widen)
Bridge No. 55-0450
SR-57 Northbound Widening
(Southern Segment)

Subject: Review of the Foundation Report

On February 26, 2009, the Office of Geotechnical Design-South 1 (OGDS1), Branch C received the Foundation Report (FR), dated February 4, 2009, and 65% Unchecked Details Plans for the Northbound widening of South Placentia Overhead, Bridge No. 55-0450. We reviewed the report and plan sheets, and our comments are as follows.

Foundation Report

1. **Section 2.1 – Tables 2-1:** Please correct Boring Nos. A-08-04 and A-08-05 to A-08-004 and A-08-005 in Table 2-1 and other parts of the report.

2. **Section 5.4.1 – Foundation Type:** The existing foundation type for the abutments is CIDH piles. As per your report, due to the reason that abutment design requires large lateral resistance and CIDH piles cannot be easily battered, driven piles are selected for the abutments for the proposed bridge widening. Please provide a comparison between the required lateral resistances for the existing abutment and new (widen) abutment. Check whether retrofitting of the existing abutment foundation is required. If retrofitting is required, please analyze the existing foundation for retrofitting.

   Combination of driven and CIDH piles is not a good practice and Caltrans discourages the use of it.

   CIDH piles have more lateral capacity than H-section piles, besides battering should not be necessary since the existing bridge is on CIDH piles.

   Our office will check the pile tip elevations at abutments when the final pile type is decided.

3. **Section 5.4.2 – Table 5-4:** Please provide Extreme Event Limit State Compression Loads per Support for Bents 2 and 3.

4. **Section 5.4.3 - Axial Capacity:** Please state in the report if the specified tip for single pile is compared to pile group of which the lowest one should govern. Please provide analyses of the pile groups for both abutments and bents in the Appendix C.

5. **Section 5.4.3 – Table 5-5:**

   - This Table gives a design tip elevation based on the settlement of a single pile (as per calculations in Appendix C). As per Section 10.7.2.3 of AASHTO LRFD Bridge design Specifications (2007), pile group settlement shall be evaluated for pile foundations in cohesive soils, soils that include cohesive layers, and piles in loose granular soils. Please discuss the applicability of evaluation of group settlement for this project. If relevant, include the equivalent footing analysis for the pile group in Appendix C.

   - Please add two columns to table 5-5 for 'Service-I Limit State Load per Support (Total and Permanent)' as per Table 5 in the Caltrans MTD 3-1 (July 2008).

   - Eliminate 'Tension' in foot notes of Table 5-5.

6. **Section 5.4.3 – Table 5-6:** Please add two columns for 'Service-I Limit State Loads per Support' and 'Total Permissible Support Settlement' as per Table 6 in the Caltrans MTD 3-1 (July 2008).

7. **Section 5.4.3 – Table 5-7:** Nominal Resistance in Pile Data Table should be rounded up to nearest 10 kips as per Tables 7 and 9 in the Caltrans MTD 3-1 (July 2008).

8. **Section 5.6** – In this Section, structure approach slab and wing walls should be discussed.

9. **Section 6.2 – Pile Construction:** Please refrain from wet method for caving control, since it necessitates additional instrumentation and possibility of creating anomalies in the pile.

10. **Appendix A – LOTB sheets:** These LOTB sheets should be same as LOTB sheets in the **Unchecked Detail Plans** after corrections. Therefore, comment No. 13 under Unchecked Detail Plans -LOTB Sheets also apply to the LOTB sheets in Appendix A.

11. **Appendix B – Table 1:** Include Direct Shear test results; but remove columns for tests not performed for this project (for example Sand Equivalent and Torvane Shear).

Unchecked Detail Plans

12. **Foundation Plan:** Add a column for "Nominal Driving Resistance" in the Pile Data Table since this project has driven piles.

13. **LOTB sheets:**

- Please explain why two different Hammer Energy Ratios are given for Borings B-08-004 and A-08-005 whereas according to Foundation Report, both borings were drilled using the same rig.

- When groundwater is not shown on the borings, note under each boring that groundwater was not encountered or not measured during field investigation.

- Pocket penetrometer (pp) values should be shown at the end of each cohesive soil layer description and consistency should be based on those values rather than on blow counts.

- Stations for the borings B-08-004 and A-08-005 are referred to the B-Line. Show the B-Line on the plan view.

- Bottom title block from left to right on LOTB and Soil Legend sheets should comply with Section 5.2.3.2 of Caltrans Soil and Rock Logging Manual, June 2007.

- When the percentages of constituents are based on the lab tests, the word "about" should be removed; and if estimated, they should be rounded to nearest 5%.

- Apparent density of cohesionless soil should be based on the SPT blow counts corrected for Hammer Energy Ratio. Some apparent densities reported on the LOTB are not correct. For example, the soil in Boring No. A-08-004, at approximate elevation +175, the field SPT value is 47 and the corrected SPT is 55; therefore, apparent density should be very dense. Please check the apparent densities in the boring logs and revise the soil descriptions when necessary.

- Correction/multiplication factor for conversion of 2.4" California Modified ring sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.

- As-Built Log of Test Borings for original bridge and previous widening containing proper title block should be included in the project plans.

- It is required to note datum used for surveying boreholes in LOTB (NGVD 29 or NAVD 88).

- If As-Built Log of Test Borings was surveyed with different datum, include the conversion factor of datum to NAVD 88.

- Bench Marks notes need to be in the same dark printing as the rest of the plan sheet.

  Remove the words "Boring Records" in the Bench Mark Notes.

  Show name and direction of nearest cities on plan views.

  Soil Legend sheets should be placed at the end of current LOTB sheet sequence.

If you have any questions, please contact Deepa Wathugala at (213) 620-2134 or Faramarz Gerami at (213) 620-2149.

Prepared by:

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c.c. OGDS-1-Los Angeles File
OGDS-1-Sacramento File
GS - Sacramento File

FINAL FOUNDATION REPORT

Crowther Avenue UC (WIDEN)
Bridge No. 55-0457
SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 16.74
EA 12-0F0311

EMI Project No. 08-115
Date: June 17, 2009

EARTH MECHANICS, INC.

Geotechnical and Earthquake Engineering

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

June 17, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Attention: Mr. Steve Huff, P.E.

Subject: **Final Foundation Report for Crowther Avenue Undercrossing (WIDEN)**,
Bridge No. 55-0457
SR-57 Northbound Improvement Project, Orange County, California
12-Ora-57, PM 16.8, EA 12-0F0311

Dear Mr. Huff:

Attached please find the final Foundation Report for the subject bridge widening project. This report contains the findings and conclusions of our field investigation and laboratory testing program. This report also contains our recommendations for the design and construction of the bridge foundation.

A draft version of this report dated February 4, 2009 was submitted to Caltrans for their review. Review comments and our responses are included in Appendix D. Our responses are all incorporated into this final report.

We appreciate the opportunity to provide geotechnical design services for this project. If you have any questions, please call us.

Sincerely,
EARTH MECHANICS, INC.

Amir Zand, RCE 73910
Staff Engineer

Lino Cheang, GE 2345
Project Manager

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

FINAL FOUNDATION REPORT

CROWTHER AVENUE UNDERCROSSING (WIDEN)
BRIDGE NO. 55-0457
SR-57 NORTHBOUND IMPROVEMENT PROJECT
ORANGE COUNTY, CALIFORNIA
12-Ora-57, PM 16.8
EA 12-0F0311

Prepared for:

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Prepared By:

Earth Mechanics, Inc.
17660 Newhope Street, Suite E
Fountain Valley, California 92708

EMI Project No. 08-115

June 17, 2009

TABLE OF CONTENTS

Section	Page
1.0 INTRODUCTION	**1**
1.1 Purpose and Scope of Study	1
1.2 Project Description	1
2.0 FIELD INVESTIGATION AND LABORATORY TESTING	**4**
2.1 Field Investigation	4
2.2 Laboratory Testing	5
3.0 GEOLOGY AND SEISMICITY	**6**
3.1 Topography and Drainage	6
3.2 Physiography	6
3.3 Geologic Structure	6
3.4 Geologic Hazards	8
3.5 Stratigraphy	8
3.6 Seismicity	10
4.0 SUBSURFACE CONDITIONS	**11**
4.1 Soil Conditions	11
4.2 Groundwater Conditions	12
5.0 CONCLUSIONS AND RECOMMENDATIONS	**13**
5.1 Seismic Design Criteria	13
5.2 Liquefaction	15
5.3 Soil Corrosivity	15
5.4 Pile Foundation Design	15
5.4.1 Foundation Type	15
5.4.2 Foundation Data Provided by Structural Designers	15
5.4.3 Axial Capacity	16
5.4.4 Lateral Resistance	17
5.5 Embankments and Settlement	17
5.6 Bridge Abutment Wall Design	18
6.0 CONSTRUCTION RECOMMENDATIONS	**19**
6.1 Earthwork	19
6.2 Pile Construction	19
6.3 Backdrain and Backfill Requirements For Abutment Walls	20
6.4 Review of Construction Plans	20
6.5 Geotechnical Observation and Testing	20
7.0 LIMITATIONS	**22**
8.0 REFERENCES	**23**

List of Tables Page

Table 2-1. Geotechnical Exploration Information 4
Table 4-1. Idealized Soil Profile and Strength Parameters 11
Table 5-1. Local Seismic Sources 13
Table 5-2. Soil Corrosion Test Results 15
Table 5-3. Foundation Design Data Sheet 16
Table 5-4. Foundation Design Loads 16
Table 5-5. Abutment Foundations Design Recommendations 16
Table 5-6. Pile Data Table 17
Table 5-7. Lateral Pile Solutions 17

List of Figures Page

Figure 1-1. Site Location Map 2
Figure 3-1. Regional Fault and Physiographic Map 7
Figure 3-2. Geological Map 9
Figure 5-1. Design ARS Curve 14
Figure 6-1. Low Expansion Material in Bridge Embankment 21

APPENDICES

Appendix A. Log of Test Borings Sheets and As-built Log of Test Borings Sheet
Appendix B. Laboratory Test Results
Appendix C. Design Calculations
Appendix D. Caltrans Review Comments and EMI Responses

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF STUDY

This Foundation Report presents the findings and conclusions of a geotechnical investigation conducted by Earth Mechanics, Inc. (EMI). It presents foundation design and construction recommendations for proposed widening of the Crowther Avenue Undercrossing (UC) in Orange County, California. A site location map is presented in Figure 1-1.

This work was performed for the Orange County Transportation Authority (OCTA) and EMI is a subconsultant to RBF Consulting (RBF). The geotechnical services provided for this project included the following tasks:

- Collection and review of existing geotechnical information;
- Field exploration consisting of drilling and logging exploratory borings;
- Laboratory testing of selected bulk and relatively undisturbed soil samples;
- Engineering calculations (see Appendix C) and analysis to develop foundation design and construction recommendations; and
- Preparation of this report presenting our findings, conclusions, and recommendations.

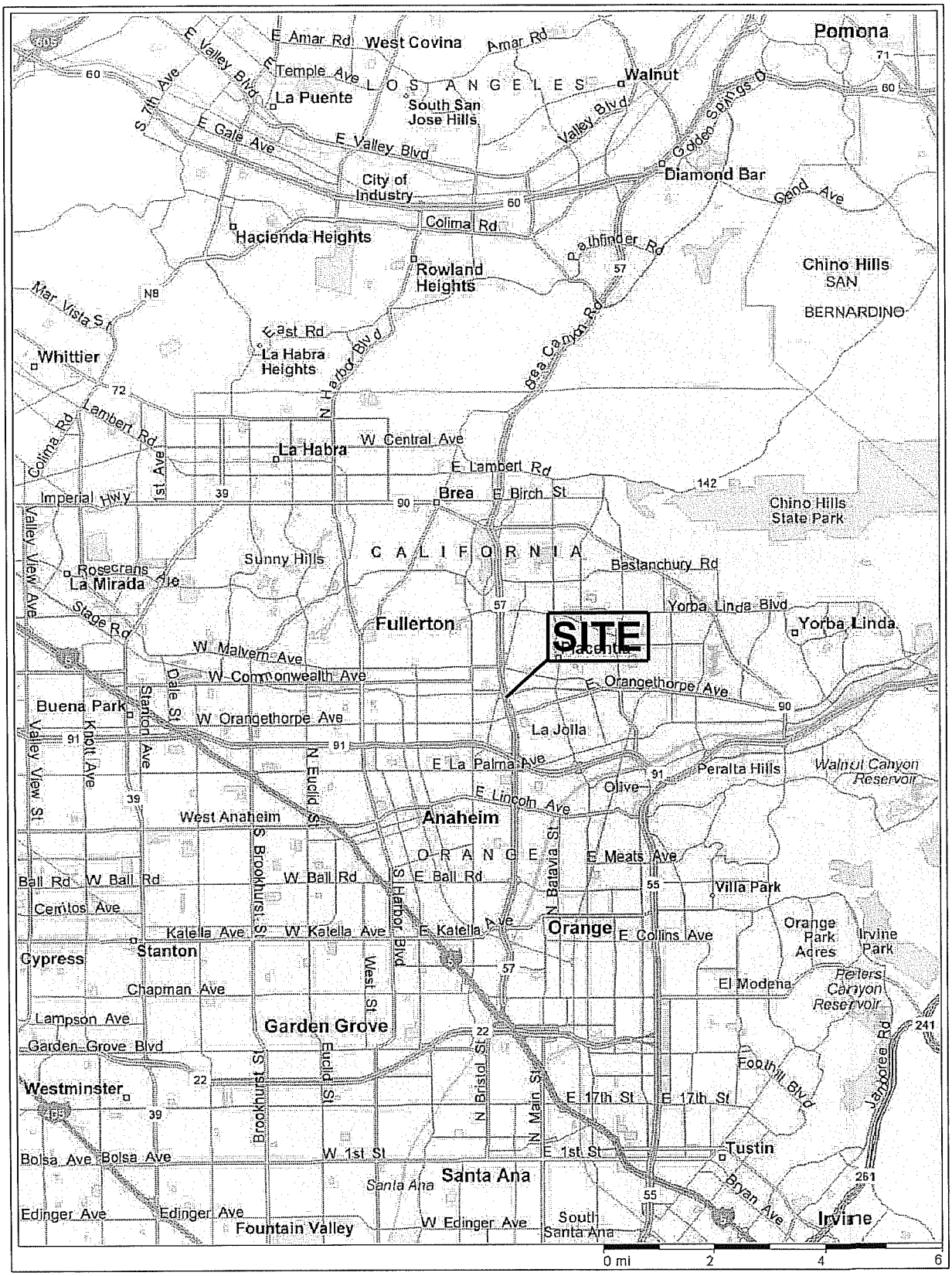
1.2 PROJECT DESCRIPTION

The Department of Transportation (Caltrans) – District 12, in cooperation with the Orange County Transportation Authority (OCTA), proposed to widen northbound State Route 57 (SR-57) by adding one northbound through lane. The project limits are between 0.2 mile south of Orangethorpe Avenue and 0.2 mile north of Yorba Linda Boulevard along northbound SR-57. Within the project limits, there are interchanges located at Orangethorpe Avenue, Chapman Avenue, Nutwood Avenue and Yorba Linda Boulevard. The entire project involves widening seven existing bridges and a tieback wall at Yorba Linda Boulevard:

- Orangethorpe Avenue Undercrossing (Bridge No. 55-0459)
- South Placentia Overhead (Bridge No. 55-0450)
- Crowther Avenue Undercrossing (Bridge No. 55-0457)
- Placentia Overhead (Bridge No. 55-0449)
- Placentia Avenue Undercrossing (Bridge No. 55-0460)
- Chapman Avenue Undercrossing (Bridge No. 55-0456)
- Nutwood Avenue Undercrossing (Bridge No. 55-04649)
- Tieback Wall at Yorba Linda Boulevard (Bridge No. 55-0468)

This report pertains to Crowther Avenue UC only; separate foundation reports are prepared for each of the above seven remaining structures.

The Crowther Avenue UC is located in the City of Placentia north of the SR-57/SR-91 interchange. SR-57 in the project area trends in a north-south direction and carries traffic from the "Orange Crush" (I-5/SR-22/SR-57 Interchange) in Orange County to Interstate 210 in Los Angeles County (See Figure 1-1).



Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SITE LOCATION MAP

Figure 1-1

CROWTHER AVENUE UC (WIDEN)

Project No. 08-115

Date: 01-05-09

Crowther Avenue is a four-lane local city street with two eastbound lanes, two westbound lanes and a raised median. Parking is prohibited on both sides of Crowther Avenue, and sidewalks exist on both sides of the street.

The existing Crowther Avenue UC was originally constructed in 1969 following the 1961 AASHTO design specifications with Caltrans supplements. The structure has one span with a total span length of 151'-10" with a skew of 2°45'47"+-. The structure is a Cast-In-Place prestressed concrete box girder with a depth of 6'-3". Total width of the structure is 148'-0", and it consists of two identical box girders, one for the northbound and one for the southbound of SR-57. The two box girders are separated with a 1/2" wide longitudinal expansion joint filler at both deck and soffit. The box girders are supported on diaphragm abutment walls connected directly to 16" (45 ton) Cast-in-Drilled Hole (CIDH) concrete piles.

The bridge was widened in 1991, approximately 12'-9" on the northbound side to provide an additional 12-foot lane in that direction. The widening is a single span cast-in-place prestressed reinforced concrete box girder bridge on open-end reinforced concrete diaphragm abutments. All widening foundations are supported on 24" (100 ton) CIDH concrete piles. The existing widened bridge supports six lanes of northbound and five lanes of southbound traffic.

This project will widen Crowther Avenue UC by approximately 13'-8 1/2" on the northbound side to provide an additional 12-foot lane in that direction.

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 FIELD INVESTIGATION

Copies of the As-Built Log-of-Test-Borings (LOTB) sheets are included in Appendix A; about 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV 88). According to these As-Built LOTB sheets, four penetration borings and one rotary-wash boring were performed in November 1965. Two hollow stem auger boring (B-3 and B-4) were performed in January 1989. During the exploration in 1965, the rotary boring was the deepest boring and was advanced to about El. +171 feet. The borings drilled in 1989 were about 65 feet deep and were advanced to about El. +171 feet (B-3) and +172 feet (B-4). Existing grade at the borehole location at the time of the investigation in 1965 and 1989 was approximately El. +208 feet and El. +236 feet, respectively. Groundwater was not encountered during drilling in November 1965 and January 1989 down to El. +171 feet.

To supplement the existing subsurface data, two soil borings were drilled (one at each abutment). These borings were drilled on September 29, 2008. Boring information, including exploration number, stations, offsets, ground surface elevations, bottom of hole elevations and water level measurements are summarized in Table 2-1. Locations of the exploratory boring are shown on the LOTB sheet provided in Appendix A.

TABLE 2-1. GEOTECHNICAL EXPLORATION INFORMATION

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-006	SR-57 (B-Line)	489+69	80 RT	+237.9	+147.4	None Encountered During Drilling
A-08-007		491+67	80 RT	+239.5	+148.0	

Exploratory borings were drilled using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. Relatively undisturbed drive samples were obtained using a 3.25-inch outer diameter California split-spoon sampler lined with brass rings. Each of these brass rings is 1-inch long with a 2.5-inch outside diameter. The California Drive sampler was driven into the ground using successive blows of a 140-lb hammer falling a distance of 30 inches. The numbers of blow for the final 12 inches or shorter of driving are shown on the LOTB sheet.

The Standard Penetration Test (SPT) sampler (1.4-inch inside diameter) was also used to obtain soil samples. The sampler was driven into the ground using a 140-lb hammer free falling from a height of 30 inches. The numbers of blow to advance the sampler each 6 inches of penetration or less was recorded. The blow counts required to drive the sampler for the last 12 inches or less was recorded as the Standard Penetration Resistance (N-value) on the LOTB sheet.

Charts published by Winterkorn and Fang (1975) can be used to determine a reduction factor used to convert blowcounts recorded using the California Drive sampler into SPT blowcounts. Using those charts, we obtained a reduction factor of 0.5 and this one-half reduction factor was used for this project.

The sampling interval is usually 5 feet. Sampling was performed by alternating the California Drive sampler and SPT sampler.

2.2 LABORATORY TESTING

Soil samples considered representative of the subsurface conditions were tested to obtain or derive relevant physical and engineering soil properties. The following laboratory tests were conducted to supplement the observations recorded during the field investigation:

- In-situ Moisture Content and Unit Weight
- Plasticity Index
- Particle Size Analysis
- Direct Shear
- Consolidation
- Unconsolidated Undrained Triaxial
- Compaction and R-Value
- Minimum Resistivity, pH, Sulfate Content and Chloride Content

The laboratory tests were conducted in general accordance with California Test Methods or American Society for Testing and Materials (ASTM) Standards. Laboratory test results are included in Appendix B.

3.0 GEOLOGY AND SEISMICITY

3.1 TOPOGRAPHY AND DRAINAGE

The project corridor is in the eastern part of the Los Angeles Basin along the southern margin of the Coyote Hills and the Puente Hills (Figure 3-1). Just north of the project corridor, the Puente Hills rise to an elevation of about 1,400 feet. The southwestern edge of the Puente Hills is paralleled by a series of low-elevation plains and hills; the Santa Fe Plain and the Coyote Hills are to the west of the project corridor, and the Richfield and Kraemer Hills are to the east. The elevations of these hills range from about 500 feet just west of the project to about 300 feet in the east. The ground upon which the project is located slopes gently to the south. Elevations along the project corridor range from about 280 feet in the north to about 200 feet on the south.

The project corridor traverses the ancient flood plains and alluvial fans of Fullerton Creek and the Santa Ana River. The major drainage in the area is the Santa Ana River which flows westerly south of the site. Fullerton Creek, a tributary to the Santa Ana River, drains southwesterly from the Puente Hills just west of the project corridor.

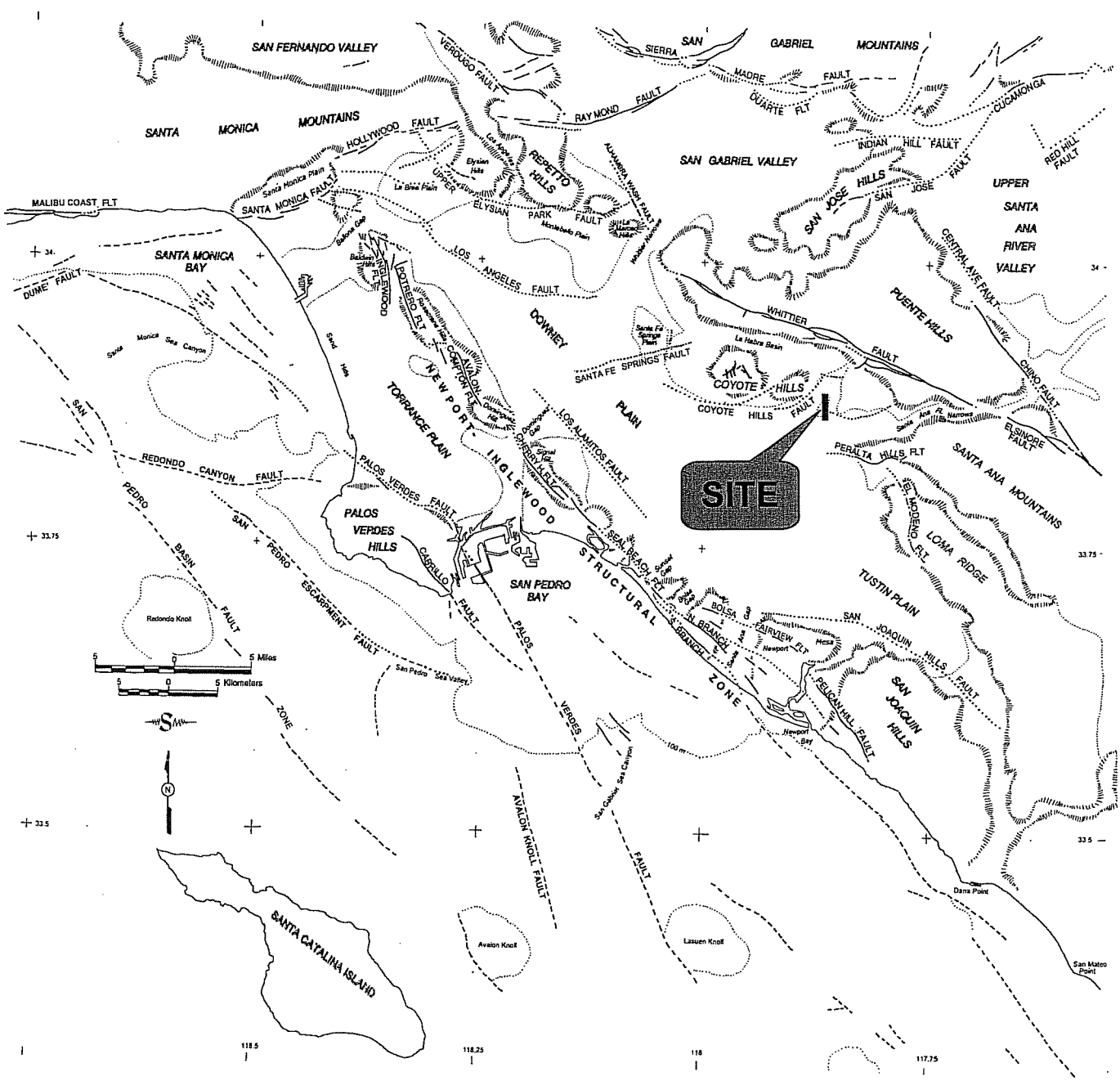
3.2 PHYSIOGRAPHY

The site area is at the eastern edge of the Los Angeles physiographic basin, a large, relatively flat, low-lying, coastal plain surrounded by mountains on the north, east, and southeast (Figure 3-1). The floor of the Los Angeles Basin is relatively flat but slopes gradually southwesterly from an elevated marginal apron to sea level along the coastline. The western margin of the Los Angeles Basin is bordered by the sea and the Palos Verdes Hills. The eastern margin is bordered by the Puente Hills and Santa Ana Mountains. The Coyote Hills, Santa Fe Springs Plain, Richfield Hills, and Kramer Hills are low elevation uplifts along the southern margin of the Puente Hills.

3.3 GEOLOGIC STRUCTURE

The geologic structure at the site is quite simple and is characterized by flat-lying Quaternary sediments overlying gently folded Tertiary sedimentary rocks. These strata rise gently to the Coyote Hills, Richfield Hills, and Kraemer Hills where they are arched upward to form anticlinal folds. The site is on the south limb of these anticlines with the early Pleistocene and Tertiary age strata dipping gently to the south and overlain by younger flat-lying Quaternary sediments.

The nearest active or potentially active surface faults are the Peralta Hills and Whittier faults (Figure 3-1). The low-elevation plains and hills along the eastern margin of the Los Angeles Basin are underlain by a series of east-west trending, en echelon, faults and folds in the subsurface; the major faults within this trend are, from north to south, the Los Angeles (Las Cienegas), Santa Fe Springs, and Coyote Hills faults (Figure 3-1). This group of faults is known as the Puente Hills fault system. Other poorly known segments of this thrust fault system underlie the Richfield and Kramer hills. All of these faults are blind thrust or reverse faults that approach within about a mile or so of the ground surface. They are identified on seismic reflection geophysical data only and are below the depths of oil wells.



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REGIONAL FAULT AND PHYSIOGRAPHIC MAP

Figure 3-1

Project No. 08-115

Date: 01-05-09

The Peralta Hills fault may be related to the Puente Hills fault system. The Peralta Hills fault is exposed along the south flank of the Peralta Hills where it displaces Tertiary-age rocks upward and over younger Quaternary alluvium. The fault extends westerly below the Santa Ana River channel where it creates barriers to ground-water flow (Figure 3-2). The barriers extend about to the SR 57 freeway just north of the Lincoln Avenue (Morton and Miller, 1981). The location of the Peralta Hills fault is well up on the flank of the hills rather than at the base of the hills indicating that it is not the only fault responsible for uplift and folding of the Peralta Hills. There must be a deeper unknown blind thrust fault below the Peralta Hills thrust fault but this feature has never been directly identified.

The Whittier fault is a major strike slip fault that extends northwesterly along the southwest flank of the Puente Hills northeast of the site (Figure 3-1). The Whittier fault is associated with the Chino fault and the Elsinore fault and together these faults form a major fault system that extends from the Los Angeles Basin into northern Mexico.

The El Modeno fault is a north-south trending feature within Loma Ridge, one of the foothills of the Santa Ana Mountains, southeast of the site. The feature is poorly known but is known to displace Holocene soil in Loma Ridge. Although the fault is grouped with the Peralta Hills fault on the Caltrans seismic hazard map (Mualchin 1996), it appears to be a discrete normal or strike-slip fault unrelated to the thrust faults of the Peralta Hills. Although the fault must be considered active because it displaces Holocene soil, the feature has a very long (thousands of years) recurrence interval.

3.4 GEOLOGIC HAZARDS

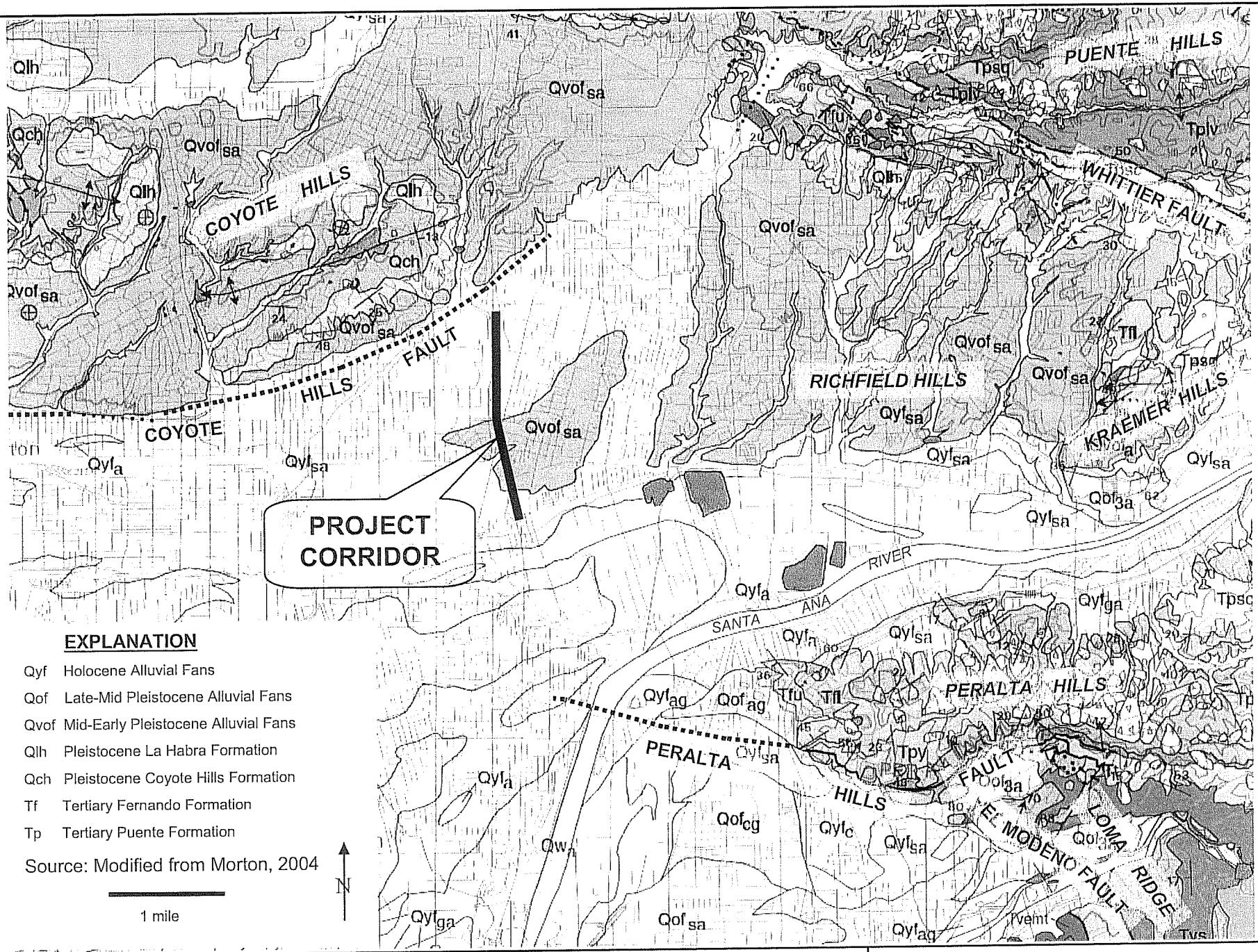
There are no steep slopes within the corridor so landsliding is not likely. There are no active faults so surface fault rupture is not likely. There are no known volcanos in the site region. The site is far from the sea on elevated land so Tsunamis are not a hazard.

The site is not identified on the State seismic hazard maps of the Anaheim and Newport Beach quadrangle as being susceptible to liquefaction (California Geological Survey/Division of Mines and Geology, 1997). This is due primarily to the depth of historically highest ground water being greater than 50 feet.

3.5 STRATIGRAPHY

Regional studies (e.g. Morton, 2004; Morton and Miller, 1981; Durham and Yerkes, 1964; California Department of Water Resources, 1961) indicate that the site area is underlain by Quaternary sediments overlying older Quaternary and Tertiary sediments and sedimentary rocks.

The surficial deposits are primarily Holocene and Pleistocene alluvial fan deposits (Figure 3-2). Older formations exposed in the hills and underlying the corridor are, in descending order, the Pleistocene-age La Habra and Coyote Hills, the Pliocene Fernando, and Pliocene-Miocene-age Puente formations. Along the corridor, the La Habra Formation is at an elevation of about sea level and therefore these older units are well below the level of interest for this project.



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Project No. 08-115 | Date: 01-05-09

GEOLOGICAL MAP

Figure 3-2

3.6 SEISMICITY

The largest historical earthquake within the Los Angeles Basin was the 1933 Long Beach earthquake of M_W=6.4 (M_L = 6.3) which is generally believed to have been associated with the Newport-Inglewood Structural Zone. The association of the 1933 event with the NISZ was based on abundant ground failures along the NISZ trend, but no unequivocal surface rupture was identified. Hauksson and Gross (1991) reevaluated the seismicity data and relocated the 1933 earthquake hypocenter to a depth of about 6 miles below the Huntington Beach-Newport Beach city boundary.

Other damaging earthquakes in the Los Angeles region include the 1971 San Fernando, the 1987 Whittier, and the 1994 Northridge events. The 1971 San Fernando (M_L= 6.4, M_W=6.7) earthquake occurred along the northern margin of the San Fernando Valley and produced a surface rupture which coincided partly with a zone of mapped surface faults along the mountain-valley margin. The more-recent 1987 Whittier earthquake (M_L=5.9, M_W=5.9) and the 1994 Northridge (M_L=6.4, M_W = 6.7) earthquake were not associated with surface faulting. Such events indicate that seismic hazards analysis must consider subsurface faulting as well as surface faulting. The Whittier event occurred at a depth of about 10 miles on a northerly dipping thrust fault dipping from the Coyote Hills area, under the Repetto and Puente Hills, to below the San Gabriel Valley. The Northridge event occurred at a depth of about 12 miles on a south-dipping reverse fault below the San Fernando Valley.

Another significant earthquake in the region was the 1812 earthquake which caused damage at the San Juan Capistrano Mission. The location and magnitude of the 1812 earthquake are unknown but geological studies (Jacoby et al., 1988; Fumal et al., 1993; Weldon et al., 2004) postulated that it did not occur in the Capistrano area, but rather was a large (M> 7.0) distant event on the San Andreas fault in the Wrightwood area of the San Gabriel Mountains.

A recent magnitude 5.4 (M_W) earthquake occurred on 29 July 2008 below the Puente Hills northeast of the site at a depth of about 10 miles. This event was a reverse type fault with a left- lateral component of slip. The causative fault is unknown. The epicenter is between the Whittier and Chino faults. The orientation of the preferred focal plane of the focal mechanism solution is somewhat compatible with the Whittier fault. The Whittier fault may have a reverse component of slip but is believed to be primarily a right-lateral fault. Furthermore dip of the preferred focal plane and the distribution of aftershocks are not very compatible with the Whittier fault. The northerly dipping buried thrust faults under the Peralta Hills, Richfield Hills, or Kraemer Hills could have been source because the preferred focal plane dips northeasterly similar to the northerly dipping faults. However, the distribution of the aftershocks does not seem compatible with the orientations of these faults.

4.0 SUBSURFACE CONDITIONS

4.1 SOIL CONDITIONS

Based on the recent field exploration and the as-built LOTB sheets in Appendix A, the subsurface materials at the site consist primarily of alternating layers of coarse-grained soils composing of clayey sand, silty sand, sand with silt, and fine grained soils composing of lean clay and lean clay with sand. Consistency of the soil generally increases with depth. The idealized soil profile and design strength parameters for foundation design are presented in Table 4-1.

TABLE 4-1. IDEALIZED SOIL PROFILE AND STRENGTH PARAMETERS

Approx. Elevation (ft)	Predominant Soil Type	Range of Measured and Converted SPT Blowcount; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion/ Undrained Shear Strength (psf)
+238 to +226	Clayey Sand (Fill)	14 to (49) Average = 26	120	32	150
+226 to +205	Lean Clay and Sandy Clay	10 to (29) Average = 16	125	0	1900
+205 to +180	Sand with Silt, Clayey Sand, Sandy Clay	14 to (39) Average = 28	117	35	50
+180 to +165	Sand with Silt, Silty Sand, Clayey Sand	40 to (>70) Average > 50	122	38	50
+165 to +155	Lean Clay with Sand, Clayey Sand	(23) to 31 Average = 26	120	0	3000
+155 to +147	Silty Sand, Clayey Sand	> 70	125	40	50

Notes:
(1) SPT = Standard Penetration Test.
(2) Values in ( ) are converted SPT blowcounts corrected for sampler size; correction factor from California sampler blowcounts to SPT blowcounts is 0.5.

The above soil strength parameters are primarily based on published correlations with SPT blowcounts (Lam and Martin, 1986). For comparison, soil strength parameters from direct shear and triaxial tests are included in Appendix B. Direct shear test on a clayey sand sample at El. +228 feet resulted in a peak friction angle of 31 degrees and cohesion of 470 psf, and an ultimate friction angle of 29 degrees and cohesion of 240 psf. Direct shear test on a clayey sand sample at El. +214 feet resulted in a peak friction angle of 41 degrees and cohesion of 170 psf, and an ultimate friction angle of 31 degrees and cohesion of 470 psf. Direct shear test on a poorly-graded sand sample at El. +184 feet resulted in a peak friction angle of 32 degrees and cohesion of 370 psf, and an ultimate friction angle of 32 degrees and cohesion of 20 psf. An unconsolidated-undrained triaxial test on a lean clay sample at El. +164 feet resulted in an undrained shear strength of 3000 psf. The ultimate strength results from shear tests and triaxial test are generally in good agreement with values obtained from SPT correlations, except strength values for sandy clay sample at El. +184 feet, which are lower than SPT correlation estimates. We believe the strength values obtained using the SPT correlation are more reliable and should be used for foundation design because the laboratory test results are affected by soil disturbance during sampling.

4.2 GROUNDWATER CONDITIONS

During the recent field investigation conducted on September 29, 2008, groundwater was not encountered down to El. +147 feet which is more than 60 feet from the freeway surface. As shown on the as-built LOTB sheets in Appendix A, groundwater was not encountered during drilling in November 1965 and February 1989 down to El. +171 feet.

The relatively deep water depth is confirmed by the historical groundwater map published by the California Geological Survey (Seismic Hazard Zones Map - Anaheim and Newport Beach Quadrangle) (CGS, 1997). This map shows the depth to groundwater to be greater than 50 feet.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SEISMIC DESIGN CRITERIA

According to the 1996 Caltrans Seismic Hazard map, the most significant faults relative to the project area are listed in Table 5-1 along with their style of fault, maximum earthquake magnitude, distance to the bridge site and resulting peak bedrock acceleration (PBA).

TABLE 5-1. LOCAL SEISMIC SOURCES

Fault or Fault Zone	Style of Faulting	Maximum Credible Earthquake (MCE) Magnitude	Distance to Site[2] (miles)	Peak Bedrock Acceleration[3] (g)
El Modeno-Peralta Hills (EMP)	Reverse-Thrust[1]	6.50	0.9	0.8
Puente Hills Blind Thrust	Reverse-Thrust	7.25	4.2	0.6
Whittier-Elsinore (WEE)	Strike-Slip	7.50	4.8	0.5

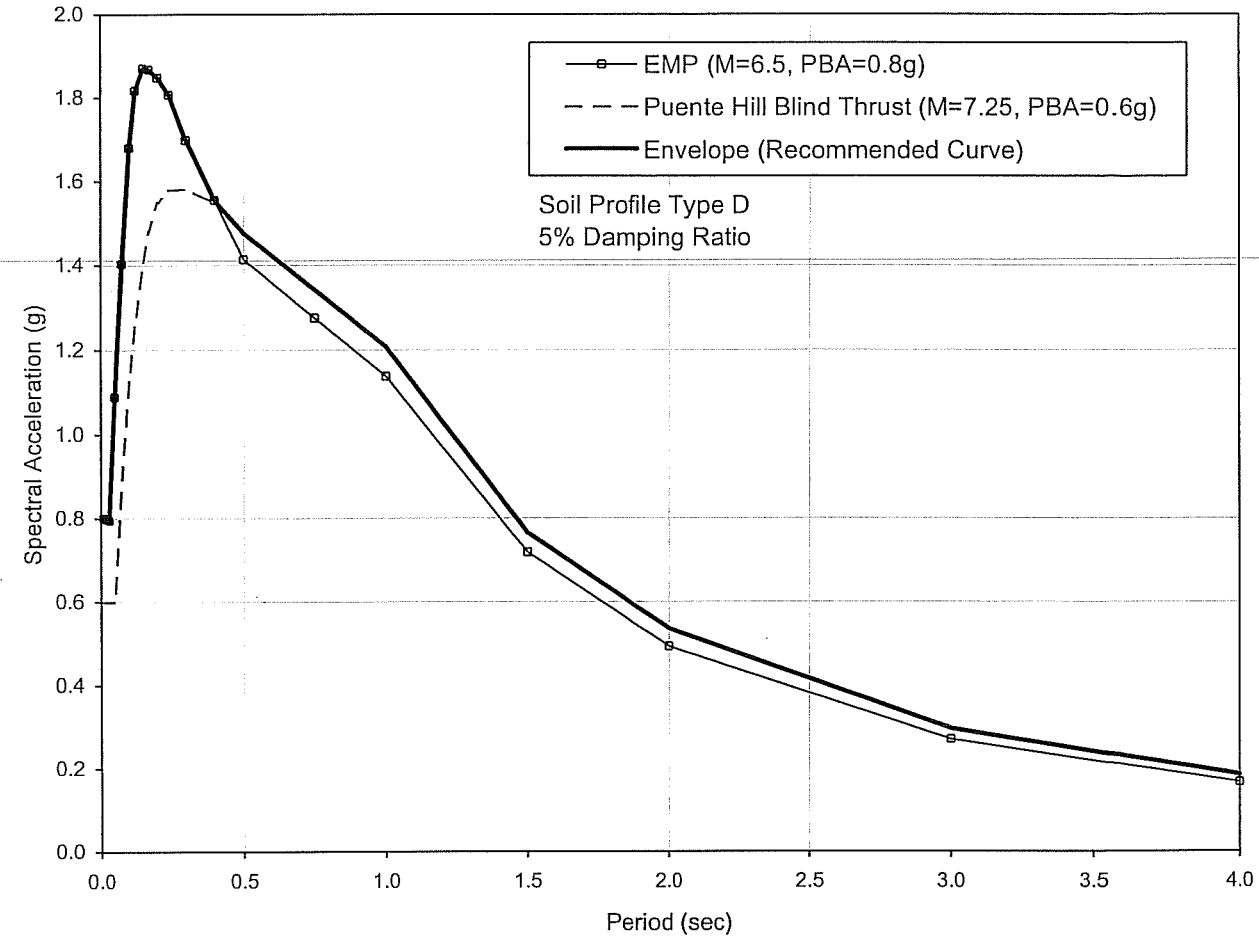
Notes:
(1) Caltrans designates the style of fault for EMP to be "unknown"; we assume a reverse-thrust fault (most conservative).
(2) For the EMP and WEE faults, the distances of each bridge site to these seismic sources were scaled from the 1996 Caltrans Seismic Hazard Map. Distances of each bridge site to the Puente Hills Blind Thrust were obtained from the seismic source model contained within the FRISKSP4.0 computer program (Blake, 2000 and 2004).
(3) The PBA is the larger of the two PBA's obtained from the attenuation relations of Sadigh (1997) and Mualchin (1996).

The ARS curves published in the Caltrans SDC (2006b) for Soil Profile Type "D" are applicable; this applies to Figures B.7 and B.8 for MCE Magnitudes (M) of 6.5±0.25 and 7.5±0.25, respectively. However, ARS curves for M of 6.5±0.25 with PBA's greater than 0.6g are not included in Figure B.7 of the Caltrans SDC (2006b). As a result, we generated an ARS curve for M=6.5±0.25 and a PBA of 0.8g by scaling the 0.6-g curve in Figure B.7 of the Caltrans SDC (2006b).

The design ARS curve envelopes the scaled ARS curve for M=6.5±0.25 and PBA=0.8g, and Figure B.8 for PBA=0.6g. According to Caltrans, this curve must also be modified to account for near-fault effects. For the near-fault effects, Caltrans Seismic Design Criteria (SDC, 2006b) Section 6.1.2.1 recommends the following modifications in the spectral accelerations:

- For periods less than 0.50 second, no change;
- For periods greater than 1.0 second, an increase of 20%;
- For periods between 0.50 and 1.0 second, a linear interpolation between the values at 0.50 and 1.0 second.

The resulting design ARS curve and the digitized coordinates are presented in Figure 5-1.



Spectral Coordinates of Recommended Curve

Period (sec)	Acc. (g)
0.010	0.800
0.020	0.797
0.030	0.795
0.050	1.089
0.075	1.403
0.100	1.680
0.120	1.817
0.150	1.871
0.170	1.867
0.200	1.848

Period (sec)	Acc. (g)
0.240	1.806
0.300	1.698
0.400	1.555
0.500	1.477
0.750	1.342
1.000	1.207
1.500	0.765
2.000	0.536
3.000	0.296
4.000	0.186

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	Project No.: 08-115 / Date: 1/12/09	Figure 5-1

5.2 LIQUEFACTION

Based on the available boring information, the subject site has a low liquefaction potential due to absence of groundwater within the depths of interest.

5.3 SOIL CORROSIVITY

Two soil samples were tested for pH, minimum resistivity, soluble chloride content and soluble sulfate content. The test results are summarized in Table 5-2. Minimum resistivities ranged from 740 to 1,800 ohm-cm. The pH ranged from 7.69 to 8.10. The soluble sulfate ranged from 100 to 500 parts per million (ppm), and the soluble chloride ranged from 162 to 168 ppm.

TABLE 5-2. SOIL CORROSION TEST RESULTS

Boring	Station (Offset) / "Station Line"	Sample Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Soluble Sulfate Content (ppm)	Soluble Chloride Content (ppm)
A-08-006	489+69 (80 RT) / SR-57 (B-Line)	15	CL	1800	8.10	100	168
A-08-007	491+67 (80 RT) / SR-57 (B-Line)	15	CL	740	7.69	500	162

Based on the Caltrans Corrosion Guidelines (2003), soils are considered corrosive if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm or greater. Based on the test results and the Caltrans criteria, the on-site soils are not considered to be corrosive to bare metals and concrete.

5.4 PILE FOUNDATION DESIGN

5.4.1 Foundation Type

The original bridge is supported on 16-inch diameter CIDH piles. The 1991 widened section is supported on 24-inch diameter CIDH piles. We recommend using 24-inch diameter CIDH piles for the proposed widening.

5.4.2 Foundation Data Provided by Structural Designers

Per Caltrans policy, the Working Stress Design (WSD) is used for abutment piles. The foundation design data sheet and foundation loads were provided by the structural designers following the latest Caltrans Memo To Designers (Caltrans, 2008), and are shown in Table 5-3 and Table 5-4, respectively.

TABLE 5-3. FOUNDATION DESIGN DATA SHEET

Location	Design Method	Pile Type	Finished Grade El. (ft)	Pile Cut-off El. (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (inch)	Number of Piles per Support
					B	L		
Abutment 1	WSD	24" CIDH	227.00	220.25	10	23	1	7
Abutment 2	WSD		229.10	221.00	10	23		7

TABLE 5-4. FOUNDATION DESIGN LOADS

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Permanent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abutment 1	1400	200	1090	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Abutment 2	1400	200	1090	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5.4.3 Axial Capacity

The abutment foundations design recommendations are presented in Table 5-5. The Pile Data Table for the contract plans is presented in Table 5-6. The design pile tip elevation for the compression load case was based on skin friction only. The pile capacities are also based on soil resistance only and may be further limited by the pile-head connection details. Pile group effects based on the layout provided by the structural engineers and the guidelines published in the AASHTO LRFD Bridge Design Specifications (2007) were included in these results.

TABLE 5-5. ABUTMENT FOUNDATIONS DESIGN RECOMMENDATIONS

Support	Pile Type	Cut-Off Elev. (feet)	LRFD Service-I Limit State Load per Support (kips)		LRFD Service-I Limit State per Pile (kips)	Nominal Resistance (kips)	Design Tip Elev. (feet)[1]	Specified Tip Elev. (feet)[2]
			Total	Permanent				
Abut 1	24" CIDH	220.25	1400	1090	200	400	+178 (a) +191 (c) +190 (d)	+178
Abut 2		221.00	1400	1090	200	400	+178 (a) +191 (c) +190 (d)	+178

Notes:
1. Design tip elevation is controlled by the following demands: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for lateral and settlement.

TABLE 5-6. PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)[1]	Specified Tip El. (ft)
		Compression	Tension		
Abutment 1	24" CIDH	400	0	+178 (a) +191 (c) +190 (d)	+178
Abutment 2		400	0	+178 (a) +191 (c) +190 (d)	+178

Note:
1. Design tip elevations are controlled by: (a) Compression, (c) Settlement, and (d) Lateral Load.

5.4.4 Lateral Resistance

Results of lateral pile analysis in terms of pile-head shear and lateral deflection for a free-head condition are presented in Table 5-7. The maximum bending moment and the location of maximum moment are also presented. The solutions presented in Table 5-7 are entirely based on soil resistance and linear pile properties. Therefore, these values may be limited by the flexural strength (plastic moment) of the piles and other connection details. Linear interpolation can be used for solutions between pile-head deflections of 0.25 and 5 inches.

TABLE 5-7. LATERAL PILE SOLUTIONS

Location	Lateral Displacement at Top of Pile (in)	Lateral Load at Top of Pile (kips)	Maximum Moment (kip-in)	Depth from Pile Head to Max. Moment (ft)
Abutments 1 & 2	¼	25	885	6
	½	35	1428	6
	1	51	2320	7
	3	90	5046	8
	5	112	7207	9

5.5 EMBANKMENTS AND SETTLEMENT

Settlement. About 25 feet of sliver fill will be placed to construct the approach embankments. Based on the onsite soil type, ground subsidence is estimated to be on the order of 3 inches. We recommend a settlement period of at least 10 calendar days for pile installation at the abutments.

Slope Stability. Global stability analyses were conducted for both static and pseudostatic conditions for the bridge end slopes. Results of this analysis are presented in Appendix C.

The factor of safety for a deep-seated failure is greater than 1.5 under static condition for the 1V:1.5H end slope with a 2-foot soil surcharge to represent traffic loading. Slope stability analysis under pseudostatic condition was performed using a seismic coefficient equal to 0.2g (which is the smaller of either one-third the horizontal peak ground acceleration or 0.2g) in accordance with guidelines provided in Section 3.12 of the Caltrans Guidelines for Foundation Investigations and Reports (Caltrans, 2006a). Analysis indicates that the factor of safety is greater than 1.1 under pseudostatic condition. The 1V:1.5H end slope has proposed concrete slope paving, therefore surficial stability is not a design issue.

Per Caltrans Memo to Designers 5-3 dated December 1992 (Caltrans, 1992a), structure approach slabs are required for this project. Selection of the approach type will be performed by the structural designer following the flowchart in Caltrans Memo to Designers 5-3, Attachment A, dated May 1996 (Caltrans, 1996).

5.6 BRIDGE ABUTMENT WALL DESIGN

Abutment Earth Pressures. If abutment walls are free to move laterally at the top, a static active lateral earth pressure of 36 psf per foot of depth is recommended for a free draining, level and compacted backfill. If lateral movement at the top of abutment walls is restrained, the lateral earth pressure for a free draining, level and compacted backfill should follow Section 5.5.5.11 of the Caltrans BDS dated August 2004. For this condition, we recommend a coefficient of active lateral earth pressure of 0.3, a coefficient of at-rest lateral earth pressure of 0.47 and a soil unit weight of 120 lb/ft^3. If applicable, a uniform lateral pressure of at least 72 psf due to vehicle loads, equivalent to a vertical pressure produced by at least 2 feet of earth, should be added to the above lateral earth pressure.

Passive Resistance of Abutment Backfill. Under seismic loading, an ultimate passive earth pressure of 5 ksf may be used for the approach backfill and abutment walls with a height equal to or greater than 5.5 feet. For abutment walls with heights less than 5.5 feet, the passive pressure may be calculated proportionally (e.g., for a 4-foot high wall, the passive pressure is [4/5.5]x 5 ksf = 3.64 ksf. The horizontal movement at which the maximum passive pressure is expected to be fully mobilized can be determined following the procedure outlined in Section 7.8.1 of the Caltrans SDC (2006b).

There is no abutment wingwalls since both abutments are adjacent to RW 486 and 492. There is a small return wall connecting the abutment to the retaining walls. This return wall sits on the abutment pile cap as a part of the abutment design. Design of RW 486 and 492 is in the roadway plans.

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 EARTHWORK

Earthwork should be performed in accordance with Caltrans Standard Specifications, Section 19 (Caltrans, 2006c). Appropriate measures should be taken to prevent damage to adjacent structures and utilities. Any design and construction of temporary sloping, sheeting, or shoring should be made the contractor's responsibility. It should be noted that it is the responsibility of the contractor to oversee the safety of the workers in the field during construction. The contractor shall conform to all applicable occupational and health standards, rules, regulations, and orders established by the State of California. In addition, other State, County, or Municipal regulations may supersede the recommendations presented in this section. If a trench shoring design and safety plan is required, the geotechnical consultant should review the plan to confirm that recommendations presented in this report have been applied to the design.

During the recent field investigation conducted on September 29, 2008, groundwater was not encountered down to El. +147 feet which is more than 60 feet from the freeway surface. As shown on the as-built LOTB sheets in Appendix A, groundwater was not encountered during drilling in November 1965 and January 1989 down to El. +171 feet. Therefore, groundwater is not expected to be encountered during footing construction. However, groundwater level can fluctuate due to seasonal rainfall amount, local irrigation and groundwater recharge program and other man-made conditions. If groundwater is encountered, it should be controlled in accordance with Section 19-3.04 of the Caltrans Standard Specifications (2006c).

6.2 PILE CONSTRUCTION

For on-center pile spacing less than six times the pile diameter, no two adjacent piles can be constructed concurrently.

Loose soils should be cleaned from the bottom of the borings. Pile borings should be inspected and approved by the geotechnical engineer prior to the installation of reinforcement. Extreme care in drilling, placement of steel, and the pouring of concrete is essential to avoid excessive disturbance of pile boring walls. Concrete placement by pumping or tremie tube to the bottom of the pile borings is recommended. Specifications should require that sufficient space be provided in the pile reinforcing cage during fabrication to allow the insertion of a tremie tube for concrete placement. The pile reinforcing cage should be installed and the concrete pumped immediately after drilling is completed.

Sandy soils were encountered in our soil borings and these materials are susceptible to caving. If caving occurs, a temporary casing may be required during construction. Casings should have an outer diameter equal to or exceeding the pile diameter. Temporary casing should be placed tight-in-hole. Vibratory or impact hammer with or without center-relief drilling can be used to install the temporary casing provided the existing structure is monitored for potential movement due to ground vibration; casing installation using this method should be suspended if excessive movement is detected. The temporary casing should be pulled as the concrete is being poured while always maintaining at least a 5-foot head of concrete inside the casing.

6.3 BACKDRAIN AND BACKFILL REQUIREMENTS FOR ABUTMENT WALLS

Per Caltrans requirements, expansive soils should not be placed as part of the embankment within the limits of a bridge abutment as shown in Figure 6-1. Materials placed behind abutment wall should be low-expansive soil with an Expansion Index (EI) less than 50 and Sand Equivalent (SE) of more than 20. The low-expansive material requirement should be supplemental to the abutment structure and pervious backfill requirement as described in Caltrans Standard Plans (2006d) and Caltrans Standard Specifications (2006c) under Sections 19-3.06 and 19-3.065, respectively.

Backfill should be compacted in accordance with Section 19-5 of the Caltrans Standard Specifications (2006c). Backfill should be placed in loose lifts not exceeding 8 inches in thickness, moisture-conditioned to near optimum moisture content, and compacted to at least 95 percent relative compaction. The relative compaction should be based on the maximum density determined by California Test 216. Jetting or flooding to compact backfill is not recommended. Heavy compaction equipment, such as vibratory rollers, dozers, or loaders, should not be used adjacent to the abutment walls in order to avoid damaging the walls due to large lateral earth pressures.

Backdrains should be installed behind abutment walls to relieve hydrostatic pressure. Backdrains should be constructed in accordance with Bridge Detail 3-1 on Sheet BO-3 per Caltrans Standard Plans (2006d) or the geocomposite drain alternative per Section 6 of the Caltrans Bridge Design Aids (1992b).

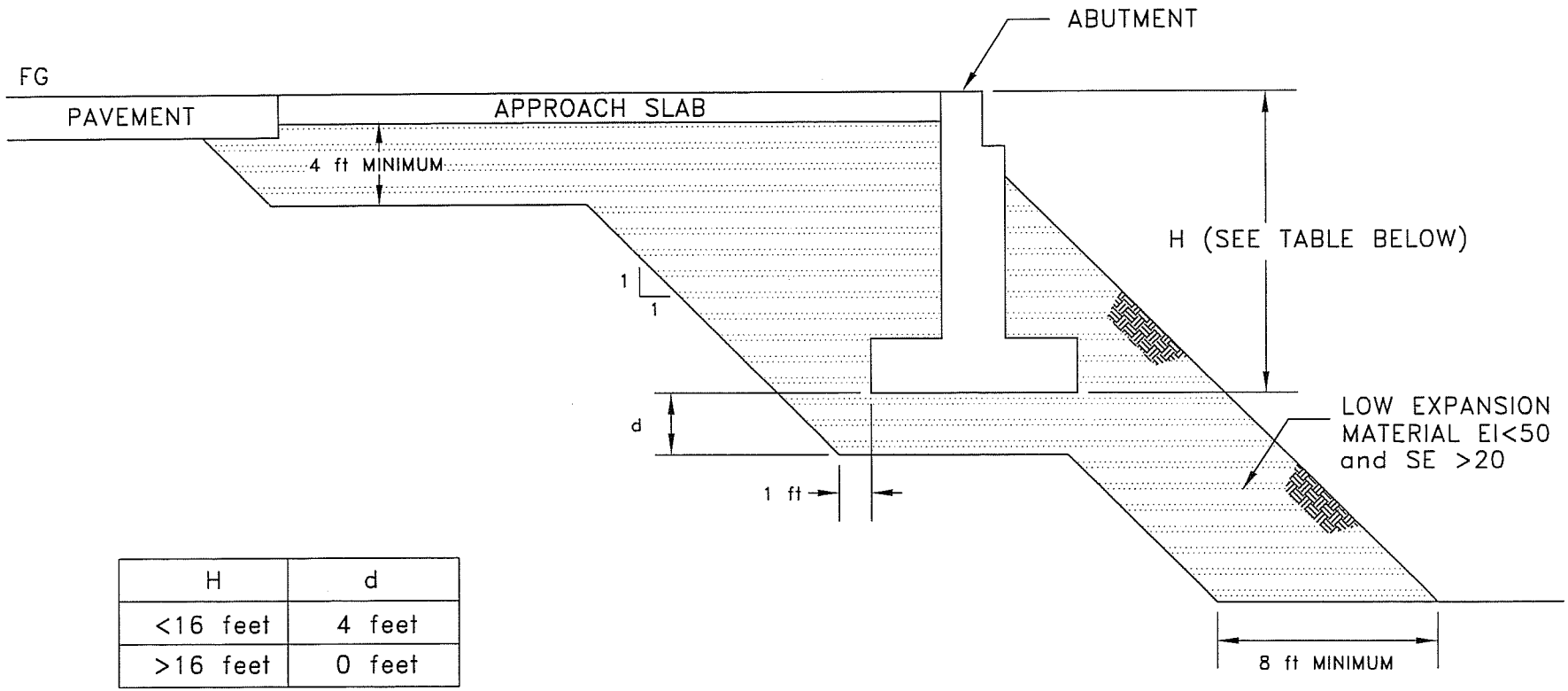
6.4 REVIEW OF CONSTRUCTION PLANS

Recommendations contained in this report are based on preliminary plans. The geotechnical consultant should review the final construction plans and specifications in order to confirm that the general intent of the recommendations contained in this report have been incorporated into the final construction documents. Recommendations contained in this report may require modification or additional recommendations may be necessary based on the final design.

6.5 GEOTECHNICAL OBSERVATION AND TESTING

It is recommended that inspections and testing be performed by the geotechnical consultant during the following stages of construction:

- Grading operations, including excavations and placement of compacted fill
- Shoring installation
- Footing excavations
- Pile installation
- Backdrain installation and backfilling of bridge abutment walls.
- Removal or installation of support of buried utilities or structures
- When any unusual subsurface conditions are encountered



H	d
<16 feet	4 feet
>16 feet	0 feet

EXPANSION INDEX TO BE DETERMINED BY ASTM D4829
SAND EQUIVALENT TO BE DETERMINED
BY CALIFORNIA TEST METHOD 217

NO SCALE

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

CROWTHER AVENUE UC (WIDEN)

EMI Project No. 08-115 | Date: 01-12-2009

LOW EXPANSION MATERIAL
IN BRIDGE EMBANKMENT

FIGURE 6-1

7.0 LIMITATIONS

This report is intended for the use of RBF Consulting, Orange County Transportation Authority and Caltrans for the widening of Crowther Avenue Undercrossing. This report is based on the project as described and the information obtained from the exploratory borings at the approximate locations indicated on the attached plans. The findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses. In addition, soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project site. However, subsurface conditions and characteristics of soils between exploratory borings can vary. The findings reflect an interpretation of the direct evidence obtained. The recommendations presented in this report are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained in this report are applicable to the specific design element(s) and location(s) which is (are) the subject of this report. They have no applicability to any other design elements or to any other locations and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

EMI has no responsibility for construction means, methods, techniques, sequences, or procedures; for safety precautions or programs in connection with the construction; for the acts or omissions of the CONTRACTOR or any other person performing any of the construction; or for the failure of any worker to carry out the construction in accordance with the Final Construction Drawings and Specifications.

Services performed by EMI have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

8.0 REFERENCES

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APPENDIX A

LOG OF TEST BORINGS SHEETS AND AS-BUILT LOG OF TEST BORINGS SHEETS

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Tina Cheang
REGISTERED ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

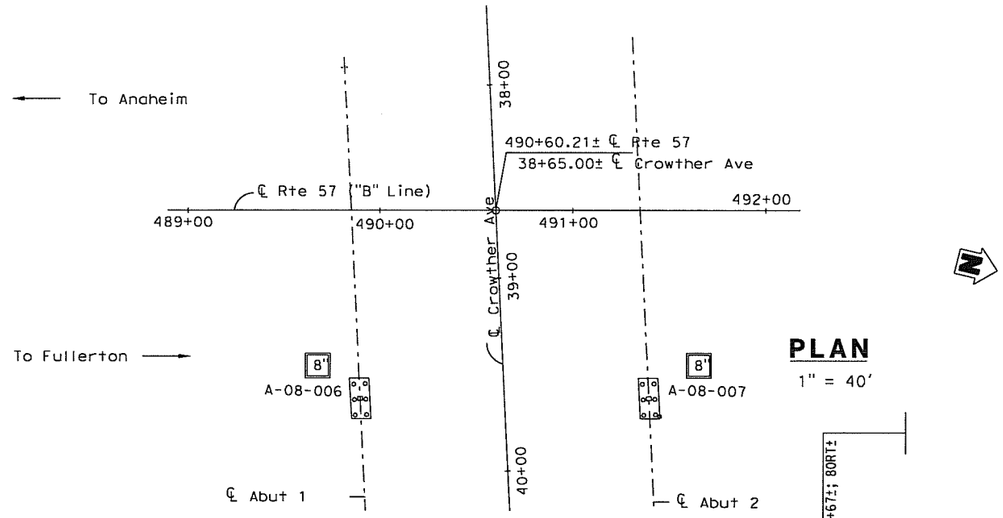
EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 40'

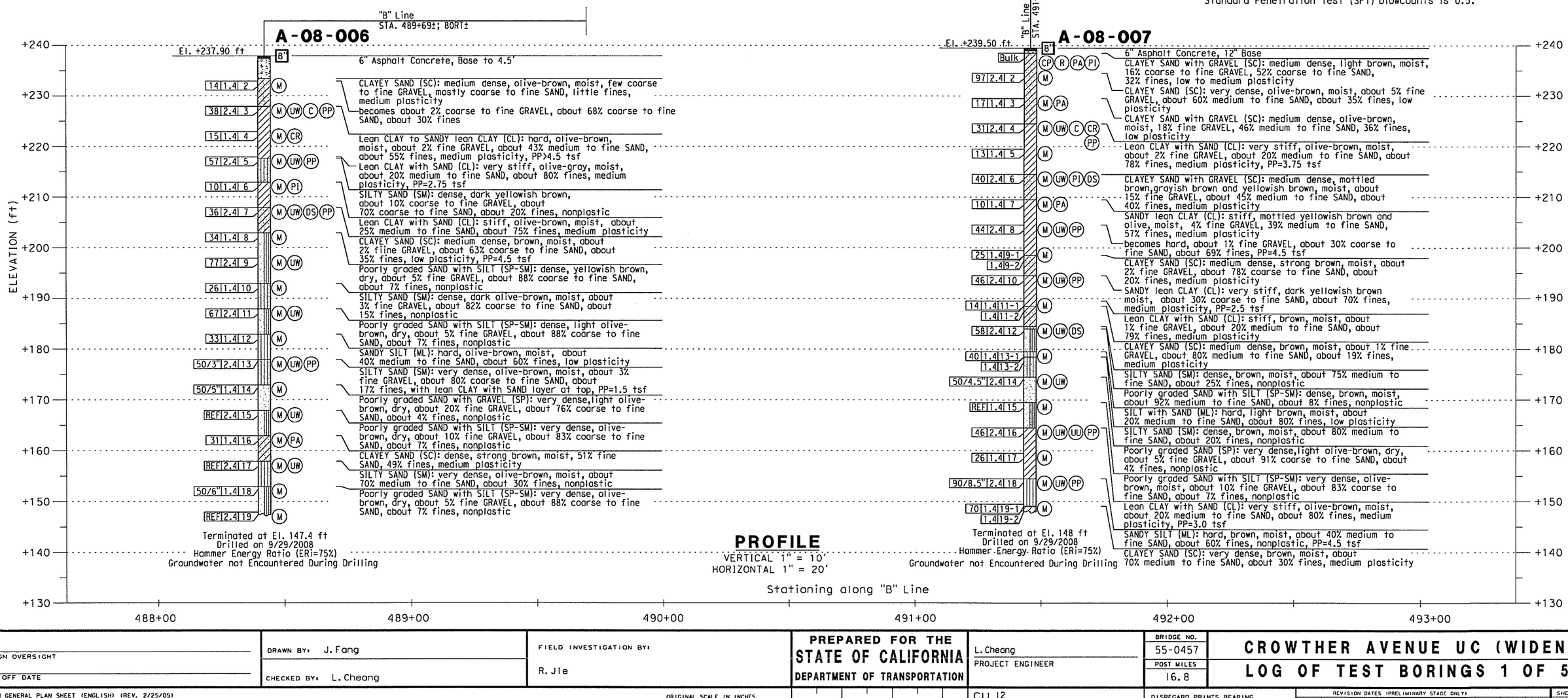
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0457 / POST MILES 16.8
SIGN OFF DATE	CHECKED BY: L. Cheang				CROWTHER AVENUE UC (WIDEN) LOG OF TEST BORINGS 1 OF 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) — 4/30/09

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REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

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FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

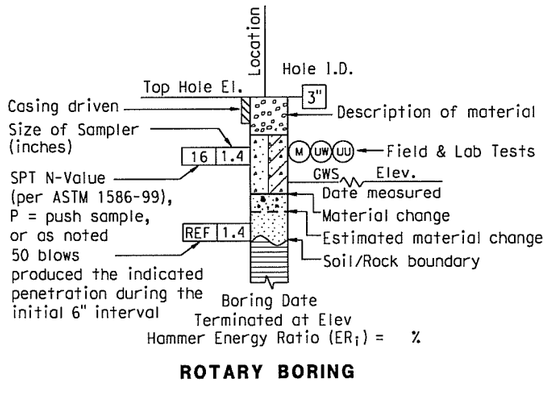
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

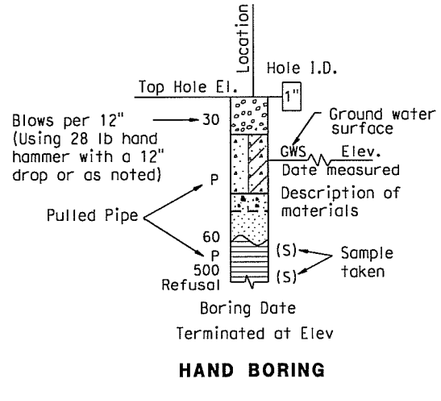
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

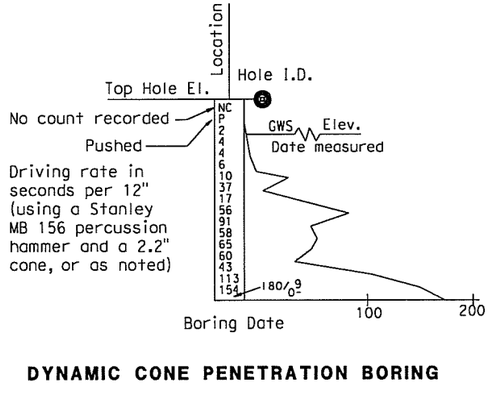
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



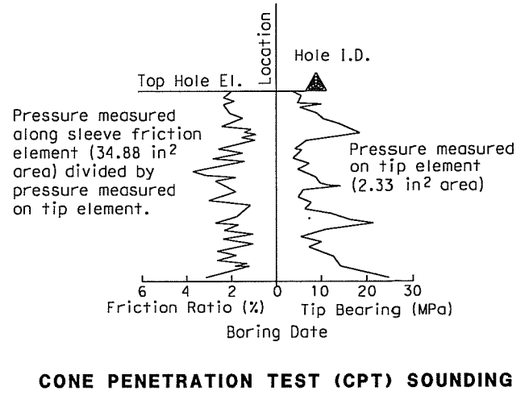
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

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SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 16.8	LOG OF TEST BORINGS 2 OF 5
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			CU 12 EA 0F0311	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) — SHEET — OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166)
Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lin Cheang
REGISTERED ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER L. CHEANG NO. GE 2345 EXP. 9-30-09 GEOTECHNICAL STATE OF CALIFORNIA

PLANS APPROVAL DATE

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550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

L. Cheang
PROJECT ENGINEER

BRIDGE NO.	
55-0457	
POST MILES	
16.8	

CROWTHER AVENUE UC (WIDEN)
LOG OF TEST BORINGS 3 OF 5

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) | SHEET | OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	476	491

Kul Bhushan 12/28/89

GEOTECHNICAL PROFESSIONAL

10-29-90

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — KUL BHUSHAN — RE GE 000144 — Exp. 12/31/1989 — GEOTECHNICAL — STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

Tim Cheang
REGISTERED CIVIL ENGINEER — DATE

CROWTHER AVENUE UC (WIDEN)

LOG OF TEST BORINGS 4 OF 5

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

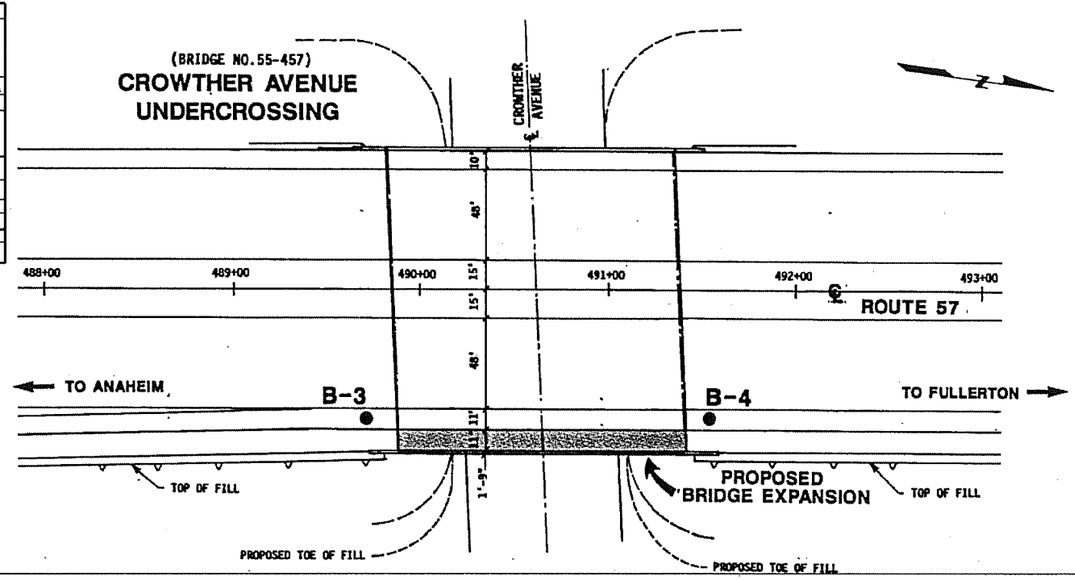
Cu 12 - Ea 0F0311

BRIDGE No. 55-0457

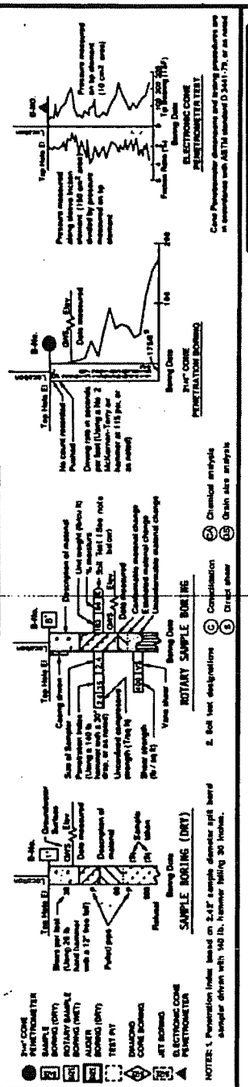
Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER — LIND C. CHEANG — NO. GE 2345 — EXP. 9/30/89 — GEOTECHNICAL — STATE OF CALIFORNIA

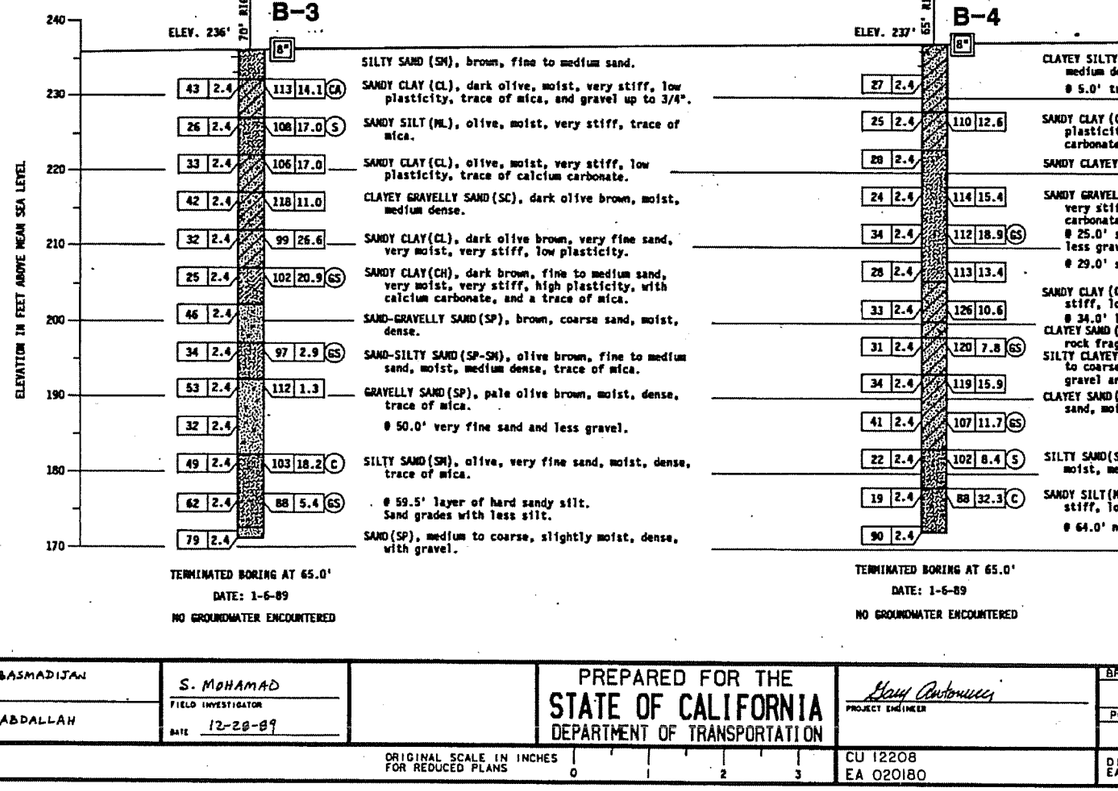
(BRIDGE NO.55-457)
CROWTHER AVENUE UNDERCROSSING



PLAN
SCALE: 1"=40'



PROFILE
VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'



B-3
ELEV. 236' — 70' RIGHT STA. 489+72 — 8"

43	2.4	113	14.1		SILTY SAND (SM), brown, fine to medium sand.
26	2.4	108	17.0	S	SANDY CLAY (CL), dark olive, moist, very stiff, low plasticity, trace of mica, and gravel up to 3/4".
33	2.4	106	17.0		SANDY SILT (ML), olive, moist, very stiff, trace of mica.
42	2.4	118	11.0		SANDY CLAY (CL), olive, moist, very stiff, low plasticity, trace of calcium carbonate.
32	2.4	99	26.6		CLAYEY GRAVELLY SAND (SC), dark olive brown, moist, medium dense.
25	2.4	102	20.9	GS	SANDY CLAY (CL), dark olive brown, very fine sand, very moist, very stiff, low plasticity.
46	2.4				SANDY CLAY(CH), dark brown, fine to medium sand, very moist, very stiff, high plasticity, with calcium carbonate, and a trace of mica.
34	2.4	97	2.9	GS	SAND-GRAVELLY SAND(SP), brown, coarse sand, moist, dense.
53	2.4	112	1.3		SAND-SILTY SAND (SP-SM), olive brown, fine to medium sand, moist, medium dense, trace of mica.
32	2.4				GRAVELLY SAND(SP), pale olive brown, moist, dense, trace of mica.
49	2.4	103	18.2	C	@ 50.0' very fine sand and less gravel.
62	2.4	88	5.4	GS	SILTY SAND(SM), olive, very fine sand, moist, dense, trace of mica.
79	2.4				@ 59.5' layer of hard sandy silt. Sand grades with less silt.
					SAND(SP), medium to coarse, slightly moist, dense, with gravel.

TERMINATED BORING AT 65.0'
DATE: 1-6-89
NO GROUNDWATER ENCOUNTERED

B-4
ELEV. 237' — 65' RIGHT STA. 491+54 — 8"

27	2.4				CLAYEY SILTY SAND (SM-SC), brown, very moist, medium dense.
25	2.4	110	12.6		@ 5.0' trace of gravel, and no clay.
28	2.4				SANDY CLAY (CL), dark olive, moist, very stiff, low plasticity, trace of gravel and calcium carbonate.
24	2.4	114	15.4		SANDY CLAYEY SILT (ML), low plasticity, very stiff.
34	2.4	112	18.9	GS	SANDY GRAVELLY SILT(ML), dark olive brown, moist, very stiff, trace of silt bedrock and calcium carbonate.
28	2.4	113	13.4		@ 25.0' soil is very moist with trace of clay and less gravel.
33	2.4	126	10.6		@ 29.0' soil is silty sand with gravel.
31	2.4	120	7.8	GS	SANDY CLAY (CL), olive to dark brown, moist, very stiff, low plasticity, trace of gravel.
34	2.4	119	15.9		@ 34.0' layer of sandy clay, dark brown.
41	2.4	107	11.7	GS	CLAYEY SAND (SC), brown, medium dense, trace of rock fragments.
22	2.4	102	8.4	S	SILTY CLAYEY SAND(SC-SM), dark reddish brown, fine to coarse sand, moist, medium dense, trace of gravel and mica.
19	2.4	88	32.3	C	CLAYEY SAND(SC), yellowish brown, fine to medium sand, moist, very stiff, trace of mica.
90	2.4				SILTY SAND(SM), olive brown, fine to medium sand, moist, medium dense.
					SANDY SILT(ML), olive, fine sand, very moist, stiff, low plasticity.
					@ 64.0' no sample recovery, hard or very dense.

TERMINATED BORING AT 65.0'
DATE: 1-6-89
NO GROUNDWATER ENCOUNTERED

AS BUILT NO AS BUILT CHANGES
CORRECTIONS BY J. PINHEIRO / I. PANGLE
CONTRACT NO. 12-020184
DATE 11-24-92

BM 535-D-70 — ELEVATION 257.37

FOUND CHISELED CROSS ON TOP OF THE #nd ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60 AND 105 FEET NORTHERLY OF THE CENTERLINE OF NUTWOOD AVE..

DESIGN ENGINEER — DATE 8-22-90
DRAWN BY B.BASMADJIAN
CHECKED BY H.ABDALLAH
S. MOHAMAD — FIELD INVESTIGATOR — DATE 12-28-89

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

PROJECT ENGINEER

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12208
EA 020180

BRIDGE NO. 55-457
POST MILE 16.8

CROWTHER AVE. UNDERCROSSING (WIDEN)

LOG OF TEST BORINGS

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 8 OF 9

DIST	COUNTY	ROUTE	POST MILES – TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	11.1/21.2	477	491

N 622 234 735
E 502 840.345

BENCH MARK

BM 491-468 Elev. 204.61

Set PK in N. curb Crowther Ave. @ BCR
10' E corner E of Placentia Ave 292' W
of E Leg 32' N. of ℄ Crowther Ave.

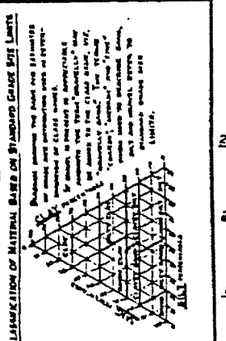
LEGEND OF SOIL BORINGS

- Penetrometer
- 2½" Core Penetrometer
- Standard Boring (auger)
- Rotary Boring (mud)
- Auger Boring (dry)
- Jet Boring
- Core Boring
- Test Pit

LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Rock Cliff or Closely Silty
- Peat and/or Organic Matter
- Fill Material
- Igneous Rock
- Sedimentary Rock
- Sandy Silt or Silty Sand
- Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS



NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

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DIST.	COUNTY	ROUTE	POST MILES -TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

Lina Cheang
REGISTERED CIVIL ENGINEER — DATE

CROWTHER AVENUE UC (WIDEN)

LOG OF TEST BORINGS 5 OF 5

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 EA: 0F0311 — BRIDGE No. 55-0457

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER — LIND C. CHEANG — NO. GE 2345 — EXP. 9/30/89 — GEOTECHNICAL — STATE OF CALIFORNIA

B-4 B-5 B-3 B-1 B-2 B-6

℄ CROWTHER AVE.

℄ FWY. RTE. 57

PLAN
Scale: 1" = 20'

AS BUILT

CORRECTIONS BY _____

CONTRACT NO. _____

D/E _____

AS - BUILT PLAN — FOR INFORMATION ONLY

Kul Bhushan
GEOTECHNICAL PROFESSIONAL
DATE APPROVED 10-29-90

CROWTHER AVENUE UC (WIDEN)

LOG OF TEST BORINGS

CU: 12298	BRIDGE No.
EA: 020181	55 - 457

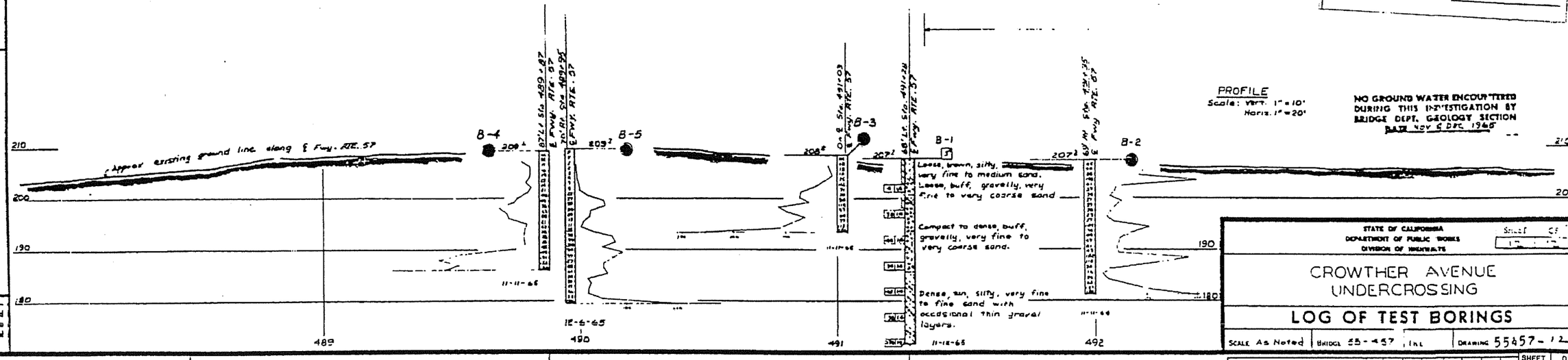
REGISTERED PROFESSIONAL ENGINEER — KUL BHUSHAN — No. GE 552144 — Exp. 12-31-93 — GEOTECHNICAL — STATE OF CALIFORNIA

AS BUILT PLANS
Contract No. 07-052124
Date Completed _____
Document No. 70000668

AS BUILT NO AS BUILT CHANGES
CONTRACT NUMBER 12- 020184
RESIDENT ENGINEER J. PALMEIRO & J. PAMBLE
COMPLETION DATE 11-24-92

PROFILE
Scale: Vert. 1"=10'
Horiz. 1"=20'

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE NOV & DEC. 1965



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

CROWTHER AVENUE
UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-457 | FHL | DRAWING 55457-12

Charge: 07208
N A : 032121

Disregard prints bearing earlier revision dates →

PREL. DRAWING No. PR- PP/J

SHEET	OF
9	9

APPENDIX B

LABORATORY TEST RESULTS

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

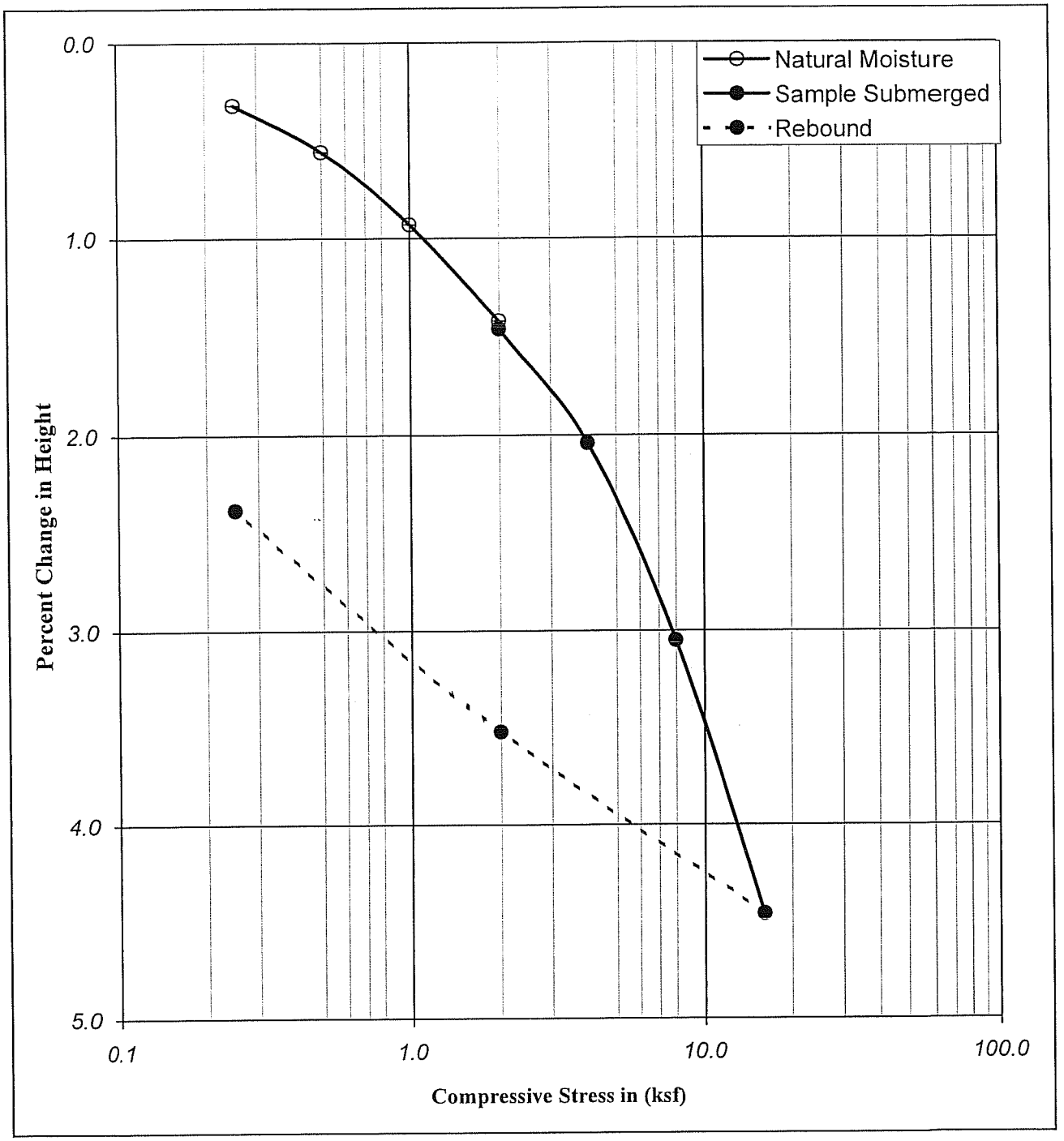
Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Grain Size Distribution GR:SA:FI (%)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-006	S-2	5	SC	13.3								
A-08-006	D-3	10	CL	25.3	127.8	>4.5						
A-08-006	S-4	15	CL	16.5					1800	8.1	100	168
A-08-006	D-5	20	CL to SM	15.7	129.2	2.75						
A-08-006	S-6	25	CL	20.6				38/18/20				
A-08-006	D-7	30	SC	18.0	129.5	4.5						
A-08-006	S-8	35	SP-SM	2.8								
A-08-006	D-9	40	SP-SM	2.2	111.9							
A-08-006	S-10	45	SM	6.1								
A-08-006	D-11	50	SP-SM	1.7	121.0							
A-08-006	S-12	55	ML	20.5								
A-08-006	D-13	60	CL to SM	20.7	126.8	1.5						
A-08-006	S-14	65	SP	1.4								
A-08-006	D-15	70	SP-SM	2.2	122.8							
A-08-006	S-16	75	SC	13.5			0:51:49					
A-08-006	D-17	80	SM	7.8	126.3							
A-08-006	S-18	85	SP-SM	3.0								
A-08-006	D-19	90	SP-SM	2.8								
A-08-007	BULK	1.5 - 5	SC					29/18/11				
A-08-007	D-2	5	SC	9.6								
A-08-007	S-3	10	SC	12.4			18:46:36					
A-08-007	D-4	15	CL	16.8	122.1	3.75			740	7.7	500	162
A-08-007	S-5	20	CL	19.1								
A-08-007	D-6	25	SC	12.8	127.2			32/19/13				
A-08-007	S-7	30	CL	18.7			4:39:57					
A-08-007	D-8	35	CL	12.1	132.6	4.5						
A-08-007	S-9	40	CL	10.9								
A-08-007	D-10	45	CL	16.3	122.9	2.5						
A-08-007	S-11	50	CL	17.0								
A-08-007	D-12	55	SM	18.6	112.9							
A-08-007	S-13	60	ML	23.7								
A-08-007	D-14	65	SP	1.3	113.8							
A-08-007	S-15	70	SP-SM	4.5								
A-08-007	D-16	75	CL	30.4	121.2	3						
A-08-007	S-17	80	CL	15.7								
A-08-007	D-18	85	ML	14.5	131.6	4.5						
A-08-007	S-19	90	ML to SC	9.8								

TABLE 2 SUMMARY OF LABORATORY STRENGTH TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No .	Sample No.	Sample Depth	Soil Identification (group symbol) ASTM D2488/D2487	Unconsolidated Undrained Triaxial Test (ASTM D2850)				Direct Shear Test (ASTM D3080)			
								Peak		Residual	
				Peak Strength S_u	Strain at Peak S_u	Shear Strength at 10% Strain S_u	Confining Pressure	ϕ	C	ϕ	C
		(ft)		(ksf)	(%)	(ksf)	(ksf)	(deg)	(ksf)	(deg)	(ksf)
A-08-006	D-4	15	SC					30.89	0.47	29.1	0.24
A-08-007	D-6	25	SC					41.63	0.17	30.53	0.47
A-08-007	D-12	55	SP-SM					31.5	0.37	31.65	0.02
A-08-007	D-16	75	CL	3.00	14.6	2.71	6.05				



Boring No.	: A-08-006			Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-3			Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft) :	10.0	11.5	Plastic Index :	-	Initial	17.05	109.64	17.26	85.66	0.54
	(m) :	3.05	3.51	Specific Gravity :	2.70	Final	18.30	112.38	17.69	98.86	0.50
Description : Olive gray with olive brown, SANDY LEAN CLAY (CL)											

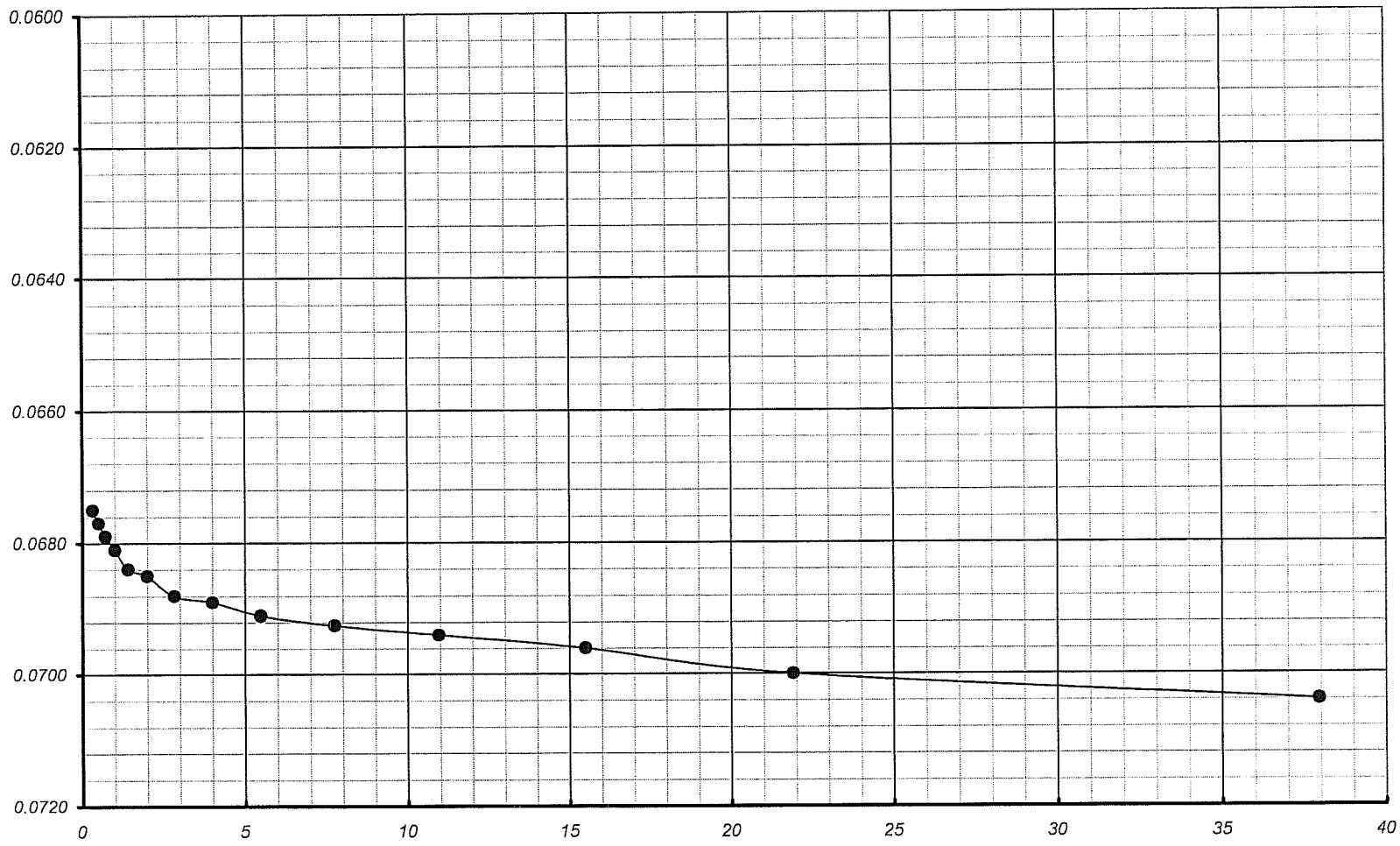
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

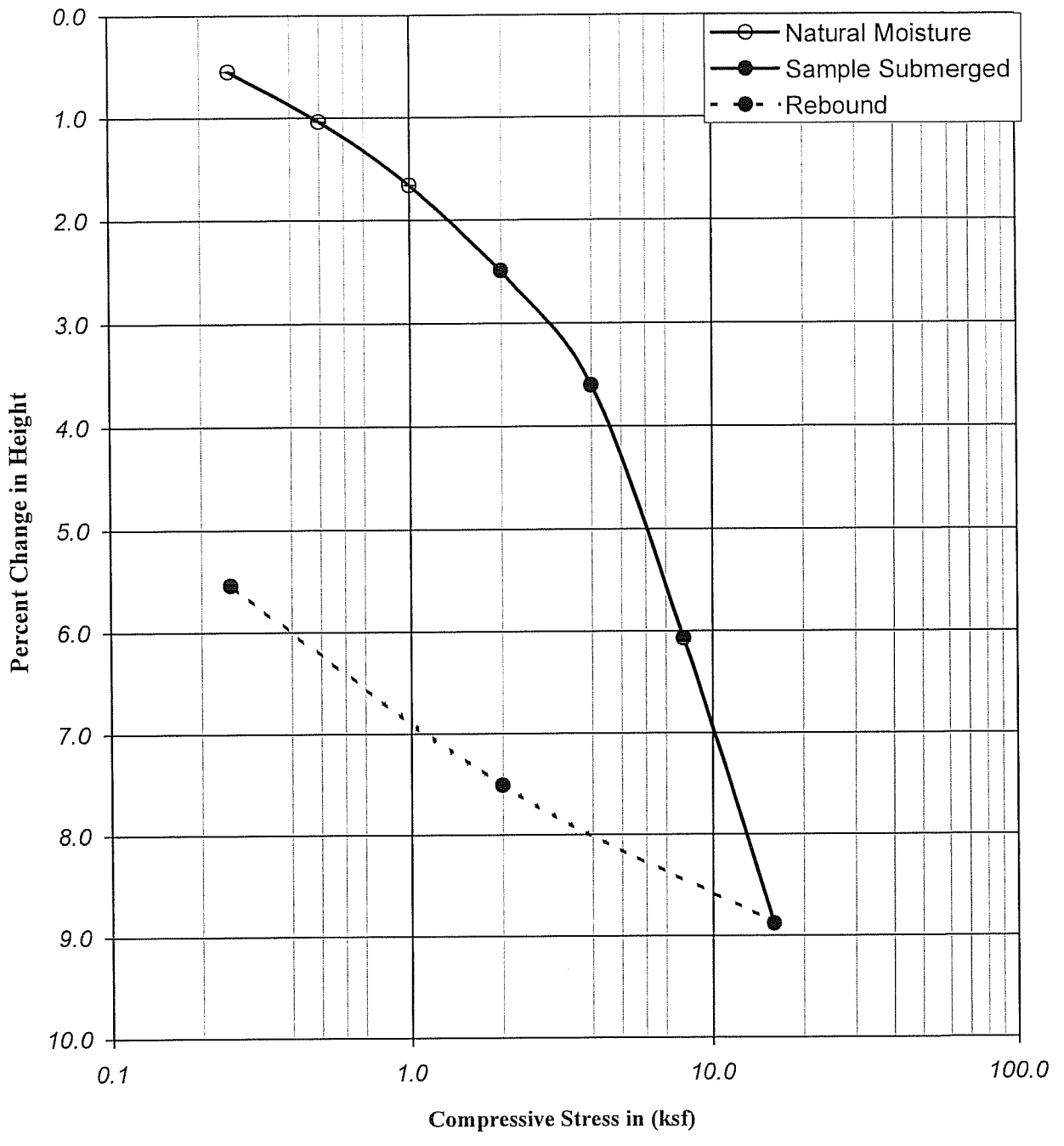
Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-006*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-3*	
EMI Project No. : *08-115*		Depth (ft/m) : *10.0* *3.1*	Veritcal Load (ksf/kpa) : *4.00* *191.5*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound	Boring No. : A-08-006	One-Dimensional Consolidation of Soil Time-Deformation Curve(Square Root of Time Method)
		Sample No. : D-3	
EMI Project No. : 08-115		Depth (ft/m) : 10.0 3.1	Veritcal Load (ksf/kpa) : 4.0 191.5



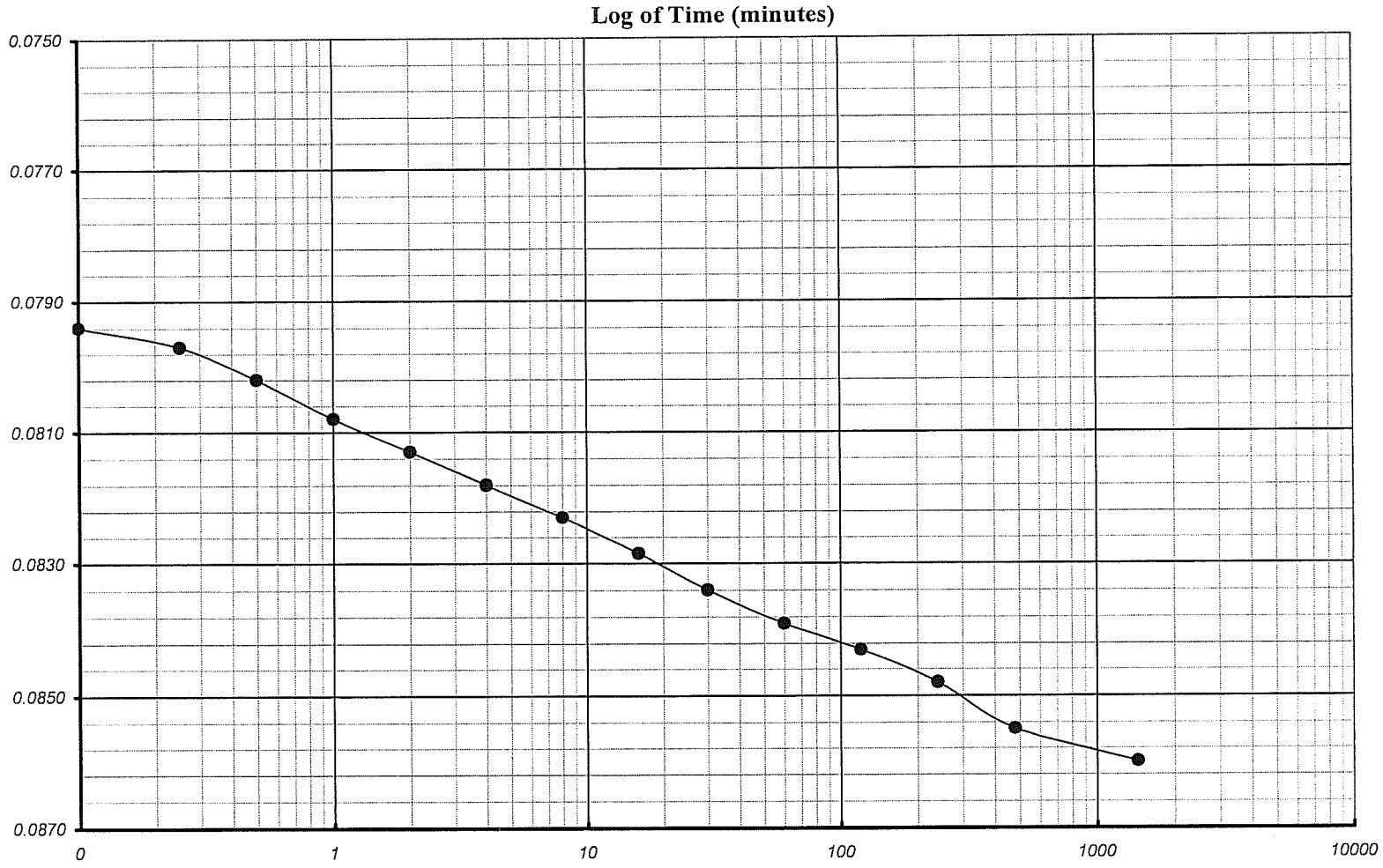
Boring No.	: A-08-007			Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-4			Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft) :	15.0	16.5	Plastic Index :	-	Initial	19.30	102.11	16.07	80.09	0.65
	(m) :	4.58	5.03	Specific Gravity :	2.70	Final	21.16	108.15	17.02	102.28	0.56
Description	: @ brown, SANDY lean CLAY (CL)										

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

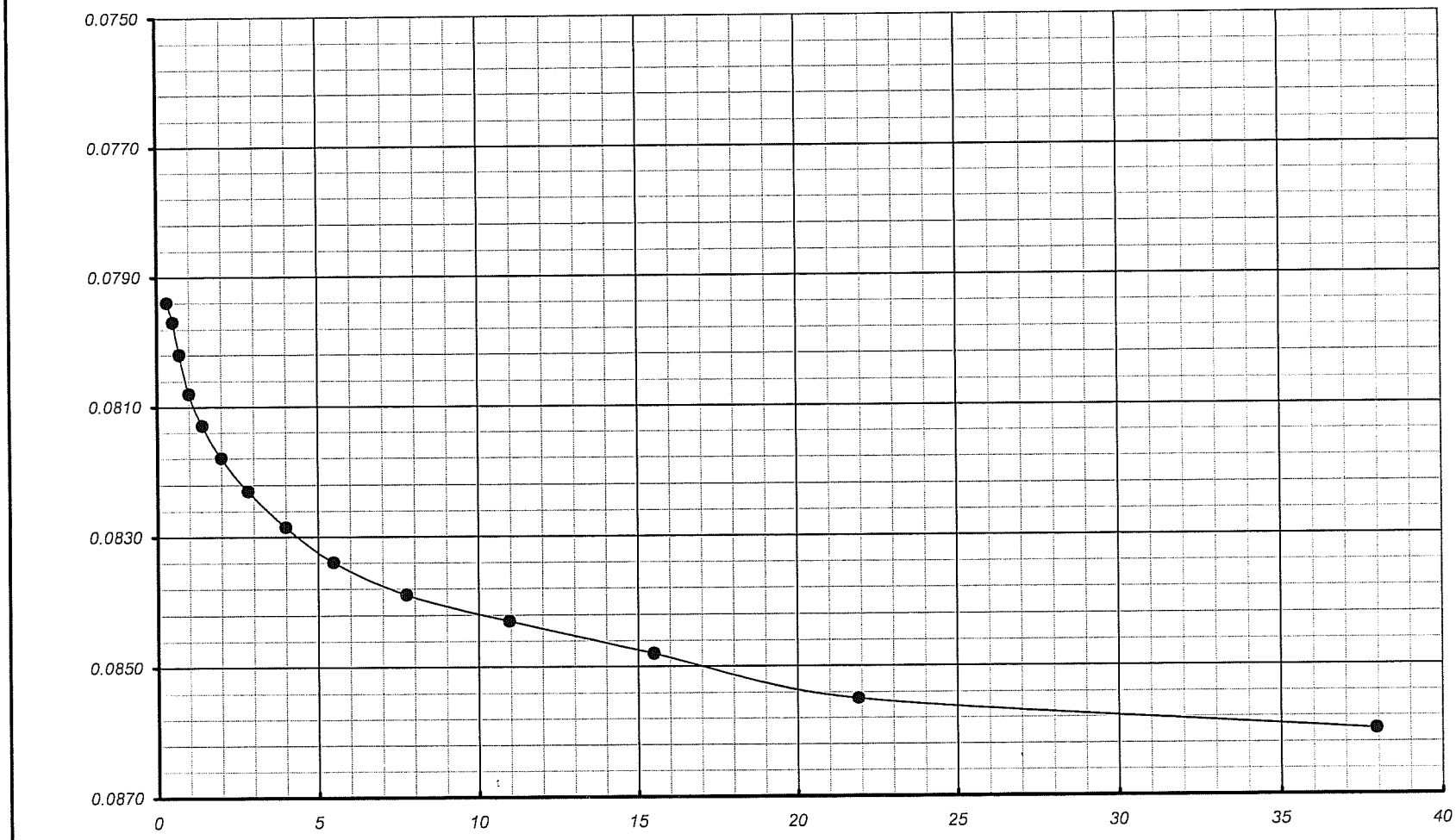
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

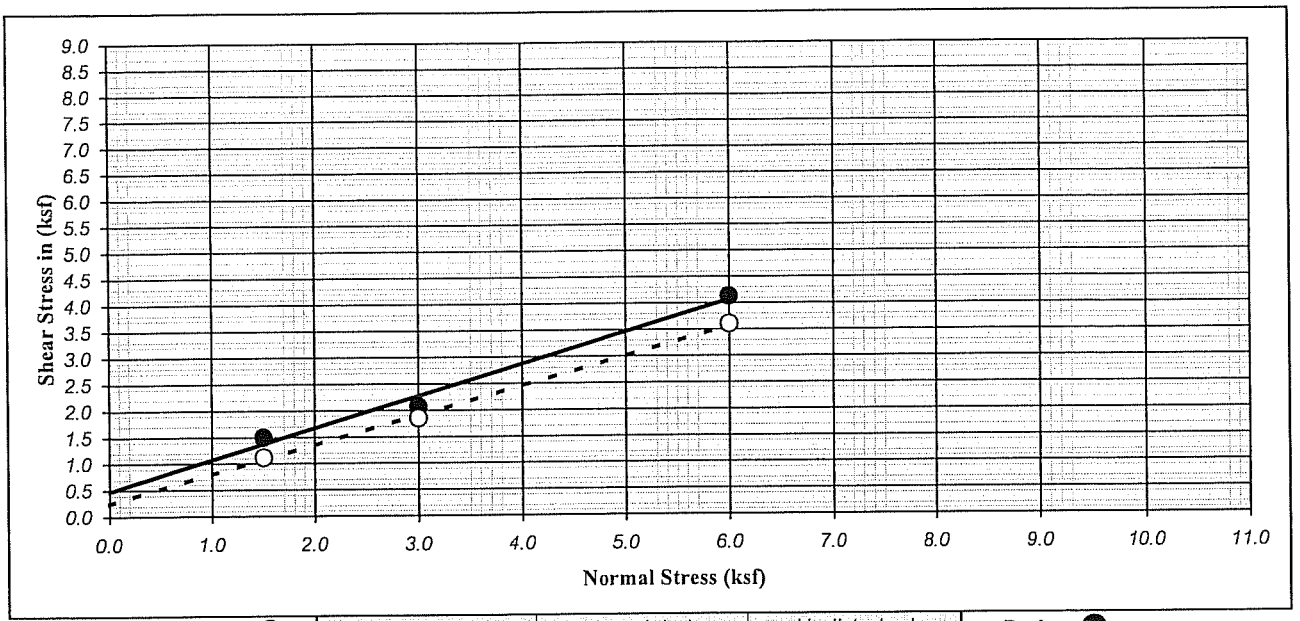
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



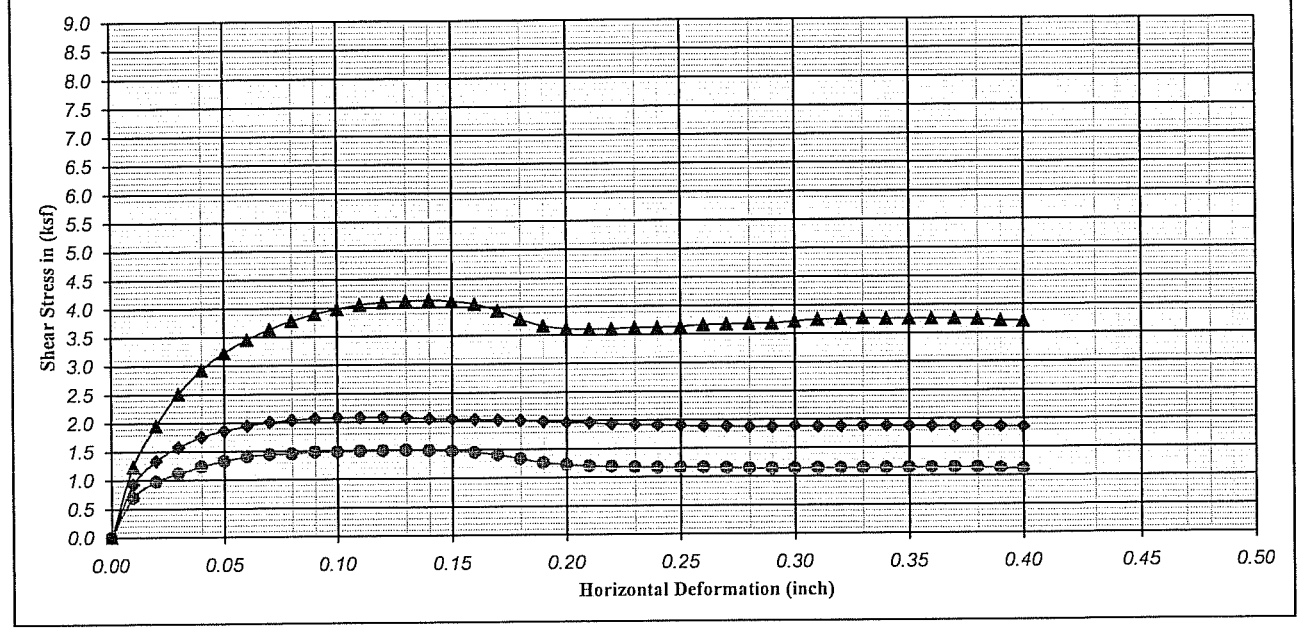
Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-007*	One-Dimensional Consolidtion of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-4*	
EMI Project No. : *08-115*		Depth (ft/m) : *15.0* *4.6*	Vertical Load(ksf/kpa) : *4.00* *191.5*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-007*	One-Dimensional Consolidtion of Soil Time-Deformation Curve (Sqare Root of Time Method)
		Sample No. : *D-4*	
EMI Project No. : *08-115*		Depth (ft/m) : *15.0* *4.6*	Critcal Load(ksf/kpa) : *4.0* *191.5*



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-006		Strength Intercept (C) :	0.47	(ksf)	Peak	0.24	(ksf)	Ultimate	
Sample No. : D-7			22.70	(kPa)		11.49	(kPa)		
Depth (ft/m) : 10.0	0.00	Friction Angle (ϕ) :	30.89	Degree		29.10	Degree		
Description : Brown, CLAYEY SAND (SC)							Shear Rate (inch/minute) :	0.02	

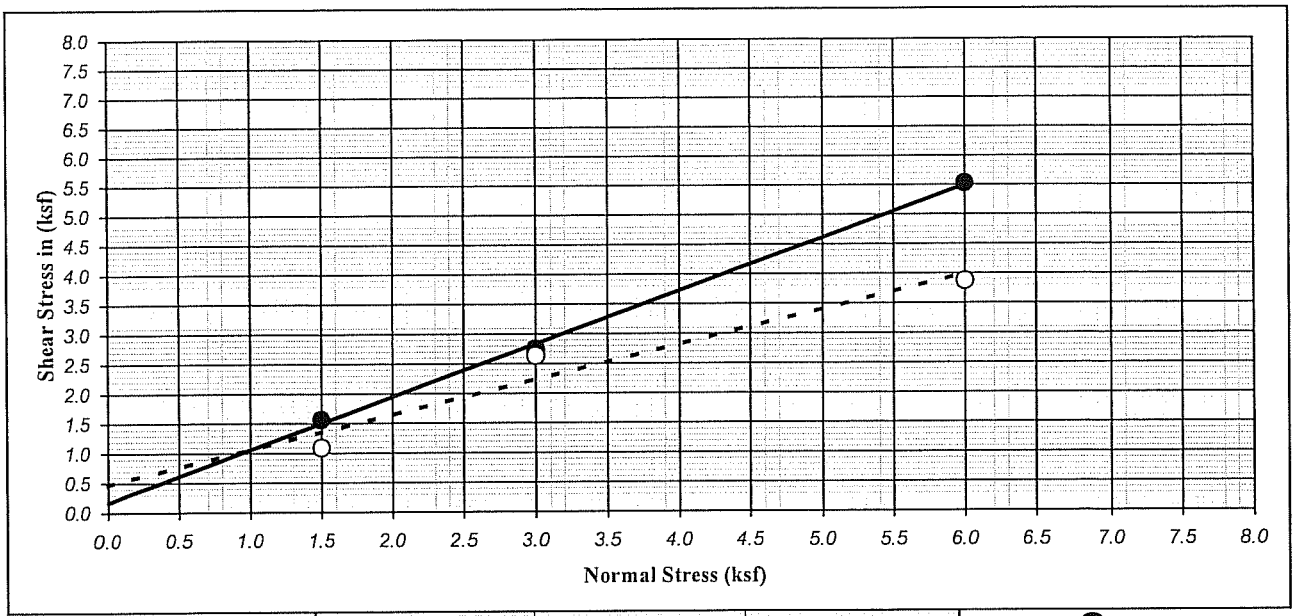
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	50.86	81.26	12.79	1.07	1.50	71.82	1.50	71.82	1.12	53.43
◆	29.72	94.69	14.90	0.78	3.00	143.64	2.08	99.40	1.85	88.48
▲	20.94	99.44	15.65	0.70	6.00	287.28	4.13	197.65	3.60	172.37

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

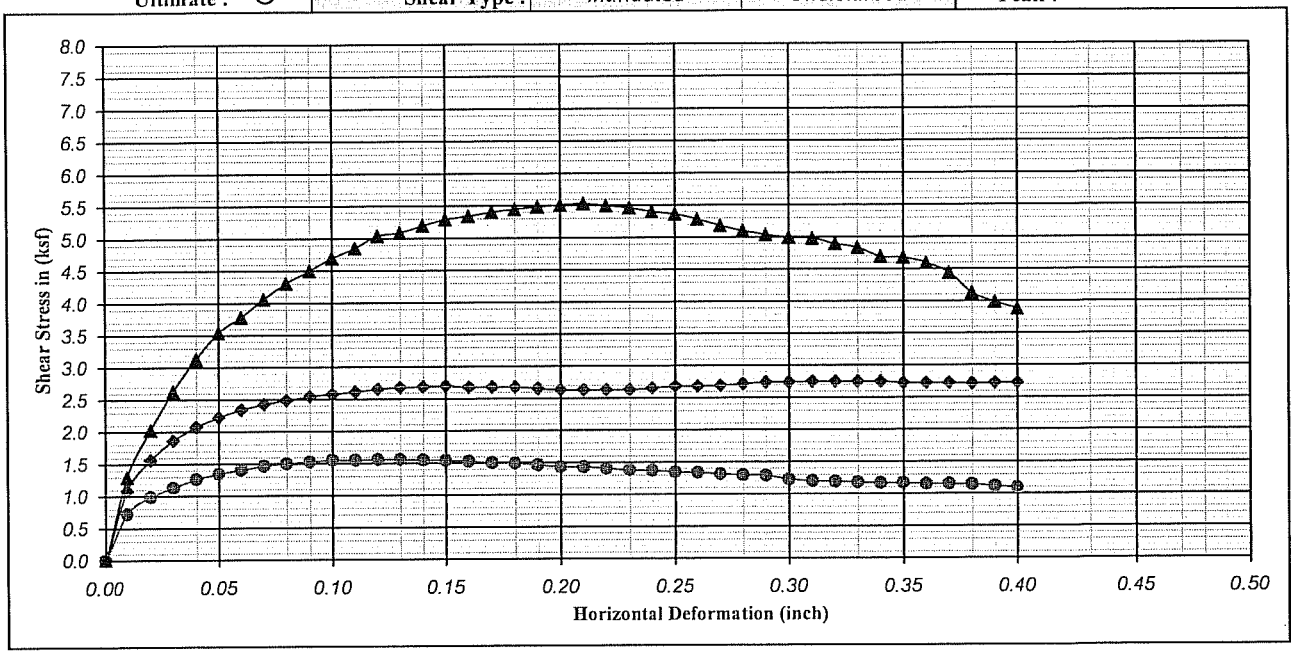
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | **Date :** 11/13/08 | Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No.	: A-08-007	Strength Intercept (C) :	0.17	(ksf)	Peak	0.47	(ksf)	Ultimate
Sample No.	: D-6		8.07	(kPa)		22.41	(kPa)	
Depth (ft/m)	: 25.0 / 0.00	Friction Angle (ϕ) :	41.63	Degree		30.53	Degree	
Description	: Mottled Brown, grayish brown and yellowish brown, CLAYEY SAND with GRAVEL (SC)				Shear Rate (inch/minute) :			0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	25.41	100.29	15.79	0.68	1.50	71.82	1.56	74.69	1.09	52.28
◆	20.12	106.34	16.74	0.59	3.00	143.64	2.75	131.57	2.63	125.83
▲	22.72	101.37	15.95	0.66	6.00	287.28	5.53	264.82	3.88	185.58

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Geotechnical and Earthquake Engineering

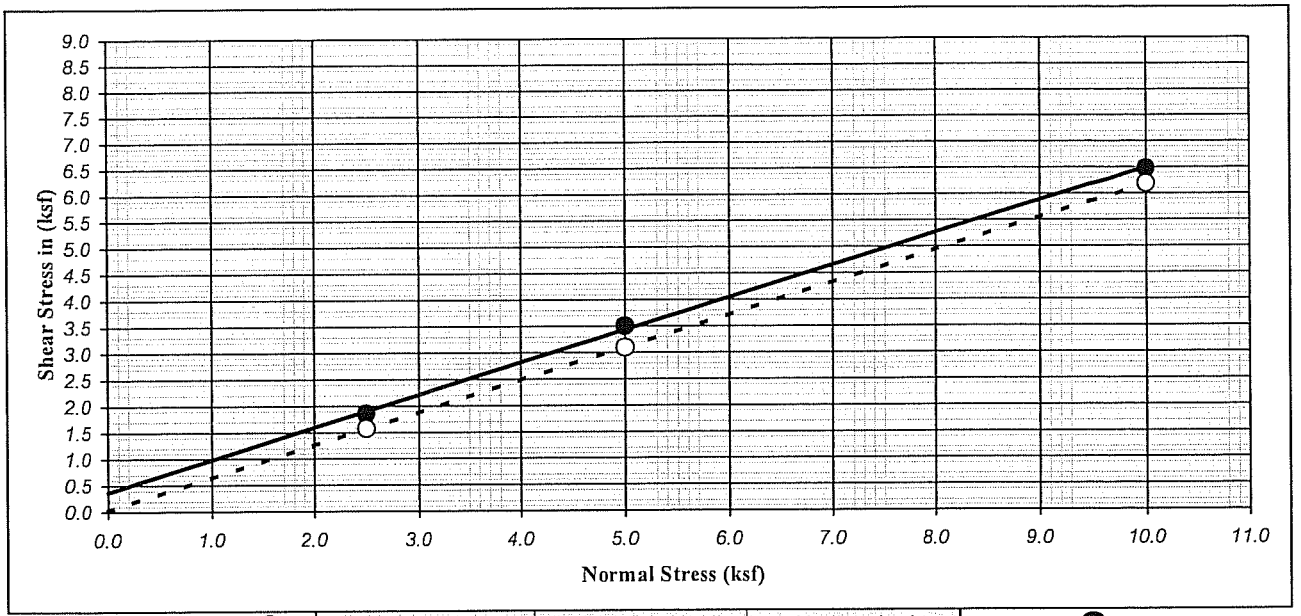
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

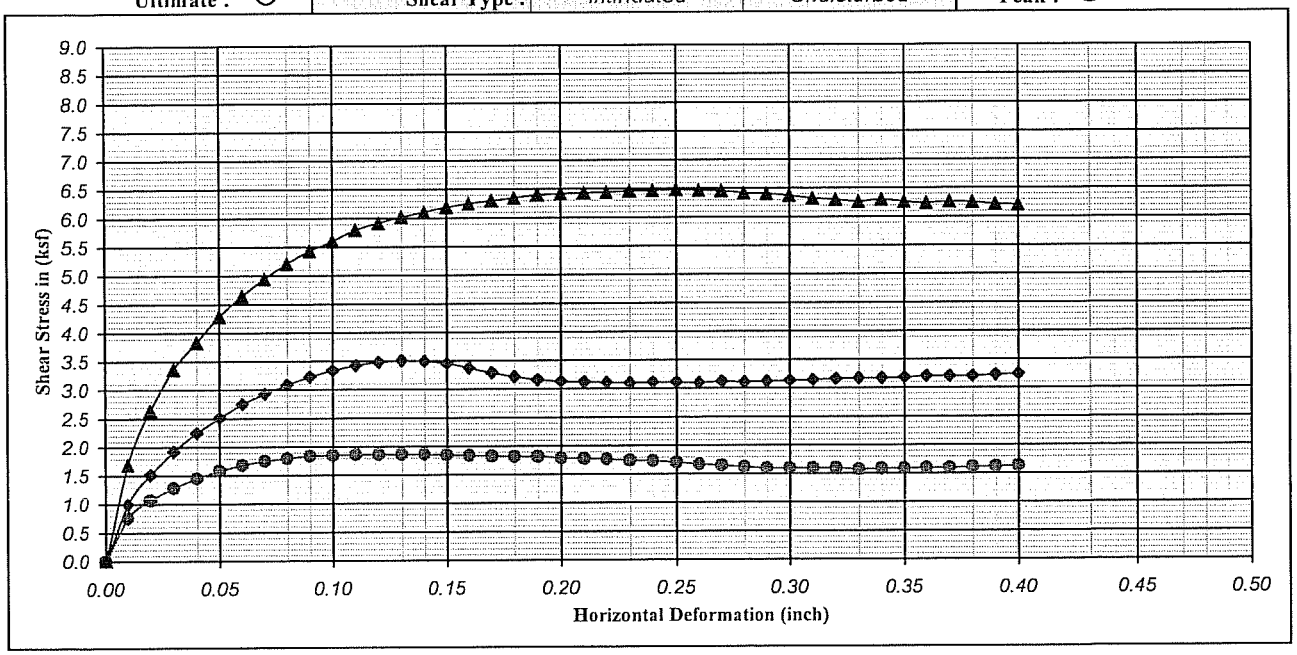
Project No. : 08-115

Date : 11/13/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No.	: A-08-007	Strength Intercept (C) :	0.37	(ksf)	Peak	0.02	(ksf)	Ultimate
Sample No.	: D-12		17.84	(kPa)		1.17	(kPa)	
Depth (ft/m)	: 55.0 0.00	Friction Angle (ϕ) :	31.50	Degree		31.65	Degree	
Description	: Brown, poorly graded SAND with SILT (SP-SM)					Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	24.90	80.29	12.64	1.10	2.50	119.70	1.86	89.06	1.57	75.27
◆	22.32	89.64	14.11	0.88	5.00	239.40	3.50	167.77	3.10	148.24
▲	24.44	81.19	12.78	1.08	10.00	478.80	6.48	310.21	6.19	296.43

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RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115

Date : 11/14/08

Figure No. :

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

ASTM D2850

Project Name:	RBF/SR-57 Northbound			**Project No:**	08-115
Boring No.:	A-08-007	**Tested by:**	R.J.	**Date:**	11/15/08
Depth (ft):	75	**Checked by:**		**Date:**	
Sample No.	D-16	**Sample Type:**	R		

Sample Description: Brown, LEAN CLAY With SAND (CL)

	1	2	3		
Diameter (in.):	2.412	2.411	2.412	Average:	2.412
Height (in.):	4.852	4.847	4.850	Average:	4.850

Moisture Content Calculation	
Wt. Wet Sample + Container (gms):	196.25
Wt. Dry Sample + Container (gms):	164.24
Container (gms) No. 37	59.06
Moisture Content (%)	**30.4**

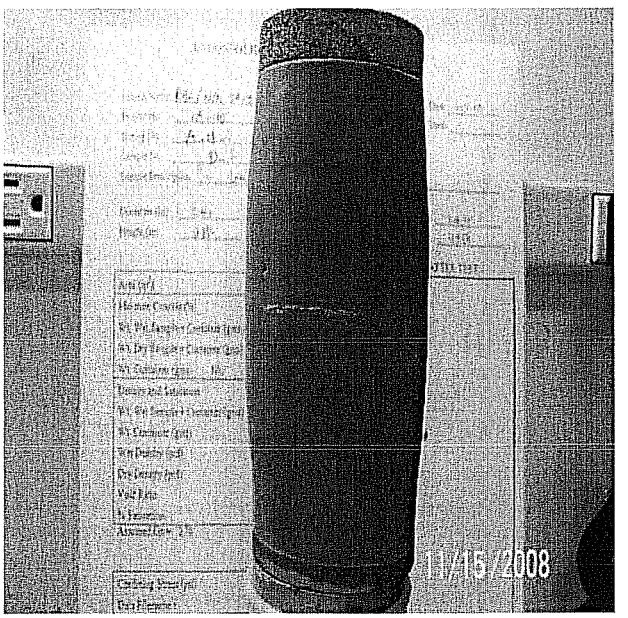
Density and Saturation	
Wt. Wet Sample + Container (gms)	956.9
Container (gms)	228.92
Wet Density (pcf)	**125.0**
Dry Density (pcf)	**95.9**
Void Ratio	**0.758**
% Saturation	**108.5**

Assume Gs=2.70

Test Data Filename:	08115A7D16.trx

SKETCH / PHOTO AFTER TEST:

PHOTO FILE NAME: Data\08-115 RBF SR-57 Northbound\UU\Photo\100_45



Shear	
Rate of Deformation (% strain / min) =	**1**
Confining Stress (ksf):	**6.05**

Failure Criterion: **criterion 1 is used**

1. the maximum deviator stress within 15% strain
2. the stress at 10% strain for no peak stress.

At Failure	
Deviator Stress (ksf)	**6.00**
Eff. Minor Principal Stress (ksf)=	**6.05**
Eff. Major Principal Stress (ksf)=	**12.05**
Axial Strain (%)=	**14.60**

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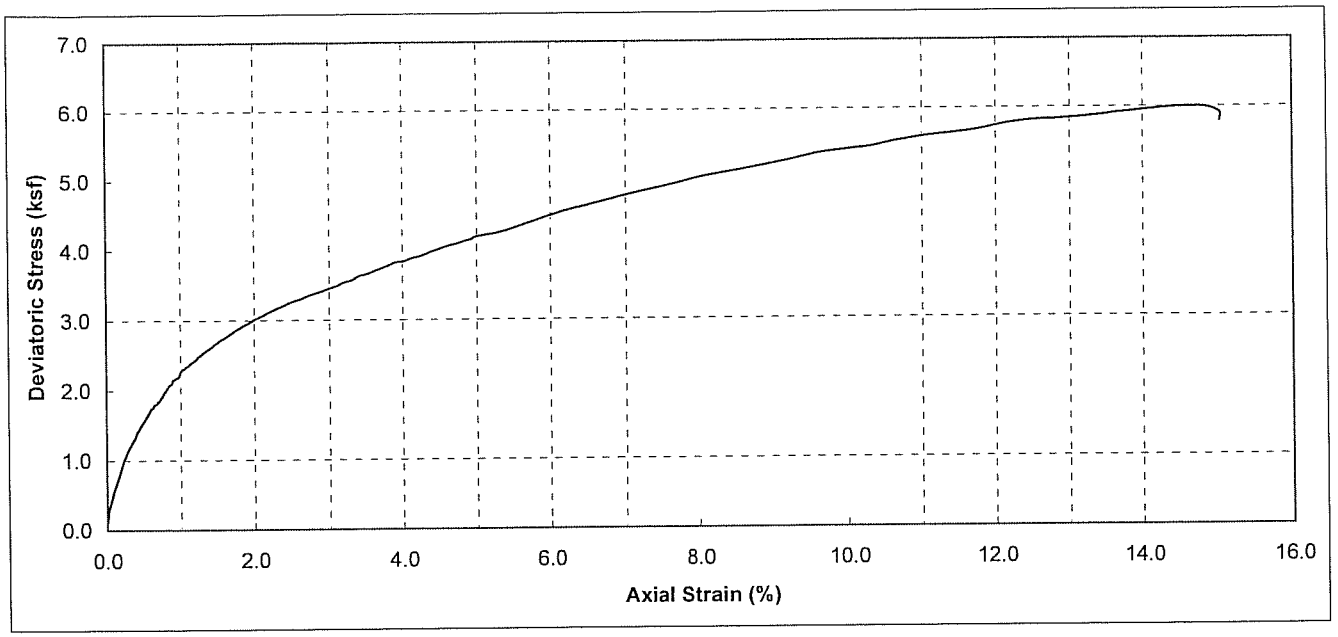
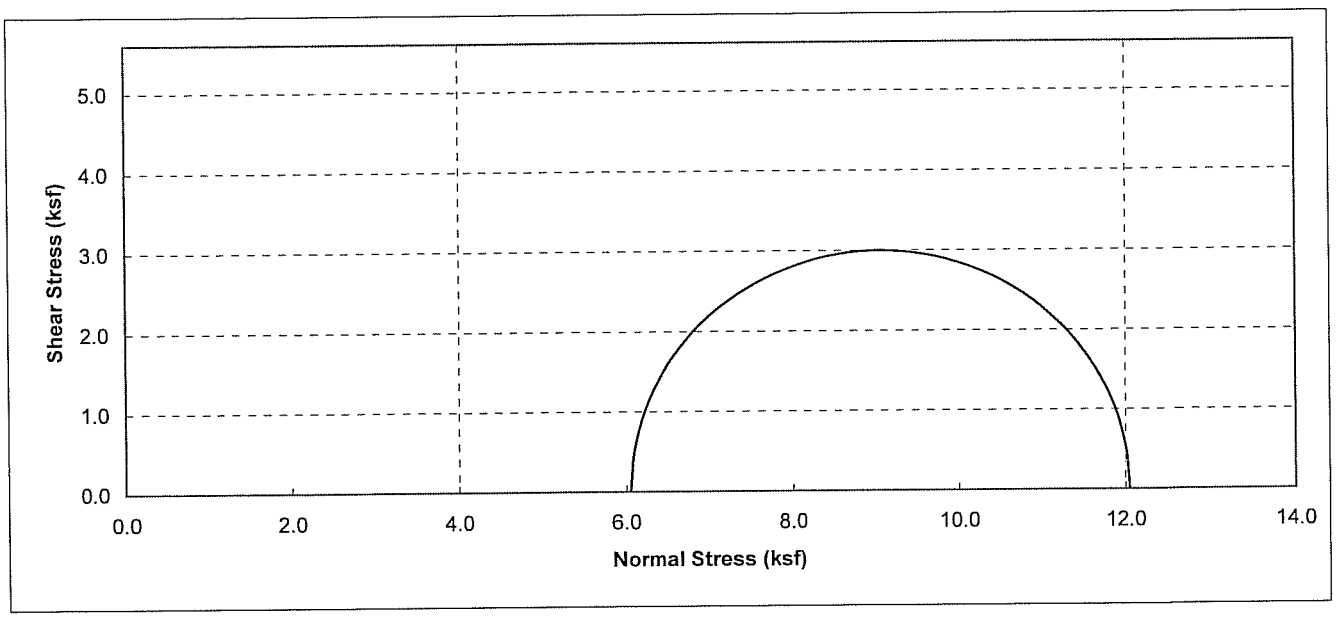
Geotechnical and Earthquake Engineering





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-007	D-16	75	Brown, LEAN CLAY With SAND (CL)	95.9	30.43	6.05	6.00	108.5

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115 **Date :** 11/15/08

Figure No. :

APPENDIX C

DESIGN CALCULATIONS

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project SR-57 NB Crowther Ave. UC Project No. _____

By _____ Date 12/30/08 Checked By _____ Date _____ Sheet ____ of ____

Pile Properties: 24" ϕ CIDH

$P = \pi D = \pi(2) = 6.283$ ft

$A = \frac{\pi D^2}{4} = \frac{\pi}{4}(2)^2 = 3.14$ ft^2 $= 452.16$ in^2

$I = \frac{\pi}{64}(24)^4 = 16,286$ in^4

$E_c = 57000\sqrt{f'_c} = 57000\sqrt{3250} = 3.25 * 10^6$ lb/in^2

$EI = 5.29 * 10^{10}$ lb-in^2

$\frac{1}{2} EI = 2.65 * 10^{10}$ lb-in^2

Axial Capacity

Both Abutments:

El.

238 — Fill $\gamma = 120$, $\phi = 33°$

226 — CL / SC

SPT ≈ 15 → c = 1.9 kips/ft^2

$\gamma = 125$ pcf

205 — SP-SM

SPT ≈ 25 → $\phi = 35°$

$\gamma = 117$ pcf

180 — SP-SM

SPT ≈ Ref → $\phi = 38°$

$\gamma = 122$ pcf

165 — CL

SPT ≈ 25 → c = 3 ksf, $\gamma = 120$

155 — SM / SC

SPT ≈ Ref. → $\phi = 40°$

$\gamma = 125$ pcf

NO G.W.T. Encountered.

Cut-off El. ≈ 221

24" CIDH

EL=221

EL=213

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project SR-57 NB Crowther UC (widen) Project No. 08-115

By AZ Date 5-18-09 Checked By _____ Date _____ Sheet ___ of ___

Axial Capacity of Abutment Piles

* Service Demand = 200 x 2 = 400 kips required nominal resistance

Pile Spacing = 6' (3D)

– axial group efficiency for CIDH pile:

in Sand	in clay
$\eta = 0.65 + \frac{0.5}{1.5} \times 0.35 = 0.77$	Compare Single Pile vs. Equiv. Pier

Equivalent Pier Perimeter:

No. of Piles = 7 (2 rows in longitudinal and 4 rows in transverse direction)

c.c in long. direction = 72" → Y = 1 x 72 = 72 in = 6 ft

c.c in trans. direction = 72" → B = 3 x 72 = 216 in = 18 ft

P = 2 x (1 x 72 + 3 x 72) = 576 in equivalent pier perimeter

Compare w/ single pile perimeter:

7 Single Piles	Eq. Pier
7 x π x 24 = 528 in	< 576 in

Use group reduction factor of $\eta = 1.0$ for clay layers.

Using SHAFT output, Pile length for compression is 40 feet.

Use a pile length of 42 feet. (Calculations shown on following page)

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
phone: (714)751-3826, Fax (714)751-3928

Project: **Crowther Avenue UC (WIDEN)** Project No. **08-115**

By AZ Date 5/18/2009 Check by _____ Date _____ Sheet _____

Drilled shaft axial capacity with group reduction factor (η)

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)	η	QS(group) (TONS)
1	0.12	3.28	0	3.28	3.28	1.64	28.22	1.00	3.28
2	0.23	6.57	0	6.57	6.57	3.28	28.22	1.00	6.57
3	0.35	9.85	0	9.85	9.85	4.93	28.22	1.00	9.85
4	0.47	13.13	0	13.13	13.13	6.57	28.22	1.00	13.13
5	0.58	16.42	0	16.42	16.42	8.21	28.22	1.00	16.42
6	0.7	19.7	0	19.7	19.7	9.85	28.22	1.00	19.70
7	0.81	22.98	0	22.98	22.98	11.49	28.22	1.00	22.98
8	0.93	26.27	0	26.27	26.27	13.13	28.22	1.00	26.27
9	1.05	29.55	0	29.55	29.55	14.78	28.22	1.00	29.55
10	1.16	32.83	0	32.83	32.83	16.42	28.22	1.00	32.83
11	1.28	36.12	0	36.12	36.12	18.06	28.22	1.00	36.12
12	1.4	39.4	0	39.4	39.4	19.7	28.22	1.00	39.40
13	1.51	42.68	0	42.68	42.68	21.34	28.22	1.00	42.68
14	1.63	45.97	0	45.97	45.97	22.98	28.22	1.00	45.97
15	1.75	49.25	0	49.25	49.25	24.63	28.22	1.00	49.25
16	1.86	52.53	0	52.53	52.53	26.27	28.22	1.00	52.53
17	1.98	58.81	0	58.81	58.81	29.4	29.73	0.77	57.37
18	2.09	65.32	0	65.32	65.32	32.66	31.18	0.77	62.38
19	2.21	72.05	0	72.05	72.05	36.03	32.59	0.77	67.56
20	2.33	79	0	79	79	39.5	33.94	0.77	72.91
21	2.44	86.16	0	86.16	86.16	43.08	35.26	0.77	78.43
22	2.56	93.52	0	93.52	93.52	46.76	36.53	0.77	84.09
23	2.68	101.07	0	101.07	101.07	50.53	37.76	0.77	89.91
24	2.79	108.81	0	108.81	108.81	54.4	38.96	0.77	95.87
25	2.91	116.72	0	116.72	116.72	58.36	40.12	0.77	101.96
26	3.03	124.8	0	124.8	124.8	62.4	41.25	0.77	108.18
27	3.14	133.05	0	133.05	133.05	66.53	42.35	0.77	114.53
28	3.26	141.45	0	141.45	141.45	70.73	43.41	0.77	121.00
29	3.37	150.01	0	150.01	150.01	75	44.45	0.77	127.59
30	3.49	158.7	0	158.7	158.7	79.35	45.46	0.77	134.28
31	3.61	167.53	0	167.53	167.53	83.76	46.44	0.77	141.08
32	3.72	176.49	0	176.49	176.49	88.24	47.39	0.77	147.98
33	3.84	185.57	0	185.57	185.57	92.78	48.32	0.77	154.97
34	3.96	194.76	0	194.76	194.76	97.38	49.22	0.77	162.05
35	4.07	204.07	0	204.07	204.07	102.03	50.1	0.77	169.22
36	4.19	213.48	0	213.48	213.48	106.74	50.96	0.77	176.46
37	4.31	222.98	0	222.98	222.98	111.49	51.79	0.77	183.78
38	4.42	232.58	0	232.58	232.58	116.29	52.6	0.77	191.17
39	4.54	242.26	0	242.26	242.26	121.13	53.38	0.77	198.62
40	4.65	252.03	0	252.03	252.03	126.01	54.14	0.77	206.14
41	4.77	261.86	0	261.86	261.86	130.93	54.88	0.77	213.71
42	4.89	271.77	0	271.77	271.77	135.89	55.61	0.77	221.34
43	5	281.76	0	281.76	281.76	140.88	56.31	0.77	229.04
44	5.12	291.81	0	291.81	291.81	145.9	56.99	0.77	236.78
45	5.24	301.92	0	301.92	301.92	150.96	57.65	0.77	244.56
46	5.35	312.08	0	312.08	312.08	156.04	58.3	0.77	252.38
47	5.47	322.29	0	322.29	322.29	161.15	58.93	0.77	260.25
48	5.59	332.54	0	332.54	332.54	166.27	59.53	0.77	268.14
49	5.7	342.83	0	342.83	342.83	171.42	60.12	0.77	276.06
50	5.82	353.16	0	353.16	353.16	176.58	60.7	0.77	284.02

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 5.0 (C) COPYRIGHT ENSOFT,INC. 1989,1995,1998,2001,2003

SR-57 NB Crowther Ave. UC - Abut 1&2 (24-in CIDH)

PROPOSED DEPTH = 50.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 60.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 2.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 2.00

SOIL INFORMATION

LAYER NO 1----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.600E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.190E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.190E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.160E+02

LAYER NO 2----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.960E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.350E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.117E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.160E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.636E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.350E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00

SOIL UNIT WEIGHT, LB/CU FT	= 0.117E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.410E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.636E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.122E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.410E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.490E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.380E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.122E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.560E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.300E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.560E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.300E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.660E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.403E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.400E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.660E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.400E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00

SOIL UNIT WEIGHT, LB/CU FT = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.100E+11
DEPTH, FT = 0.150E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 2.000 FT.
DIAMETER OF BASE = 2.000 FT.
END OF STEM TO BASE = 0.000 FT.
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 0.000 FT.
IGNORED BOTTOM PORTION = 0.000 FT.
AREA OF ONE PERCENT STEEL = 4.524 SQ.IN.
ELASTIC MODULUS, Ec = 0.325E+07 LB/SQ IN
VOLUME OF UNDERREAM = 0.000 CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY APPLIED TO THE ULTIMATE SIDE RESISTANCE AND THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
1.0	0.12	3.28	0.00	3.28	3.28	1.64	28.22
2.0	0.23	6.57	0.00	6.57	6.57	3.28	28.22
3.0	0.35	9.85	0.00	9.85	9.85	4.93	28.22
4.0	0.47	13.13	0.00	13.13	13.13	6.57	28.22
5.0	0.58	16.42	0.00	16.42	16.42	8.21	28.22
6.0	0.70	19.70	0.00	19.70	19.70	9.85	28.22
7.0	0.81	22.98	0.00	22.98	22.98	11.49	28.22
8.0	0.93	26.27	0.00	26.27	26.27	13.13	28.22
9.0	1.05	29.55	0.00	29.55	29.55	14.78	28.22
10.0	1.16	32.83	0.00	32.83	32.83	16.42	28.22
11.0	1.28	36.12	0.00	36.12	36.12	18.06	28.22
12.0	1.40	39.40	0.00	39.40	39.40	19.70	28.22
13.0	1.51	42.68	0.00	42.68	42.68	21.34	28.22
14.0	1.63	45.97	0.00	45.97	45.97	22.98	28.22
15.0	1.75	49.25	0.00	49.25	49.25	24.63	28.22
16.0	1.86	52.53	0.00	52.53	52.53	26.27	28.22
17.0	1.98	58.81	0.00	58.81	58.81	29.40	29.73
18.0	2.09	65.32	0.00	65.32	65.32	32.66	31.18
19.0	2.21	72.05	0.00	72.05	72.05	36.03	32.59
20.0	2.33	79.00	0.00	79.00	79.00	39.50	33.94
21.0	2.44	86.16	0.00	86.16	86.16	43.08	35.26
22.0	2.56	93.52	0.00	93.52	93.52	46.76	36.53
23.0	2.68	101.07	0.00	101.07	101.07	50.53	37.76
24.0	2.79	108.81	0.00	108.81	108.81	54.40	38.96
25.0	2.91	116.72	0.00	116.72	116.72	58.36	40.12
26.0	3.03	124.80	0.00	124.80	124.80	62.40	41.25
27.0	3.14	133.05	0.00	133.05	133.05	66.53	42.35
28.0	3.26	141.45	0.00	141.45	141.45	70.73	43.41
29.0	3.37	150.01	0.00	150.01	150.01	75.00	44.45
30.0	3.49	158.70	0.00	158.70	158.70	79.35	45.46
31.0	3.61	167.53	0.00	167.53	167.53	83.76	46.44
32.0	3.72	176.49	0.00	176.49	176.49	88.24	47.39
33.0	3.84	185.57	0.00	185.57	185.57	92.78	48.32
34.0	3.96	194.76	0.00	194.76	194.76	97.38	49.22
35.0	4.07	204.07	0.00	204.07	204.07	102.03	50.10
36.0	4.19	213.48	0.00	213.48	213.48	106.74	50.96

37.0	4.31	222.98	0.00	222.98	222.98	111.49	51.79
38.0	4.42	232.58	0.00	232.58	232.58	116.29	52.60
39.0	4.54	242.26	0.00	242.26	242.26	121.13	53.38
40.0	4.65	252.03	0.00	252.03	252.03	126.01	54.14
41.0	4.77	261.86	0.00	261.86	261.86	130.93	54.88
42.0	4.89	271.77	0.00	271.77	271.77	135.89	55.61
43.0	5.00	281.76	0.00	281.76	281.76	140.88	56.31
44.0	5.12	291.81	0.00	291.81	291.81	145.90	56.99
45.0	5.24	301.92	0.00	301.92	301.92	150.96	57.65
46.0	5.35	312.08	0.00	312.08	312.08	156.04	58.30
47.0	5.47	322.29	0.00	322.29	322.29	161.15	58.93
48.0	5.59	332.54	0.00	332.54	332.54	166.27	59.53
49.0	5.70	342.83	0.00	342.83	342.83	171.42	60.12
50.0	5.82	353.16	0.00	353.16	353.16	176.58	60.70

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.9352E+00	0.4440E-03	0.2291E-08	0.1000E-03
0.9352E+01	0.4440E-02	0.2291E-07	0.1000E-02
0.2359E+02	0.1113E-01	0.5728E-07	0.2500E-02
0.4750E+02	0.2237E-01	0.1146E-06	0.5000E-02
0.6985E+02	0.3355E-01	0.1718E-06	0.7500E-02
0.8900E+02	0.4429E-01	0.2291E-06	0.1000E-01
0.1770E+03	0.1008E+00	0.5728E-06	0.2500E-01
0.2476E+03	0.1655E+00	0.1146E-05	0.5000E-01
0.2813E+03	0.2101E+00	0.1718E-05	0.7500E-01
0.3016E+03	0.2469E+00	0.2291E-05	0.1000E+00
0.3309E+03	0.4164E+00	0.5603E-05	0.2500E+00
0.3267E+03	0.6656E+00	0.9040E-05	0.5000E+00
0.3264E+03	0.9154E+00	0.1176E-04	0.7500E+00
0.3260E+03	0.1165E+01	0.1418E-04	0.1000E+01
0.3240E+03	0.2564E+01	0.2294E-04	0.2400E+01

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Project SR-57 NB Crowther UC (widen) Project No. 08-115

By AZ Date 5-18-09 Checked By _____ Date _____ Sheet ___ of ___

Pile Group Settlement

Due to presence of a clay layer between El. +165 and El. +155 ft, the Pile Group settlement is evaluated using equivalent pier method.

Soil Profile according to AASHTO Table 10.7.2.3.1-1 is Type c.

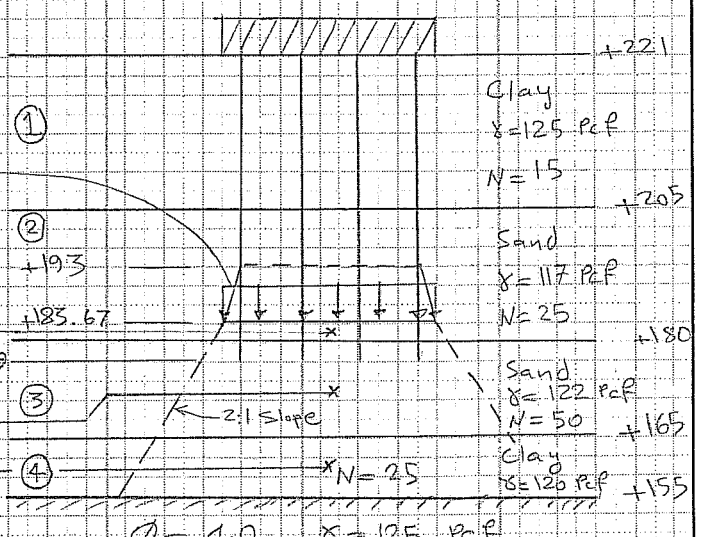
Equivalent pier is at depth $\frac{2}{3}D$ (D: pile length) $D_b = \frac{1}{3}D = \frac{42}{3} = 14$ ft.

D = 42' → Equivalent pier length = $B_1 = B + \frac{1}{2}\times\frac{2}{3}D_b = 18 + \frac{1}{2}\times 9.33 = 22.67$ ft

Equivalent pier width = $Y_1 = Y + \frac{1}{2}\times\frac{2}{3}D_b = 6 + \frac{1}{2}\times 9.33 = 10.67$ ft

Equivalent Pressure = $\frac{Q}{B_1 Y_1} = \frac{1090}{22.67\times 10.67} = 4.508$ ksf

Equivalent Pier EL. = 183.67 ft.



q = 4.51 ksf (22.67' × 10.67')

$\Delta\sigma = \frac{1090}{(22.67+1.84)(10.67+1.84)} = 3.56$ ksf

$\Delta\sigma = \frac{1090}{(22.67+11.17)(10.67+11.17)} = 1.47$ ksf

$\Delta\sigma = \frac{1090}{(22.67+23.67)(10.67+23.67)} = 0.69$ ksf

Point	Depth (ft)	Layer H (ft)	σ'_{vo} (ksf)	$\Delta\sigma$ (ksf)	σ'_{vf} (ksf)	c' *	Settlement (in)
2	181.83	3.67	3.71	3.56	7.27	65	0.198
3	172.5	15	4.84	1.47	6.32	85	0.245
4	160	10	6.36	0.69	7.04	20	0.268

Layer settlement = $S = H \cdot \frac{1}{C'} \cdot \log\frac{\sigma'_{vf}}{\sigma'_{o}}$ $S_{total} = 0.71$ in

* See Fill settlement calcs for reference on c' values.

Immediate Settlement of clay is evaluated on the following page.

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Project SR-57 NB Crowther Ave. UC (Widen) Project No. 08-115

By AZ Date 05-18-09 Checked By _____ Date _____ Sheet ____ of ____

Pile Group Immediate Settlement

$$S_{vd} = C_s q B \left(\frac{1-\nu^2}{E_u}\right)$$

Eq. pier dimensions on clay layer @EL. +165: $L = 22.67 + 18.67 = 41.34'$

$B = 10.67 + 18.67 = 29.34'$

$\frac{L}{B} = \frac{41.34}{29.34} = 1.41$ $\quad q = \frac{1400}{41.34 \times 29.34} = 1.15$ ksf

$\frac{D}{B} = \frac{10}{29.34} = 0.34$ Conservatively assume $\frac{D}{B} = 1.0 \rightarrow C_s \approx 0.14$

Reference: Table 10.5, Essentials of Soil Mechanics and Foundations, 5th ed. D.F. McCarthy

C_s was estimated by linear interpolation.

$\nu = 0.5$ for saturated clay

$E_u = 500\, C_u \sim 1500\, C_u$ (Same reference)

Assume $E_u = 1000\, C_u = 1000 \times 3000 = 3{,}000{,}000$ PSF

Immediate settlement of clay:

$S_{vd} = 0.14 \times 1150 \times 29.34 \times \left(\frac{1-0.5^2}{3{,}000{,}000}\right) = 1.184 \times 10^{-3}$ ft $= 0.014$ in

Immediate settlement of clay layer is negligible in comparison to consolidation settlement.

Using similar procedure, the pile length corresponding to an allowable settlement of 1" was estimated to be 29 ft.

$D = 29$ ft $\rightarrow$ $B_1 = 21.22'$ $\quad Y_1 = 9.22'$ $\quad q = 5.57$ ksf

$S = 0.985$ in

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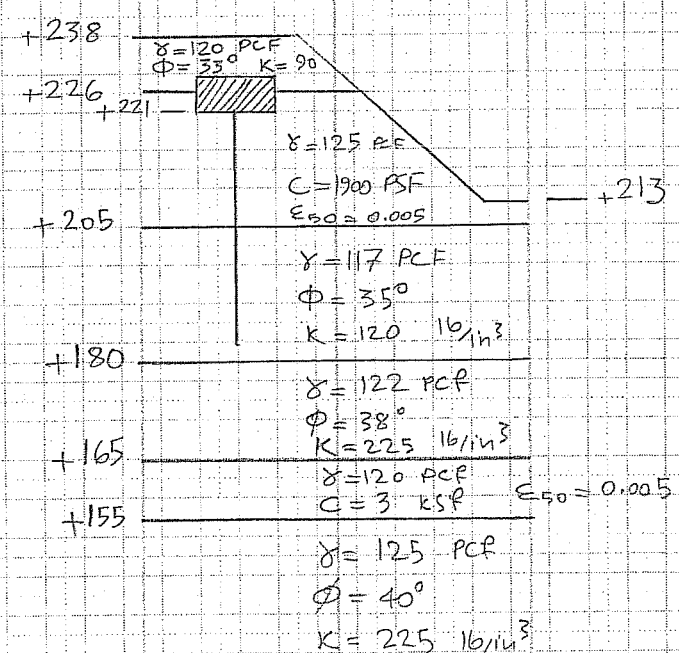
Project Crowther Ave. UC (Widen) Project No. 08-115

By AZ Date 12-29-08 Checked By _____ Date _____ Sheet 2 of ____

Lateral Pile Solutions

Abutments:



Group Efficiency Factor GEF = 0.77

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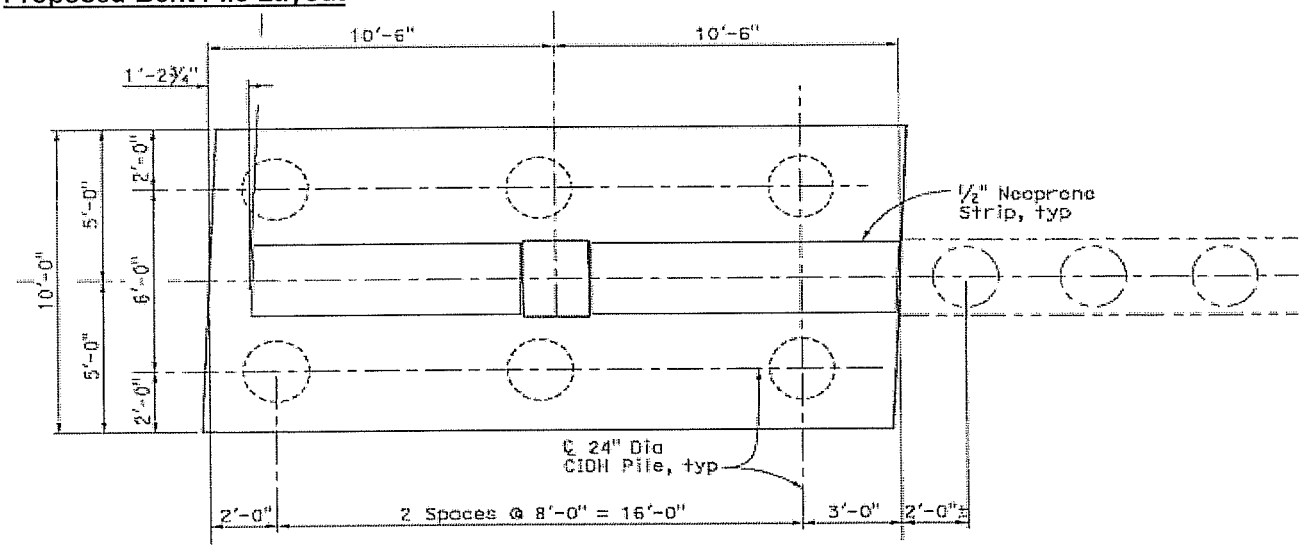
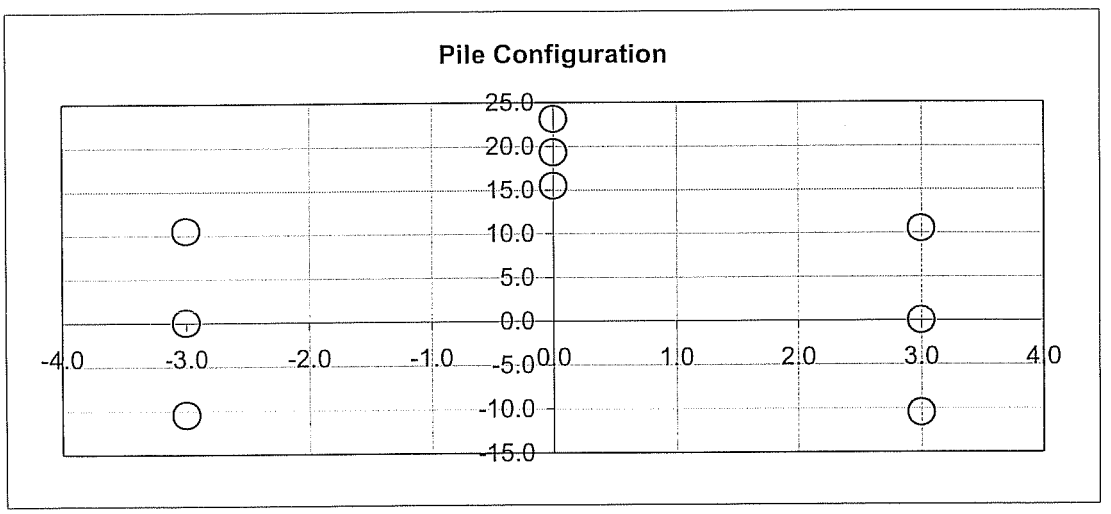
By AZ Date 12/28/08 Check by Date Sheet

Proposed Bent Pile Layout



Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia. (feet): 2
No. of Piles: 9

Group Efficiency	X-Dir	Y-Dir
	0.795	0.745

Pile No.	X	Y
1	-3.000	-10.50
2	3.000	-10.50
3	-3.000	0.00
4	3.000	0.00
5	-3.000	10.50
6	3.000	10.50
7	0.000	15.50
8	0.000	19.30
9	0.000	23.10

Reduction Factors in X-dir	Reduction Factors in Y-dir
0.720	0.807
0.931	0.807
0.712	0.807
0.931	0.807
0.619	0.620
0.859	0.620
0.640	0.417
0.625	0.507
0.795	0.819

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Project: **Crowther Avenue UC (WIDEN)** Project No. **08-115**
By AZ Date 12/28/08 Check by Date Sheet

Fx1 = 0.72 = 0.729 (lbl-21) x 1 (sbs-31) x 0.988 (skew-41) x 1 (sbs-51) x 1 (skew-61) x 1 (skew-71) x 1 (skew-81) x 1 (skew-91)

skew-41 = 0.988 = SQRT((0.951*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-61 = 1 = SQRT((1*Cos(1.292))^2 + 1*Sin(1.292))^2)
skew-71 = 1 = SQRT((1*Cos(1.456))^2 + 1*Sin(1.456))^2)
skew-81 = 1 = SQRT((1*Cos(1.47))^2 + 1*Sin(1.47))^2)
skew-91 = 1 = SQRT((1*Cos(1.482))^2 + 1*Sin(1.482))^2)

Fx2 = 0.931 = 0.931 (lbl-12) x 1 (skew-32) x 1 (sbs-42) x 1 (skew-52) x 1 (sbs-62) x 1 (skew-72) x 1 (skew-82) x 1 (skew-92)

skew-32 = 1 = SQRT((1*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-52 = 1 = SQRT((1*Cos(1.292))^2 + 1*Sin(1.292))^2)
skew-72 = 1 = SQRT((1*Cos(1.456))^2 + 1*Sin(1.456))^2)
skew-82 = 1 = SQRT((1*Cos(1.47))^2 + 1*Sin(1.47))^2)
skew-92 = 1 = SQRT((1*Cos(1.482))^2 + 1*Sin(1.482))^2)

Fx3 = 0.712 = 1 (sbs-13) x 0.988 (skew-23) x 0.729 (lbl-43) x 1 (sbs-53) x 0.988 (skew-63) x 1 (skew-73) x 1 (skew-83) x 1 (skew-93)

skew-23 = 0.988 = SQRT((0.951*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-63 = 0.988 = SQRT((0.951*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-73 = 1 = SQRT((1*Cos(1.38))^2 + 1*Sin(1.38))^2)
skew-83 = 1 = SQRT((1*Cos(1.417))^2 + 1*Sin(1.417))^2)
skew-93 = 1 = SQRT((1*Cos(1.442))^2 + 1*Sin(1.442))^2)

Fx4 = 0.931 = 1 (skew-14) x 1 (sbs-24) x 0.931 (lbl-34) x 1 (skew-54) x 1 (sbs-64) x 1 (skew-74) x 1 (skew-84) x 1 (skew-94)

skew-14 = 1 = SQRT((1*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-54 = 1 = SQRT((1*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-74 = 1 = SQRT((1*Cos(1.38))^2 + 1*Sin(1.38))^2)
skew-84 = 1 = SQRT((1*Cos(1.417))^2 + 1*Sin(1.417))^2)
skew-94 = 1 = SQRT((1*Cos(1.442))^2 + 1*Sin(1.442))^2)

Fx5 = 0.619 = 1 (sbs-15) x 1 (skew-25) x 1 (sbs-35) x 0.988 (skew-45) x 0.729 (lbl-65) x 0.872 (skew-75) x 0.986 (skew-85) x 0.999 (skew-95)

skew-25 = 1 = SQRT((1*Cos(1.292))^2 + 1*Sin(1.292))^2)
skew-45 = 0.988 = SQRT((0.951*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-75 = 0.872 = SQRT((0.721*Cos(1.03))^2 + 0.921*Sin(1.03))^2)
skew-85 = 0.986 = SQRT((0.861*Cos(1.242))^2 + 1*Sin(1.242))^2)
skew-95 = 0.999 = SQRT((0.976*Cos(1.337))^2 + 1*Sin(1.337))^2)

Fx6 = 0.859 = 1 (skew-16) x 1 (sbs-26) x 1 (skew-36) x 1 (sbs-46) x 0.931 (lbl-56) x 0.922 (skew-76) x 1 (skew-86) x 1 (skew-96)

skew-16 = 1 = SQRT((1*Cos(1.292))^2 + 1*Sin(1.292))^2)
skew-36 = 1 = SQRT((1*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-76 = 0.922 = SQRT((0.925*Cos(1.03))^2 + 0.921*Sin(1.03))^2)
skew-86 = 1 = SQRT((1*Cos(1.242))^2 + 1*Sin(1.242))^2)
skew-96 = 1 = SQRT((1*Cos(1.337))^2 + 1*Sin(1.337))^2)

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Project: **Crowther Avenue UC (WIDEN)** Project No. **08-115**
By AZ Date 12/28/08 Check by Date Sheet

Fx7 = 0.64 = 1 (skew-17) x 1 (skew-27) x 1 (skew-37) x 1 (skew-47) x 0.922 (skew-57) x 0.872 (skew-67) x 0.796 (sbs-87) x 1 (sbs-97)

skew-17 = 1 = SQRT((1*Cos(1.456))^2 + 1*Sin(1.456))^2)
skew-27 = 1 = SQRT((1*Cos(1.456))^2 + 1*Sin(1.456))^2)
skew-37 = 1 = SQRT((1*Cos(1.38))^2 + 1*Sin(1.38))^2)
skew-47 = 1 = SQRT((1*Cos(1.38))^2 + 1*Sin(1.38))^2)
skew-57 = 0.922 = SQRT((0.925*Cos(1.03))^2 + 0.921*Sin(1.03))^2)
skew-67 = 0.872 = SQRT((0.721*Cos(1.03))^2 + 0.921*Sin(1.03))^2)

Fx8 = 0.625 = 1 (skew-18) x 1 (skew-28) x 1 (skew-38) x 1 (skew-48) x 1 (skew-58) x 0.986 (skew-68) x 0.796 (sbs-78) x 0.796 (sbs-98)

skew-18 = 1 = SQRT((1*Cos(1.47))^2 + 1*Sin(1.47))^2)
skew-28 = 1 = SQRT((1*Cos(1.47))^2 + 1*Sin(1.47))^2)
skew-38 = 1 = SQRT((1*Cos(1.417))^2 + 1*Sin(1.417))^2)
skew-48 = 1 = SQRT((1*Cos(1.417))^2 + 1*Sin(1.417))^2)
skew-58 = 1 = SQRT((1*Cos(1.242))^2 + 1*Sin(1.242))^2)
skew-68 = 0.986 = SQRT((0.861*Cos(1.242))^2 + 1*Sin(1.242))^2)

Fx9 = 0.795 = 1 (skew-19) x 1 (skew-29) x 1 (skew-39) x 1 (skew-49) x 1 (skew-59) x 0.999 (skew-69) x 1 (sbs-79) x 0.796 (sbs-89)

skew-19 = 1 = SQRT((1*Cos(1.482))^2 + 1*Sin(1.482))^2)
skew-29 = 1 = SQRT((1*Cos(1.482))^2 + 1*Sin(1.482))^2)
skew-39 = 1 = SQRT((1*Cos(1.442))^2 + 1*Sin(1.442))^2)
skew-49 = 1 = SQRT((1*Cos(1.442))^2 + 1*Sin(1.442))^2)
skew-59 = 1 = SQRT((1*Cos(1.337))^2 + 1*Sin(1.337))^2)
skew-69 = 0.999 = SQRT((0.976*Cos(1.337))^2 + 1*Sin(1.337))^2)

Fy1 = 0.72 = 0.93 (sbs-21) x 0.901 (lbl-31) x 0.963 (skew-41) x 1 (lbl-51) x 1 (skew-61) x 1 (skew-71) x 1 (skew-81) x 1 (skew-91)

skew-41 = 0.963 = SQRT((0.951*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-61 = 1 = SQRT((1*Cos(0.278))^2 + 1*Sin(0.278))^2)
skew-71 = 1 = SQRT((1*Cos(0.115))^2 + 1*Sin(0.115))^2)
skew-81 = 1 = SQRT((1*Cos(0.1))^2 + 1*Sin(0.1))^2)
skew-91 = 1 = SQRT((1*Cos(0.089))^2 + 1*Sin(0.089))^2)

Fy2 = 0.931 = 0.93 (sbs-12) x 0.963 (skew-32) x 0.901 (lbl-42) x 1 (skew-52) x 1 (lbl-62) x 1 (skew-72) x 1 (skew-82) x 1 (skew-92)

skew-32 = 0.963 = SQRT((0.951*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-52 = 1 = SQRT((1*Cos(0.278))^2 + 1*Sin(0.278))^2)
skew-72 = 1 = SQRT((1*Cos(0.115))^2 + 1*Sin(0.115))^2)
skew-82 = 1 = SQRT((1*Cos(0.1))^2 + 1*Sin(0.1))^2)
skew-92 = 1 = SQRT((1*Cos(0.089))^2 + 1*Sin(0.089))^2)

Fy3 = 0.712 = 1 (lbl-13) x 1 (skew-23) x 0.93 (sbs-43) x 0.901 (lbl-53) x 0.963 (skew-63) x 1 (skew-73) x 1 (skew-83) x 1 (skew-93)

skew-23 = 1 = SQRT((1*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-63 = 0.963 = SQRT((0.951*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-73 = 1 = SQRT((1*Cos(0.191))^2 + 1*Sin(0.191))^2)
skew-83 = 1 = SQRT((1*Cos(0.154))^2 + 1*Sin(0.154))^2)

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Project: **Crowther Avenue UC (WIDEN)** Project No. **08-115**
By AZ Date 12/28/08 Check by Date Sheet _____

skew-93 = 1 = SQRT((1*Cos(0.129))^2 + 1*Sin(0.129))^2)

Fy4 = 0.931 = 1 (skew-14) x 1 (lbl-24) x 0.93 (sbs-34) x 0.963 (skew-54) x 0.901 (lbl-64) x 1 (skew-74) x 1 (skew-84) x 1 (skew-94)
skew-14 = 1 = SQRT((1*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-54 = 0.963 = SQRT((0.951*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-74 = 1 = SQRT((1*Cos(0.191))^2 + 1*Sin(0.191))^2)
skew-84 = 1 = SQRT((1*Cos(0.154))^2 + 1*Sin(0.154))^2)
skew-94 = 1 = SQRT((1*Cos(0.129))^2 + 1*Sin(0.129))^2)

Fy5 = 0.619 = 1 (lbl-15) x 1 (skew-25) x 1 (lbl-35) x 1 (skew-45) x 0.93 (sbs-65) x 0.779 (skew-75) x 0.876 (skew-85) x 0.977 (skew-95)
skew-25 = 1 = SQRT((1*Cos(0.278))^2 + 1*Sin(0.278))^2)
skew-45 = 1 = SQRT((1*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-75 = 0.779 = SQRT((0.721*Cos(0.54))^2 + 0.921*Sin(0.54))^2)
skew-85 = 0.876 = SQRT((0.861*Cos(0.329))^2 + 1*Sin(0.329))^2)
skew-95 = 0.977 = SQRT((0.976*Cos(0.234))^2 + 1*Sin(0.234))^2)

Fy6 = 0.859 = 1 (skew-16) x 1 (lbl-26) x 1 (skew-36) x 1 (lbl-46) x 0.93 (sbs-56) x 0.779 (skew-76) x 0.876 (skew-86) x 0.977 (skew-96)
skew-16 = 1 = SQRT((1*Cos(0.278))^2 + 1*Sin(0.278))^2)
skew-36 = 1 = SQRT((1*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-76 = 0.779 = SQRT((0.721*Cos(0.54))^2 + 0.921*Sin(0.54))^2)
skew-86 = 0.876 = SQRT((0.861*Cos(0.329))^2 + 1*Sin(0.329))^2)
skew-96 = 0.977 = SQRT((0.976*Cos(0.234))^2 + 1*Sin(0.234))^2)

Fy7 = 0.64 = 1 (skew-17) x 1 (skew-27) x 1 (skew-37) x 1 (skew-47) x 0.924 (skew-57) x 0.924 (skew-67) x 0.613 (lbl-87) x 0.797 (lbl-97)
skew-17 = 1 = SQRT((1*Cos(0.115))^2 + 1*Sin(0.115))^2)
skew-27 = 1 = SQRT((1*Cos(0.115))^2 + 1*Sin(0.115))^2)
skew-37 = 1 = SQRT((1*Cos(0.191))^2 + 1*Sin(0.191))^2)
skew-47 = 1 = SQRT((1*Cos(0.191))^2 + 1*Sin(0.191))^2)
skew-57 = 0.924 = SQRT((0.925*Cos(0.54))^2 + 0.921*Sin(0.54))^2)
skew-67 = 0.924 = SQRT((0.925*Cos(0.54))^2 + 0.921*Sin(0.54))^2)

Fy8 = 0.625 = 1 (skew-18) x 1 (skew-28) x 1 (skew-38) x 1 (skew-48) x 1 (skew-58) x 1 (skew-68) x 0.827 (lbl-78) x 0.613 (lbl-98)
skew-18 = 1 = SQRT((1*Cos(0.1))^2 + 1*Sin(0.1))^2)
skew-28 = 1 = SQRT((1*Cos(0.1))^2 + 1*Sin(0.1))^2)
skew-38 = 1 = SQRT((1*Cos(0.154))^2 + 1*Sin(0.154))^2)
skew-48 = 1 = SQRT((1*Cos(0.154))^2 + 1*Sin(0.154))^2)
skew-58 = 1 = SQRT((1*Cos(0.329))^2 + 1*Sin(0.329))^2)
skew-68 = 1 = SQRT((1*Cos(0.329))^2 + 1*Sin(0.329))^2)

Fy9 = 0.795 = 1 (skew-19) x 1 (skew-29) x 1 (skew-39) x 1 (skew-49) x 1 (skew-59) x 1 (skew-69) x 0.99 (lbl-79) x 0.827 (lbl-89)
skew-19 = 1 = SQRT((1*Cos(0.089))^2 + 1*Sin(0.089))^2)
skew-29 = 1 = SQRT((1*Cos(0.089))^2 + 1*Sin(0.089))^2)
skew-39 = 1 = SQRT((1*Cos(0.129))^2 + 1*Sin(0.129))^2)

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Project: **Crowther Avenue UC (WIDEN)** Project No. **08-115**
By AZ Date 12/28/08 Check by Date Sheet

skew-49 = 1 = SQRT((1*Cos(0.129))^2 + 1*Sin(0.129))^2)
skew-59 = 1 = SQRT((1*Cos(0.234))^2 + 1*Sin(0.234))^2)
skew-69 = 1 = SQRT((1*Cos(0.234))^2 + 1*Sin(0.234))^2)

where
lbl: line-by-line effect
sbs: side-by-side effect
skew: skew effect

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.31)

              Analysis of Individual Piles and Drilled Shafts
            Subjected to Lateral Loading Using the p-y Method

                        (c) 1985-2007 by Ensoft, Inc.
                             All Rights Reserved

================================================================================

This program is licensed to:

AZ
Earth Mechanics, Inc.

Path to file locations:      C:\Amir Files\Projects\Lino\SR-57\Crowther\LPile\
Name of input data file:     Crowther Ave.lpd
Name of output file:         Crowther Ave.lpo
Name of plot output file:    Crowther Ave.lpp
Name of runtime file:        Crowther Ave.lpr

--------------------------------------------------------------------------------
                           Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  January 12, 2009     Time:  10:11:34

--------------------------------------------------------------------------------
                                  Problem Title
--------------------------------------------------------------------------------

SR-57 NB Crowther Ave. UC Abut 1&2 (24-in CIDH)

--------------------------------------------------------------------------------
                                  Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments            =          100
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1

--------------------------------------------------------------------------------
                     Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                                  =     456.00 in
Depth of ground surface below top of pile =        .00 in
Slope angle of ground surface                =        .00 deg.

Structural properties of pile defined using  2 points

Point    Depth        Pile       Moment of       Pile      Modulus of
           X        Diameter      Inertia        Area      Elasticity
           in          in          in**4        Sq.in      lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   24.00000000    8143.0000     452.0000      3250000.
  2     456.0000   24.00000000    8143.0000     452.0000      3250000.
```

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = .000 in
Distance from top of pile to bottom of layer = 192.000 in

Layer 2 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 192.000 in
Distance from top of pile to bottom of layer = 492.000 in
p-y subgrade modulus k for top of soil layer = 120.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 120.000 lbs/in**3

Layer 3 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 492.000 in
Distance from top of pile to bottom of layer = 672.000 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

Layer 4 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 672.000 in
Distance from top of pile to bottom of layer = 792.000 in

Layer 5 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 792.000 in
Distance from top of pile to bottom of layer = 1500.000 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

(Depth of lowest layer extends 1044.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 10 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	.00	.07230
2	192.00	.07230
3	192.00	.06770
4	492.00	.06770
5	492.00	.07060
6	672.00	.07060
7	672.00	.06940
8	792.00	.06940
9	792.00	.07230
10	1500.00	.07230

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 10 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	13.20000	.00	.00500	.0
2	192.000	13.20000	.00	.00500	.0
3	192.000	.00000	35.00	------	------
4	492.000	.00000	35.00	------	------
5	492.000	.00000	38.00	------	------
6	672.000	.00000	38.00	------	------
7	672.000	20.83000	.00	.00500	.0
8	792.000	20.83000	.00	.00500	.0
9	792.000	.00000	40.00	------	------
10	1500.000	.00000	40.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	.000	.7700	1.0000
2	465.000	.7700	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves

****
*
* NOTE: PAGES REMOVED TO REDUCE OUTPUT SIZE *
*
****

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .250000	M= 0.000	173000.	.2500000	884849.	24767.7258
4	y= .500000	M= 0.000	173000.	.5000000	1427917.	35452.0891
4	y= 1.000000	M= 0.000	173000.	1.0000000	2320163.	50905.4996
4	y= 3.000	M= 0.000	173000.	3.0000	5046274.	89979.7192
4	y= 5.000	M= 0.000	173000.	5.0000	7207520.	111617.

The analysis ended normally.

Summary of Warning Messages

**** WARNING ****

An unreasonable input value for shear strength has been specified for layer

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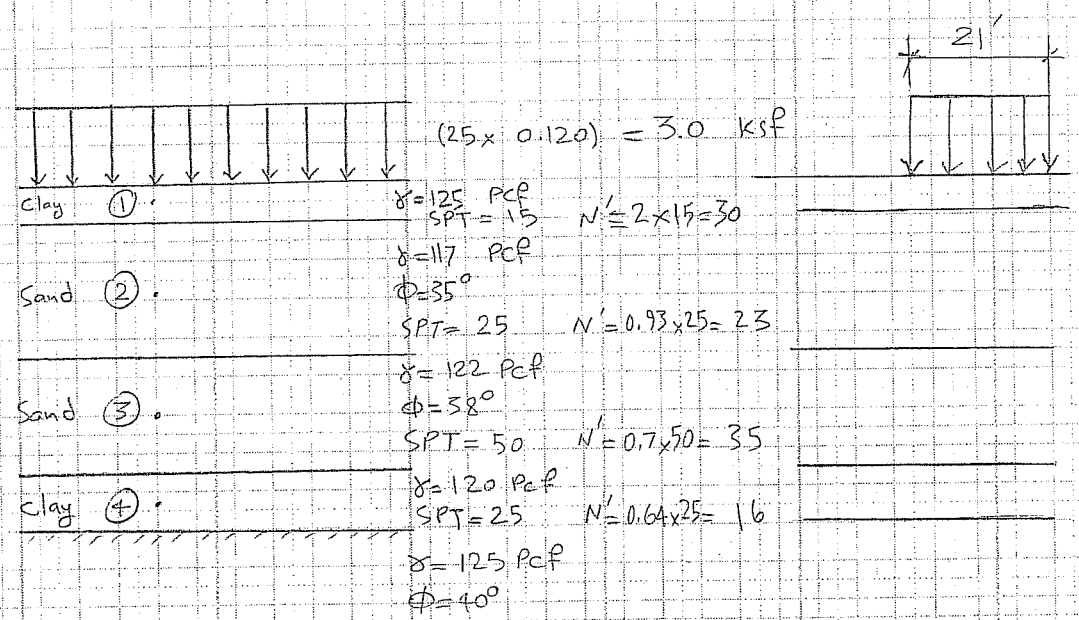
Project Crowther Ave. UC (widen) Project No. 08-115

By AZ Date 1-5-09 Checked By _____ Date _____ Sheet ____ of ____

Settlement

Loading: 25' of sliver fill



Stress distribution was calculated from elastic solution.

Point	Depth (ft)	σ_{v_o} (ksf)	$\Delta\sigma$ (ksf)	σ_{vf} (ksf)	c'*	Settlement (in)
1	4.0	0.50	2.95	3.45	45	1.8
2	19.0	2.46	1.78	4.24	65	1.1
3	39	4.84	0.99	5.83	85	0.2
4	51.5	6.36	0.76	7.12	20	0.3

$S_{total} = 3.3$ in.

layer settlement: $S = H \frac{1}{C'} \log \frac{\sigma_{vf}}{\sigma_{v_o}}$

* Note: Bearing capacity index (C') for clay layers was estimated from consolidation tests in nearby borings.
For sand layers FHWA (1982) Figure 13 was used.

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By AZ Date 1-5-08 Checked By _____ Date _____ Sheet ____ of ____

Abutment Lateral Earth Pressures

$\phi = 32^\circ$ (Compacted Fill)

$K_a = \tan^2(45^\circ - \frac{\phi}{2}) = 0.30$

$K_a\gamma = (0.30)(120) = 36$ pcf

$K_o = 1 - \sin\phi = 1 - \sin 32^\circ = 0.47$

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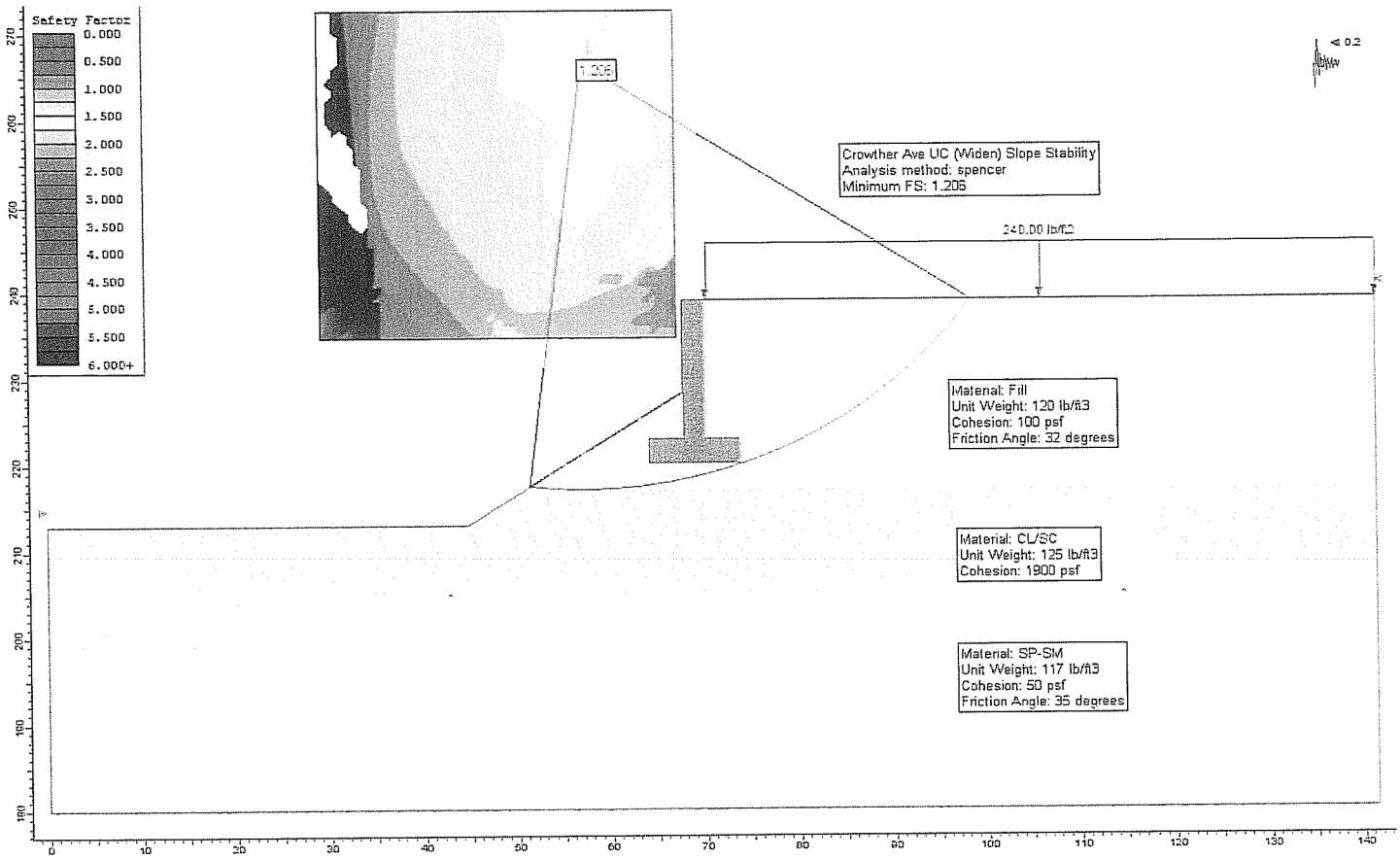
Project: **Crowther Avenue UC (WIDEN)** Project No. **08-115**

By AZ Date 01/08/09 Check by Date Sheet

Seismic Slope Stability



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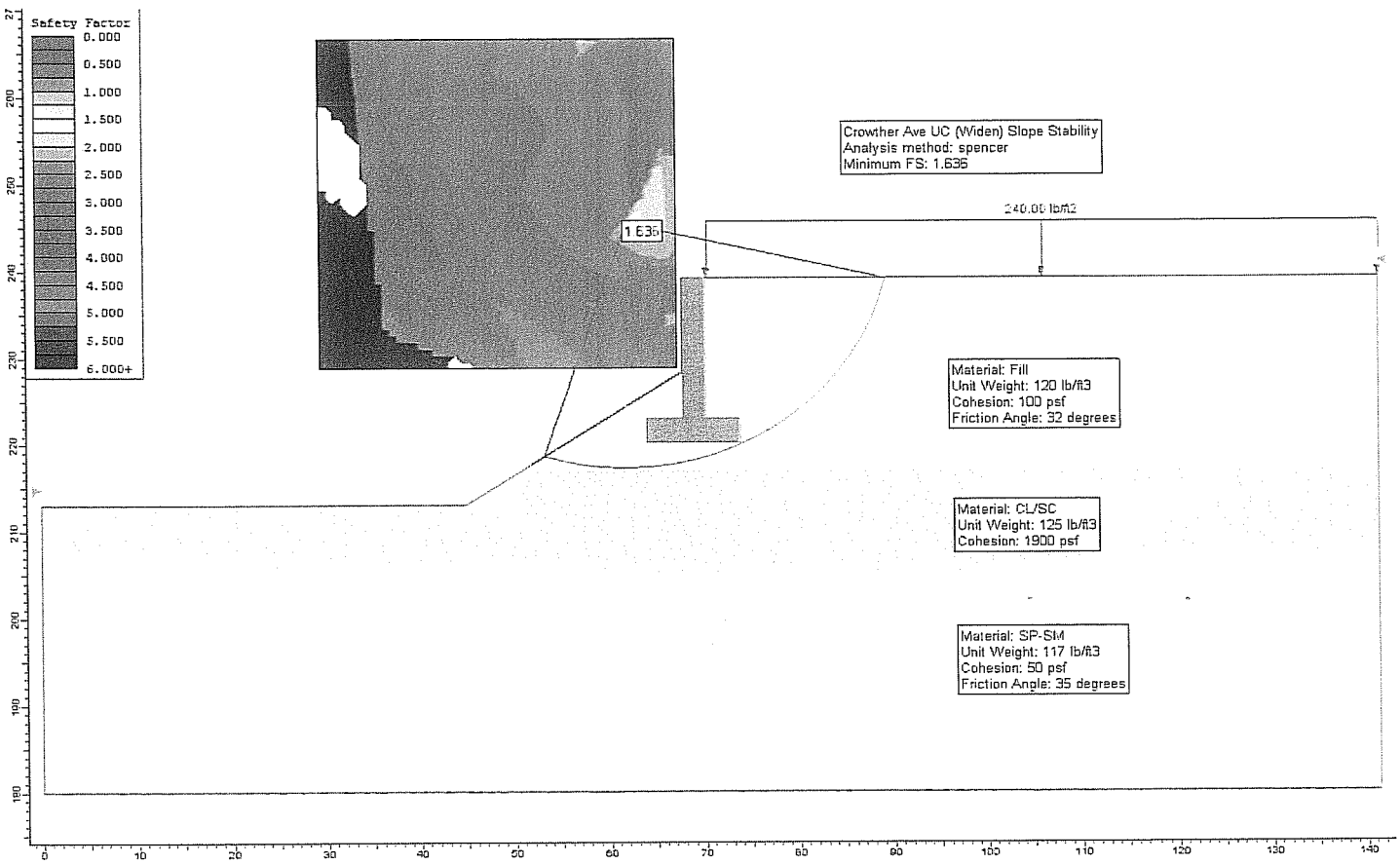
Project: **Crowther Avenue UC (WIDEN)** Project No. **08-115**

By AZ Date 01/08/09 Check by Date Sheet

Static Slope Stability



APPENDIX D

CALTRANS REVIEW COMMENTS AND EMI RESPONSES

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: May 28, 2009
File: 12-ORA-57-PM16.74
12-0F0311

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design-South 1, Branch C

Crowther Ave. UC (widen)
Bridge No. 55-0457
SR-57 Northbound Widening
(Southern Segment)

Subject: Review of Response to Caltrans Comments on the Foundation Report

On May 20, 2009, the Office of Geotechnical Design-South 1 (OGDS1), Branch C received Response to Caltrans Comments on the Foundation Report (dated February 4, 2009) for the Northbound widening of Crowther Ave. UC, Bridge No. 55-0457. We reviewed the responses, and our comments are as follows.

1. Settlement calculations: We revised the calculations and pile tip for settlement con
   For consolidation settlement calculations for clay layers why did you use 1400 kips? We revised 9'.
   Use 1090 kips.

   If you reach pile length equal to 12 feet before you get 1" settlement, stop your calculations. In Foundation Design Recommendation Table and in Pile Data Table, add a note stating, "There is no design tip elevation for settlement at Abut No. 1 and 2"

2. Why did you include two similar as-built LOTB sheets (one is for 1990 Widen with the same boring logs in original 1969)? There will be only five LOTB sheets. Title Block of current LOTB sheet should read LOG OF TEST BORINGS 1 OF 5. Title Block of Legend sheets should read LOG OF TEST BORINGS 2 OF 5 and LOG OF TEST BORINGS 3 OF 5. Title Block of As-built should read LOG OF TEST BORINGS 4 OF 5 and LOG OF TEST BORINGS 5 OF 5. We have revised

3. There are still dotted lines marking elevation intervals through the boring graphic column.

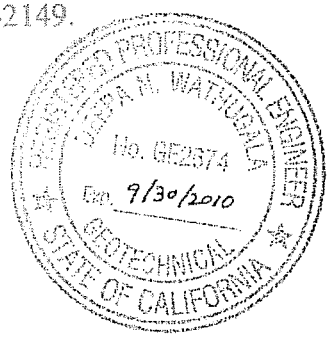
4. Please include the note "Add 2 feet to the As-Built elevation to match Vertical Datum NAVD 88" in the report. See first sentence under Section 2.1

5. In Table 5-5, Abut 3 should be changed to Abut 2. We have revised

6. A new Table 2 has been included for results of Direct Shear tests and Triaxial UU test; you still need to remove columns in Table 1 for tests not performed for this project (for example Sand Equivalent and Torvane Shear). We have revised

If you have any questions, please contact Deepa Wathugala at (213) 620-2134 or Faramarz Gerami at (213) 620-2149.

Prepared by:



Deepa Wathugala, Ph.D., P.E., G.E.
Transportation Engineer
Office of Geotechnical Design South 1
Branch C

Reviewed by:

Chi-Tseng Ted Liu, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design South 1
Branch C

Faramarz Gerami, P.G., C.E.G.
Engineering Geologist
Office of Geotechnical Design South 1
Branch C

c.c. OGDS-1-Los Angeles File
OGDS-1-Sacramento File
GS - Sacramento File

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

May 18, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Attention: Mr. Steve Huff

Subject: Response to Caltrans Foundation Review Comments on "Foundation Report (dated 2/04/09) Crowther Avenue UC (Widen), Bridge No. 55-0457, SR-57 Northbound Widening"
12-Ora-57, PM 16.8, EA 12-0F0311

Dear Mr. Huff:

Caltrans issued a Foundation Review sheet dated April 22, 2009 for the subject project. A copy of this review sheet is attached. The following are our responses to those comments:

Section 2.1, Table 2-1

Response: Boring numbers were corrected in the report. The revised Table 2-1 and Table 5-2 are presented below:

TABLE 2-1. GEOTECHNICAL EXPLORATION INFORMATION

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-006	Rte 57 ("B-Line")	489+69	80 RT	+237.9	+147.4	None Encountered During Drilling
A-08-007	Rte 57 ("B-Line")	491+67	80 RT	+239.5	+148.0	

TABLE 5-2. SOIL CORROSION TEST RESULTS

Boring	Station (Offset) / "Station Line"	Sample Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Soluble Sulfate Content (ppm)	Soluble Chloride Content (ppm)
A-08-006	489+69 (80 RT) / Rte 57 ("B-Line")	15	CL	1800	8.10	100	168
A-08-007	491+67 (80 RT) / Rte 57 ("B-Line")	15	CL	740	7.69	500	162

Section 4.1:

Response: It is not unusual to have an ultimate cohesion that is greater than the peak cohesion (but ultimate friction angle should always be lower than peak friction angle). However, the theoretical shear strength (s) is a function of both cohesion (c), friction angle (ϕ) and overburden:

$s = c + \text{Overburden} \times \tan(\phi)$

According to Table 5-3, The pile top is at least 7 feet below the ground surface; at depths of 7 feet or greater, the theoretical shear strength (s) obtained using the peak values of c (170 psf) and ϕ (41 degrees) is always higher that those obtained using the ultimate values of c (470 psf) and ϕ (31 degrees).

Section 5.4.3, Axial Capacity

Response: The revised Table 5-3 and Table 5-4 are presented below:

TABLE 5-3. FOUNDATION DESIGN DATA SHEET

Location	Design Method	Pile Type	Finished Grade El. (ft)	Pile Cut-off El. (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (inch)	Number of Piles per Support
					B	L		
Abutment 1	WSD	24" CIDH	227.00	220.25	10	23	1	7
Abutment 2	WSD		229.10	221.00	10	23		7

TABLE 5-4. FOUNDATION DESIGN LOADS

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Permanent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abutment 1	1400	200	1090	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Abutment 2	1400	200	1090	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

We incorporated the group efficiency factors per AASHTO LRFD Bridge Design Specifications. Our calculation sheets based on the loads from Table 5-4 are attached. As shown, pile lengths were increased by 6 feet as compared to our previous recommendation (42 feet vs.36 feet). Since all piles are mostly within sand layers, the block failure mechanism to check for group failure per AASHTO C10.7.3.9 is not applicable to the pile groups. However, group capacity and settlement are included in the attached calculations. Revised pile tip elevations are presented in Table 5-5

and Table 5-6 on Page 3.

Section 5.4.3, Table 5-5

Equivalent Pier method was used to estimate the settlement of pile group. Total settlement was evaluated as sum of consolidation settlement and immediate settlement. The calculations are attached. The settlement of equivalent pier under service load (200 kips per pile) was 0.89 inch for pile length of 42 feet and 1.0 inch for pile length of 38 feet.

Two columns for "Service I Limit State Load per Support (Total and Permanent)" were added to Table 5-5. "Tension" was removed from the footnote of Table 5-5. "Nominal Driving Resistance" column was removed from Tables 5-5 and 5-6. The revised Table 5-5 and Table 5-6 are presented below. In these tables specified tip elevations were revised to reflect change in pile length.

TABLE 5-5. ABUTMENT FOUNDATIONS DESIGN RECOMMENDATIONS

Support	Pile Type	Cut-Off Elev. (feet)	LRFD Service-I Limit State Load per Support (kips)		LRFD Service-I Limit State per Pile (kips)	Nominal Resistance (kips)	Design Tip Elev. (feet)[1]	Specified Tip Elev. (feet)[2]
			Total	Perma-nent				
Abut 1	24" CIDH	220.25	1400	1090	200	400	+178 (a) +182 (c) +190 (d)	+178
Abut 3		221.00	1400	1090	200	400	+178 (a) +182 (c) +190 (d)	+178

Notes:
1. Design tip elevation is controlled by the following demands: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for lateral and settlement.

TABLE 5-6. PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)[1]	Specified Tip El. (ft)
		Compression	Tension		
Abutment 1	24" CIDH	400	0	+178 (a) +182 (c) +190 (d)	+178
Abutment 2		400	0	+178 (a) +182 (c) +190 (d)	+178

Note:
1. Design tip elevations are controlled by: (a) Compression, (c) Settlement, and (d) Lateral Load.

Section 5.5, Embankment and Settlement

Response: We will change silver to sliver.

We will add the following paragraph in Section 5.5, Embankment and Settlement: "Per Caltrans Memo to Designers 5-3 dated December 1992, structure approach slabs are required for this project. Selection of the approach type will be performed by the structurral designer following the flowchart in Caltrans Memo to Designers 5-3, Attachment A, dated May 1996."

There is no abutment wingwalls since both abutments are adjacent to RW 486 and 492. There is a small return wall connecting the abutment to the retaining walls. This return wall sits on the abutment pile cap as a part of the abutment design. Design of RW 486 and 492 is in the roadway plans.

Section 6.2, Pile Construction

Response: We will remove wet method recommendations from this section.

Appendix A-Log of Test Borings (LOTB) Sheets and As-Built Log of Test Borings Sheets

Response: LOTB sheets in the report and Detail Plans will be replaced with revised versions.

Appendix B-Laboratory Test Results

Response: Table 1 in Appendix B is quite congested already. We will add the attached Table 2 (Strength test results) in Appendix B.

Unchecked Detail Plans

Foundation Plan

Contour lines will be shown on the Foundation Plan.

LOTB Sheets

Response: LOTB sheets will be replaced with the following revisions per Caltrans review:

- "Groundwater Not Encountered during drilling" is added under each boring.
- Pocket penetrometer results added to description of layers wherever applicable.
- Note Rte 57 ("B-Line") was added to LOTBs.
- Proper title block is now included.
- When percentages of constitutes are estimated, they are rounded to nearest 5%.
- Conversion factor from 2.4" California Modified Ring sampler blowcount to 1.4" Standard Penetration Test sampler blowcount is added to the "Notes"
- Proper title block for As-Built Log of Test Borings is now included.
- The note "Add 2.00 feet to the As-Built elevation to match Vertical Datum NAVD 88" is

included below the title block.

- We added Vertical Datum is NAVD 88.
- Appropriate font is used for Benchmark notes.
- "Boring Records" is removed in the Benchmark notes.
- Name and direction of the nearest cities are added to plan views in LOTBs.
- Soil legend sheets will be placed at the end of current LOTB sheets.
- Dotted lines marking elevation intervals were eliminated within the boring graphic columns.

We will add the following sentence at the beginning of Section 6.2, Pile Construction:
"For on-center pile spacing less than six times the pile diameter, no two adjacent piles can be constructed concurrently."

Sincerely,
EARTH MECHANICS, INC.

Lino Cheang

Lino Cheang, GE 2345
Project Manager

Attachments
-Caltrans Foundation Review sheet dated April 2, 2009
-Axial Pile Capacity Calculation Sheets
-Equivalent Pier Settlement Calculation Sheet
-Revised LOTB Sheets
-Table 2

← in foundation report

State of California — Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: April 22, 2009
File: 12-ORA-57-PM16.74
12-0F0311

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design-South 1, Branch C

Crowther Ave. UC (widen)
Bridge No. 55-0457
SR-57 Northbound Widening
(Southern Segment)

Subject: Review of the Foundation Report

On February 26, 2009, the Office of Geotechnical Design-South 1 (OGDS1), Branch C received the Foundation Report (FR), dated February 4, 2009, and 65% Unchecked Details Plans for the Northbound widening of Crowther Ave. UC, Bridge No. 55-0457. We reviewed the report and plan sheets, and our comments are as follows.

Foundation Report

1. **Section 2.1 – Tables 2-1:** Please correct Boring Nos. A-08-06 and A-08-07 to A-08-006 and A-08-007 in Tables 2-1 and 5-2, and other parts of the report.

2. **Section 4.1** – On page 12, from Direct shear test results for a sample at El. +214, ultimate values are greater than peak values (ultimate friction angle of 31 degrees and cohesion of 470 psf verses peak friction angle of 41 degrees and cohesion of 170 psf). Please explain the reason.

3. **Section 5.4.3 - Axial Capacity**: Please state in the report if the specified tip for single pile is compared to pile group of which the lowest one should govern. Please provide analyses of the pile groups in the Appendix C.

4. **Section 5.4.3 – Table 5-5:**

   - This Table gives a design tip elevation based on the settlement of a single pile (as per calculations in Appendix C). As per Section 10.7.2.3 of AASHTO LRFD Bridge design Specifications (2007), pile group settlement shall be evaluated. Please discuss the applicability of evaluation of group settlement for this project. If relevant, include the equivalent footing analysis for the pile group in Appendix C.

   - Please add two columns to Table 5-5 for 'Service-I Limit State Load per Support (Total and Permanent)' as per Table 5 in the Caltrans MTD 3-1 (July 2008).

- Eliminate 'Tension' in foot notes of Table 5-5.

- Eliminate 'Nominal Driving Resistance' column in Tables 5-5 and 5-6.

5. **Section 5.5** – In the first sentence, the word silver needs to be corrected to sliver.

6. **Section 5.6** – In this Section, structure approach slab and wing walls should be discussed.

7. **Section 6.2 – Pile Construction**: Please refrain from wet method for caving control, since it necessitates additional instrumentation and possibility of creating anomalies in the pile.

8. **Appendix A – Log of Test Borings (LOTB) sheets:** These LOTB sheets should be same as LOTB sheets in the **Unchecked Detail Plans** after corrections. Therefore, comment No. 11 under Unchecked Detail Plans -LOTB Sheets also apply to the LOTB sheets in Appendix A.

9. **Appendix B – Table 1:** Include results of Direct Shear tests and Triaxial UU test; but remove columns for tests not performed for this project (for example Sand Equivalent and Torvane Shear).

Unchecked Detail Plans

10. **Foundation Plan:** Provide contour lines.

11. **LOTB sheets**:

- When groundwater is not shown on the borings, note under each boring that groundwater was not encountered or not measured during field investigation.

- Pocket penetrometer (pp) values should be shown at the end of each cohesive soil layer description and consistency should be based on those values rather than on blow counts.

- Stations for the borings B-08-006 and A-08-007 are referred to the B-Line. Show the B-Line on the plan view.

- Bottom title block from left to right on LOTB and Soil Legend sheets should comply with Section 5.2.3.2 of Caltrans Soil and Rock Logging Manual, June 2007.

- When the percentages of constituents are estimated, they should be rounded to nearest 5%.

- Correction/multiplication factor for conversion of 2.4" California Modified ring sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.

- As-Built Log of Test Borings for original bridge and previous widening containing proper title block should be included in the project plans. If As-Built Log of Test Borings was surveyed with different datum, include the conversion factor of datum to NAVD 88.

- It is required to note datum used for surveying boreholes in LOTB (NGVD 29 or NAVD 88).

- Bench Marks notes need to be in the same dark printing as the rest of the plan sheet.

- Remove the words "Boring Records" in the Bench Mark Notes.

  Show name and direction of nearest cities on plan views.

- Soil Legend sheets should be placed at the end of current LOTB sheet sequence.

- Dotted lines marking elevation intervals should not carry through the boring graphic column.

If you have any questions, please contact Deepa Wathugala at (213) 620-2134 or Faramarz Gerami at (213) 620-2149.

Prepared by:

04/22/2009

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Reviewed by:

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Senior Transportation Engineer
Office of Geotechnical Design South 1
Branch C

c.c. OGDS-1-Los Angeles File
OGDS-1-Sacramento File
GS - Sacramento File

FINAL FOUNDATION REPORT

Placentia Overhead (WIDEN)
Bridge No. 55-0449
SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 16.84
EA 12-0F0311

EMI Project No. 08-115
Date: June 17, 2009

EARTH MECHANICS, INC.

Geotechnical and Earthquake Engineering

June 17, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Attention: Mr. Steve Huff, P.E.

Subject: **Final Foundation Report for Placentia Overhead (WIDEN),**
Bridge No. 55-0449
SR-57 Northbound Improvement Project, Orange County, California
12-Ora-57, PM 16.84, EA 12-0F0311

Dear Mr. Huff:

Attached please find the final Foundation Report for the subject bridge widening project. This report contains the findings and conclusions of our field investigation and laboratory testing program. This report also contains our recommendations for the design and construction of the bridge foundation.

An earlier version of this Foundation Report, dated February 11, 2009, was prepared by EMI and reviewed by Caltrans. Copies of the review sheets and our responses are attached in Appendix D. This report has been revised to incorporate our responses to the review comments.

We appreciate the opportunity to provide geotechnical design services for this project. If you have any questions, please call us.

Sincerely,
EARTH MECHANICS, INC.

Chien-Tai Yang, RCE 66374
Project Engineer

Lino Cheang, GE 2345
Project Manager

FINAL FOUNDATION REPORT

PLACENTIA OVERHEAD (WIDEN)
BRIDGE NO. 55-449
SR-57 NORTHBOUND IMPROVEMENT PROJECT
ORANGE COUNTY, CALIFORNIA
12-Ora-57, PM 16.84
EA 12-0F0311

Prepared for:

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Prepared By:

Earth Mechanics, Inc.
17660 Newhope Street, Suite E
Fountain Valley, California 92708

EMI Project No. 08-115

June 17, 2009

TABLE OF CONTENTS

Section	Page
1.0 INTRODUCTION	**1**
1.1 Purpose and Scope of Study	1
1.2 Project Description	1
2.0 FIELD INVESTIGATION AND LABORATORY TESTING	**4**
2.1 Field Investigation	4
2.2 Laboratory Testing	5
3.0 GEOLOGY and Seismicity	**6**
3.1 Topography and Drainage	6
3.2 Physiography	6
3.3 Geologic Structure	6
3.4 Geologic Hazards	8
3.5 Stratigraphy	8
3.6 Seismicity	10
4.0 SUBSURFACE CONDITIONS	**11**
4.1 Soil Conditions	11
4.2 Groundwater Conditions	12
5.0 CONCLUSIONS AND RECOMMENDATIONS	**13**
5.1 Seismic Design Criteria	13
5.2 Liquefaction	15
5.3 Soil Corrosivity	15
5.4 Pile Foundation Design	15
5.4.1 Foundation Type	15
5.4.2 Foundation Data Provided by Structural Designers	16
5.4.3 Axial Capacity	17
5.4.4 Lateral Resistance	19
5.5 Embankments and Settlement	19
5.6 Bridge Abutment Wall Design	21
6.0 Construction Recommendations	**22**
6.1 Earthwork	22
6.2 Pile Construction	22
6.3 Backdrain and Backfill Requirements For Abutment Walls	23
6.4 Review of Construction Plans	25
6.5 Geotechnical Observation and Testing	25

7.0 LIMITATIONS **26**

8.0 REFERENCES **27**

List of Tables Page

Table 2-1. Geotechnical Exploration Information 4
Table 4-1. Idealized Soil Profile and Strength Parameters 11
Table 5-1. Local Seismic Sources 13
Table 5-2. Soil Corrosion Test Results 15
Table 5-3. Foundation Design Data Sheet 16
Table 5-4. Foundation Design Loads 17
Table 5-5. Abutment Foundations Design Recommendations 17
Table 5-6. Bent Foundation Design Recommendations 18
Table 5-7. Pile Data Table 18
Table 5-8. Lateral Pile Solutions 20

List of Figures Page

Figure 1-1. Site Location Map 2
Figure 3-1. Regional Fault and Physiographic Map 7
Figure 3-2. Geological Map 9
Figure 5-1. Design ARS Curve 14
Figure 6-1. Low Expansion Material in Bridge Embankment 24

APPENDICES

Appendix A. Log of Test Borings Sheets and As-built Log of Test Borings Sheet
Appendix B. Laboratory Test Results
Appendix C. Design Calculations
Appendix D. Caltrans Review Comments and EMI Responses

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF STUDY

This Foundation Report presents the findings and conclusions of a geotechnical investigation conducted by Earth Mechanics, Inc. (EMI). It presents foundation design and construction recommendations for proposed widening of the Placentia Overhead (OH) in Orange County, California. A site location map is presented in Figure 1-1.

This work was performed for the Orange County Transportation Authority (OCTA) and EMI is a subconsultant to RBF Consulting (RBF). The geotechnical services provided for this project included the following tasks:

- Collection and review of existing geotechnical information;
- Field exploration consisting of drilling and logging exploratory borings;
- Laboratory testing of selected bulk and relatively undisturbed soil samples;
- Engineering calculations (see Appendix C) and analysis to develop foundation design and construction recommendations; and
- Preparation of this report presenting our findings, conclusions, and recommendations.

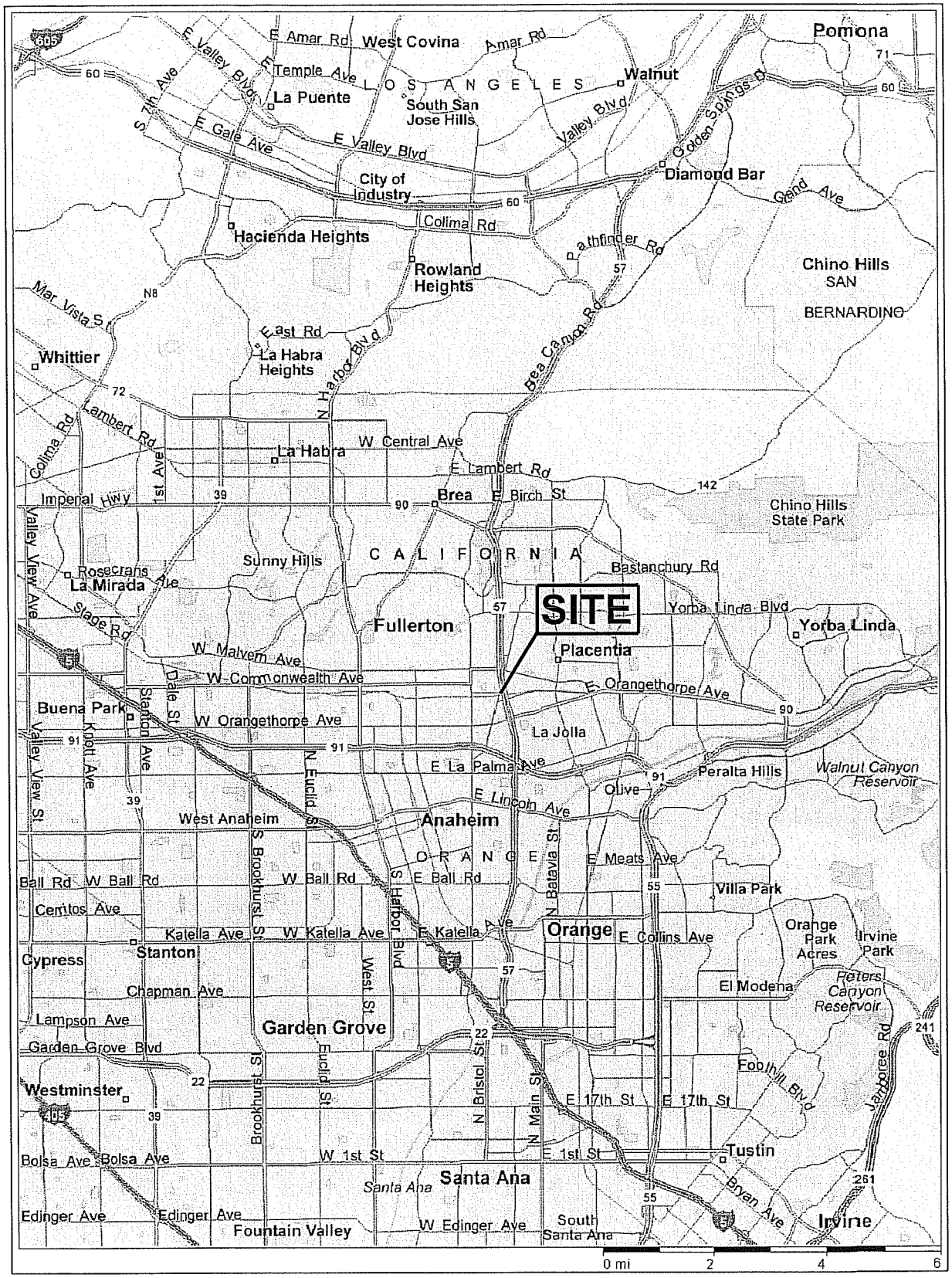
1.2 PROJECT DESCRIPTION

The Department of Transportation (Caltrans) – District 12, in cooperation with the Orange County Transportation Authority (OCTA), proposed to widen northbound State Route 57 (SR-57) by adding one northbound through lane. The project limits are between 0.2 mile south of Orangethorpe Avenue and 0.2 mile north of Yorba Linda Boulevard along northbound SR-57. Within the project limits, there are interchanges located at Orangethorpe Avenue, Chapman Avenue, Nutwood Avenue and Yorba Linda Boulevard. The entire project involves widening seven existing bridges and a tieback wall at Yorba Linda Boulevard:

- Orangethorpe Avenue Undercrossing (Bridge No. 55-0459)
- South Placentia Overhead (Bridge No. 55-0450)
- Crowther Avenue Undercrossing (Bridge No. 55-0457)
- Placentia Overhead (Bridge No. 55-0449)
- Placentia Avenue Undercrossing (Bridge No. 55-0460)
- Chapman Avenue Undercrossing (Bridge No. 55-0456)
- Nutwood Avenue Undercrossing (Bridge No. 55-04649)
- Tieback Wall at Yorba Linda Boulevard (Bridge No. 55-0468)

This report pertains to Placentia OH only; separate foundation reports are prepared for each of the above seven remaining structures.

The Placentia OH is located in the City of Placentia north of the SR-57/SR-91 interchange. SR-57 in the project area trends in a north-south direction and carries traffic from the "Orange Crush" (I-5/SR-22/SR-57 Interchange) in Orange County to Interstate 210 in Los Angeles County (See Figure 1-1).



Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SITE LOCATION MAP

Figure 1-1

PLACENTIA OVERHEAD (WIDEN)

Project No. 08-115

Date: 01-07-09

The existing Placentia OH is a three-span structure that carries SR-57 northbound and southbound traffic over BNSF. The structure was originally constructed in 1969 and widened in 1992. The structure has three spans with a total span length of 159'-7". The original 1969 bridge is a reinforced concrete T-beam with a depth of 4'-6". The 1992 widening is a precast prestressed concrete I-girder with a depth of 4'-3". Total width of the original plus widening is 160'-9". The original and widened bridges are supported on diaphragm abutment walls with 16-inch diameter (45 ton) CIDH concrete piles.

This project will widen Placentia OH by approximately 19'-9" on the northbound side. The proposed widening is a precast prestressed I-girder with diaphragm-type abutments. The new structure depth is 3'-9". Abutment 1 spans an existing 72" storm drain and will be supported on 30" CIDH piles. The bents will also be supported on 30" CIDH piles. Abutment 4 will be supported on 16" CIDH piles.

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 FIELD INVESTIGATION

Copies of the As-Built Log-of-Test-Borings (LOTB) sheets are included in Appendix A. About 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV88). According to these As-Built LOTB sheets, one rotary boring and three penetration borings were performed in April 1966, and one hollow stem boring and one cone penetration test were performed in January 1989. During the 1966 investigation, the rotary boring was the deepest boring and was advanced to about El. +175 feet. Existing grade at the time of the investigation in 1966 was approximately between El. +205 and 211 feet. In 1989, the hollow stem boring was the deepest boring and was advanced to about El. +164 feet. Existing grade at the time of the investigation in 1989 was approximately between El. +239 and 241 feet. Groundwater was not encountered during drilling in April 1966 down to El. +175 feet, and in January 1989 down to El. +164 feet.

To supplement the existing subsurface data, two soil borings were drilled (one at each abutment). These borings were drilled on September 23, 2008. Boring information, including exploration number, stations, offsets, ground surface elevations, bottom of hole elevations and water level measurements are summarized in Table 2-1. Locations of the exploratory boring are shown on the LOTB sheet provided in Appendix A.

TABLE 2-1. GEOTECHNICAL EXPLORATION INFORMATION

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-008	SR-57 Main Line (B-Line)	494+45	80 RT	+241.9	+145.4	None Encountered During Drilling
A-08-009	SR-57 Main Line (B-Line)	496+47	80 RT	+243.7	+152.2	

Exploratory borings were drilled using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. Relatively undisturbed drive samples were obtained using a 3.25-inch outer diameter California split-spoon sampler lined with brass rings. Each of these brass rings is 1-inch long with a 2.5-inch outside diameter. The California Drive sampler was driven into the ground using successive blows of a 140-lb hammer falling a distance of 30 inches. The numbers of blow for the final 12 inches or shorter of driving are shown on the LOTB sheet.

The Standard Penetration Test (SPT) sampler (1.4-inch inside diameter) was also used to obtain soil samples. The sampler was driven into the ground using a 140-lb hammer free falling from a height of 30 inches. The numbers of blow to advance the sampler each 6 inches of penetration or less was recorded. The blow counts required to drive the sampler for the last 12 inches or less was recorded as the Standard Penetration Resistance (N-value) on the LOTB sheet.

Charts published by Winterkorn and Fang (1975) can be used to determine a reduction factor used to convert blowcounts recorded using the California Drive sampler into SPT blowcounts. Using those

Charts published by Winterkorn and Fang (1975) can be used to determine a reduction factor used to convert blowcounts recorded using the California Drive sampler into SPT blowcounts. Using those charts, we obtained a reduction factor of 0.5 and this one-half reduction factor was used for this project.

The sampling interval is usually 5 feet. Sampling was performed by alternating the California Drive sampler and SPT sampler.

2.2 LABORATORY TESTING

Soil samples considered representative of the subsurface conditions were tested to obtain or derive relevant physical and engineering soil properties. The following laboratory tests were conducted to supplement the observations recorded during the field investigation:

- In-situ Moisture Content and Unit Weight
- Pocket Penetrometer
- Percent Passing No. 200 Sieve
- Atterberg Limits
- Direct Shear
- UU Triaxial Test
- Consolidation
- Minimum Resistivity, pH, Sulfate Content and Chloride Content

The laboratory tests were conducted in general accordance with California Test Methods or American Society for Testing and Materials (ASTM) Standards. Laboratory test results are included in Appendix B.

3.0 GEOLOGY AND SEISMICITY

3.1 TOPOGRAPHY AND DRAINAGE

The project corridor is in the eastern part of the Los Angeles Basin along the southern margin of the Coyote Hills and the Puente Hills (Figure 3-1). Just north of the project corridor, the Puente Hills rise to an elevation of about 1,400 feet. The southwestern edge of the Puente Hills is paralleled by a series of low-elevation plains and hills; the Santa Fe Plain and the Coyote Hills are to the west of the project corridor, and the Richfield and Kraemer Hills are to the east. The elevations of these hills range from about 500 feet just west of the project to about 300 feet in the east. The ground upon which the project is located slopes gently to the south. Elevations along the project corridor range from about 280 feet in the north to about 200 feet on the south.

The project corridor traverses the ancient flood plains and alluvial fans of Fullerton Creek and the Santa Ana River. The major drainage in the area is the Santa Ana River which flows westerly south of the site. Fullerton Creek, a tributary to the Santa Ana River, drains southwesterly from the Puente Hills just west of the project corridor.

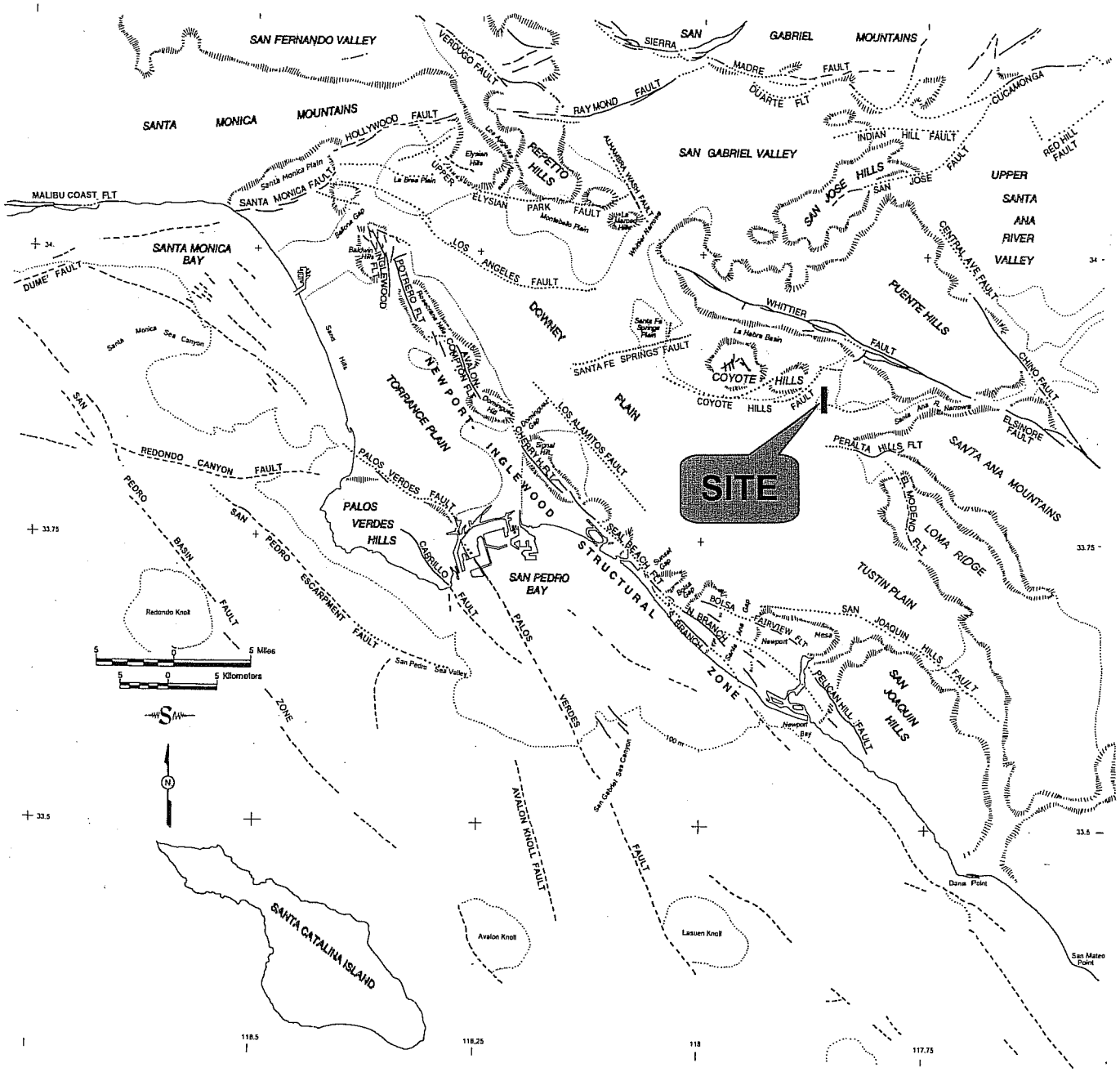
3.2 PHYSIOGRAPHY

The site area is at the eastern edge of the Los Angeles physiographic basin, a large, relatively flat, low-lying, coastal plain surrounded by mountains on the north, east, and southeast (Figure 3-1). The floor of the Los Angeles Basin is relatively flat but slopes gradually southwesterly from an elevated marginal apron to sea level along the coastline. The western margin of the Los Angeles Basin is bordered by the sea and the Palos Verdes Hills. The eastern margin is bordered by the Puente Hills and Santa Ana Mountains. The Coyote Hills, Santa Fe Springs Plain, Richfield Hills, and Kramer Hills are low elevation uplifts along the southern margin of the Puente Hills.

3.3 GEOLOGIC STRUCTURE

The geologic structure at the site is quite simple and is characterized by flat-lying Quaternary sediments overlying gently folded Tertiary sedimentary rocks. These strata rise gently to the Coyote Hills, Richfield Hills, and Kraemer Hills where they are arched upward to form anticlinal folds. The site is on the south limb of these anticlines with the early Pleistocene and Tertiary age strata dipping gently to the south and overlain by younger flat-lying Quaternary sediments.

The nearest active or potentially active surface faults are the Peralta Hills and Whittier faults (Figure 3-1). The low-elevation plains and hills along the eastern margin of the Los Angeles Basin are underlain by a series of east-west trending, en echelon, faults and folds in the subsurface; the major faults within this trend are, from north to south, the Los Angeles (Las Cienegas), Santa Fe Springs, and Coyote Hills faults (Figure 3-1). This group of faults is known as the Puente Hills fault system. Other poorly known segments of this thrust fault system underlie the Richfield and Kramer hills. All of these faults are blind thrust or reverse faults that approach within about a mile or so of the ground surface. They are identified on seismic reflection geophysical data only and are below the depths of oil wells.



PLACENTIA OVERHEAD (WIDEN)

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REGIONAL FAULT AND PHYSIOGRAPHIC MAP

Figure 3-1

Project No. 08-115

Date: 01-07-09

The Peralta Hills fault may be related to the Puente Hills fault system. The Peralta Hills fault is exposed along the south flank of the Peralta Hills where it displaces Tertiary-age rocks upward and over younger Quaternary alluvium. The fault extends westerly below the Santa Ana River channel where it creates barriers to ground-water flow (Figure 3-2). The barriers extend about to the SR 57 freeway just north of the Lincoln Avenue (Morton and Miller, 1981). The location of the Peralta Hills fault is well up on the flank of the hills rather than at the base of the hills indicating that it is not the only fault responsible for uplift and folding of the Peralta Hills. There must be a deeper unknown blind thrust fault below the Peralta Hills thrust fault but this feature has never been directly identified.

The Whittier fault is a major strike slip fault that extends northwesterly along the southwest flank of the Puente Hills northeast of the site (Figure 3-1). The Whittier fault is associated with the Chino fault and the Elsinore fault and together these faults form a major fault system that extends from the Los Angeles Basin into northern Mexico.

The El Modeno fault is a north-south trending feature within Loma Ridge, one of the foothills of the Santa Ana Mountains, southeast of the site. The feature is poorly known but is known to displace Holocene soil in Loma Ridge. Although the fault is grouped with the Peralta Hills fault on the Caltrans seismic hazard map (Mualchin 1996), it appears to be a discrete normal or strike-slip fault unrelated to the thrust faults of the Peralta Hills. Although the fault must be considered active because it displaces Holocene soil, the feature has a very long (thousands of years) recurrence interval.

3.4 GEOLOGIC HAZARDS

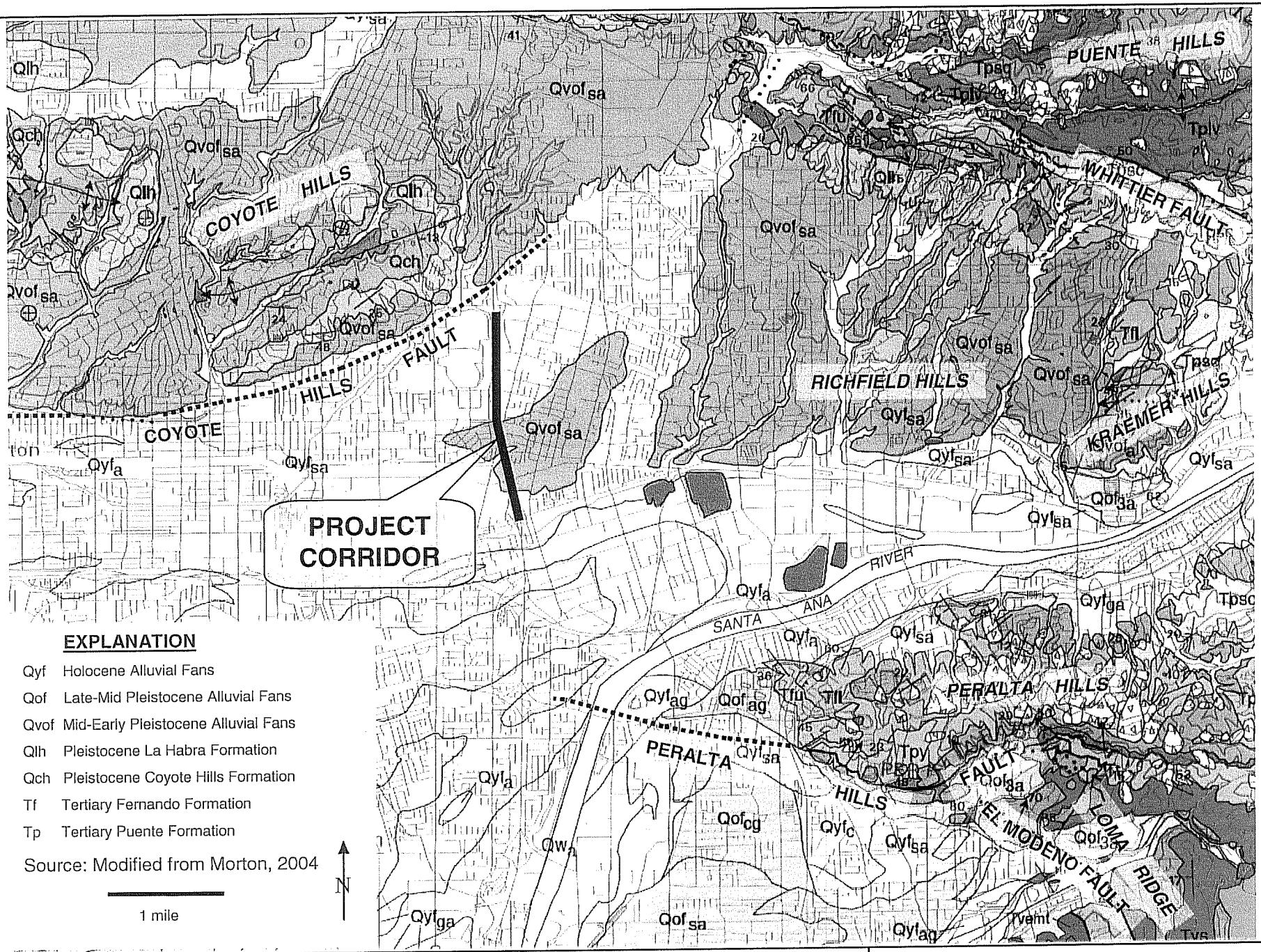
There are no steep slopes within the corridor so landsliding is not likely. There are no active faults so surface fault rupture is not likely. There are no known volcanos in the site region. The site is far from the sea on elevated land so Tsunamis are not a hazard.

The site is not identified on the State seismic hazard maps of the Anaheim and Newport Beach quadrangle as being susceptible to liquefaction (California Geological Survey/Division of Mines and Geology, 1997). This is due primarily to the depth of historically highest ground water being greater than 50 feet.

3.5 STRATIGRAPHY

Regional studies (e.g. Morton, 2004; Morton and Miller, 1981; Durham and Yerkes, 1964; California Department of Water Resources, 1961) indicate that the site area is underlain by Quaternary sediments overlying older Quaternary and Tertiary sediments and sedimentary rocks.

The surficial deposits are primarily Holocene and Pleistocene alluvial fan deposits (Figure 3-2). Older formations exposed in the hills and underlying the corridor are, in descending order, the Pleistocene-age La Habra and Coyote Hills, the Pliocene Fernando, and Pliocene-Miocene-age Puente formations. Along the corridor, the La Habra Formation is at an elevation of about sea level and therefore these older units are well below the level of interest for this project.



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PLACENTIA OVERHEAD (WIDEN)

Project No. 08-115 | Date: 01-08-09

GEOLOGICAL MAP

Figure 3-2

3.6 SEISMICITY

The largest historical earthquake within the Los Angeles Basin was the 1933 Long Beach earthquake of M_W=6.4 (M_L = 6.3) which is generally believed to have been associated with the Newport-Inglewood Structural Zone. The association of the 1933 event with the NISZ was based on abundant ground failures along the NISZ trend, but no unequivocal surface rupture was identified. Hauksson and Gross (1991) reevaluated the seismicity data and relocated the 1933 earthquake hypocenter to a depth of about 6 miles below the Huntington Beach-Newport Beach city boundary.

Other damaging earthquakes in the Los Angeles region include the 1971 San Fernando, the 1987 Whittier, and the 1994 Northridge events. The 1971 San Fernando (M_L= 6.4, M_W=6.7) earthquake occurred along the northern margin of the San Fernando Valley and produced a surface rupture which coincided partly with a zone of mapped surface faults along the mountain-valley margin. The more-recent 1987 Whittier earthquake (M_L=5.9, M_W=5.9) and the 1994 Northridge (M_L=6.4, M_W = 6.7) earthquake were not associated with surface faulting. Such events indicate that seismic hazards analysis must consider subsurface faulting as well as surface faulting. The Whittier event occurred at a depth of about 10 miles on a northerly dipping thrust fault dipping from the Coyote Hills area, under the Repetto and Puente Hills, to below the San Gabriel Valley. The Northridge event occurred at a depth of about 12 miles on a south-dipping reverse fault below the San Fernando Valley.

Another significant earthquake in the region was the 1812 earthquake which caused damage at the San Juan Capistrano Mission. The location and magnitude of the 1812 earthquake are unknown but geological studies (Jacoby et al., 1988; Fumal et al., 1993; Weldon et al., 2004) postulated that it did not occur in the Capistrano area, but rather was a large (M> 7.0) distant event on the San Andreas fault in the Wrightwood area of the San Gabriel Mountains.

A recent magnitude 5.4 (M_W) earthquake occurred on 29 July 2008 below the Puente Hills northeast of the site at a depth of about 10 miles. This event was a reverse type fault with a left- lateral component of slip. The causative fault is unknown. The epicenter is between the Whittier and Chino faults. The orientation of the preferred focal plane of the focal mechanism solution is somewhat compatible with the Whittier fault. The Whittier fault may have a reverse component of slip but is believed to be primarily a right-lateral fault. Furthermore dip of the preferred focal plane and the distribution of aftershocks are not very compatible with the Whittier fault. The northerly dipping buried thrust faults under the Peralta Hills, Richfield Hills, or Kraemer Hills could have been source because the preferred focal plane dips northeasterly similar to the northerly dipping faults. However, the distribution of the aftershocks does not seem compatible with the orientations of these faults.

4.0 SUBSURFACE CONDITIONS

4.1 SOIL CONDITIONS

Based on the recent field exploration and the as-built LOTB sheets in Appendix A, the subsurface materials at the site consist of primarily lean clay and lean clay with sand overlying silty and clayey sand and sand. The idealized soil profile and design strength parameters for foundation design are presented in Table 4-1.

TABLE 4-1. IDEALIZED SOIL PROFILE AND STRENGTH PARAMETERS

Approx. Elevation (ft)	Predominant Soil Type	Range of Measured and Converted SPT Blowcount; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion/ Undrained Shear Strength (psf)
Abutment 1					
+241.9 to +230	Sand with Silt	15 to 26 Average = 20	120	32	100
+230 to +181	Lean Clay and Lean Clay with Sand	9 to (21) Average = 15	120	-	1,600
+181 to +161	Clayey Sand	19 to (28) Average = 23	120	33	100
+161 to +151	Lean Clay with Sand	20 to (27) Average = 24	125	-	3,000
+151 to +145.4	Sand with Silt and Silty Sand	>70	128	40	50
Bent 2					
O.G. to +185	Lean Clay and Lean Clay with Sand	9 to (21) Average = 15	120	-	1,600
+185 to +160	Clayey Sand	19 to (28) Average = 23	120	33	100
+160 to +150	Lean Clay with Sand	20 to (27) Average = 24	125	-	3,000
+150 to +145.4	Sand with Silt and Silty Sand	>70	128	40	50
Bent 3					
O.G. to +190	Lean Clay and Lean Clay with Sand	12 to (21) Average = 16	120	-	1,600
+190 to +179	Sand with Silt	(27) to (36) Average = 34	125	36	50
+179 to +164	Sand with Silt and Silty Sand	>70	128	40	50
+164 to +152.2	Lean Clay with Sand	(13) to (29) Average = 21	125	-	2,800

TABLE 4-1 (CONT). IDEALIZED SOIL PROFILE AND STRENGTH PARAMETERS

Approx. Elevation (ft)	Predominant Soil Type	Range of Measured and Converted SPT Blowcount; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion/ Undrained Shear Strength (psf)
Abutment 4					
+243.7 to +234	Silty Sand	8 to 15 Average = 12	120	30	100
+234 to +204	Lean Clay and Lean Clay with Sand	12 to (21) Average = 16	120	-	1,600
+204 to +199	Clayey Sand	12	120	30	100
+199 to +179	Sand with Silt	(27) to (36) Average = 29	125	36	50
+179 to +164	Sand with Silt and Silty Sand	>70	128	40	50
+164 to +152.2	Lean Clay with Sand	(13) to (29) Average = 21	125	-	2,800

Notes:
(1) SPT = Standard Penetration Test.
(2) Values in ( ) are converted SPT blowcounts corrected for sampler size. Based on Winterkorn and Fang (1975), a correction factor from California sampler blowcounts to SPT blowcounts is 0.5.
(3) O.G.: original grade.

The above soil strength parameters are primarily based on published correlations with SPT blowcounts (Lam and Martin, 1986). The above soil strength parameters are slightly conservative compared to direct shear test and UU triaxial test results included in Appendix B.

4.2 GROUNDWATER CONDITIONS

During the recent field investigation conducted on September 23, 2008, groundwater was not encountered down to El. +145.4 feet which is more than 90 feet from the freeway surface. As shown on the as-built LOTB sheets in Appendix A, groundwater was not encountered during drilling in April 1966 down to El. +175 feet, and in January 1989 down to El. +164 feet.

The relatively deep water depth is confirmed by the historical groundwater map published by the California Geological Survey (Seismic Hazard Zones Map - Anaheim and Newport Beach Quadrangle) (CGS, 1997). This map shows the depth to groundwater to be greater than 50 feet.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SEISMIC DESIGN CRITERIA

According to the 1996 Caltrans Seismic Hazard map, the most significant faults relative to the project area are listed in Table 5-1 along with their style of fault, maximum earthquake magnitude, distance to the bridge site and resulting peak bedrock acceleration (PBA).

TABLE 5-1. LOCAL SEISMIC SOURCES

Fault or Fault Zone	Style of Faulting	Maximum Credible Earthquake (MCE) Magnitude	Distance to Site[2] (miles)	Peak Bedrock Acceleration[3] (g)
El Modeno-Peralta Hills (EMP)	Reverse-Thrust[1]	6.50	1.1	0.8
Puente Hills Blind Thrust	Reverse-Thrust	7.25	4.1	0.6
Whittier-Elsinore (WEE)	Strike-Slip	7.50	4.9	0.5

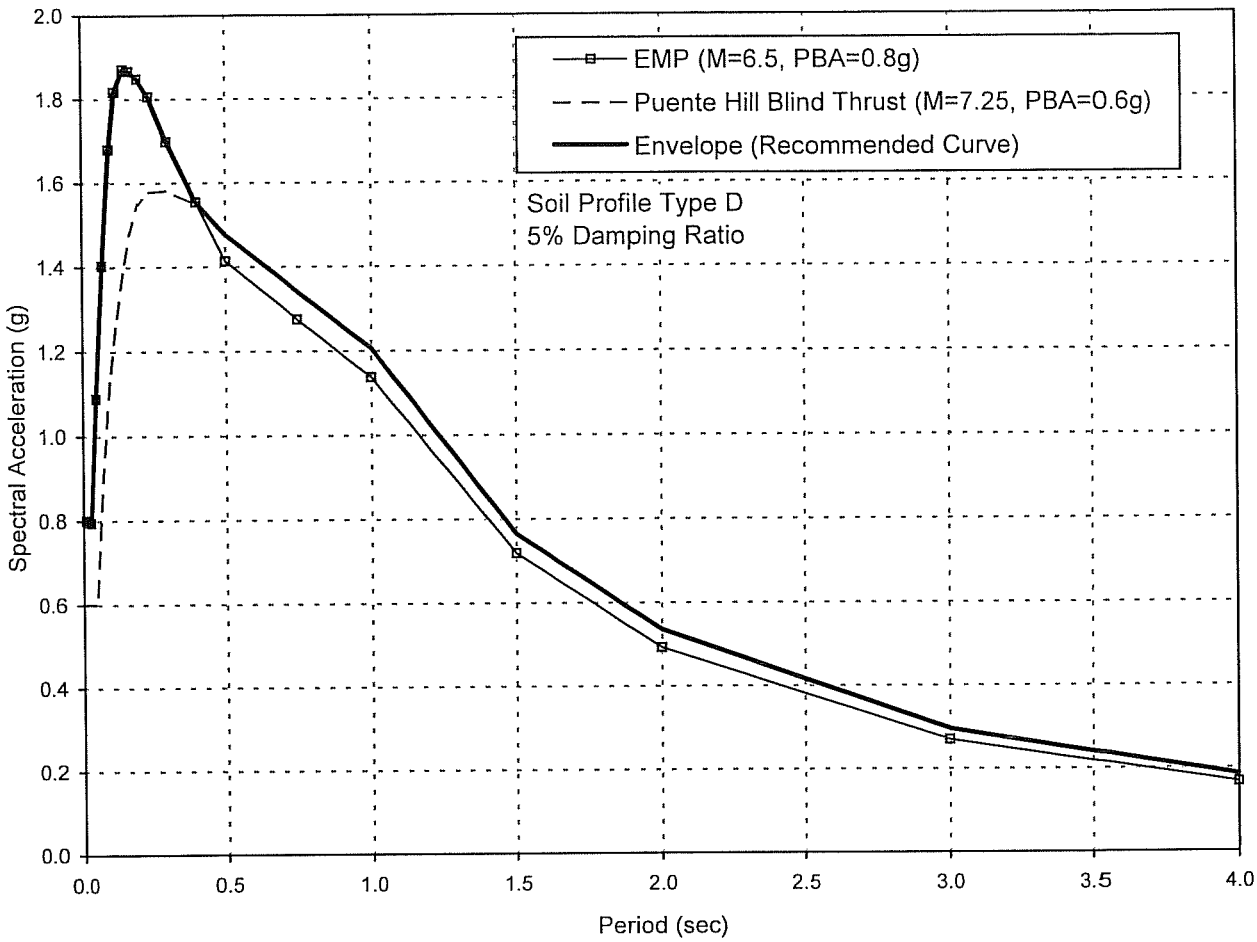
Notes:
(1) Caltrans designates the style of fault for EMP to be "unknown"; we assume a reverse-thrust fault (most conservative).
(2) For the EMP and WEE faults, the distances of each bridge site to these seismic sources were scaled from the 1996 Caltrans Seismic Hazard Map. Distances of each bridge site to the Puente Hills Blind Thrust were obtained from the seismic source model contained within the FRISKSP4.0 computer program (Blake, 2000 and 2004).
(3) The PBA is the larger of the two PBA's obtained from the attenuation relations of Sadigh (1997) and Mualchin (1996).

The ARS curves published in the Caltrans SDC (2006b) for Soil Profile Type "D" are applicable; this applies to Figures B.7 and B.8 for MCE Magnitudes (M) of 6.5±0.25 and 7.5±0.25, respectively. However, ARS curves for M of 6.5±0.25 with PBA's greater than 0.6g are not included in Figure B.7 of the Caltrans SDC (2006b). As a result, we generated an ARS curve for M=6.5±0.25 and a PBA of 0.8g by scaling the 0.6-g curve in Figure B.7 of the Caltrans SDC (2006b).

The design ARS curve envelopes the scaled ARS curve for M=6.5±0.25 and PBA=0.8g, and Figure B.8 for PBA=0.6g. According to Caltrans, this curve must also be modified to account for near-fault effects. For the near-fault effects, Caltrans Seismic Design Criteria (SDC, 2006b) Section 6.1.2.1 recommends the following modifications in the spectral accelerations:

- For periods less than 0.50 second, no change;
- For periods greater than 1.0 second, an increase of 20%;
- For periods between 0.50 and 1.0 second, a linear interpolation between the values at 0.50 and 1.0 second.

The resulting design ARS curve and the digitized coordinates are presented in Figure 5-1 . Based on our soil borings, soils at the bridge site meet the "Competent Soil" requirements per SDC Section 6.2.2 (Caltrans, 2006b).



Spectral Coordinates of Recommended Curve

Period (sec)	Acc. (g)
0.010	0.800
0.020	0.797
0.030	0.795
0.050	1.089
0.075	1.403
0.100	1.680
0.120	1.817
0.150	1.871
0.170	1.867
0.200	1.848

Period (sec)	Acc. (g)
0.240	1.806
0.300	1.698
0.400	1.555
0.500	1.477
0.750	1.342
1.000	1.207
1.500	0.765
2.000	0.536
3.000	0.296
4.000	0.186

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	Placentia Overhead	ARS Design Spectrum
	Project No.: 08-115 / Date: 01/07/09	Figure 5-1

5.2 LIQUEFACTION

Based on the available boring information, the subject site has a low liquefaction potential due to absence of groundwater within the depths of interest.

5.3 SOIL CORROSIVITY

Three soil samples were tested for pH, minimum resistivity, soluble chloride content and soluble sulfate content. The test results are summarized in Table 5-2. Minimum resistivities ranged from 510 to 850 ohm-cm. The pH ranged from 7.4 to 7.7. The soluble sulfate ranged from 300 to 750 parts per million (ppm), and the soluble chloride ranged from 142 to 213 ppm.

TABLE 5-2. SOIL CORROSION TEST RESULTS

Boring	Station (Offset) / "Station Line"	Sample Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Soluble Sulfate Content (ppm)	Soluble Chloride Content (ppm)
A-08-008	494+45 (80RT) / "B" Line"	10	CL	810	7.7	450	213
A-08-008	494+45 (80RT) / "B" Line"	30	CL	510	7.4	750	208
A-08-009	496+47 (80RT) / "B" Line"	25	CL	850	7.7	300	142

Based on the Caltrans Corrosion Guidelines (2003), soils are considered corrosive if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm or greater. Based on the test results and the Caltrans criteria, the on-site soils are not considered to be corrosive to bare metals and concrete.

5.4 PILE FOUNDATION DESIGN

5.4.1 Foundation Type

The existing bridge is supported on 16-inch diameter Cast-In-Drilled-Hole (CIDH) piles. We recommend using the same pile type for the proposed widening. Sixteen-inch diameter piles are recommended for Abutment 4 and the 30-inch diameter piles will be used at the remaining supports due to higher foundation loads.

Per BNSF Guidelines for Railroad Grade Separation Projects (2007), a casing should be used for the drilled shaft within the influence of track surcharge to avoid potential loss or displacement of the railroad base materials due to pile construction. According to the data provided by the bridge engineer, the closest distance between the Bent-2 top-of-pile and centerline of track is about 34 feet, and this distance is equal to 13.5 times the pile diameter of 30 inches. In addition, the closest soil boring (Boring A-08-008) data indicates the predominant soil type is fine-grained (clayey) soils. Based on the above information, we do not believe a permanent casing is needed for construction of the Bent-2 piles.

The closest distance between the Bent-3 pile and centerline of track is about 19 feet. The closest soil boring data (Boring A-08-009) indicates that the 30-inch diameter CIDH piles will be embedded primarily in silty sand and sand with silt materials, followed by fine-grained soils within the last 10 feet of the specified pile tip elevation. At this support location, we recommend using a permanent casing of 15 feet, measured from the footing bottom elevation. Together with the shoring proposed for construction of the Bent-3 pile footing, at least 28 feet of soil below the railroad track will be retained by shoring and the permanent casing. At this distance, even if soil caving occurs below the permanent casing (a worst case scenario) during construction of the Bent-3 CIDH piles, we do not believe that such soil movement can propagate horizontally and vertically upward to reach the railroad track. Furthermore, we will prescribe restrictions and requirements in the construction specifications (1) to control duration in which a pile bore can remain open, (2) to disallow the excavation of a new pile bore until concrete in the adjacent pile bore has set and (3) mandate the contractor to provide equipment and personnel so that if soil caving does occur, the borehole shall be quickly backfilled with cement slurry.

A crash wall is located in front of Bent 3 column to protect from a derailed train damaging the subject bridge. This crash wall is seating ontop of the Bent 3 pile cap. The foundation design loads in Table 5-4 provided by the structural engineers already include in the loading from the crash wall.

5.4.2 Foundation Data Provided by Structural Designers

Per Caltrans policy, the Load and Resistant Factor Design (LRFD) method is used for bent piles and the Working Stress Design (WSD) is used for abutment piles. The foundation design data sheet and factored foundation loads were provided by the structural designers following the latest Caltrans Memo To Designers (Caltrans, 2008), and are shown in Table 5-3 and Table 5-4, respectively.

TABLE 5-3. FOUNDATION DESIGN DATA SHEET

Location	Design Method	Pile Type	Finished Grade El. (ft)	Pile Cut-off El. (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (inch)	Number of Piles per Support
					B	L		
Abutment 1	WSD	30" CIDH	243.5	215.92/ 219.42/ 222.42	Var 23.5 & 25	26	1	8
Bent 2	LRFD		209.5	201.5	12	16.5		6
Bent 3	LRFD		214.0	202.1	12	16.5		6
Abutment 4	WSD	16" CIDH	245.0	226.65/ 229.57	7	21		7

TABLE 5-4. FOUNDATION DESIGN LOADS

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Perm-anent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abutment 1	1600	275	1460	-	-	-	-	-	-	-	-
Bents 2 & 3	1200	300	1025	1600	475	-	-	950	650	-	350
Abutment 4	500	100	365	-	-	-	-	-	-	-	-

5.4.3 Axial Capacity

The abutment and bent foundations design recommendations are presented in Table 5-5 and Table 5-6, respectively. The Pile Data Table for the contract plans is presented in Table 5-7. The design pile tip elevation for the compression load case was based on skin friction only. The pile capacities are also based on soil resistance only and may be further limited by the pile-head connection details. The pile length is estimated using the more critical case between a single pile and pile group.

TABLE 5-5. ABUTMENT FOUNDATIONS DESIGN RECOMMENDATIONS

Support	Pile Type	Cut-Off Elev. (feet)	LRFD Service-I Limit State per Pile (kips)	Nominal Resistance (kips)	Design Tip Elev. (feet)[1]	Specified Tip Elev. (feet)[2]	Steel Casing Specified Tip El. (ft)
Abut 1	30" CIDH	215.92/ 219.42/ 222.42	280	560	+162 (a) +178 (c) +187 (d)	+162	N/A
Abut 4	16" CIDH	226.65/ 229.57	100	200	+188 (a) +205 (c) +196 (d)	+188	N/A

Notes:
1. Design tip elevation is controlled by the following demands: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for lateral and settlement.

TABLE 5-6. BENT FOUNDATION DESIGN RECOMMENDATIONS

Support Location	Pile Type	Cut-off El. (ft)	Required Factored Nominal Resistance (kips)				Design Tip El. (ft)	Specified Tip El. (ft)	Steel Casing Specified Tip El. (ft)
			Strength Limit		Extreme Event				
			Comp. ($\phi = 0.7$)	Tension ($\phi = 0.7$)	Comp. ($\phi = 1$)	Tension ($\phi = 1$)			
Bent 2	30" CIDH	201.5	480	0	650	350	+150 (a-I) +154 (a-II) +164 (b-II) +155 (c) +161 (d)	+150	N/A
Bent 3	30" CIDH piles with permanent steel casing	202.1					+150 (a-I) +155 (a-II) +162 (b-II) +170 (c) +162 (d)	+150	+187

Notes:
1. Design tip elevation is controlled by the following demands: (a-I) Compression (Strength Limit), (a-II) Compression (Extreme Event), (b-II) Tension (Extreme Event), (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for tension, lateral and tolerable settlement.

TABLE 5-7. PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)	Specified Tip El. (ft)	Steel Casing Specified Tip El. (ft)
		Compression	Tension			
Abutment 1	30" CIDH	560	0	+162 (a) +178 (c) +187 (d)	+162	N/A
Bent 2	30" CIDH	690	350	+150 (a) +164 (b) +155 (c) +161 (d)	+150	N/A
Bent 3	30" CIDH piles with permanent steel casing	690	350	+150 (a) +162 (b) +170 (c) +162 (d)	+150	+187
Abutment 4	16" CIDH	200	0	+188 (a) +205 (c) +196 (d)	+188	N/A

Notes:
1. Design tip elevations for ***Abutments*** are controlled by: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. Design tip elevations for ***Bent*** are controlled by: (a) Compression, (b) Tension, (c) Settlement, and (d) Lateral Load.

5.4.4 Lateral Resistance

Results of lateral pile analysis in terms of pile-head shear and lateral deflection for both free-head and fixed-head condition are presented in Table 5-8. The maximum bending moment and the location of maximum moment are also presented. The solutions presented in Table 5-8 are entirely based on soil resistance and linear pile properties. Therefore, these values may be limited by the flexural strength (plastic moment) of the piles and other connection details. Linear interpolation can be used for solutions between pile-head deflections of 0.25 and 6 inches.

5.5 EMBANKMENTS AND SETTLEMENT

Settlement. About 34 feet of sliver fill will be placed to construct the approach embankments. Based on the onsite soil type, ground subsidence is estimated to be on the order of 3 inches. Due to the presence of a sandy lean clay layer immediately below the existing BNSF ground surface, we recommend a settlement period of at least 14 calendar days for pile installation at the abutments only.

Slope Stability. Global stability analyses were conducted using the computer program PCSTABL (Achilleos, 1988) for both static and pseudostatic conditions for the bridge end slopes. Results of this analysis are presented in Appendix C.

The factor of safety for a deep-seated failure is greater than 1.5 under static condition for the 1V:1.5H end slope with a 2-foot soil surcharge to represent traffic loading. Slope stability analysis under pseudostatic condition was performed using a seismic coefficient equal to 0.2g (which is the smaller of either one-third the horizontal peak ground acceleration or 0.2g) in accordance with guidelines provided in Section 3.12 of the Caltrans Guidelines for Foundation Investigations and Reports (Caltrans, 2006a). Analysis indicates that the factor of safety is greater than 1.1 under pseudostatic condition. The 1V:1.5H end slope has proposed concrete slope paving, therefore surficial stability is not a design issue.

Structural Approach Slab. Per Caltrans Memo to Designers 5-3 dated December 1992, structure approach slabs are required for this project. Selection of the approach type will be performed by the structurral designer following the flowchart in Caltrans Memo to Designers 5-3, Attachment A dated May 1996.

TABLE 5-8. LATERAL PILE SOLUTIONS

Lateral Displacement at Top of Pile (in)	Fixed Head		Free Head		
	Lateral Load at Top of Pile (kips)	Max. Bending Moment (kip-in)	Lateral Load at Top of Pile (kips)	Max. Bending Moment (kip-in)	Depth from Pile Head to Max. Moment (ft)
Abutment 1 - 30" CIDH					
0.25	65.8	3861	33.5	1470	7.4
0.5	95.1	6241	48.1	2374	8.2
1	137.7	10096	69.2	3838	9.2
2	199.5	16338	99.8	6209	10.4
3	247.8	21652	123.7	8231	11.0
4	289.2	26445	144.0	10050	11.4
6	354.2	34855	177.3	13317	12.2
Bent 2 - 30" CIDH					
0.25	49.2	3206	24.8	1215	8.2
0.5	71.9	5246	35.7	1965	9.2
1	105.7	8627	51.6	3200	10.2
2	156.0	14228	74.9	5258	11.6
3	196.4	19089	93.4	7058	12.4
4	231.4	23530	109.4	8713	13.0
6	288.9	31548	136.0	11739	14.0
Bent 3 - 30" CIDH					
0.25	51.3	3351	24.4	1181	8.2
0.5	81.8	5967	36.0	2007	9.4
1	133.7	10763	54.9	3672	11.0
2	214.6	18975	86.3	6900	11.6
3	277.5	25953	112.5	9810	12.2
4	330.2	32184	135.1	12435	12.4
6	415.6	43194	172.5	17085	13.2
Abutment 4 - 16" CIDH					
0.25	28.3	946	14.5	361	4.2
0.5	40.8	1526	20.8	581	4.8
1	58.9	2463	29.9	937	5.2
2	85.1	3976	43.0	1513	5.8
3	104.6	5253	53.0	2003	6.2
4	118.2	6333	60.3	2441	6.6
6	137.8	8129	70.9	3205	7.2

5.6 BRIDGE ABUTMENT WALL DESIGN

Abutment Earth Pressures. If abutment walls are free to move laterally at the top, a static active lateral earth pressure of 36 psf per foot of depth is recommended for a free draining, level and compacted backfill. If lateral movement at the top of abutment walls is restrained, the lateral earth pressure for a free draining, level and compacted backfill should follow Section 5.5.5.11 of the Caltrans BDS dated August 2004. For this condition, we recommend a coefficient of active lateral earth pressure of 0.3, a coefficient of at-rest lateral earth pressure of 0.47 and a soil unit weight of 120 lb/ft^3. If applicable, a uniform lateral pressure of at least 72 psf due to vehicle loads, equivalent to a vertical pressure produced by at least 2 feet of earth, should be added to the above lateral earth pressure.

Passive Resistance of Abutment Backfill. Under seismic loading, an ultimate passive earth pressure of 5 ksf may be used for the approach backfill and abutment walls with a height equal to or greater than 5.5 feet. For abutment walls with heights less than 5.5 feet, the passive pressure may be calculated proportionally (e.g., for a 4-foot high wall, the passive pressure is [4/5.5]x 5 ksf = 3.64 ksf. The horizontal movement at which the maximum passive pressure is expected to be fully mobilized can be determined following the procedure outlined in Section 7.8.1 of the Caltrans SDC (2006b).

Abutment Wingwall. The abutments are adjacent to RW 492 and 496. Both abutment wingwalls are relatively narrow and only extend to the end of the abutment pile caps; two wingwalls sit on the abutment pile caps as a part of the abutment design. Design of RW 492 and 496 is in a separate report.

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 EARTHWORK

Earthwork should be performed in accordance with Caltrans Standard Specifications, Section 19 (Caltrans, 2006c). Appropriate measures should be taken to prevent damage to adjacent structures and utilities. Any design and construction of temporary sloping, sheeting, or shoring should be made the contractor's responsibility. It should be noted that it is the responsibility of the contractor to oversee the safety of the workers in the field during construction. The contractor shall conform to all applicable occupational and health standards, rules, regulations, and orders established by the State of California. In addition, other State, County, or Municipal regulations may supersede the recommendations presented in this section. If a trench shoring design and safety plan is required, the geotechnical consultant should review the plan to confirm that recommendations presented in this report have been applied to the design.

During the recent field investigation conducted on September 23, 2008, groundwater was not encountered down to El. +145.4 feet which is more than 90 feet from the freeway surface. As shown on the as-built LOTB sheets in Appendix A, groundwater was not encountered during drilling in April 1966 down to El. +175 feet, and in January 1989 down to El. +164 feet. Therefore, groundwater is not expected to be encountered during footing construction. However, groundwater level can fluctuate due to seasonal rainfall amount, local irrigation and groundwater recharge program and other man-made conditions. If groundwater is encountered, it should be controlled in accordance with Section 19-3.04 of the Caltrans Standard Specifications (2006c).

At Bent 3, Caltrans Structure Backfill shall be used between the crash wall footing and pile cap with a minimum relative compaction of 95% of maximum density as determined by Caltrans Test Method 216.

6.2 PILE CONSTRUCTION

For on-center pile spacings less than six times the pile diameter, no two adjacent piles can be constructed concurrently.

Piles at Abutment 1 will straddle an existing 72-inch diameter RCP storm drain pipe. To minimize the potential for damaging the RCP, two adjacent CIDH piles are not allowed to be drilling concurrently without a casing.

At Bent 3, a 15-foot long permanent casing is recommended for the CIDH piles in order to avoid potential loss of the railroad base materials due to pile construction. The permanent casing should be placed tight-in-hole. The use of vibratory or impact hammer for installation of permanent casing is not recommended since it could cause settlement of the railroad track base materials. The oscillation or drill ahead and case methods would have much less effects on the railroad tracks. The following restrictions should also be enforced during pile construction at Bent 3:

- No pile boring should be left open during a work-shift; that is, if excavation is started for any pile boring, the same pile boring must be filled with concrete before the CIDH pile construction crew can terminate that work shift.

- No boring should be drilled until concrete in any adjacent pile within 5 pile diameters has attained its initial set.
- Soil caving, if any, should be controlled expeditiously; low-strength sand-cement slurry can be used to fill the caved region and drilling may continue when the slurry has reached its initial set.

At all locations, loose soils should be cleaned from the bottom of the borings. Pile borings should be inspected and approved by the geotechnical engineer prior to the installation of reinforcement. Extreme care in drilling, placement of steel, and the pouring of concrete is essential to avoid excessive disturbance of pile boring walls. Concrete placement by pumping or tremie tube to the bottom of the pile borings is recommended. Specifications should require that sufficient space be provided in the pile reinforcing cage during fabrication to allow the insertion of a tremie tube for concrete placement. The pile reinforcing cage should be installed and the concrete pumped immediately after drilling is completed.

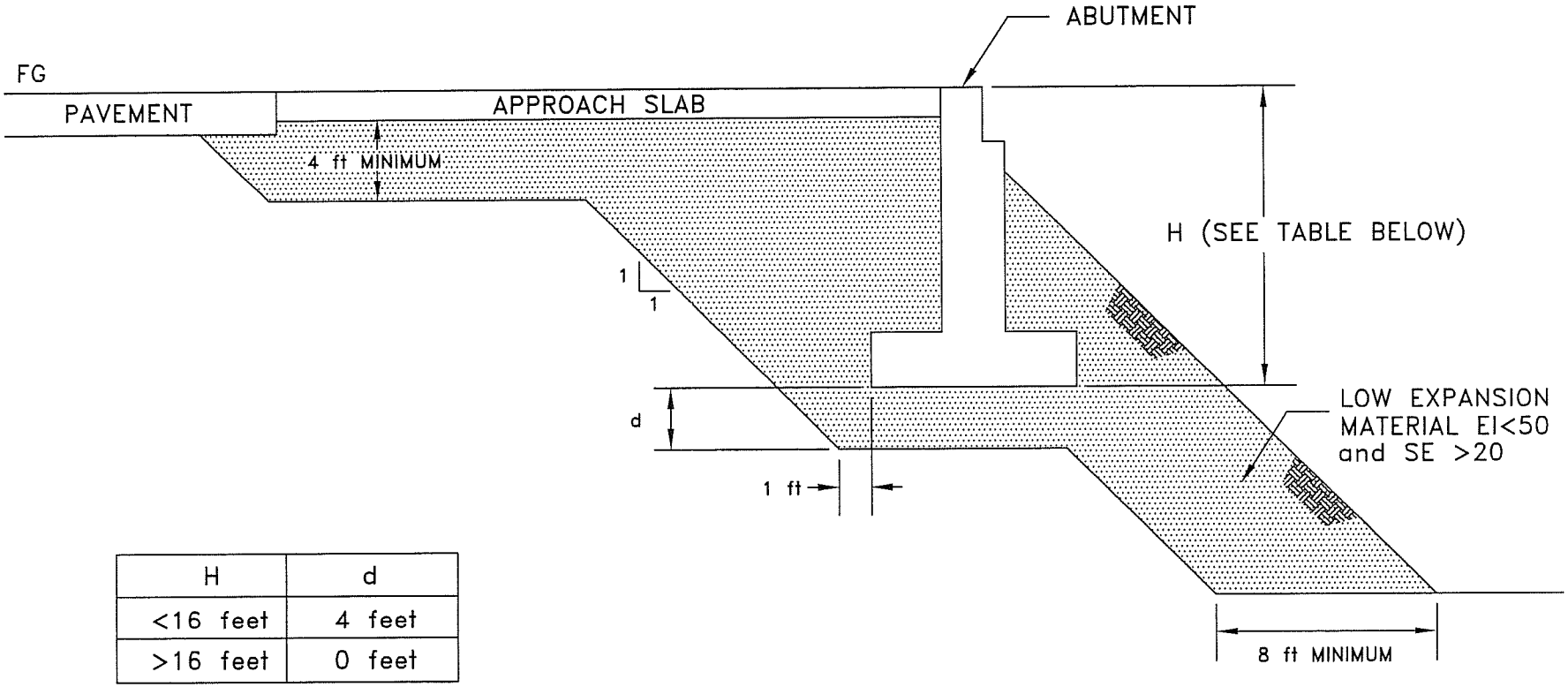
Sand was encountered in our soil borings and these materials are susceptible to caving. If caving occurs, a temporary casing may be required during construction. The temporary casings should have an inner diameter equal to or exceeding the pile diameter. Oversized predrilling and vibratory hammers are not allowed for temporary casing installation. The temporary casing should be pulled as the concrete is being poured while always maintaining at least a 5-foot head of concrete inside the casing.

6.3 BACKDRAIN AND BACKFILL REQUIREMENTS FOR ABUTMENT WALLS

Per Caltrans requirements, expansive soils should not be placed as part of the embankment within the limits of a bridge abutment as shown in Figure 6-1. Materials placed behind abutment wall should be low-expansive soil with an Expansion Index (EI) less than 50 and Sand Equivalent (SE) of more than 20. The low-expansive material requirement should be supplemental to the abutment structure and pervious backfill requirement as described in Caltrans Standard Plans (2006d) and Caltrans Standard Specifications (2006c) under Sections 19-3.06 and 19-3.065, respectively.

Backfill should be compacted in accordance with Section 19-5 of the Caltrans Standard Specifications (2006c). Backfill should be placed in loose lifts not exceeding 8 inches in thickness, moisture-conditioned to near optimum moisture content, and compacted to at least 95 percent relative compaction. The relative compaction should be based on the maximum density determined by California Test 216. Jetting or flooding to compact backfill is not recommended. Heavy compaction equipment, such as vibratory rollers, dozers, or loaders, should not be used adjacent to the abutment walls in order to avoid damaging the walls due to large lateral earth pressures.

Backdrains should be installed behind abutment walls to relieve hydrostatic pressure. Backdrains should be constructed in accordance with Bridge Detail 3-1 on Sheet BO-3 per Caltrans Standard Plans (2006d) or the geocomposite drain alternative per Section 6 of the Caltrans Bridge Design Aids (1992).



H	d
<16 feet	4 feet
>16 feet	0 feet

EXPANSION INDEX TO BE DETERMINED BY ASTM D4829
SAND EQUIVALENT TO BE DETERMINED
BY CALIFORNIA TEST METHOD 217

NO SCALE

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

PLACENTIA OVERHEAD (WIDEN)

EMI Project No. 08-115 | Date: 12-12-2008

LOW EXPANSION MATERIAL
IN BRIDGE EMBANKMENT

FIGURE 6-1

6.4 REVIEW OF CONSTRUCTION PLANS

Recommendations contained in this report are based on preliminary plans. The geotechnical consultant should review the final construction plans and specifications in order to confirm that the general intent of the recommendations contained in this report have been incorporated into the final construction documents. Recommendations contained in this report may require modification or additional recommendations may be necessary based on the final design.

6.5 GEOTECHNICAL OBSERVATION AND TESTING

It is recommended that inspections and testing be performed by the geotechnical consultant during the following stages of construction:

- Grading operations, including excavations and placement of compacted fill
- Shoring installation
- Footing excavations
- Pile installation
- Backdrain installation and backfilling of bridge abutment walls.
- Removal or installation of support of buried utilities or structures
- When any unusual subsurface conditions are encountered

7.0 LIMITATIONS

This report is intended for the use of RBF Consulting, Orange County Transportation Authority and Caltrans for the widening of Placentia Overhead. This report is based on the project as described and the information obtained from the exploratory borings at the approximate locations indicated on the attached plans. The findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses. In addition, soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project site. However, subsurface conditions and characteristics of soils between exploratory borings can vary. The findings reflect an interpretation of the direct evidence obtained. The recommendations presented in this report are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained in this report are applicable to the specific design element(s) and location(s) which is (are) the subject of this report. They have no applicability to any other design elements or to any other locations and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

EMI has no responsibility for construction means, methods, techniques, sequences, or procedures; for safety precautions or programs in connection with the construction; for the acts or omissions of the CONTRACTOR or any other person performing any of the construction; or for the failure of any worker to carry out the construction in accordance with the Final Construction Drawings and Specifications.

Services performed by EMI have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

8.0 REFERENCES

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APPENDIX A

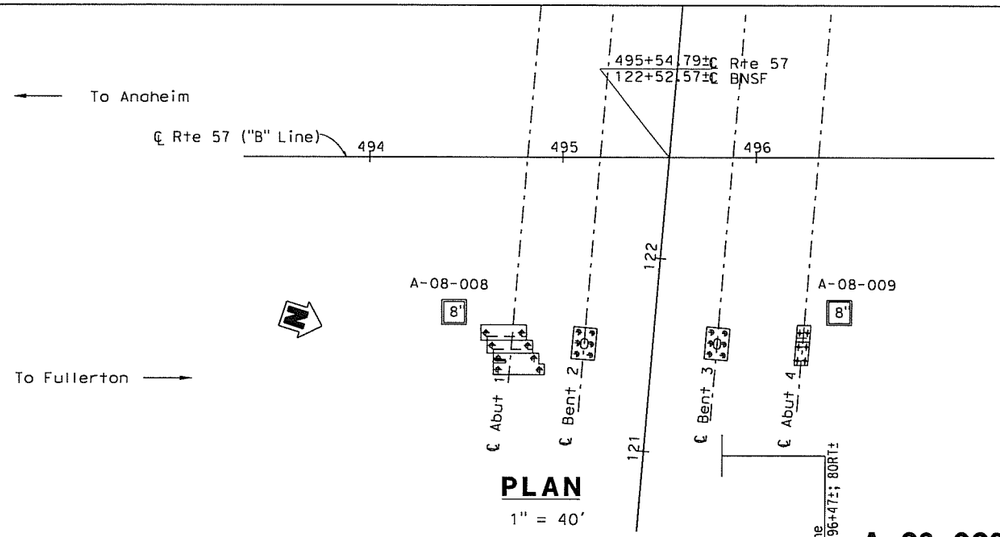
LOG OF TEST BORINGS SHEETS AND AS-BUILT LOG OF TEST BORINGS SHEETS

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 40'

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lina Cheang
REGISTERED ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

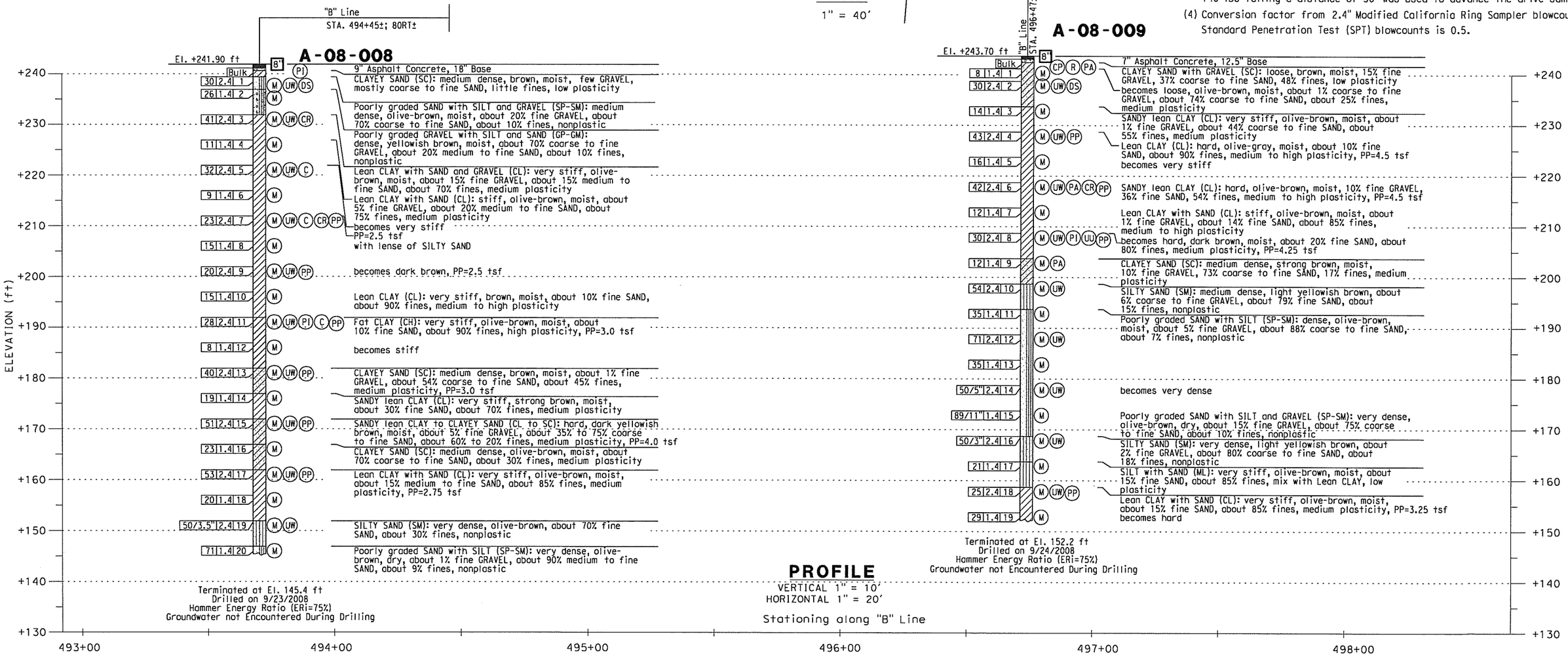
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'
Stationing along "B" Line

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0449 / POST MILES 16.9
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			

PLACENTIA OH (WIDEN)
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3
CU 12
EA 0F0311
DISREGARD PRINTS BEARING EARLIER REVISION DATES →
REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09
SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lina Cheang
REGISTERED ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER
L. CHEANG
NO. GE 2345
EXP. 9-30-09
GEOTECHNICAL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
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EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

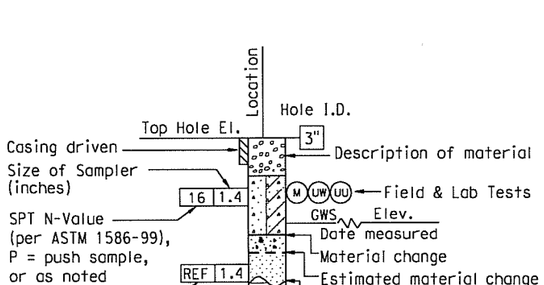
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

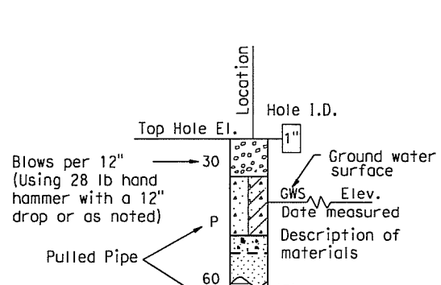
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

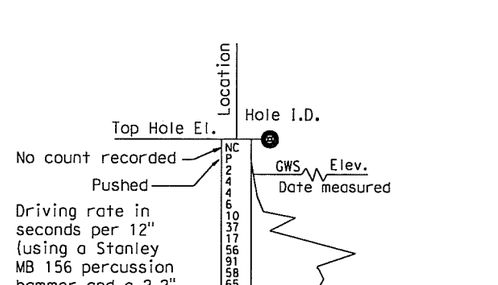
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



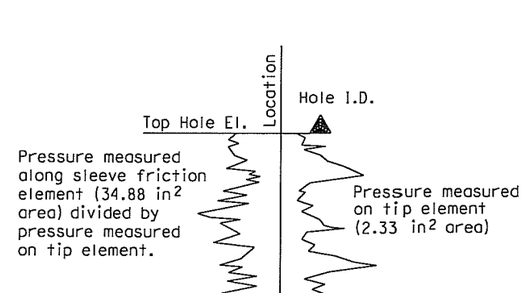
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0449 POST MILES 16.9

PLACENTIA OH (WIDEN)

LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME -> $USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90)
Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166)
Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lin Cheang
REGISTERED ENGINEER — DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

L. Cheang
PROJECT ENGINEER

BRIDGE NO. 55-0449
POST MILES 16.9

PLACENTIA OH (WIDEN)
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
12	Ora	57	11.1/21.2	490	491

Kul Bhushan 12/28/89
GEOTECHNICAL PROFESSIONAL
10-29-90
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — KUL BHUSHAN — No. GE 000144 — Exp. 12/31/1989 — GEOTECHNICAL — STATE OF CALIFORNIA

GEOFON, INC.
5552 CERRITOS AVENUE, SUITE B
CYPRESS, CALIFORNIA
JOB NO.: 88-351

REGISTERED PROFESSIONAL ENGINEER — LIND C. CHEANG — No. GE 2345 — EXP. 9/30/89 — GEOTECHNICAL — STATE OF CALIFORNIA

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

Lino Cheang
REGISTERED CIVIL ENGINEER — DATE

PLACENTIA OH (WIDEN)

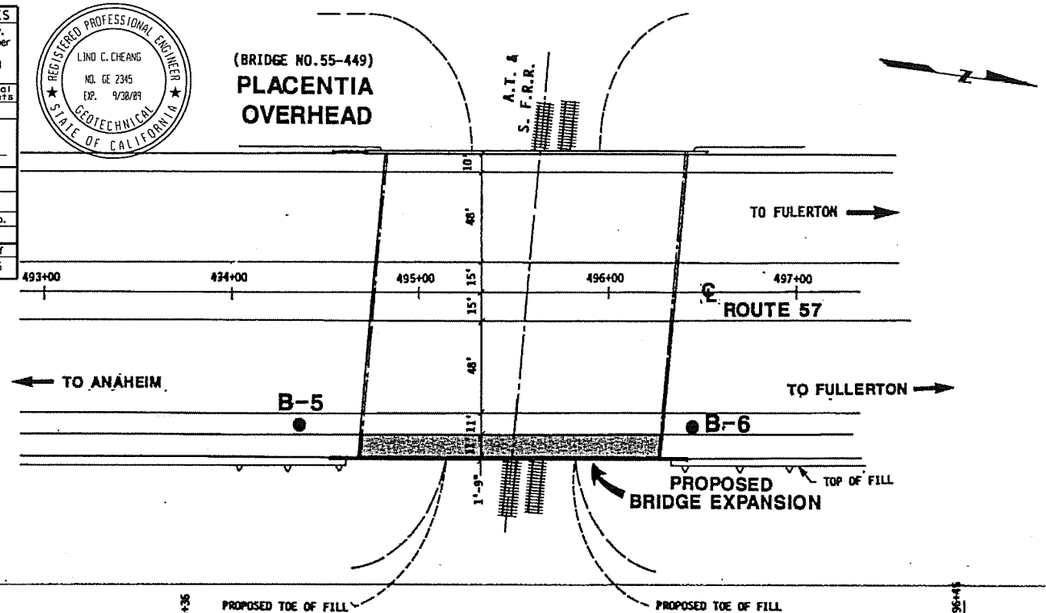
AS-BUILT LOG OF TEST BORINGS NO.1

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

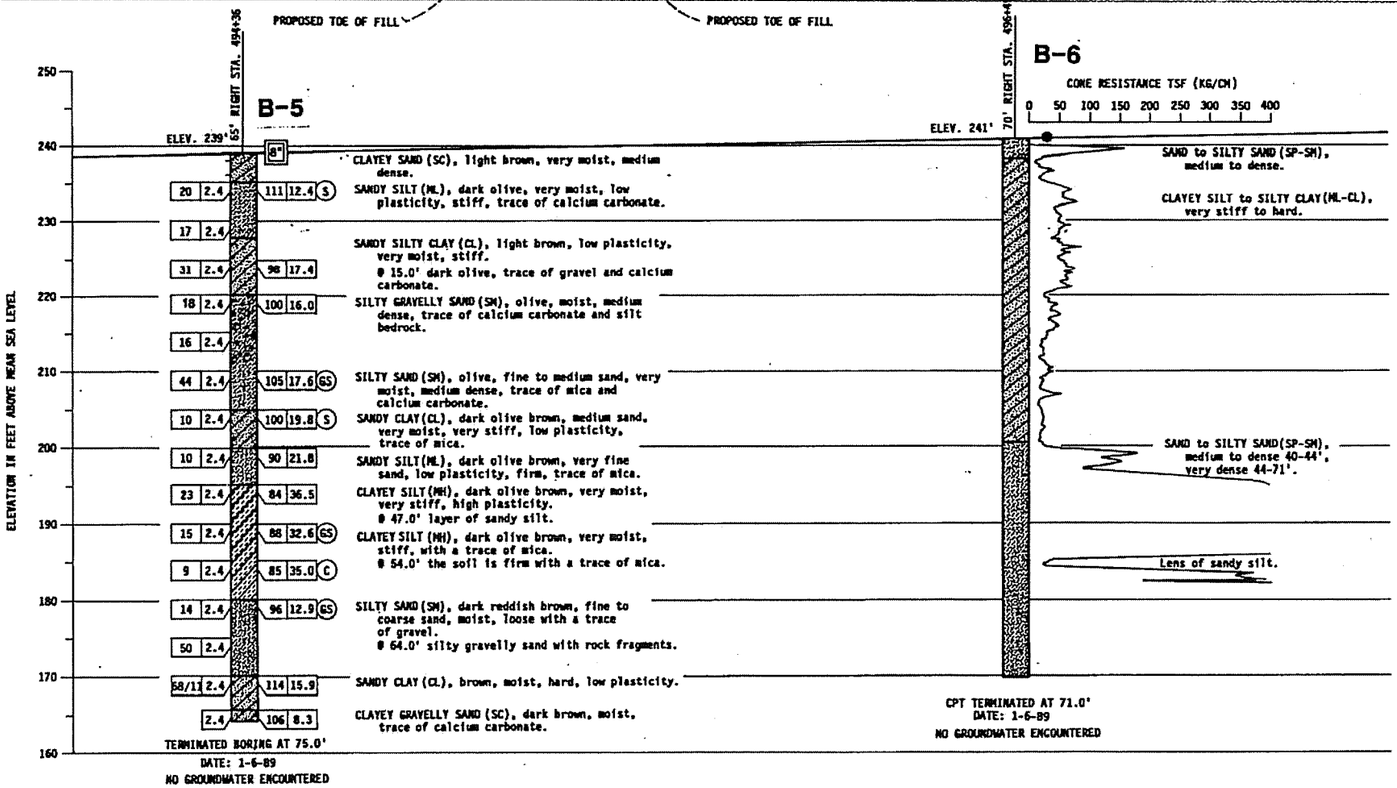
BRIDGE No.	
55-0449	
Sheet	of
35	36

(BRIDGE NO.55-449)
PLACENTIA OVERHEAD



PLAN
SCALE: 1"=40'

PROFILE
VERTICAL SCALE: 1"=10'
HORIZONTAL SCALE: 1"=20'

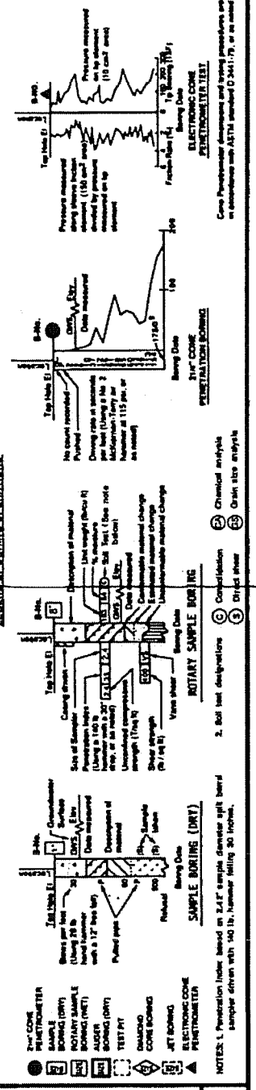


AS BUILT — NO AS BUILT CHANGE
CORRECTIONS BY J. PUNZALAN
CONTRACT NO. 12-020184
DATE 11-23-92

BM 535-D-70 — ELEVATION 257.37

FOUND CHISELED CROSS ON TOP OF THE NW ANCHOR BOLT OF A SIGN BASE 77 FEET EASTERLY OF THE CENTERLINE OF ROUTE 57 (ORANGE FREEWAY) STATION 535+60 AND 105 FEET NORTHERLY OF THE CENTERLINE OF RUTWOOD AVE..

LEGEND OF BORING OPERATIONS


Pressure measured during Penetration (Pushing) Test (Reading on gage divided by pressure measured on top element)
ELECTRONIC CONE PENETROMETER TEST
Cone Penetrometer dimensions and testing procedures are in accordance with ASTM standard D 3441-79, or as revised
Drilling Date
Ground Surface Elev.
Date Measured
Depth to Water
Bottom of Hole
Backfilled
Sand Backfill
Bentonite Grout
Cement Grout
Asphalt Concrete
Concrete
Bedrock
Bottom of Casing
Top of Hole
Bottom of Hole
Core Barrel
Casing
Core Sample
Core Hole
Drive Sample
Ring Sample
Grab Sample
Bag Sample
Description of material
Boring Data
Soil Test (See note below)
Core Recovery
Core Hole Diameter
Unconfined Compressive Strength
Undisturbed Sample
Undisturbable Material
Change
Chemical analysis
Grain size analysis
Consolidation
Direct shear
ROTARY SAMPLE BORING
Cleaning Drum
Size of Sampler
Blows per foot (Driving a 140 lb. hammer falling 30 inches on a 2" O.D. split spoon sampler)
Shear strength (lb/sq ft)
Vane shear
Core Sample
Core Hole
Core Barrel
Casing

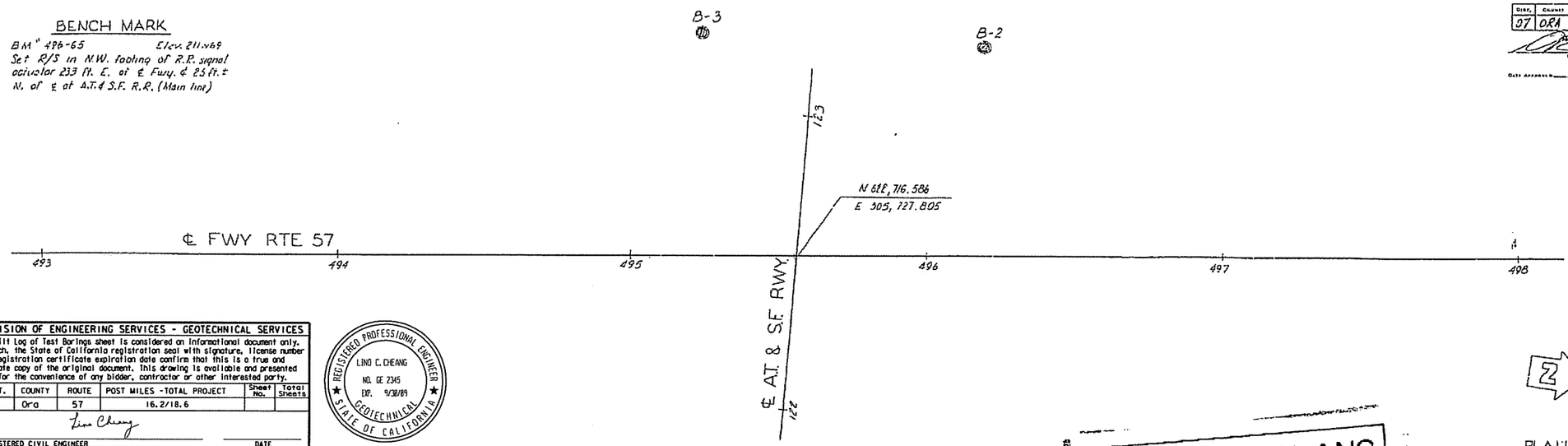
FED. ROAD DIV. NO.	STATE	F. A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	15.6/21.8	147	197

DISTRICT ENGINEER — Date approved: August 28 1967

BENCH MARK

BM "496-65" Elev. 211.469
Set R/S in NW. footing of R.R. signal
activator 233 ft. E. of ℄ Fury. & 25 ft. ±
N. of ℄ of A.T. & S.F. R.R. (Main line)



DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES					
As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.					
DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		
Lino Cheung					
REGISTERED CIVIL ENGINEER			DATE		

REGISTERED PROFESSIONAL ENGINEER — LINO C. CHEUNG — NO. GE 2345 — EXP. 9/30/69 — STATE OF CALIFORNIA — GEOTECHNICAL

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668

PLAN
Scale 1" = 20'

PLACENTIA OH (WIDEN)

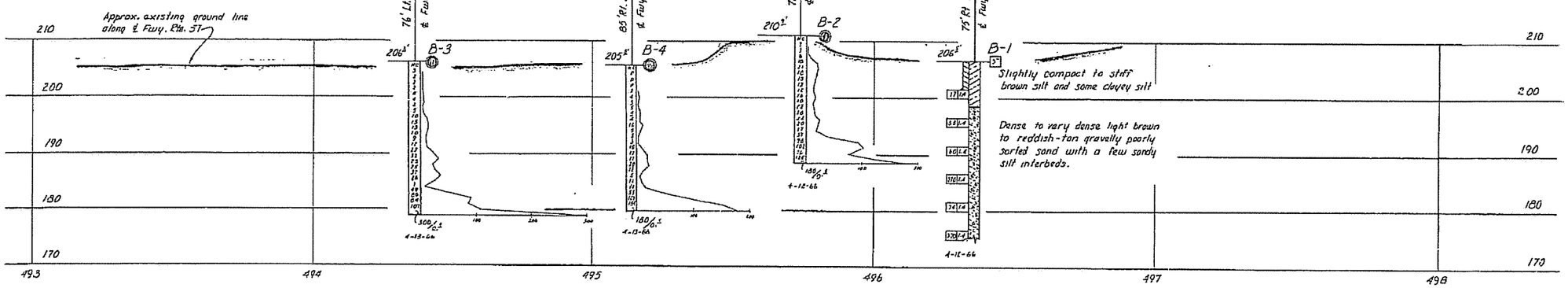
AS-BUILT LOG OF TEST BORINGS NO.2

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

Cu: 12
Ea: 0F0311

BRIDGE No. 55-0449

Sheet 36 of 36



PROFILE
Scale Vert. 1" = 10'
Horiz. 1" = 20'

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE April 1966

AS BUILT
CORRECTIONS BY Hixson 7-28-69
CONTRACT NO. 07-032124
DATE 5-11-69

SHEET	OF
13	13

LEGEND OF BORING OPERATIONS

Penetrometer; 2½" Cone Penetrometer; Sampler boring (dry); Rotary boring (wet); Rotary boring (dry); Auger boring (dry); Jet boring; Core boring; Test pit

LEGEND OF EARTH MATERIALS

Gravel; Sand; Silt; Clay; Silty Clay or Clayey Silt; Peat and Organic Matter; Fill Material; Sandy Clay or Clayey Sand; Silty Silt or Silty Sand; Igneous Rock; Sedimentary Rock; Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

Diagram showing the basis for classifier of grain size materials used in description of clay hills. Adjectives for approximate percentages the terms "gravelly sand" or add to the class name, viz. "gravelly sand, trace silt" means 10% to 20% gravel, 5% to 10% silt and gravel refer to standard scale size limits.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

FIELD STUDY	H. D. CRAWFORD	4-13-66
DRAWN	M. ALLREAD	4-21-66
CHECKED	W. CAIN	5-26-66

Approved Maurice Sherman
Engineering Geologist

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PLACENTIA OVERHEAD

LOG OF TEST BORINGS

SCALE	BRIDGE	FILE	DRAWING
As Noted	55-449 L		55449-16

Charge 07208
W.A. 032121

Disregard prints bearing earlier numbers

PREL. DRAWING NO. PR- 9/67

147

APPENDIX B

LABORATORY TEST RESULTS

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

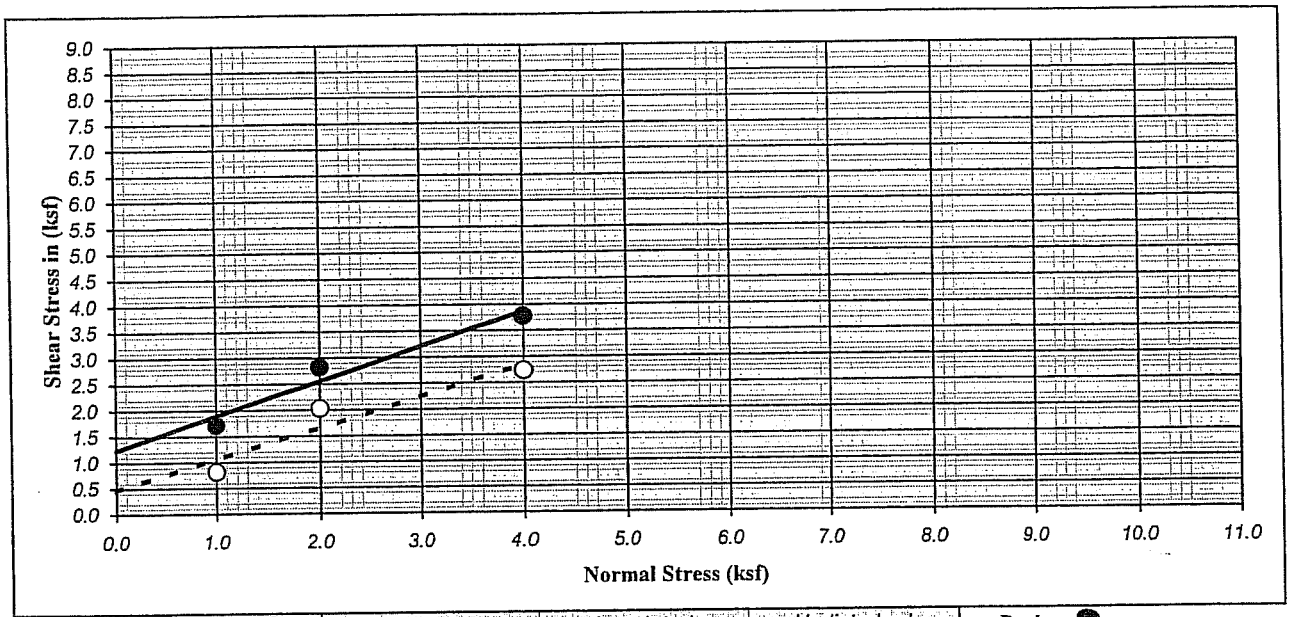
Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-008	BULK	2.5-5	SC							24/15/9				
A-08-008	D-1	2.5	SP-SM	7.0	123.6									
A-08-008	S-2	5	GP-GM	2.7										
A-08-008	D-3	10	CL	17.9	126.7						810	7.7	450	213
A-08-008	S-4	15	CL	17.1										
A-08-008	D-5	20	CL	16.0	131.8									
A-08-008	S-6	25	CL	18.4										
A-08-008	D-7	30	CL	20.8	122.5	2.5					510	7.4	750	208
A-08-008	S-8	35	CL	20.1										
A-08-008	D-9	40	CL	18.4	122.3	2.5								
A-08-008	S-10	45	CL	33.6										
A-08-008	D-11	50	CH	32.5	118.3	3.0				58/19/39				
A-08-008	S-12	55	CL	38.4										
A-08-008	D-13	60	CL to SC	14.2	138.7	3.0								
A-08-008	S-14	65	CL	17.2										
A-08-008	D-15	70	CL to SC	11.9	141.2	4.0								
A-08-008	S-16	75	SC	14.5										
A-08-008	D-17	80	CL	20.5	131.2	2.75								
A-08-008	S-18	85	CL	18.3										
A-08-008	D-19	90	SM	16.3	134.3									
A-08-008	S-20	95	SP-SM	2.8										
A-08-009	S-1	2.5	SC	9.8										
A-08-009	D-2	5	SC	12.9	113.7									
A-08-009	S-3	10	CL	12.6										
A-08-009	D-4	15	CL	17.3	109.4	>4.5								
A-08-009	S-5	20	CL	17.8										
A-08-009	D-6	25	CL	15.6	119.7	4.5		10:36:54			850	7.7	300	142
A-08-009	S-7	30	CL	17.6										
A-08-009	D-8	35	CL	16.6	124.7	4.25				42/17/25				
A-08-009	S-9	40	SC	5.3				10:73:17						
A-08-009	D-10	45	SM	1.6	102.7									
A-08-009	S-11	50	SP-SM	2.3										
A-08-009	D-12	55	SP-SM	4.8	109.7									
A-08-009	S-13	60	SP-SM	2.4										
A-08-009	D-14	65	SP-SM	2.0	101.5									
A-08-009	S-15	70	SP-SM	1.8										
A-08-009	D-16	75	SM	8.3	104.1									
A-08-009	S-17	80	ML	31.6										
A-08-009	D-18	85	CL	21.5	129.5	3.5								
A-08-009	S-19	90	CL	22.1										

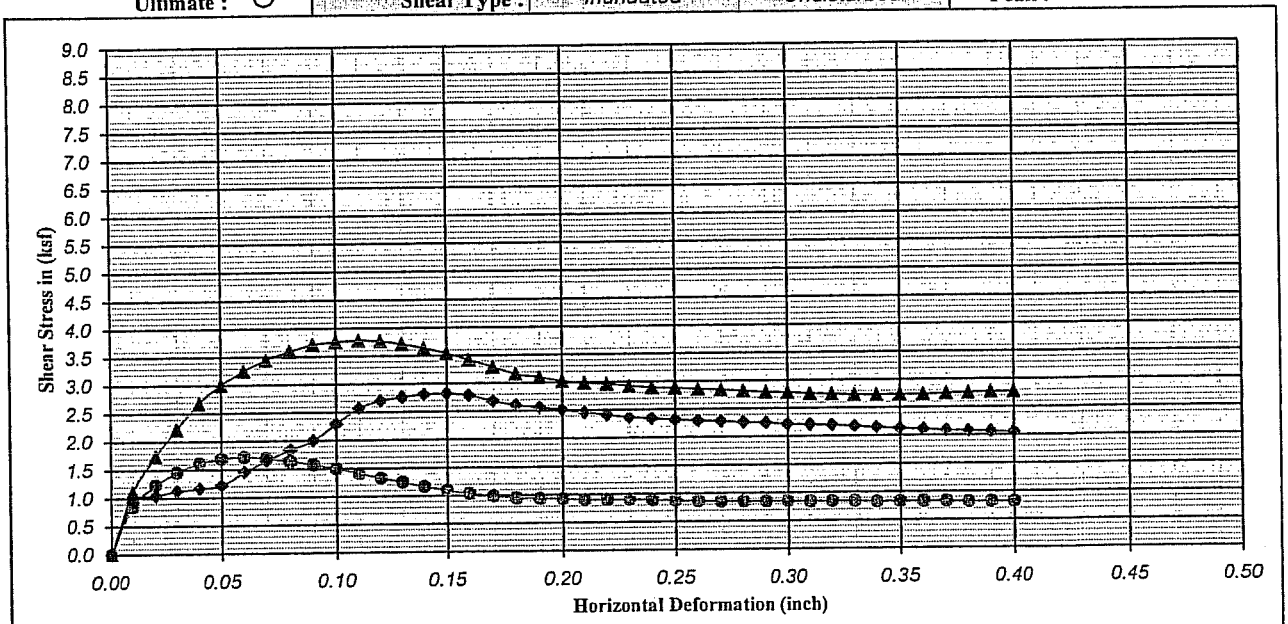
TABLE 2 SUMMARY OF LABORATORY STRENGTH TEST RESULTS

Project No. : *08-115* **Project Name :** RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth	Soil Identification (group symbol) ASTM D2488/D2487	Unconsolidated Undrained Triaxial Test (ASTM D2850)				Direct Shear Test (ASTM D3080)			
								Peak		Residual	
				Peak Strength S_u	Strain at Peak S_u	Shear Strength at 10% Strain S_u	Confining Pressure	ϕ	C	ϕ	C
		(ft)		(ksf)	(%)	(ksf)	(ksf)	(deg)	(ksf)	(deg)	(ksf)
A-08-008	*D-1*	2.5	SC					57.36	0	38.74	0.16
A-08-008	*D-5*	20	CL					33.36	1.24	30.94	0.46
A-08-009	*D-2*	5	SC					63.38	0.64	42.15	0.19
A-08-009	*D-8*	35	CL	3.85	12.34	3.66	2.73				



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-008	Strength Intercept (C) :	1.24	(ksf)		0.46	(ksf)		
Sample No. : D-5		59.18	(kPa)	Peak	22.12	(kPa)	Ultimate	
Depth (ft/m) : 20.0 | 0.00	Friction Angle (ϕ) :	33.36	Degree		30.93	Degree		
Description : Olive, Lean CLAY with SAND (CL)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	20.33	109.98	17.31	0.53	1.00	47.88	1.72	82.16	0.82	39.07
◆	22.02	105.52	16.61	0.60	2.00	95.76	2.82	135.02	2.03	97.10
▲	18.31	107.45	16.91	0.57	4.00	191.52	3.78	180.99	2.74	131.00

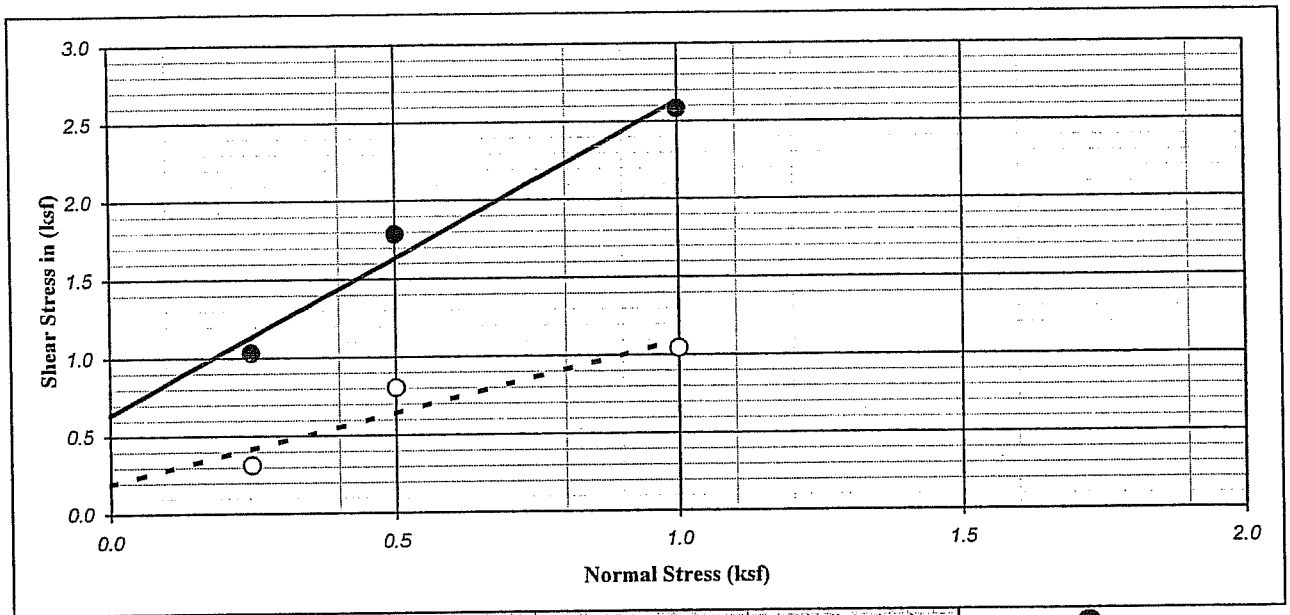
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

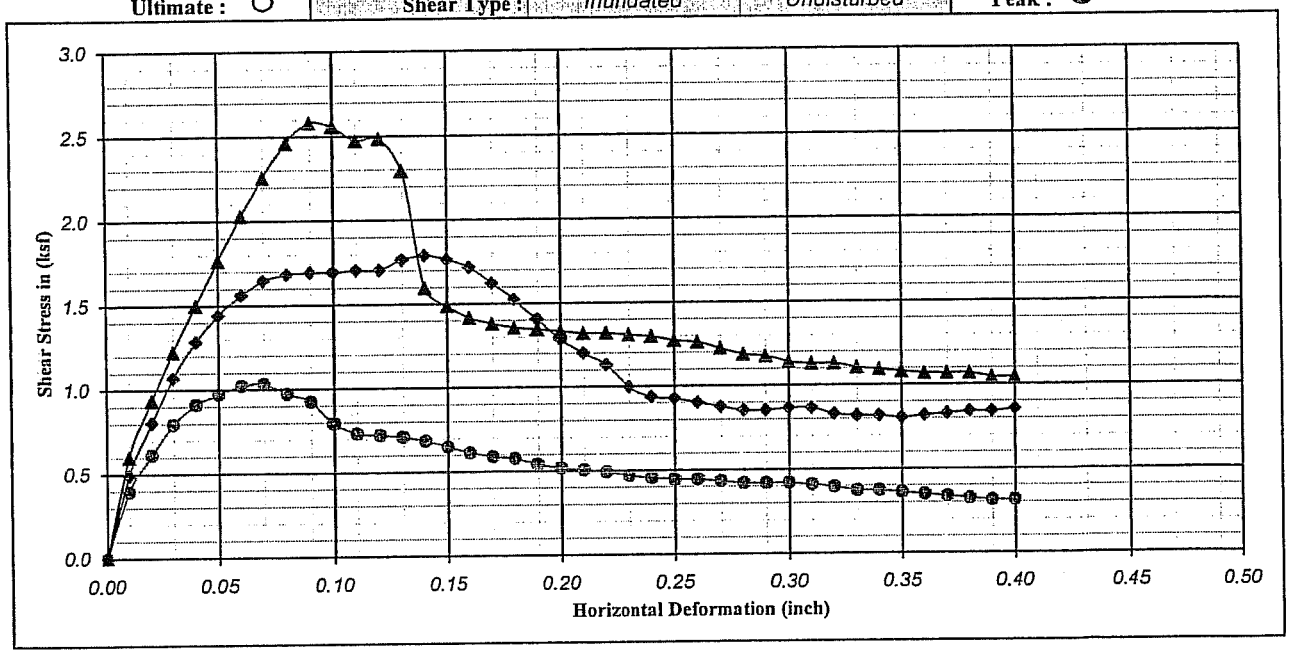
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/14/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-009		Strength Intercept (C) :	0.64	(ksf)		0.19	(ksf)	
Sample No. : D-2			30.45	(kPa)	Peak	9.19	(kPa)	Ultimate
Depth (ft/m) : 5.0	0.00	Friction Angle (ϕ) :	63.38	Degree		42.15	Degree	

Description : Mottled olive brown, yellowish brown, brown, CLAYEY SAND (SC) — Shear Rate (inch/minute) : 0.02

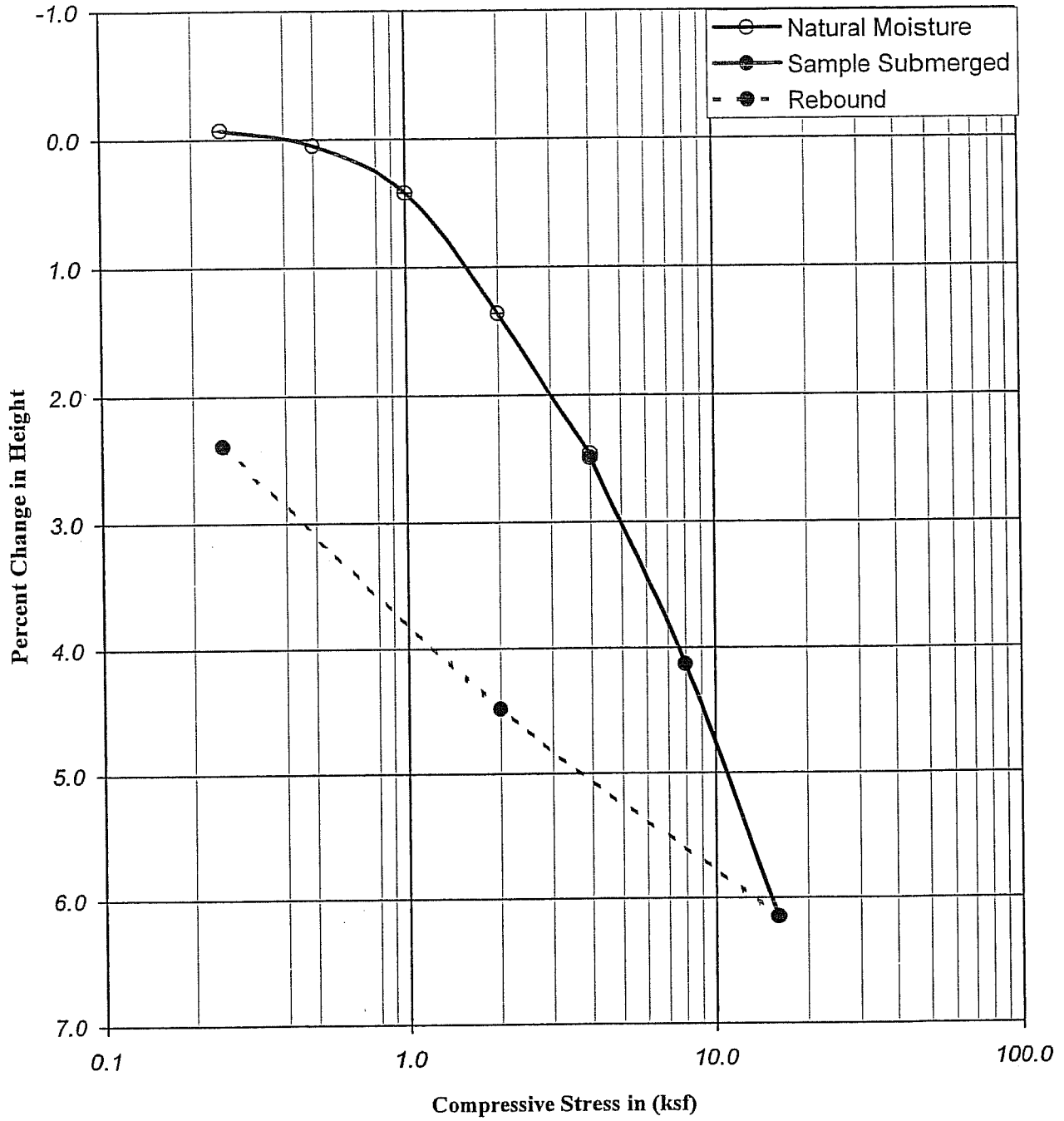
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	13.01	100.63	15.84	0.68	0.25	11.97	1.03	49.41	0.31	14.94
◆	13.46	102.67	16.16	0.64	0.50	23.94	1.79	85.61	0.80	38.50
▲	13.35	104.37	16.43	0.61	1.00	47.88	2.58	123.53	1.04	49.99

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/21/08 | Figure No. :



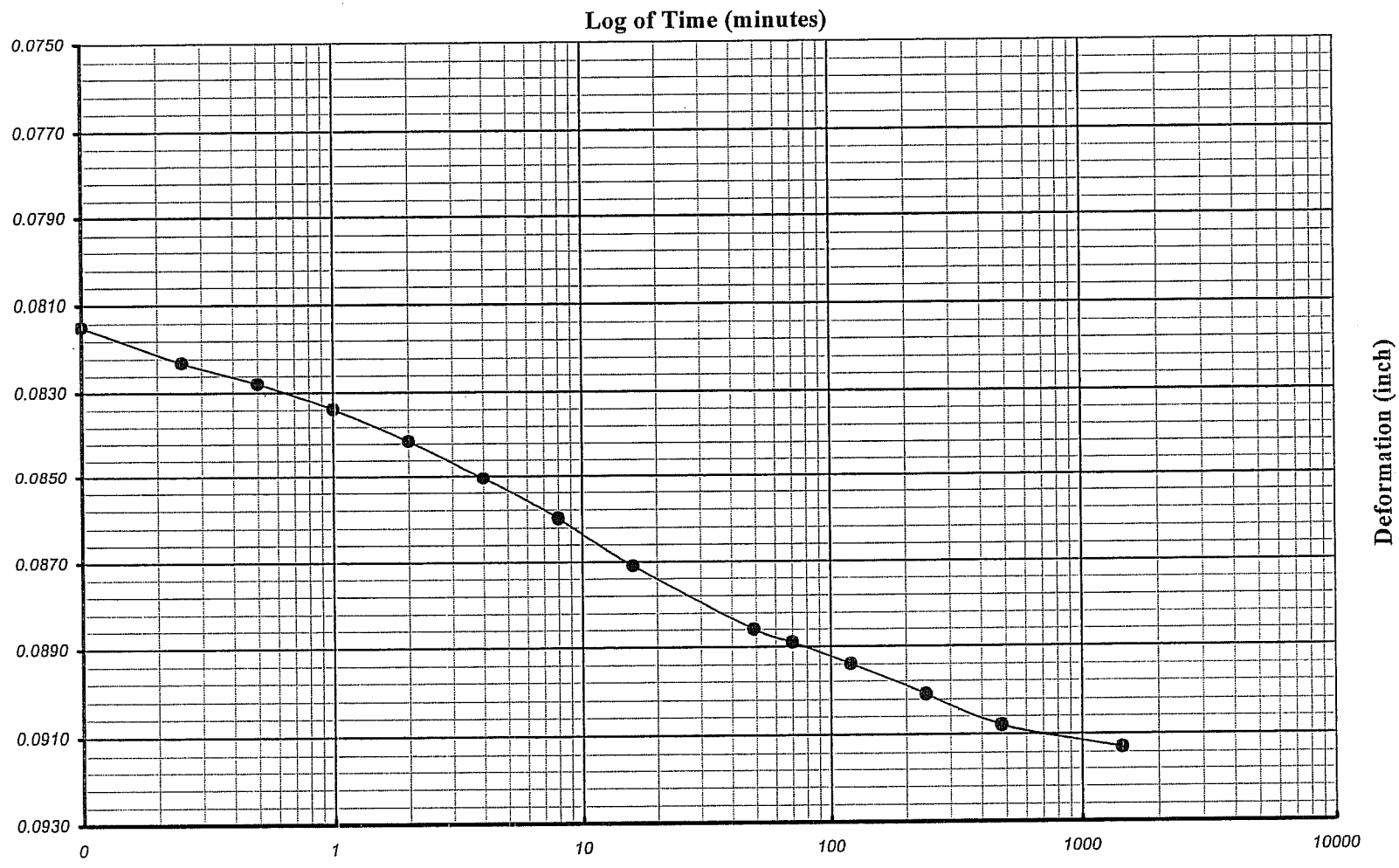
Boring No. : A-08-008				Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No. : D-5				Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft) : 20.0		21.5	Plastic Index :	-	Initial	21.90	102.37	16.11	91.45	0.65
	(m) : 6.10		6.56	Specific Gravity :	2.70	Final	23.11	104.95	16.52	102.93	0.61
Description : Olive, Lean CLAY With SAND(CL)											

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

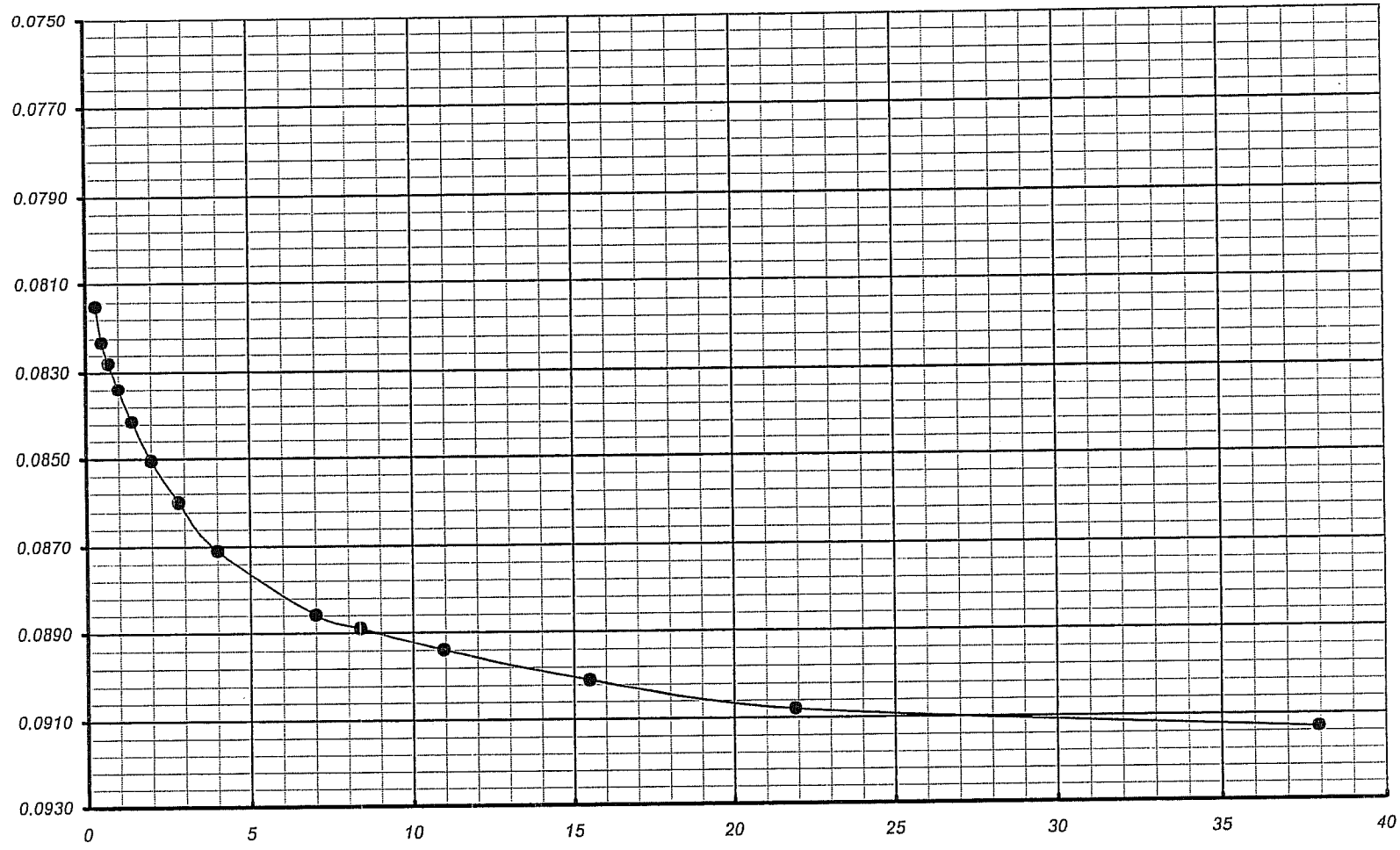
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

Project No. : 08-115 12/05/08

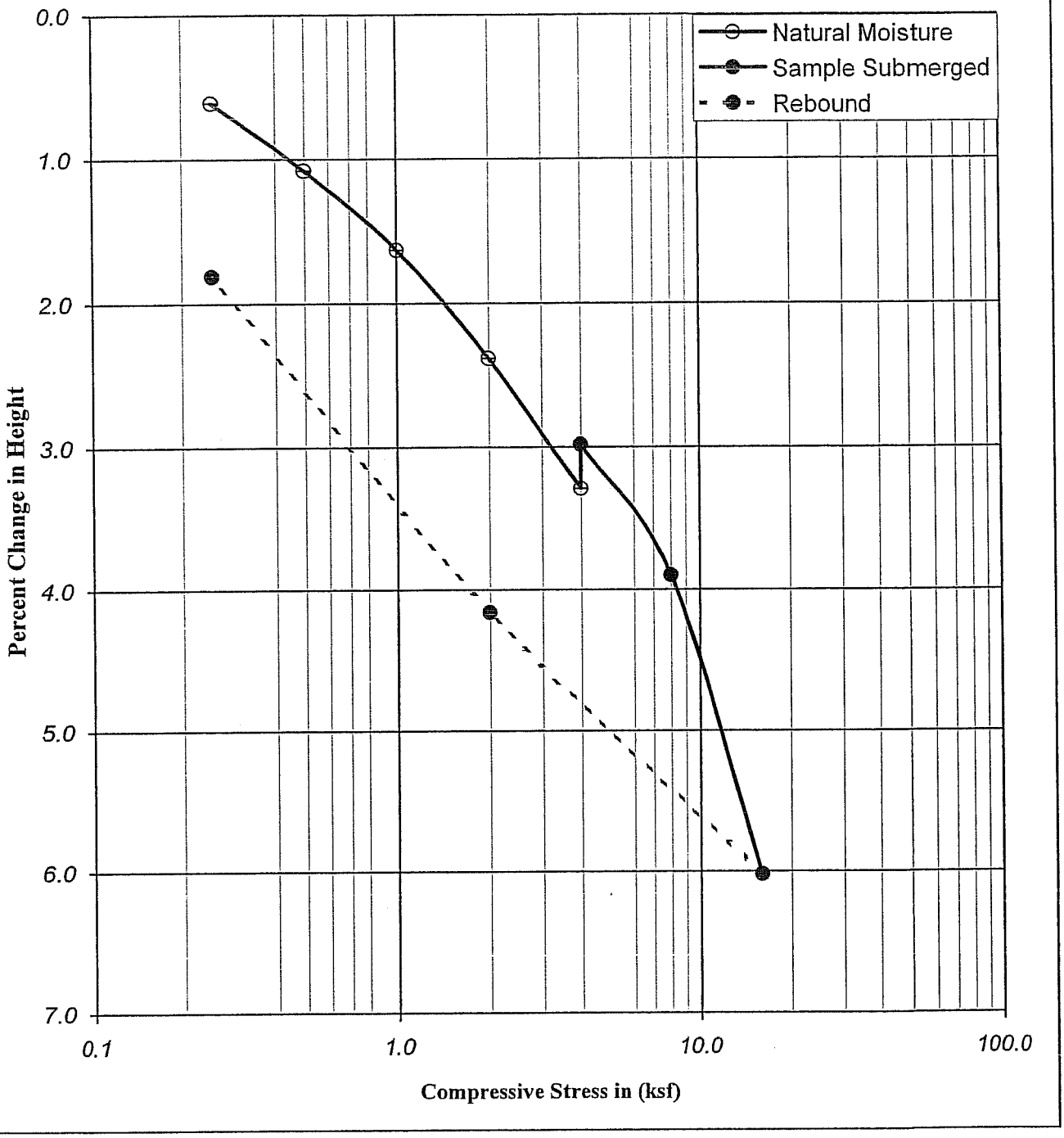


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-5*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.00* *383.0*

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-5*	
EMI Project No. : *08-115*		Depth (ft/m) : *35.0* *10.7*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



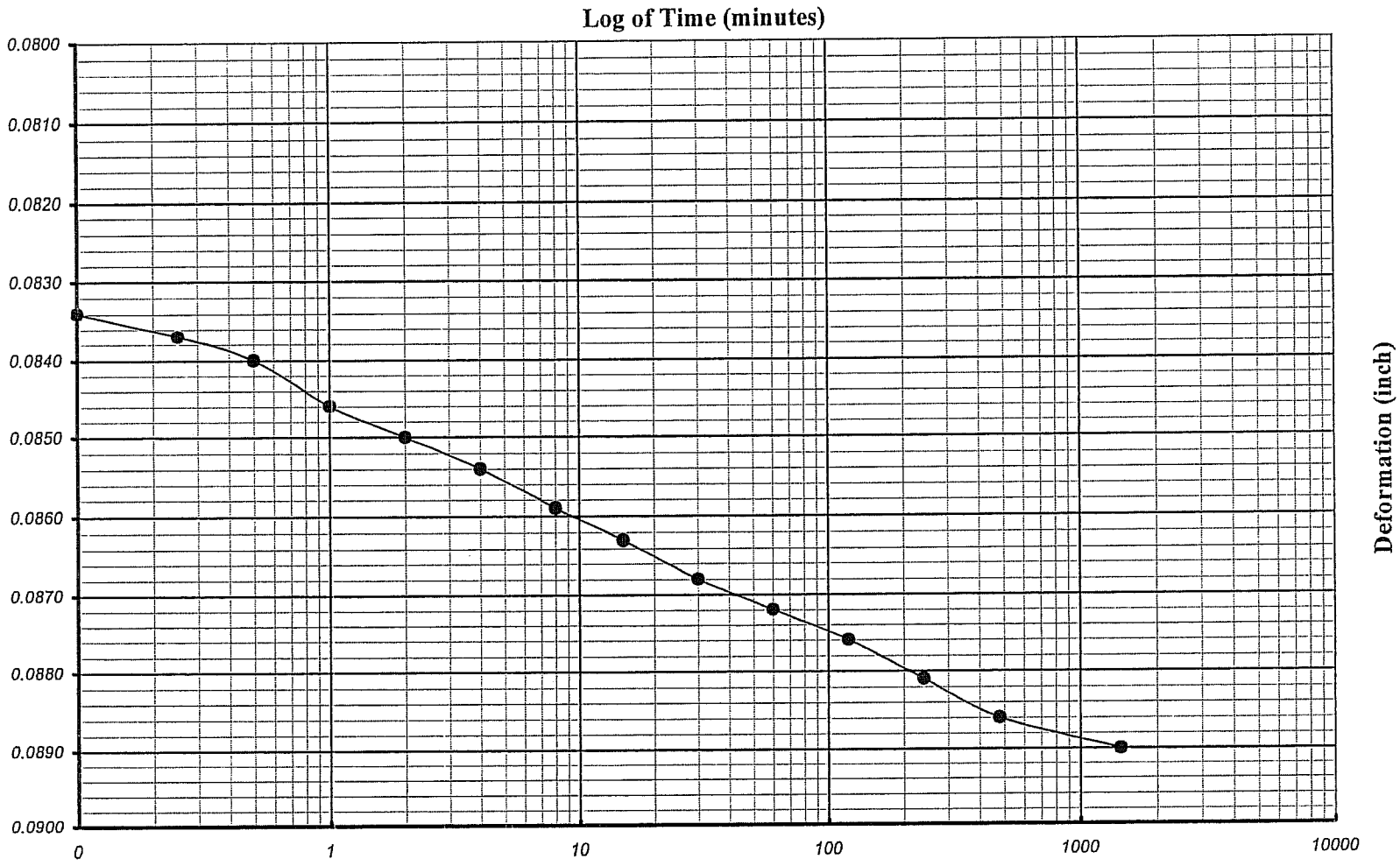
Boring No.	: A-08-008		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-7		Plastic Limit :	-						
Depth (ft)	: 30.0	31.5	Plastic Index :	-	Initial	24.51	99.60	15.68	95.60	0.69
Depth (m)	: 9.15	9.61	Specific Gravity :	2.70	Final	25.56	101.48	15.97	104.41	0.66
Description	: Olive gray, lean CLAY (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

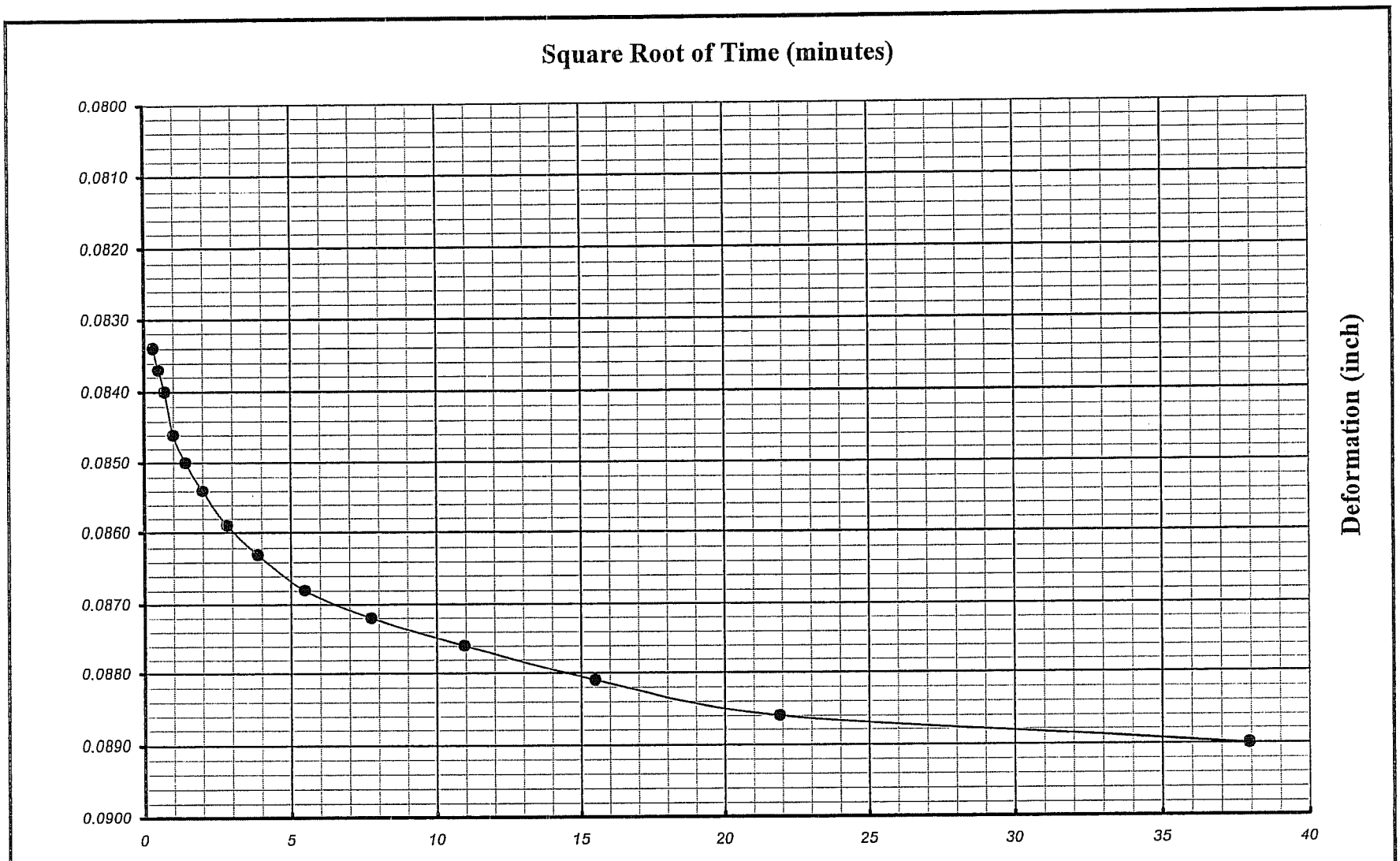
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

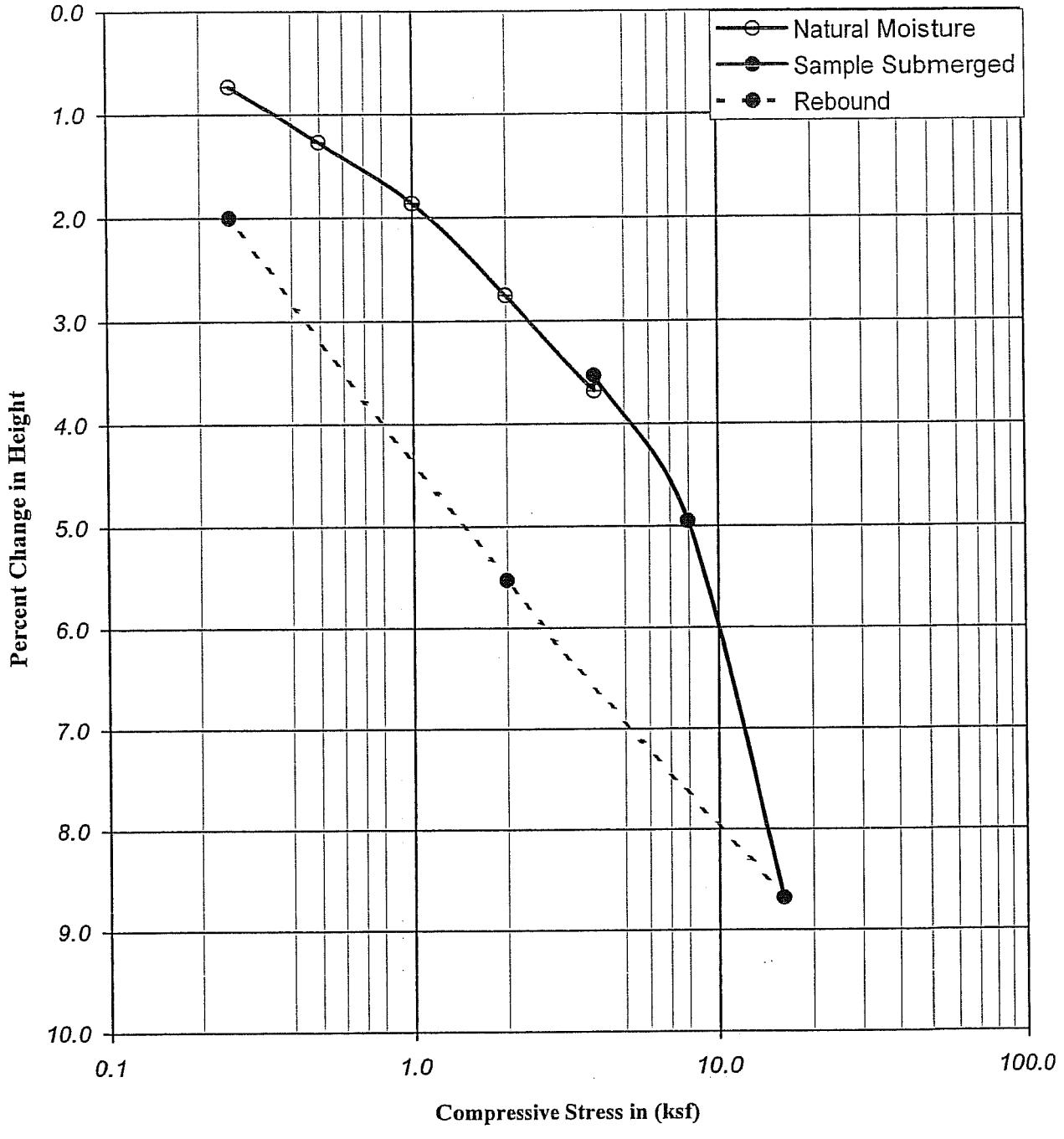
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Log of Time Method)**
		Sample No. : *D-7*	
EMI Project No. : *08-115*		Depth (ft/m) : *30.0* *9.2*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	**One-Dimensional Consolidation of Soil** Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-7*	
EMI Project No. : *08-115*		Depth (ft/m) : *30.0* *9.2*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



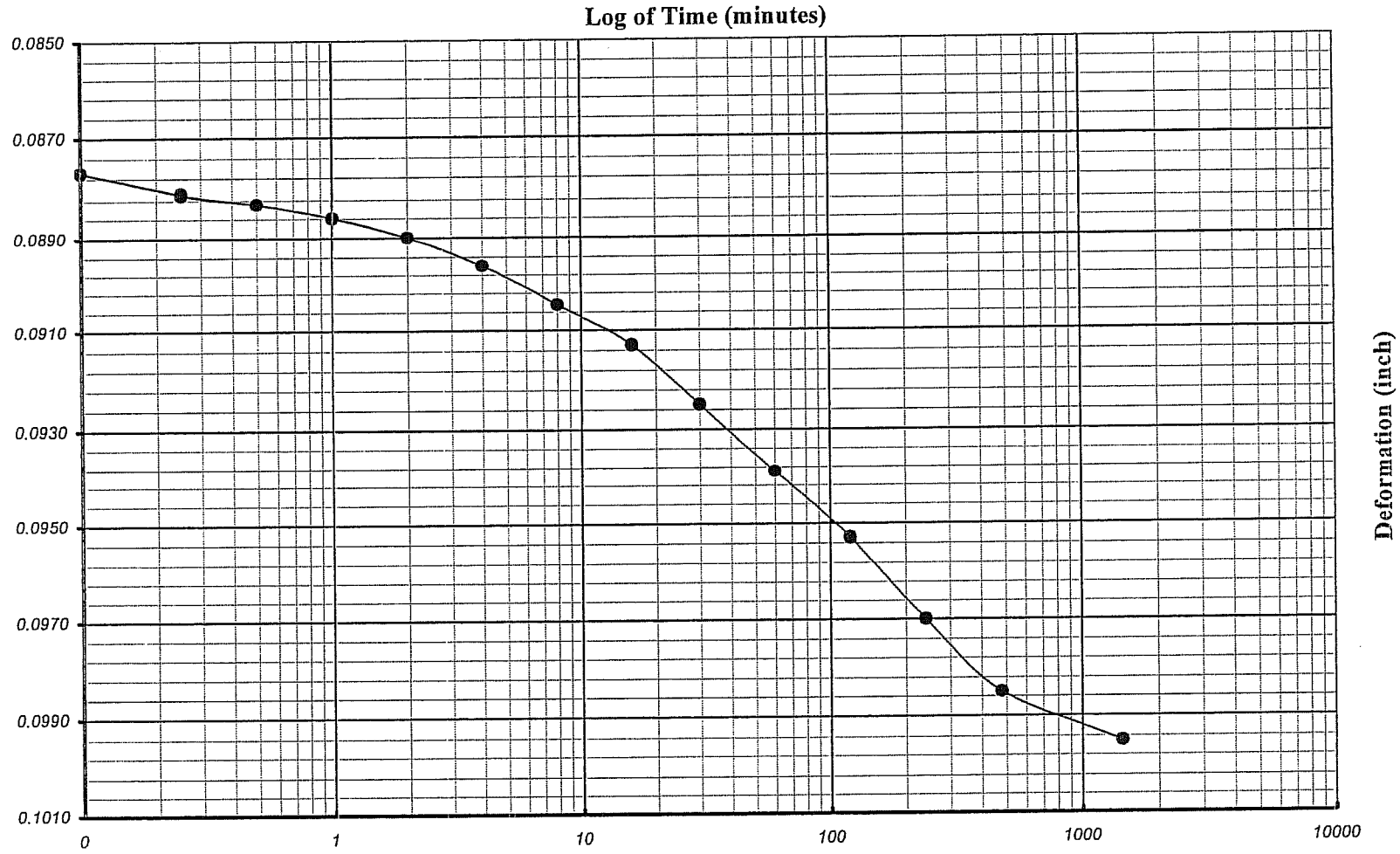
Boring No.	: A-08-008		Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-11		Plastic Limit :	-			(pcf)	(kN/m³)		
Depth (ft)	: 50.0	51.5	Plastic Index :	-	Initial	32.62	88.25	13.89	96.78	0.91
Depth (m)	: 15.25	15.71	Specific Gravity :	2.70	Final	33.01	90.09	14.18	102.31	0.87
Description	: Brown, FAT CLAY (CH)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

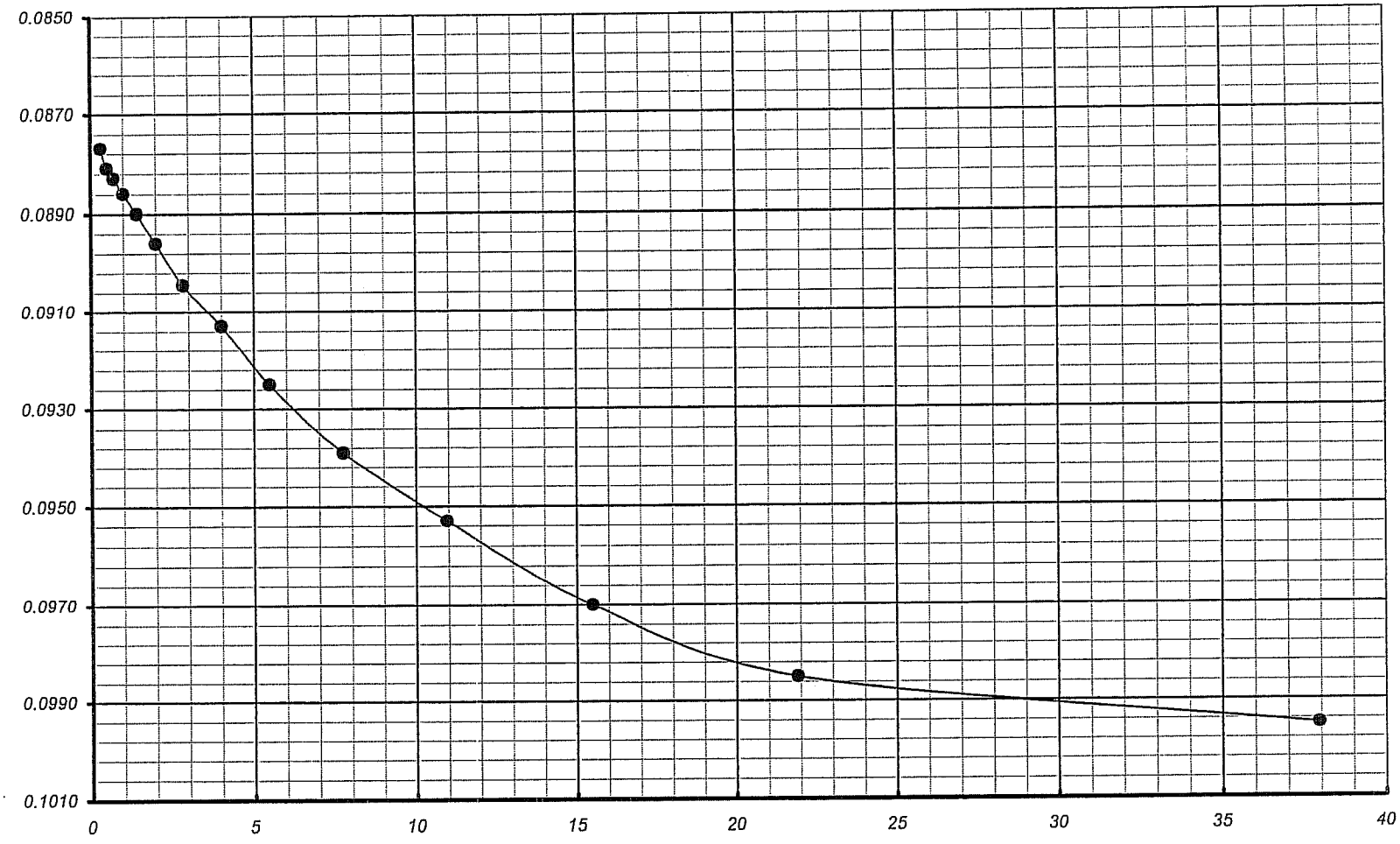
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

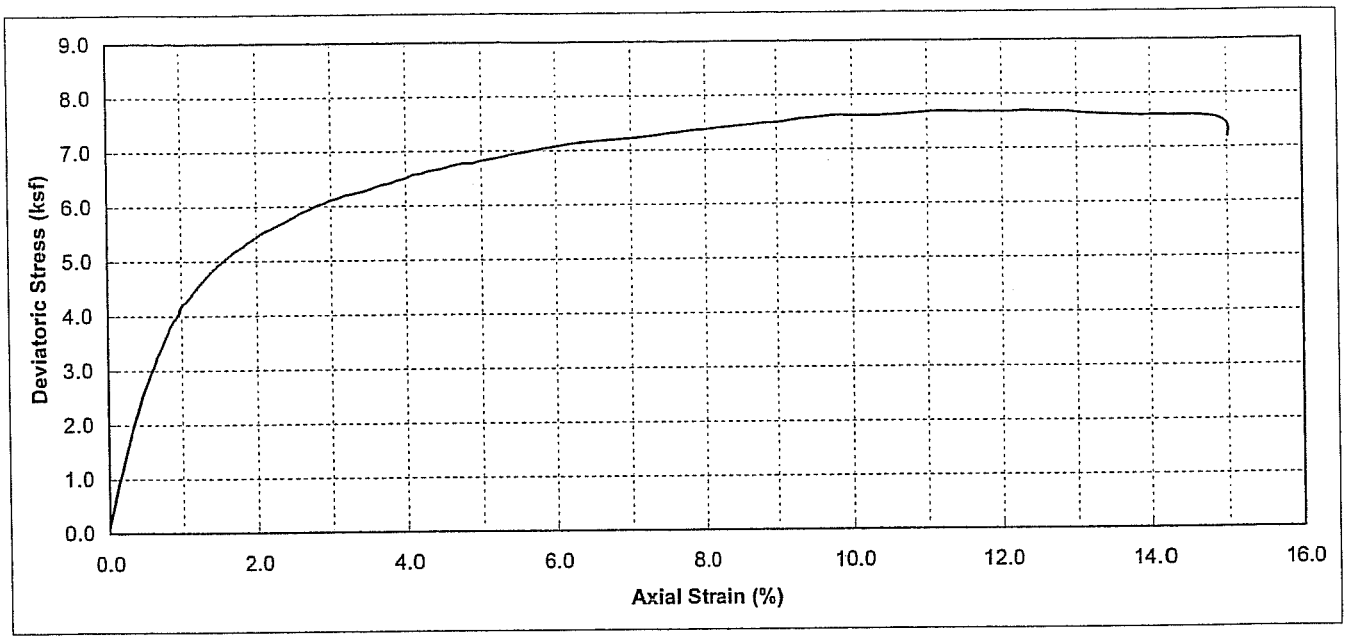
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

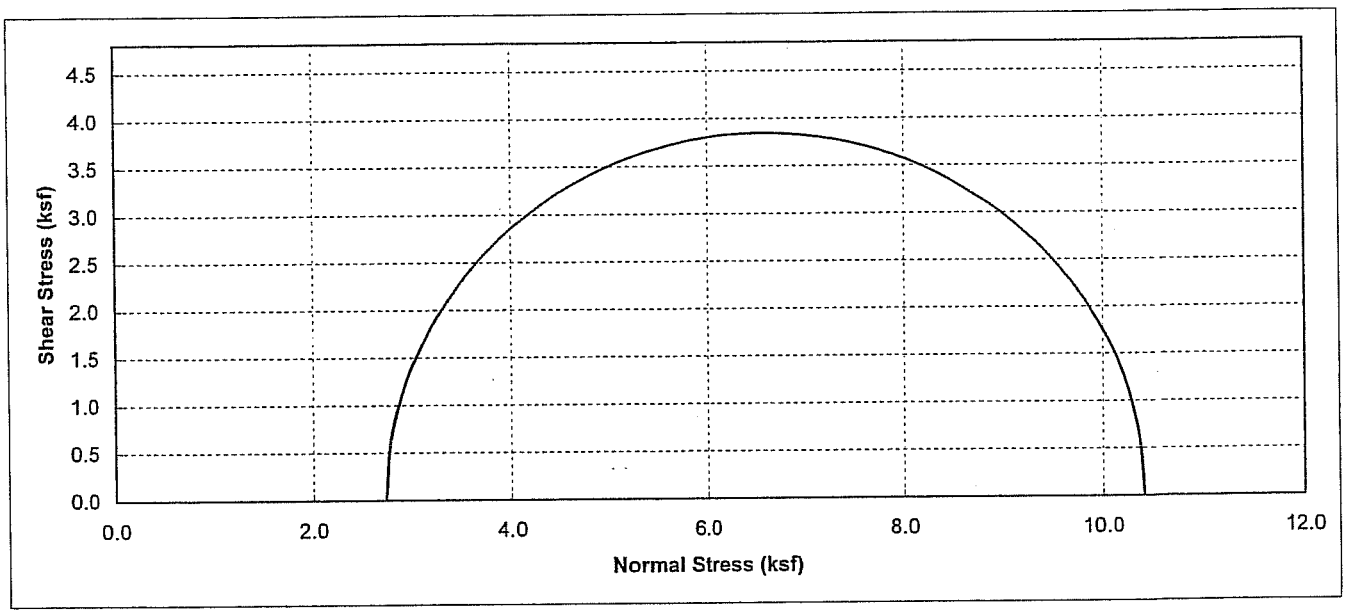


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-11*	
EMI Project No. : *08-115*		Depth (ft/m) : *50.0* *15.3*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-008*	**One-Dimensional Consolidation of Soil** **Time-Deformation Curve (Square Root of Time Method)**
		Sample No. : *D-11*	
EMI Project No. : *08-115*		Depth (ft/m) : *50.0* *15.3*	Veritcal Load (ksf/kpa) : *8.0* *383.0*





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-009	D-8	35	Dark Brown,LEAN CLAY With SAND (CL)	105.7	16.60	2.73	7.69	75.4

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/15/08

Figure No. :

APPENDIX C

DESIGN CALCULATIONS

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project Placentia Overhead Project No. 08-115

By CTY Date 12/31/2008 Checked By _____ Date _____ Sheet 1 of ____

Pile Properties

30" ϕ CIDH pile – Abut 1, bents 2 & 3

$I = \frac{\pi}{64}(30)^4 = 39760 \text{ in}^4$

$I_{cr} = \frac{1}{2} I = 19870 \text{ in}^4$

$E = 57000\sqrt{4000} = 3.6 \times 10^6 \text{ psi}$

16" ϕ CIDH pile – Abut 4

$I = \frac{\pi}{64}(16)^4 = 3217 \text{ in}^4$

$I_{cr} = \frac{1}{2} I = 1608 \text{ in}^4$

$E = 3.6 \times 10^6 \text{ psi}$

Idealized Soil properties (2ft soil cover used for lateral calc.)

Abut 1

E1		Depth
217	γ = 120 pcf C = 1000 pcf $\varepsilon_{50} = 0.008$	0 – 11
206	γ = 120 pcf ϕ = 33° k = 80 pci	11 – 36
184	γ = 125 pcf C = 3000 pcf $\varepsilon_{50} = 0.005$	36 – 56
161	γ = 135 pcf ϕ = 40° k = 260 pci	56 – 66

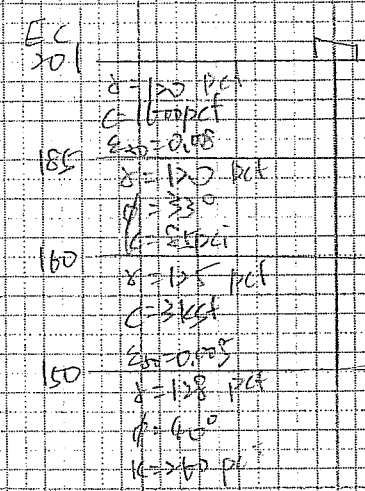
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

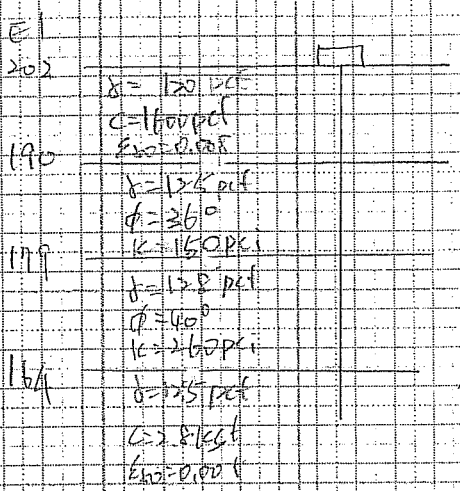
Project Placentia Overhead Project No. _____

By CTY Date 12/31/2008 Checked By _____ Date _____ Sheet 1 of _____

Bent 2

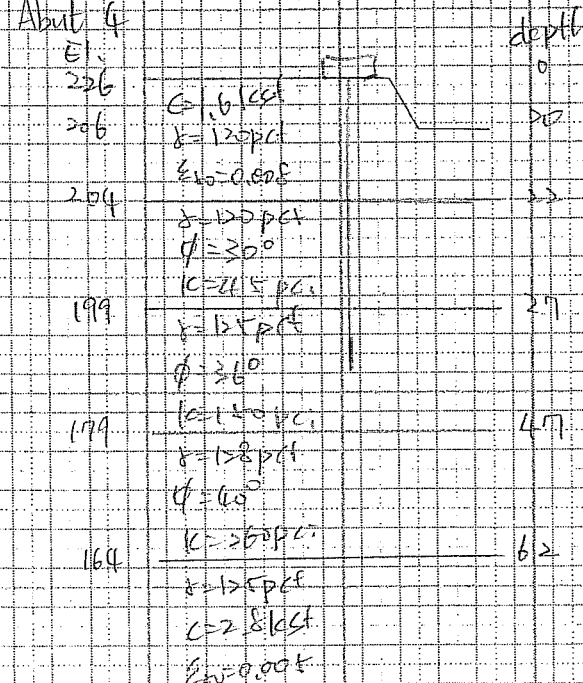


Bent 3



15' casing for Bent 3

Abut 4



Earth Mechanics, Inc.
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Project Placentia Overhead Project No. 05-105

By CTY Date 5/13/09 Checked By _____ Date _____ Sheet ____ of ____

Abut 1 (>0' casing to the bottom of PAP)

Single pile:

pile demand = 800/0.5 = 560 ⇒ L = 55'

⇒ ≥ 117 - 55 = 16' E.

pile group:

In clay:

the less of $\left[\begin{array}{l}\Sigma \text{ single pile} \\ \text{equivalent pier}\end{array}\right.$

⇒ $\eta_{clay} = 1$ ∵ the perimeter of equiv. pier ≥ Σ single pile

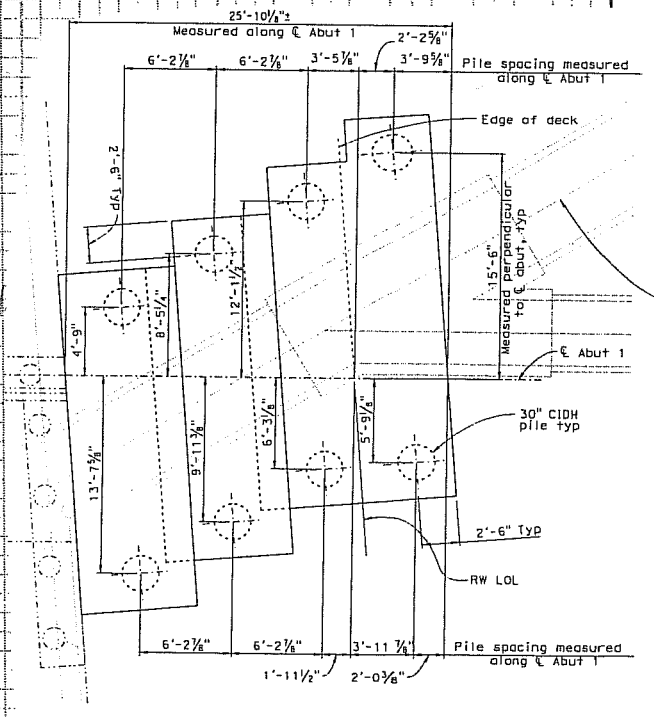
In Sand:

$\eta = 0.77$ for C-C spacing = 3D

pile group demand = 1600/0.5

= 3200 kips

⇒ L = 52'



ABUTMENT 1 PILE LAYOUT

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia OH (widen) Abut 1 - single Pile ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 01/07/09

CHECKED BY: DATE:

D_s => 2.5 ft Hw => 100.0 ft Hg => 0.0 ft

p = 7.8540 ft Ho => 0.0 ft Hf => 20.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

casing to bottom of RCP

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	11	120	57.6	1.60	0
(2)	11	37	120	57.6	1.60	0
(3)	37	56	120	57.6	0.00	33
(4)	56	66	125	62.6	3.00	0
(5)	66	150	128	65.6	0.00	40
(6)	66	150	128	65.6	0.00	40
(7)	66	150	128	65.6	0.00	40
(8)	66	150	128	65.6	0.00	40

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i[a]	ΔQ_s[a]	Q_s[a]	f_i[c]	ΔQ_s[c]	Q_s[c]	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)	(kips)
0	0.0	0.0	0.0	120.0	0									
1	20.0	10.0	10.0	120.0	1200	1.6				0.0			0.0	0.0
2	21.0	20.5	20.5	120.0	2460	1.6	0.8888	0.0000	0.0	0.0	0.8800	6.9	6.9	6.9
3	23.0	22.0	22.0	120.0	2640	1.6	0.8668	0.0000	0.0	0.0	0.8800	13.8	20.7	20.7
4	25.0	24.0	24.0	120.0	2880	1.6	0.8386	0.0000	0.0	0.0	0.8800	13.8	34.6	34.6
5	27.0	26.0	26.0	120.0	3120	1.6	0.8116	0.0000	0.0	0.0	0.8800	13.8	48.4	48.4
6	29.0	28.0	28.0	120.0	3360	1.6	0.7856	0.0000	0.0	0.0	0.8800	13.8	62.2	62.2
7	31.0	30.0	30.0	120.0	3600	1.6	0.7606	0.0000	0.0	0.0	0.8800	13.8	76.0	76.0
8	33.0	32.0	32.0	120.0	3840	1.6	0.7363	0.0000	0.0	0.0	0.8800	13.8	89.8	89.8
9	35.0	34.0	34.0	120.0	4080	1.6	0.7128	0.0000	0.0	0.0	0.8800	13.8	103.7	103.7
10	37.0	36.0	36.0	120.0	4320	1.6	0.6900	0.0000	0.0	0.0	0.8800	13.8	117.5	117.5
11	38.0	37.5	37.5	120.0	4500	0.0	0.6733	3.0298	23.8	23.8	0.0000	0.0	117.5	141.3
12	39.0	38.5	38.5	120.0	4620	0.0	0.6623	3.0600	24.0	47.8	0.0000	0.0	117.5	165.3
13	40.0	39.5	39.5	120.0	4740	0.0	0.6515	3.0883	24.3	72.1	0.0000	0.0	117.5	189.6
14	41.0	40.5	40.5	120.0	4860	0.0	0.6409	3.1146	24.5	96.5	0.0000	0.0	117.5	214.0
15	42.0	41.5	41.5	120.0	4980	0.0	0.6303	3.1390	24.7	121.2	0.0000	0.0	117.5	238.7
16	43.0	42.5	42.5	120.0	5100	0.0	0.6199	3.1615	24.8	146.0	0.0000	0.0	117.5	263.5
17	44.0	43.5	43.5	120.0	5220	0.0	0.6096	3.1822	25.0	171.0	0.0000	0.0	117.5	288.5
18	45.0	44.5	44.5	120.0	5340	0.0	0.5994	3.2010	25.1	196.2	0.0000	0.0	117.5	313.7
19	46.0	45.5	45.5	120.0	5460	0.0	0.5894	3.2180	25.3	221.4	0.0000	0.0	117.5	338.9
20	47.0	46.5	46.5	120.0	5580	0.0	0.5794	3.2332	25.4	246.8	0.0000	0.0	117.5	364.3
21	48.0	47.5	47.5	120.0	5700	0.0	0.5696	3.2466	25.5	272.3	0.0000	0.0	117.5	389.8
22	49.0	48.5	48.5	120.0	5820	0.0	0.5598	3.2582	25.6	297.9	0.0000	0.0	117.5	415.4
23	50.0	49.5	49.5	120.0	5940	0.0	0.5502	3.2681	25.7	323.6	0.0000	0.0	117.5	441.1
24	51.0	50.5	50.5	120.0	6060	0.0	0.5406	3.2763	25.7	349.3	0.0000	0.0	117.5	466.8
25	52.0	51.5	51.5	120.0	6180	0.0	0.5312	3.2828	25.8	375.1	0.0000	0.0	117.5	492.6
26	53.0	52.5	52.5	120.0	6300	0.0	0.5218	3.2875	25.8	400.9	0.0000	0.0	117.5	518.4
27	54.0	53.5	53.5	120.0	6420	0.0	0.5126	3.2906	25.8	426.8	0.0000	0.0	117.5	544.3
28	55.0	54.5	54.5	120.0	6540	0.0	0.5034	3.2921	25.9	452.6	0.0000	0.0	117.5	570.1
29	56.0	55.5	55.5	120.0	6660	0.0	0.4943	3.2919	25.9	478.5	0.0000	0.0	117.5	596.0
30	57.0	56.5	56.5	125.0	6785	3.0	0.4853	0.0000	0.0	478.5	1.6500	13.0	130.5	608.9
31	58.0	57.5	57.5	125.0	6910	3.0	0.4763	0.0000	0.0	478.5	1.6500	13.0	143.4	621.9
32	59.0	58.5	58.5	125.0	7035	3.0	0.4674	0.0000	0.0	478.5	1.6500	13.0	156.4	634.9
33	60.0	59.5	59.5	125.0	7160	3.0	0.4587	0.0000	0.0	478.5	1.6500	13.0	169.3	647.8
34	61.0	60.5	60.5	125.0	7285	3.0	0.4499	0.0000	0.0	478.5	1.6500	13.0	182.3	660.8
35	62.0	61.5	61.5	125.0	7410	3.0	0.4413	0.0000	0.0	478.5	1.6500	13.0	195.2	673.7
36	63.0	62.5	62.5	125.0	7535	3.0	0.4327	0.0000	0.0	478.5	1.6500	13.0	208.2	686.7
37	64.0	63.5	63.5	125.0	7660	3.0	0.4242	0.0000	0.0	478.5	1.6500	13.0	221.2	699.6
38	65.0	64.5	64.5	125.0	7785	3.0	0.4158	0.0000	0.0	478.5	1.6500	13.0	234.1	712.6
39	66.0	65.5	65.5	125.0	7910	3.0	0.4074	0.0000	0.0	478.5	1.6500	13.0	247.1	725.6
40	67.0	66.5	66.5	128.0	8038	0.0	0.3991	3.2080	25.2	503.7	0.0000	0.0	247.1	750.8
41	68.0	67.5	67.5	128.0	8166	0.0	0.3909	3.1918	25.1	528.7	0.0000	0.0	247.1	775.8
42	69.0	68.5	68.5	128.0	8294	0.0	0.3827	3.1739	24.9	553.7	0.0000	0.0	247.1	800.8
43	70.0	69.5	69.5	128.0	8422	0.0	0.3746	3.1545	24.8	578.4	0.0000	0.0	247.1	825.5
44	71.0	70.5	70.5	128.0	8550	0.0	0.3665	3.1334	24.6	603.1	0.0000	0.0	247.1	850.1

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia OH (widen) Abut 1 - pile group ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 05/01/09

CHECKED BY: DATE:

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

D_s =>	2.5 ft	Hw =>	100.0 ft	Hg =>	0.0 ft	
no. of piles=	8	Ho =>	0.0 ft	Hf =>	20.0 ft	
p =	62.83 ft					

>0' casing

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	φ' =>	η
(1)	0	11	120	57.6	1.60	0	1.00
(2)	11	36	120	57.6	1.60	0	1.00
(3)	37	56	120	57.6	0.00	33	0.77
(4)	56	66	125	62.6	3.00	0	1.00
(5)	66	150	128	65.6	0.00	40	0.77
(6)	66	150	128	65.6	0.00	40	0.77
(7)	66	150	128	65.6	0.00	40	0.77
(8)	66	150	128	65.6	0.00	40	0.77

C-C Sp/D	η
2.5	0.65
3.0	0.77
3.5	0.88
4.0	1.00

Current C-C Spacing/D 3.0

Clay group eff 1.0

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	η	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)		(kips)
0	0.0	0.0	0.0	120.0	0										
1	20.0	10.0	10.0	120.0	1200	1.6				0.0			0.0	1.00	0.0
2	21.0	20.5	20.5	120.0	2460	1.6	0.8888	0.0000	0.0	0.0	0.8800	55.3	55.3	1.00	55.3
3	23.0	22.0	22.0	120.0	2640	1.6	0.8668	0.0000	0.0	0.0	0.8800	110.6	165.9	1.00	165.9
4	25.0	24.0	24.0	120.0	2880	1.6	0.8386	0.0000	0.0	0.0	0.8800	110.6	276.5	1.00	276.5
5	27.0	26.0	26.0	120.0	3120	1.6	0.8116	0.0000	0.0	0.0	0.8800	110.6	387.0	1.00	387.0
6	29.0	28.0	28.0	120.0	3360	1.6	0.7856	0.0000	0.0	0.0	0.8800	110.6	497.6	1.00	497.6
7	31.0	30.0	30.0	120.0	3600	1.6	0.7606	0.0000	0.0	0.0	0.8800	110.6	608.2	1.00	608.2
8	33.0	32.0	32.0	120.0	3840	1.6	0.7363	0.0000	0.0	0.0	0.8800	110.6	718.8	1.00	718.8
9	35.0	34.0	34.0	120.0	4080	1.6	0.7128	0.0000	0.0	0.0	0.8800	110.6	829.4	1.00	829.4
10	37.0	36.0	36.0	120.0	4320	1.6	0.6900	0.0000	0.0	0.0	0.8800	110.6	940.0	1.00	940.0
11	39.0	38.0	38.0	120.0	4560	0.0	0.6678	3.0452	382.7	294.7	0.0000	0.0	940.0	0.77	1234.6
12	41.0	40.0	40.0	120.0	4800	0.0	0.6462	3.1017	389.8	594.8	0.0000	0.0	940.0	0.77	1534.7
13	43.0	42.0	42.0	120.0	5040	0.0	0.6251	3.1505	395.9	899.6	0.0000	0.0	940.0	0.77	1839.6
14	45.0	44.0	44.0	120.0	5280	0.0	0.6045	3.1918	401.1	1208.5	0.0000	0.0	940.0	0.77	2148.4
15	46.0	45.5	45.5	120.0	5460	0.0	0.5894	3.2180	202.2	1364.2	0.0000	0.0	940.0	0.77	2304.1
16	47.0	46.5	46.5	120.0	5580	0.0	0.5794	3.2332	203.1	1520.6	0.0000	0.0	940.0	0.77	2460.5
17	48.0	47.5	47.5	120.0	5700	0.0	0.5696	3.2466	204.0	1677.7	0.0000	0.0	940.0	0.77	2617.6
18	49.0	48.5	48.5	120.0	5820	0.0	0.5598	3.2582	204.7	1835.3	0.0000	0.0	940.0	0.77	2775.3
19	50.0	49.5	49.5	120.0	5940	0.0	0.5502	3.2681	205.3	1993.4	0.0000	0.0	940.0	0.77	2933.4
20	51.0	50.5	50.5	120.0	6060	0.0	0.5406	3.2763	205.9	2151.9	0.0000	0.0	940.0	0.77	3091.9
21	52.0	51.5	51.5	120.0	6180	0.0	0.5312	3.2828	206.3	2310.7	0.0000	0.0	940.0	0.77	3250.7
22	53.0	52.5	52.5	120.0	6300	0.0	0.5218	3.2875	206.6	2469.8	0.0000	0.0	940.0	0.77	3409.7
23	54.0	53.5	53.5	120.0	6420	0.0	0.5126	3.2906	206.8	2629.0	0.0000	0.0	940.0	0.77	3569.0
24	55.0	54.5	54.5	120.0	6540	0.0	0.5034	3.2921	206.8	2788.3	0.0000	0.0	940.0	0.77	3728.2
25	56.0	55.5	55.5	120.0	6660	0.0	0.4943	3.2919	206.8	2947.5	0.0000	0.0	940.0	0.77	3887.5
26	57.0	56.5	56.5	125.0	6785	3.0	0.4853	0.0000	0.0	2947.5	1.6500	103.7	1043.6	1.00	3991.2
27	58.0	57.5	57.5	125.0	6910	3.0	0.4763	0.0000	0.0	2947.5	1.6500	103.7	1147.3	1.00	4094.8
28	59.0	58.5	58.5	125.0	7035	3.0	0.4674	0.0000	0.0	2947.5	1.6500	103.7	1251.0	1.00	4198.5
29	60.0	59.5	59.5	125.0	7160	3.0	0.4587	0.0000	0.0	2947.5	1.6500	103.7	1354.7	1.00	4302.2
30	61.0	60.5	60.5	125.0	7285	3.0	0.4499	0.0000	0.0	2947.5	1.6500	103.7	1458.3	1.00	4405.8
31	62.0	61.5	61.5	125.0	7410	3.0	0.4413	0.0000	0.0	2947.5	1.6500	103.7	1562.0	1.00	4509.5
32	63.0	62.5	62.5	125.0	7535	3.0	0.4327	0.0000	0.0	2947.5	1.6500	103.7	1665.7	1.00	4613.2
33	64.0	63.5	63.5	125.0	7660	3.0	0.4242	0.0000	0.0	2947.5	1.6500	103.7	1769.3	1.00	4716.9
34	65.0	64.5	64.5	125.0	7785	3.0	0.4158	0.0000	0.0	2947.5	1.6500	103.7	1873.0	1.00	4820.5
35	66.0	65.5	65.5	125.0	7910	3.0	0.4074	0.0000	0.0	2947.5	1.6500	103.7	1976.7	1.00	4924.2
36	67.0	66.5	66.5	128.0	8038	0.0	0.3991	3.2080	201.6	3102.7	0.0000	0.0	1976.7	0.77	5079.4
37	68.0	67.5	67.5	128.0	8166	0.0	0.3909	3.1918	200.5	3257.1	0.0000	0.0	1976.7	0.77	5233.8
38	69.0	68.5	68.5	128.0	8294	0.0	0.3827	3.1739	199.4	3410.7	0.0000	0.0	1976.7	0.77	5387.4
39	70.0	69.5	69.5	128.0	8422	0.0	0.3746	3.1545	198.2	3563.3	0.0000	0.0	1976.7	0.77	5540.0
40	71.0	70.5	70.5	128.0	8550	0.0	0.3665	3.1334	196.9	3714.9	0.0000	0.0	1976.7	0.77	5691.6
41	72.0	71.5	71.5	128.0	8678	0.0	0.3585	3.1108	195.5	3865.4	0.0000	0.0	1976.7	0.77	5842.1
42	73.0	72.5	72.5	128.0	8806	0.0	0.3505	3.0866	193.9	4014.8	0.0000	0.0	1976.7	0.77	5991.4
43	74.0	73.5	73.5	128.0	8934	0.0	0.3426	3.0609	192.3	4162.8	0.0000	0.0	1976.7	0.77	6139.5
44	75.0	74.5	74.5	128.0	9062	0.0	0.3348	3.0337	190.6	4309.6	0.0000	0.0	1976.7	0.77	6286.3

1600/0.5=3200

L=52'

Earth Mechanics, Inc.
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Project: **Placentia Overhead Abut 1 (Widen)** Project No. **08-115**
By CTY Date 5/1/2009 Check by Date Sheet

Settlement Calculation for Pile Group

Pile Top Depth.= 25 ft @ El. 217 ft
Pile Tip Depth= 64 ft @ El. 178 ft
Pile Length= 39 ft
Equivalent Footing
Depth = 51 ft (usually 2/3 of pile length)
Width = 20.0 ft Length= 20.0 ft
Load per Support= 1600 kips
Equivalent Load = 4.0 ksf

Check Settlement:
Method: FHWA Hough Method

Layer	Top Elev. (ft)	Bottom Elev. (ft)	Top Depth (ft)	Bottom Depth (ft)	Soil Type	γ' pcf	(N')	c'	
1	242	217	0	25	SP	120	20	68	
2	217	181	25	61	CL	120	13	40	
3	181	161	61	81	SM	120	23	63	
4	161	151	81	91	CL	125	28	62	
5	151	100	91	142	SP	128	80	218	Hard Layer

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Depth	Layer Thick. (ft)	Mid pt. depth (ft)	γ' kcf	σ_{vo}' (ksf)	depth to Equiv. Footing (ft)	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)	Total ΔS (in)
0										
4	4	2	0.12	0.24	-49	0.00	0.24	68	0.00	0.00
8	4	6	0.12	0.72	-45	0.00	0.72	68	0.00	0.00
12	4	10	0.12	1.20	-41	0.00	1.20	68	0.00	0.00
16	4	14	0.12	1.68	-37	0.00	1.68	68	0.00	0.00
20	4	18	0.12	2.16	-33	0.00	2.16	68	0.00	0.00
24	4	22	0.12	2.64	-29	0.00	2.64	68	0.00	0.00
25	1	24.5	0.12	2.94	-26.5	0.00	2.94	68	0.00	0.00
29	4	27	0.12	3.24	-24	0.00	3.24	40	0.00	0.00
33	4	31	0.12	3.72	-20	0.00	3.72	40	0.00	0.00
37	4	35	0.12	4.20	-16	0.00	4.20	40	0.00	0.00
41	4	39	0.12	4.68	-12	0.00	4.68	40	0.00	0.00
45	4	43	0.12	5.16	-8	0.00	5.16	40	0.00	0.00
49	4	47	0.12	5.64	-4	0.00	5.64	40	0.00	0.00
51	2	50	0.12	6.00	-1	0.00	6.00	40	0.00	0.00
55	4	53	0.12	6.36	2	3.64	10.00	40	0.24	0.24
59	4	57	0.12	6.84	6	3.08	9.92	40	0.19	0.43
61	2	60	0.12	7.20	9	2.76	9.96	40	0.08	0.51
65	4	63	0.12	7.56	12	2.50	10.06	63	0.09	0.61
69	4	67	0.12	8.04	16	2.22	10.26	63	0.08	0.69
73	4	71	0.12	8.52	20	2.00	10.52	63	0.07	0.76
77	4	75	0.12	9.00	24	1.82	10.82	63	0.06	0.82
81	4	79	0.12	9.48	28	1.67	11.15	63	0.05	0.87
85	4	83	0.125	9.97	32	1.54	11.51	62	0.05	0.92
89	4	87	0.125	10.47	36	1.43	11.90	62	0.04	0.96
91	2	90	0.125	10.85	39	1.36	12.20	62	0.02	0.98

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project Placentia Overhead Project No. _____

By CTY Date 5/15/09 Checked By _____ Date _____ Sheet ____ of ____

Bent 2

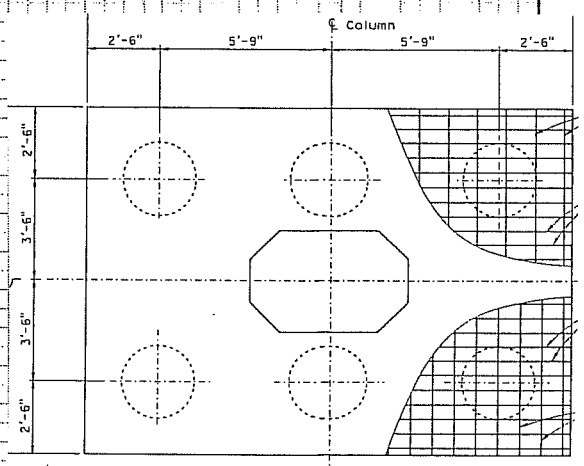
△ strength limit:

single p.t. demand = 4800/0.7 = 6857 < Case (690k)

⇒ Length = 52' ⇒ El + 150'

pile group:

$\eta_{clay} = \frac{[(11.5+25+(17+12.5)]\times 2}{6\times 25\times\pi} = 0.99$



c-c spacing = $\frac{59}{25}$ = 2.36D

$\eta_{sand} = 0.62$

demand = $\frac{1600}{0.7}$ = 2286k

⇒ Length = 42'

△ Extreme limit:

single pile demand = 650k

⇒ Length = 49' ⇒ El + 154'

pile group demand = 950k

⇒ Length = 71'

tension demand = 350k

corresponding compression = $350\times\frac{0.7}{0.5}$ = 490k

⇒ Length = 78' ⇒ El + 164'

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia OH (widen) Bent 2 - single pile ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 01/07/09

CHECKED BY: DATE:

D_s => 2.5 ft Hw => 100.0 ft Hg => 0.0 ft

p = 7.8540 ft Ho => 0.0 ft Hf => 5.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	16	120	57.6	1.60	0
(2)	16	41	120	57.6	0.00	33
(3)	41	51	125	62.6	3.00	0
(4)	51	80	128	65.6	0.00	40
(5)	80	150	128	65.6	0.00	40
(6)	80	150	128	65.6	0.00	40
(7)	80	150	128	65.6	0.00	40
(8)	80	150	128	65.6	0.00	40

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	Q_s	Q_{final}
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)	(kips)	(kips)
0	0.0	0.0	0.0	120.0	0										
1	5.0	2.5	2.5	120.0	300	1.6				0.0			0.0	0.0	0.0
2	6.0	5.5	5.5	120.0	660	1.6	1.1834	0.0000	0.0	0.0	0.8800	6.9	6.9	6.9	6.6
3	8.0	7.0	7.0	120.0	840	1.6	1.1428	0.0000	0.0	0.0	0.8800	13.8	20.7	20.7	19.7
4	10.0	9.0	9.0	120.0	1080	1.6	1.0950	0.0000	0.0	0.0	0.8800	13.8	34.6	34.6	32.8
5	11.0	10.5	10.5	120.0	1260	1.6	1.0626	0.0000	0.0	0.0	0.8800	6.9	41.5	41.5	39.4
6	12.0	11.5	11.5	120.0	1380	1.6	1.0422	0.0000	0.0	0.0	0.8800	6.9	48.4	48.4	46.0
7	13.0	12.5	12.5	120.0	1500	1.6	1.0227	0.0000	0.0	0.0	0.8800	6.9	55.3	55.3	52.5
8	14.0	13.5	13.5	120.0	1620	1.6	1.0040	0.0000	0.0	0.0	0.8800	6.9	62.2	62.2	59.1
9	15.0	14.5	14.5	120.0	1740	1.6	0.9859	0.0000	0.0	0.0	0.8800	6.9	69.1	69.1	65.7
10	16.0	15.5	15.5	120.0	1860	1.6	0.9685	0.0000	0.0	0.0	0.8800	6.9	76.0	76.0	72.2
11	17.0	16.5	16.5	120.0	1980	0.0	0.9516	1.8842	14.8	14.8	0.0000	0.0	76.0	90.8	86.3
12	18.0	17.5	17.5	120.0	2100	0.0	0.9353	1.9640	15.4	30.2	0.0000	0.0	76.0	106.3	100.9
13	19.0	18.5	18.5	120.0	2220	0.0	0.9193	2.0409	16.0	46.3	0.0000	0.0	76.0	122.3	116.2
14	20.0	19.5	19.5	120.0	2340	0.0	0.9039	2.1150	16.6	62.9	0.0000	0.0	76.0	138.9	131.9
15	22.0	21.0	21.0	120.0	2520	0.0	0.8814	2.2210	34.9	97.8	0.0000	0.0	76.0	173.8	165.1
16	24.0	23.0	23.0	120.0	2760	0.0	0.8526	2.3531	37.0	134.7	0.0000	0.0	76.0	210.7	200.2
17	26.0	25.0	25.0	120.0	3000	0.0	0.8250	2.4750	38.9	173.6	0.0000	0.0	76.0	249.6	237.1
18	28.0	27.0	27.0	120.0	3240	0.0	0.7985	2.5872	40.6	214.2	0.0000	0.0	76.0	290.3	275.7
19	30.0	29.0	29.0	120.0	3480	0.0	0.7730	2.6900	42.3	256.5	0.0000	0.0	76.0	332.5	315.9
20	32.0	31.0	31.0	120.0	3720	0.0	0.7484	2.7839	43.7	300.2	0.0000	0.0	76.0	376.2	357.4
21	34.0	33.0	33.0	120.0	3960	0.0	0.7245	2.8690	45.1	345.3	0.0000	0.0	76.0	421.3	400.2
22	36.0	35.0	35.0	120.0	4200	0.0	0.7013	2.9456	46.3	391.6	0.0000	0.0	76.0	467.6	444.2
23	38.0	37.0	37.0	120.0	4440	0.0	0.6788	3.0140	47.3	438.9	0.0000	0.0	76.0	514.9	489.2
24	40.0	39.0	39.0	120.0	4680	0.0	0.6569	3.0744	48.3	487.2	0.0000	0.0	76.0	563.2	535.1
25	41.0	40.5	40.5	120.0	4860	0.0	0.6409	3.1146	24.5	511.6	0.0000	0.0	76.0	587.7	558.3
26	42.0	41.5	41.5	125.0	4985	3.0	0.6303	0.0000	0.0	511.6	1.6500	13.0	89.0	600.6	570.6
27	43.0	42.5	42.5	125.0	5110	3.0	0.6199	0.0000	0.0	511.6	1.6500	13.0	101.9	613.6	582.9
28	44.0	43.5	43.5	125.0	5235	3.0	0.6096	0.0000	0.0	511.6	1.6500	13.0	114.9	626.6	595.2
29	45.0	44.5	44.5	125.0	5360	3.0	0.5994	0.0000	0.0	511.6	1.6500	13.0	127.9	639.5	607.5
30	46.0	45.5	45.5	125.0	5485	3.0	0.5894	0.0000	0.0	511.6	1.6500	13.0	140.8	652.5	619.8
31	47.0	46.5	46.5	125.0	5610	3.0	0.5794	0.0000	0.0	511.6	1.6500	13.0	153.8	665.4	632.2
32	48.0	47.5	47.5	125.0	5735	3.0	0.5696	0.0000	0.0	511.6	1.6500	13.0	166.7	678.4	644.5
33	49.0	48.5	48.5	125.0	5860	3.0	0.5598	0.0000	0.0	511.6	1.6500	13.0	179.7	691.3	656.8
34	50.0	49.5	49.5	125.0	5985	3.0	0.5502	0.0000	0.0	511.6	1.6500	13.0	192.7	704.3	669.1
35	51.0	50.5	50.5	125.0	6110	3.0	0.5406	0.0000	0.0	511.6	1.6500	13.0	205.6	717.3	681.4
36	52.0	51.5	51.5	128.0	6238	0.0	0.5312	3.3136	26.0	537.7	0.0000	0.0	205.6	743.3	706.1
37	53.0	52.5	52.5	128.0	6366	0.0	0.5218	3.3220	26.1	563.8	0.0000	0.0	205.6	769.4	730.9

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia OH (widen) Bent 2 - pile group ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 05/01/09

CHECKED BY: DATE:

D_s =>	2.5	ft	Hw =>	100.0	ft	Hg =>	0.0 ft
no. of piles=	6		Ho =>	0.0	ft	Hf =>	5.0 ft
p =	47.12	ft					

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	φ' =>	η
(1)	0	16	120	57.6	1.60	0	0.99
(2)	16	41	120	57.6	0.00	33	0.62
(3)	41	51	125	62.6	3.00	0	0.99
(4)	51	80	128	65.6	0.00	40	0.62
(5)	80	150	128	65.6	0.00	40	0.62
(6)	80	150	128	65.6	0.00	40	0.62
(7)	80	150	128	65.6	0.00	40	0.62
(8)	80	150	128	65.6	0.00	40	0.62

C-C Sp/D	η
2.5	0.65
3.0	0.77
3.5	0.88
4.0	1.00

Current C-C Spacing/D 2.36

Clay group eff 0.99

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	η	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)		(kips)
0	0.0	0.0	0.0	120.0	0										
1	5.0	2.5	2.5	120.0	300	1.6				0.0			0.0	0.99	0.0
2	6.0	5.5	5.5	120.0	660	1.6	1.1834	0.0000	0.0	0.0	0.8800	41.5	41.1	0.99	41.1
3	8.0	7.0	7.0	120.0	840	1.6	1.1428	0.0000	0.0	0.0	0.8800	82.9	123.2	0.99	123.2
4	10.0	9.0	9.0	120.0	1080	1.6	1.0950	0.0000	0.0	0.0	0.8800	82.9	205.3	0.99	205.3
5	12.0	11.0	11.0	120.0	1320	1.6	1.0523	0.0000	0.0	0.0	0.8800	82.9	287.4	0.99	287.4
6	14.0	13.0	13.0	120.0	1560	1.6	1.0133	0.0000	0.0	0.0	0.8800	82.9	369.5	0.99	369.5
7	16.0	15.0	15.0	120.0	1800	1.6	0.9771	0.0000	0.0	0.0	0.8800	82.9	451.6	0.99	451.6
8	18.0	17.0	17.0	120.0	2040	0.0	0.9434	1.9245	181.4	111.8	0.0000	0.0	451.6	0.62	563.4
9	20.0	19.0	19.0	120.0	2280	0.0	0.9115	2.0783	195.9	232.5	0.0000	0.0	451.6	0.62	684.1
10	22.0	21.0	21.0	120.0	2520	0.0	0.8814	2.2210	209.3	361.6	0.0000	0.0	451.6	0.62	813.2
11	24.0	23.0	23.0	120.0	2760	0.0	0.8526	2.3531	221.8	498.3	0.0000	0.0	451.6	0.62	949.9
12	26.0	25.0	25.0	120.0	3000	0.0	0.8250	2.4750	233.3	642.1	0.0000	0.0	451.6	0.62	1093.7
13	28.0	27.0	27.0	120.0	3240	0.0	0.7985	2.5872	243.8	792.4	0.0000	0.0	451.6	0.62	1244.0
14	30.0	29.0	29.0	120.0	3480	0.0	0.7730	2.6900	253.5	948.6	0.0000	0.0	451.6	0.62	1400.2
15	31.0	30.5	30.5	120.0	3660	0.0	0.7544	2.7612	130.1	1028.8	0.0000	0.0	451.6	0.62	1480.4
16	32.0	31.5	31.5	120.0	3780	0.0	0.7423	2.8059	132.2	1110.3	0.0000	0.0	451.6	0.62	1561.9
17	33.0	32.5	32.5	120.0	3900	0.0	0.7304	2.8485	134.2	1193.1	0.0000	0.0	451.6	0.62	1644.7
18	34.0	33.5	33.5	120.0	4020	0.0	0.7186	2.8889	136.1	1277.0	0.0000	0.0	451.6	0.62	1728.6
19	35.0	34.5	34.5	120.0	4140	0.0	0.7071	2.9272	137.9	1362.0	0.0000	0.0	451.6	0.62	1813.6
20	36.0	35.5	35.5	120.0	4260	0.0	0.6956	2.9634	139.6	1448.1	0.0000	0.0	451.6	0.62	1899.7
21	37.0	36.5	36.5	120.0	4380	0.0	0.6844	2.9976	141.3	1535.2	0.0000	0.0	451.6	0.62	1986.8
22	38.0	37.5	37.5	120.0	4500	0.0	0.6733	3.0298	142.8	1623.2	0.0000	0.0	451.6	0.62	2074.8
23	39.0	38.5	38.5	120.0	4620	0.0	0.6623	3.0600	144.2	1712.1	0.0000	0.0	451.6	0.62	2163.7
24	40.0	39.5	39.5	120.0	4740	0.0	0.6515	3.0883	145.5	1801.8	0.0000	0.0	451.6	0.62	2253.4
25	41.0	40.5	40.5	120.0	4860	0.0	0.6409	3.1146	146.8	1892.2	0.0000	0.0	451.6	0.62	2343.8
26	42.0	41.5	41.5	125.0	4985	3.0	0.6303	0.0000	0.0	1892.2	1.6500	77.8	528.6	0.99	2420.8
27	43.0	42.5	42.5	125.0	5110	3.0	0.6199	0.0000	0.0	1892.2	1.6500	77.8	605.6	0.99	2497.8
28	44.0	43.5	43.5	125.0	5235	3.0	0.6096	0.0000	0.0	1892.2	1.6500	77.8	682.5	0.99	2574.8
29	45.0	44.5	44.5	125.0	5360	3.0	0.5994	0.0000	0.0	1892.2	1.6500	77.8	759.5	0.99	2651.8
30	46.0	45.5	45.5	125.0	5485	3.0	0.5894	0.0000	0.0	1892.2	1.6500	77.8	836.5	0.99	2728.7
31	47.0	46.5	46.5	125.0	5610	3.0	0.5794	0.0000	0.0	1892.2	1.6500	77.8	913.5	0.99	2805.7
32	48.0	47.5	47.5	125.0	5735	3.0	0.5696	0.0000	0.0	1892.2	1.6500	77.8	990.4	0.99	2882.7
33	49.0	48.5	48.5	125.0	5860	3.0	0.5598	0.0000	0.0	1892.2	1.6500	77.8	1067.4	0.99	2959.7
34	50.0	49.5	49.5	125.0	5985	3.0	0.5502	0.0000	0.0	1892.2	1.6500	77.8	1144.4	0.99	3036.6
35	51.0	50.5	50.5	125.0	6110	3.0	0.5406	0.0000	0.0	1892.2	1.6500	77.8	1221.4	0.99	3113.6
36	52.0	51.5	51.5	128.0	6238	0.0	0.5312	3.3136	156.1	1988.5	0.0000	0.0	1221.4	0.62	3209.9
37	53.0	52.5	52.5	128.0	6366	0.0	0.5218	3.3220	156.5	2085.0	0.0000	0.0	1221.4	0.62	3306.4
38	54.0	53.5	53.5	128.0	6494	0.0	0.5126	3.3286	156.9	2181.7	0.0000	0.0	1221.4	0.62	3403.0
39	55.0	54.5	54.5	128.0	6622	0.0	0.5034	3.3333	157.1	2278.5	0.0000	0.0	1221.4	0.62	3499.9
40	56.0	55.5	55.5	128.0	6750	0.0	0.4943	3.3363	157.2	2375.4	0.0000	0.0	1221.4	0.62	3596.8
41	57.0	56.5	56.5	128.0	6878	0.0	0.4853	3.3376	157.3	2472.4	0.0000	0.0	1221.4	0.62	3693.7
42	58.0	57.5	57.5	128.0	7006	0.0	0.4763	3.3370	157.3	2569.3	0.0000	0.0	1221.4	0.62	3790.7
43	59.0	58.5	58.5	128.0	7134	0.0	0.4674	3.3348	157.1	2666.2	0.0000	0.0	1221.4	0.62	3887.5
44	60.0	59.5	59.5	128.0	7262	0.0	0.4587	3.3308	157.0	2762.9	0.0000	0.0	1221.4	0.62	3984.3

extreme $L = 25'$ for 950k

strength limit $L = 41'$ for 2238k

Earth Mechanics, Inc.
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Project: **Placentia Overhead Bent 2 (Widen)** Project No. **08-115**
By CTY Date 5/1/2009 Check by Date Sheet

Settlement Calculation for Pile Group

Pile Top Depth.= 9 ft @ El. 201 ft
Pile Tip Depth= 55 ft @ El. 155 ft
Pile Length= 46 ft
Equivalent Footing
Depth = 40 ft (usually 2/3 of pile length)
Width = 9.5 ft Length= 14.0 ft
Load per Support= 1200 kips
Equivalent Load = 9.0 ksf

Check Settlement:
Method: FHWA Hough Method

Layer	Top Elev. (ft)	Bottom Elev. (ft)	Top Depth (ft)	Bottom Depth (ft)	Soil Type	γ' pcf	(N')	c'	
1	210	185	0	25	CL	120	13	40	
2	185	160	25	50	SC	120	23	63	
3	160	150	50	60	CL	120	28	62	
4	150	100	60	110	SC	125	80	184	Hard Layer

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Depth	Layer Thick. (ft)	Mid pt. depth (ft)	γ' kcf	σ_{vo}' (ksf)	depth to Equiv. Footing (ft)	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)	Total ΔS (in)
0										
4	4	2	0.12	0.24	-38	0.00	0.24	40	0.00	0.00
8	4	6	0.12	0.72	-34	0.00	0.72	40	0.00	0.00
12	4	10	0.12	1.20	-30	0.00	1.20	40	0.00	0.00
16	4	14	0.12	1.68	-26	0.00	1.68	40	0.00	0.00
20	4	18	0.12	2.16	-22	0.00	2.16	40	0.00	0.00
24	4	22	0.12	2.64	-18	0.00	2.64	40	0.00	0.00
25	1	24.5	0.12	2.94	-15.5	0.00	2.94	40	0.00	0.00
29	4	27	0.12	3.24	-13	0.00	3.24	63	0.00	0.00
33	4	31	0.12	3.72	-9	0.00	3.72	63	0.00	0.00
37	4	35	0.12	4.20	-5	0.00	4.20	63	0.00	0.00
40	3	38.5	0.12	4.62	-1.5	0.00	4.62	63	0.00	0.00
44	4	42	0.12	5.04	2	7.45	12.49	63	0.30	0.30
48	4	46	0.12	5.52	6	5.53	11.05	63	0.23	0.53
50	2	49	0.12	5.88	9	4.63	10.51	63	0.10	0.63
54	4	52	0.12	6.24	12	3.99	10.23	62	0.17	0.79
58	4	56	0.12	6.72	16	3.36	10.08	62	0.14	0.93
60	2	59	0.12	7.08	19	3.01	10.09	62	0.06	0.99

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

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Project Placentia OH Project No. 05-115

By CTY Date 5/15/09 Checked By _____ Date _____ Sheet ___ of ___

Bent 3

△ Strength limit:

single pile demand = 4785/0.7 = 6836^k

⇒ length = 49' use 52' ⇒ El +110'

pile group

the same as Bent 2

⇒ η_{day} = 0.99

η_{sand} = 0.62

demand = 2284^k

⇒ length = 44'

△ Extreme limit

single pile demand = 6501^k

⇒ length = 47' ⇒ El +113'

pile group demand = 9170^k

⇒ length = 30'

tension demand = 3507^k

corresponding compression = 4907^k

⇒ length = 40' ⇒ El +162'

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia OH (widen) Bent 3 - single pile ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 01/07/09

CHECKED BY: DATE:

D_s => 2.5 ft Hw => 100.0 ft Hg => 0.0 ft

p = 7.8540 ft Ho => 0.0 ft Hf => 15.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	12	120	57.6	1.60	0
(2)	12	23	125	62.6	0.00	36
(3)	23	38	128	65.6	0.00	40
(4)	46	80	125	62.6	2.80	0
(5)	80	150	125	62.6	2.80	0
(6)	80	150	125	62.6	2.80	0
(7)	80	150	125	62.6	2.80	0
(8)	80	150	125	62.6	2.80	0

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	Q_s	Q_{final}	
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)	(kips)	(kips)	
0	0.0	0.0	0.0	120.0	0											
1	15.0	7.5	7.5	120.0	900	1.6				0.0			0.0	0.0	0.0	
2	16.0	15.5	15.5	125.0	1900	0.0	0.9685	1.8402	14.5	14.5	0.0000	0.0	0.0	14.5	13.7	
3	18.0	17.0	17.0	125.0	2088	0.0	0.9434	1.9693	30.9	45.4	0.0000	0.0	0.0	45.4	43.1	
4	20.0	19.0	19.0	125.0	2338	0.0	0.9115	2.1307	33.5	78.9	0.0000	0.0	0.0	78.9	74.9	
5	22.0	21.0	21.0	125.0	2588	0.0	0.8814	2.2805	35.8	114.7	0.0000	0.0	0.0	114.7	108.9	
6	24.0	23.0	23.0	128.0	2844	0.0	0.8526	2.4243	38.1	152.8	0.0000	0.0	0.0	152.8	145.1	
7	26.0	25.0	25.0	128.0	3100	0.0	0.8250	2.5571	40.2	192.9	0.0000	0.0	0.0	192.9	183.3	
8	28.0	27.0	27.0	128.0	3356	0.0	0.7985	2.6794	42.1	235.0	0.0000	0.0	0.0	235.0	223.3	
9	30.0	29.0	29.0	128.0	3612	0.0	0.7730	2.7917	43.9	278.9	0.0000	0.0	0.0	278.9	264.9	
10	32.0	31.0	31.0	128.0	3868	0.0	0.7484	2.8943	45.5	324.3	0.0000	0.0	0.0	324.3	308.1	
11	34.0	33.0	33.0	128.0	4124	0.0	0.7245	2.9874	46.9	371.3	0.0000	0.0	0.0	371.3	352.7	
12	36.0	35.0	35.0	128.0	4380	0.0	0.7013	3.0715	48.2	419.5	0.0000	0.0	0.0	419.5	398.5	L=40
13	38.0	37.0	37.0	128.0	4636	0.0	0.6788	3.1467	49.4	468.9	0.0000	0.0	0.0	468.9	445.5	Tangent
14	40.0	39.0	39.0	128.0	4892	0.0	0.6569	3.2133	50.5	519.4	0.0000	0.0	0.0	519.4	493.4	
15	42.0	41.0	41.0	128.0	5148	0.0	0.6356	3.2716	51.4	570.8	0.0000	0.0	0.0	570.8	542.3	
16	43.0	42.5	42.5	128.0	5340	0.0	0.6199	3.3100	26.0	596.8	0.0000	0.0	0.0	596.8	567.0	
17	44.0	43.5	43.5	128.0	5468	0.0	0.6096	3.3331	26.2	623.0	0.0000	0.0	0.0	623.0	591.8	
18	45.0	44.5	44.5	128.0	5596	0.0	0.5994	3.3542	26.3	649.3	0.0000	0.0	0.0	649.3	616.8	extra
19	46.0	45.5	45.5	128.0	5724	0.0	0.5894	3.3733	26.5	675.8	0.0000	0.0	0.0	675.8	642.0	
20	47.0	46.5	46.5	125.0	5849	2.8	0.5794	0.0000	0.0	675.8	1.5400	12.1	12.1	687.9	653.5	L=47
21	48.0	47.5	47.5	125.0	5974	2.8	0.5696	0.0000	0.0	675.8	1.5400	12.1	24.2	700.0	665.0	
22	49.0	48.5	48.5	125.0	6099	2.8	0.5598	0.0000	0.0	675.8	1.5400	12.1	36.3	712.1	676.5	L=49
23	50.0	49.5	49.5	125.0	6224	2.8	0.5502	0.0000	0.0	675.8	1.5400	12.1	48.4	724.2	688.0	for dy
24	51.0	50.5	50.5	125.0	6349	2.8	0.5406	0.0000	0.0	675.8	1.5400	12.1	60.5	736.3	699.5	678
25	52.0	51.5	51.5	125.0	6474	2.8	0.5312	0.0000	0.0	675.8	1.5400	12.1	72.6	748.4	711.0	
26	53.0	52.5	52.5	125.0	6599	2.8	0.5218	0.0000	0.0	675.8	1.5400	12.1	84.7	760.5	722.4	
27	54.0	53.5	53.5	125.0	6724	2.8	0.5126	0.0000	0.0	675.8	1.5400	12.1	96.8	772.6	733.9	
28	55.0	54.5	54.5	125.0	6849	2.8	0.5034	0.0000	0.0	675.8	1.5400	12.1	108.9	784.7	745.4	
29	56.0	55.5	55.5	125.0	6974	2.8	0.4943	0.0000	0.0	675.8	1.5400	12.1	121.0	796.8	756.9	
30	58.0	57.0	57.0	125.0	7161	2.8	0.4808	0.0000	0.0	675.8	1.5400	24.2	145.1	820.9	779.9	
31	60.0	59.0	59.0	125.0	7411	2.8	0.4630	0.0000	0.0	675.8	1.5400	24.2	169.3	845.1	802.9	
32	62.0	61.0	61.0	125.0	7661	2.8	0.4456	0.0000	0.0	675.8	1.5400	24.2	193.5	869.3	825.9	
33	64.0	63.0	63.0	125.0	7911	2.8	0.4285	0.0000	0.0	675.8	1.5400	24.2	217.7	893.5	848.8	
34	66.0	65.0	65.0	125.0	8161	2.8	0.4116	0.0000	0.0	675.8	1.5400	24.2	241.9	917.7	871.8	
35	68.0	67.0	67.0	125.0	8411	2.8	0.3950	0.0000	0.0	675.8	1.5400	24.2	266.1	941.9	894.8	
36	70.0	69.0	69.0	125.0	8661	2.8	0.3786	0.0000	0.0	675.8	1.5400	24.2	290.3	966.1	917.8	
37	72.0	71.0	71.0	125.0	8911	2.8	0.3625	0.0000	0.0	675.8	1.5400	24.2	314.5	990.3	940.8	

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia OH (widen) Bent 3 - pile group ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 05/01/09

CHECKED BY: DATE:

D_s => 2.5 ft Hw => 100.0 ft Hg => 0.0 ft

no. of piles= 6 Ho => 0.0 ft Hf => 15.0 ft

p = 47.12 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>	η
(1)	0	12	120	57.6	1.60	0	0.99
(2)	12	23	125	62.6	0.00	36	0.62
(3)	23	38	128	65.6	0.00	40	0.62
(4)	46	80	125	62.6	2.80	0	0.99
(5)	80	150	125	62.6	2.80	0	0.99
(6)	80	150	125	62.6	2.80	0	0.99
(7)	80	150	125	62.6	2.80	0	0.99
(8)	80	150	125	62.6	2.80	0	0.99

C-C Sp/D	η
2.5	0.65
3.0	0.77
3.5	0.88
4.0	1.00

Current C-C Spacing/D 2.36

Clay group eff 0.99

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	η	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)		(kips)
0	0.0	0.0	0.0	120.0	0					0.0			0.0	0.99	0.0
1	15.0	7.5	7.5	120.0	900	1.6									
2	16.0	15.5	15.5	125.0	1900	0.0	0.9685	1.8402	86.7	53.5	0.0000	0.0	0.0	0.62	53.5
3	18.0	17.0	17.0	125.0	2088	0.0	0.9434	1.9693	185.6	167.9	0.0000	0.0	0.0	0.62	167.9
4	20.0	19.0	19.0	125.0	2338	0.0	0.9115	2.1307	200.8	291.6	0.0000	0.0	0.0	0.62	291.6
5	22.0	21.0	21.0	125.0	2588	0.0	0.8814	2.2805	214.9	424.1	0.0000	0.0	0.0	0.62	424.1
6	24.0	23.0	23.0	128.0	2844	0.0	0.8526	2.4243	228.5	565.0	0.0000	0.0	0.0	0.62	565.0
7	26.0	25.0	25.0	128.0	3100	0.0	0.8250	2.5571	241.0	713.5	0.0000	0.0	0.0	0.62	713.5
8	28.0	27.0	27.0	128.0	3356	0.0	0.7985	2.6794	252.5	869.2	0.0000	0.0	0.0	0.62	869.2
9	30.0	29.0	29.0	128.0	3612	0.0	0.7730	2.7917	263.1	1031.4	0.0000	0.0	0.0	0.62	1031.4
10	32.0	31.0	31.0	128.0	3868	0.0	0.7484	2.8943	272.8	1199.5	0.0000	0.0	0.0	0.62	1199.5
11	34.0	33.0	33.0	128.0	4124	0.0	0.7245	2.9874	281.6	1373.0	0.0000	0.0	0.0	0.62	1373.0
12	36.0	35.0	35.0	128.0	4380	0.0	0.7013	3.0715	289.5	1551.5	0.0000	0.0	0.0	0.62	1551.5
13	38.0	37.0	37.0	128.0	4636	0.0	0.6788	3.1467	296.6	1734.3	0.0000	0.0	0.0	0.62	1734.3
14	40.0	39.0	39.0	128.0	4892	0.0	0.6569	3.2133	302.9	1921.0	0.0000	0.0	0.0	0.62	1921.0
15	41.0	40.5	40.5	128.0	5084	0.0	0.6409	3.2578	153.5	2015.6	0.0000	0.0	0.0	0.62	2015.6
16	42.0	41.5	41.5	128.0	5212	0.0	0.6303	3.2849	154.8	2111.0	0.0000	0.0	0.0	0.62	2111.0
17	43.0	42.5	42.5	128.0	5340	0.0	0.6199	3.3100	156.0	2207.2	0.0000	0.0	0.0	0.62	2207.2
18	44.0	43.5	43.5	128.0	5468	0.0	0.6096	3.3331	157.1	2304.0	0.0000	0.0	0.0	0.62	2304.0
19	45.0	44.5	44.5	128.0	5596	0.0	0.5994	3.3542	158.1	2401.4	0.0000	0.0	0.0	0.62	2401.4
20	46.0	45.5	45.5	128.0	5724	0.0	0.5894	3.3733	159.0	2499.4	0.0000	0.0	0.0	0.62	2499.4
21	47.0	46.5	46.5	125.0	5849	2.8	0.5794	0.0000	0.0	2499.4	1.5400	72.6	71.8	0.99	2571.2
22	48.0	47.5	47.5	125.0	5974	2.8	0.5696	0.0000	0.0	2499.4	1.5400	72.6	143.7	0.99	2643.1
23	49.0	48.5	48.5	125.0	6099	2.8	0.5598	0.0000	0.0	2499.4	1.5400	72.6	215.5	0.99	2714.9
24	50.0	49.5	49.5	125.0	6224	2.8	0.5502	0.0000	0.0	2499.4	1.5400	72.6	287.4	0.99	2786.8
25	51.0	50.5	50.5	125.0	6349	2.8	0.5406	0.0000	0.0	2499.4	1.5400	72.6	359.2	0.99	2858.6
26	52.0	51.5	51.5	125.0	6474	2.8	0.5312	0.0000	0.0	2499.4	1.5400	72.6	431.1	0.99	2930.5
27	53.0	52.5	52.5	125.0	6599	2.8	0.5218	0.0000	0.0	2499.4	1.5400	72.6	502.9	0.99	3002.3
28	54.0	53.5	53.5	125.0	6724	2.8	0.5126	0.0000	0.0	2499.4	1.5400	72.6	574.8	0.99	3074.1
29	55.0	54.5	54.5	125.0	6849	2.8	0.5034	0.0000	0.0	2499.4	1.5400	72.6	646.6	0.99	3146.0
30	56.0	55.5	55.5	125.0	6974	2.8	0.4943	0.0000	0.0	2499.4	1.5400	72.6	718.5	0.99	3217.8
31	57.0	56.5	56.5	125.0	7099	2.8	0.4853	0.0000	0.0	2499.4	1.5400	72.6	790.3	0.99	3289.7
32	58.0	57.5	57.5	125.0	7224	2.8	0.4763	0.0000	0.0	2499.4	1.5400	72.6	862.1	0.99	3361.5
33	59.0	58.5	58.5	125.0	7349	2.8	0.4674	0.0000	0.0	2499.4	1.5400	72.6	934.0	0.99	3433.4
34	60.0	59.5	59.5	125.0	7474	2.8	0.4587	0.0000	0.0	2499.4	1.5400	72.6	1005.8	0.99	3505.2
35	61.0	60.5	60.5	125.0	7599	2.8	0.4499	0.0000	0.0	2499.4	1.5400	72.6	1077.7	0.99	3577.1
36	62.0	61.5	61.5	125.0	7724	2.8	0.4413	0.0000	0.0	2499.4	1.5400	72.6	1149.5	0.99	3648.9
37	63.0	62.5	62.5	125.0	7849	2.8	0.4327	0.0000	0.0	2499.4	1.5400	72.6	1221.4	0.99	3720.8
38	64.0	63.5	63.5	125.0	7974	2.8	0.4242	0.0000	0.0	2499.4	1.5400	72.6	1293.2	0.99	3792.6
39	65.0	64.5	64.5	125.0	8099	2.8	0.4158	0.0000	0.0	2499.4	1.5400	72.6	1365.1	0.99	3864.4
40	66.0	65.5	65.5	125.0	8224	2.8	0.4074	0.0000	0.0	2499.4	1.5400	72.6	1436.9	0.99	3936.3
41	67.0	66.5	66.5	125.0	8349	2.8	0.3991	0.0000	0.0	2499.4	1.5400	72.6	1508.7	0.99	4008.1
42	68.0	67.5	67.5	125.0	8474	2.8	0.3909	0.0000	0.0	2499.4	1.5400	72.6	1580.6	0.99	4080.0
43	69.0	68.5	68.5	125.0	8599	2.8	0.3827	0.0000	0.0	2499.4	1.5400	72.6	1652.4	0.99	4151.8
44	70.0	69.5	69.5	125.0	8724	2.8	0.3746	0.0000	0.0	2499.4	1.5400	72.6	1724.3	0.99	4223.7

L = 36' for extreme 950k

L = 44' for strength 228k

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Project: **Placentia Overhead Bent 3 (Widen)** Project No. **08-115**
By CTY Date 5/1/2009 Check by Date Sheet

Settlement Calculation for Pile Group

Pile Top Depth.= 12 ft @ El. 202 ft
Pile Tip Depth= 44 ft @ El. 170 ft
Pile Length= 32 ft
Equivalent Footing
Depth = 33 ft (usually 2/3 of pile length)
Width = 9.5 ft Length= 14.0 ft
Load per Support= 1200 kips
Equivalent Load = 9.0 ksf

Check Settlement:
Method: FHWA Hough Method

Layer	Top Elev. (ft)	Bottom Elev. (ft)	Top Depth (ft)	Bottom Depth (ft)	Soil Type	γ' pcf	(N')	c'	
1	214	190	0	24	CL	120	13	40	
2	190	179	24	35	SC	120	23	63	
3	179	164	35	50	CL	120	28	62	
4	164	100	50	114	SC	125	80	184	Hard Layer

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Depth	Layer Thick. (ft)	Mid pt. depth (ft)	γ' kcf	σ_{vo}' (ksf)	depth to Equiv. Footing (ft)	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)	Total ΔS (in)
0										
4	4	2	0.12	0.24	-31	0.00	0.24	40	0.00	0.00
8	4	6	0.12	0.72	-27	0.00	0.72	40	0.00	0.00
12	4	10	0.12	1.20	-23	0.00	1.20	40	0.00	0.00
16	4	14	0.12	1.68	-19	0.00	1.68	40	0.00	0.00
20	4	18	0.12	2.16	-15	0.00	2.16	40	0.00	0.00
24	4	22	0.12	2.64	-11	0.00	2.64	40	0.00	0.00
28	4	26	0.12	3.12	-7	0.00	3.12	63	0.00	0.00
32	4	30	0.12	3.60	-3	0.00	3.60	63	0.00	0.00
33	1	32.5	0.12	3.90	-0.5	0.00	3.90	63	0.00	0.00
35	2	34	0.12	4.08	1	8.16	12.24	63	0.18	0.18
39	4	37	0.12	4.44	4	6.35	10.79	62	0.30	0.48
43	4	41	0.12	4.92	8	4.90	9.82	62	0.23	0.71
47	4	45	0.12	5.40	12	3.99	9.39	62	0.19	0.90
50	3	48.5	0.12	5.82	15.5	3.43	9.25	62	0.12	1.02

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

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Project Placentia Overhead Project No. _____

By CTY Date 5/15/09 Checked By _____ Date _____ Sheet ___ of ___

Abut 4

Δ Single pile =

demand = 100/0.5 = 200 k per pile

⇒ Length = 35' Use 38'

⇒ EI = 188'

Δ pile group =

In clay =

$$\eta = \frac{(14.3+1.33)\times 2+(4+1.33)\times 2}{7\times 1.33\times \pi} \rightarrow 1$$

$\eta_{clay} = 1$

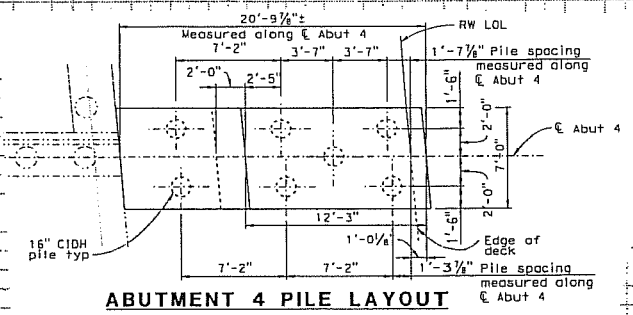
In Sand =

c-c spacing = $\frac{\sqrt{3.5^2+1.2^2}}{1.33} = 3.16$

$\eta_{sand} = 0.8$

demand = 500/0.5 = 1000 k per support

⇒ Length = 32'



ABUTMENT 4 PILE LAYOUT

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia OH (widen) Abut 4 single pile ITEM: 1.33-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 05/12/09

CHECKED BY: DATE:

D_s => 1.3333 ft Hw => 100.0 ft Hg => 0.0 ft

p = 4.1888 ft Ho => 0.0 ft Hf => 5.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	20	120	57.6	1.60	0
(2)	20	22	120	57.6	1.60	0
(3)	22	27	120	57.6	0.00	30
(4)	27	47	125	62.6	0.00	36
(5)	47	62	128	65.6	0.00	40
(6)	62	150	125	62.6	2.80	0
(7)	62	150	125	62.6	2.80	0
(8)	62	150	125	62.6	2.80	0

Sublayer No.	Depth, z (ft)	z_l (ft)	New Depth (ft)	Soil Unit Weight (pcf)	Overburden Pressure (psf)	c' (ksf)	β	f_l^s (ksf)	ΔQ_s^s (kips)	Q_s^s (kips)	f_l^c (ksf)	ΔQ_s^c (kips)	Q_s^c (kips)	Q_s (kips)
0	0.0	0.0	0.0	120.0	0									
1	5.0	2.5	2.5	120.0	300	1.6				0.0			0.0	0.0
2	6.0	5.5	5.5	120.0	660	1.6	1.1834	0.0000	0.0	0.0	0.8800	3.7	3.7	3.7
3	8.0	7.0	7.0	120.0	840	1.6	1.1428	0.0000	0.0	0.0	0.8800	7.4	11.1	11.1
4	10.0	9.0	9.0	120.0	1080	1.6	1.0950	0.0000	0.0	0.0	0.8800	7.4	18.4	18.4
5	12.0	11.0	11.0	120.0	1320	1.6	1.0523	0.0000	0.0	0.0	0.8800	7.4	25.8	25.8
6	14.0	13.0	13.0	120.0	1560	1.6	1.0133	0.0000	0.0	0.0	0.8800	7.4	33.2	33.2
7	16.0	15.0	15.0	120.0	1800	1.6	0.9771	0.0000	0.0	0.0	0.8800	7.4	40.5	40.5
8	18.0	17.0	17.0	120.0	2040	1.6	0.9434	0.0000	0.0	0.0	0.8800	7.4	47.9	47.9
9	20.0	19.0	19.0	120.0	2280	1.6	0.9115	0.0000	0.0	0.0	0.8800	7.4	55.3	55.3
10	22.0	21.0	21.0	120.0	2520	1.6	0.8814	0.0000	0.0	0.0	0.8800	7.4	62.7	62.7
11	24.0	23.0	23.0	120.0	2760	0.0	0.8526	2.3531	19.7	19.7	0.0000	0.0	62.7	82.4
12	26.0	25.0	25.0	120.0	3000	0.0	0.8250	2.4750	20.7	40.4	0.0000	0.0	62.7	103.1
13	28.0	27.0	27.0	125.0	3250	0.0	0.7985	2.5952	21.7	62.2	0.0000	0.0	62.7	124.9
14	30.0	29.0	29.0	125.0	3500	0.0	0.7730	2.7055	22.7	84.9	0.0000	0.0	62.7	147.5
15	31.0	30.5	30.5	125.0	3688	0.0	0.7544	2.7820	11.7	96.5	0.0000	0.0	62.7	159.2
16	32.0	31.5	31.5	125.0	3813	0.0	0.7423	2.8301	11.9	108.4	0.0000	0.0	62.7	171.0
17	33.0	32.5	32.5	125.0	3938	0.0	0.7304	2.8759	12.0	120.4	0.0000	0.0	62.7	183.1
18	34.0	33.5	33.5	125.0	4063	0.0	0.7186	2.9194	12.2	132.6	0.0000	0.0	62.7	195.3
19	35.0	34.5	34.5	125.0	4188	0.0	0.7071	2.9608	12.4	145.0	0.0000	0.0	62.7	207.7
20	36.0	35.5	35.5	125.0	4313	0.0	0.6956	3.0000	12.6	157.6	0.0000	0.0	62.7	220.3
21	37.0	36.5	36.5	125.0	4438	0.0	0.6844	3.0370	12.7	170.3	0.0000	0.0	62.7	233.0
22	38.0	37.5	37.5	125.0	4563	0.0	0.6733	3.0719	12.9	183.2	0.0000	0.0	62.7	245.9
23	39.0	38.5	38.5	125.0	4688	0.0	0.6623	3.1048	13.0	196.2	0.0000	0.0	62.7	258.9
24	40.0	39.5	39.5	125.0	4813	0.0	0.6515	3.1355	13.1	209.3	0.0000	0.0	62.7	272.0
25	41.0	40.5	40.5	125.0	4938	0.0	0.6409	3.1643	13.3	222.6	0.0000	0.0	62.7	285.3
26	42.0	41.5	41.5	125.0	5063	0.0	0.6303	3.1910	13.4	236.0	0.0000	0.0	62.7	298.6
27	43.0	42.5	42.5	125.0	5188	0.0	0.6199	3.2158	13.5	249.4	0.0000	0.0	62.7	312.1
28	44.0	43.5	43.5	125.0	5313	0.0	0.6096	3.2386	13.6	263.0	0.0000	0.0	62.7	325.7
29	45.0	44.5	44.5	125.0	5438	0.0	0.5994	3.2594	13.7	276.6	0.0000	0.0	62.7	339.3
30	46.0	45.5	45.5	125.0	5563	0.0	0.5894	3.2784	13.7	290.4	0.0000	0.0	62.7	353.0
31	47.0	46.5	46.5	125.0	5688	0.0	0.5794	3.2955	13.8	304.2	0.0000	0.0	62.7	366.8
32	48.0	47.5	47.5	128.0	5816	0.0	0.5696	3.3124	13.9	318.1	0.0000	0.0	62.7	380.7
33	49.0	48.5	48.5	128.0	5944	0.0	0.5598	3.3274	13.9	332.0	0.0000	0.0	62.7	394.7
34	50.0	49.5	49.5	128.0	6072	0.0	0.5502	3.3405	14.0	346.0	0.0000	0.0	62.7	408.7

L=35' for rock

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia OH (widen) Abut 4 - pile group ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 05/01/09

CHECKED BY: DATE:

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

D_s =>	1.333	ft	Hw =>	100.0 ft	Hg =>	0.0 ft
no. of piles=	7		Ho =>	0.0 ft	Hf =>	5.0 ft
p =	29.31	ft				

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>	η
(1)	0	20	120	57.6	1.60	0	1.00
(2)	20	22	120	57.6	1.60	0	1.00
(3)	22	27	120	57.6	0.00	30	0.81
(4)	27	47	125	62.6	0.00	36	0.81
(5)	47	62	128	65.6	0.00	40	0.81
(6)	62	150	125	62.6	2.80	0	1.00
(7)	62	150	125	62.6	2.80	0	1.00
(8)	62	150	125	62.6	2.80	0	1.00

C-C Sp/D	η
2.5	0.65
3.0	0.77
3.5	0.88
4.0	1.00

Current C-C Spacing/D 3.2

Clay group eff 1.00

Sublayer No.	Depth, z	z_1	New Depth	Soil Unit	Overburden	c'	β	f_1^s	ΔQ_s^s	Q_s^s	f_1^c	ΔQ_s^c	Q_s^c	η	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)		(kips)
0	0.0	0.0	0.0	120.0	0										
1	5.0	2.5	2.5	120.0	300	1.6				0.0			0.0	1.00	0.0
2	6.0	5.5	5.5	120.0	660	1.6	1.1834	0.0000	0.0	0.0	0.8800	25.8	25.8	1.00	25.8
3	8.0	7.0	7.0	120.0	840	1.6	1.1428	0.0000	0.0	0.0	0.8800	51.6	77.4	1.00	77.4
4	10.0	9.0	9.0	120.0	1080	1.6	1.0950	0.0000	0.0	0.0	0.8800	51.6	129.0	1.00	129.0
5	12.0	11.0	11.0	120.0	1320	1.6	1.0523	0.0000	0.0	0.0	0.8800	51.6	180.6	1.00	180.6
6	14.0	13.0	13.0	120.0	1560	1.6	1.0133	0.0000	0.0	0.0	0.8800	51.6	232.2	1.00	232.2
7	16.0	15.0	15.0	120.0	1800	1.6	0.9771	0.0000	0.0	0.0	0.8800	51.6	283.8	1.00	283.8
8	18.0	17.0	17.0	120.0	2040	1.6	0.9434	0.0000	0.0	0.0	0.8800	51.6	335.4	1.00	335.4
9	20.0	19.0	19.0	120.0	2280	1.6	0.9115	0.0000	0.0	0.0	0.8800	51.6	386.9	1.00	386.9
10	22.0	21.0	21.0	120.0	2520	1.6	0.8814	0.0000	0.0	0.0	0.8800	51.6	438.5	1.00	438.5
11	24.0	23.0	23.0	120.0	2760	0.0	0.8526	2.3531	138.0	111.1	0.0000	0.0	438.5	0.81	549.6
12	26.0	25.0	25.0	120.0	3000	0.0	0.8250	2.4750	145.1	227.9	0.0000	0.0	438.5	0.81	666.5
13	28.0	27.0	27.0	125.0	3250	0.0	0.7985	2.5952	152.2	350.4	0.0000	0.0	438.5	0.81	789.0
14	30.0	29.0	29.0	125.0	3500	0.0	0.7730	2.7055	158.6	478.2	0.0000	0.0	438.5	0.81	916.7
15	31.0	30.5	30.5	125.0	3688	0.0	0.7544	2.7820	81.6	543.8	0.0000	0.0	438.5	0.81	982.4
16	32.0	31.5	31.5	125.0	3813	0.0	0.7423	2.8301	83.0	610.6	0.0000	0.0	438.5	0.81	1049.2
17	33.0	32.5	32.5	125.0	3938	0.0	0.7304	2.8759	84.3	678.5	0.0000	0.0	438.5	0.81	1117.0
18	34.0	33.5	33.5	125.0	4063	0.0	0.7186	2.9194	85.6	747.4	0.0000	0.0	438.5	0.81	1186.0
19	35.0	34.5	34.5	125.0	4188	0.0	0.7071	2.9608	86.8	817.3	0.0000	0.0	438.5	0.81	1255.8
20	36.0	35.5	35.5	125.0	4313	0.0	0.6956	3.0000	87.9	888.1	0.0000	0.0	438.5	0.81	1326.6
21	37.0	36.5	36.5	125.0	4438	0.0	0.6844	3.0370	89.0	959.8	0.0000	0.0	438.5	0.81	1398.3
22	38.0	37.5	37.5	125.0	4563	0.0	0.6733	3.0719	90.1	1032.3	0.0000	0.0	438.5	0.81	1470.8
23	39.0	38.5	38.5	125.0	4688	0.0	0.6623	3.1048	91.0	1105.6	0.0000	0.0	438.5	0.81	1544.1
24	40.0	39.5	39.5	125.0	4813	0.0	0.6515	3.1355	91.9	1179.6	0.0000	0.0	438.5	0.81	1618.1
25	41.0	40.5	40.5	125.0	4938	0.0	0.6409	3.1643	92.8	1254.3	0.0000	0.0	438.5	0.81	1692.8
26	42.0	41.5	41.5	125.0	5063	0.0	0.6303	3.1910	93.5	1329.6	0.0000	0.0	438.5	0.81	1768.1
27	43.0	42.5	42.5	125.0	5188	0.0	0.6199	3.2158	94.3	1405.5	0.0000	0.0	438.5	0.81	1844.1
28	44.0	43.5	43.5	125.0	5313	0.0	0.6096	3.2386	94.9	1482.0	0.0000	0.0	438.5	0.81	1920.5
29	45.0	44.5	44.5	125.0	5438	0.0	0.5994	3.2594	95.5	1558.9	0.0000	0.0	438.5	0.81	1997.4
30	46.0	45.5	45.5	125.0	5563	0.0	0.5894	3.2784	96.1	1636.3	0.0000	0.0	438.5	0.81	2074.8
31	47.0	46.5	46.5	125.0	5688	0.0	0.5794	3.2955	96.6	1714.1	0.0000	0.0	438.5	0.81	2152.6
32	48.0	47.5	47.5	128.0	5816	0.0	0.5696	3.3124	97.1	1792.2	0.0000	0.0	438.5	0.81	2230.8
33	49.0	48.5	48.5	128.0	5944	0.0	0.5598	3.3274	97.5	1870.8	0.0000	0.0	438.5	0.81	2309.3
34	50.0	49.5	49.5	128.0	6072	0.0	0.5502	3.3405	97.9	1949.6	0.0000	0.0	438.5	0.81	2388.2
35	51.0	50.5	50.5	128.0	6200	0.0	0.5406	3.3517	98.3	2028.7	0.0000	0.0	438.5	0.81	2467.3
36	52.0	51.5	51.5	128.0	6328	0.0	0.5312	3.3611	98.5	2108.1	0.0000	0.0	438.5	0.81	2546.6
37	53.0	52.5	52.5	128.0	6456	0.0	0.5218	3.3687	98.8	2187.6	0.0000	0.0	438.5	0.81	2626.1
38	54.0	53.5	53.5	128.0	6584	0.0	0.5126	3.3744	98.9	2267.2	0.0000	0.0	438.5	0.81	2705.8
39	55.0	54.5	54.5	128.0	6712	0.0	0.5034	3.3784	99.0	2347.0	0.0000	0.0	438.5	0.81	2785.5
40	56.0	55.5	55.5	128.0	6840	0.0	0.4943	3.3806	99.1	2426.8	0.0000	0.0	438.5	0.81	2865.3
41	57.0	56.5	56.5	128.0	6968	0.0	0.4853	3.3810	99.1	2506.6	0.0000	0.0	438.5	0.81	2945.1
42	58.0	57.5	57.5	128.0	7096	0.0	0.4763	3.3797	99.1	2586.4	0.0000	0.0	438.5	0.81	3024.9
43	59.0	58.5	58.5	128.0	7224	0.0	0.4674	3.3766	99.0	2666.1	0.0000	0.0	438.5	0.81	3104.6
44	60.0	59.5	59.5	128.0	7352	0.0	0.4587	3.3718	98.8	2745.6	0.0000	0.0	438.5	0.81	3184.2

L=32' for long tip

Earth Mechanics, Inc.
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Project: **Placentia Overhead Abut 4(Widen)** Project No. **08-115**
By CTY Date 5/1/2009 Check by Date Sheet

Settlement Calculation for Pile Group

Pile Top Depth.= 17 ft @ El. 226 ft
Pile Tip Depth= 38 ft @ El. 205 ft
Pile Length= 21 ft
Equivalent Footing
Depth = 31 ft (usually 2/3 of pile length)
Width = 5.3 ft Length= 15.7 ft
Load per Support= 500 kips
Equivalent Load = 6.0 ksf

Check Settlement:
Method: FHWA Hough Method

Layer	Top Elev. (ft)	Bottom Elev. (ft)	Top Depth (ft)	Bottom Depth (ft)	Soil Type	γ' pcf	(N')	c'	
1	243	233	0	10	SC	120	14	48	
2	233	204	10	39	CL	120	16	44	
3	204	199	39	44	SM	125	23	63	
4	199	179	44	64	SM	128	28	72	
5	179	164	64	79	SP	128	80	218	Hard Layer

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Depth	Layer Thick. (ft)	Mid pt. depth (ft)	γ' kcf	σ_{vo}' (ksf)	depth to Equiv. Footing (ft)	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)	Total ΔS (in)
0										
4	4	2	0.12	0.24	-29	0.00	0.24	48	0.00	0.00
8	4	6	0.12	0.72	-25	0.00	0.72	48	0.00	0.00
10	2	9	0.12	1.08	-22	0.00	1.08	48	0.00	0.00
14	4	12	0.12	1.44	-19	0.00	1.44	44	0.00	0.00
18	4	16	0.12	1.92	-15	0.00	1.92	44	0.00	0.00
22	4	20	0.12	2.40	-11	0.00	2.40	44	0.00	0.00
26	4	24	0.12	2.88	-7	0.00	2.88	44	0.00	0.00
30	4	28	0.12	3.36	-3	0.00	3.36	44	0.00	0.00
31	1	30.5	0.12	3.66	-0.5	0.00	3.66	44	0.00	0.00
35	4	33	0.12	3.96	2	4.36	8.32	44	0.35	0.35
39	4	37	0.12	4.44	6	2.82	7.26	44	0.23	0.58
43	4	41	0.125	4.93	10	2.08	7.01	63	0.12	0.70
44	1	43.5	0.125	5.24	12.5	1.79	7.03	63	0.02	0.73
48	4	46	0.128	5.56	15	1.57	7.13	72	0.07	0.80
52	4	50	0.128	6.07	19	1.31	7.39	72	0.06	0.85
56	4	54	0.128	6.59	23	1.13	7.71	72	0.05	0.90
60	4	58	0.128	7.10	27	0.99	8.08	72	0.04	0.94
64	4	62	0.128	7.61	31	0.88	8.49	72	0.03	0.97

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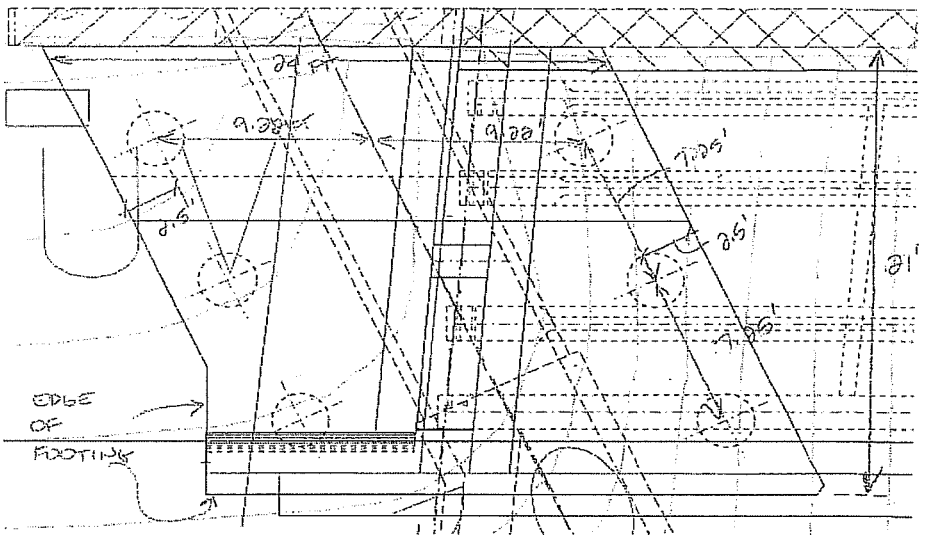
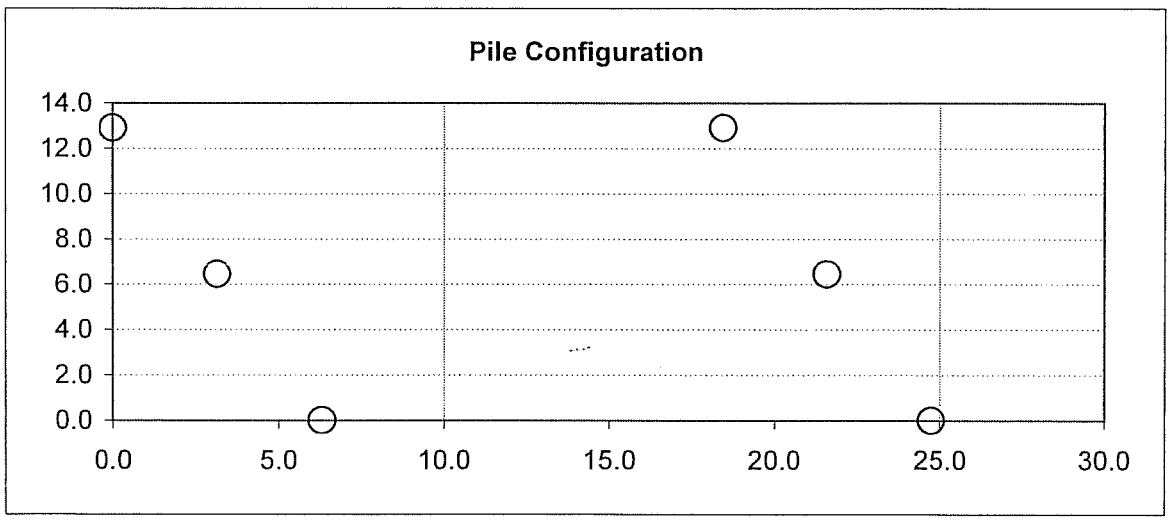
Project: **Placentia OH (WIDEN) - Abutment 1** Project No. **08-115**
By CTY Date 12/11/08 Check by Date Sheet

Proposed Abutment 1 Pile Layout



Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia. (feet): 2.5
No. of Piles: 6

Group Efficiency	X-Dir	Y-Dir
	0.857	0.707

Avg = 0.78

Coordinates

Pile No.	X	Y
1	6.300	0.00
2	24.740	0.00
3	3.150	6.45
4	21.590	6.45
5	0.000	12.90
6	18.440	12.90

Reduction Factors in X-dir	Reduction Factors in Y-dir
0.906	0.717
0.917	0.718
0.798	0.697
0.808	0.698
0.870	0.920
0.870	0.920

Fx1 = 0.906 = 1 (lbl-21) x 0.917 (skew-31) x 0.988 (skew-41) x 1 (skew-51) x 1 (skew-61)
skew-31 = 0.917 = SQRT((0.921*Cos(1.116))^2 + 0.916*Sin(1.116))^2)
skew-41 = 0.988 = SQRT((0.985*Cos(0.399))^2 + 1*Sin(0.399))^2)
skew-51 = 1 = SQRT((1*Cos(1.116))^2 + 1*Sin(1.116))^2)
skew-61 = 1 = SQRT((1*Cos(0.816))^2 + 1*Sin(0.816))^2)

Fx2 = 0.917 = 1 (lbl-12) x 1 (skew-32) x 0.917 (skew-42) x 1 (skew-52) x 1 (skew-62)
skew-32 = 1 = SQRT((1*Cos(0.29))^2 + 1*Sin(0.29))^2)
skew-42 = 0.917 = SQRT((0.921*Cos(1.116))^2 + 0.916*Sin(1.116))^2)
skew-52 = 1 = SQRT((1*Cos(0.481))^2 + 1*Sin(0.481))^2)
skew-62 = 1 = SQRT((1*Cos(1.116))^2 + 1*Sin(1.116))^2)

Fx3 = 0.798 = 0.881 (skew-13) x 1 (skew-23) x 1 (lbl-43) x 0.917 (skew-53) x 0.988 (skew-63)
skew-13 = 0.881 = SQRT((0.717*Cos(1.116))^2 + 0.916*Sin(1.116))^2)
skew-23 = 1 = SQRT((1*Cos(0.29))^2 + 1*Sin(0.29))^2)
skew-53 = 0.917 = SQRT((0.921*Cos(1.116))^2 + 0.916*Sin(1.116))^2)
skew-63 = 0.988 = SQRT((0.985*Cos(0.399))^2 + 1*Sin(0.399))^2)

Fx4 = 0.808 = 1 (skew-14) x 0.881 (skew-24) x 1 (lbl-34) x 1 (skew-54) x 0.917 (skew-64)
skew-14 = 1 = SQRT((1*Cos(0.399))^2 + 1*Sin(0.399))^2)
skew-24 = 0.881 = SQRT((0.717*Cos(1.116))^2 + 0.916*Sin(1.116))^2)
skew-54 = 1 = SQRT((1*Cos(0.29))^2 + 1*Sin(0.29))^2)
skew-64 = 0.917 = SQRT((0.921*Cos(1.116))^2 + 0.916*Sin(1.116))^2)

Fx5 = 0.87 = 0.987 (skew-15) x 1 (skew-25) x 0.881 (skew-35) x 1 (skew-45) x 1 (lbl-65)
skew-15 = 0.987 = SQRT((0.933*Cos(1.116))^2 + 1*Sin(1.116))^2)
skew-25 = 1 = SQRT((1*Cos(0.481))^2 + 1*Sin(0.481))^2)
skew-35 = 0.881 = SQRT((0.717*Cos(1.116))^2 + 0.916*Sin(1.116))^2)
skew-45 = 1 = SQRT((1*Cos(0.29))^2 + 1*Sin(0.29))^2)

Fx6 = 0.87 = 1 (skew-16) x 0.987 (skew-26) x 1 (skew-36) x 0.881 (skew-46) x 1 (lbl-56)
skew-16 = 1 = SQRT((1*Cos(0.816))^2 + 1*Sin(0.816))^2)
skew-26 = 0.987 = SQRT((0.933*Cos(1.116))^2 + 1*Sin(1.116))^2)
skew-36 = 1 = SQRT((1*Cos(0.399))^2 + 1*Sin(0.399))^2)
skew-46 = 0.881 = SQRT((0.717*Cos(1.116))^2 + 0.916*Sin(1.116))^2)

Fx1 = 0.906 = 1 (lbl-21) x 0.917 (skew-31) x 0.988 (skew-41) x 1 (skew-51) x 1 (skew-61)
skew-31 = 0.759 = SQRT((0.717*Cos(0.454))^2 + 0.916*Sin(0.454))^2)
skew-41 = 0.998 = SQRT((0.985*Cos(1.172))^2 + 1*Sin(1.172))^2)
skew-51 = 0.946 = SQRT((0.933*Cos(0.454))^2 + 1*Sin(0.454))^2)
skew-61 = 1 = SQRT((1*Cos(0.755))^2 + 1*Sin(0.755))^2)

Fx2 = 0.917 = 1 (lbl-12) x 1 (skew-32) x 0.917 (skew-42) x 1 (skew-52) x 1 (skew-62)
skew-32 = 1 = SQRT((1*Cos(1.28))^2 + 1*Sin(1.28))^2)
skew-42 = 0.759 = SQRT((0.717*Cos(0.454))^2 + 0.916*Sin(0.454))^2)
skew-52 = 1 = SQRT((1*Cos(1.09))^2 + 1*Sin(1.09))^2)
skew-62 = 0.946 = SQRT((0.933*Cos(0.454))^2 + 1*Sin(0.454))^2)

Fx3 = 0.798 = 0.881 (skew-13) x 1 (skew-23) x 1 (lbl-43) x 0.917 (skew-53) x 0.988 (skew-63)

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Project: **Placentia OH (WIDEN) - Abutment 1** Project No. **08-115**
By CTY Date 12/11/08 Check by Date Sheet _____

skew-13 = 0.92 = SQRT((0.921*Cos(0.454))^2 + 0.916*Sin(0.454))^2)
skew-23 = 1 = SQRT((1*Cos(1.28))^2 + 1*Sin(1.28))^2)
skew-53 = 0.759 = SQRT((0.717*Cos(0.454))^2 + 0.916*Sin(0.454))^2)
skew-63 = 0.998 = SQRT((0.985*Cos(1.172))^2 + 1*Sin(1.172))^2)

Fx4 = 0.808 = 1 (skew-14) x 0.881 (skew-24) x 1 (lbl-34) x 1 (skew-54) x 0.917 (skew-64)
skew-14 = 1 = SQRT((1*Cos(1.172))^2 + 1*Sin(1.172))^2)
skew-24 = 0.92 = SQRT((0.921*Cos(0.454))^2 + 0.916*Sin(0.454))^2)
skew-54 = 1 = SQRT((1*Cos(1.28))^2 + 1*Sin(1.28))^2)
skew-64 = 0.759 = SQRT((0.717*Cos(0.454))^2 + 0.916*Sin(0.454))^2)

Fx5 = 0.87 = 0.987 (skew-15) x 1 (skew-25) x 0.881 (skew-35) x 1 (skew-45) x 1 (lbl-65)
skew-15 = 1 = SQRT((1*Cos(0.454))^2 + 1*Sin(0.454))^2)
skew-25 = 1 = SQRT((1*Cos(1.09))^2 + 1*Sin(1.09))^2)
skew-35 = 0.92 = SQRT((0.921*Cos(0.454))^2 + 0.916*Sin(0.454))^2)
skew-45 = 1 = SQRT((1*Cos(1.28))^2 + 1*Sin(1.28))^2)

Fx6 = 0.87 = 1 (skew-16) x 0.987 (skew-26) x 1 (skew-36) x 0.881 (skew-46) x 1 (lbl-56)
skew-16 = 1 = SQRT((1*Cos(0.755))^2 + 1*Sin(0.755))^2)
skew-26 = 1 = SQRT((1*Cos(0.454))^2 + 1*Sin(0.454))^2)
skew-36 = 1 = SQRT((1*Cos(1.172))^2 + 1*Sin(1.172))^2)
skew-46 = 0.92 = SQRT((0.921*Cos(0.454))^2 + 0.916*Sin(0.454))^2)

where
lbl: line-by-line effect
sbs: side-by-side effect
skew: skew effect

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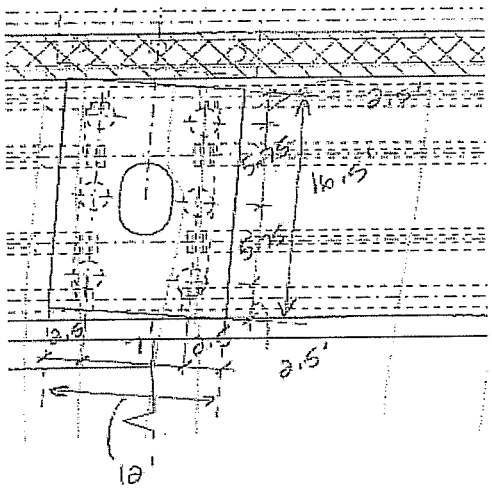
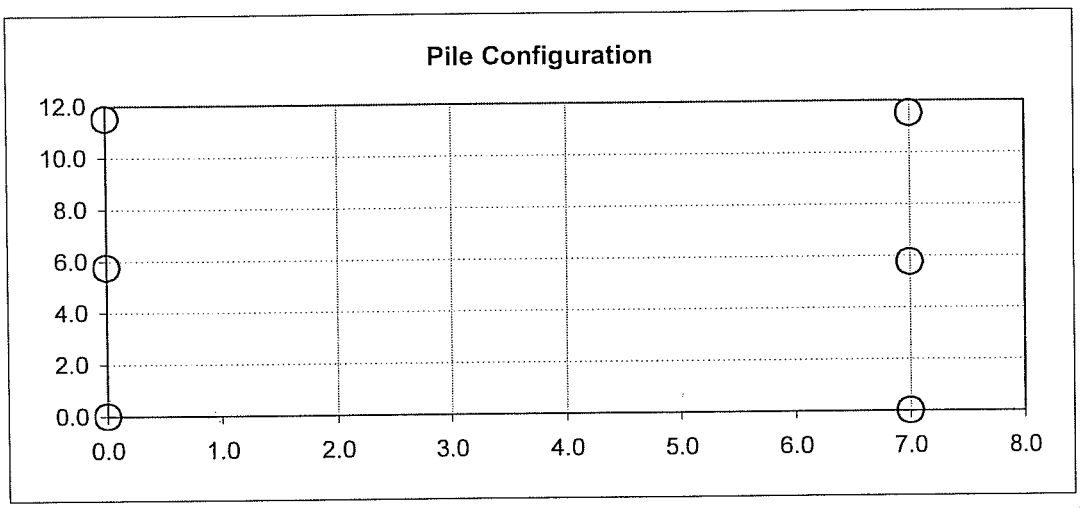
Project: Placentia OH (WIDEN) - Bents 2 and 3 Project No. 08-115
By CTY Date 12/11/08 Check by Date Sheet

Proposed Bents 2 and 3 Pile Layout



Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia. (feet): 2.5
No. of Piles: 6

Group Efficiency	X-Dir	Y-Dir
	0.577	0.453

Avg = 0.51

Coordinates

Pile No.	X	Y
1	0.000	0.000
2	7.000	0.000
3	0.000	5.750
4	7.000	5.750
5	0.000	11.500
6	7.000	11.500

Reduction Factors in X-dir	Reduction Factors in Y-dir
0.514	0.438
0.764	0.438
0.390	0.468
0.639	0.468
0.514	0.779
0.764	0.779

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Project: Placentia OH (WIDEN) - Bents 2 and 3 Project No. 08-115
By CTY Date 12/11/08 Check by Date Sheet

Fx1 = 0.514 = 0.71 (lbl-21) x 0.85 (sbs-31) x 0.873 (skew-41) x 1 (sbs-51) x 0.977 (skew-61)
skew-41 = 0.873 = SQRT((0.783*Cos(0.688))^2 + 0.991*Sin(0.688))^2)
skew-61 = 0.977 = SQRT((0.91*Cos(1.024))^2 + 1*Sin(1.024))^2)

Fx2 = 0.764 = 0.915 (lbl-12) x 0.984 (skew-32) x 0.85 (sbs-42) x 1 (skew-52) x 1 (sbs-62)
skew-32 = 0.984 = SQRT((0.978*Cos(0.688))^2 + 0.991*Sin(0.688))^2)
skew-52 = 1 = SQRT((1*Cos(1.024))^2 + 1*Sin(1.024))^2)

Fx3 = 0.39 = 0.85 (sbs-13) x 0.873 (skew-23) x 0.71 (lbl-43) x 0.85 (sbs-53) x 0.873 (skew-63)
skew-23 = 0.873 = SQRT((0.783*Cos(0.688))^2 + 0.991*Sin(0.688))^2)
skew-63 = 0.873 = SQRT((0.783*Cos(0.688))^2 + 0.991*Sin(0.688))^2)

Fx4 = 0.639 = 0.984 (skew-14) x 0.85 (sbs-24) x 0.915 (lbl-34) x 0.984 (skew-54) x 0.85 (sbs-64)
skew-14 = 0.984 = SQRT((0.978*Cos(0.688))^2 + 0.991*Sin(0.688))^2)
skew-54 = 0.984 = SQRT((0.978*Cos(0.688))^2 + 0.991*Sin(0.688))^2)

Fx5 = 0.514 = 1 (sbs-15) x 0.977 (skew-25) x 0.85 (sbs-35) x 0.873 (skew-45) x 0.71 (lbl-65)
skew-25 = 0.977 = SQRT((0.91*Cos(1.024))^2 + 1*Sin(1.024))^2)
skew-45 = 0.873 = SQRT((0.783*Cos(0.688))^2 + 0.991*Sin(0.688))^2)

Fx6 = 0.764 = 1 (skew-16) x 1 (sbs-26) x 0.984 (skew-36) x 0.85 (sbs-46) x 0.915 (lbl-56)
skew-16 = 1 = SQRT((1*Cos(1.024))^2 + 1*Sin(1.024))^2)
skew-36 = 0.984 = SQRT((0.978*Cos(0.688))^2 + 0.991*Sin(0.688))^2)

Fx1 = 0.514 = 0.71 (lbl-21) x 0.85 (sbs-31) x 0.873 (skew-41) x 1 (sbs-51) x 0.977 (skew-61)
skew-41 = 0.913 = SQRT((0.783*Cos(0.883))^2 + 0.991*Sin(0.883))^2)
skew-61 = 0.935 = SQRT((0.91*Cos(0.547))^2 + 1*Sin(0.547))^2)

Fx2 = 0.764 = 0.915 (lbl-12) x 0.984 (skew-32) x 0.85 (sbs-42) x 1 (skew-52) x 1 (sbs-62)
skew-32 = 0.913 = SQRT((0.783*Cos(0.883))^2 + 0.991*Sin(0.883))^2)
skew-52 = 0.935 = SQRT((0.91*Cos(0.547))^2 + 1*Sin(0.547))^2)

Fx3 = 0.39 = 0.85 (sbs-13) x 0.873 (skew-23) x 0.71 (lbl-43) x 0.85 (sbs-53) x 0.873 (skew-63)
skew-23 = 0.986 = SQRT((0.978*Cos(0.883))^2 + 0.991*Sin(0.883))^2)
skew-63 = 0.913 = SQRT((0.783*Cos(0.883))^2 + 0.991*Sin(0.883))^2)

Fx4 = 0.639 = 0.984 (skew-14) x 0.85 (sbs-24) x 0.915 (lbl-34) x 0.984 (skew-54) x 0.85 (sbs-64)
skew-14 = 0.986 = SQRT((0.978*Cos(0.883))^2 + 0.991*Sin(0.883))^2)
skew-54 = 0.913 = SQRT((0.783*Cos(0.883))^2 + 0.991*Sin(0.883))^2)

Fx5 = 0.514 = 1 (sbs-15) x 0.977 (skew-25) x 0.85 (sbs-35) x 0.873 (skew-45) x 0.71 (lbl-65)
skew-25 = 1 = SQRT((1*Cos(0.547))^2 + 1*Sin(0.547))^2)
skew-45 = 0.986 = SQRT((0.978*Cos(0.883))^2 + 0.991*Sin(0.883))^2)

Fx6 = 0.764 = 1 (skew-16) x 1 (sbs-26) x 0.984 (skew-36) x 0.85 (sbs-46) x 0.915 (lbl-56)
skew-16 = 1 = SQRT((1*Cos(0.547))^2 + 1*Sin(0.547))^2)
skew-36 = 0.986 = SQRT((0.978*Cos(0.883))^2 + 0.991*Sin(0.883))^2)

where
lbl: line-by-line effect
sbs: side-by-side effect
skew: skew effect

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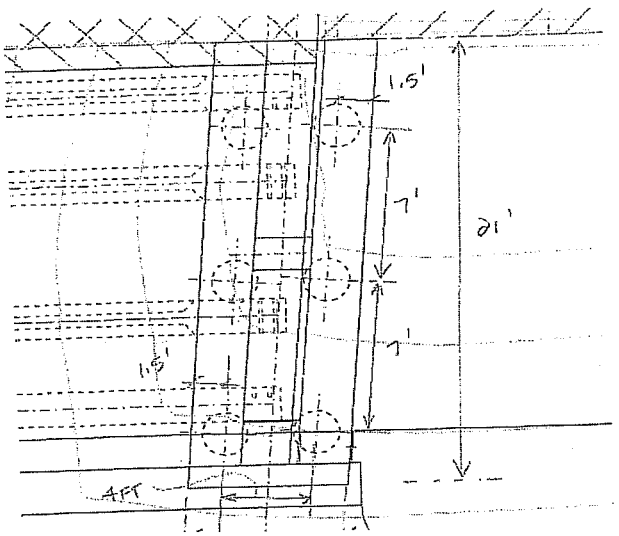
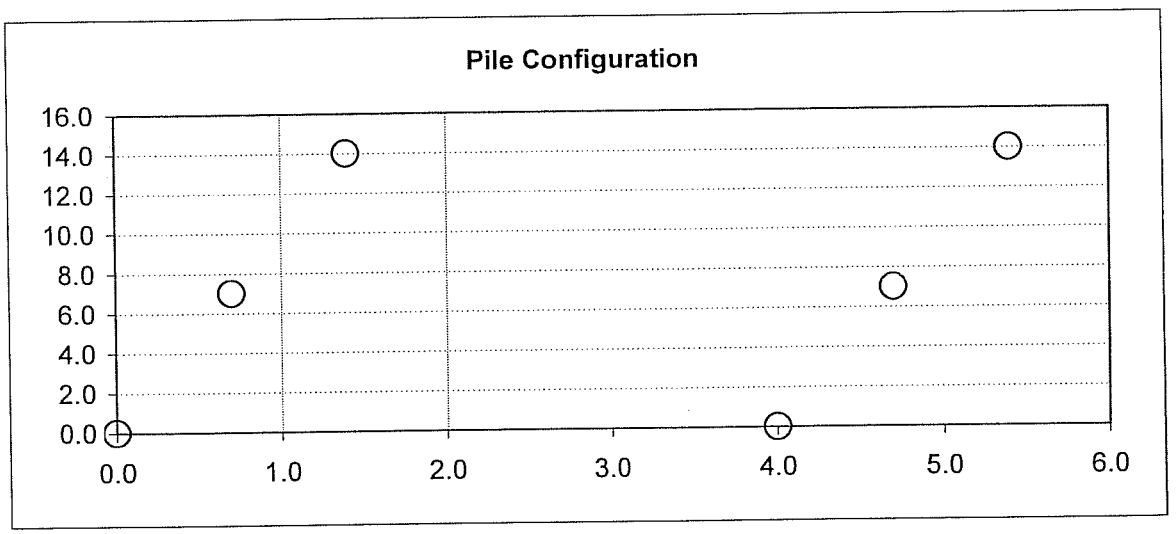
Project: **Placentia OH (WIDEN) - Abutment 4** Project No. **08-115**
By CTY Date 12/11/08 Check by Date Sheet _____

Proposed Abutment 4 Pile Layout



Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia. (feet): 1.333
No. of Piles: 6

Group Efficiency	X-Dir	Y-Dir
	0.824	0.810

Avg = 0.8 ≥

Coordinates

Pile No.	X	Y
1	0.000	0.00
2	4.000	0.00
3	0.700	7.00
4	4.700	7.00
5	1.400	14.00
6	5.400	14.00

Reduction Factors in X-dir	Reduction Factors in Y-dir
0.721	0.822
0.931	0.797
0.713	0.822
0.931	0.797
0.721	0.930
0.931	0.930

Fx1 = 0.721 = 0.729 (lbl-21) x 0.999 (skew-31) x 0.99 (skew-41) x 1 (skew-51) x 1 (skew-61)
skew-31 = 0.999 = SQRT((0.903*Cos(1.471))^2 + 1*Sin(1.471))^2)
skew-41 = 0.99 = SQRT((0.967*Cos(0.98))^2 + 1*Sin(0.98))^2)
skew-51 = 1 = SQRT((1*Cos(1.471))^2 + 1*Sin(1.471))^2)
skew-61 = 1 = SQRT((1*Cos(1.203))^2 + 1*Sin(1.203))^2)

Fx2 = 0.931 = 0.931 (lbl-12) x 1 (skew-32) x 0.999 (skew-42) x 1 (skew-52) x 1 (skew-62)
skew-32 = 1 = SQRT((1*Cos(1.13))^2 + 1*Sin(1.13))^2)
skew-42 = 0.999 = SQRT((0.903*Cos(1.471))^2 + 1*Sin(1.471))^2)
skew-52 = 1 = SQRT((1*Cos(1.387))^2 + 1*Sin(1.387))^2)
skew-62 = 1 = SQRT((1*Cos(1.471))^2 + 1*Sin(1.471))^2)

Fx3 = 0.713 = 1 (skew-13) x 0.989 (skew-23) x 0.729 (lbl-43) x 0.999 (skew-53) x 0.99 (skew-63)
skew-13 = 1 = SQRT((1*Cos(1.471))^2 + 1*Sin(1.471))^2)
skew-23 = 0.989 = SQRT((0.936*Cos(1.13))^2 + 1*Sin(1.13))^2)
skew-53 = 0.999 = SQRT((0.903*Cos(1.471))^2 + 1*Sin(1.471))^2)
skew-63 = 0.99 = SQRT((0.967*Cos(0.98))^2 + 1*Sin(0.98))^2)

Fx4 = 0.931 = 1 (skew-14) x 1 (skew-24) x 0.931 (lbl-34) x 1 (skew-54) x 0.999 (skew-64)
skew-14 = 1 = SQRT((1*Cos(0.98))^2 + 1*Sin(0.98))^2)
skew-24 = 1 = SQRT((1*Cos(1.471))^2 + 1*Sin(1.471))^2)
skew-54 = 1 = SQRT((1*Cos(1.13))^2 + 1*Sin(1.13))^2)
skew-64 = 0.999 = SQRT((0.903*Cos(1.471))^2 + 1*Sin(1.471))^2)

Fx5 = 0.721 = 1 (skew-15) x 1 (skew-25) x 1 (skew-35) x 0.989 (skew-45) x 0.729 (lbl-65)
skew-15 = 1 = SQRT((1*Cos(1.471))^2 + 1*Sin(1.471))^2)
skew-25 = 1 = SQRT((1*Cos(1.387))^2 + 1*Sin(1.387))^2)
skew-35 = 1 = SQRT((1*Cos(1.471))^2 + 1*Sin(1.471))^2)
skew-45 = 0.989 = SQRT((0.936*Cos(1.13))^2 + 1*Sin(1.13))^2)

Fx6 = 0.931 = 1 (skew-16) x 1 (skew-26) x 1 (skew-36) x 1 (skew-46) x 0.931 (lbl-56)
skew-16 = 1 = SQRT((1*Cos(1.203))^2 + 1*Sin(1.203))^2)
skew-26 = 1 = SQRT((1*Cos(1.471))^2 + 1*Sin(1.471))^2)
skew-36 = 1 = SQRT((1*Cos(0.98))^2 + 1*Sin(0.98))^2)
skew-46 = 1 = SQRT((1*Cos(1.471))^2 + 1*Sin(1.471))^2)

Fx1 = 0.721 = 0.729 (lbl-21) x 0.999 (skew-31) x 0.99 (skew-41) x 1 (skew-51) x 1 (skew-61)
skew-31 = 0.904 = SQRT((0.903*Cos(0.1))^2 + 1*Sin(0.1))^2)
skew-41 = 0.978 = SQRT((0.967*Cos(0.591))^2 + 1*Sin(0.591))^2)
skew-51 = 1 = SQRT((1*Cos(0.1))^2 + 1*Sin(0.1))^2)
skew-61 = 1 = SQRT((1*Cos(0.368))^2 + 1*Sin(0.368))^2)

Fx2 = 0.931 = 0.931 (lbl-12) x 1 (skew-32) x 0.999 (skew-42) x 1 (skew-52) x 1 (skew-62)
skew-32 = 0.948 = SQRT((0.936*Cos(0.441))^2 + 1*Sin(0.441))^2)
skew-42 = 0.904 = SQRT((0.903*Cos(0.1))^2 + 1*Sin(0.1))^2)
skew-52 = 1 = SQRT((1*Cos(0.184))^2 + 1*Sin(0.184))^2)
skew-62 = 1 = SQRT((1*Cos(0.1))^2 + 1*Sin(0.1))^2)

Fx3 = 0.713 = 1 (skew-13) x 0.989 (skew-23) x 0.729 (lbl-43) x 0.999 (skew-53) x 0.99 (skew-63)

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Project: **Placentia OH (WIDEN) - Abutment 4** Project No. **08-115**
By CTY Date 12/11/08 Check by Date Sheet

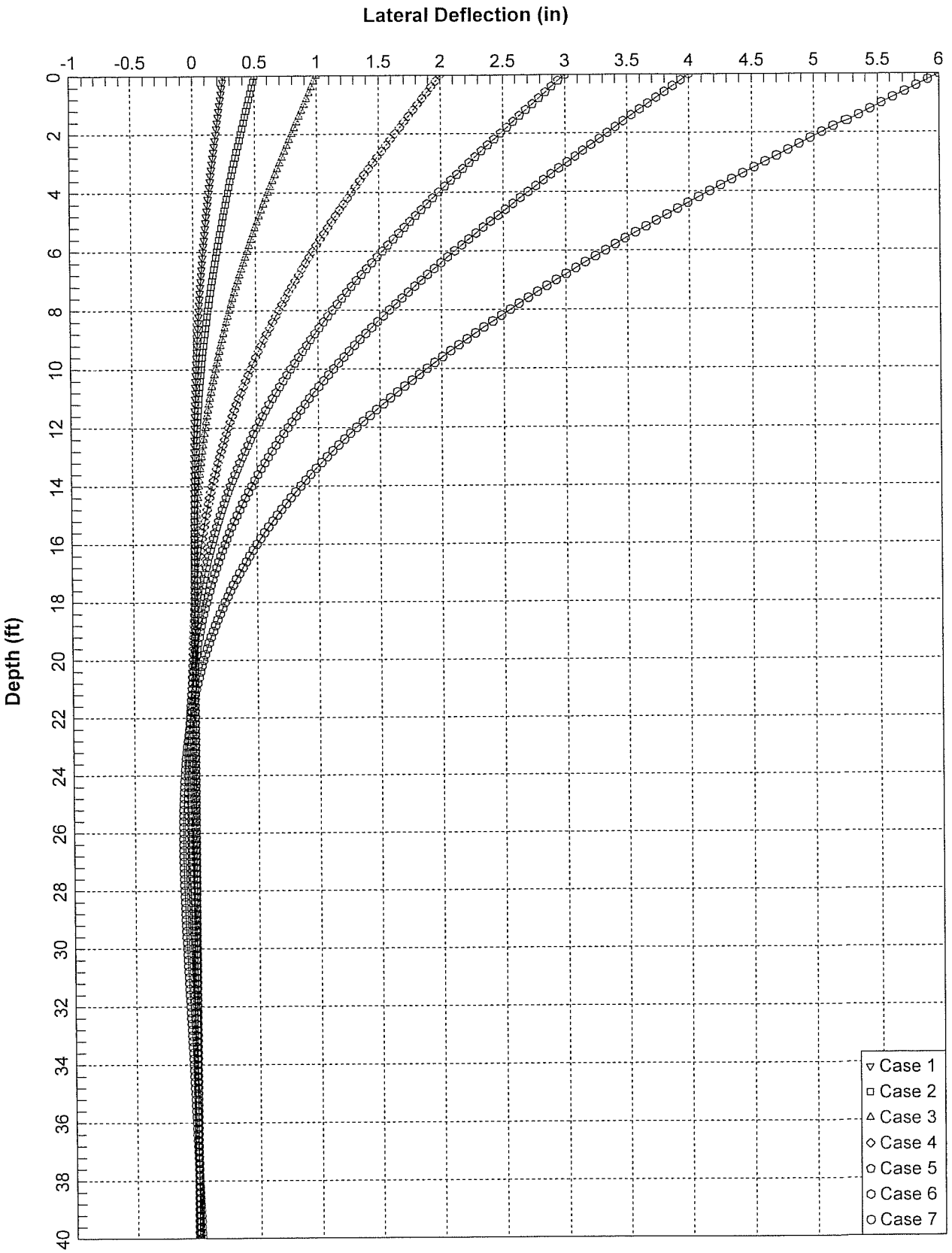
skew-13 = 1 = SQRT((1*Cos(0.1))^2 + 1*Sin(0.1))^2)
skew-23 = 1 = SQRT((1*Cos(0.441))^2 + 1*Sin(0.441))^2)
skew-53 = 0.904 = SQRT((0.903*Cos(0.1))^2 + 1*Sin(0.1))^2)
skew-63 = 0.978 = SQRT((0.967*Cos(0.591))^2 + 1*Sin(0.591))^2)

Fx4 = 0.931 = 1 (skew-14) x 1 (skew-24) x 0.931 (lbl-34) x 1 (skew-54) x 0.999 (skew-64)
skew-14 = 1 = SQRT((1*Cos(0.591))^2 + 1*Sin(0.591))^2)
skew-24 = 1 = SQRT((1*Cos(0.1))^2 + 1*Sin(0.1))^2)
skew-54 = 0.948 = SQRT((0.936*Cos(0.441))^2 + 1*Sin(0.441))^2)
skew-64 = 0.904 = SQRT((0.903*Cos(0.1))^2 + 1*Sin(0.1))^2)

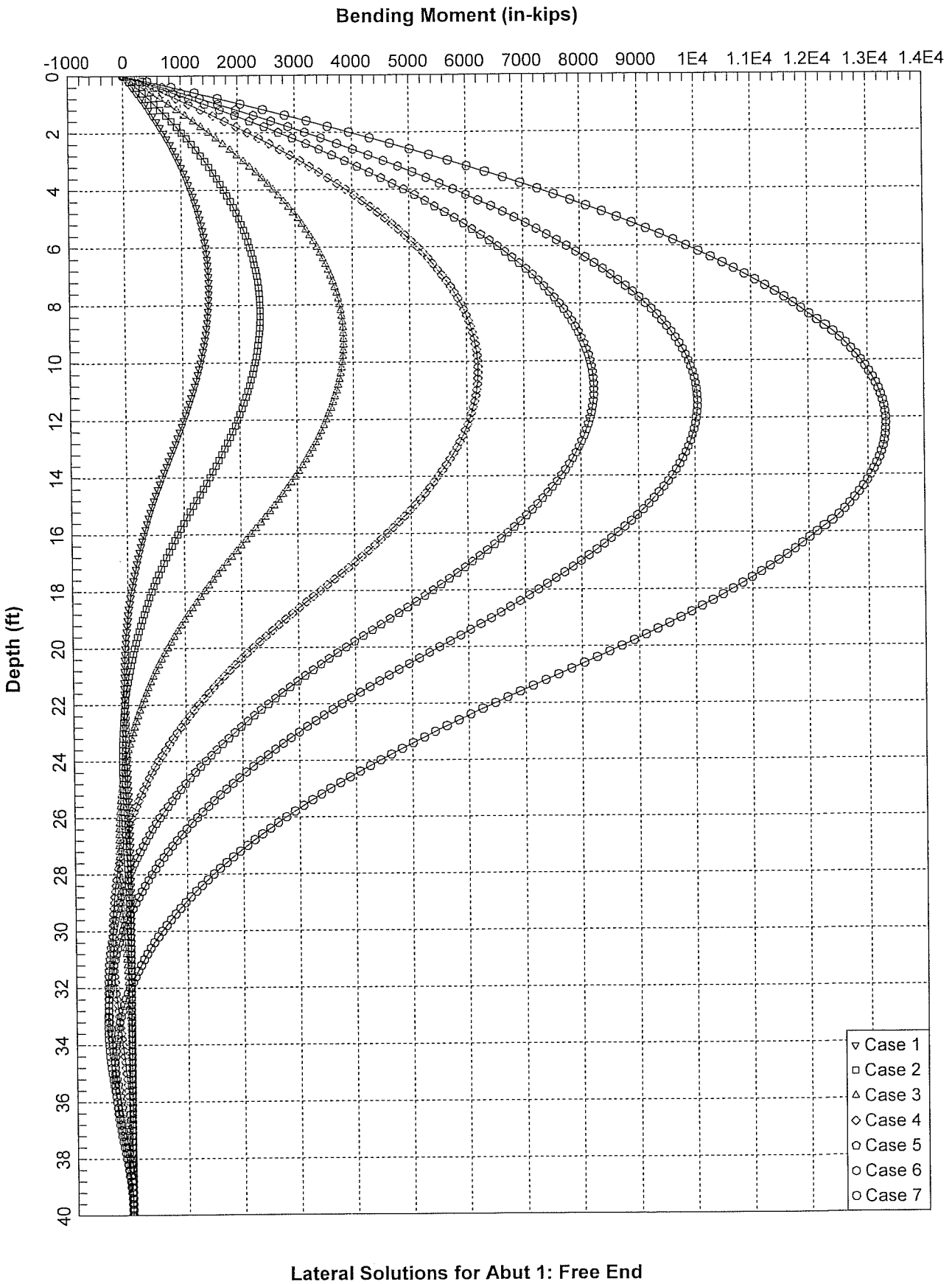
Fx5 = 0.721 = 1 (skew-15) x 1 (skew-25) x 1 (skew-35) x 0.989 (skew-45) x 0.729 (lbl-65)
skew-15 = 1 = SQRT((1*Cos(0.1))^2 + 1*Sin(0.1))^2)
skew-25 = 1 = SQRT((1*Cos(0.184))^2 + 1*Sin(0.184))^2)
skew-35 = 1 = SQRT((1*Cos(0.1))^2 + 1*Sin(0.1))^2)
skew-45 = 1 = SQRT((1*Cos(0.441))^2 + 1*Sin(0.441))^2)

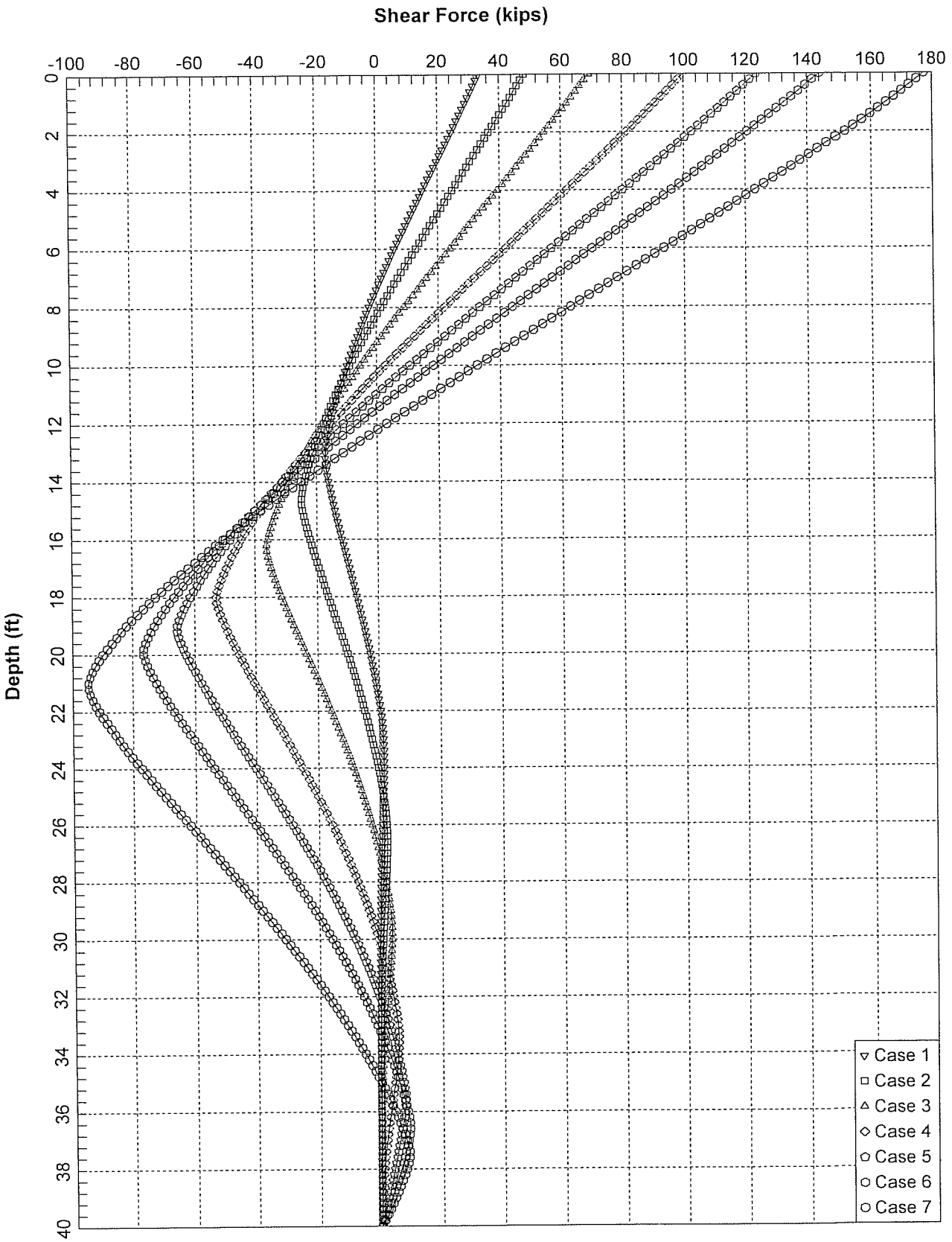
Fx6 = 0.931 = 1 (skew-16) x 1 (skew-26) x 1 (skew-36) x 1 (skew-46) x 0.931 (lbl-56)
skew-16 = 1 = SQRT((1*Cos(0.368))^2 + 1*Sin(0.368))^2)
skew-26 = 1 = SQRT((1*Cos(0.1))^2 + 1*Sin(0.1))^2)
skew-36 = 1 = SQRT((1*Cos(0.591))^2 + 1*Sin(0.591))^2)
skew-46 = 1 = SQRT((1*Cos(0.1))^2 + 1*Sin(0.1))^2)

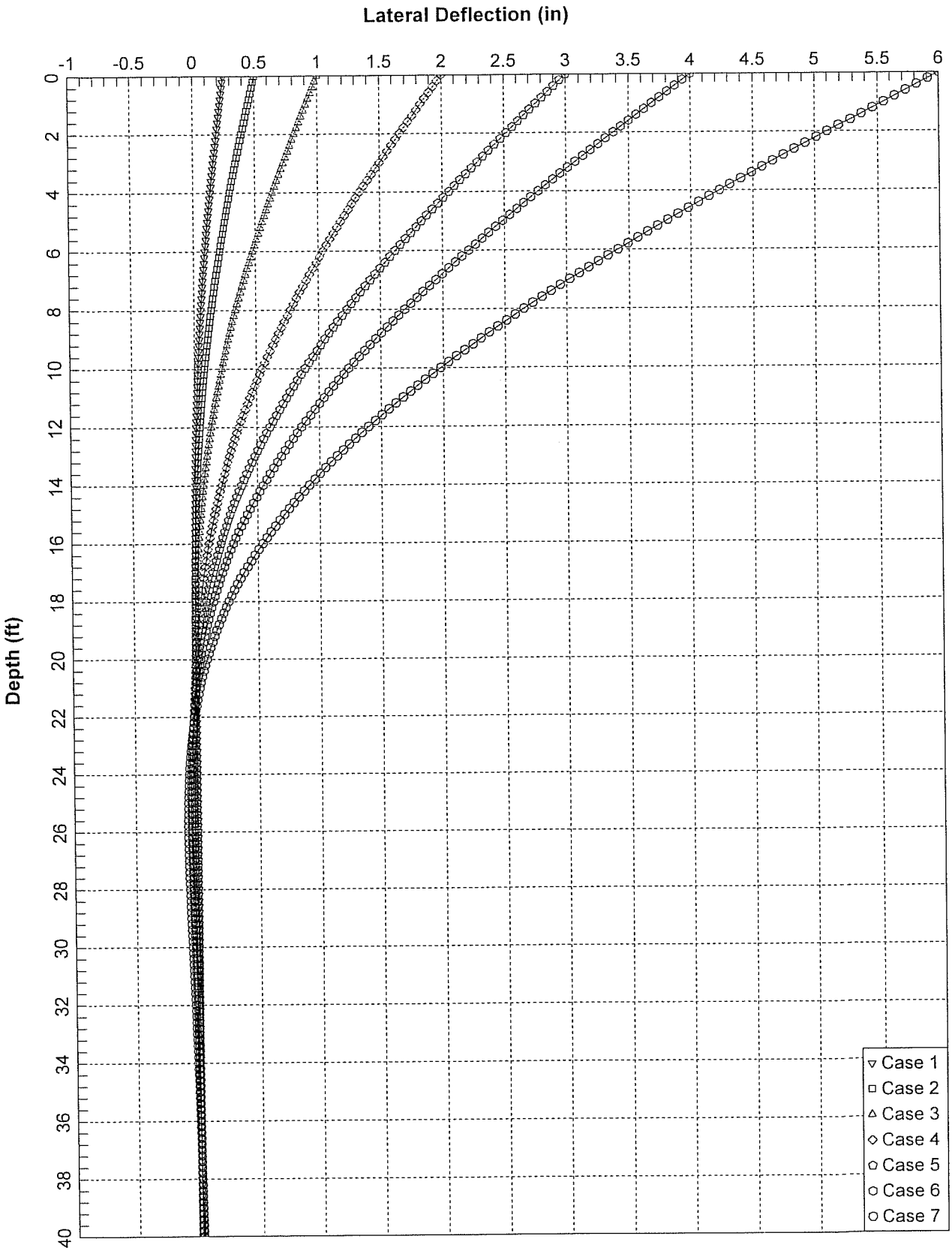
where
lbl: line-by-line effect
sbs: side-by-side effect
skew: skew effect



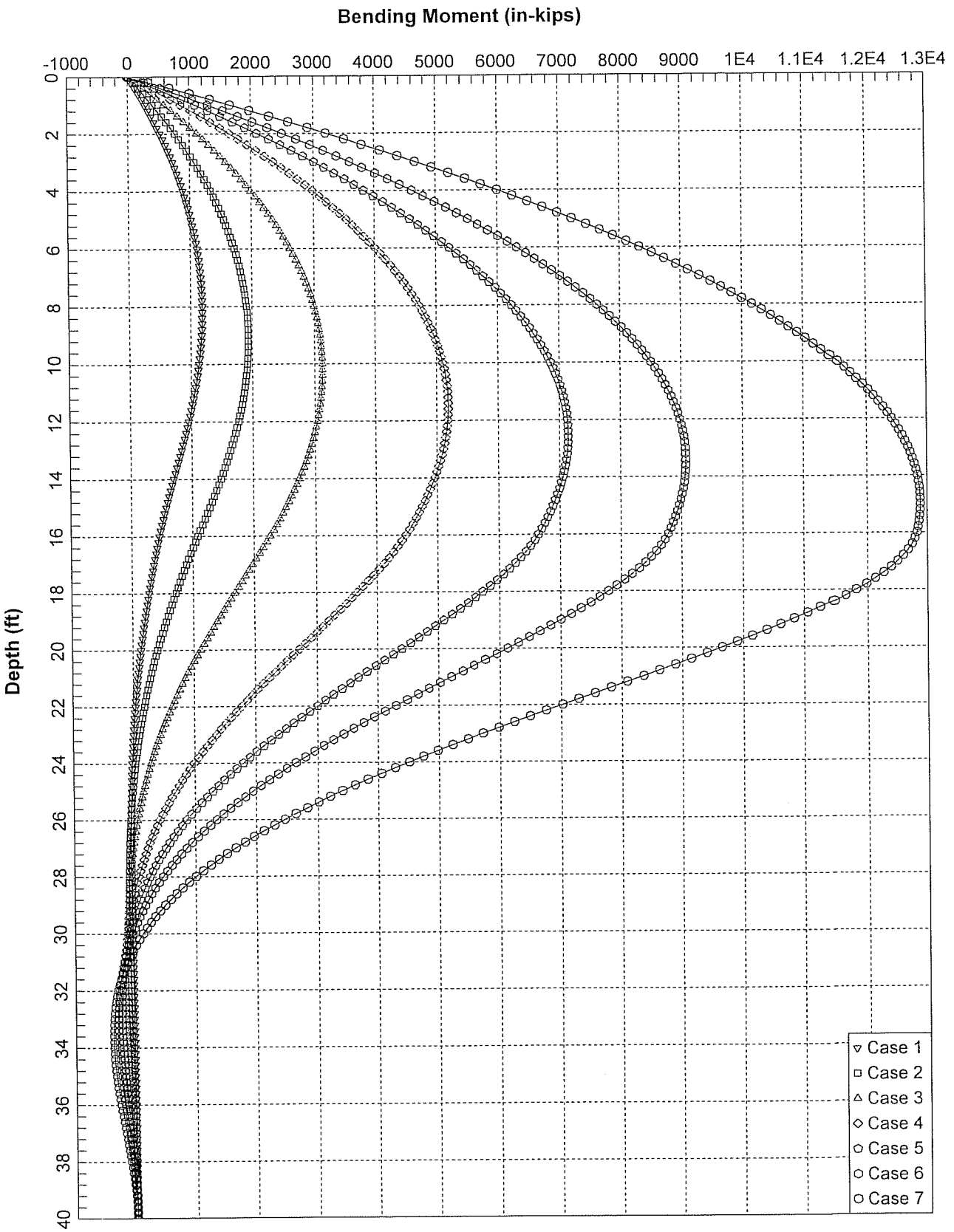
Lateral Solutions for Abut 1: Free End


Bending Moment (in-kips)
-1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 1E4 1.1E4 1.2E4 1.3E4 1.4E4
Depth (ft)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Lateral Solutions for Abut 1: Free End

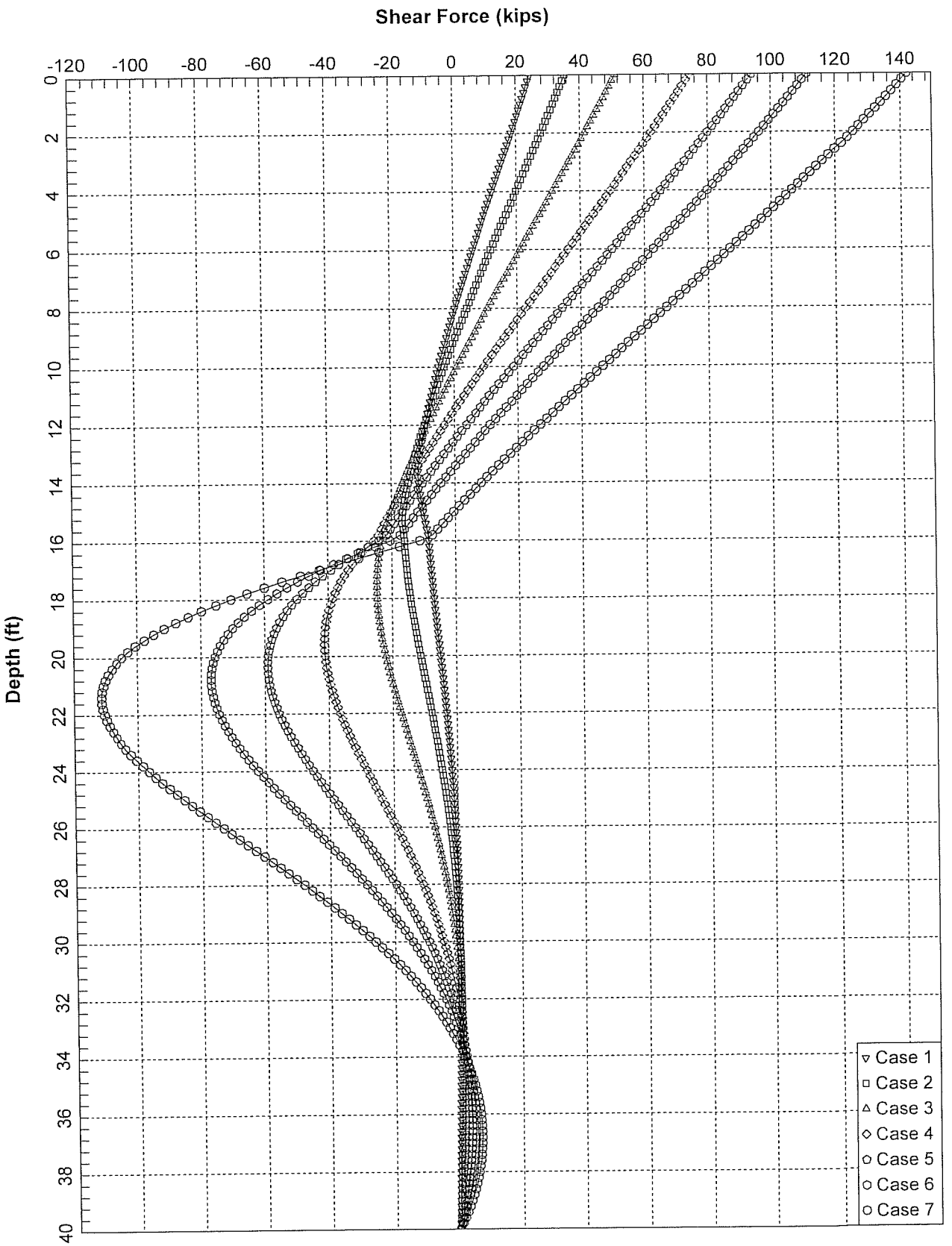

Shear Force (kips)
-100
-80
-60
-40
-20
0
20
40
60
80
100
120
140
160
180
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Lateral Solutions for Abut 1: Free End



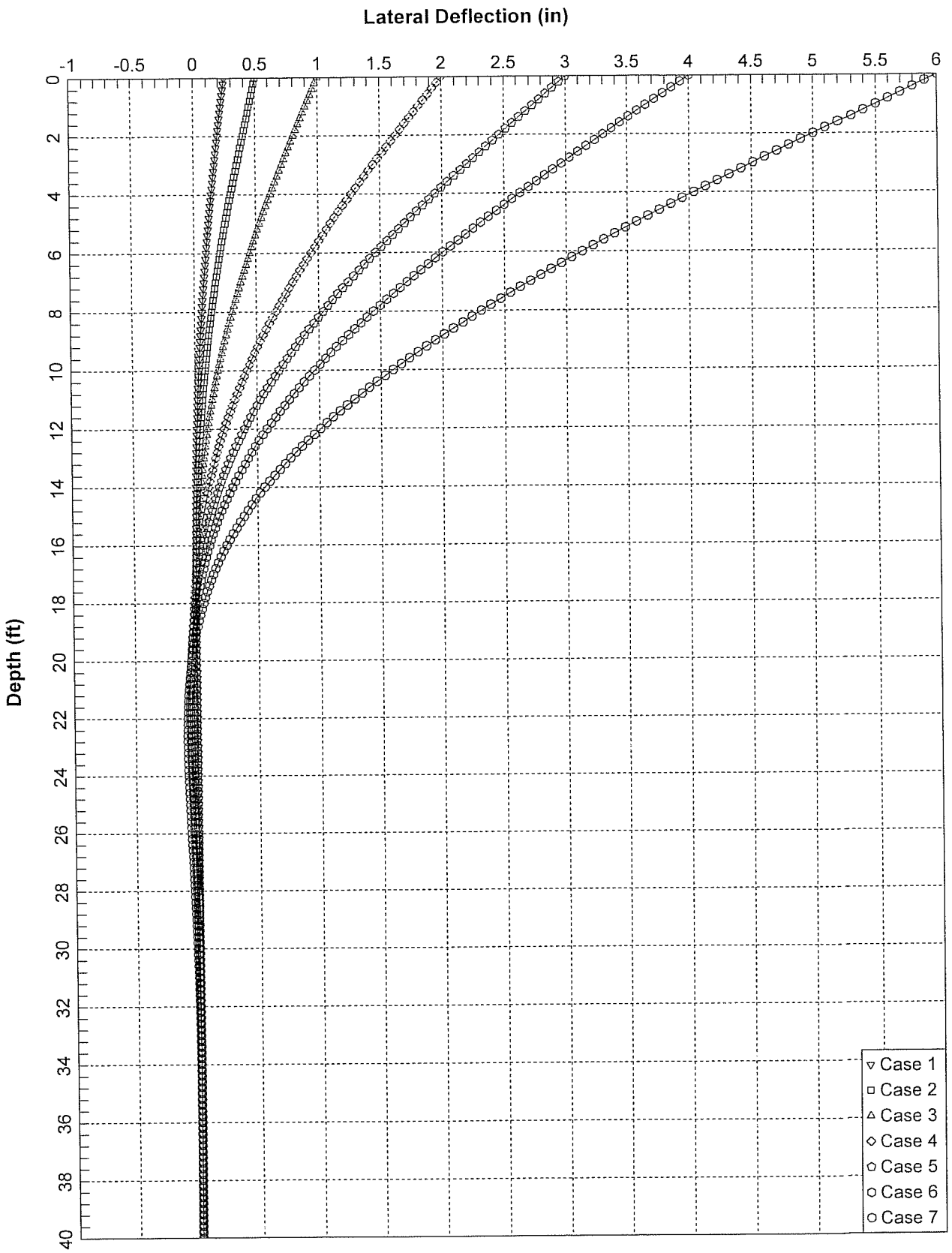
Lateral Solutions for Bent 2: Free End



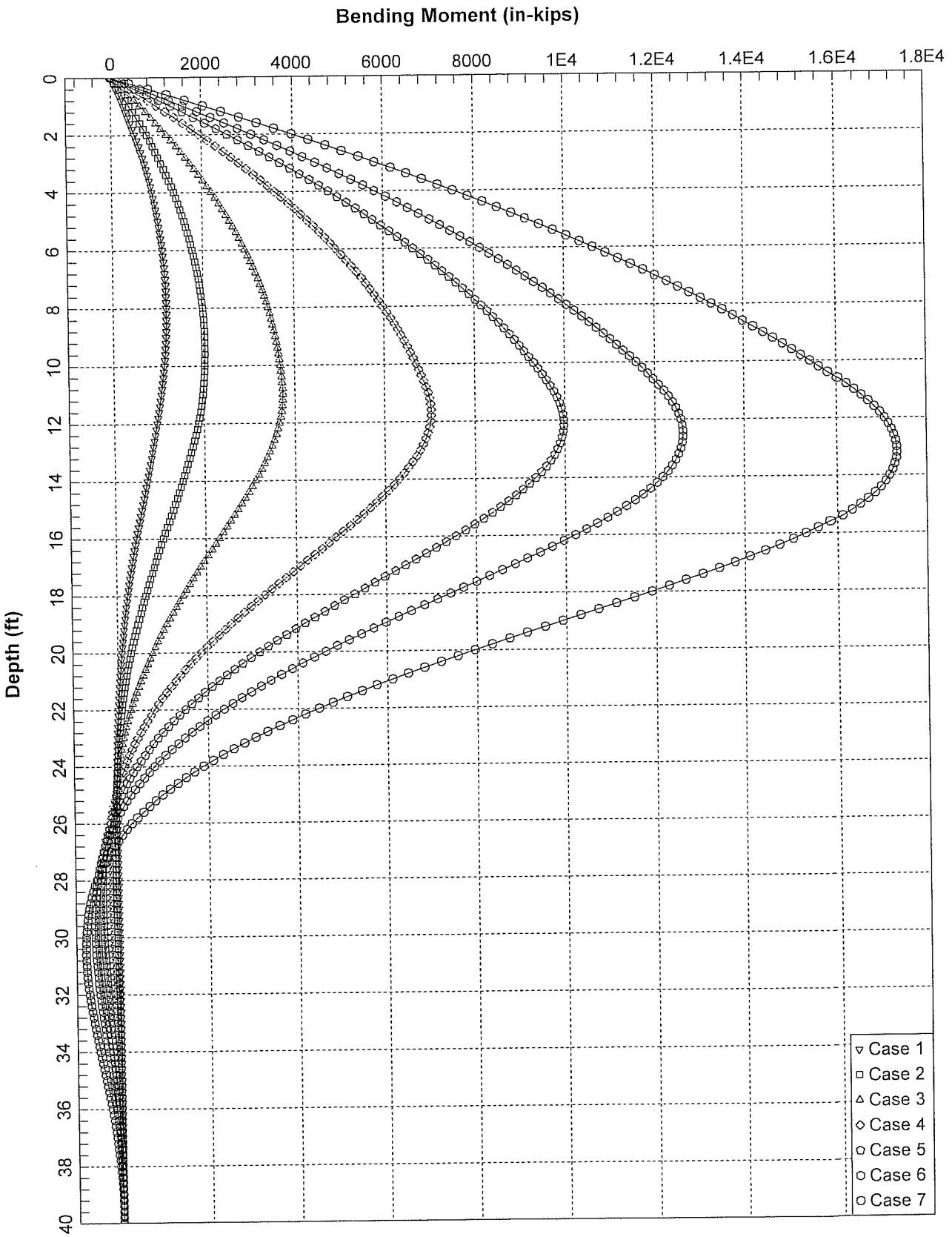
Lateral Solutions for Bent 2: Free End



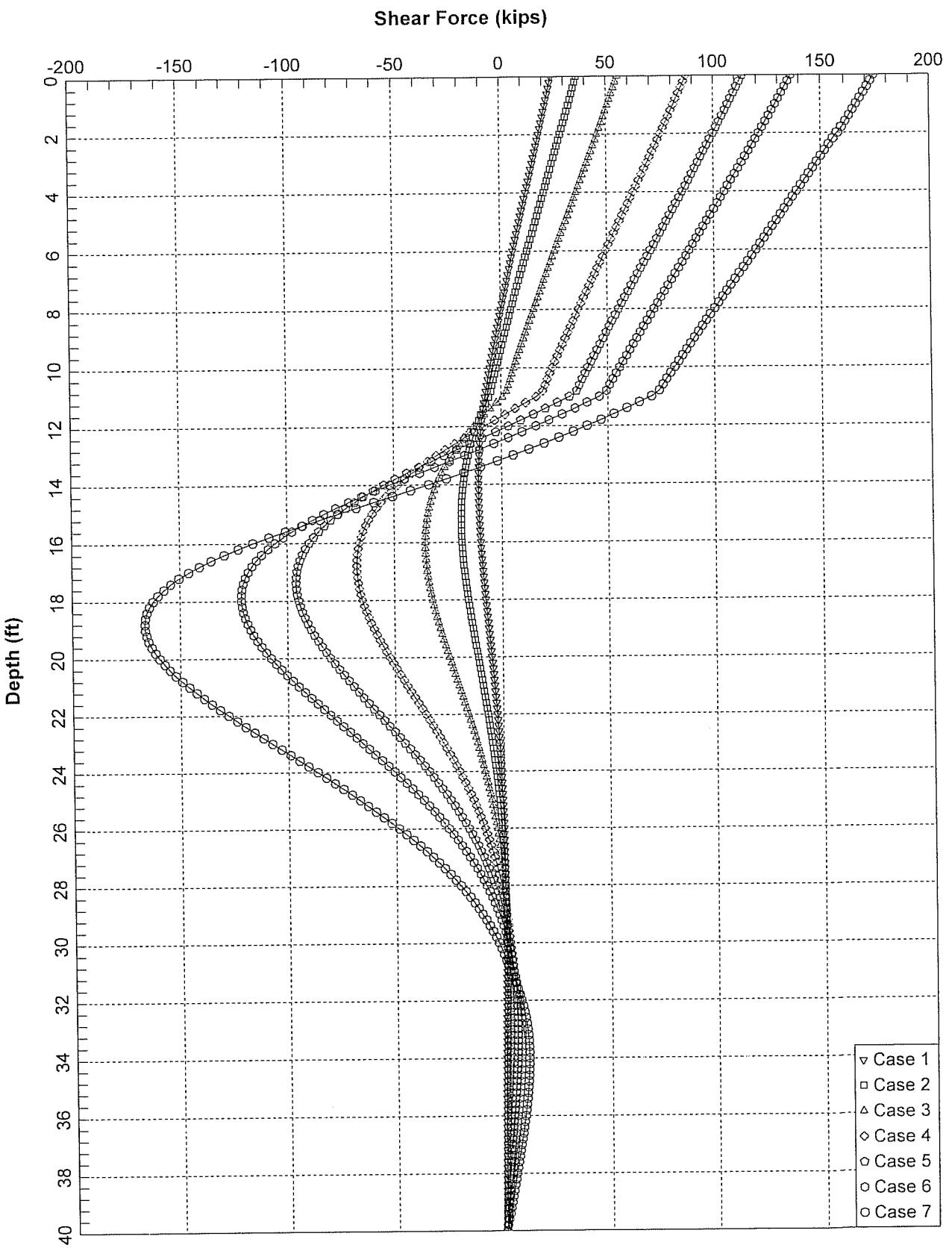
Lateral Solutions for Bent 2: Free End



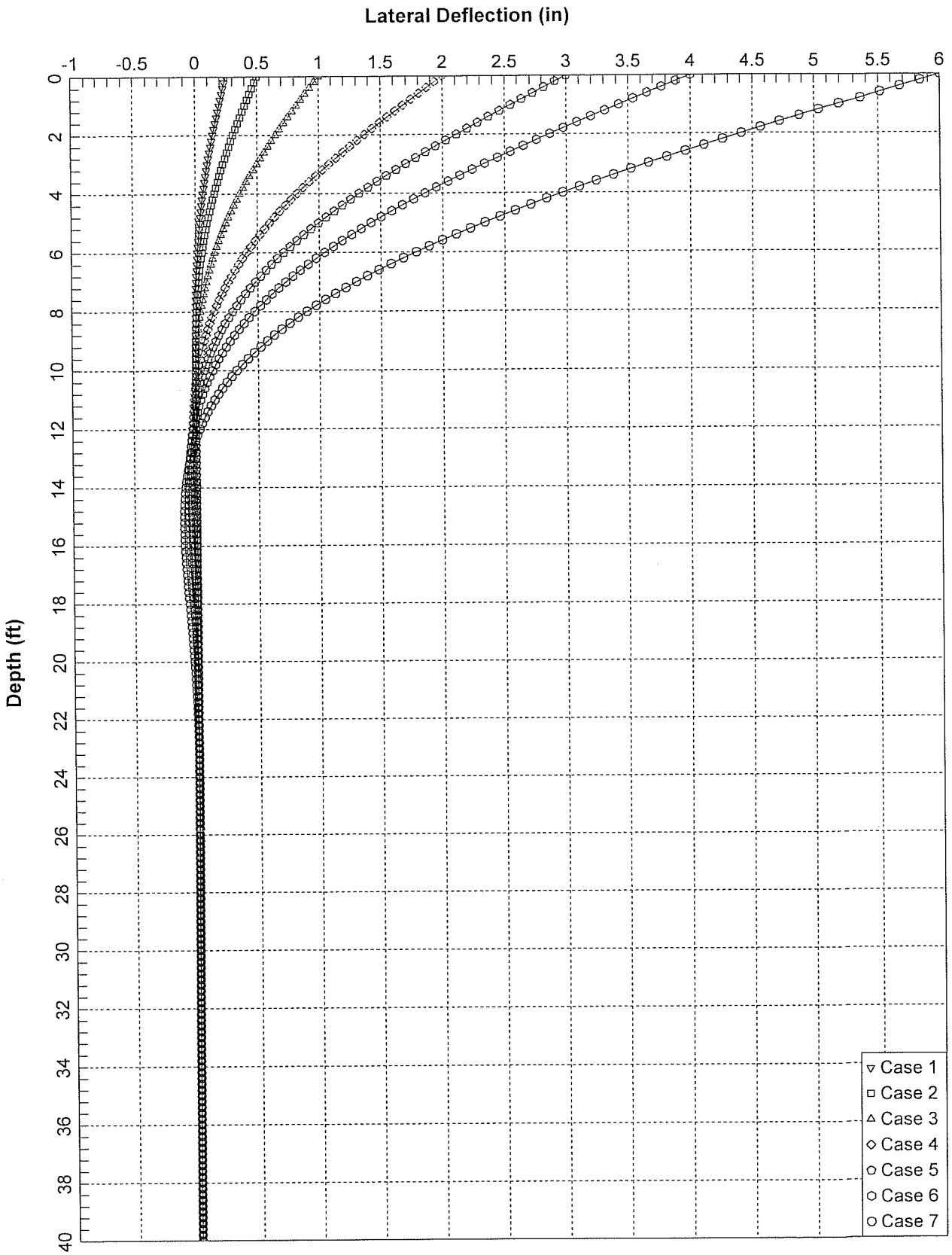
Lateral Solutions for Bent 3: Free End



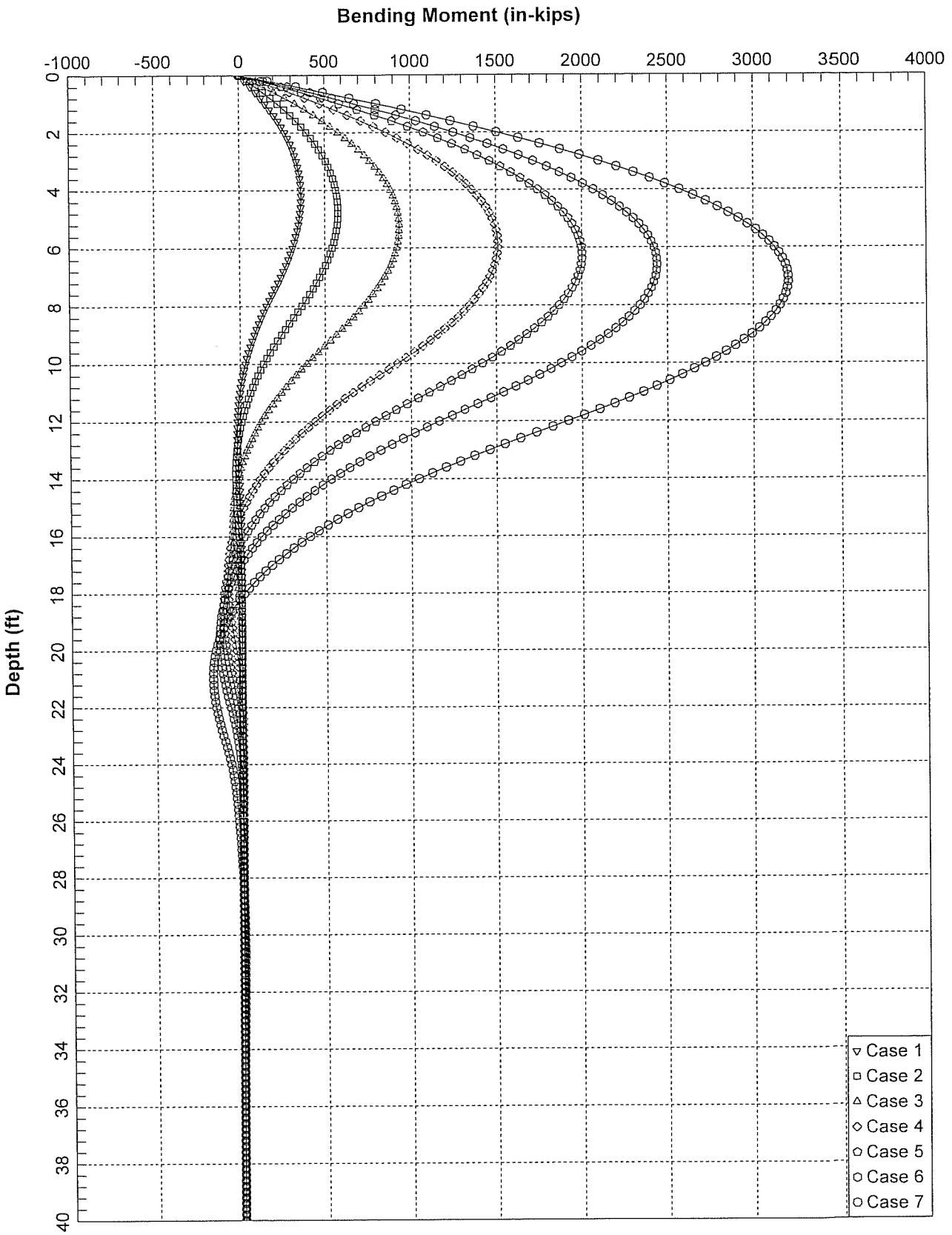
Lateral Solutions for Bent 3: Free End



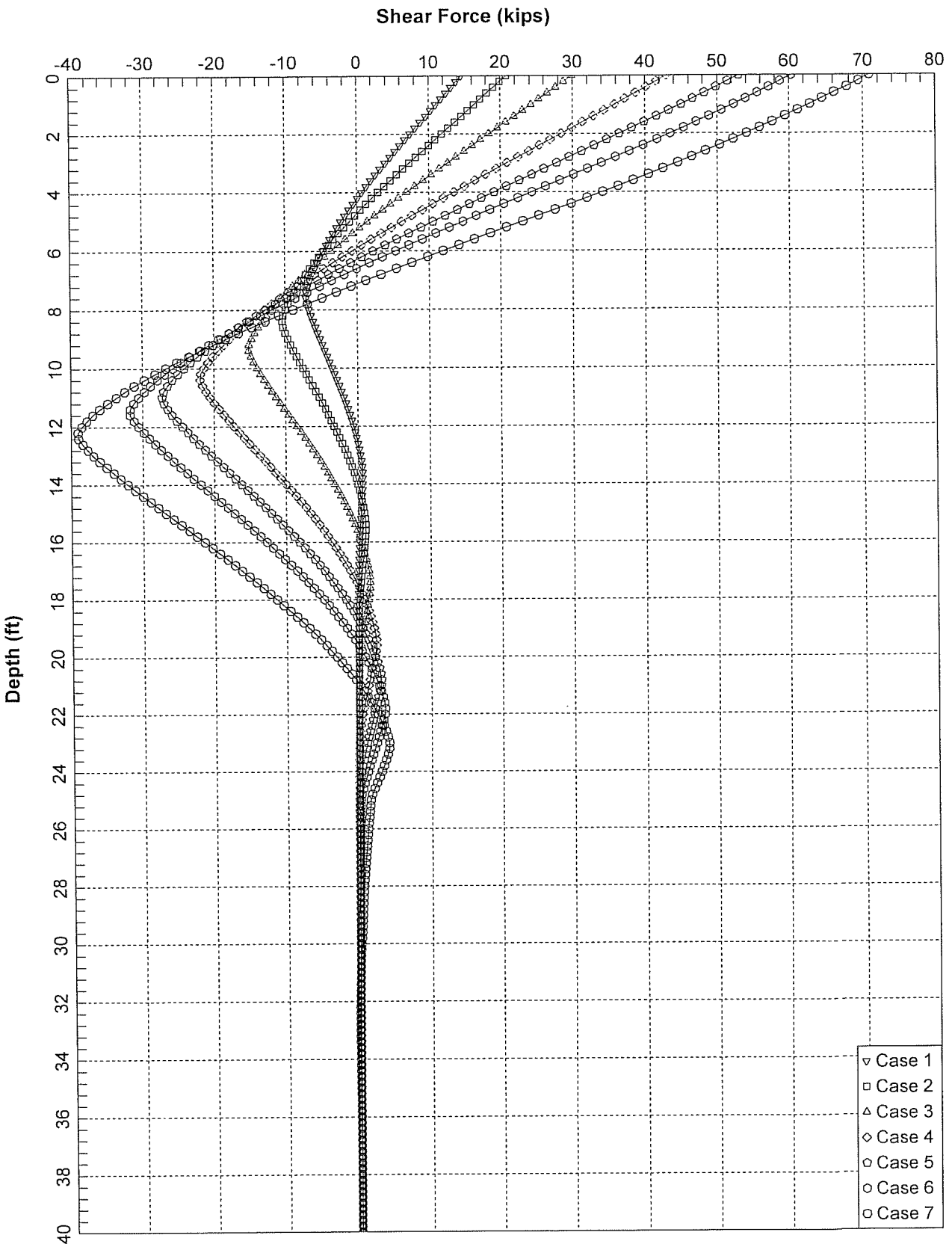
Lateral Solutions for Bent 3: Free End



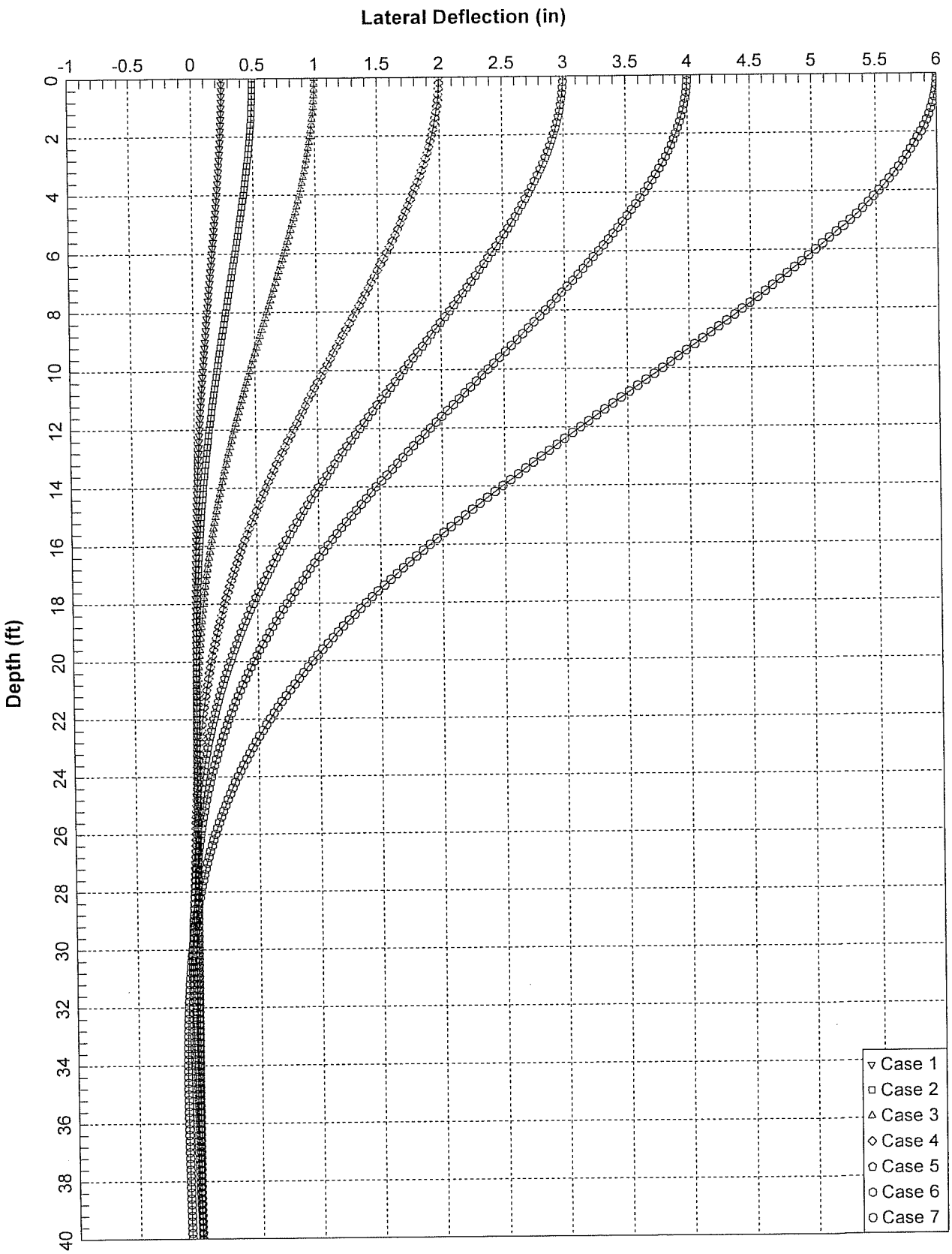
Lateral Solutions for Abut 4: Free End



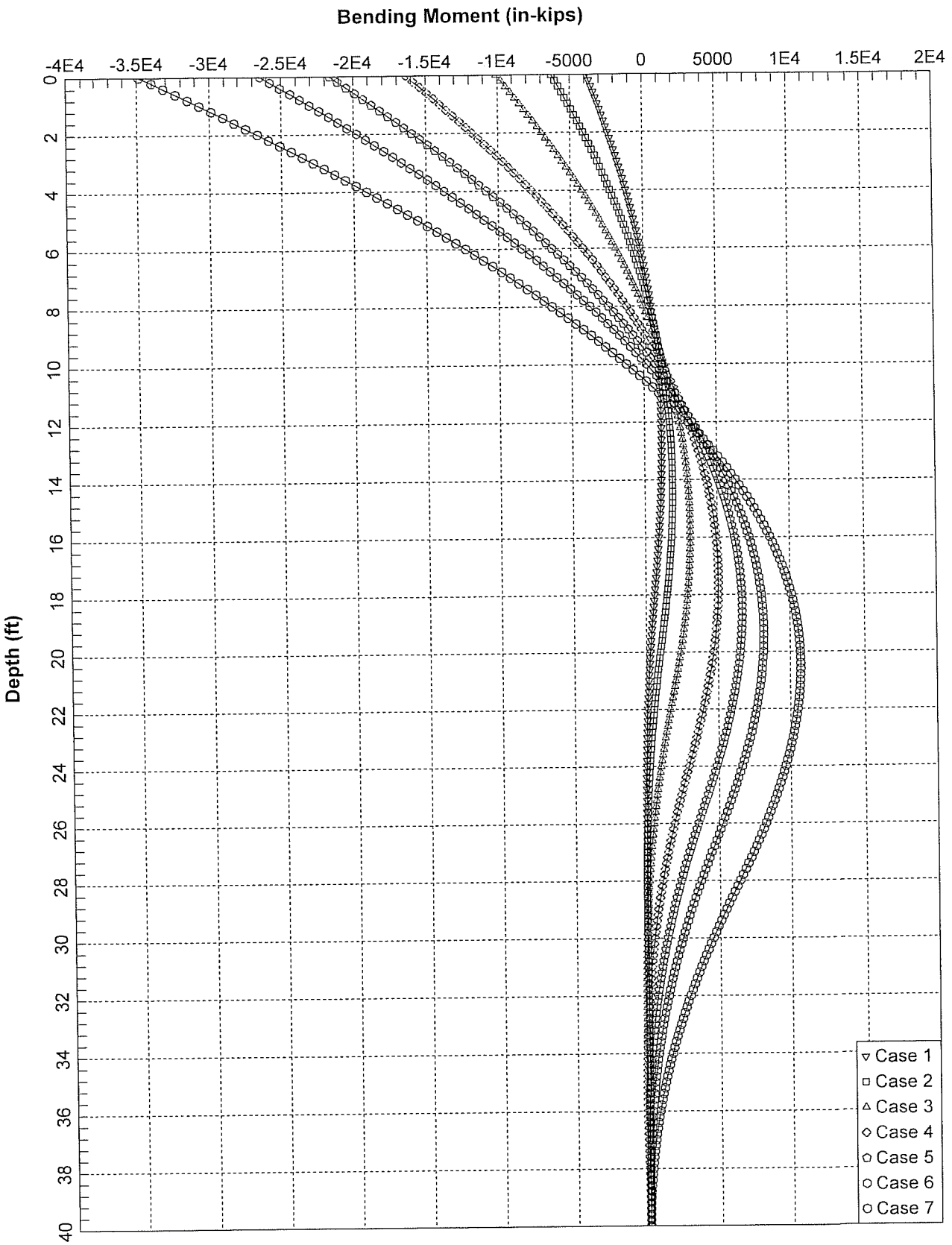
Lateral Solutions for Abut 4: Free End



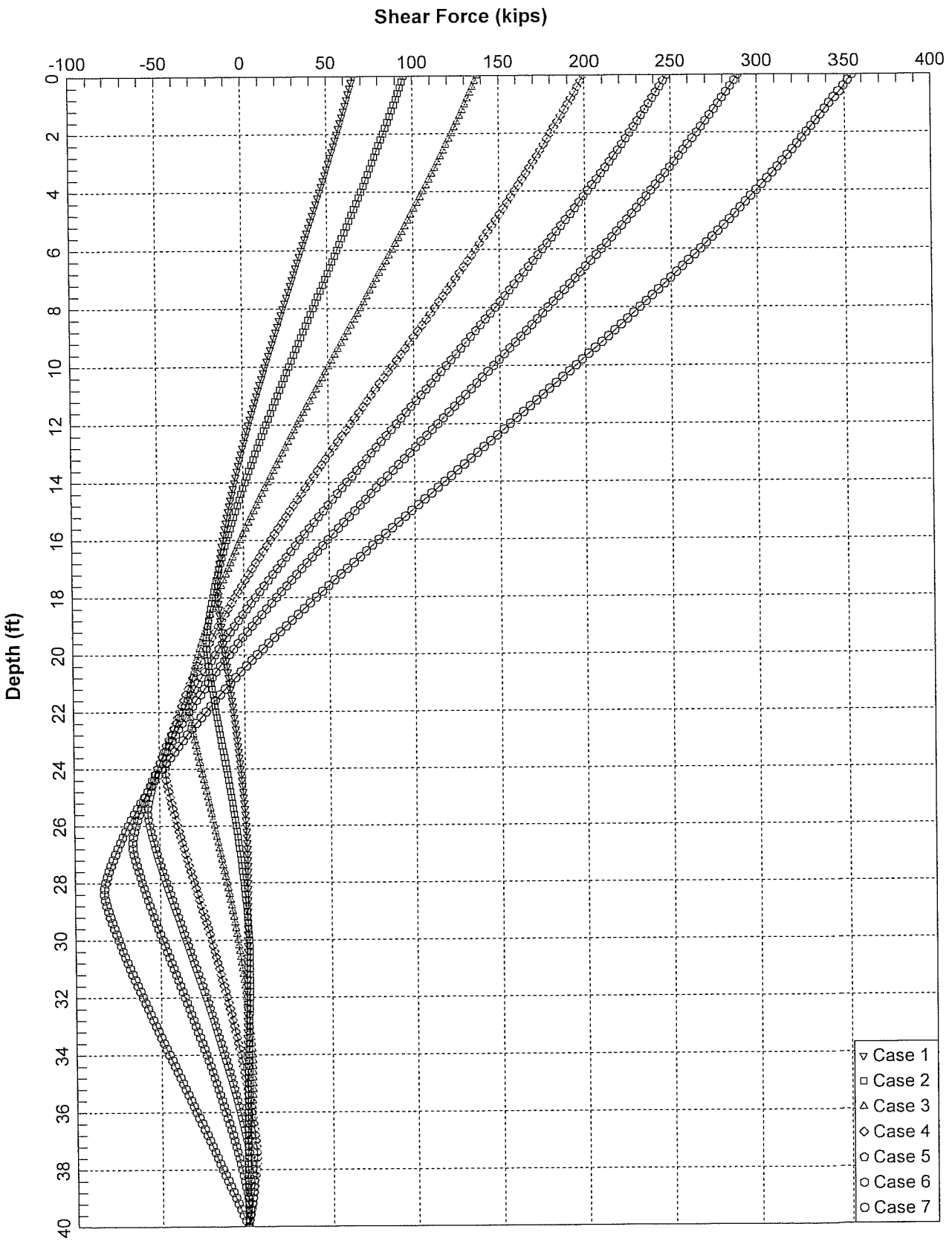
Lateral Solutions for Abut 4: Free End



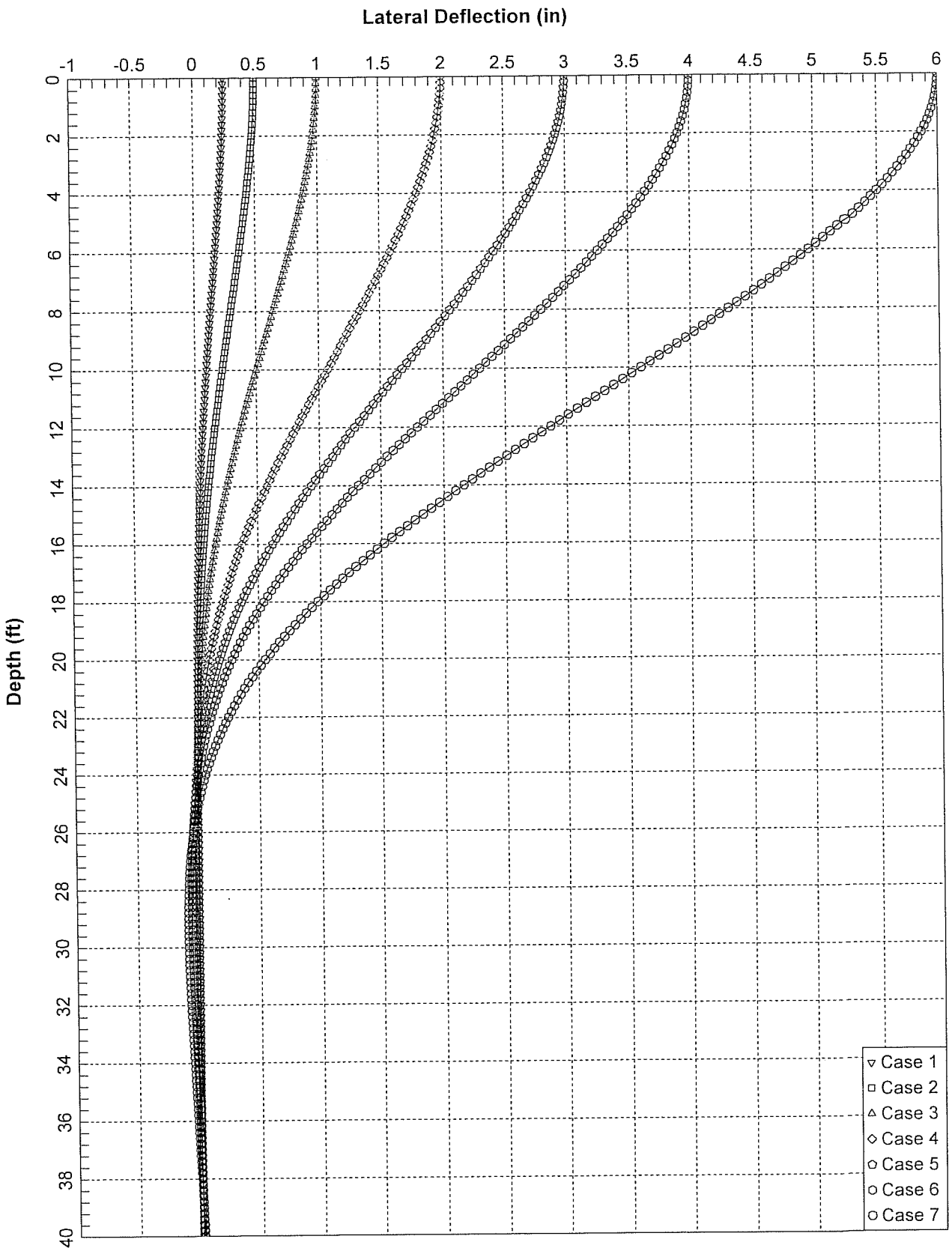
Lateral Solutions for Abut 1: Fixed End



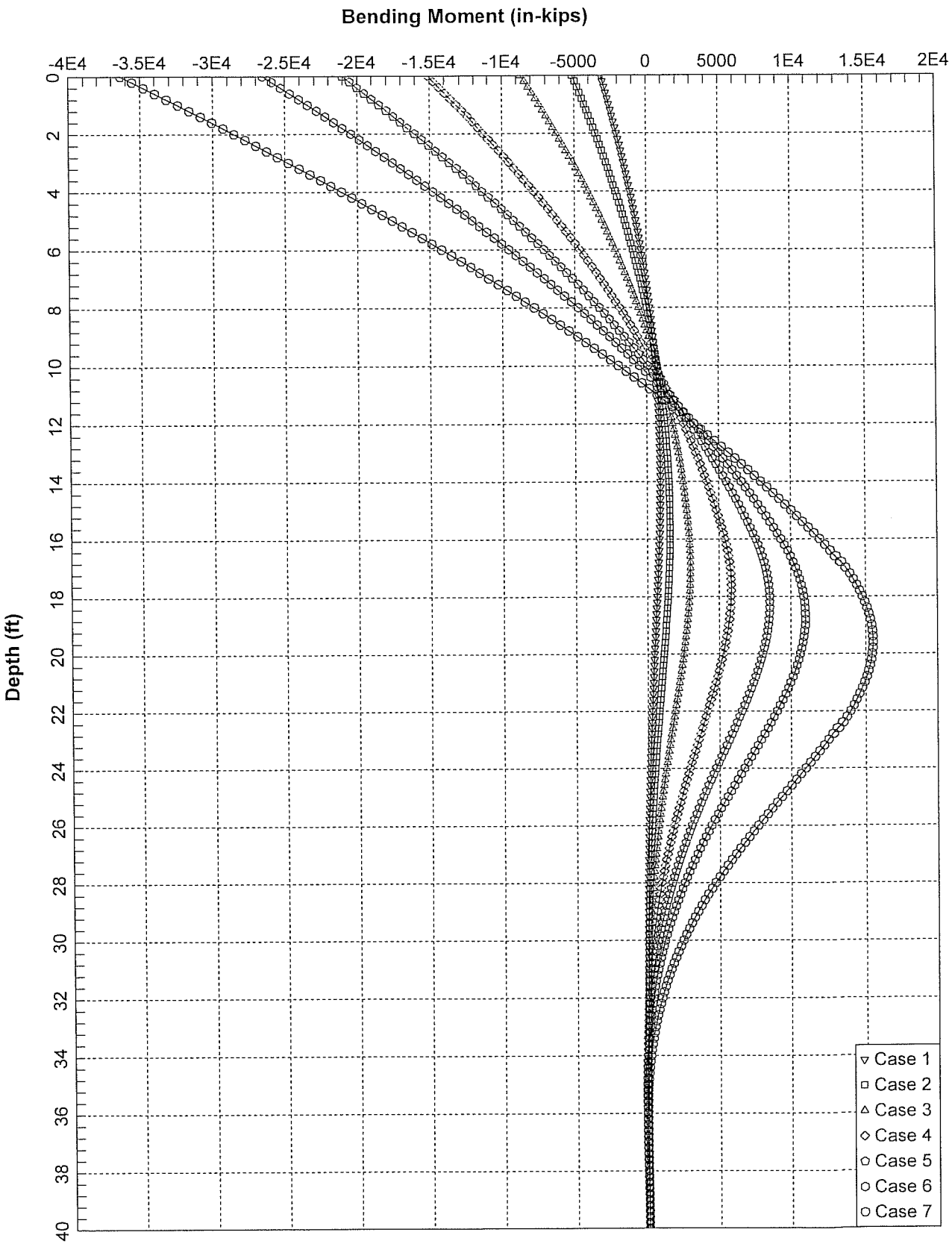
Lateral Solutions for Abut 1: Fixed End



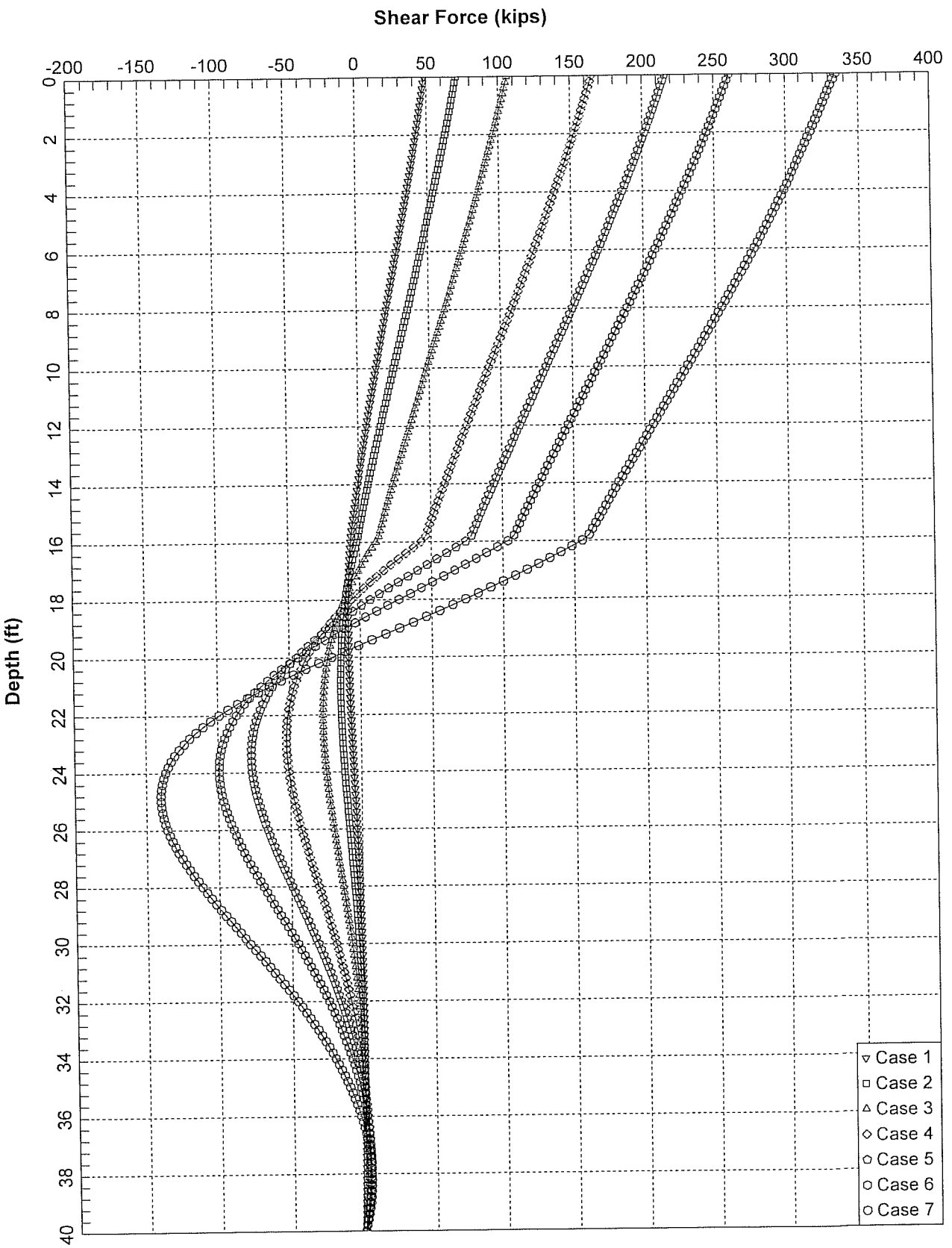
Lateral Solutions for Abut 1: Fixed End



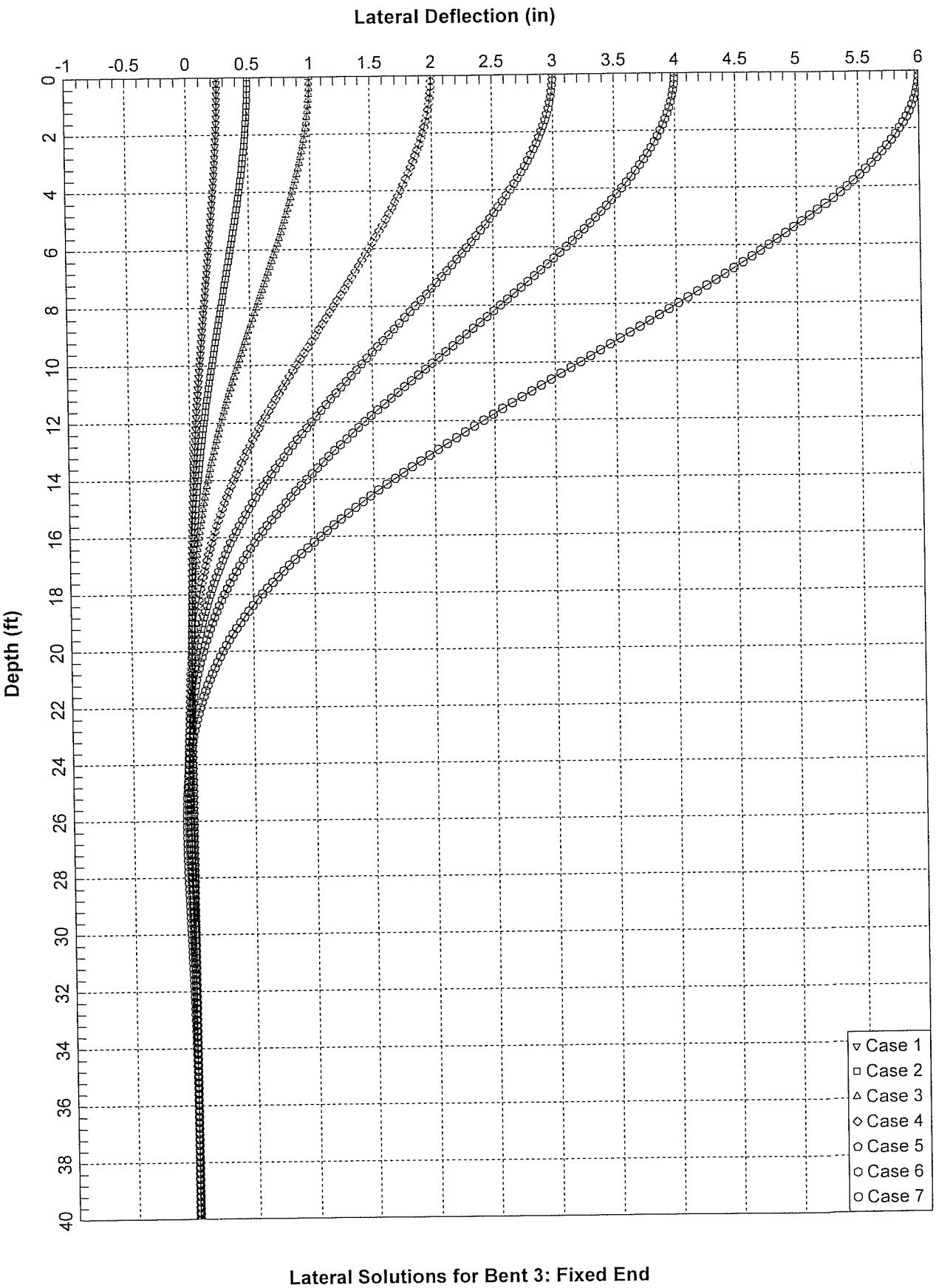
Lateral Solutions for Bent 2: Fixed End

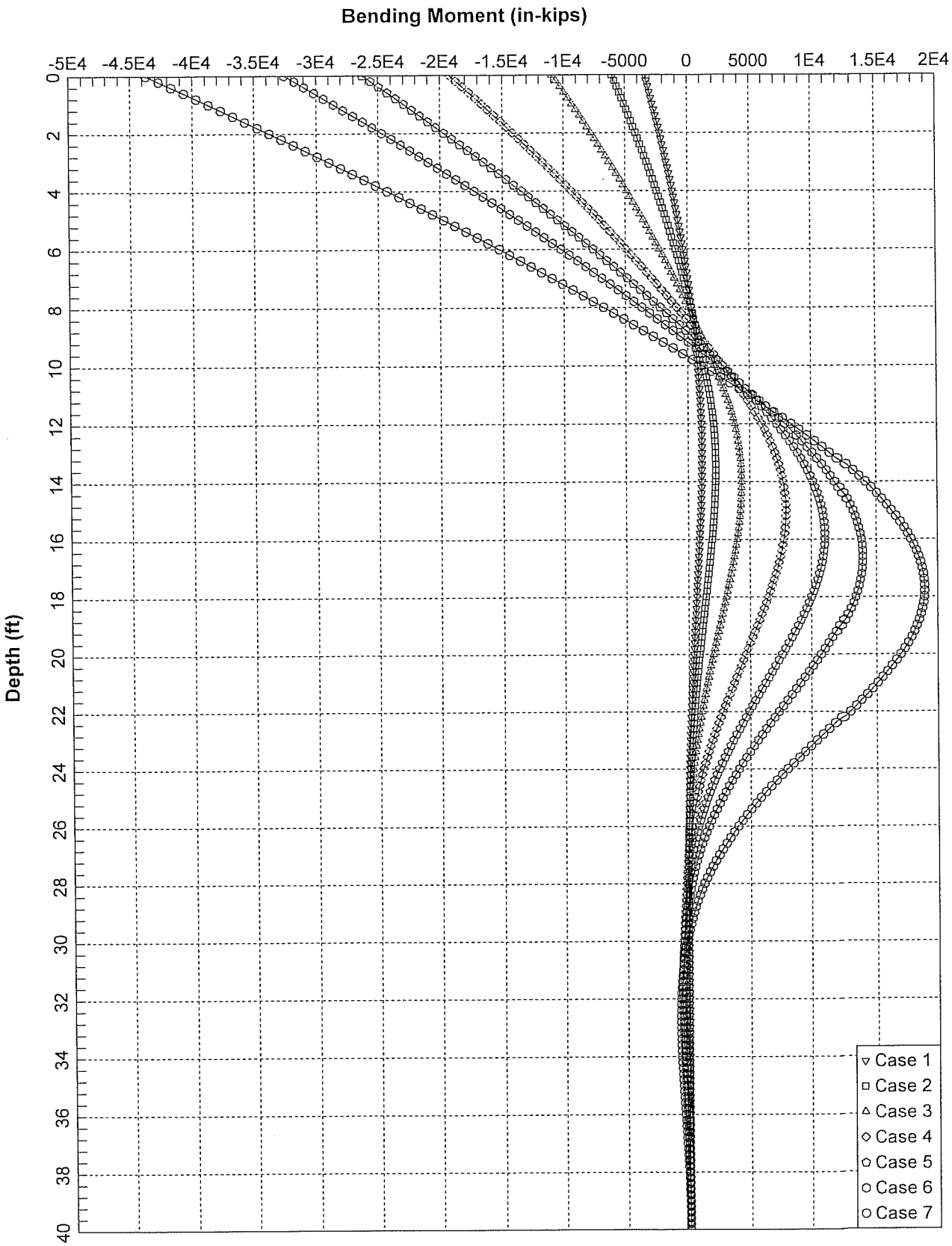


Lateral Solutions for Bent 2: Fixed End

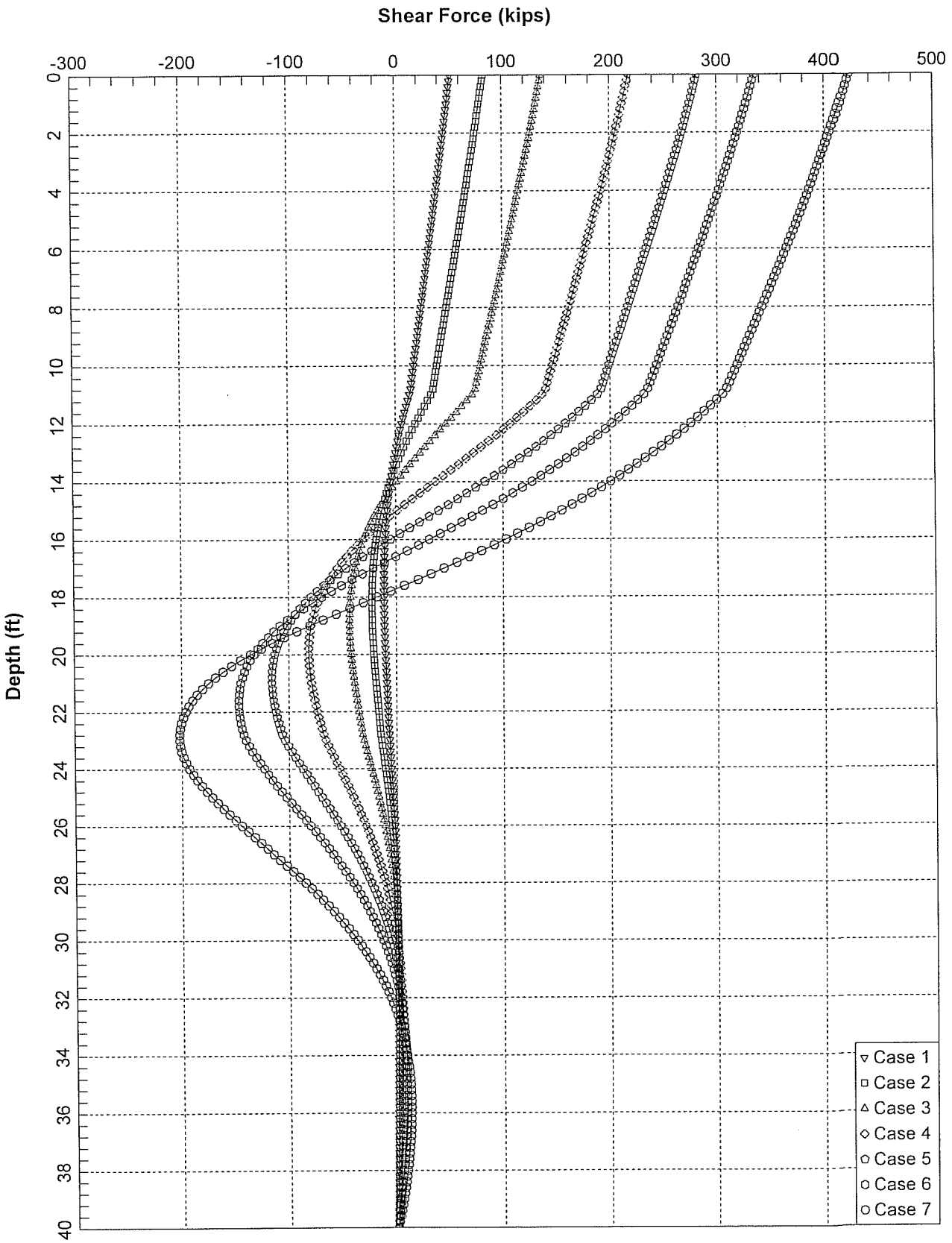


Lateral Solutions for Bent 2: Fixed End

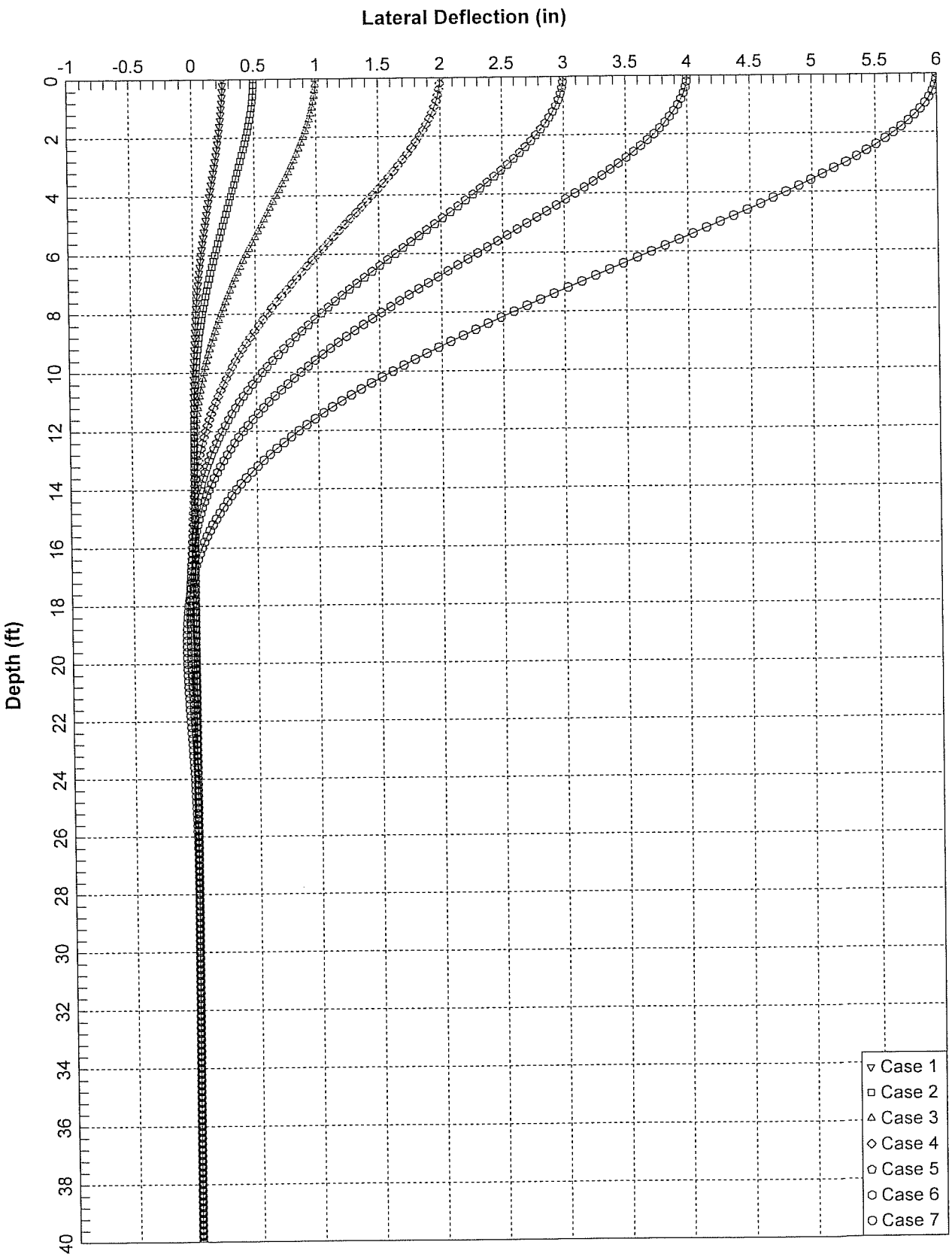

Lateral Deflection (in)
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Lateral Solutions for Bent 3: Fixed End



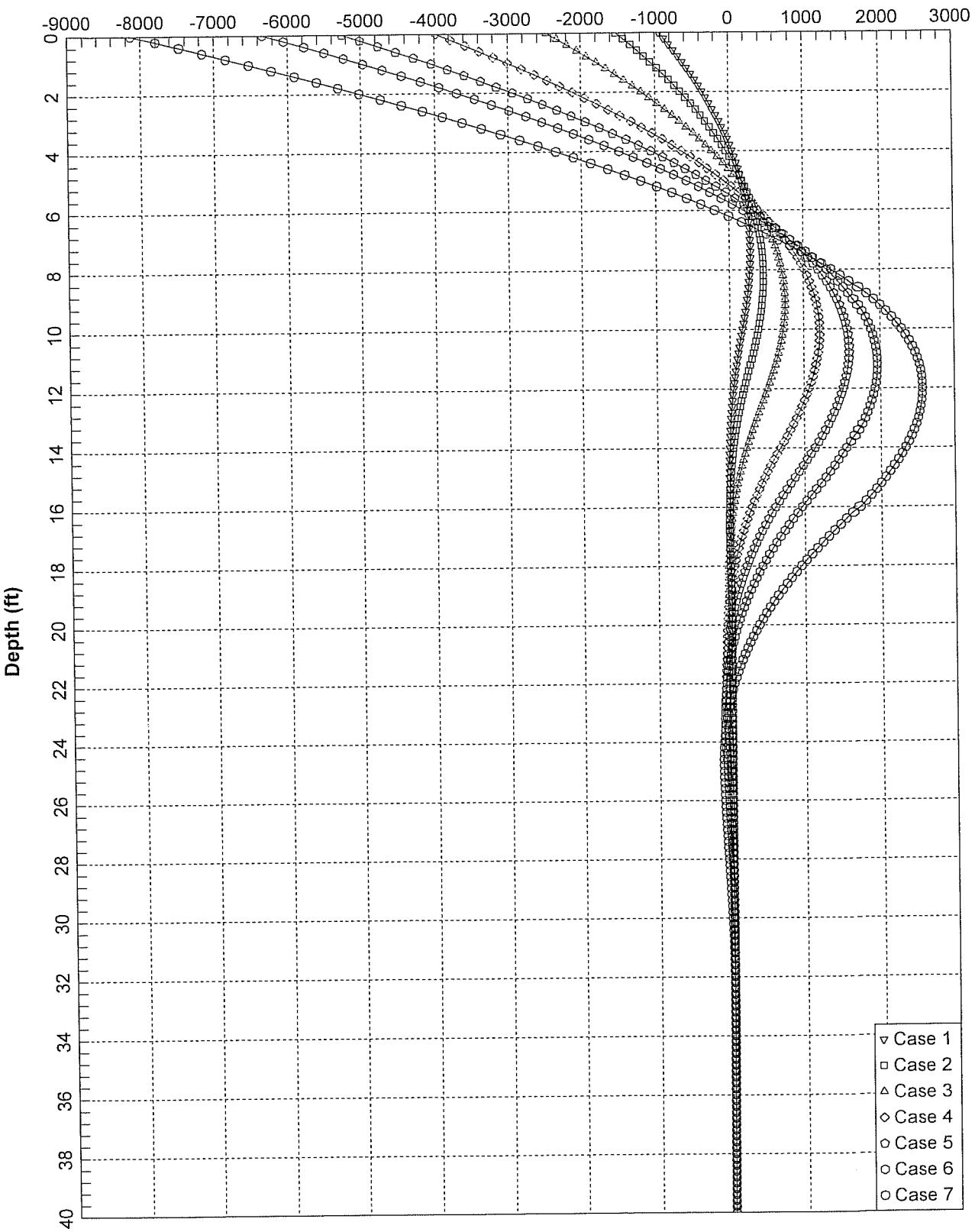
Lateral Solutions for Bent 3: Fixed End



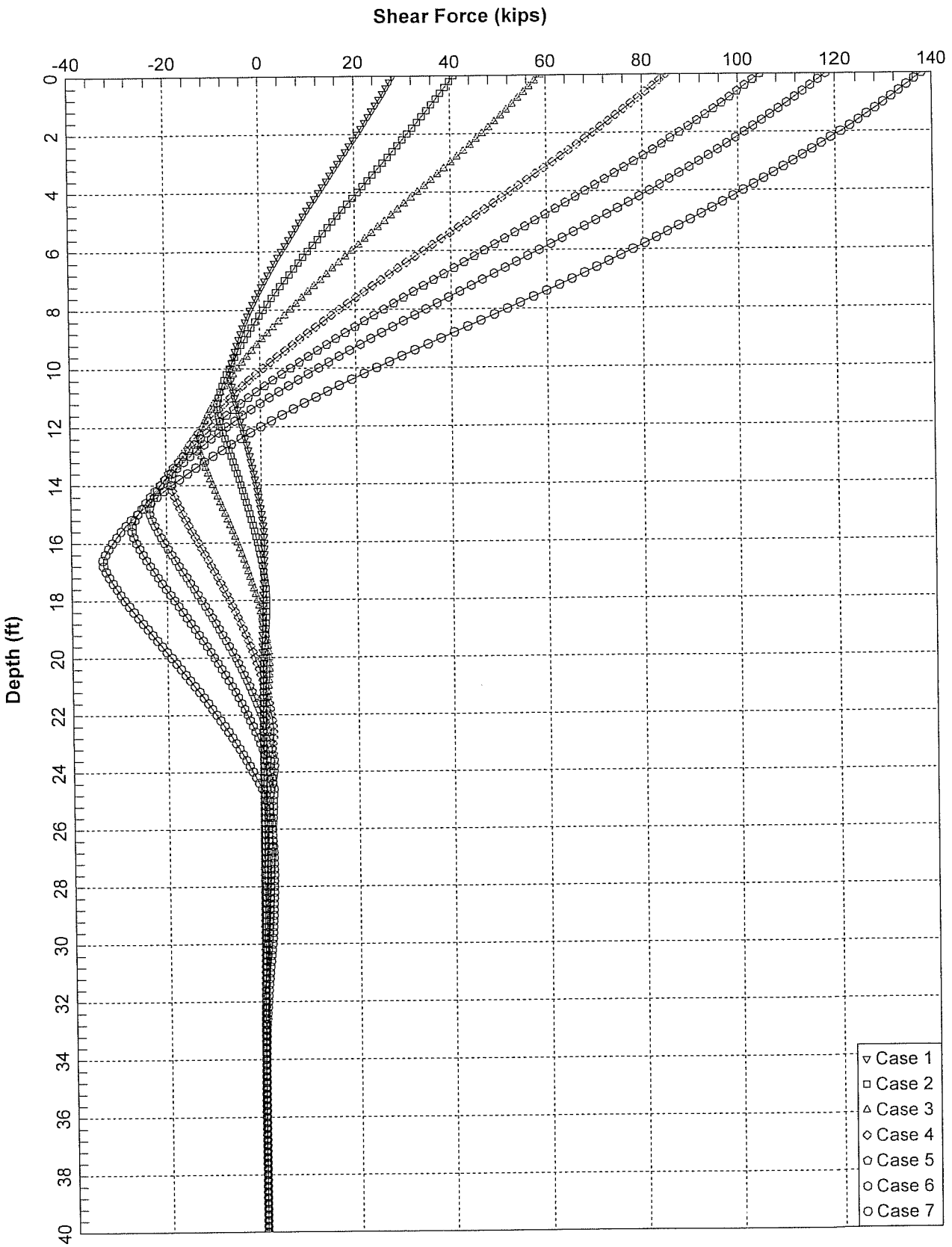
Lateral Solutions for Bent 3: Fixed End



Lateral Solutions for Abut 4: Fixed End



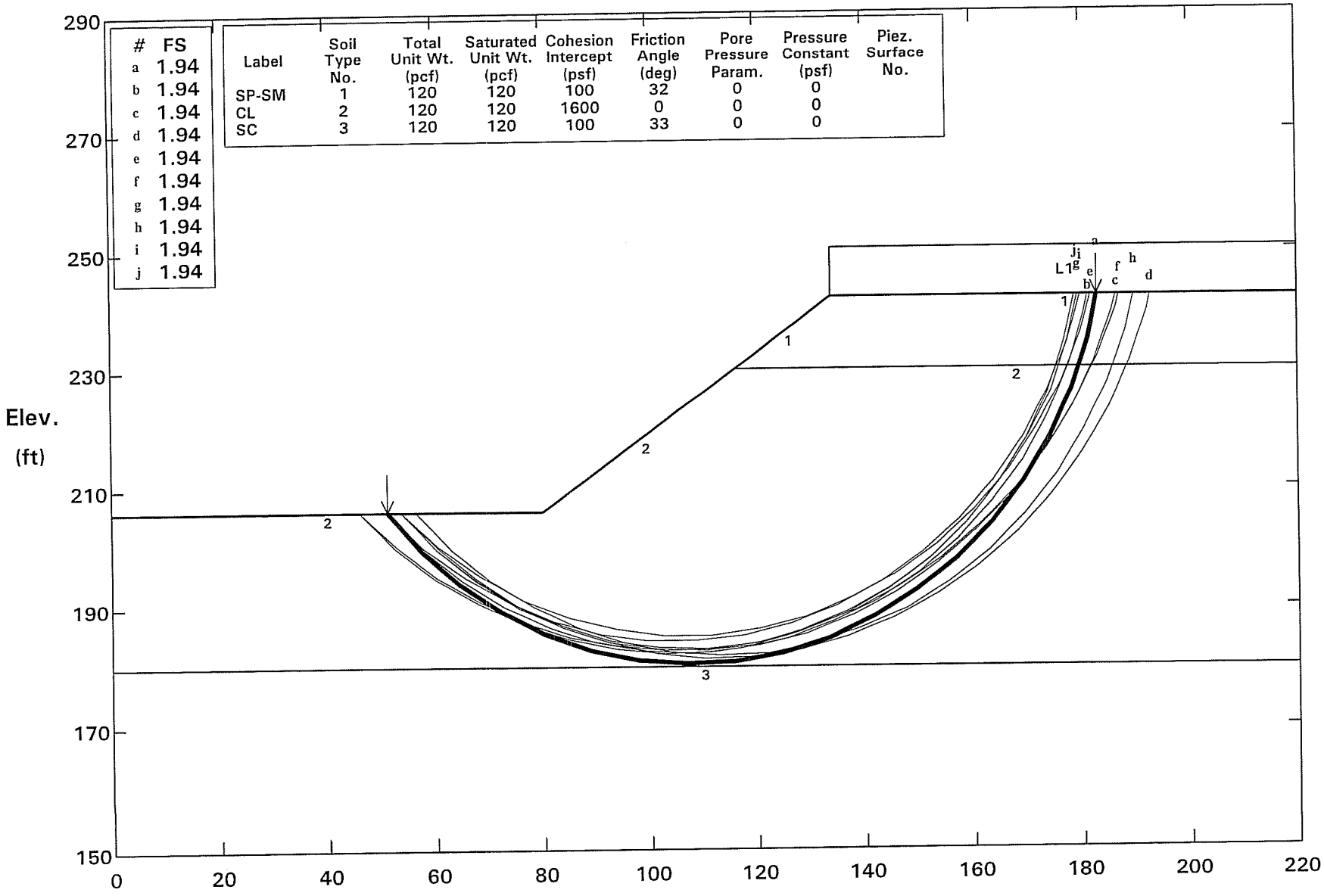
Lateral Solutions for Abut 4: Fixed End



Lateral Solutions for Abut 4: Fixed End

Placentia Overhead (Widen) Abut 1 Static Condition

Ten Most Critical. D:PLOHA1S.PLT 01-08-09 1:46pm



#	FS
a	1.94
b	1.94
c	1.94
d	1.94
e	1.94
f	1.94
g	1.94
h	1.94
i	1.94
j	1.94

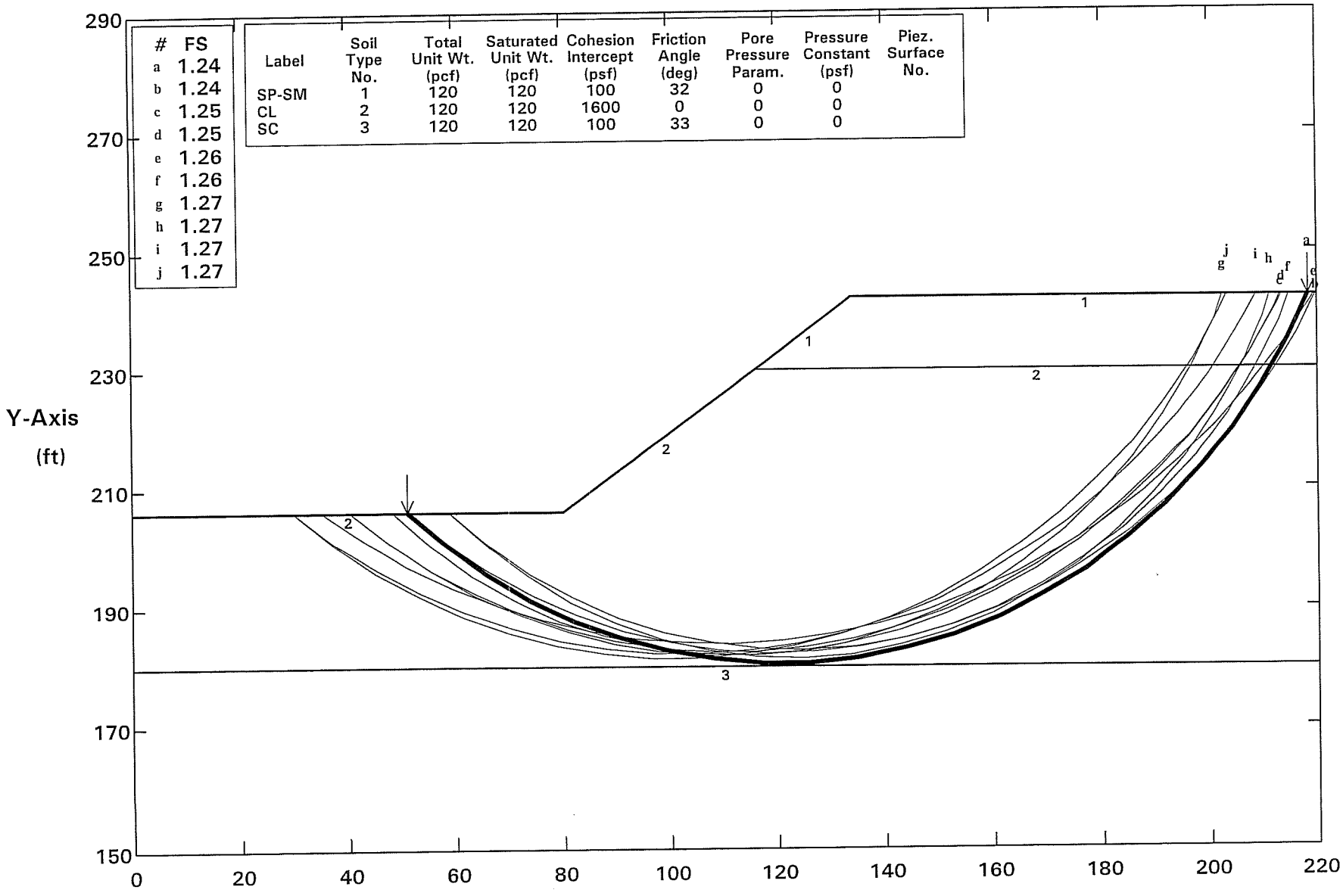
Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SP-SM	1	120	120	100	32	0	0	
CL	2	120	120	1600	0	0	0	
SC	3	120	120	100	33	0	0	

STABL6H FSmin = 1.94 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Placentia Overhead (Widen) Abut 1 Pseudostatic Condition (kh = 0.2)

Ten Most Critical. D:PLOHA1D.PLT 01-08-09 1:48pm



#	FS
a	1.24
b	1.24
c	1.25
d	1.25
e	1.26
f	1.26
g	1.27
h	1.27
i	1.27
j	1.27

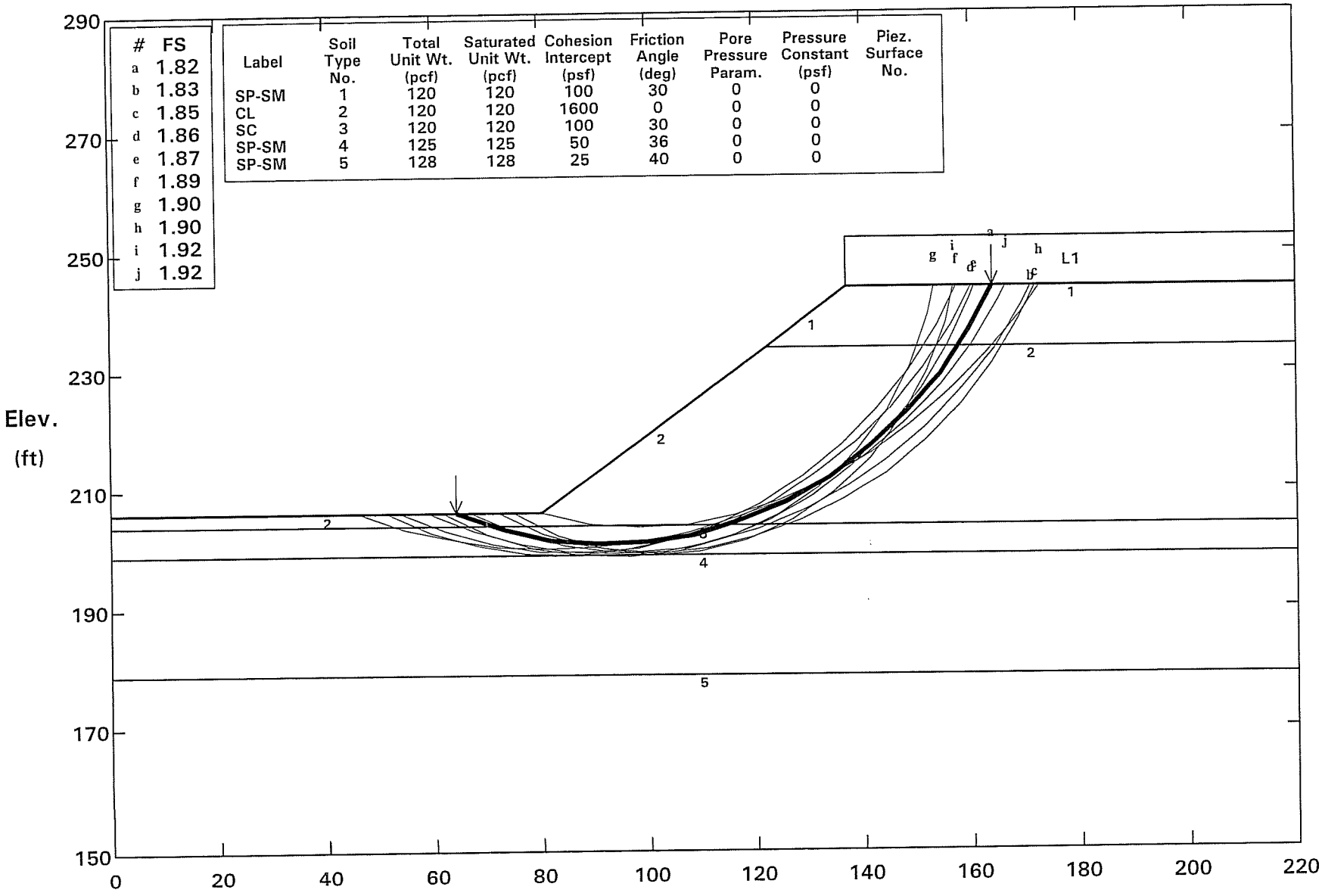
Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SP-SM	1	120	120	100	32	0	0	
CL	2	120	120	1600	0	0	0	
SC	3	120	120	100	33	0	0	

STABL6H FSmin = 1.24 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Placentia Overhead (Widen) Abut 2 Static Condition

Ten Most Critical. D:PLOHA2S.PLT 01-08-09 1:56pm



#	FS
a	1.82
b	1.83
c	1.85
d	1.86
e	1.87
f	1.89
g	1.90
h	1.90
i	1.92
j	1.92

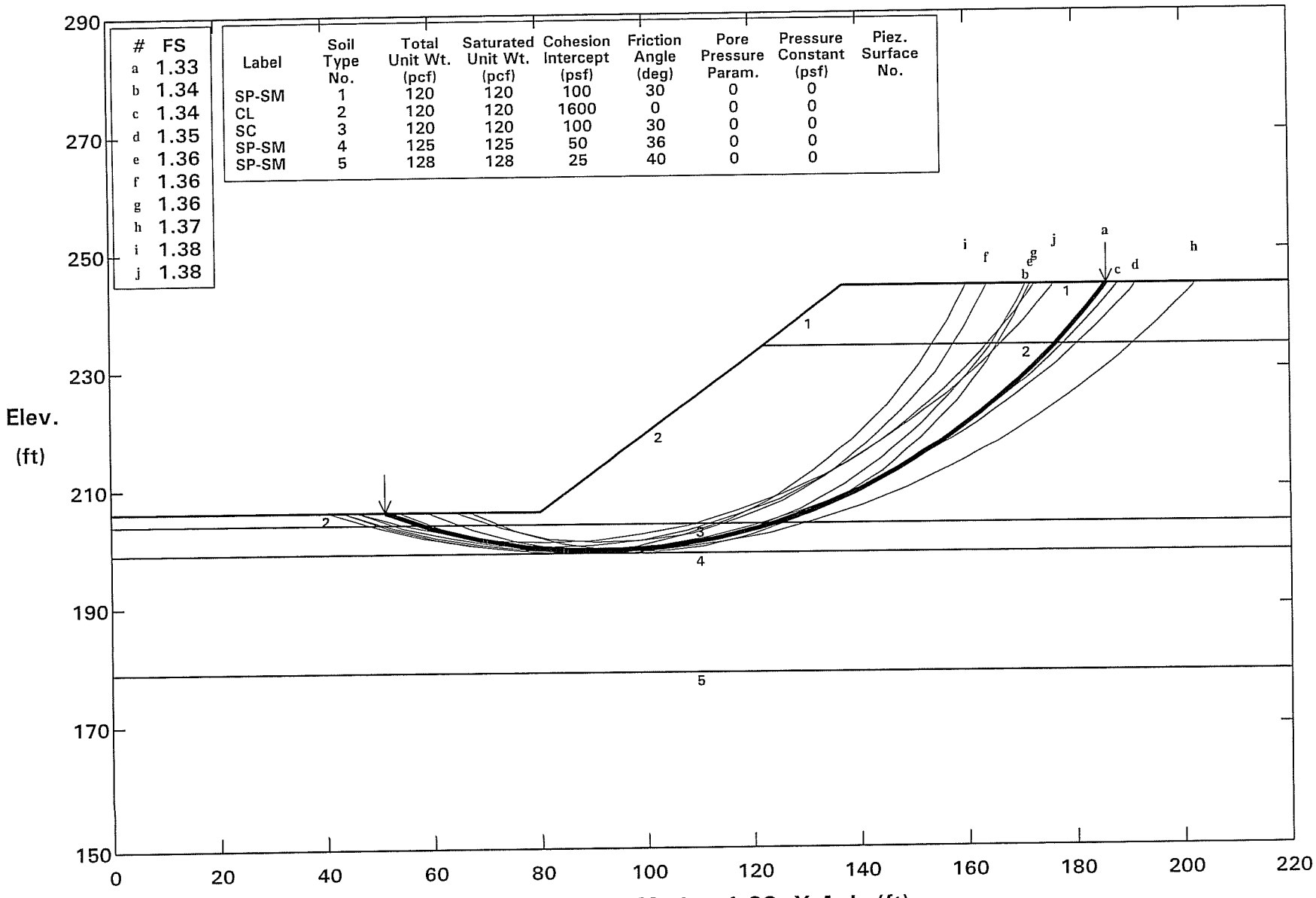
Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SP-SM	1	120	120	100	30	0	0	
CL	2	120	120	1600	0	0	0	
SC	3	120	120	100	30	0	0	
SP-SM	4	125	125	50	36	0	0	
SP-SM	5	128	128	25	40	0	0	

STABL6H FSmin = 1.82 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Placentia Overhead (Widen) Abut 2 Pseudostatic Condition (kh = 0.2)

Ten Most Critical. D:PLOHA2D.PLT 01-08-09 1:56pm



#	FS
a	1.33
b	1.34
c	1.34
d	1.35
e	1.36
f	1.36
g	1.36
h	1.37
i	1.38
j	1.38

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SP-SM	1	120	120	100	30	0	0	
CL	2	120	120	1600	0	0	0	
SC	3	120	120	100	30	0	0	
SP-SM	4	125	125	50	36	0	0	
SP-SM	5	128	128	25	40	0	0	

STABL6H FSmin = 1.33 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

APPENDIX D

CALTRANS REVIEW COMMENTS AND EMI RESPONSES

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

May 27, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Attention: Mr. Steve Huff

Subject: Response to 2nd Caltrans Foundation Review Comments on "Foundation Report (dated 2/11/09) Placentia Overhead (Widen), Bridge No. 55-0449, SR-57 Northbound Widening", 12-ORA-57, PM 16.84, EA 12-0F0311

Dear Mr. Huff:

Caltrans issued a 2nd Foundation Review sheet dated May 27, 2009 for the subject project. The following shows the Caltrans review comments and our responses to those comments:

- Although soil legend sheets are not included in submitted LOTB sheets, but based on EMI response, it is our understanding that they would be part of LOTB in final plans.

Response: Yes, the LOTB legend sheets will be a part of the LOTB in the final foundation report and final plans.

- Dotted lines marking elevation intervals should not carry through the boring column.

Response: We will edit the LOTB sheet so that dotted lines will NOT carry through the boring column and the revised LOTB sheet will be included in the final foundation report and final plans.

- The reason for deletion of Table 5-8 (lateral pile solutions).

Response: No, we have NOT deleted Table 5-8. This table will be in the final foundation report.

- The reason for substantial raise in settlement design tips at Abutments 1& 4 and Bent 3.

Response: Previously, we did not follow the calculation procedure described in AASHTO LRFD Bridge Design Specifications.

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

- Although tension load has been increased about 20 kips, the tension design tip has been raised one (1) foot at Bent 2 while it has been lowered 2 feet at Bent 3.

Response: Previously, we conservatively added 2 feet to the calculated tension pile tip. In our revised calculations, we eliminated the 2 feet of conservatism. Also in the previous calculations, we included some skin friction resistance for the cased portion of the Bent-3 piles. In our revised calculations, skin friction is zero for the cased portion of the Bent-3 piles.

Sincerely,
EARTH MECHANICS, INC.

Lino Cheang

Lino Cheang, GE 2345
Project Manager

State of California — Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: May 27, 2009
File: 12-ORA-57-PM 16.84
12-0F0311

Placentia OH (widen)
Bridge No. 55-0449
SR-57 Northbound Widening
(Southern Segment)

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of the Consultant Response to Foundation Report Comments

On May 20, 2009, we received a response and portions of the revised Foundation Report for the Northbound widening of Placentia OH, Br. # 55-0449. The following comments are based on the response and partially submitted revised report prepared by Earth Mechanics, Inc. (EMI), dated May 19, 2009.

- Although soil legend sheets are not included in submitted LOTB sheets, but based on EMI response, it is our understanding that they would be part of LOTB in final plans.
- Dotted lines marking elevation intervals should not carry through the boring column.
- The reason for deletion of Table 5-8 (lateral pile solutions).
- The reason for substantial raise in settlement design tips at Abutments 1& 4 and Bent 3.
- Although tension load has been increased about 20 kips, the tension design tip has been raised one (1) foot at Bent 2 while it has been lowered 2 feet at Bent 3.

Any questions regarding the above comments should be directed to Faramarz Gerami at (213) 620-2149 or Ted Liu at (213) 620-2136.

Report by:

FARAMARZ GERAMI, P.G., C.E.G.
Engineering Geologist
Office of Geotechnical Design - South 1
Branch C

Reviewed by: Date: 5/27/09

CHI-TSENG TED LIU, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design - South 1
Branch C

REGISTERED PROFESSIONAL ENGINEER
CHI-TSENG TED LIU
No. 2669
Exp. 6-30-2010
GEOTECHNICAL
STATE OF CALIFORNIA

c: OGDS1 - LA. File
OGDS1 - Sac. File
GS – Sac. File

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

May 19, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Attention: Mr. Steve Huff

Subject: Response to Caltrans Foundation Review Comments on "Foundation Report (dated 2/11/09) Placentia Overhead (Widen), Bridge No. 55-0449, SR-57 Northbound Widening"
12-Ora-57, PM 16.84, EA 12-0F0311

Dear Mr. Huff:

Caltrans issued a Foundation Review sheet dated April 15, 2009 for the subject project. A copy of this review sheet is attached at the end. The following are our responses to those comments. ~~Many of these responses require revisions of the foundation report. We have included those revised pages from the foundation report as attachments, and the actual revisions are also identified by a vertical line place on the right side of the text.~~

5.4.2 Table 5-4

- Compression load per support for Extreme Event Limit State seems to be too low, please clarify.

Response: We checked with the structural engineer, compression load per support for Extreme Event Limit in Table 5-4 is correct. However, the "max per pile" under Service-I Limit State for Abutment 4 has been revised (see ~~attached~~ Page 17).

5.4.3 Axial Capacity

- According to AASHTO LRFD Bridge Design Specification, pile group effects should be considered for pile spacing of less than 4, not less than 3 as implied for pile group effects at Abutments 1 and 4.

Response: We incorporated the group efficiency factors per AASHTO LRFD Bridge Design Specification. Our calculation sheets are attached. The revised tables are attached (see ~~attached~~ Pages 17 and 18).

- The tension in Table 5-5 foot note should be deleted since design tip for tension is not provided (due to no tension demand at abutments).

Response: We eliminated the "tension" term in foot note in the attached Table 5-5 (see ~~attached~~ Page 17).

- The unit for steel casing specified tip elevation in Tables 5-6 & 5-7 should be (ft).

Response: The unit for steel casing specified tip elevation in Tables 5-6 and 5-7 has been changed to (ft) (see ~~attached~~ Page 18).

- In order to prevent compromising side and base soil resistance of the existing RCP storm drain pipe, CIDH piles at Abutment1 should probably be cased to the invert elevation of the RCP and lower the pile tip about 2 to 3 feet.

Response: On Sheet 9 of 36 of the Bridge Plans, Note 3 says "To minimize the potential for damaging the existing RCP, two adjacent CIDH piles shall not be drilled concurrently without a temporary casing." We believe this note alone should be sufficient to prevent compromising loss of side and base soil resistance for the following reasons:

(1) The top and bottom of the RCP is near El. +206 and +199 feet, respectively. Based on the LOTB sheets, materials encountered within these elevations are predominantly lean clay and lean clay with sand; the caving potential of this soil type is expected to be low.

(2) We do not want to mandate using a casing because it could actually worsen the situation. To install the casing, we will not allow (i) the use of a vibratory hammer because it may cause settlement of the existing foundation, and (ii) oversized predrilling because this would face the same risk of compromising loss of side and base soil resistance. So, the only means appears to be center-relief drilling ahead of the casing with tapping-and-pushing to advance the casing to the required penetration. This operation is slow, costly and may even require different drilling equipment.

(3) The Caltrans SSP for CIDH piles already has requirements for contractor to control caving soils, if it occurs.

- Please lower the specified pile tip at Bent 3 to match that of Bent 2 (elevation 151).

Response: The specified pile tip at Bent3 was lowered to match that of Bent 2.

5.5 and/or 5.6

- Structure approach slab should be recommended and wing walls discussed separately.

Response: The following responses have been added to Section 5.5 (see ~~attached~~ Page 19): "Per Caltrans Memo to Designers 5-3 dated December 1992, structure approach slabs are required for this project. Selection of the approach type will be performed by the structurral designer following the flowchart in Caltrans Memo to Designers 5-3, Attachment A dated May 1 996."

The following responses have been added to Section 5.6 (see ~~attached~~ Page 20): "The abutments are adjacent to RW 492 and 496. Both abutment wingwalls are relatively narrow and only extend to the end of the abutment pile caps; two wingwalls sit on the abutment pile caps as a part of the abutment design. Design of RW 492 and 496 is in a separate report."

6.2 Pile Construction

- The use of vibratory or impact hammer for installation of permanent casing could cause settlement of the railroad track base material, therefore should not be recommended. However, oscillation or drill ahead and case methods could have much less effects on the railroad tracks.

Response: The above recommendation has been added to the revised report (see ~~attached~~ Pages 22 and 23).

- Please refrain from wet method for caving control, since it necessitates additional instrumentation and possibility of creating anomalies in the pile.

Response: The recommendation for wet method has been deleted. The following paragraph was added to Pile Construction: "For on-center pile spacings less than six times the pile diameter, no two adjacent piles can be constructed concurrently." (see ~~attached~~ Pages 22 and 23)

Attachment A - Log of Test Borings (LOTB)

- Soil legend sheets should be the end sheets of the recent LOTB (i.e. sheets 2 and 3).
- Correction/multiplication factor for conversion of 2.4" California Modified ring sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.
- When soil group name is changed a solid separation line should be drawn through boring graphic column. Dotted lines marking elevation intervals should not carry through the boring graphic column.
- Pocket penetrometer (pp) values should be shown at the end of each cohesive soil layer description and consistency should be based on those values rather than blow counts.
- Apparent density of cohesion less soils should be based on corrected blow count for hammer efficiency; however, the actual blow counts (raw field blow counts) as currently shown on LOTB should not be changed.
- Show name and directions of nearest cities on plan view.
- Control line "B" line should be shown on plan view as equal to ℄ Rte 57.

- Bottom title block from left to right on LOTB and soil legend sheets should comply with Section 5.2.3.2 of Caltrans Soil and Rock Logging Manual, June 2007.

- Identify the vertical datum used to determine the benchmark elevations.

- Include a conversion factor on As Built LOTB for conversion of As Built elevations (NGVD29 datum) to current NAVD88 datum elevations.

- As Built LOTB for original structure and subsequent widening (if applicable) with proper title block as described in Section 5.2.4 of Caltrans Soil and Rock Logging Manual, June 2007, should be included in Foundation Report and Structure Plans.

Response: The attached LOTB sheets incorporated the following revisions per Caltrans review:

- Legend sheet will be moved to the end sheet of the recent LOTB.
- Conversion factor from 2.4" California Modified Ring sampler blowcount to 1.4" Standard Penetration Test sampler blowcount is added to the "Notes"
- Separation lines are drawn where group ~~name~~ symbol changes. (CCTV 5/29/09)
- Pocket penetrometer test results are added and used for classifying cohesive soils.
- Apparent density was revised based on the blowcount and hammer efficiency.
- Directions to the nearest cities are added.
- "B-Line" in parenthesis was added to the plan next to the existing SR-57 Centerline mark.
- An appropriate bottom title block was used in the attached LOTB sheets.
- We added "Vertical Datum is NAVD 88".
- The following sentence has been added to Section 2.1 Field Investigation: "About 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV88)."
- Proper title block was now included for as-built LOTB.

Unchecked Structure Plans

- The crash wall shown in General should be described in Foundation Report. Has the additional dead load been considered in foundation support calculations.

Response: The load from the crash wall was already factored in the foundation design load in Table 5-4. The paragraphs for the crash wall were added to the revised report (see ~~attached~~ Page 16 and 20).

- All comments in Attachment A – LOTB also apply to the LOTB in Structure Plans (unchecked detail plans).

Response: RBF will comply.

- A completed Pile Data Table (similar to Foundation Report) with additional column for steel casing should be replace the Pile Data Table shown in Foundation Plan.

Response: RBF will comply.

In addition to the above comments, the structural engineers have requested us to add the following sentence into the final report (see ~~attached~~ Page 13).

"Based on our soil borings, soils at the bridge site meet the "Competent Soil" requirements per SDC Section 6.2.2 (Caltrans, 2006b)."

Sincerely,
EARTH MECHANICS, INC.

Chien-Tai Yang, GE 2827
Project Engineer

Attachments

Attachment 1:
-Revised Report Page 4 for **Conversion Factor for Datum Change and Table 2-1**
-Revised Report Page 13 for **Competent Soil**
-Revised Report Page 16 for **Table 5-3 and Crash Wall**
-Revised Report Page 17 for **Table 5-4 and Table 5-5**
-Revised Report Page 18 for **Table 5-6 and Table 5-7**
-Revised Report Page 19 for **Structural Approach Slab**
-Revised Report Page 21 for **Abutment Wingwall**
-Revised Report Page 22 for **Crash Wall Construction Issue and Pile Construction**
-Revised Report Page 23 for **Pile Construction**
-Revised LOTB Sheets
-Axial Pile Capacity Calculation Sheets

deleted (See the final report)

Attachment 2:
-Caltrans Foundation Review Comment Sheets dated April 20, 2009

Attachment 1

Portions of Revised Reports Related to the Review Comments, Revised LOTB sheets, and Calculation Sheets for Axial Capacity

deleted

(See the final report)

Attachment 2

Caltrans Foundation Review Comment Sheets dated April 20, 2009

State of California | Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: April 15, 2009
File: 12-ORA-57-PM 16.84
12-0F0311

Placentia OH (widen)
Bridge No. 55-0449
SR-57 Northbound Widening
(Southern Segment)

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of the Foundation Report

On February 26, 2009, we received Foundation Report and unchecked Plans for the Northbound widening of Placentia OH, Br. # 55-0449. The existing bridge is located on SR-57 between Placentia Ave. to the north and West Crowther Ave. to the south. The following comments are based on the subject report prepared by Earth Mechanics, Inc., dated February 11, 2009.

5.4.2 Table 5-4

- Compression load per support for Extreme Event Limit State seems to be too low, please clarify.

5.4.3 Axial Capacity

- According to AASHTO LRFD Bridge Design Specification, pile group effects should be considered for pile spacing of less than 4, not less than 3 as implied for pile group effects at Abutments 1 and 4.

- The tension in Table 5-5 foot note should be deleted since design tip for tension is not provided (due to no tension demand at abutments).

- The unit for steel casing specified tip elevation in Tables 5-6 & 5-7 should be (ft).

- In order to prevent compromising side and base soil resistance of the existing RCP storm drain pipe, CIDH piles at Abutment1 should probably be cased to the invert elevation of the RCP and lower the pile tip about 2 to 3 feet.

- Please lower the specified pile tip at Bent 3 to match that of Bent 2 (elevation 151).

5.5 and/or 5.6

- Structure approach slab should be recommended and wing walls discussed separately.

6.2 Pile Construction

- The use of vibratory or impact hammer for installation of permanent casing could cause settlement of the railroad track base material, therefore should not be recommended. However, oscillation or drill ahead and case methods could have much less effects on the railroad tracks.

- Please refrain from wet method for caving control, since it necessitates additional instrumentation and possibility of creating anomalies in the pile.

Attachment A - Log of Test Borings (LOTB)

- Soil legend sheets should be the end sheets of the recent LOTB (i.e. sheets 2 and 3).

- Correction/multiplication factor for conversion of 2.4" California Modified ring sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.

- When ground water is not shown on the borings, explain under each boring that "Ground water was not encountered or measured during field investigation".

- When soil group name is changed a solid separation line should be drawn through boring graphic column. Dotted lines marking elevation intervals should not carry through the boring graphic column.

- Pocket penetrometer (pp) values should be shown at the end of each cohesive soil layer description and consistency should be based on those values rather than blow counts.

- Apparent density of cohesion less soils should be based on corrected blow count for hammer efficiency; however, the actual blow counts (raw field blow counts) as currently shown on LOTB should not be changed.

- Show name and directions of nearest cities on plan view.

- Control line "B" line should be shown on plan view as equal to ℄ Rte 57.

- Bottom title block from left to right on LOTB and soil legend sheets should comply with Section 5.2.3.2 of Caltrans Soil and Rock Logging Manual, June 2007.
- Identify the vertical datum used to determine the benchmark elevations.
- Include a conversion factor on As Built LOTB for conversion of As Built elevations (NGVD29 datum) to current NAVD88 datum elevations.
- As Built LOTB for original structure and subsequent widening (if applicable) with proper title block as described in Section 5.2.4 of Caltrans Soil and Rock Logging Manual, June 2007, should be included in Foundation Report and Structure Plans.

Unchecked Structure Plans

- The crash wall shown in General should be described in Foundation Report. Has the additional dead load been considered in foundation support calculations.
- All comments in Attachment A – LOTB also apply to the LOTB in Structure Plans (unchecked detail plans).
- A completed Pile Data Table (similar to Foundation Report) with additional column for steel casing should be replace the Pile Data Table shown in Foundation Plan.

Any questions regarding the above comments should be directed to Faramarz Gerami at (213) 620-2149 or Ted Liu at (213) 620-2136.

Report by:

FARAMARZ GERAMI, P.G., C.E.G.
Engineering Geologist
Office of Geotechnical Design - South 1
Branch C

Reviewed by: Date: 4/15/09

CHI-TSENG TED LIU, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design - South 1
Branch C

REGISTERED PROFESSIONAL ENGINEER
CHI-TSENG TED LIU
No. 2669
Exp. 6-30-2010
GEOTECHNICAL
STATE OF CALIFORNIA

c: OGDS1 - LA. File
OGDS1 - Sac. File
GS – Sac. File

FINAL FOUNDATION REPORT

Placentia Avenue Undercrossing (WIDEN)
Bridge No. 55-0460
SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 17.1
EA 12-0F0311

EMI Project No. 08-115
Date: June 17, 2009

EARTH MECHANICS, INC.

Geotechnical and Earthquake Engineering

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

June 17, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Attention: Mr. Steve Huff, P.E.

Subject: **Final Foundation Report for Placentia Avenue Undercrossing (WIDEN),**
Bridge No. 55-0460
SR-57 Northbound Improvement Project, Orange County, California
12-Ora-57, PM 17.1, EA 12-0F0311

Dear Mr. Huff:

Attached please find the final Foundation Report for the subject bridge widening project. This report contains the findings and conclusions of our field investigation and laboratory testing program. This report also contains our recommendations for the design and construction of the bridge foundation.

An earlier version of this Foundation Report, dated February 11, 2009, was prepared by EMI and reviewed by Caltrans. Copies of the review sheets and our responses are attached in Appendix D. This report has been revised to incorporate our responses to the review comments.

We appreciate the opportunity to provide geotechnical design services for this project. If you have any questions, please call us.

Sincerely,
EARTH MECHANICS, INC.

Chien-Tai Yang, RCE 66374
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
CHIEN-TAI YANG
NO. C66374
EXP. 6-30-2010
CIVIL
STATE OF CALIFORNIA

Lino Cheang, GE 2345
Project Manager

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

FINAL FOUNDATION REPORT

PLACENTIA AVENUE UNDERCROSSING (WIDEN)
BRIDGE NO. 55-0460
SR-57 NORTHBOUND IMPROVEMENT PROJECT
ORANGE COUNTY, CALIFORNIA
12-Ora-57, PM 17.1
EA 12-0F0311

Prepared for:

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Prepared By:

Earth Mechanics, Inc.
17660 Newhope Street, Suite E
Fountain Valley, California 92708

EMI Project No. 08-115

June 17, 2009

TABLE OF CONTENTS

Section		Page
1.0 INTRODUCTION		**1**
1.1	Purpose and Scope of Study	1
1.2	Project Description	1
2.0 FIELD INVESTIGATION AND LABORATORY TESTING		**4**
2.1	Field Investigation	4
2.2	Laboratory Testing	5
3.0 GEOLOGY AND SEISMICITY		**6**
3.1	Topography and Drainage	6
3.2	Physiography	6
3.3	Geologic Structure	6
3.4	Geologic Hazards	8
3.5	Stratigraphy	8
3.6	Seismicity	10
4.0 SUBSURFACE CONDITIONS		**11**
4.1	Soil Conditions	11
4.2	Groundwater Conditions	13
5.0 CONCLUSIONS AND RECOMMENDATIONS		**14**
5.1	Seismic Design Criteria	14
5.2	Liquefaction	16
5.3	Soil Corrosivity	16
5.4	Pile Foundation Design	16
5.4.1	Foundation Type	16
5.4.2	Foundation Data Provided by Structural Designers	16
5.4.3	Axial Capacity	17
5.4.4	Lateral Resistance	19
5.5	Embankments and Settlement	19
5.6	Bridge Abutment Wall Design	21
6.0 CONSTRUCTION RECOMMENDATIONS		**22**
6.1	Earthwork	22
6.2	Pile Construction	22
6.3	Backdrain and Backfill Requirements For Abutment Walls	23
6.4	Review of Construction Plans	23
6.5	Geotechnical Observation and Testing	23
7.0 LIMITATIONS		**25**
8.0 REFERENCES		**26**

List of Tables Page

Table 2-1. Geotechnical Exploration Information 4
Table 4-1. Idealized Soil Profile and Strength Parameters 11
Table 5-1. Local Seismic Sources 14
Table 5-2. Soil Corrosion Test Results 16
Table 5-3. Foundation Design Data Sheet 17
Table 5-4. Foundation Design Loads 17
Table 5-5. Abutment Foundations Design Recommendations 18
Table 5-6. Bent Foundation Design Recommendations 18
Table 5-7. Pile Data Table 19
Table 5-8. Lateral Pile Solutions 20

List of Figures Page

Figure 1-1. Site Location Map 2
Figure 3-1. Regional Fault and Physiographic Map 7
Figure 3-2. Geological Map 9
Figure 5-1. Design ARS Curve 15
Figure 6-1. Low Expansion Material in Bridge Embankment 24

APPENDICES

Appendix A. Log of Test Borings Sheets and As-built Log of Test Borings Sheet
Appendix B. Laboratory Test Results
Appendix C. Design Calculations
Appendix D. Caltrans Review Comments and EMI Responses

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF STUDY

This Foundation Report presents the findings and conclusions of a geotechnical investigation conducted by Earth Mechanics, Inc. (EMI). It presents foundation design and construction recommendations for proposed widening of the Placentia Avenue Undercrossing (UC) in Orange County, California. A site location map is presented in Figure 1-1.

This work was performed for the Orange County Transportation Authority (OCTA) and EMI is a subconsultant to RBF Consulting (RBF). The geotechnical services provided for this project included the following tasks:

- Collection and review of existing geotechnical information;
- Field exploration consisting of drilling and logging exploratory borings;
- Laboratory testing of selected bulk and relatively undisturbed soil samples;
- Engineering calculations (see Appendix C) and analysis to develop foundation design and construction recommendations; and
- Preparation of this report presenting our findings, conclusions, and recommendations.

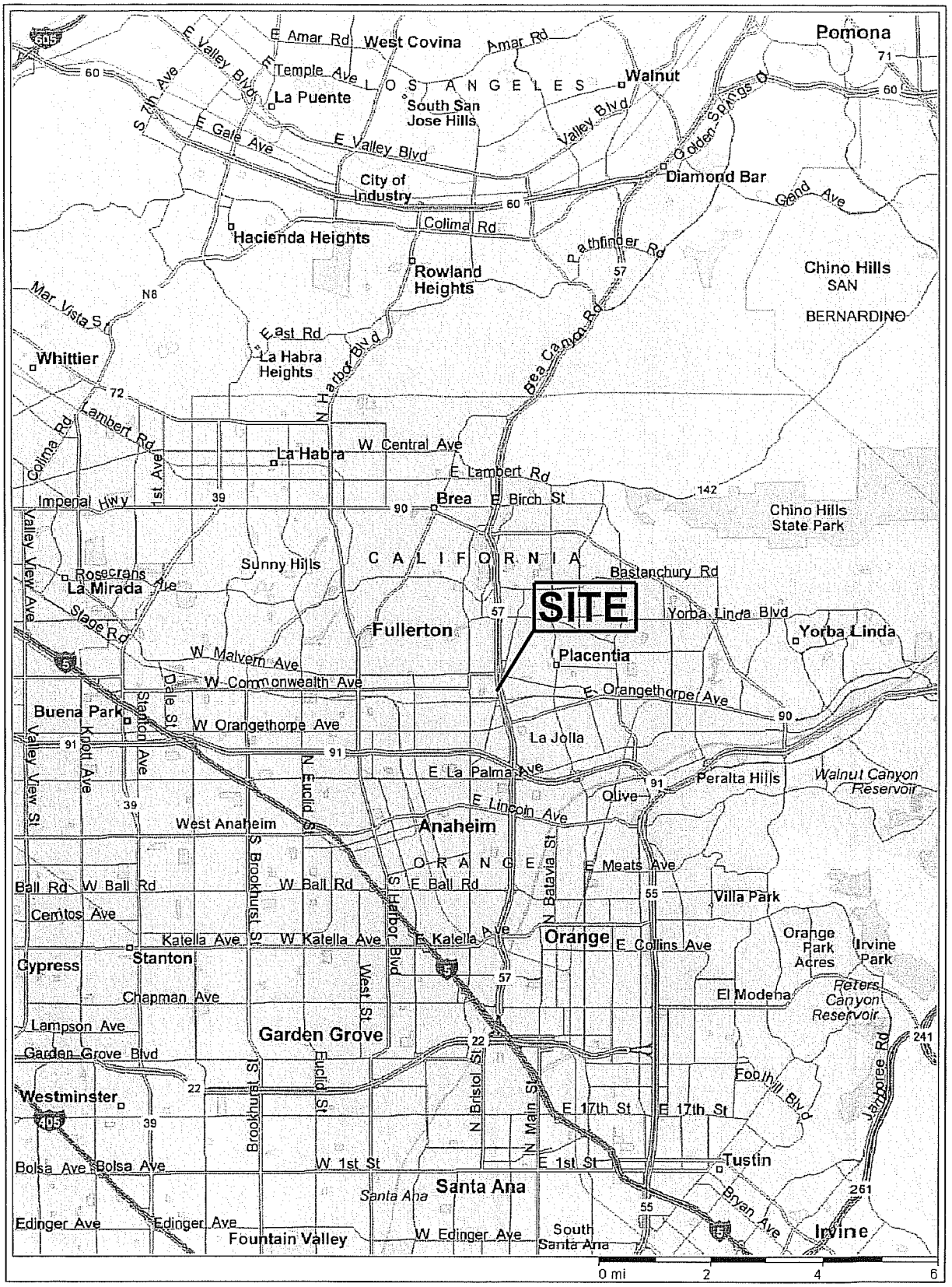
1.2 PROJECT DESCRIPTION

The Department of Transportation (Caltrans) – District 12, in cooperation with the Orange County Transportation Authority (OCTA), proposed to widen northbound State Route 57 (SR-57) by adding one northbound through lane. The project limits are between 0.2 mile south of Orangethorpe Avenue and 0.2 mile north of Yorba Linda Boulevard along northbound SR-57. Within the project limits, there are interchanges located at Orangethorpe Avenue, Chapman Avenue, Nutwood Avenue and Yorba Linda Boulevard. The entire project involves widening seven existing bridges and a tieback wall at Yorba Linda Boulevard:

- Orangethorpe Avenue Undercrossing (Bridge No. 55-0459)
- South Placentia Overhead (Bridge No. 55-0450)
- Crowther Avenue Undercrossing (Bridge No. 55-0457)
- Placentia Overhead (Bridge No. 55-0449)
- Placentia Avenue Undercrossing (Bridge No. 55-0460)
- Chapman Avenue Undercrossing (Bridge No. 55-0456)
- Nutwood Avenue Undercrossing (Bridge No. 55-04649)
- Tieback Wall at Yorba Linda Boulevard (Bridge No. 55-0468)

This report pertains to Placentia Avenue UC only; separate foundation reports are prepared for each of the above seven remaining structures.

The Placentia Avenue UC borders Cities of Placentia and Fullerton and is located north of the SR-57/SR-91 interchange. SR-57 in the project area trends in a north-south direction and carries traffic from the "Orange Crush" (I-5/SR-22/SR-57 Interchange) in Orange County to Interstate 210 in Los Angeles County (See Figure 1-1).



Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SITE LOCATION MAP

Figure 1-1

PLACENTIA AVENUE UC (WIDEN)

Project No. 08-115

Date: 01-18-09

The existing Placentia Avenue UC is a 4-span structure that carries SR-57 traffic over Placentia Avenue. The structure was constructed in 1969. The cast-in-place reinforced concrete box girder superstructure has a depth of 5.75 feet and the spans are approximately 78, 102, 107, and 71 feet with a total span length of approximately 358 feet measured along the centerline of SR-57. Total width of prestressed concrete box girder structure varies from 158 to 175 feet. The box girders are supported on diaphragm abutment walls with 16" CIDH piles connecting directly to the diaphragm abutments.

This project will widen Placentia Avenue UC by 22'-6" minimum and varies on the northbound side to provide an additional 12-foot lane and 10-foot shoulder in that direction. The proposed widening structure type is a CIP prestressed concrete box girder with precast bathtub girders in spans 3 and 4, and diaphragm-type abutments. The proposed structure will match the existing structure span geometry.

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 FIELD INVESTIGATION

A copy of the As-Built Log-of-Test-Borings (LOTB) sheet is included in Appendix A. About 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV88). According to this As-Built LOTB sheet, two rotary borings and five penetration borings were performed in November 1965 and April 1966. During the investigation, the rotary boring was the deepest boring and was advanced to about El. +173 feet. Existing grade at the time of the investigation was approximately between El. +214 and 217 feet. Groundwater was not encountered during drilling in November 1965 and April 1966 down to El. +173 feet.

To supplement the existing subsurface data, four soil borings were drilled (one at each abutment; one each near Bents 2 and 3). These borings were drilled on September 26 and 30, 2008. Boring information, including exploration number, stations, offsets, ground surface elevations, bottom of hole elevations and water level measurements are summarized in Table 2-1. Locations of the exploratory boring are shown on the LOTB sheets provided in Appendix A.

TABLE 2-1. GEOTECHNICAL EXPLORATION INFORMATION

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-010	SR-57 Main Line (B-Line)	505+67	80RT	+243.5	+137.0	None Encountered During Drilling
A-08-011	SR-57 Main Line (B-Line)	507+45	100RT	+217.4	+145.9	
A-08-012	SR-57 Main Line (B-Line)	507+94	97RT	+217.9	+146.4	
A-08-013	SR-57 Main Line (B-Line)	510+43	89RT	+241.3	+149.8	

Exploratory borings were drilled using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. Relatively undisturbed drive samples were obtained using a 3.25-inch outer diameter California split-spoon sampler lined with brass rings. Each of these brass rings is 1-inch long with a 2.5-inch outside diameter. The California Drive sampler was driven into the ground using successive blows of a 140-lb hammer falling a distance of 30 inches. The numbers of blow for the final 12 inches or shorter of driving are shown on the LOTB sheets.

The Standard Penetration Test (SPT) sampler (1.4-inch inside diameter) was also used to obtain soil samples. The sampler was driven into the ground using a 140-lb hammer free falling from a height of 30 inches. The numbers of blow to advance the sampler each 6 inches of penetration or less was recorded. The blow counts required to drive the sampler for the last 12 inches or less was recorded as the Standard Penetration Resistance (N-value) on the LOTB sheets.

Charts published by Winterkorn and Fang (1975) can be used to determine a reduction factor used to

convert blowcounts recorded using the California Drive sampler into SPT blowcounts. Using those charts, we obtained a reduction factor of 0.5 and this one-half reduction factor was used for this project.

The sampling interval is usually 5 feet. Sampling was performed by alternating the California Drive sampler and SPT sampler.

2.2 LABORATORY TESTING

Soil samples considered representative of the subsurface conditions were tested to obtain or derive relevant physical and engineering soil properties. The following laboratory tests were conducted to supplement the observations recorded during the field investigation:

- In-situ Moisture Content and Unit Weight
- Pocket Penetrometer
- Percent Passing No. 200 Sieve
- Atterberg Limits
- Direct Shear
- UU Triaxial Test
- Consolidation
- Minimum Resistivity, pH, Sulfate Content and Chloride Content

The laboratory tests were conducted in general accordance with California Test Methods or American Society for Testing and Materials (ASTM) Standards. Laboratory test results are included in Appendix B.

3.0 GEOLOGY AND SEISMICITY

3.1 TOPOGRAPHY AND DRAINAGE

The project corridor is in the eastern part of the Los Angeles Basin along the southern margin of the Coyote Hills and the Puente Hills (Figure 3-1). Just north of the project corridor, the Puente Hills rise to an elevation of about 1,400 feet. The southwestern edge of the Puente Hills is paralleled by a series of low-elevation plains and hills; the Santa Fe Plain and the Coyote Hills are to the west of the project corridor, and the Richfield and Kraemer Hills are to the east. The elevations of these hills range from about 500 feet just west of the project to about 300 feet in the east. The ground upon which the project is located slopes gently to the south. Elevations along the project corridor range from about 280 feet in the north to about 200 feet on the south.

The project corridor traverses the ancient flood plains and alluvial fans of Fullerton Creek and the Santa Ana River. The major drainage in the area is the Santa Ana River which flows westerly south of the site. Fullerton Creek, a tributary to the Santa Ana River, drains southwesterly from the Puente Hills just west of the project corridor.

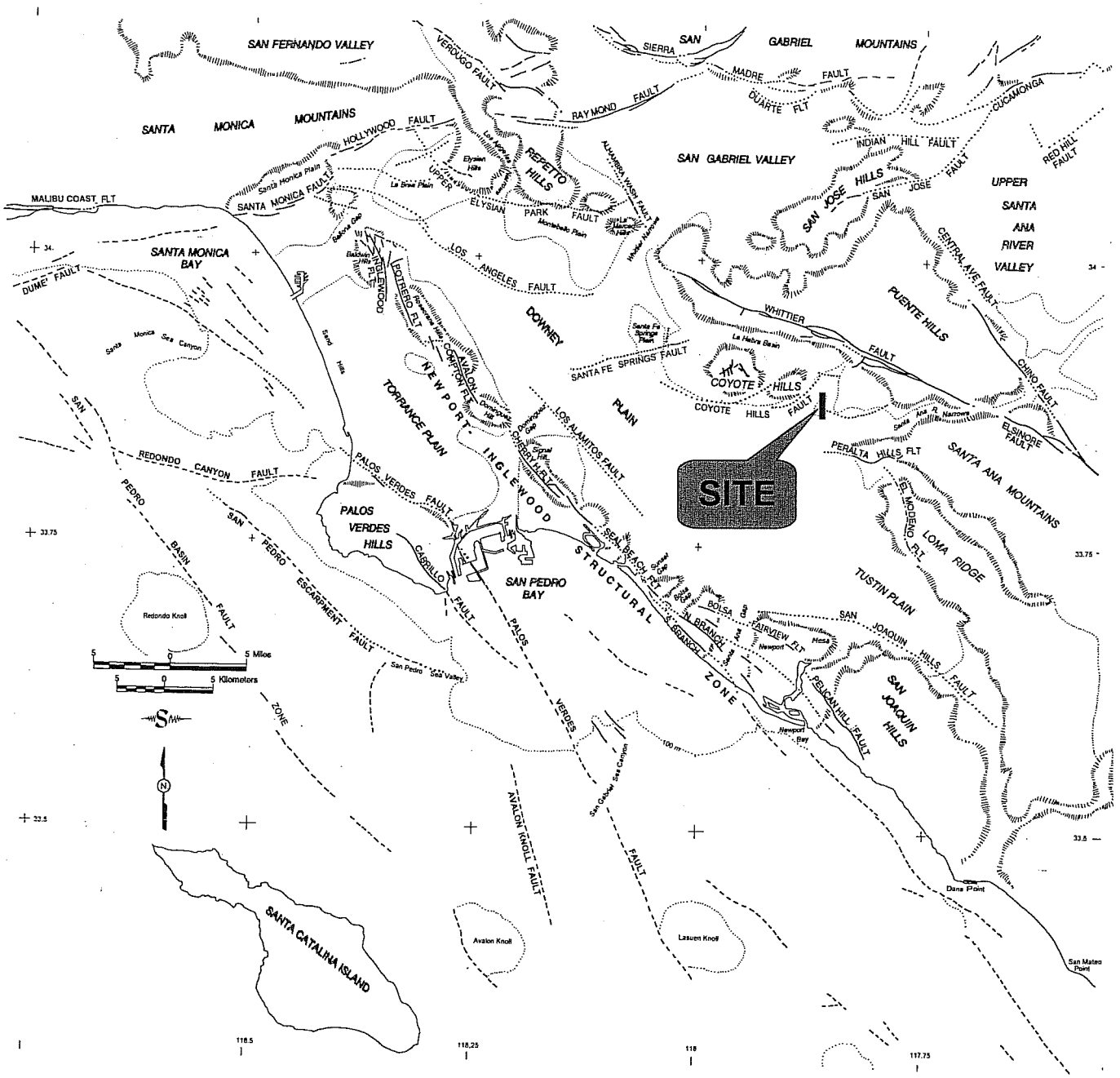
3.2 PHYSIOGRAPHY

The site area is at the eastern edge of the Los Angeles physiographic basin, a large, relatively flat, low-lying, coastal plain surrounded by mountains on the north, east, and southeast (Figure 3-1). The floor of the Los Angeles Basin is relatively flat but slopes gradually southwesterly from an elevated marginal apron to sea level along the coastline. The western margin of the Los Angeles Basin is bordered by the sea and the Palos Verdes Hills. The eastern margin is bordered by the Puente Hills and Santa Ana Mountains. The Coyote Hills, Santa Fe Springs Plain, Richfield Hills, and Kramer Hills are low elevation uplifts along the southern margin of the Puente Hills.

3.3 GEOLOGIC STRUCTURE

The geologic structure at the site is quite simple and is characterized by flat-lying Quaternary sediments overlying gently folded Tertiary sedimentary rocks. These strata rise gently to the Coyote Hills, Richfield Hills, and Kraemer Hills where they are arched upward to form anticlinal folds. The site is on the south limb of these anticlines with the early Pleistocene and Tertiary age strata dipping gently to the south and overlain by younger flat-lying Quaternary sediments.

The nearest active or potentially active surface faults are the Peralta Hills and Whittier faults (Figure 3-1). The low-elevation plains and hills along the eastern margin of the Los Angeles Basin are underlain by a series of east-west trending, en echelon, faults and folds in the subsurface; the major faults within this trend are, from north to south, the Los Angeles (Las Cienegas), Santa Fe Springs, and Coyote Hills faults (Figure 3-1). This group of faults is known as the Puente Hills fault system. Other poorly known segments of this thrust fault system underlie the Richfield and Kramer hills. All of these faults are blind thrust or reverse faults that approach within about a mile or so of the ground surface. They are identified on seismic reflection geophysical data only and are below the depths of oil wells.



PLACENTIA AVENUE UC (WIDEN)

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REGIONAL FAULT AND PHYSIOGRAPHIC MAP

Figure 3-1

Project No. 08-115

Date: 01-17-09

The Peralta Hills fault may be related to the Puente Hills fault system. The Peralta Hills fault is exposed along the south flank of the Peralta Hills where it displaces Tertiary-age rocks upward and over younger Quaternary alluvium. The fault extends westerly below the Santa Ana River channel where it creates barriers to ground-water flow (Figure 3-2). The barriers extend about to the SR 57 freeway just north of the Lincoln Avenue (Morton and Miller, 1981). The location of the Peralta Hills fault is well up on the flank of the hills rather than at the base of the hills indicating that it is not the only fault responsible for uplift and folding of the Peralta Hills. There must be a deeper unknown blind thrust fault below the Peralta Hills thrust fault but this feature has never been directly identified.

The Whittier fault is a major strike slip fault that extends northwesterly along the southwest flank of the Puente Hills northeast of the site (Figure 3-1). The Whittier fault is associated with the Chino fault and the Elsinore fault and together these faults form a major fault system that extends from the Los Angeles Basin into northern Mexico.

The El Modeno fault is a north-south trending feature within Loma Ridge, one of the foothills of the Santa Ana Mountains, southeast of the site. The feature is poorly known but is known to displace Holocene soil in Loma Ridge. Although the fault is grouped with the Peralta Hills fault on the Caltrans seismic hazard map (Mualchin 1996), it appears to be a discrete normal or strike-slip fault unrelated to the thrust faults of the Peralta Hills. Although the fault must be considered active because it displaces Holocene soil, the feature has a very long (thousands of years) recurrence interval.

3.4 GEOLOGIC HAZARDS

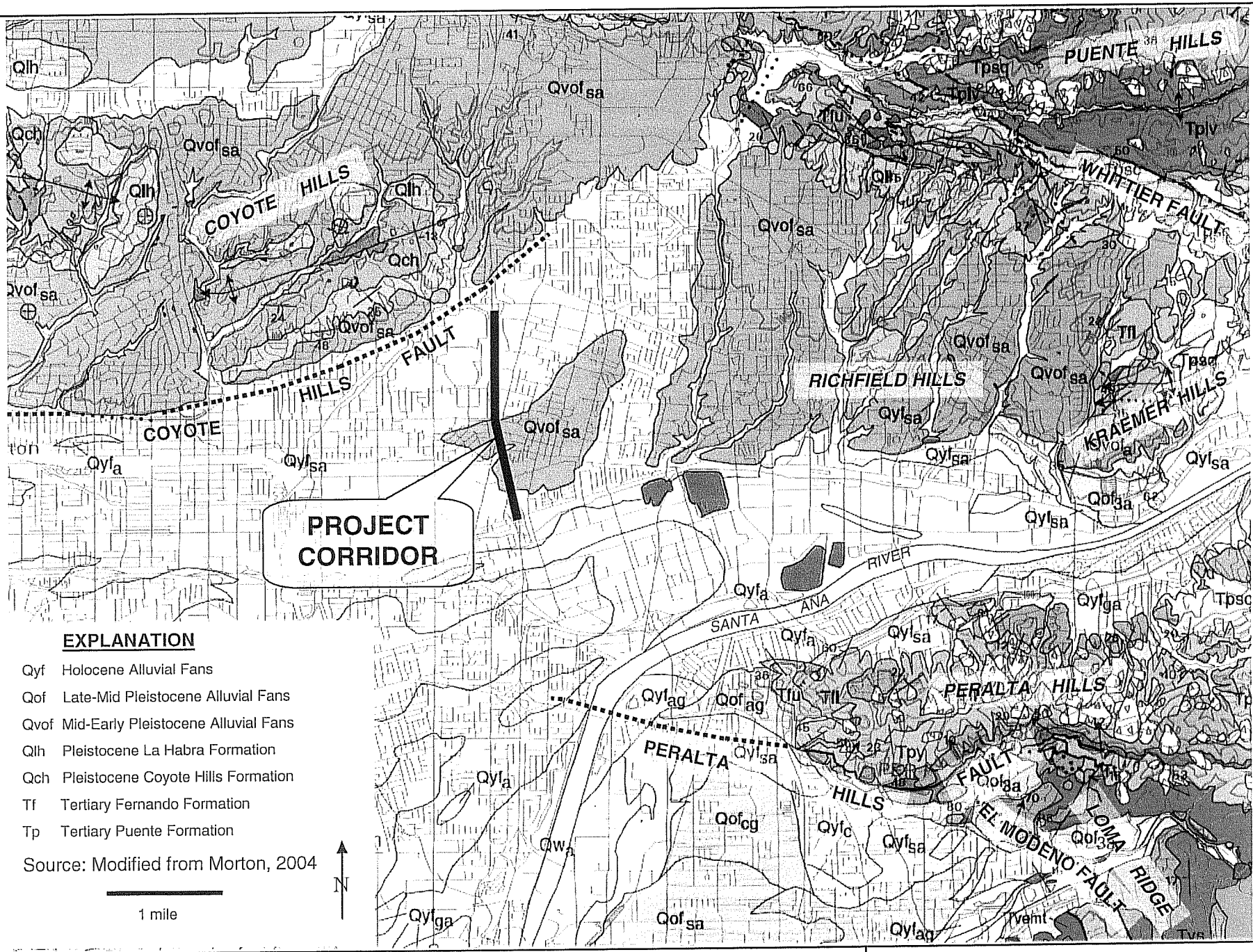
There are no steep slopes within the corridor so landsliding is not likely. There are no active faults so surface fault rupture is not likely. There are no known volcanos in the site region. The site is far from the sea on elevated land so Tsunamis are not a hazard.

The site is not identified on the State seismic hazard maps of the Anaheim and Newport Beach quadrangle as being susceptible to liquefaction (California Geological Survey/Division of Mines and Geology, 1997). This is due primarily to the depth of historically highest ground water being greater than 50 feet.

3.5 STRATIGRAPHY

Regional studies (e.g. Morton, 2004; Morton and Miller, 1981; Durham and Yerkes, 1964; California Department of Water Resources, 1961) indicate that the site area is underlain by Quaternary sediments overlying older Quaternary and Tertiary sediments and sedimentary rocks.

The surficial deposits are primarily Holocene and Pleistocene alluvial fan deposits (Figure 3-2). Older formations exposed in the hills and underlying the corridor are, in descending order, the Pleistocene-age La Habra and Coyote Hills, the Pliocene Fernando, and Pliocene-Miocene-age Puente formations. Along the corridor, the La Habra Formation is at an elevation of about sea level and therefore these older units are well below the level of interest for this project.



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

PLACENTIA AVENUE UC (WIDEN)

Project No. 08-115 | Date: 01-18-09

GEOLOGICAL MAP

Figure 3-2

3.6 SEISMICITY

The largest historical earthquake within the Los Angeles Basin was the 1933 Long Beach earthquake of M_W=6.4 (M_L = 6.3) which is generally believed to have been associated with the Newport-Inglewood Structural Zone. The association of the 1933 event with the NISZ was based on abundant ground failures along the NISZ trend, but no unequivocal surface rupture was identified. Hauksson and Gross (1991) reevaluated the seismicity data and relocated the 1933 earthquake hypocenter to a depth of about 6 miles below the Huntington Beach-Newport Beach city boundary.

Other damaging earthquakes in the Los Angeles region include the 1971 San Fernando, the 1987 Whittier, and the 1994 Northridge events. The 1971 San Fernando (M_L= 6.4, M_W=6.7) earthquake occurred along the northern margin of the San Fernando Valley and produced a surface rupture which coincided partly with a zone of mapped surface faults along the mountain-valley margin. The more-recent 1987 Whittier earthquake (M_L=5.9, M_W=5.9) and the 1994 Northridge (M_L=6.4, M_W = 6.7) earthquake were not associated with surface faulting. Such events indicate that seismic hazards analysis must consider subsurface faulting as well as surface faulting. The Whittier event occurred at a depth of about 10 miles on a northerly dipping thrust fault dipping from the Coyote Hills area, under the Repetto and Puente Hills, to below the San Gabriel Valley. The Northridge event occurred at a depth of about 12 miles on a south-dipping reverse fault below the San Fernando Valley.

Another significant earthquake in the region was the 1812 earthquake which caused damage at the San Juan Capistrano Mission. The location and magnitude of the 1812 earthquake are unknown but geological studies (Jacoby et al., 1988; Fumal et al., 1993; Weldon et al., 2004) postulated that it did not occur in the Capistrano area, but rather was a large (M> 7.0) distant event on the San Andreas fault in the Wrightwood area of the San Gabriel Mountains.

A recent magnitude 5.4 (M_W) earthquake occurred on 29 July 2008 below the Puente Hills northeast of the site at a depth of about 10 miles. This event was a reverse type fault with a left- lateral component of slip. The causative fault is unknown. The epicenter is between the Whittier and Chino faults. The orientation of the preferred focal plane of the focal mechanism solution is somewhat compatible with the Whittier fault. The Whittier fault may have a reverse component of slip but is believed to be primarily a right-lateral fault. Furthermore dip of the preferred focal plane and the distribution of aftershocks are not very compatible with the Whittier fault. The northerly dipping buried thrust faults under the Peralta Hills, Richfield Hills, or Kraemer Hills could have been source because the preferred focal plane dips northeasterly similar to the northerly dipping faults. However, the distribution of the aftershocks does not seem compatible with the orientations of these faults.

4.0 SUBSURFACE CONDITIONS

4.1 SOIL CONDITIONS

Based on the recent field exploration and the as-built LOTB sheet in Appendix A, the subsurface materials at the site can be generalized into three soil layers. The top layer consists of 30 to 40 feet of sandy lean clay and lean clay with sand. It overlies a 30-to-45-foot-thick layer of sand with silt. This sand layer is underlain by a layer of lean clay with sand. The idealized soil profile and design strength parameters for foundation design are presented in Table 4-1.

TABLE 4-1. IDEALIZED SOIL PROFILE AND STRENGTH PARAMETERS

Approx. Elevation (ft)	Predominant Soil Type	Range of Measured and Converted SPT Blowcount; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion/ Undrained Shear Strength (psf)
Abutment 1					
+243.5 to +233	Sandy Clay	24	120	-	2,500
+233 to +228	Clayey Sand	(38)	123	34	100
+228 to +198	Sandy Clay to Lean Clay with Sand	12 to (55) Average = 20	123	-	2,500
+198 to +151	Sand with Silt and Silty Sand	30 to (>70) Average = 45	128	38	50
+151 to +137	Lean Clay with Sand	(10) to 30 Average = 20	123	-	2,500
Bent 2					
+217.4 to +207	Sand with Silt	4 and (14) Average = 9	120	29	150
+207 to +182	Lean Clay with Sand and Sandy Lean Clay	16 to 27 Average = 21	123	-	2,500
+182 to +177	Clayey Sand	15	120	31	150
+177 to +152	Sand with Silt	(26) to (>70) Average = 45	128	38	50
+152 to +145.9	Lean Clay with Sand	(25) and 32 Average = 28	125	-	3,000

TABLE 4-1 (CONT). IDEALIZED SOIL PROFILE AND STRENGTH PARAMETERS

Approx. Elevation (ft)	Predominant Soil Type	Range of Measured and Converted SPT Blowcount; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion/ Undrained Shear Strength (psf)
Bents 3 and 4					
+217.9 to +193	Lean Clay with Sand	4 to 11 Average = 9	120	-	1,100
+193 to +188	Sandy Lean Clay	(24)	123	-	2,500
+188 to +183	Clayey Sand	18	120	31	150
+183 to +168	Sand with Silt	39 to (>70) Average = 45	128	38	50
+168 to +163	Lean Clay	12	120	-	1,300
+163 to +153	Sand with Silt	63 and (>70) Average = 65	130	40	50
+153 to +146.4	Lean Clay with Sand	23 and (25) Average = 24	123	-	2,500
Abutment 5					
+241.5 to +227	Clayey Sand	12 to (16) Average = 14	120	30	150
+227 to +192	Sandy Clay to Lean Clay with Sand	12 to (55) Average = 20	123	-	2,500
+192 to +167	Sand with Silt and Silty Sand	(28) to (>70) Average = 45	128	38	50
+167 to +162	Lean Clay with Sand	(>70)	123	-	3,000
+162 to +150	Sand with Silt	33 to (>70) Average = 45	128	38	50

Notes:
(1) SPT = Standard Penetration Test.
(2) Values in ( ) are converted SPT blowcounts corrected for sampler size. Based on Winterkorn and Fang (1975), a correction factor from California sampler blowcounts to SPT blowcounts is 0.5.

The above soil strength parameters are primarily based on published correlations with SPT blowcounts (Lam and Martin, 1986). The above soil strength parameters for the sandy materials are lower than the ultimate values obtained from the direct shear test results included in Appendix B. The undrained shear strengths for the clayey materials in Table 4-1 are also lower than the UU triaxial test results.

4.2 GROUNDWATER CONDITIONS

During the recent field investigation conducted on September 26 and 30, 2008, groundwater was not encountered down to El. +137 feet which is more than 100 feet from the freeway surface. As shown on the as-built LOTB sheet in Appendix A, groundwater was not encountered during drilling in November 1965 and April 1966 down to El. +173 feet.

The relatively deep water depth is confirmed by the historical groundwater map published by the California Geological Survey (Seismic Hazard Zones Map - Anaheim and Newport Beach Quadrangle) (CGS, 1997). This map shows the depth to groundwater to be greater than 50 feet.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SEISMIC DESIGN CRITERIA

According to the 1996 Caltrans Seismic Hazard map, the most significant faults relative to the project area are listed in Table 5-1 along with their style of fault, maximum earthquake magnitude, distance to the bridge site and resulting peak bedrock acceleration (PBA).

TABLE 5-1. LOCAL SEISMIC SOURCES

Fault or Fault Zone	Style of Faulting	Maximum Credible Earthquake (MCE) Magnitude	Distance to Site[2] (miles)	Peak Bedrock Acceleration[3] (g)
El Modeno-Peralta Hills (EMP)	Reverse-Thrust[1]	6.50	1.3	0.7
Puente Hills Blind Thrust	Reverse-Thrust	7.25	3.9	0.6
Whittier-Elsinore (WEE)	Strike-Slip	7.50	4.6	0.5

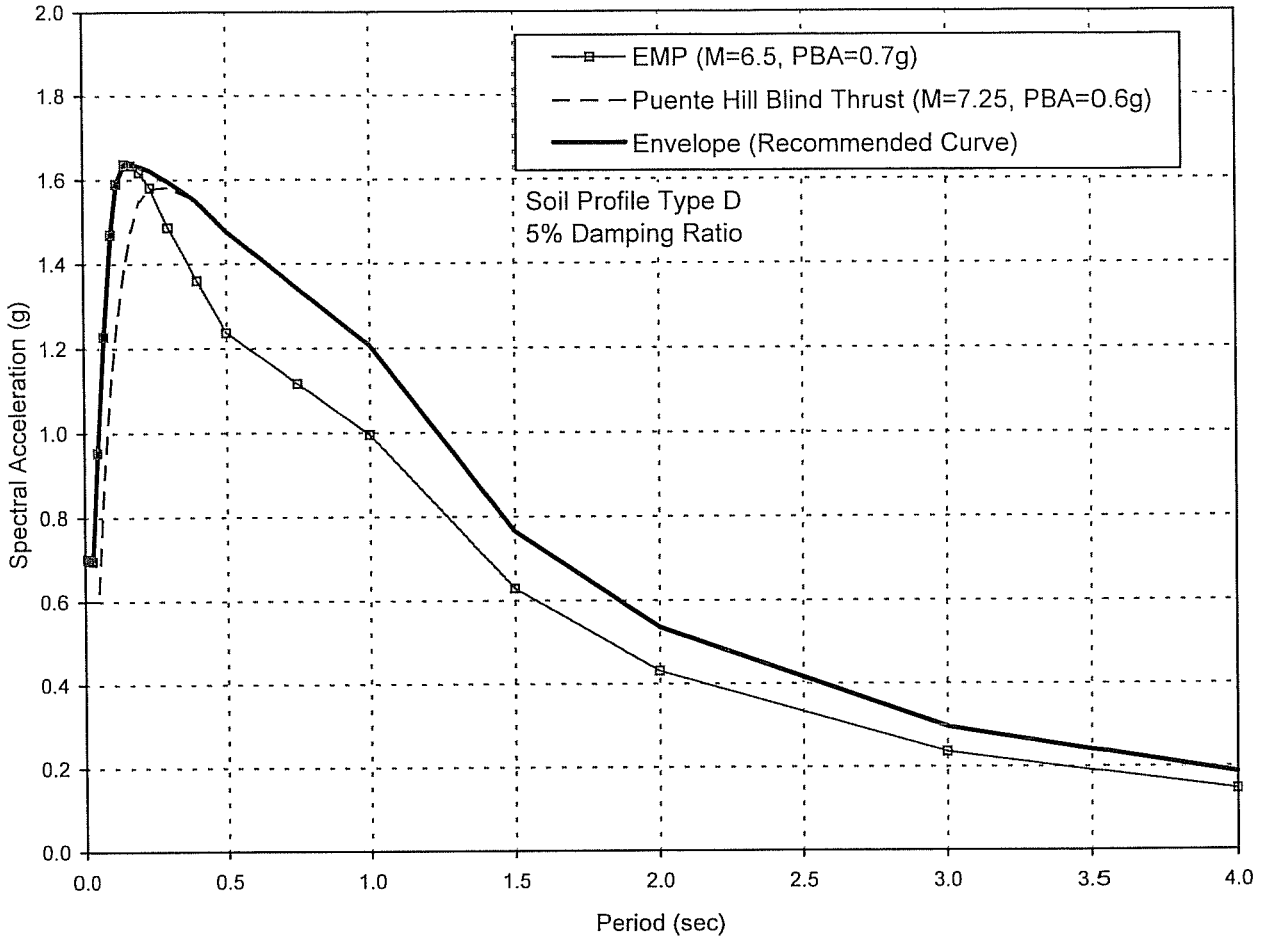
Notes:
(1) Caltrans designates the style of fault for EMP to be "unknown"; we assume a reverse-thrust fault (most conservative).
(2) For the EMP and WEE faults, the distances of each bridge site to these seismic sources were scaled from the 1996 Caltrans Seismic Hazard Map. Distances of each bridge site to the Puente Hills Blind Thrust were obtained from the seismic source model contained within the FRISKSP4.0 computer program (Blake, 2000 and 2004).
(3) The PBA is the larger of the two PBA's obtained from the attenuation relations of Sadigh (1997) and Mualchin (1996).

The ARS curves published in the Caltrans SDC (2006b) for Soil Profile Type "D" are applicable; this applies to Figures B.7 and B.8 for MCE Magnitudes (M) of 6.5±0.25 and 7.5±0.25, respectively. However, ARS curves for M of 6.5±0.25 with PBA's greater than 0.6g are not included in Figure B.7 of the Caltrans SDC (2006b). As a result, we generated an ARS curve for M=6.5±0.25 and a PBA of 0.7g by scaling the 0.6-g curve in Figure B.7 of the Caltrans SDC (2006b).

The design ARS curve envelopes the scaled ARS curve for M=6.5±0.25 and PBA=0.7g, and Figure B.8 for PBA=0.6g. According to Caltrans, this curve must also be modified to account for near-fault effects. For the near-fault effects, Caltrans Seismic Design Criteria (SDC, 2006b) Section 6.1.2.1 recommends the following modifications in the spectral accelerations:

- For periods less than 0.50 second, no change;
- For periods greater than 1.0 second, an increase of 20%;
- For periods between 0.50 and 1.0 second, a linear interpolation between the values at 0.50 and 1.0 second.

The resulting design ARS curve and the digitized coordinates are presented in Figure 5-1 . Based on our soil borings, soils at the bridge site meet the "Competent Soil" requirements per SDC Section 6.2.2 (Caltrans, 2006b).



Spectral Coordinates of Recommended Curve

Period (sec)	Acc. (g)
0.010	0.700
0.020	0.697
0.030	0.696
0.050	0.953
0.075	1.228
0.100	1.470
0.120	1.590
0.150	1.637
0.170	1.636
0.200	1.631

Period (sec)	Acc. (g)
0.240	1.621
0.300	1.595
0.400	1.548
0.500	1.477
0.750	1.342
1.000	1.207
1.500	0.765
2.000	0.536
3.000	0.296
4.000	0.186

5.2 LIQUEFACTION

Based on the available boring information, the subject site has a low liquefaction potential due to absence of groundwater within the depths of interest.

5.3 SOIL CORROSIVITY

Three soil samples were tested for pH, minimum resistivity, soluble chloride content and soluble sulfate content. The test results are summarized in Table 5-2. Minimum resistivities ranged from 850 to 1,300 ohm-cm. The pH ranged from 7.4 to 8.0. The soluble sulfate ranged from 50 to 200 parts per million (ppm), and the soluble chloride ranged from 123 to 245 ppm.

TABLE 5-2. SOIL CORROSION TEST RESULTS

Boring	Station (Offset) / "Station Line"	Sample Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Soluble Sulfate Content (ppm)	Soluble Chloride Content (ppm)
A-08-010	505+67 (80RT) / "B" Line"	5	CL	1,300	8.0	100	123
A-08-012	507+94 (97RT) / "B" Line"	15	CL	850	7.4	50	245
A-08-013	510+43 (89RT) / "B" Line"	20	CL	1,050	7.8	200	238

Based on the Caltrans Corrosion Guidelines (2003), soils are considered corrosive if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm or greater. Based on the test results and the Caltrans criteria, the on-site soils are not considered to be corrosive to bare metals and concrete.

5.4 PILE FOUNDATION DESIGN

5.4.1 Foundation Type

The existing bridge is supported on 16-inch diameter Cast-In-Drilled-Hole (CIDH) piles. We recommend using the same pile type for the proposed widening except the diameters are 24 inches at the abutments and 30 inches at the bents.

5.4.2 Foundation Data Provided by Structural Designers

Per Caltrans policy, the Load and Resistant Factor Design (LRFD) method is used for bent piles and the Working Stress Design (WSD) is used for abutment piles. The foundation design data sheet and factored foundation loads were provided by the structural designers following the latest Caltrans Memo To Designers (Caltrans, 2008), and are shown in Table 5-3 and Table 5-4, respectively.

TABLE 5-3. FOUNDATION DESIGN DATA SHEET

Location	Design Method	Pile Type	Finished Grade El. (ft)	Pile Cut-off El. (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (inch)	Number of Piles per Support
					B	L		
Abutment 1	WSD	24" CIDH	243.5	+214.25/ +220.75	Var Max 24	Var Max 62	1	24
Bent 2	LRFD	30" CIDH	217.5	+209.75	11	17		6
Bent 3			217.5	+210.75	11	17		6
Bent 4			217.5	+211.75	11	17		6
Abutment 5	WSD	24" CIDH	241.3	+217.75/ +222.75	Var Max 11	Var Max 96		25

TABLE 5-4. FOUNDATION DESIGN LOADS

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Perma-nent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abutment 1	3550	270	2950	-	-	-	-	-	-	-	-
Bent 2	1140	190	760	1764	294	-	-	1500	380	-	60
Bent 3	1320	220	890	1974	329	-	-	1520	380	-	60
Bent 4	1380	230	960	2100	350	-	-	1420	380	-	60
Abutment 5	2650	200	1820	-	-	-	-	-	-	-	-

5.4.3 Axial Capacity

The abutment and bent foundations design recommendations are presented in Table 5-5 and Table 5-6, respectively. The Pile Data Table for the contract plans is presented in Table 5-7. The design pile tip elevation for the compression load case was based on skin friction only. The pile capacities are also based on soil resistance only and may be further limited by the pile-head connection details. The pile length is estimated using the more critical case between a single pile and pile group.

TABLE 5-5. ABUTMENT FOUNDATIONS DESIGN RECOMMENDATIONS

Support	Pile Type	Cut-Off Elev. (feet)	LRFD Service-I Limit State per Support (kips)		LRFD Service-I Limit State per Pile (kips)	Nominal Resistance (kips)	Design Tip Elev. (feet)[1]	Specified Tip Elev. (feet)[2]
			Total	Perma-nent				
Abut 1	24" CIDH	214.25/ 220.75	3550	2950	270	540	+170 (a) +198 (c) +179 (d)	+170
Abut 5		217.75/ 222.75	2650	1820	200	400	+180 (a) +205 (c) +183 (d)	+180

Notes:
1. Design tip elevation is controlled by the following demands: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for lateral and settlement.

TABLE 5-6. BENT FOUNDATION DESIGN RECOMMENDATIONS

Support Location	Pile Type	Cut-off El. (ft)	Required Factored Nominal Resistance (kips)				Design Tip El. (ft)	Specified Tip El. (ft)
			Strength Limit		Extreme Event			
			Comp. ($\phi = 0.7$)	Tension ($\phi = 0.7$)	Comp. ($\phi = 1$)	Tension ($\phi = 1$)		
Bent 2	30" CIDH	+209.75	294	0	380	60	+170 (a-I) +174 (a-II) +194 (b-II) +170 (c) +175 (d)	+170
Bent 3		+210.75	329	0	380	60	+160 (a-I) +173 (a-II) +187 (b-II) +171 (c) +176 (d)	+160
Bent 4		+211.75	350	0	380	60	+159 (a-I) +174 (a-II) +188 (b-II) +171 (c) +177 (d)	+159

Notes:
1. Design tip elevation is controlled by the following demands: (a-I) Compression (Strength Limit), (a-II) Compression (Extreme Event), (b-II) Tension (Extreme Event), (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for tension, lateral and tolerable settlement.

TABLE 5-7. PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)	Specified Tip El. (ft)
		Compression	Tension		
Abutment 1	24" CIDH	540	0	+170 (a) +198 (c) +179 (d)	+170
Bent 2	30" CIDH	420	60	+170 (a) +194 (b) +170 (c) +175 (d)	+170
Bent 3		470	60	+160 (a) +187 (b) +171 (c) +176 (d)	+160
Bent 4		500	60	+159 (a) +188 (b) +171 (c) +177 (d)	+159
Abutment 5	24" CIDH	400	0	+180 (a) +205 (c) +183 (d)	+180

Notes: Design tip elevations are controlled by: (a) Compression, (b) Tension, (c) Settlement, and (d) Lateral Load.

5.4.4 Lateral Resistance

Results of lateral pile analysis in terms of pile-head shear and lateral deflection for both free-head and fixed-head condition are presented in Table 5-8. The maximum bending moment and the location of maximum moment are also presented in Table 5-8. The solutions presented in Table 5-8 are entirely based on soil resistance and linear pile properties. Therefore, these values may be limited by the flexural strength (plastic moment) of the piles and other connection details. Linear interpolation can be used for solutions between pile-head deflections of 0.25 and 6 inches.

In addition to lateral resistance from the piles, the passive resistance for the pile cap can be simplified as a bi-linear (elastic-perfectly plastic) curve. The maximum pressure is 3.8 ksf at a displacement of 0.05H (where H is the pile cap thickness).

5.5 EMBANKMENTS AND SETTLEMENT

Settlement. About 26 feet of sliver fill will be placed to construct the approach embankments. Based on the onsite soil type, ground subsidence is estimated to be on the order of 2.2 inches. Due to the presence of a sandy lean clay layer immediately below the existing Placentia Avenue ground surface, we recommend a settlement period of at least 14 calendar days for pile installation at the abutments only.

TABLE 5-8. LATERAL PILE SOLUTIONS

Lateral Displacement at Top of Pile (in)	Fixed Head		Free Head		
	Lateral Load at Top of Pile (kips)	Max. Bending Moment* (kip-in)	Lateral Load at Top of Pile (kips)	Max. Bending Moment (kip-in)	Depth from Pile Head to Max. Moment (ft)
Abutment 1 – 24" CIDH					
0.25	58.6	2637	30.1	1005	5.6
0.5	84.6	4260	43.1	1615	6.4
1	122.2	6881	62.0	2611	7.0
2	177.9	11217	89.4	4236	8.0
3	220.9	15064	109.9	5622	8.4
4	253.3	18491	124.8	6856	9.0
6	305.8	24576	146.6	9030	9.6
Bent 2 – 30" CIDH					
0.25	64.8	4140	28.5	1596	7.4
0.5	98.3	6783	44.5	2604	8.0
1	148.2	11074	69.0	4240	8.8
2	218.8	18011	103.5	6881	9.8
3	272.3	23909	128.6	9113	10.4
4	314.8	29124	149.4	11131	11.0
6	375.6	37841	181.3	14726	11.8
Bents 3 and 4 – 30" CIDH					
0.25	40.4	2818	20.3	1075	8.8
0.5	59.3	4641	29.2	1727	9.8
1	88.1	7729	42.1	2804	11.0
2	131.3	12827	61.6	4648	12.4
3	167.0	17376	77.2	6303	13.2
4	199.1	21669	90.9	7850	14.0
6	257.3	29802	114.3	10677	15.2
Abutment 5 – 24" CIDH					
0.25	69.1	2938	35.5	1121	5.4
0.5	99.5	4735	50.9	1805	6.0
1	143.4	7640	73.0	2910	6.8
2	207.3	12353	104.9	4695	7.6
3	253.9	16309	128.9	6222	8.0
4	286.2	19646	146.3	7589	8.4
6	334.3	25283	171.6	9979	9.2

* maximum beding moment at pile top.

Slope Stability. Global stability analyses were conducted using the computer program PCSTABL (Achilleos, 1988) for both static and pseudostatic conditions for the bridge end slopes. Results of this analysis are presented in Appendix C.

The factor of safety for a deep-seated failure is greater than 1.5 under static condition for the 1V:1.5H end slope with a 2-foot soil surcharge to represent traffic loading. Slope stability analysis under pseudostatic condition was performed using a seismic coefficient equal to 0.2g (which is the smaller of either one-third the horizontal peak ground acceleration or 0.2g) in accordance with guidelines provided in Section 3.12 of the Caltrans Guidelines for Foundation Investigations and Reports (Caltrans, 2006a). Analysis indicates that the factor of safety is greater than 1.1 under pseudostatic condition. The 1V:1.5H end slope has proposed concrete slope paving, therefore surficial stability is not a design issue.

Structural Approach Slab. Per Caltrans Memo to Designers 5-3 dated December 1992, structure approach slabs are required for this project. Selection of the approach type will be performed by the structurral designer following the flowchart in Caltrans Memo to Designers 5-3, Attachment A dated May 1996.

5.6 BRIDGE ABUTMENT WALL DESIGN

Abutment Earth Pressures. If abutment walls are free to move laterally at the top, a static active lateral earth pressure of 36 psf per foot of depth is recommended for a free draining, level and compacted backfill. If lateral movement at the top of abutment walls is restrained, the lateral earth pressure for a free draining, level and compacted backfill should follow Section 5.5.5.11 of the Caltrans BDS dated August 2004. For this condition, we recommend a coefficient of active lateral earth pressure of 0.3, a coefficient of at-rest lateral earth pressure of 0.47 and a soil unit weight of 120 lb/ft^3. If applicable, a uniform lateral pressure of at least 72 psf due to vehicle loads, equivalent to a vertical pressure produced by at least 2 feet of earth, should be added to the above lateral earth pressure.

Passive Resistance of Abutment Backfill. Under seismic loading, an ultimate passive earth pressure of 5 ksf may be used for the approach backfill and abutment walls with a height equal to or greater than 5.5 feet. For abutment walls with heights less than 5.5 feet, the passive pressure may be calculated proportionally (e.g., for a 4-foot high wall, the passive pressure is [4/5.5]x 5 ksf = 3.64 ksf. The horizontal movement at which the maximum passive pressure is expected to be fully mobilized can be determined following the procedure outlined in Section 7.8.1 of the Caltrans SDC (2006b).

Abutment Wingwall. The abutments are adjacent to RW 496 and 512. Both abutment wingwalls are relatively narrow and only extend to the end of the abutment pile caps; two wingwalls sit on the abutment pile caps as a part of the abutment design. Design of RW 496 and 512 is in a separate report.

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 EARTHWORK

Earthwork should be performed in accordance with Caltrans Standard Specifications, Section 19 (Caltrans, 2006c). Appropriate measures should be taken to prevent damage to adjacent structures and utilities. Any design and construction of temporary sloping, sheeting, or shoring should be made the contractor's responsibility. It should be noted that it is the responsibility of the contractor to oversee the safety of the workers in the field during construction. The contractor shall conform to all applicable occupational and health standards, rules, regulations, and orders established by the State of California. In addition, other State, County, or Municipal regulations may supersede the recommendations presented in this section. If a trench shoring design and safety plan is required, the geotechnical consultant should review the plan to confirm that recommendations presented in this report have been applied to the design.

During the recent field investigation conducted on September 26 and 30, 2008, groundwater was not encountered down to El. +137 feet which is more than 100 feet from the freeway surface. As shown on the as-built LOTB sheet in Appendix A, groundwater was not encountered during drilling in November 1965 and April 1966 down to El. +173 feet. Therefore, groundwater is not expected to be encountered during footing construction. However, groundwater level can fluctuate due to seasonal rainfall amount, local irrigation and groundwater recharge program and other man-made conditions. If groundwater is encountered, it should be controlled in accordance with Section 19-3.04 of the Caltrans Standard Specifications (2006c).

6.2 PILE CONSTRUCTION

For on-center pile spacings less than six times the pile diameter, no two adjacent piles can be constructed concurrently.

Loose soils should be cleaned from the bottom of the borings. Pile borings should be inspected and approved by the geotechnical engineer prior to the installation of reinforcement. Extreme care in drilling, placement of steel, and the pouring of concrete is essential to avoid excessive disturbance of pile boring walls. Concrete placement by pumping or tremie tube to the bottom of the pile borings is recommended. Specifications should require that sufficient space be provided in the pile reinforcing cage during fabrication to allow the insertion of a tremie tube for concrete placement. The pile reinforcing cage should be installed and the concrete pumped immediately after drilling is completed.

Sand was encountered in our soil borings and these materials are susceptible to caving. If caving occurs, a temporary casing may be required during construction. Temporary casings should have an inner diameter equal to or exceeding the pile diameter. Oversized predrilling and vibratory hammers are not allowed for temporary casing installation. The temporary casing should be pulled as the concrete is being poured while always maintaining at least a 5-foot head of concrete inside the casing.

In the event that any boring becomes bell-shaped and cannot be advanced due to severe caving, all loose material should be removed from the bottom of the boring and the caved region filled with a low strength sand-cement slurry. Drilling may continue when the slurry has reached its initial set.

6.3 BACKDRAIN AND BACKFILL REQUIREMENTS FOR ABUTMENT WALLS

Per Caltrans requirements, expansive soils should not be placed as part of the embankment within the limits of a bridge abutment as shown in Figure 6-1. Materials placed behind abutment wall should be low-expansive soil with an Expansion Index (EI) less than 50 and Sand Equivalent (SE) of more than 20. The low-expansive material requirement should be supplemental to the abutment structure and pervious backfill requirement as described in Caltrans Standard Plans (2006d) and Caltrans Standard Specifications (2006c) under Sections 19-3.06 and 19-3.065, respectively.

Backfill should be compacted in accordance with Section 19-5 of the Caltrans Standard Specifications (2006c). Backfill should be placed in loose lifts not exceeding 8 inches in thickness, moisture-conditioned to near optimum moisture content, and compacted to at least 95 percent relative compaction. The relative compaction should be based on the maximum density determined by California Test 216. Jetting or flooding to compact backfill is not recommended. Heavy compaction equipment, such as vibratory rollers, dozers, or loaders, should not be used adjacent to the abutment walls in order to avoid damaging the walls due to large lateral earth pressures.

Backdrains should be installed behind abutment walls to relieve hydrostatic pressure. Backdrains should be constructed in accordance with Bridge Detail 3-1 on Sheet BO-3 per Caltrans Standard Plans (2006d) or the geocomposite drain alternative per Section 6 of the Caltrans Bridge Design Aids (1992).

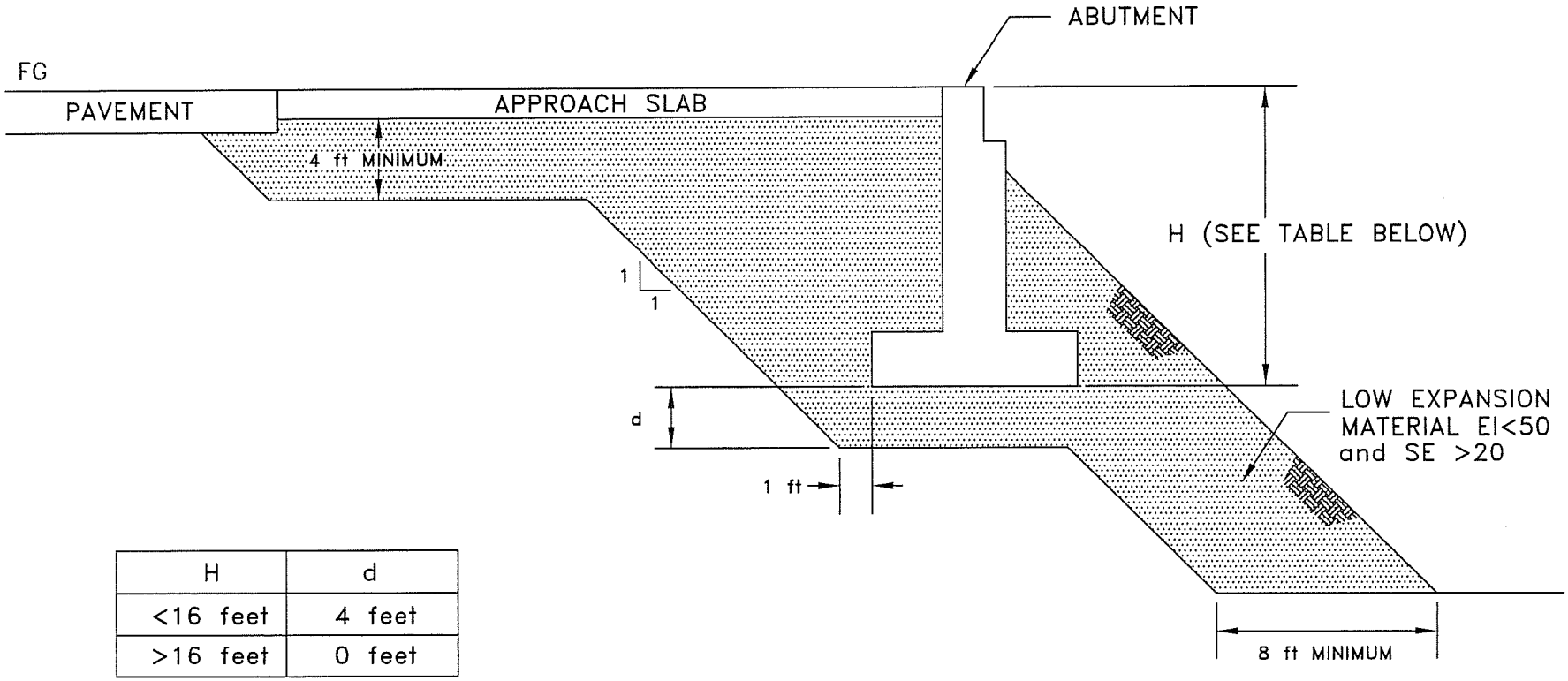
6.4 REVIEW OF CONSTRUCTION PLANS

Recommendations contained in this report are based on preliminary plans. The geotechnical consultant should review the final construction plans and specifications in order to confirm that the general intent of the recommendations contained in this report have been incorporated into the final construction documents. Recommendations contained in this report may require modification or additional recommendations may be necessary based on the final design.

6.5 GEOTECHNICAL OBSERVATION AND TESTING

It is recommended that inspections and testing be performed by the geotechnical consultant during the following stages of construction:

- Grading operations, including excavations and placement of compacted fill
- Shoring installation
- Footing excavations
- Pile installation
- Backdrain installation and backfilling of bridge abutment walls.
- Removal or installation of support of buried utilities or structures
- When any unusual subsurface conditions are encountered



H	d
<16 feet	4 feet
>16 feet	0 feet

EXPANSION INDEX TO BE DETERMINED BY ASTM D4829
SAND EQUIVALENT TO BE DETERMINED
BY CALIFORNIA TEST METHOD 217

NO SCALE

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

PLACENTIA AVENUE UC (WIDEN)

EMI Project No. 08-115 | Date: 01-19-2009

LOW EXPANSION MATERIAL
IN BRIDGE EMBANKMENT

FIGURE 6-1

7.0 LIMITATIONS

This report is intended for the use of RBF Consulting, Orange County Transportation Authority and Caltrans for the widening of Placentia Avenue Undercrossing. This report is based on the project as described and the information obtained from the exploratory borings at the approximate locations indicated on the attached plans. The findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses. In addition, soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project site. However, subsurface conditions and characteristics of soils between exploratory borings can vary. The findings reflect an interpretation of the direct evidence obtained. The recommendations presented in this report are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained in this report are applicable to the specific design element(s) and location(s) which is (are) the subject of this report. They have no applicability to any other design elements or to any other locations and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

EMI has no responsibility for construction means, methods, techniques, sequences, or procedures; for safety precautions or programs in connection with the construction; for the acts or omissions of the CONTRACTOR or any other person performing any of the construction; or for the failure of any worker to carry out the construction in accordance with the Final Construction Drawings and Specifications.

Services performed by EMI have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

8.0 REFERENCES

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APPENDIX A

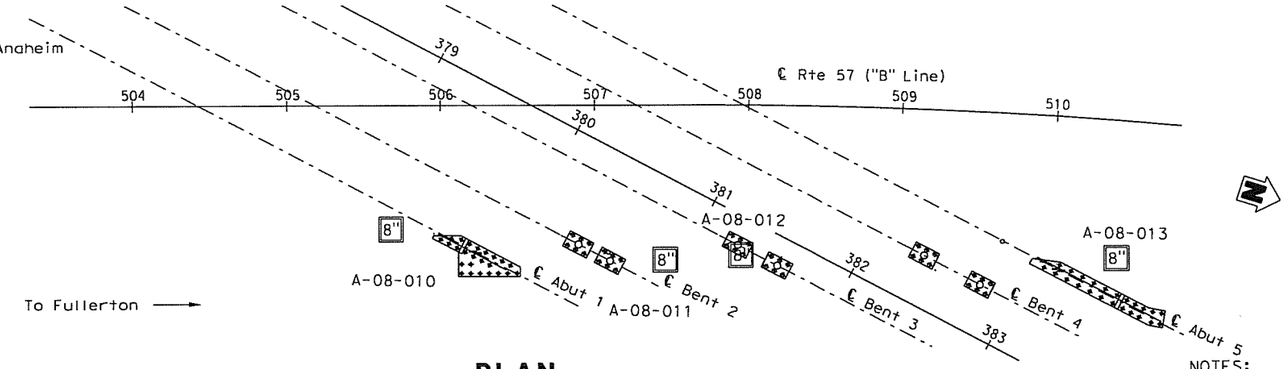
LOG OF TEST BORINGS SHEETS AND AS-BUILT LOG OF TEST BORINGS SHEET

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN

1" = 50'

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Tina Cheang
REGISTERED ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER L. CHEANG NO. GE 2345 EXP. 9-30-09 GEOTECHNICAL STATE OF CALIFORNIA

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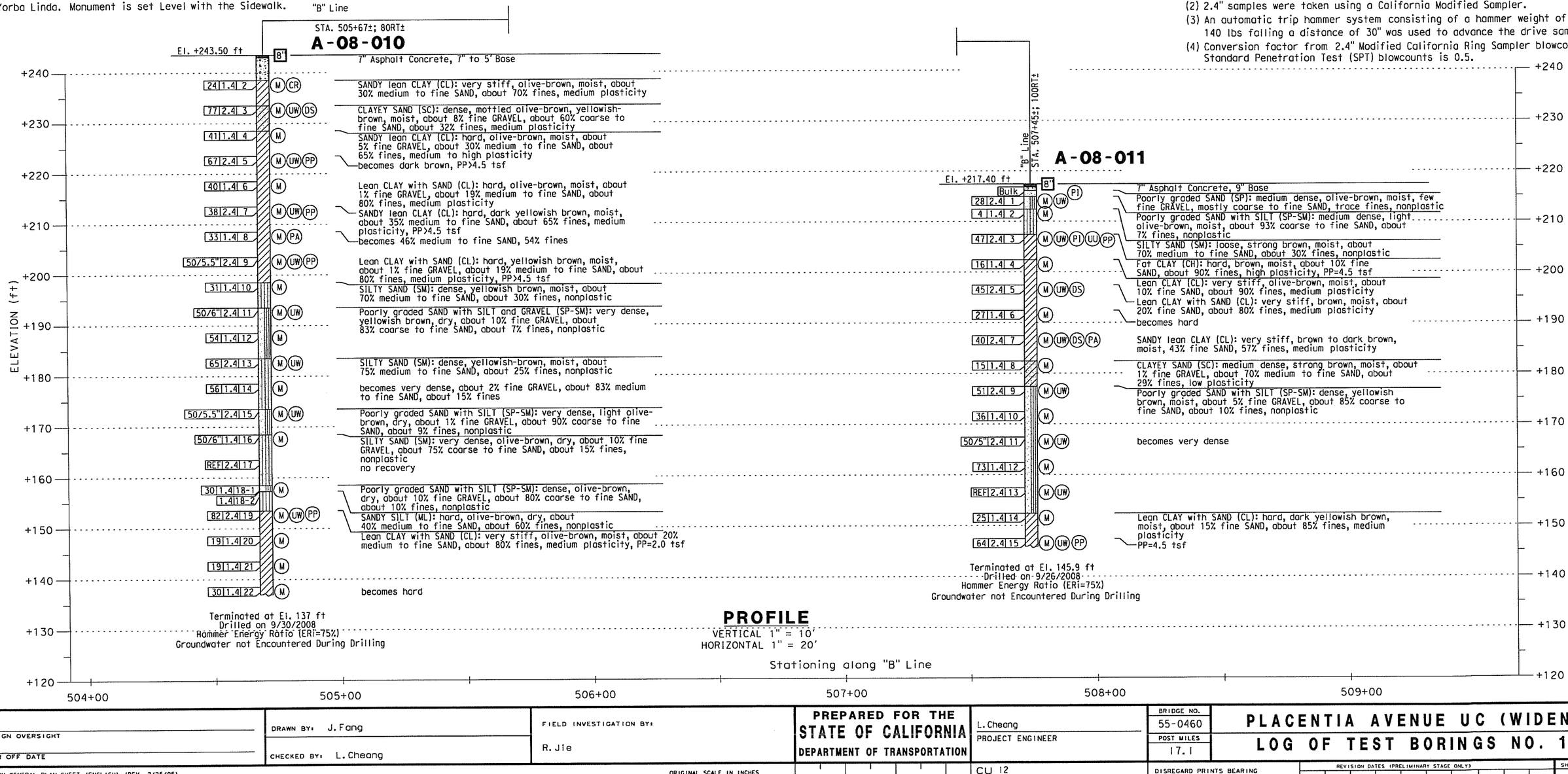
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:
(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE

VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0460
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 17.1

PLACENTIA AVENUE UC (WIDEN)

LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET OF

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DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lina Cheang
REGISTERED ENGINEER — DATE

L. CHEANG NO. GE 2345 EXP. 9-30-09 REGISTERED PROFESSIONAL ENGINEER GEOTECHNICAL STATE OF CALIFORNIA

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17660 NEWHOPE STREET, SUITE E
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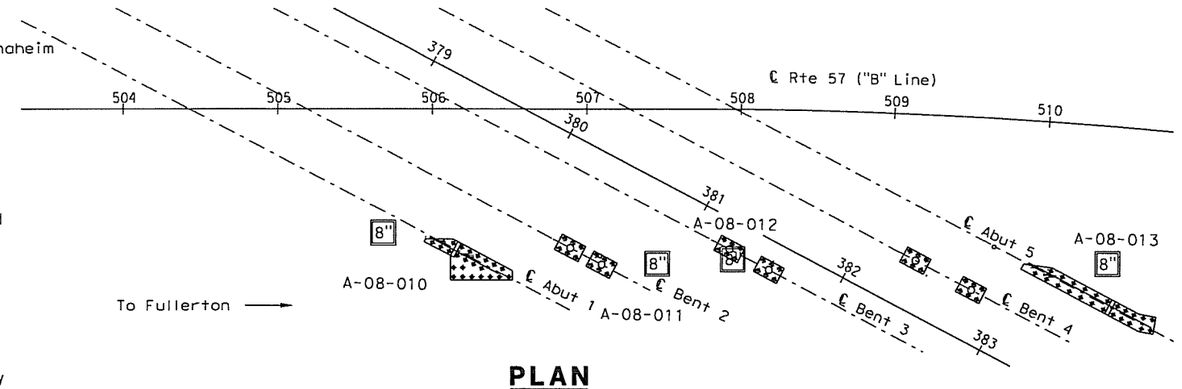

PLAN
1" = 50'

NOTES:
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(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
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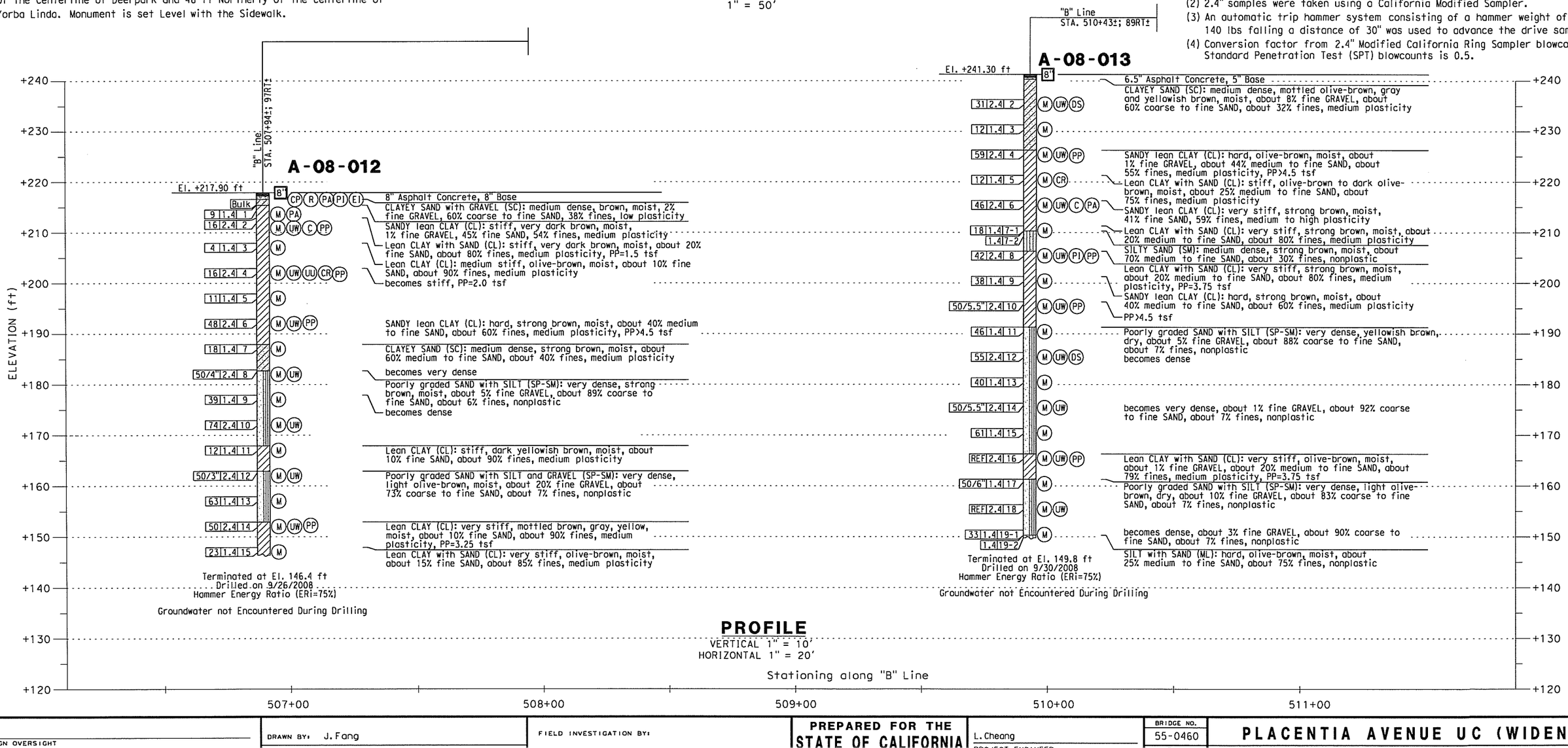

PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0460	PLACENTIA AVENUE UC (WIDEN)	
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 17.1	LOG OF TEST BORINGS NO. 2	

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05) — ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3 — CU 12 EA 0F031I — DISREGARD PRINTS BEARING EARLIER REVISION DATES → — REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09 — SHEET OF

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REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lina Cheang
REGISTERED ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

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OCTA
550 S MAIN STREET
ORANGE, CA 92868

EARTH MECHANICS, INC.
17660, NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
	D	Dynamic Cone Penetration Boring
	CPT	Cone Penetration Test (ASTM D 5778-95)
	O	Other

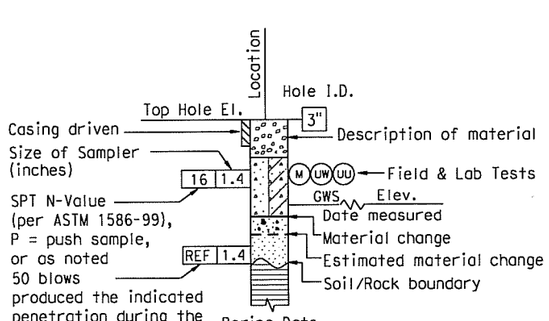
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

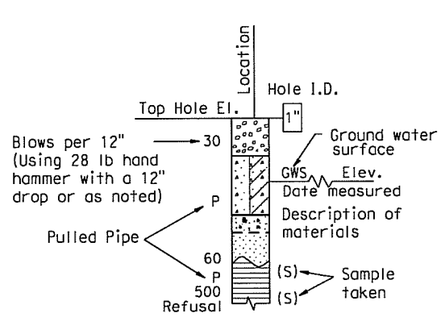
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

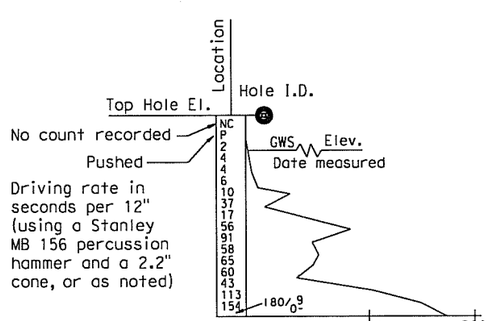
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



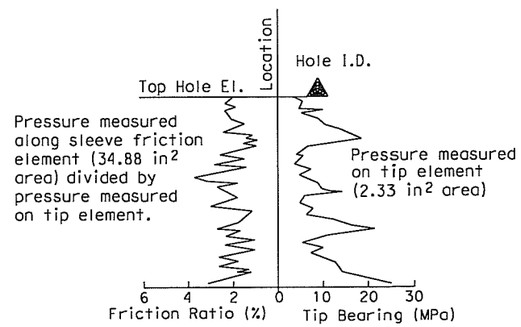
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

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SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 17.1	LOG OF TEST BORINGS NO. 3
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			CU 12 EA 0F031I	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) — SHEET — OF

DATE PLOTTED => $DATE TIME PLOTTED => $TIME
USERNAME => $USER

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166)
Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lino Cheang
REGISTERED ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

OCTA
550 S MAIN STREET
ORANGE, CA 92868

EARTH MECHANICS, INC.
17660, NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

L. Cheang
PROJECT ENGINEER

BRIDGE NO. 55-0460
POST MILES 17.1

PLACENTIA AVENUE UC (WIDEN)
LOG OF TEST BORINGS NO. 4

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST.	COUNTY	ROUTE	POST MILES	TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6			

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

Lino Cheang
REGISTERED CIVIL ENGINEER — DATE

PLACENTIA AVENUE UC (WIDEN)

AS-BUILT LOG OF TEST BORINGS

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No. 55-0460

Sheet 42 of 42

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

LEGEND OF SUBSURFACE OPERATIONS

- Penetrometer
- 2½" Cone Penetrometer
- Sampler boring (drv)
- Rotary boring (drv)
- Auger boring (drv)
- Jet boring
- Core boring
- Test pit

LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Silty Clay or Clayey Silt
- Peat and/or Organic Matter
- Fill Material
- Igneous Rock
- Sandy Clay or Clayey Sand
- Sandy Silt or Silty Sand
- Sedimentary Rock
- Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

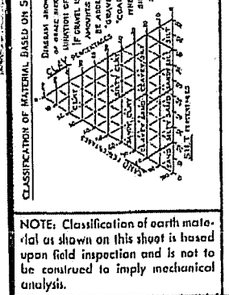


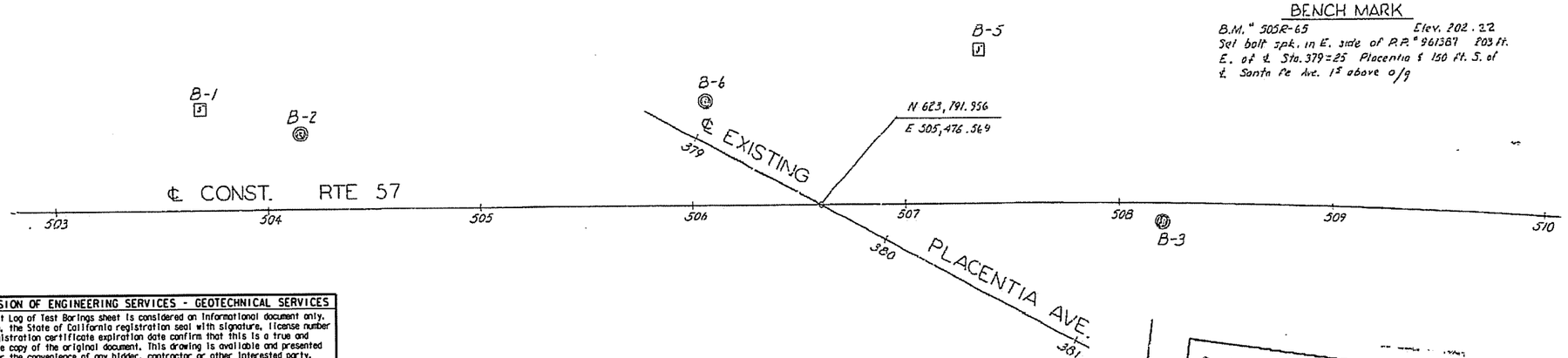
DIAGRAM SHOWING THE BASIS FOR ESTIMATES OF PERCENTAGES OF MATERIAL AS USED IN DESCRIPTION OF CLASS SHAPES.

IF GRAVEL IS PRESENT IN APPRECIABLE QUANTITY THE TERM "GRAVELLY" MAY BE ADDED TO ANY OF THE ABOVE CLASS NAMES. THE TERMS "COARSE", "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE SAND, SILT OR GRAVEL REFER TO STANDARD GRAIN SIZE LIMITS.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BENCH MARK

B.M. " 505R-65 Elev. 202.22
Set bolt spk. in E. side of P.P. " 961387 203 ft. E. of ℄ Sta. 379+25 Placentia ℄ 150 ft. S. of ℄ Santa Fe Ave. 1' above o/g

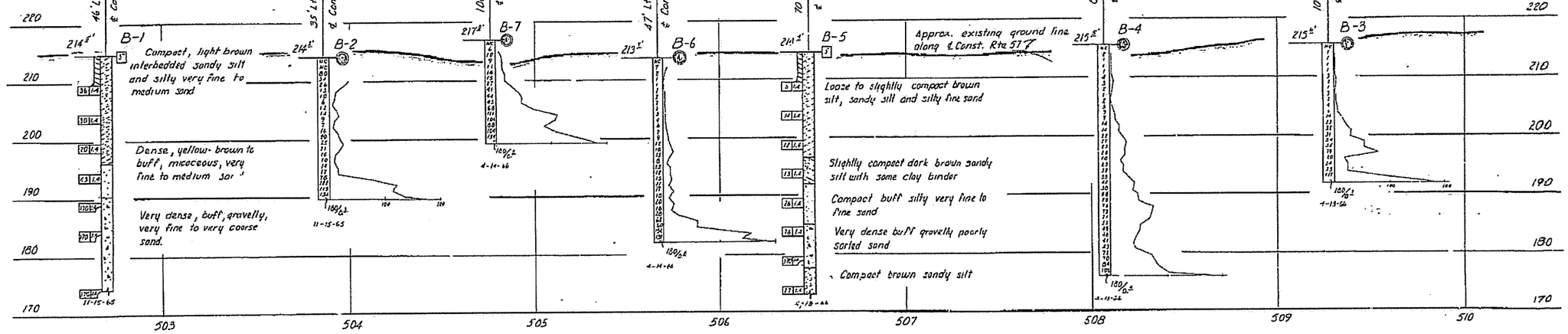


PLAN
Scale 1"=30'

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE April 1966

AS BUILT
CORRECTIONS BY Hixson dtd 7-29-69
CONTRACT NO. 07-032124
DATE 5-11-69



PROFILE
Scale Vert. 1"= 10'
Horiz. 1"= 30'

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PLACENTIA AVENUE UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-460 | FILE | DRAWING 55460-2

Discard prints bearing earlier numbers → PREL. DRAWING No. PR-

DRAWN	M. ALLREAD	4-20-65
CHECKED	W. CAIN	5-10-65

Approved for Recommendation by: Chief, Bridge Department

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

173

Charge 07208

SHEET	OF
26	26

DIST.	COUNTY	ROUTE	POST MILES	PHASE	Sheet No.	Total Sheets
07	ORA	57	15.6/18.1	1	173	197

7 CALIF.

APPENDIX B

LABORATORY TEST RESULTS

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Expansion Index	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-010	S-2	5	CL	10.5							1300	8.0	100	123
A-08-010	D-3	10	SC	9.6	133.2									
A-08-010	S-4	15	CL	11.3										
A-08-010	D-5	20	CL	11.3	134.6	>4.5								
A-08-010	S-6	25	CL	10.9										
A-08-010	D-7	30	CL	8.2	121.8	>4.5								
A-08-010	S-8	35	CL	7.2				0:46:54						
A-08-010	D-9	40	CL	9.2	127.4	>4.5								
A-08-010	S-10	45	SM	3.1										
A-08-010	D-11	50	SP-SM	0.9	128.8									
A-08-010	S-12	55	SP-SM	1.1										
A-08-010	D-13	60	SM	5.6	119.3									
A-08-010	S-14	65	SM	1.7										
A-08-010	D-15	70	SP-SM	0.9	118.6									
A-08-010	S-16	75	SM	1.3										
A-08-010	S-18	85	SP-SM	2.9										
A-08-010	D-19	90	CL	16.4	132.7	2.0								
A-08-010	S-20	95	CL	24.1										
A-08-010	S-21	100	CL	22.7										
A-08-010	S-22	105	CL	17.7										
A-08-011	BULK	1.5-5	SP							Non-Plastic				
A-08-011	D-1	2.5	SP-SM	4.2	117.9									
A-08-011	S-2	5	SM	11.1										
A-08-011	D-3	10	CH	27.1	116.6	4.5				66/28/38				
A-08-011	S-4	15	CL	30.8										
A-08-011	D-5	20	CL	19.5	122.3									
A-08-011	S-6	25	CL	12.7										
A-08-011	D-7	30	CL	12.5	135.5			0:43:57						
A-08-011	S-8	35	SC	6.9										
A-08-011	D-9	40	SP-SM	3.6	122.7									
A-08-011	S-10	45	SP-SM	6.6										
A-08-011	D-11	50	SP-SM	6.2	121.8									
A-08-011	S-12	55	SP-SM	4.5										
A-08-011	D-13	60	SP-SM	5.0	121.7									
A-08-011	S-14	65	CL	18.0										
A-08-011	D-15	70	CL	18.4	131.2	4.5								

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

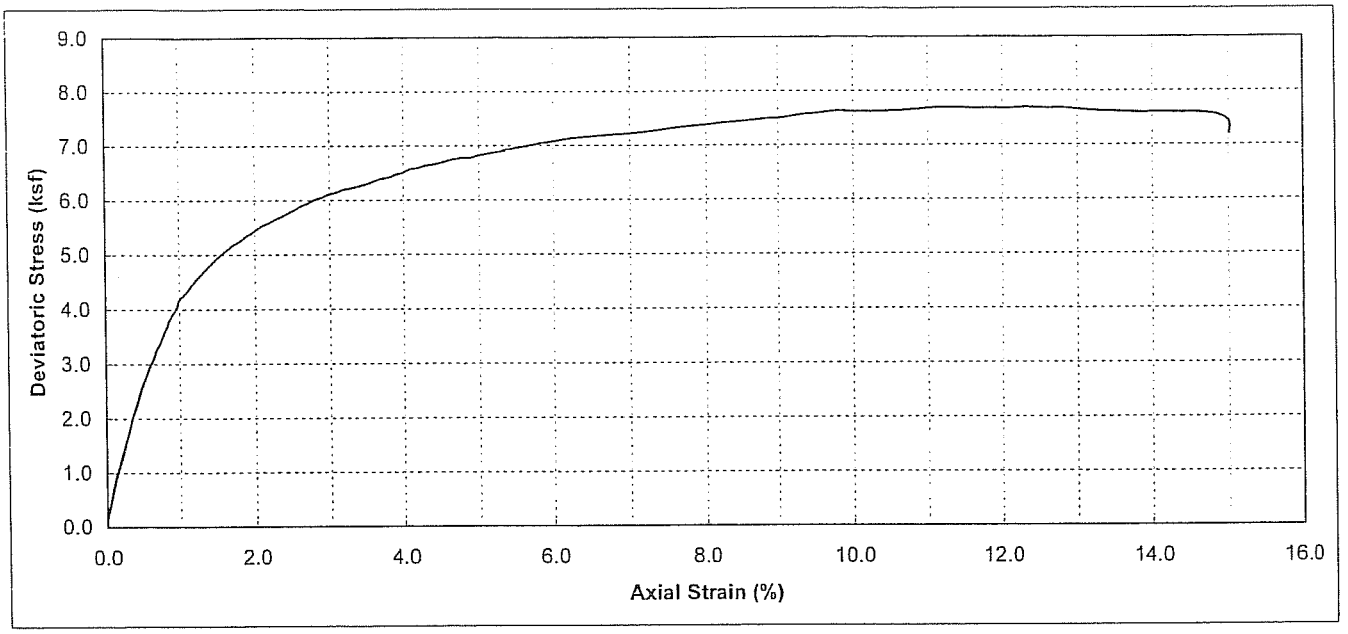
Project No. : 08-115 Project Name : RBF/SR-57 Northbound

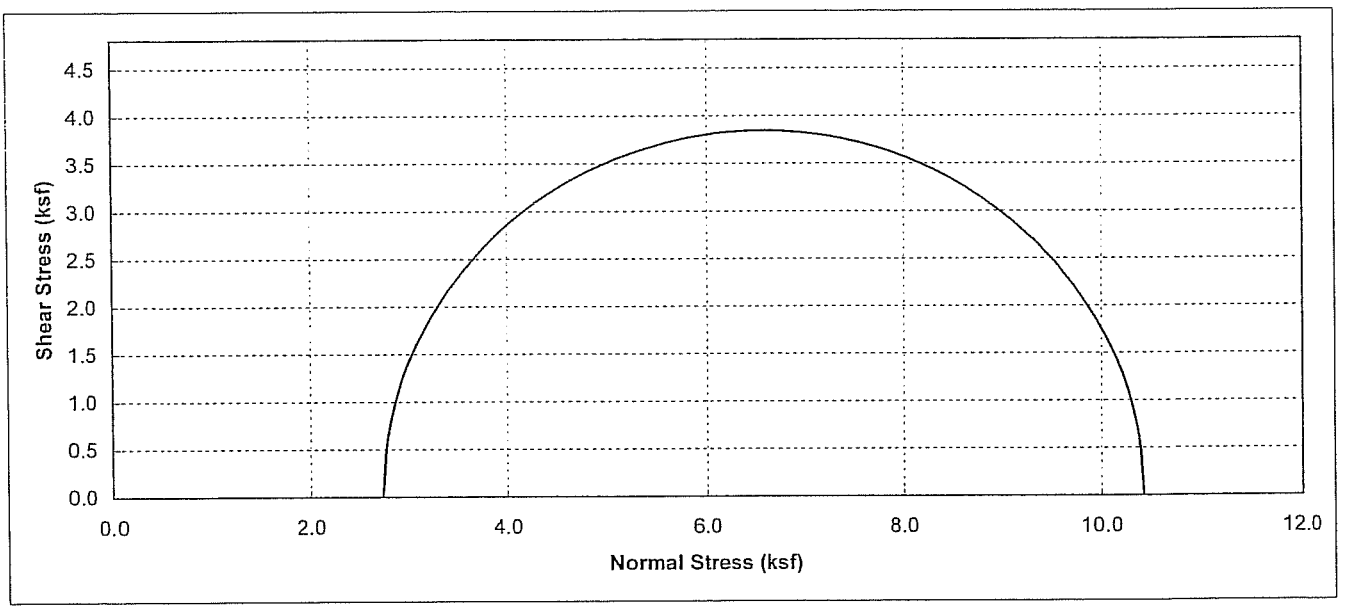
Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Expansion Index	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-012	BULK	1.5-5	SC				19			30/14/16				
A-08-012	S-1	2.5	CL	15.4				1:45:54						
A-08-012	D-2	5	CL	22.4	124.8	1.5								
A-08-012	S-3	10	CL	30.4										
A-08-012	D-4	15	CL	36.7	112.8	2.0					850	7.4	50	245
A-08-012	S-5	20	CL	34.4										
A-08-012	D-6	25	CL	14.0	134.5	>4.5								
A-08-012	S-7	30	SC	14.9										
A-08-012	D-8	35	SP-SM	5.6	119.2									
A-08-012	S-9	40	SP-SM	9.9										
A-08-012	D-10	45	SP-SM	4.7	116.1									
A-08-012	S-11	50	CL	26.4										
A-08-012	D-12	55	SP-SM	2.1	128.7									
A-08-012	S-13	60	SP-SM	5.4										
A-08-012	D-14	65	CL	34.5	115.3	3.25								
A-08-012	S-15	70	CL	19.7										
A-08-013	D-2	5	SC	16.4	125.9									
A-08-013	S-3	10	SC	14.2										
A-08-013	D-4	15	CL	16.4	129.6	>4.5								
A-08-013	S-5	20	CL	16.2							1050	7.8	200	238
A-08-013	D-6	25	CL	15.3	133.4			0:41:59						
A-08-013	S-7	30	CL	22.0										
A-08-013	D-8	35	CL	22.1	121.2	3.75				38/22/16				
A-08-013	S-9	40	CL	14.8										
A-08-013	D-10	45	CL to SC	9.4	137.0	>4.5								
A-08-013	S-11	50	SP-SM	2.0										
A-08-013	D-12	55	SP-SM	1.3	113.6									
A-08-013	S-13	60	SP-SM	8.0										
A-08-013	D-14	65	SP-SM	2.0	104.9									
A-08-013	S-15	70	SP-SM	1.8										
A-08-013	D-16	75	CL	24.7	116.8	3.75								
A-08-013	S-17	80	SP-SM	2.2										
A-08-013	D-18	85	SP-SM	2.9										
A-08-013	S-19-1	90	SP-SM	2.3										
A-08-013	S-19-2	91	ML	23.6										

TABLE 2 SUMMARY OF LABORATORY STRENGTH TEST RESULTS

Project No. : 08-115 **Project Name :** RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth	Soil Identification (group symbol) ASTM D2488/D2487	Unconsolidated Undrained Triaxial Test (ASTM D2850)				Direct Shear Test (ASTM D3080)			
								Peak		Residual	
				Peak Strength S_u	Strain at Peak S_u	Shear Strength at 10% Strain S_u	Confining Pressure	ϕ	C	ϕ	C
		(ft)		(ksf)	(%)	(ksf)	(ksf)	(deg)	(ksf)	(deg)	(ksf)
A-08-010	D-3	10	SC					69.44	1.44	47.7	0.01
A-08-011	D-3	10	CH	4.23	8.55	3.45	0.86				
A-08-011	D-5	20	CL					43.07	1.99	35.59	0.19
A-08-011	D-7	30	CL					27.55	2.15	34.59	0.25
A-08-012	D-4	15	CL	1.27	14.88	1.125	1.15				
A-08-013	D-2	5	SC					28.75	0.71	31.54	0.16
A-08-013	D-12	55	SP-SM					36.72	0.49	34.46	0.06





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-009	D-8	35	Dark Brown,LEAN CLAY With SAND (CL)	105.7	16.60	2.73	7.69	75.4

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

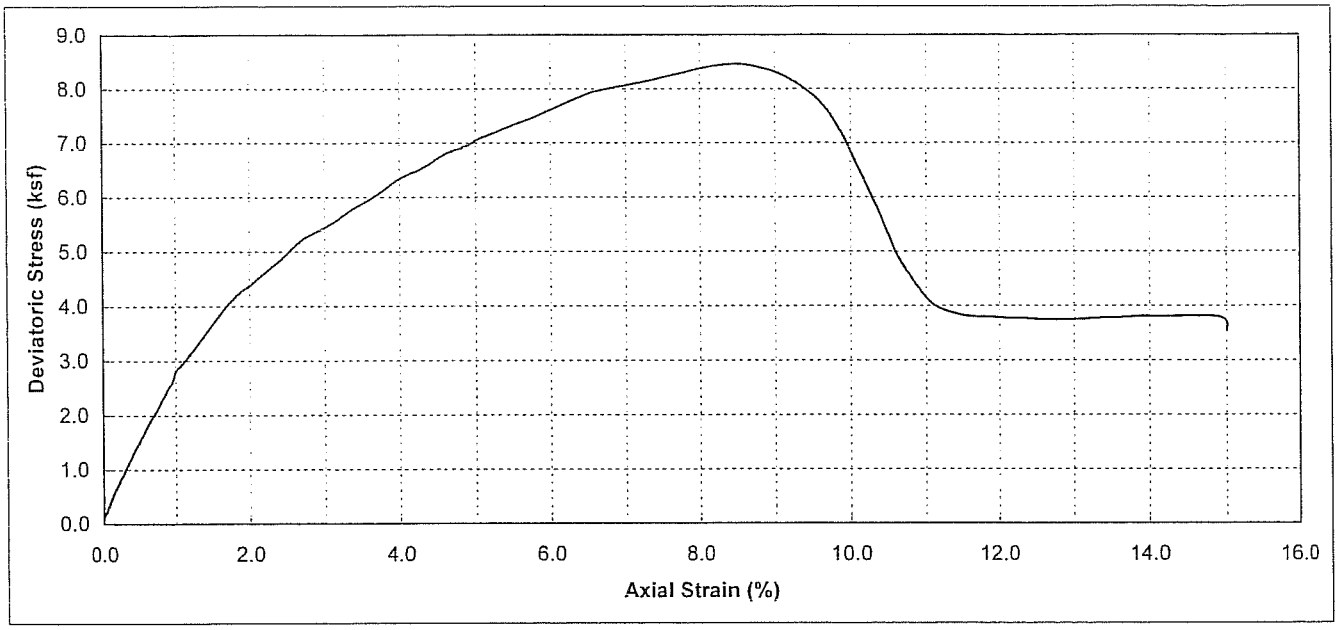
RBF/SR-57 Northbound

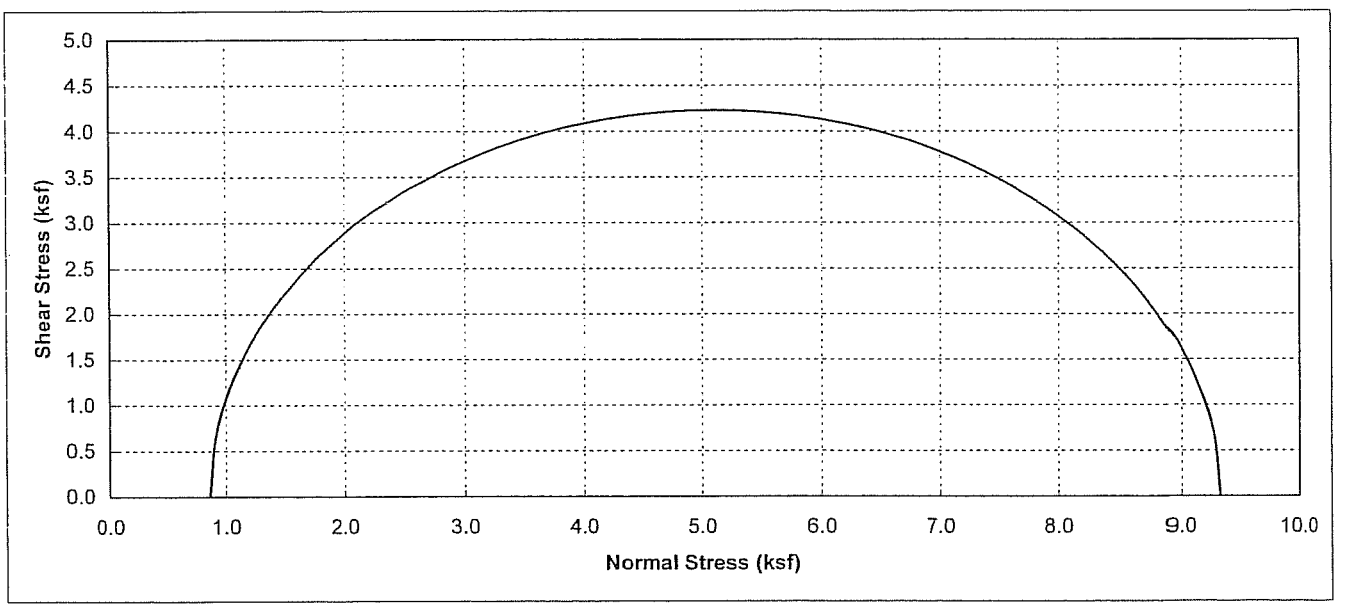
UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/15/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-011	D-3	10	Brown, FAT CLAY (CH)	91.6	27.09	0.86	8.46	87.2

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

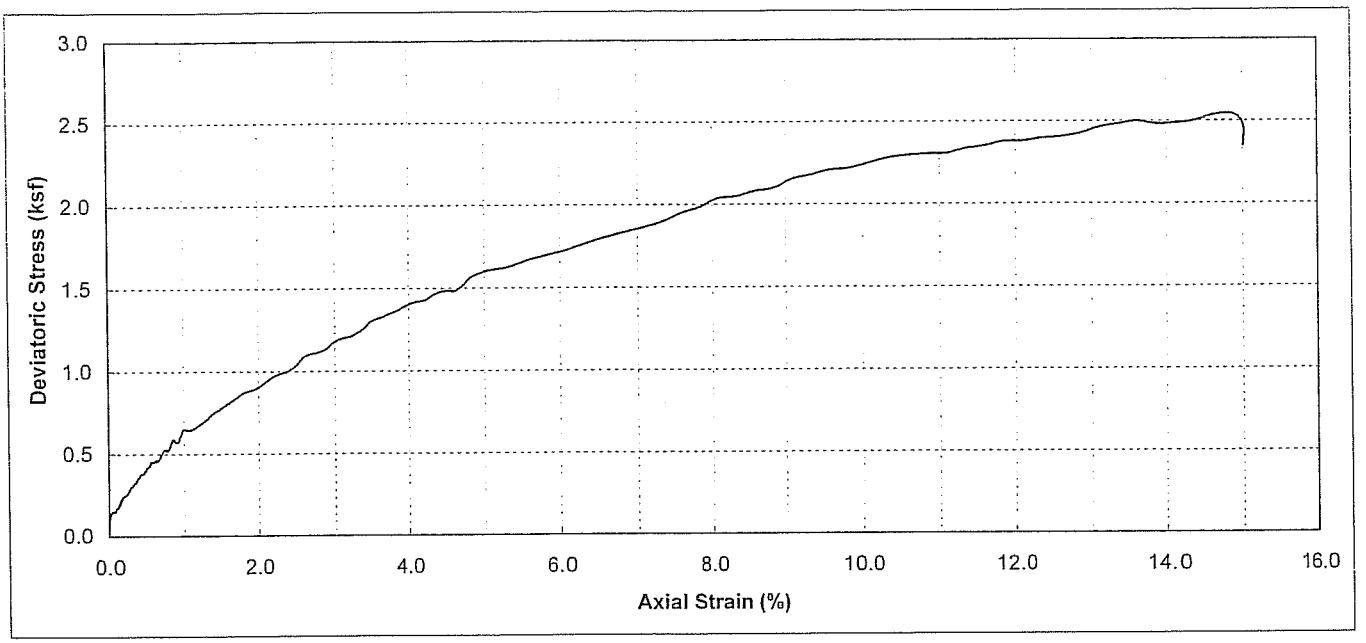
RBF/SR-57 Northbound

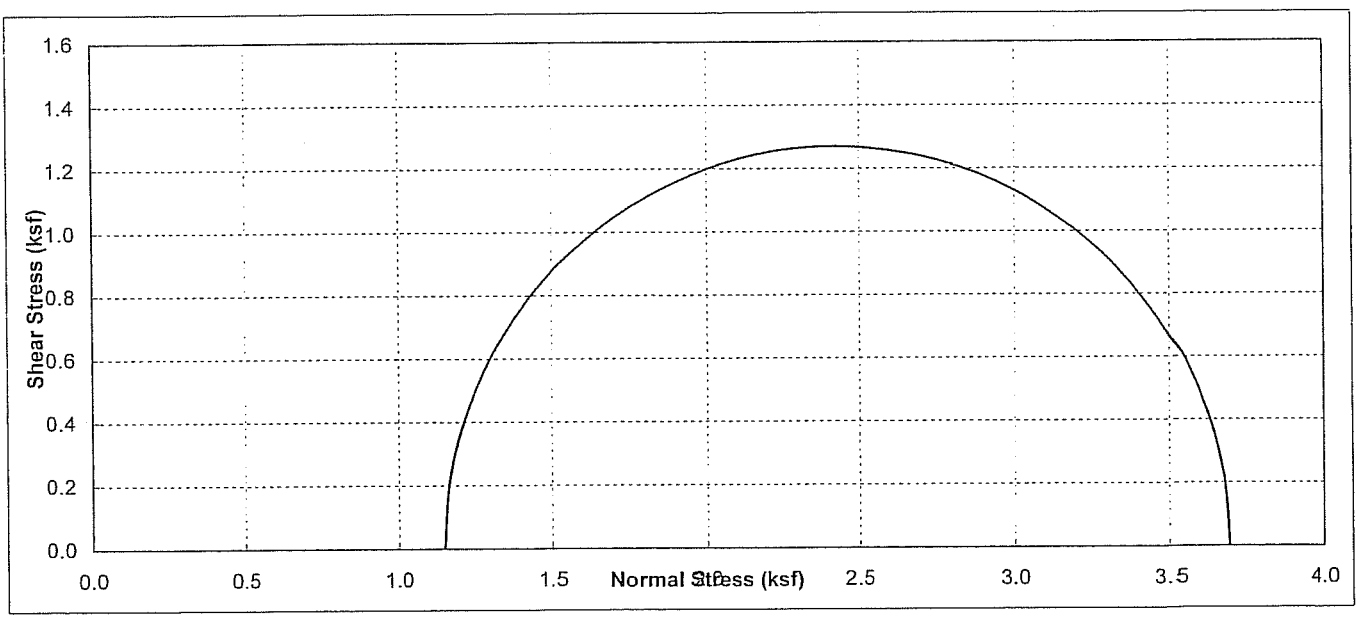
UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/15/08

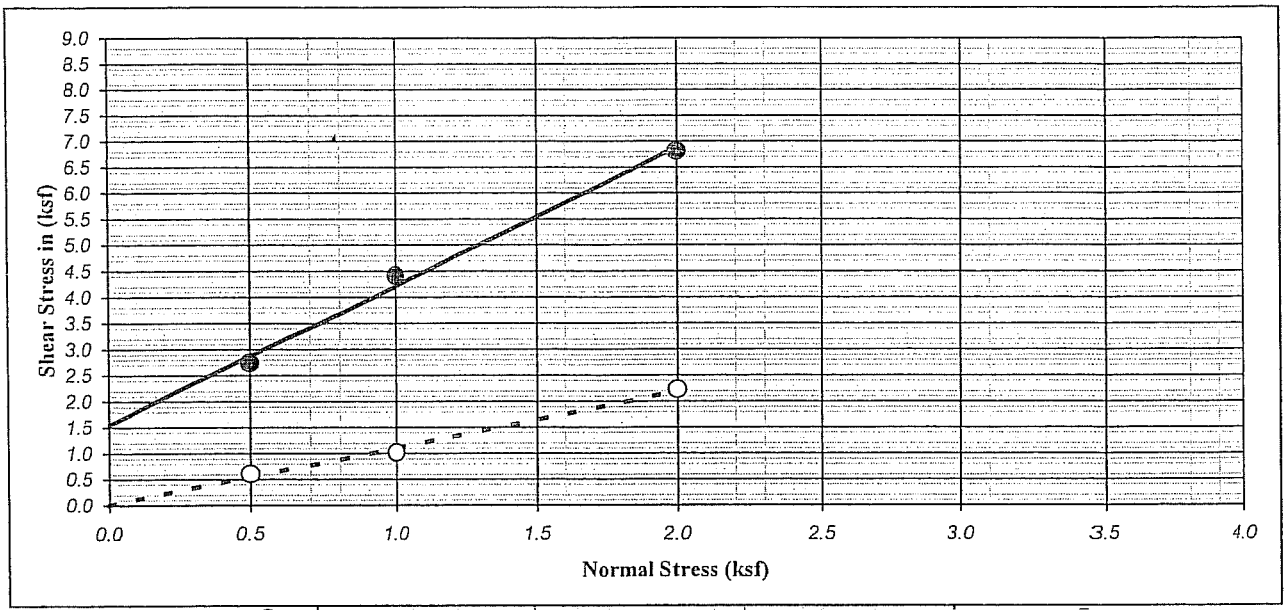
Figure No. :



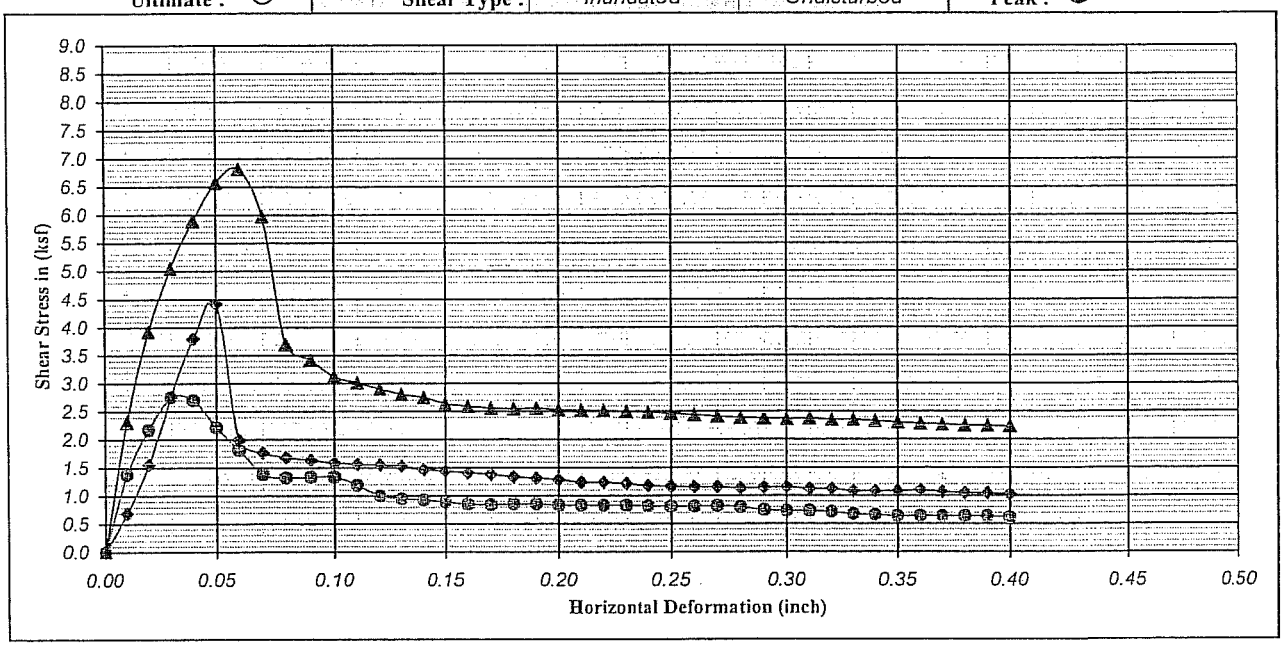


Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-012	D-4	15	Brown, LEAN CLAY (CL)	82.6	36.67	1.15	2.54	95.2

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound
	UNCONSOLIDATED UNDRAINED TEST
Project No. : 08-115 Date : 11/15/08	(ASTM D2850) Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No.	: A-08-010	Strength Intercept (C) :	1.55	(ksf)	Peak	0.01	(ksf)	Ultimate	
Sample No.	: D-3		74.14	(kPa)		0.29	(kPa)		
Depth (ft/m)	: 10.0 | 0.00	Friction Angle (ϕ) :	69.44	Degree		47.70	Degree		
Description	: Mottled olive brown, yellowish brown, brown, CLAYEY SAND (SC)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	10.14	126.22	19.87	0.34	0.50	23.94	2.75	131.57	0.61	29.30
◆	10.34	123.00	19.36	0.37	1.00	47.88	4.42	211.44	1.02	48.84
▲	10.58	123.26	19.40	0.37	2.00	95.76	6.82	326.30	2.23	106.87

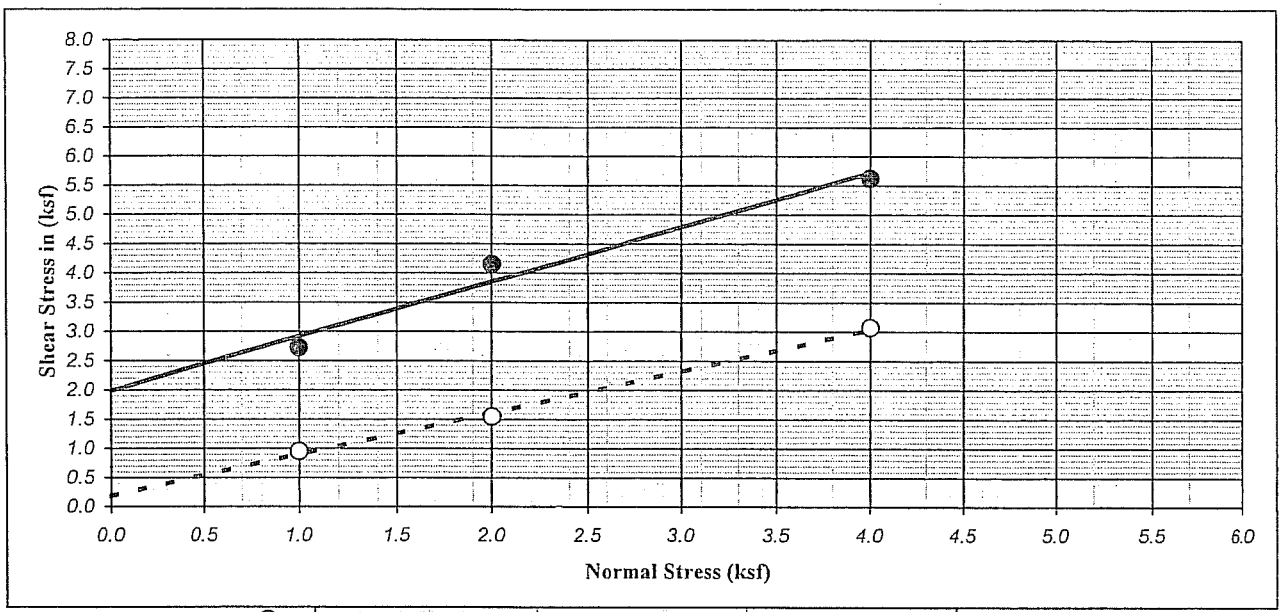
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

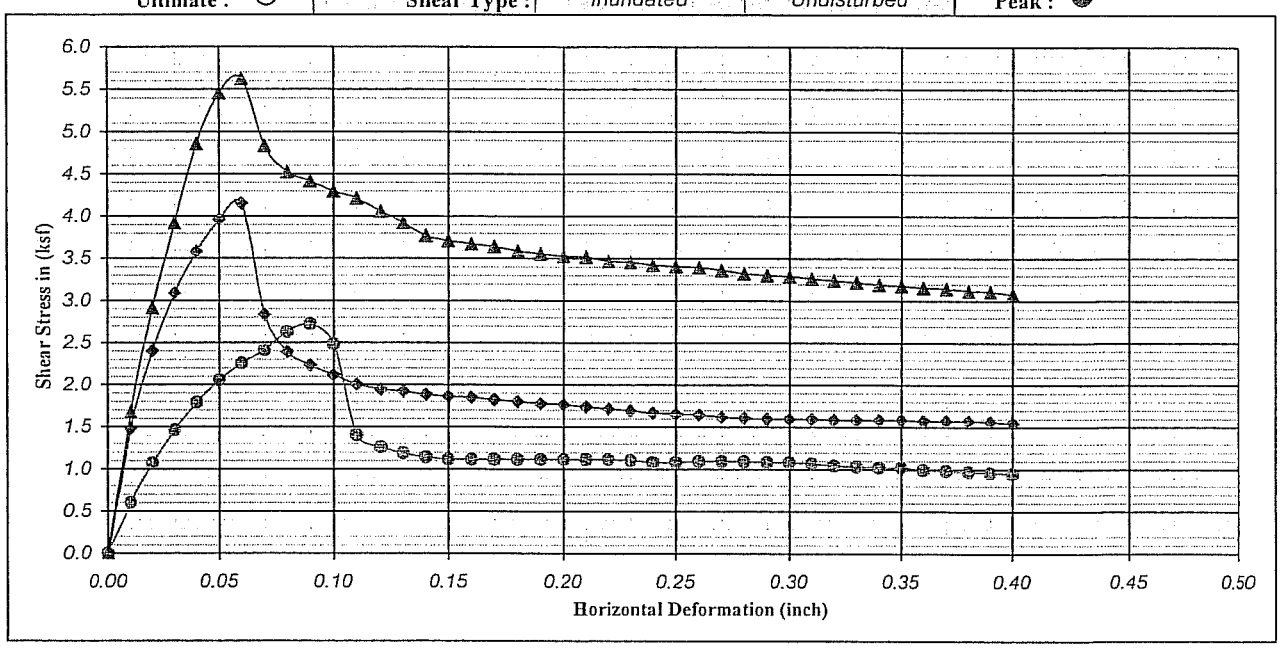
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-011		Strength Intercept (C) :	1.99	(ksf)	Peak	0.19	(ksf)	Ultimate
Sample No. : D-5			95.11	(kPa)		8.91	(kPa)	
Depth (ft/m) : 20.0	0.00	Friction Angle (ϕ) :	43.07	Degree		35.59	Degree	
Description : Brown, Lean CLAY with SAND (CL)					Shear Rate (inch/minute) :		0.02	

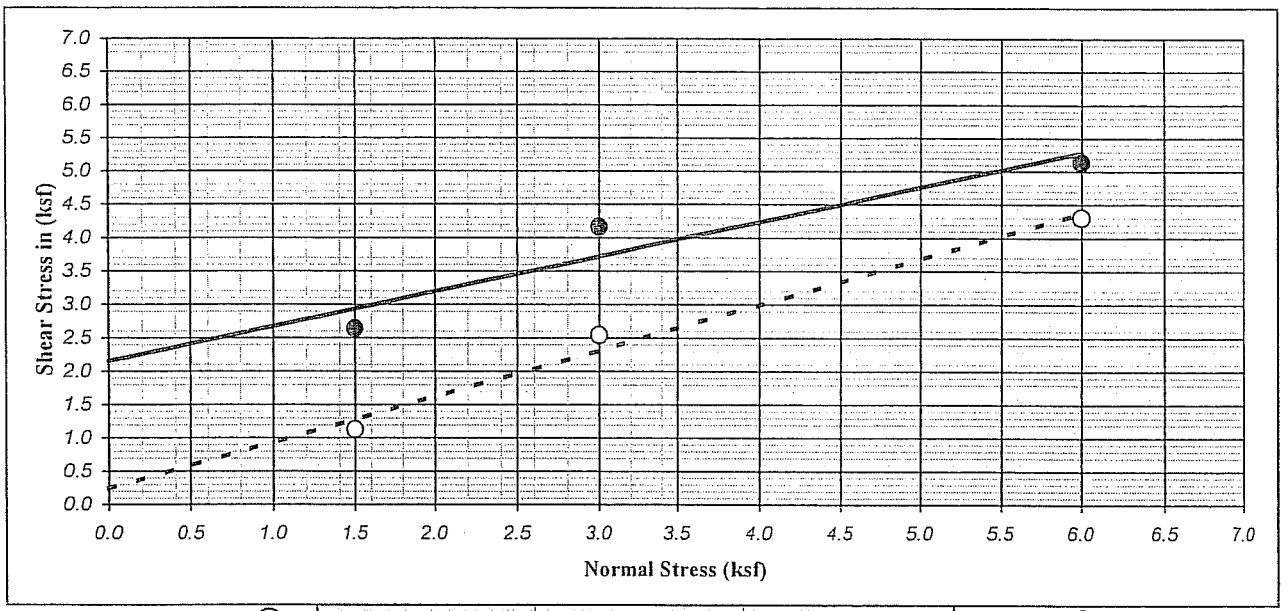
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.35	102.70	16.17	0.64	1.00	47.88	2.72	130.43	0.95	45.39
◆	18.92	106.02	16.69	0.59	2.00	95.76	4.15	198.80	1.55	74.12
▲	16.19	111.34	17.52	0.51	4.00	191.52	5.63	269.42	3.07	147.09

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

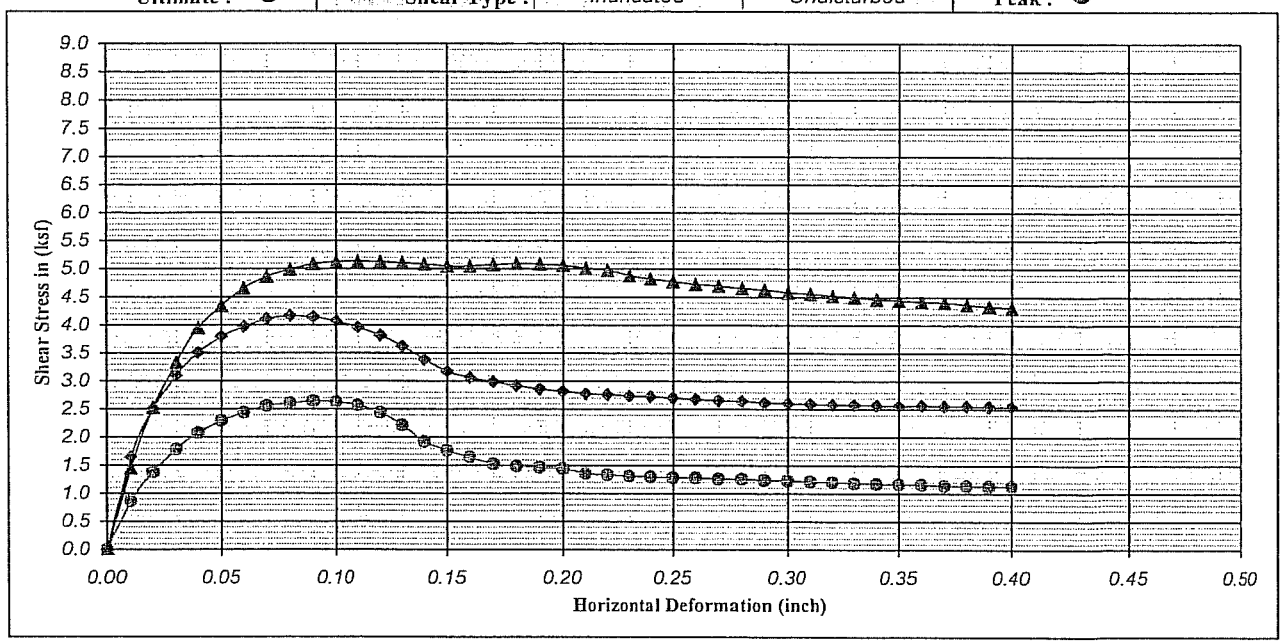
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115	Date : 11/23/08	Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No.	: A-08-011	Strength Intercept (C) :	2.15	(ksf)	Peak	0.25	(ksf)	Ultimate
Sample No.	: D-7		103.13	(kPa)		11.78	(kPa)	
Depth (ft/m)	: 30.0 0.00	Friction Angle (ϕ) :	27.55	Degree		34.59	Degree	
Description	: Brown to dark brown, SANDY LEAN CLAY (CL)					Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	16.08	116.72	18.37	0.44	1.50	71.82	2.64	126.40	1.13	54.01
◆	15.82	119.90	18.87	0.41	3.00	143.64	4.16	199.37	2.54	121.81
▲	16.81	117.88	18.55	0.43	6.00	287.28	5.14	245.91	4.31	206.27

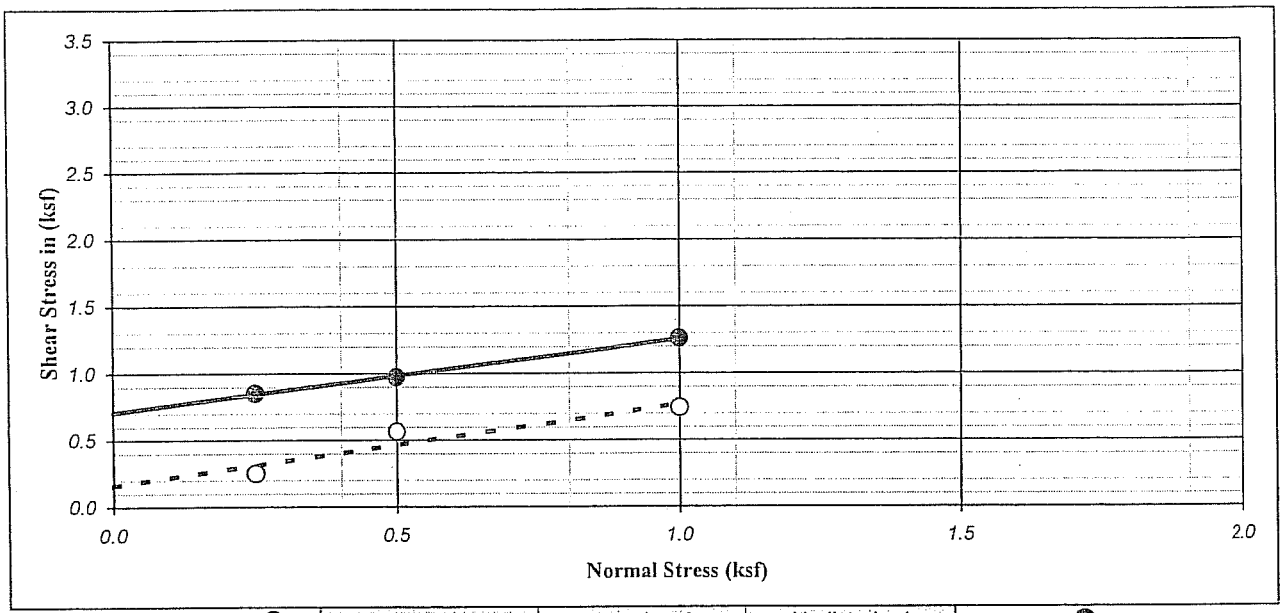
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

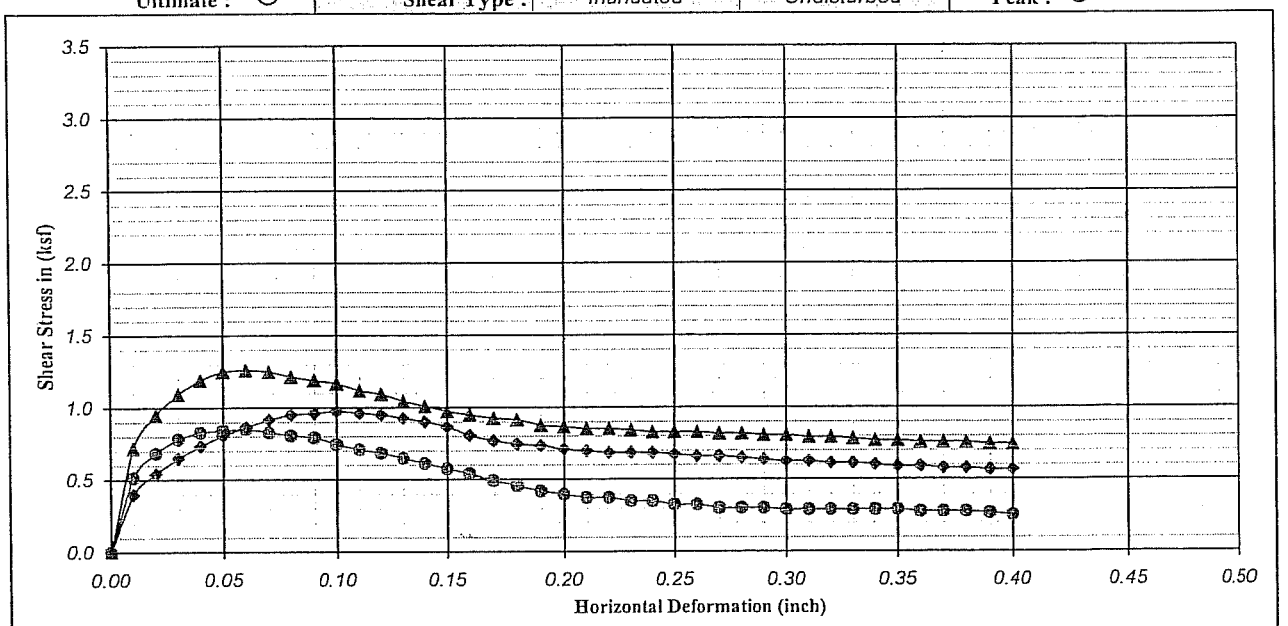
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-013		Strength Intercept (C) :	0.71	(ksf)		0.16	(ksf)	
Sample No. : D-2			33.90	(kPa)	Peak	7.76	(kPa)	Ultimate
Depth (ft/m) : 5.0	0.00	Friction Angle (ϕ) :	28.75	Degree		31.54	Degree	
Description : Mottled olive brown, yellowish brown, CLAYEY SAND (SC)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	24.16	102.19	16.08	0.65	0.25	11.97	0.85	40.79	0.25	12.07
◆	23.10	101.16	15.92	0.67	0.50	23.94	0.97	46.54	0.56	27.00
▲	20.94	101.47	15.97	0.66	1.00	47.88	1.26	60.33	0.74	35.62

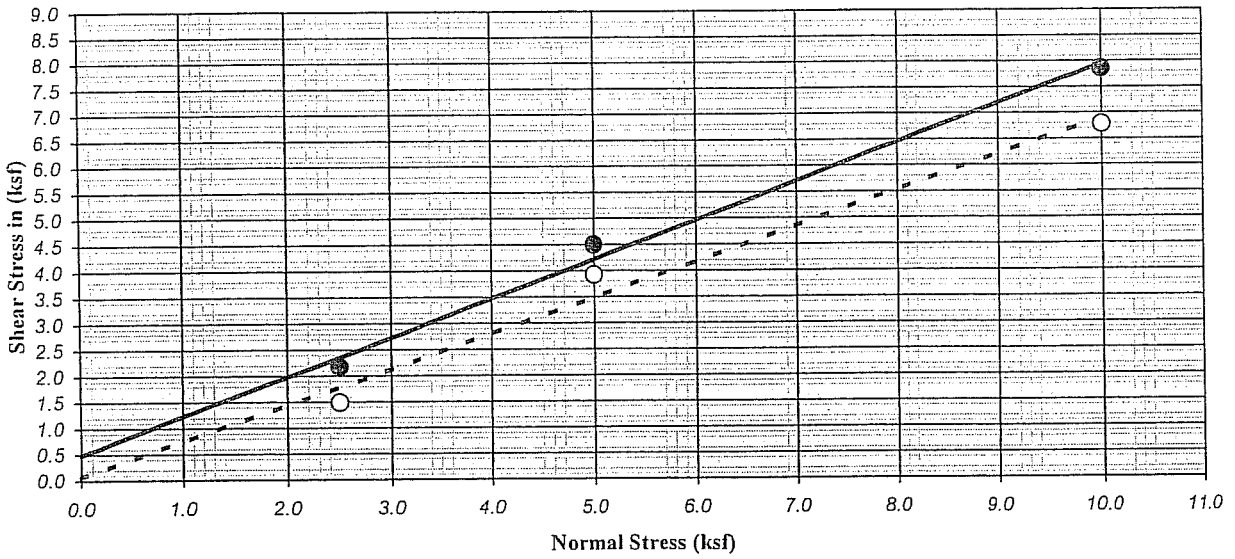
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

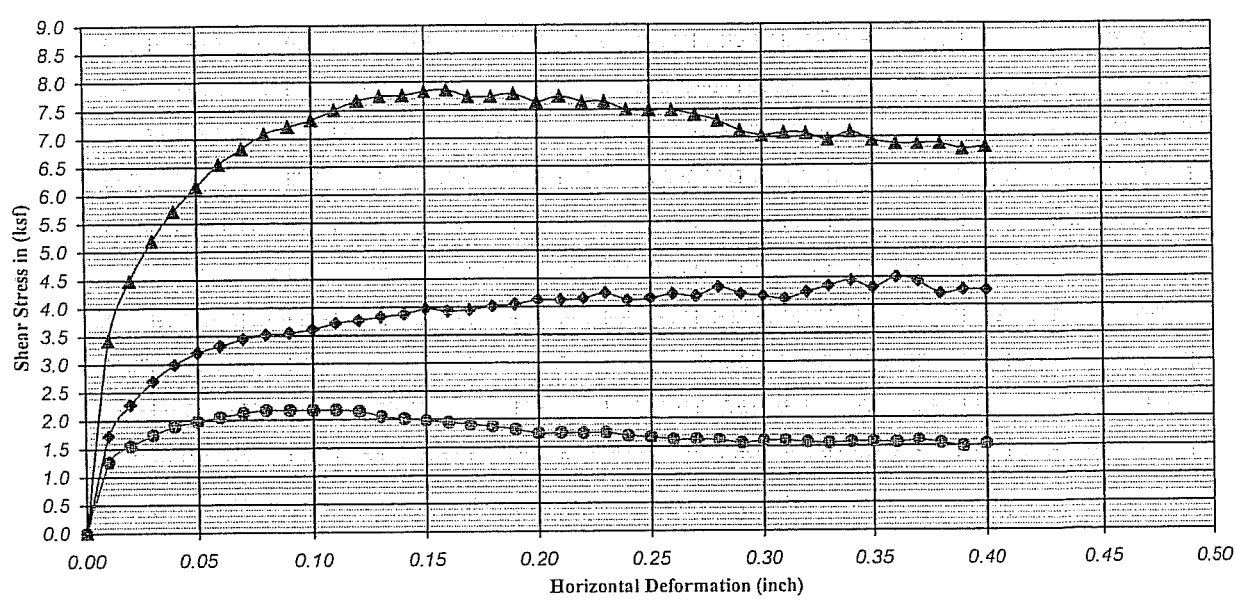
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No.	: A-08-013	Strength Intercept (C) :	0.49	(ksf)	Peak	0.06	(ksf)	Ultimate	
Sample No.	: D-12		23.58	(kPa)		2.90	(kPa)		
Depth (ft/m)	: 55.0 0.00	Friction Angle (ϕ) :	36.72	Degree		34.46	Degree		
Description	: Yellowish brown, Poorly-graded SAND with SILT (SP-SM)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	17.57	103.83	16.34	0.62	2.50	119.70	2.17	104.00	1.49	71.25
◆	16.58	102.89	16.19	0.64	5.00	239.40	4.50	215.46	3.92	187.88
▲	15.95	107.70	16.95	0.57	10.00	478.80	7.86	376.29	6.78	324.58

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

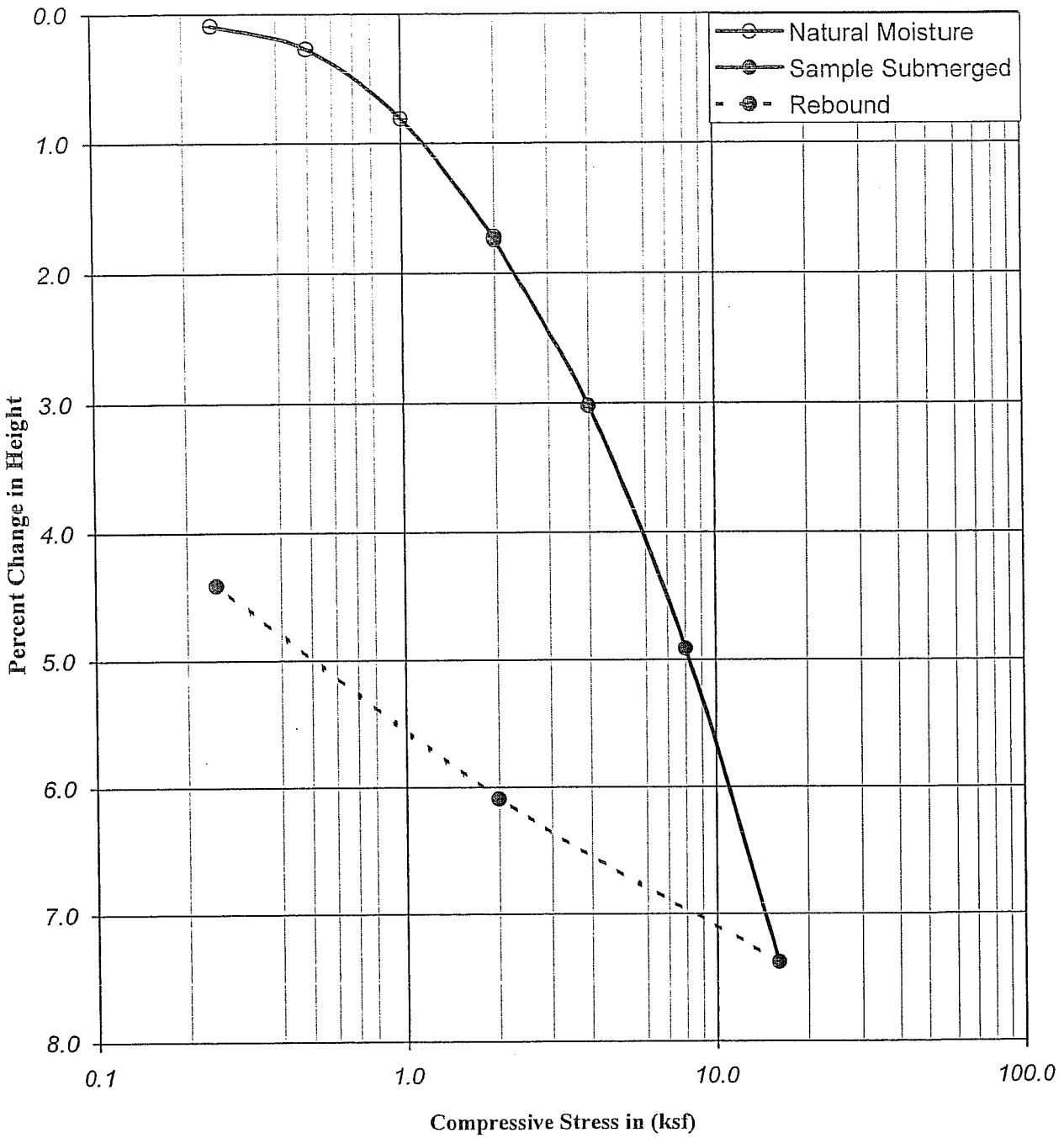
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115

Date : 11/23/08

Figure No. :



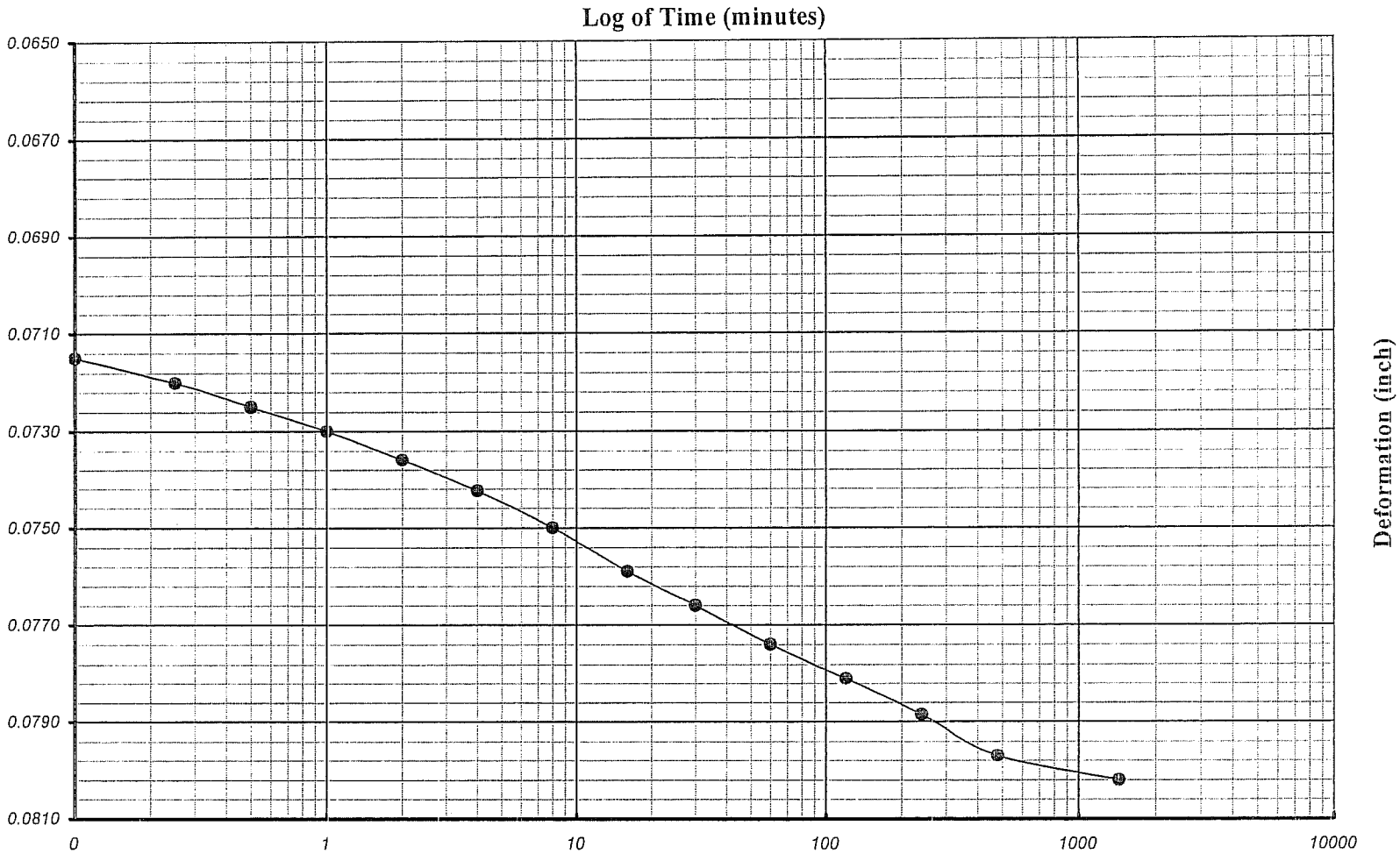
Boring No.	: A-08-012		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-2		Plastic Limit :	-						
Depth (ft)	: 5.0	6.5	Plastic Index :	-	Initial	20.71	105.63	16.63	93.85	0.60
Depth (m)	: 1.53	1.98	Specific Gravity :	2.70	Final	20.02	110.55	17.40	103.00	0.52
Description	: Very dark yellowish brown, lean CLAY with SAND (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

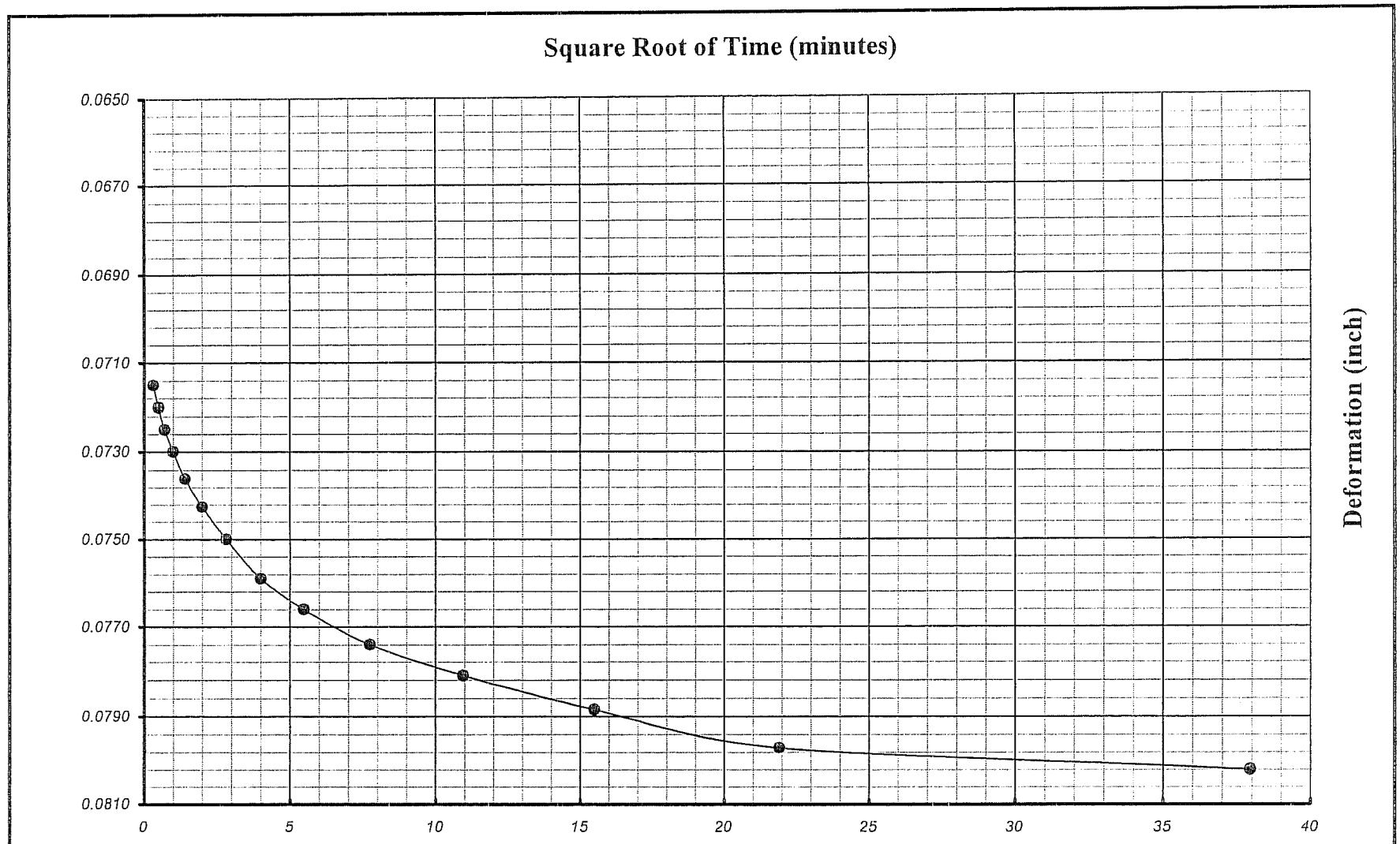
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

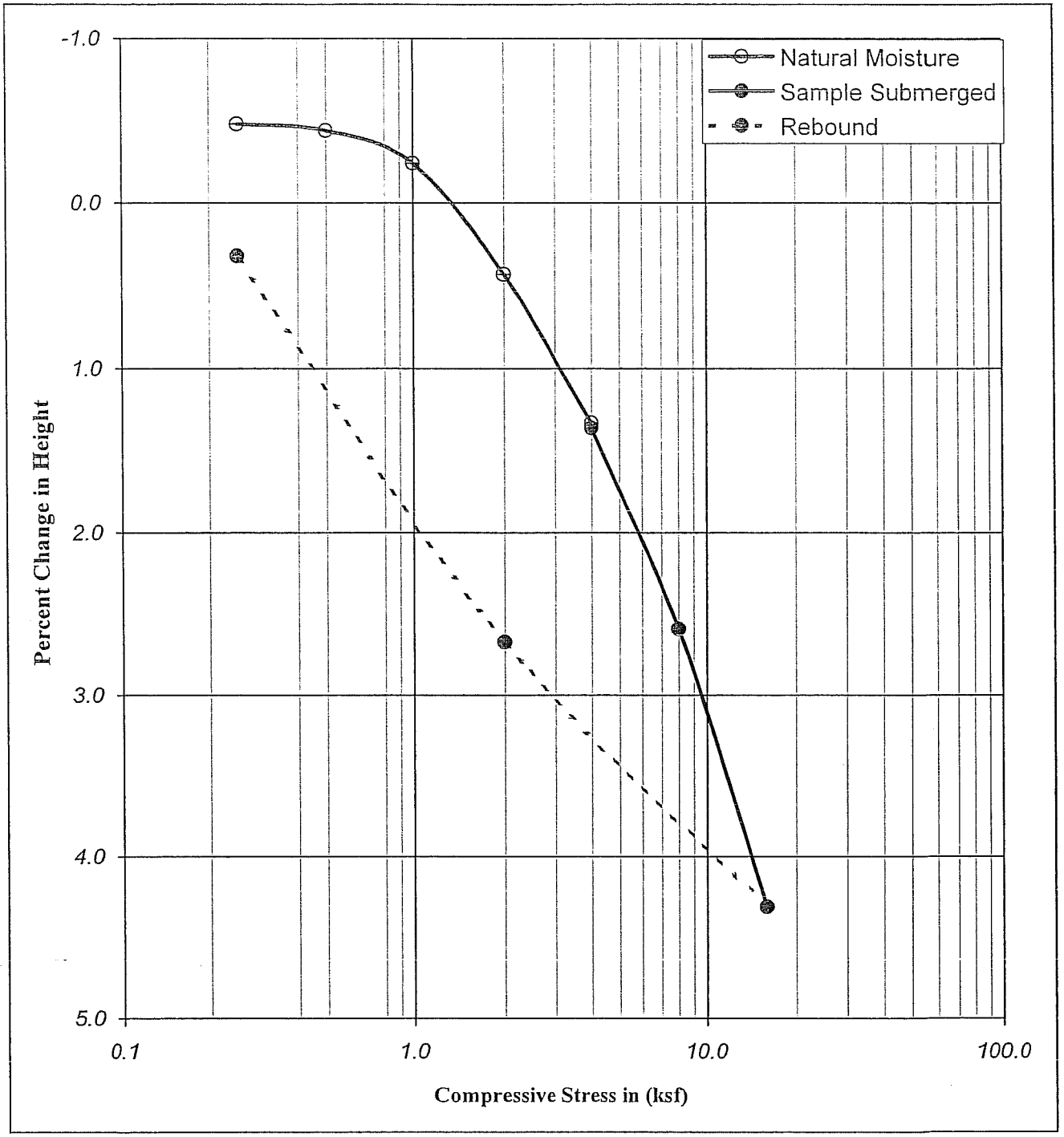
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-012*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.00* *191.5*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-012*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-2*	
EMI Project No. : *08-115*		Depth (ft/m) : *5.0* *1.5*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



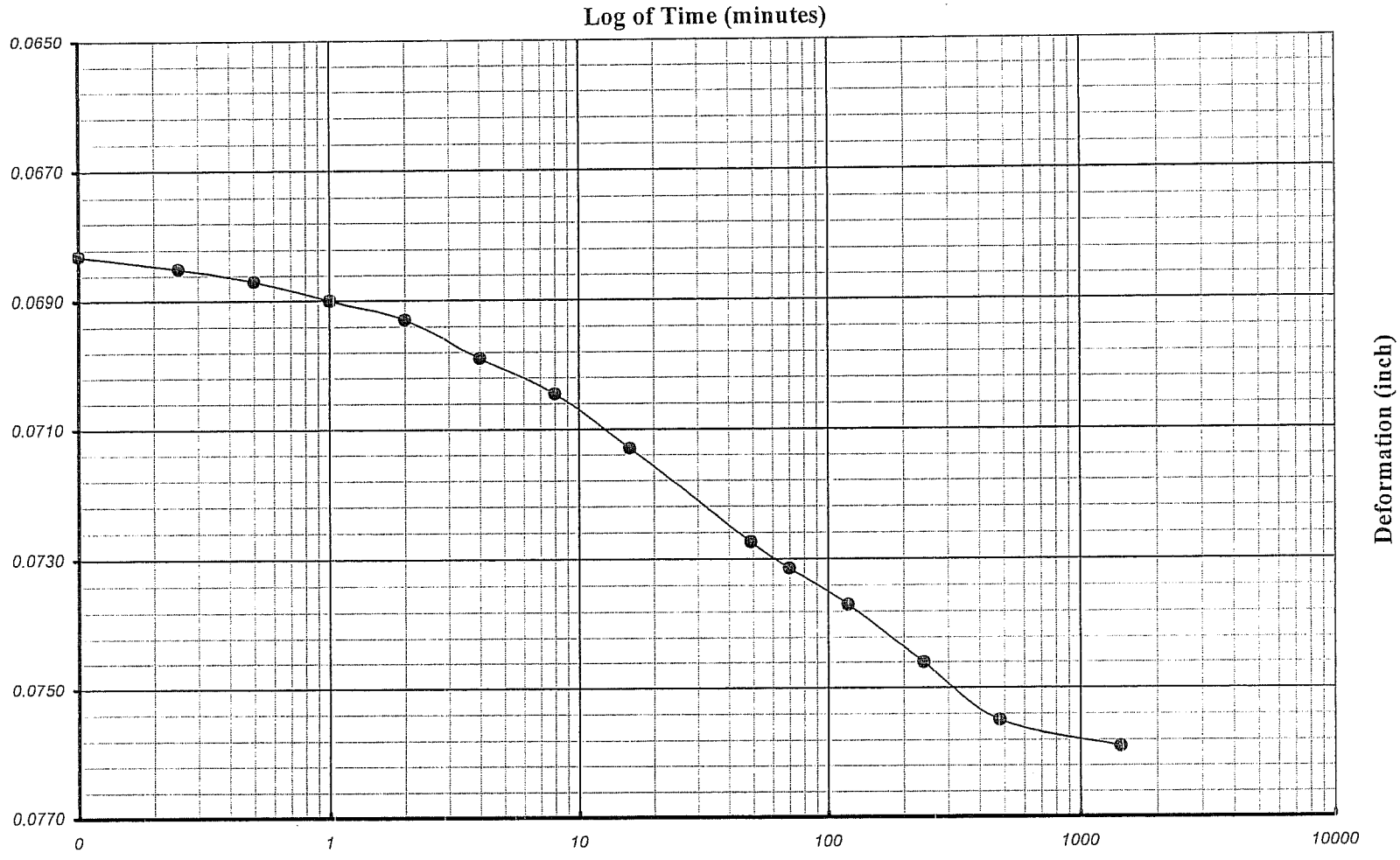
Boring No.	: A-08-013			Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-6			Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft) :	25.0	26.5	Plastic Index :	-	Initial	16.10	114.51	18.02	92.10	0.47
	(m) :	7.63	8.08	Specific Gravity :	2.70	Final	17.92	115.43	18.17	105.14	0.46
Description : Strong brown, SANDY lean CLAY (CL)											

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

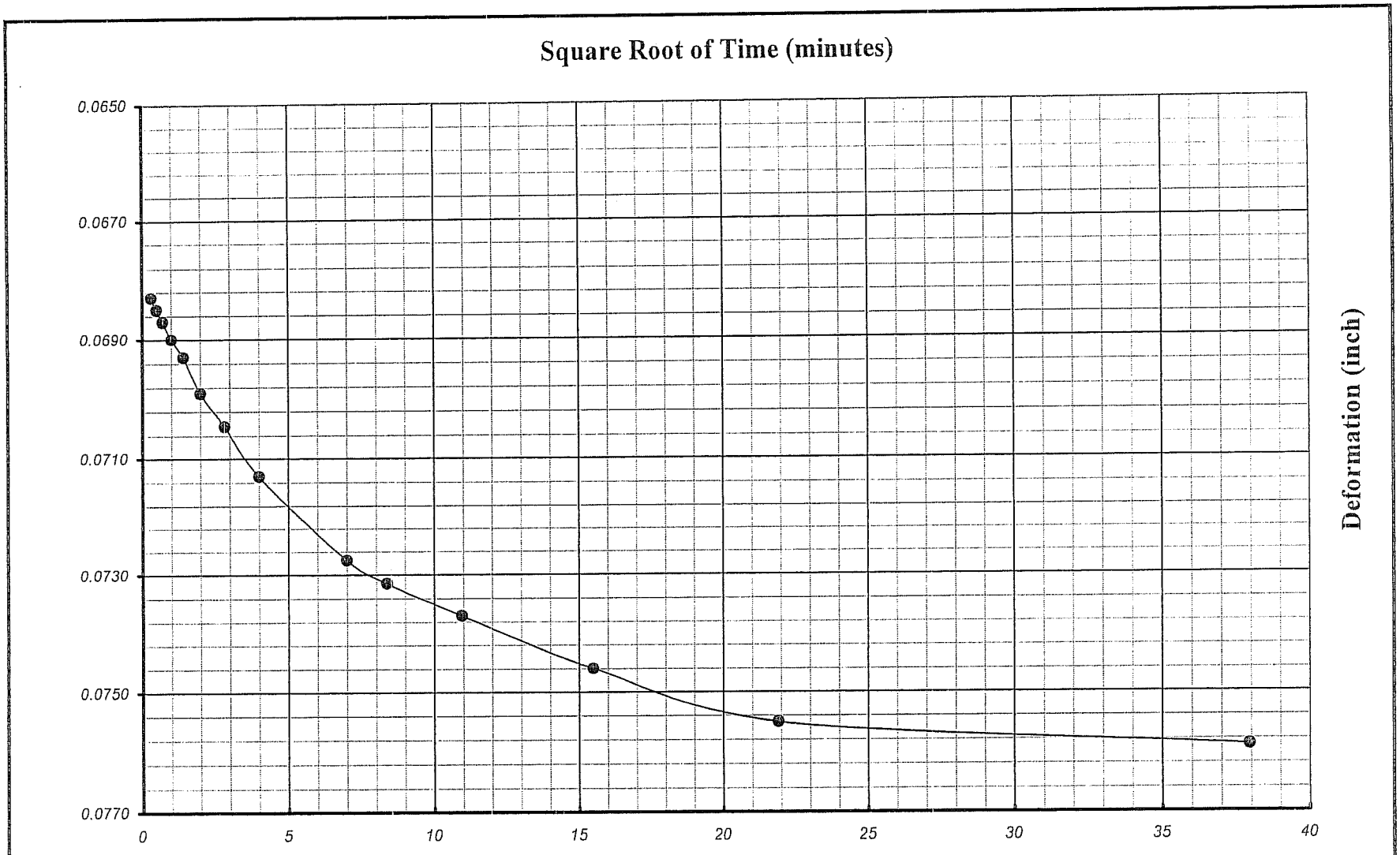
RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-013*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-6*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *8.00* *383.0*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-013*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-6*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *8.0* *383.0*

APPENDIX C

DESIGN CALCULATIONS

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project Placentia Ave I/C Project No. _____

By CTY Date 1/28/09 Checked By _____ Date _____ Sheet ____ of ____

Pile Properties

30" ϕ CIDH piles – Bents

$I = \frac{\pi}{64}(30)^4 = 39740\ in^4$

$I_{cr} = \frac{1}{2} I = 19870\ in^4$

$E = 57000\sqrt{4000} = 3.60 \times 10^6\ psi$

24" ϕ CIDH piles – Abutments

$I = \frac{\pi}{64}(24)^4 = 16278\ in^4$

$I_{cr} = \frac{1}{2} I = 8139\ in^4$

$E = 3.60 \times 10^6\ psi$

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

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Project Placentia AVE UC Project No. _____

By CTY Date 4/30/09 Checked By _____ Date _____ Sheet ____ of ____

Abut 1

El ≈ 214'

depth

0

CL
γ = 123 pcf ε_{50} = 0.007
C = 2 ksf

16'

198'

SM/SP
γ = 128 pcf
ϕ = 38° Ic = 205 pci

53'

15'

CL
γ = 123 pcf
C = 2 ksf ε_{50} = 0.007

Abut 5

El. ≈ 18'

depth

0

CL
γ = 123 pcf
C = 2 ksf ε_{50} = 0.007

26'

192'

SM/SP
γ = 128 pcf
ϕ = 38° Ic = 205 pci

51'

167'

CL
γ = 123 pcf
C = 2 ksf ε_{50} = 0.007

56'

162'

SP-SM
γ = 128 pcf
ϕ = 38° Ic = 205 pci

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project Placentia Ave UC Project No. 08-115

By CTY Date 1/17/09 Checked By _____ Date _____ Sheet ____ of ____

Bent 2

El.		depth
210'		0'
	SP-SM ϕ=29° γ=120pcf	
207'		3'
	CL γ=123pcf C=2.5ksf	
182'		28'
	SC γ=120pcf ϕ=31°	
177'		33'
	SP-SM γ=128pcf ϕ=38°	
152'		58'
	CL γ=127pcf C=3ksf	

Bents 3 & 4

El.		depth
211'		0'
	CL γ=120pcf C=1.1ksf	
193'		18'
	CL γ=128 pcf C=2ksf	
188'		23'
	SC γ=120pcf ϕ=31°	
183'		28'
	SP-SM γ=128pcf ϕ=38°	
168'		43'
	CL γ=120 pcf C=1.3ksf	
163'		48'
	SP-SM γ=130 ϕ=40°	
143'		68'
	CL γ=123 C=3.5	

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Project Placentia Ave UC Project No. _____

By CRY Date 5/16/09 Checked By _____ Date _____ Sheet ____ of ____

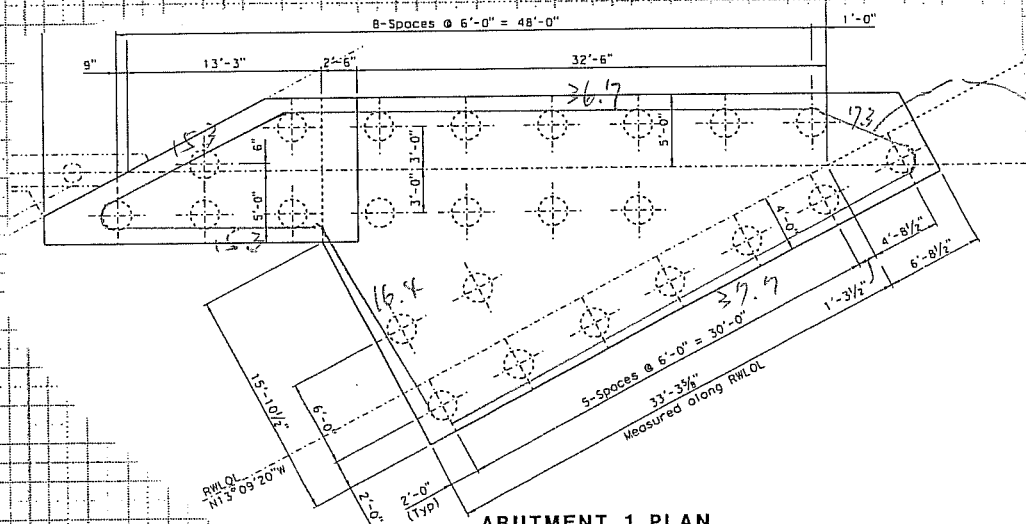
Abut 1

Δ Single pile :

pile demand = $\frac{210}{0.5}$ = 420 k

⇒ L = 60' ~~or~~ 44' ⇒ El. 1170'

Δ Pile group



ABUTMENT 1 PLAN

perimeter of equivalent pier

In clay :

$\eta_{clay} = \frac{\text{resistance of equivalent pier}}{\text{resistance of } \Sigma \text{ single pile}} = \frac{c(36.7+23.4+37.7+16.4+15.3+15.3)}{0.5 \times c \times \pi \times 24} = 1.5$

⇒ $\eta_{clay} = 1$

$\eta_{sand} = 0.77$ for c-c spacing = 5D

Pile group demand = $\frac{3500}{0.5}$ = 7000 kips

⇒ L = 33'

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia UC (widen) Abut 1 - single pile ITEM: 2-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 01/30/09

CHECKED BY: DATE:

D_s => 2 ft Hw => 100.0 ft Hg => 0.0 ft

p = 6.2832 ft Ho => 0.0 ft Hf => 5.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	16	123	60.6	2.50	0
(2)	16	63	128	65.6	0.00	38
(3)	63	150	123	60.6	2.50	0
(4)	63	150	123	60.6	2.50	0
(5)	63	150	123	60.6	2.50	0
(6)	63	150	123	60.6	2.50	0
(7)	63	150	123	60.6	2.50	0
(8)	63	150	123	60.6	2.50	0

Sublayer No.	Depth, z (ft)	z_l (ft)	New Depth (ft)	Soil Unit Weight (pcf)	Overburden Pressure (psf)	c' (ksf)	β	f_l^a (ksf)	ΔQ_s^a (kips)	Q_s^a (kips)	f_l^c (ksf)	ΔQ_s^c (kips)	Q_s^c (kips)	Q_s (kips)
0	0.0	0.0	0.0	123.0	0									
1	5.0	2.5	2.5	123.0	308	2.5				0.0			0.0	0.0
2	6.0	5.5	5.5	123.0	677	2.5	1.1834	0.0000	0.0	0.0	1.3750	8.6	8.6	8.6
3	8.0	7.0	7.0	123.0	861	2.5	1.1428	0.0000	0.0	0.0	1.3750	17.3	25.9	25.9
4	10.0	9.0	9.0	123.0	1107	2.5	1.0950	0.0000	0.0	0.0	1.3750	17.3	43.2	43.2
5	12.0	11.0	11.0	123.0	1353	2.5	1.0523	0.0000	0.0	0.0	1.3750	17.3	60.5	60.5
6	14.0	13.0	13.0	123.0	1599	2.5	1.0133	0.0000	0.0	0.0	1.3750	17.3	77.8	77.8
7	16.0	15.0	15.0	123.0	1845	2.5	0.9771	0.0000	0.0	0.0	1.3750	17.3	95.0	95.0
8	18.0	17.0	17.0	128.0	2101	0.0	0.9434	1.9820	24.9	24.9	0.0000	0.0	95.0	119.9
9	20.0	19.0	19.0	128.0	2357	0.0	0.9115	2.1485	27.0	51.9	0.0000	0.0	95.0	146.9
10	22.0	21.0	21.0	128.0	2613	0.0	0.8814	2.3030	28.9	80.8	0.0000	0.0	95.0	175.9
11	24.0	23.0	23.0	128.0	2869	0.0	0.8526	2.4460	30.7	111.6	0.0000	0.0	95.0	206.6
12	26.0	25.0	25.0	128.0	3125	0.0	0.8250	2.5781	32.4	144.0	0.0000	0.0	95.0	239.0
13	28.0	27.0	27.0	128.0	3381	0.0	0.7985	2.6998	33.9	177.9	0.0000	0.0	95.0	272.9
14	30.0	29.0	29.0	128.0	3637	0.0	0.7730	2.8114	35.3	213.2	0.0000	0.0	95.0	308.3
15	31.0	30.5	30.5	128.0	3829	0.0	0.7544	2.8887	18.2	231.4	0.0000	0.0	95.0	326.4
16	32.0	31.5	31.5	128.0	3957	0.0	0.7423	2.9373	18.5	249.8	0.0000	0.0	95.0	344.9
17	33.0	32.5	32.5	128.0	4085	0.0	0.7304	2.9836	18.7	268.6	0.0000	0.0	95.0	363.6
18	34.0	33.5	33.5	128.0	4213	0.0	0.7186	3.0276	19.0	287.6	0.0000	0.0	95.0	382.6
19	35.0	34.5	34.5	128.0	4341	0.0	0.7071	3.0693	19.3	306.9	0.0000	0.0	95.0	401.9
20	36.0	35.5	35.5	128.0	4469	0.0	0.6956	3.1088	19.5	326.4	0.0000	0.0	95.0	421.5
21	37.0	36.5	36.5	128.0	4597	0.0	0.6844	3.1462	19.8	346.2	0.0000	0.0	95.0	441.2
22	38.0	37.5	37.5	128.0	4725	0.0	0.6733	3.1813	20.0	366.2	0.0000	0.0	95.0	461.2
23	39.0	38.5	38.5	128.0	4853	0.0	0.6623	3.2144	20.2	386.4	0.0000	0.0	95.0	481.4
24	40.0	39.5	39.5	128.0	4981	0.0	0.6515	3.2453	20.4	406.8	0.0000	0.0	95.0	501.8
25	41.0	40.5	40.5	128.0	5109	0.0	0.6409	3.2742	20.6	427.3	0.0000	0.0	95.0	522.4
26	42.0	41.5	41.5	128.0	5237	0.0	0.6303	3.3010	20.7	448.1	0.0000	0.0	95.0	543.1
27	43.0	42.5	42.5	128.0	5365	0.0	0.6199	3.3258	20.9	469.0	0.0000	0.0	95.0	564.0
28	44.0	43.5	43.5	128.0	5493	0.0	0.6096	3.3486	21.0	490.0	0.0000	0.0	95.0	585.1
29	45.0	44.5	44.5	128.0	5621	0.0	0.5994	3.3694	21.2	511.2	0.0000	0.0	95.0	606.2
30	46.0	45.5	45.5	128.0	5749	0.0	0.5894	3.3883	21.3	532.5	0.0000	0.0	95.0	627.5
31	47.0	46.5	46.5	128.0	5877	0.0	0.5794	3.4053	21.4	553.9	0.0000	0.0	95.0	648.9
32	48.0	47.5	47.5	128.0	6005	0.0	0.5696	3.4203	21.5	575.4	0.0000	0.0	95.0	670.4
33	49.0	48.5	48.5	128.0	6133	0.0	0.5598	3.4335	21.6	596.9	0.0000	0.0	95.0	692.0
34	50.0	49.5	49.5	128.0	6261	0.0	0.5502	3.4447	21.6	618.6	0.0000	0.0	95.0	713.6
35	51.0	50.5	50.5	128.0	6389	0.0	0.5406	3.4542	21.7	640.3	0.0000	0.0	95.0	735.3
36	52.0	51.5	51.5	128.0	6517	0.0	0.5312	3.4618	21.8	662.0	0.0000	0.0	95.0	757.1
37	53.0	52.5	52.5	128.0	6645	0.0	0.5218	3.4676	21.8	683.8	0.0000	0.0	95.0	778.9
38	54.0	53.5	53.5	128.0	6773	0.0	0.5126	3.4716	21.8	705.6	0.0000	0.0	95.0	800.7
39	55.0	54.5	54.5	128.0	6901	0.0	0.5034	3.4738	21.8	727.5	0.0000	0.0	95.0	822.5
40	56.0	55.5	55.5	128.0	7029	0.0	0.4943	3.4742	21.8	749.3	0.0000	0.0	95.0	844.3
41	57.0	56.5	56.5	128.0	7157	0.0	0.4853	3.4730	21.8	771.1	0.0000	0.0	95.0	866.2
42	58.0	57.5	57.5	128.0	7285	0.0	0.4763	3.4699	21.8	792.9	0.0000	0.0	95.0	888.0
43	59.0	58.5	58.5	128.0	7413	0.0	0.4674	3.4652	21.8	814.7	0.0000	0.0	95.0	909.7
44	60.0	59.5	59.5	128.0	7541	0.0	0.4587	3.4588	21.7	836.4	0.0000	0.0	95.0	931.5

L=42' for 5ft dia

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia UC (widen) Abut 1 - pile group ITEM: 2-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 05/16/09

CHECKED BY: DATE:

D_s => 2 ft Hw => 100.0 ft Hg => 0.0 ft

no. of piles= 24 Ho => 0.0 ft Hf => 5.0 ft

p = 150.80 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>	η
(1)	0	16	123	60.6	2.50	0	1.00
(2)	16	63	128	65.6	0.00	38	0.77
(3)	63	150	123	60.6	2.50	0	1.00
(4)	63	150	123	60.6	2.50	0	1.00
(5)	63	150	123	60.6	2.50	0	1.00
(6)	63	150	123	60.6	2.50	0	1.00
(7)	63	150	123	60.6	2.50	0	1.00
(8)	63	150	123	60.6	2.50	0	1.00

C-C Sp/D	η
2.5	0.65
3.0	0.77
3.5	0.88
4.0	1.00

Current C-C Spacing/D 3.0

Clay group eff 1.00

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	η	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)		(kips)
0	0.0	0.0	0.0	123.0	0					0.0			0.0	1.00	0.0
1	5.0	2.5	2.5	123.0	308	2.5				0.0			0.0	1.00	0.0
2	6.0	5.5	5.5	123.0	677	2.5	1.1834	0.0000	0.0	0.0	1.3750	207.3	207.3	1.00	207.3
3	8.0	7.0	7.0	123.0	861	2.5	1.1428	0.0000	0.0	0.0	1.3750	414.7	622.0	1.00	622.0
4	10.0	9.0	9.0	123.0	1107	2.5	1.0950	0.0000	0.0	0.0	1.3750	414.7	1036.7	1.00	1036.7
5	12.0	11.0	11.0	123.0	1353	2.5	1.0523	0.0000	0.0	0.0	1.3750	414.7	1451.4	1.00	1451.4
6	14.0	13.0	13.0	123.0	1599	2.5	1.0133	0.0000	0.0	0.0	1.3750	414.7	1866.1	1.00	1866.1
7	16.0	15.0	15.0	123.0	1845	2.5	0.9771	0.0000	0.0	0.0	1.3750	414.7	2280.8	1.00	2280.8
8	18.0	17.0	17.0	128.0	2101	0.0	0.9434	1.9820	597.8	460.3	0.0000	0.0	2280.8	0.77	2741.1
9	20.0	19.0	19.0	128.0	2357	0.0	0.9115	2.1485	648.0	959.2	0.0000	0.0	2280.8	0.77	3240.0
10	22.0	21.0	21.0	128.0	2613	0.0	0.8814	2.3030	694.6	1494.0	0.0000	0.0	2280.8	0.77	3774.8
11	24.0	23.0	23.0	128.0	2869	0.0	0.8526	2.4460	737.7	2062.1	0.0000	0.0	2280.8	0.77	4342.9
12	26.0	25.0	25.0	128.0	3125	0.0	0.8250	2.5781	777.5	2660.8	0.0000	0.0	2280.8	0.77	4941.6
13	28.0	27.0	27.0	128.0	3381	0.0	0.7985	2.6998	814.2	3287.7	0.0000	0.0	2280.8	0.77	5568.5
14	30.0	29.0	29.0	128.0	3637	0.0	0.7730	2.8114	847.9	3940.6	0.0000	0.0	2280.8	0.77	6221.4
15	31.0	30.5	30.5	128.0	3829	0.0	0.7544	2.8887	435.6	4276.0	0.0000	0.0	2280.8	0.77	6556.8
16	32.0	31.5	31.5	128.0	3957	0.0	0.7423	2.9373	442.9	4617.1	0.0000	0.0	2280.8	0.77	6897.9
17	33.0	32.5	32.5	128.0	4085	0.0	0.7304	2.9836	449.9	4963.5	0.0000	0.0	2280.8	0.77	7244.3
18	34.0	33.5	33.5	128.0	4213	0.0	0.7186	3.0276	456.6	5315.1	0.0000	0.0	2280.8	0.77	7595.9
19	35.0	34.5	34.5	128.0	4341	0.0	0.7071	3.0693	462.8	5671.5	0.0000	0.0	2280.8	0.77	7952.3
20	36.0	35.5	35.5	128.0	4469	0.0	0.6956	3.1088	468.8	6032.5	0.0000	0.0	2280.8	0.77	8313.2
21	37.0	36.5	36.5	128.0	4597	0.0	0.6844	3.1462	474.4	6397.8	0.0000	0.0	2280.8	0.77	8678.6
22	38.0	37.5	37.5	128.0	4725	0.0	0.6733	3.1813	479.7	6767.2	0.0000	0.0	2280.8	0.77	9048.0
23	39.0	38.5	38.5	128.0	4853	0.0	0.6623	3.2144	484.7	7140.4	0.0000	0.0	2280.8	0.77	9421.2
24	40.0	39.5	39.5	128.0	4981	0.0	0.6515	3.2453	489.4	7517.2	0.0000	0.0	2280.8	0.77	9798.0
25	41.0	40.5	40.5	128.0	5109	0.0	0.6409	3.2742	493.7	7897.4	0.0000	0.0	2280.8	0.77	10178.2
26	42.0	41.5	41.5	128.0	5237	0.0	0.6303	3.3010	497.8	8280.7	0.0000	0.0	2280.8	0.77	10561.5
27	43.0	42.5	42.5	128.0	5365	0.0	0.6199	3.3258	501.5	8666.8	0.0000	0.0	2280.8	0.77	10947.6
28	44.0	43.5	43.5	128.0	5493	0.0	0.6096	3.3486	505.0	9055.7	0.0000	0.0	2280.8	0.77	11336.5
29	45.0	44.5	44.5	128.0	5621	0.0	0.5994	3.3694	508.1	9446.9	0.0000	0.0	2280.8	0.77	11727.7
30	46.0	45.5	45.5	128.0	5749	0.0	0.5894	3.3883	510.9	9840.3	0.0000	0.0	2280.8	0.77	12121.1
31	47.0	46.5	46.5	128.0	5877	0.0	0.5794	3.4053	513.5	10235.7	0.0000	0.0	2280.8	0.77	12516.5
32	48.0	47.5	47.5	128.0	6005	0.0	0.5696	3.4203	515.8	10632.9	0.0000	0.0	2280.8	0.77	12913.7
33	49.0	48.5	48.5	128.0	6133	0.0	0.5598	3.4335	517.8	11031.5	0.0000	0.0	2280.8	0.77	13312.3
34	50.0	49.5	49.5	128.0	6261	0.0	0.5502	3.4447	519.5	11431.5	0.0000	0.0	2280.8	0.77	13712.3
35	51.0	50.5	50.5	128.0	6389	0.0	0.5406	3.4542	520.9	11832.6	0.0000	0.0	2280.8	0.77	14113.4
36	52.0	51.5	51.5	128.0	6517	0.0	0.5312	3.4618	522.0	12234.6	0.0000	0.0	2280.8	0.77	14515.4
37	53.0	52.5	52.5	128.0	6645	0.0	0.5218	3.4676	522.9	12637.2	0.0000	0.0	2280.8	0.77	14918.0
38	54.0	53.5	53.5	128.0	6773	0.0	0.5126	3.4716	523.5	13040.3	0.0000	0.0	2280.8	0.77	15321.1
39	55.0	54.5	54.5	128.0	6901	0.0	0.5034	3.4738	523.8	13443.6	0.0000	0.0	2280.8	0.77	15724.4
40	56.0	55.5	55.5	128.0	7029	0.0	0.4943	3.4742	523.9	13847.0	0.0000	0.0	2280.8	0.77	16127.8
41	57.0	56.5	56.5	128.0	7157	0.0	0.4853	3.4730	523.7	14250.3	0.0000	0.0	2280.8	0.77	16531.1
42	58.0	57.5	57.5	128.0	7285	0.0	0.4763	3.4699	523.3	14653.2	0.0000	0.0	2280.8	0.77	16934.0
43	59.0	58.5	58.5	128.0	7413	0.0	0.4674	3.4652	522.5	15055.6	0.0000	0.0	2280.8	0.77	17336.4
44	60.0	59.5	59.5	128.0	7541	0.0	0.4587	3.4588	521.6	15457.2	0.0000	0.0	2280.8	0.77	17738.0

L=22' for 7100 k

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
17660 Newhope Street, Suite E, Fountain Valley, CA 92708
phone: (714)751-3826, Fax (714)751-3928

Project: Placentia Avenue UC Abut 1 (Widen) Project No. 08-115
By CTY Date 5/1/2009 Check by Date Sheet

Settlement Calculation for Pile Group

Pile Top Depth.= 29 ft @ El. 214 ft
Pile Tip Depth= 45 ft @ El. 198 ft
Pile Length= 16 ft
Equivalent Footing
Depth = 40 ft (usually 2/3 of pile length)
Width = 18.0 ft Length= 40.0 ft
Load per Support= 3550 kips
Equivalent Load = 4.9 ksf

Check Settlement:
Method: FHWA Hough Method

Layer	Top Elev. (ft)	Bottom Elev. (ft)	Top Depth (ft)	Bottom Depth (ft)	Soil Type	γ' pcf	(N')	c'
1	243	233	0	10	CL	120	24	56
2	233	228	10	15	SC	123	38	92
3	228	198	15	45	CL	123	20	50
4	198	151	45	92	SM	128	45	107
5	151	137	92	106	CL	123	20	50

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Depth	Layer Thick. (ft)	Mid pt. depth (ft)	γ' kcf	σ_{vo}' (ksf)	depth to Equiv. Footing (ft)	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)	Total ΔS (in)
0										
4	4	2	0.12	0.24	-38	0.00	0.24	56	0.00	0.00
8	4	6	0.12	0.72	-34	0.00	0.72	56	0.00	0.00
10	2	9	0.12	1.08	-31	0.00	1.08	56	0.00	0.00
14	4	12	0.123	1.45	-28	0.00	1.45	92	0.00	0.00
15	1	14.5	0.123	1.75	-25.5	0.00	1.75	92	0.00	0.00
19	4	17	0.123	2.06	-23	0.00	2.06	50	0.00	0.00
23	4	21	0.123	2.55	-19	0.00	2.55	50	0.00	0.00
27	4	25	0.123	3.05	-15	0.00	3.05	50	0.00	0.00
31	4	29	0.123	3.54	-11	0.00	3.54	50	0.00	0.00
35	4	33	0.123	4.03	-7	0.00	4.03	50	0.00	0.00
39	4	37	0.123	4.52	-3	0.00	4.52	50	0.00	0.00
40	1	39.5	0.123	4.83	-0.5	0.00	4.83	50	0.00	0.00
44	4	42	0.123	5.14	2	4.44	9.57	50	0.26	0.26
45	1	44.5	0.123	5.44	4.5	3.94	9.39	50	0.06	0.32
49	4	47	0.128	5.76	7	3.55	9.31	107	0.09	0.41
53	4	51	0.128	6.27	11	3.06	9.33	107	0.08	0.49
57	4	55	0.128	6.79	15	2.69	9.47	107	0.07	0.55
61	4	59	0.128	7.30	19	2.40	9.70	107	0.06	0.61
65	4	63	0.128	7.81	23	2.16	9.97	107	0.05	0.66
69	4	67	0.128	8.32	27	1.97	10.29	107	0.04	0.70
73	4	71	0.128	8.83	31	1.81	10.64	107	0.04	0.73
77	4	75	0.128	9.35	35	1.67	11.02	107	0.03	0.77
81	4	79	0.128	9.86	39	1.56	11.41	107	0.03	0.79
85	4	83	0.128	10.37	43	1.45	11.82	107	0.03	0.82
89	4	87	0.128	10.88	47	1.37	12.25	107	0.02	0.84
92	3	90.5	0.128	11.33	50.5	1.30	12.62	107	0.02	0.86
96	4	94	0.123	11.77	54	1.23	13.00	50	0.04	0.90
100	4	98	0.123	12.26	58	1.17	13.43	50	0.04	0.94
104	4	102	0.123	12.75	62	1.11	13.86	50	0.03	0.97

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Project Placentia Ave UC Project No. _____

By CTY Date _____ Checked By _____ Date _____ Sheet ___ of ___

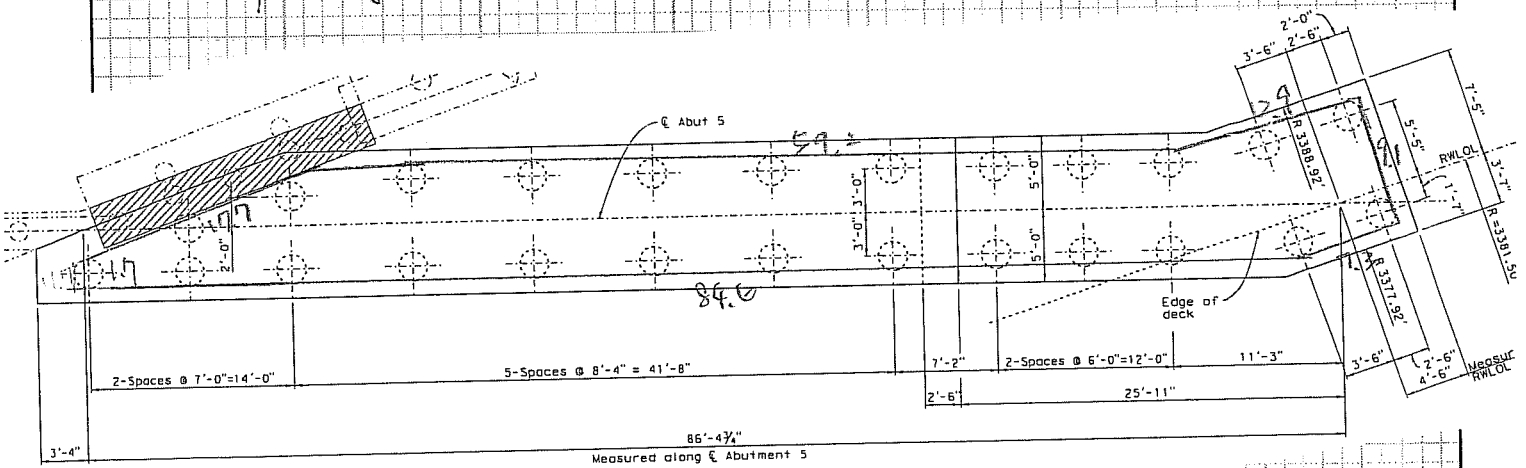
Abut 5

△ single pile:

pile demand = $\frac{2200}{0.5}$ = 4400 k

⇒ L = 36' say ≥ 38' ⇒ El + 180'

△ pile group:



ABUTMENT 5 PLAN

$$\eta_{clay} = \frac{\text{Cx}[89.6+73+91+12.9+59.2+12.7+11.7]}{0.5\text{C} \times 2\pi \times 22} \rightarrow 1$$

Σ No of pile

$\eta_{clay} = 1$

$\eta_{sand} = 0.77$ for average C-C spacing = 3D

pile group demand = $\frac{26400}{0.5}$ = 53000 k

⇒ L = 30'

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia Ave UC (widen) Abut 5 - single pile ITEM: 2-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 01/30/09

CHECKED BY: DATE:

D_s => 2 ft Hw => 100.0 ft Hg => 0.0 ft

p = 6.2832 ft Ho => 0.0 ft Hf => 5.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	20	123	60.6	2.50	0
(2)	20	67	128	65.6	0.00	38
(3)	67	150	123	60.6	2.50	0
(4)	67	150	123	60.6	2.50	0
(5)	67	150	123	60.6	2.50	0
(6)	67	150	123	60.6	2.50	0
(7)	67	150	123	60.6	2.50	0
(8)	67	150	123	60.6	2.50	0

Sublayer No.	Depth, z (ft)	z_i (ft)	New Depth (ft)	Soil Unit Weight (pcf)	Overburden Pressure (psf)	c' (ksf)	β	f_i^s (ksf)	ΔQ_s^s (kips)	Q_s^s (kips)	f_i^c (ksf)	ΔQ_s^c (kips)	Q_s^c (kips)	Q_s (kips)
0	0.0	0.0	0.0	123.0	0					0.0			0.0	0.0
1	5.0	2.5	2.5	123.0	308	2.5								
2	6.0	5.5	5.5	123.0	677	2.5	1.1834	0.0000	0.0	0.0	1.3750	8.6	8.6	8.6
3	8.0	7.0	7.0	123.0	861	2.5	1.1428	0.0000	0.0	0.0	1.3750	17.3	25.9	25.9
4	10.0	9.0	9.0	123.0	1107	2.5	1.0950	0.0000	0.0	0.0	1.3750	17.3	43.2	43.2
5	12.0	11.0	11.0	123.0	1353	2.5	1.0523	0.0000	0.0	0.0	1.3750	17.3	60.5	60.5
6	14.0	13.0	13.0	123.0	1599	2.5	1.0133	0.0000	0.0	0.0	1.3750	17.3	77.8	77.8
7	16.0	15.0	15.0	123.0	1845	2.5	0.9771	0.0000	0.0	0.0	1.3750	17.3	95.0	95.0
8	18.0	17.0	17.0	123.0	2091	2.5	0.9434	0.0000	0.0	0.0	1.3750	17.3	112.3	112.3
9	20.0	19.0	19.0	123.0	2337	2.5	0.9115	0.0000	0.0	0.0	1.3750	17.3	129.6	129.6
10	22.0	21.0	21.0	128.0	2593	0.0	0.8814	2.2853	28.7	28.7	0.0000	0.0	129.6	158.3
11	24.0	23.0	23.0	128.0	2849	0.0	0.8526	2.4290	30.5	59.2	0.0000	0.0	129.6	188.8
12	26.0	25.0	25.0	128.0	3105	0.0	0.8250	2.5616	32.2	91.4	0.0000	0.0	129.6	221.0
13	28.0	27.0	27.0	128.0	3361	0.0	0.7985	2.6838	33.7	125.2	0.0000	0.0	129.6	254.7
14	30.0	29.0	29.0	128.0	3617	0.0	0.7730	2.7960	35.1	160.3	0.0000	0.0	129.6	289.9
15	31.0	30.5	30.5	128.0	3809	0.0	0.7544	2.8737	18.1	178.3	0.0000	0.0	129.6	307.9
16	32.0	31.5	31.5	128.0	3937	0.0	0.7423	2.9225	18.4	196.7	0.0000	0.0	129.6	326.3
17	33.0	32.5	32.5	128.0	4065	0.0	0.7304	2.9690	18.7	215.4	0.0000	0.0	129.6	345.0
18	34.0	33.5	33.5	128.0	4193	0.0	0.7186	3.0132	18.9	234.3	0.0000	0.0	129.6	363.9
19	35.0	34.5	34.5	128.0	4321	0.0	0.7071	3.0552	19.2	253.5	0.0000	0.0	129.6	383.1
20	36.0	35.5	35.5	128.0	4449	0.0	0.6956	3.0949	19.4	272.9	0.0000	0.0	129.6	402.5
21	37.0	36.5	36.5	128.0	4577	0.0	0.6844	3.1325	19.7	292.6	0.0000	0.0	129.6	422.2
22	38.0	37.5	37.5	128.0	4705	0.0	0.6733	3.1679	19.9	312.5	0.0000	0.0	129.6	442.1
23	39.0	38.5	38.5	128.0	4833	0.0	0.6623	3.2011	20.1	332.6	0.0000	0.0	129.6	462.2
24	40.0	39.5	39.5	128.0	4961	0.0	0.6515	3.2323	20.3	352.9	0.0000	0.0	129.6	482.5
25	41.0	40.5	40.5	128.0	5089	0.0	0.6409	3.2614	20.5	373.4	0.0000	0.0	129.6	503.0
26	42.0	41.5	41.5	128.0	5217	0.0	0.6303	3.2884	20.7	394.1	0.0000	0.0	129.6	523.7
27	43.0	42.5	42.5	128.0	5345	0.0	0.6199	3.3134	20.8	414.9	0.0000	0.0	129.6	544.5
28	44.0	43.5	43.5	128.0	5473	0.0	0.6096	3.3364	21.0	435.9	0.0000	0.0	129.6	565.5
29	45.0	44.5	44.5	128.0	5601	0.0	0.5994	3.3575	21.1	457.0	0.0000	0.0	129.6	586.6
30	46.0	45.5	45.5	128.0	5729	0.0	0.5894	3.3765	21.2	478.2	0.0000	0.0	129.6	607.8
31	47.0	46.5	46.5	128.0	5857	0.0	0.5794	3.3937	21.3	499.5	0.0000	0.0	129.6	629.1
32	48.0	47.5	47.5	128.0	5985	0.0	0.5696	3.4089	21.4	520.9	0.0000	0.0	129.6	650.5
33	49.0	48.5	48.5	128.0	6113	0.0	0.5598	3.4223	21.5	542.4	0.0000	0.0	129.6	672.0
34	50.0	49.5	49.5	128.0	6241	0.0	0.5502	3.4337	21.6	564.0	0.0000	0.0	129.6	693.6

L=36'
for 402.5 kips

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia UC (widen) Abut 5 - pile group ITEM: 2-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 05/16/09

CHECKED BY: DATE:

D_s => 2 ft Hw => 100.0 ft Hg => 0.0 ft

no. of piles= 23 Ho => 0.0 ft Hf => 5.0 ft

p = 144.51 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>	η
(1)	0	20	123	60.6	2.50	0	1.00
(2)	20	67	128	65.6	0.00	38	0.77
(3)	67	150	123	60.6	2.50	0	1.00
(4)	67	150	123	60.6	2.50	0	1.00
(5)	67	150	123	60.6	2.50	0	1.00
(6)	67	150	123	60.6	2.50	0	1.00
(7)	67	150	123	60.6	2.50	0	1.00
(8)	67	150	123	60.6	2.50	0	1.00

C-C Sp/D	η
2.5	0.65
3.0	0.77
3.5	0.88
4.0	1.00

Current C-C Spacing/D 3.0

Clay group eff 1.00

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	η	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)		(kips)
0	0.0	0.0	0.0	123.0	0										
1	5.0	2.5	2.5	123.0	308	2.5				0.0			0.0	1.00	0.0
2	6.0	5.5	5.5	123.0	677	2.5	1.1834	0.0000	0.0	0.0	1.3750	198.7	198.7	1.00	198.7
3	8.0	7.0	7.0	123.0	861	2.5	1.1428	0.0000	0.0	0.0	1.3750	397.4	596.1	1.00	596.1
4	10.0	9.0	9.0	123.0	1107	2.5	1.0950	0.0000	0.0	0.0	1.3750	397.4	993.5	1.00	993.5
5	12.0	11.0	11.0	123.0	1353	2.5	1.0523	0.0000	0.0	0.0	1.3750	397.4	1390.9	1.00	1390.9
6	14.0	13.0	13.0	123.0	1599	2.5	1.0133	0.0000	0.0	0.0	1.3750	397.4	1788.4	1.00	1788.4
7	16.0	15.0	15.0	123.0	1845	2.5	0.9771	0.0000	0.0	0.0	1.3750	397.4	2185.8	1.00	2185.8
8	18.0	17.0	17.0	123.0	2091	2.5	0.9434	0.0000	0.0	0.0	1.3750	397.4	2583.2	1.00	2583.2
9	20.0	19.0	19.0	123.0	2337	2.5	0.9115	0.0000	0.0	0.0	1.3750	397.4	2980.6	1.00	2980.6
10	22.0	21.0	21.0	128.0	2593	0.0	0.8814	2.2853	660.5	508.6	0.0000	0.0	2980.6	0.77	3489.2
11	24.0	23.0	23.0	128.0	2849	0.0	0.8526	2.4290	702.0	1049.2	0.0000	0.0	2980.6	0.77	4029.8
12	26.0	25.0	25.0	128.0	3105	0.0	0.8250	2.5616	740.4	1619.3	0.0000	0.0	2980.6	0.77	4599.8
13	28.0	27.0	27.0	128.0	3361	0.0	0.7985	2.6838	775.7	2216.5	0.0000	0.0	2980.6	0.77	5197.1
14	30.0	29.0	29.0	128.0	3617	0.0	0.7730	2.7960	808.1	2838.8	0.0000	0.0	2980.6	0.77	5819.4
15	31.0	30.5	30.5	128.0	3809	0.0	0.7544	2.8737	415.3	3158.6	0.0000	0.0	2980.6	0.77	6139.1
16	32.0	31.5	31.5	128.0	3937	0.0	0.7423	2.9225	422.3	3483.8	0.0000	0.0	2980.6	0.77	6464.3
17	33.0	32.5	32.5	128.0	4065	0.0	0.7304	2.9690	429.1	3814.1	0.0000	0.0	2980.6	0.77	6794.7
18	34.0	33.5	33.5	128.0	4193	0.0	0.7186	3.0132	435.5	4149.4	0.0000	0.0	2980.6	0.77	7130.0
19	35.0	34.5	34.5	128.0	4321	0.0	0.7071	3.0552	441.5	4489.4	0.0000	0.0	2980.6	0.77	7470.0
20	36.0	35.5	35.5	128.0	4449	0.0	0.6956	3.0949	447.3	4833.8	0.0000	0.0	2980.6	0.77	7814.4
21	37.0	36.5	36.5	128.0	4577	0.0	0.6844	3.1325	452.7	5182.3	0.0000	0.0	2980.6	0.77	8162.9
22	38.0	37.5	37.5	128.0	4705	0.0	0.6733	3.1679	457.8	5534.9	0.0000	0.0	2980.6	0.77	8515.4
23	39.0	38.5	38.5	128.0	4833	0.0	0.6623	3.2011	462.6	5891.1	0.0000	0.0	2980.6	0.77	8871.6
24	40.0	39.5	39.5	128.0	4961	0.0	0.6515	3.2323	467.1	6250.7	0.0000	0.0	2980.6	0.77	9231.3
25	41.0	40.5	40.5	128.0	5089	0.0	0.6409	3.2614	471.3	6613.6	0.0000	0.0	2980.6	0.77	9594.2
26	42.0	41.5	41.5	128.0	5217	0.0	0.6303	3.2884	475.2	6979.6	0.0000	0.0	2980.6	0.77	9960.1
27	43.0	42.5	42.5	128.0	5345	0.0	0.6199	3.3134	478.8	7348.3	0.0000	0.0	2980.6	0.77	10328.8
28	44.0	43.5	43.5	128.0	5473	0.0	0.6096	3.3364	482.2	7719.5	0.0000	0.0	2980.6	0.77	10700.1
29	45.0	44.5	44.5	128.0	5601	0.0	0.5994	3.3575	485.2	8093.1	0.0000	0.0	2980.6	0.77	11073.7
30	46.0	45.5	45.5	128.0	5729	0.0	0.5894	3.3765	488.0	8468.8	0.0000	0.0	2980.6	0.77	11449.4
31	47.0	46.5	46.5	128.0	5857	0.0	0.5794	3.3937	490.4	8846.5	0.0000	0.0	2980.6	0.77	11827.1
32	48.0	47.5	47.5	128.0	5985	0.0	0.5696	3.4089	492.6	9225.8	0.0000	0.0	2980.6	0.77	12206.4
33	49.0	48.5	48.5	128.0	6113	0.0	0.5598	3.4223	494.6	9606.6	0.0000	0.0	2980.6	0.77	12587.2
34	50.0	49.5	49.5	128.0	6241	0.0	0.5502	3.4337	496.2	9988.7	0.0000	0.0	2980.6	0.77	12969.3
35	51.0	50.5	50.5	128.0	6369	0.0	0.5406	3.4434	497.6	10371.9	0.0000	0.0	2980.6	0.77	13352.5
36	52.0	51.5	51.5	128.0	6497	0.0	0.5312	3.4512	498.7	10755.9	0.0000	0.0	2980.6	0.77	13736.5
37	53.0	52.5	52.5	128.0	6625	0.0	0.5218	3.4571	499.6	11140.6	0.0000	0.0	2980.6	0.77	14121.2
38	54.0	53.5	53.5	128.0	6753	0.0	0.5126	3.4613	500.2	11525.7	0.0000	0.0	2980.6	0.77	14506.3
39	55.0	54.5	54.5	128.0	6881	0.0	0.5034	3.4637	500.6	11911.2	0.0000	0.0	2980.6	0.77	14891.8
40	56.0	55.5	55.5	128.0	7009	0.0	0.4943	3.4644	500.6	12296.7	0.0000	0.0	2980.6	0.77	15277.3
41	57.0	56.5	56.5	128.0	7137	0.0	0.4853	3.4632	500.5	12682.0	0.0000	0.0	2980.6	0.77	15662.6
42	58.0	57.5	57.5	128.0	7265	0.0	0.4763	3.4604	500.1	13067.1	0.0000	0.0	2980.6	0.77	16047.7
43	59.0	58.5	58.5	128.0	7393	0.0	0.4674	3.4558	499.4	13451.7	0.0000	0.0	2980.6	0.77	16432.2
44	60.0	59.5	59.5	128.0	7521	0.0	0.4587	3.4496	498.5	13835.5	0.0000	0.0	2980.6	0.77	16816.1

L=30' for 5 to 1

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
17660 Newhope Street, Suite E, Fountain Valley, CA 92708
phone: (714)751-3826, Fax (714)751-3928

Project: **Placentia Overhead Abut 5 (Widen)** Project No. **08-115**
By CTY Date 5/1/2009 Check by Date Sheet

Settlement Calculation for Pile Group

Pile Top Depth.= 23 ft @ El. 218 ft
Pile Tip Depth= 35 ft @ El. 206 ft
Pile Length= 12 ft
Equivalent Footing
Depth = 31 ft (usually 2/3 of pile length)
Width = 8.0 ft Length= 70.0 ft
Load per Support= 2650 kips
Equivalent Load = 4.7 ksf

Check Settlement:
Method: FHWA Hough Method

Layer	Top Elev. (ft)	Bottom Elev. (ft)	Top Depth (ft)	Bottom Depth (ft)	Soil Type	γ' pcf	(N')	c'
1	241	227	0	14	SC	120	14	48
2	227	192	14	49	CL	123	20	50
3	192	167	49	74	SM	128	45	107
4	167	162	74	79	CL	123	70	125
5	162	150	79	91	SM	128	45	107

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Depth	Layer Thick. (ft)	Mid pt. depth (ft)	γ' kcf	σ_{vo}' (ksf)	depth to Equiv. Footing (ft)	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)	Total ΔS (in)
0										
4	4	2	0.12	0.24	-29	0.00	0.24	48	0.00	0.00
8	4	6	0.12	0.72	-25	0.00	0.72	48	0.00	0.00
12	4	10	0.12	1.20	-21	0.00	1.20	48	0.00	0.00
14	2	13	0.12	1.56	-18	0.00	1.56	48	0.00	0.00
18	4	16	0.123	1.93	-15	0.00	1.93	50	0.00	0.00
22	4	20	0.123	2.42	-11	0.00	2.42	50	0.00	0.00
26	4	24	0.123	2.91	-7	0.00	2.91	50	0.00	0.00
30	4	28	0.123	3.40	-3	0.00	3.40	50	0.00	0.00
31	1	30.5	0.123	3.71	-0.5	0.00	3.71	50	0.00	0.00
35	4	33	0.123	4.02	2	3.79	7.80	50	0.28	0.28
39	4	37	0.123	4.51	6	2.70	7.21	50	0.20	0.47
43	4	41	0.123	5.00	10	2.10	7.10	50	0.15	0.62
47	4	45	0.123	5.49	14	1.72	7.21	50	0.11	0.73
49	2	48	0.123	5.86	17	1.51	7.38	50	0.05	0.78
53	4	51	0.128	6.24	20	1.35	7.59	107	0.04	0.82
57	4	55	0.128	6.75	24	1.18	7.94	107	0.03	0.85
61	4	59	0.128	7.27	28	1.05	8.32	107	0.03	0.88
65	4	63	0.128	7.78	32	0.95	8.72	107	0.02	0.90

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Project Placentia Ave UC Project No. _____

By CIK Date 5/16/09 Checked By _____ Date _____ Sheet ____ of ____

Bent 2

△ Strength Limit State

– single pile

pile demand = 294/0.7 = 420 k

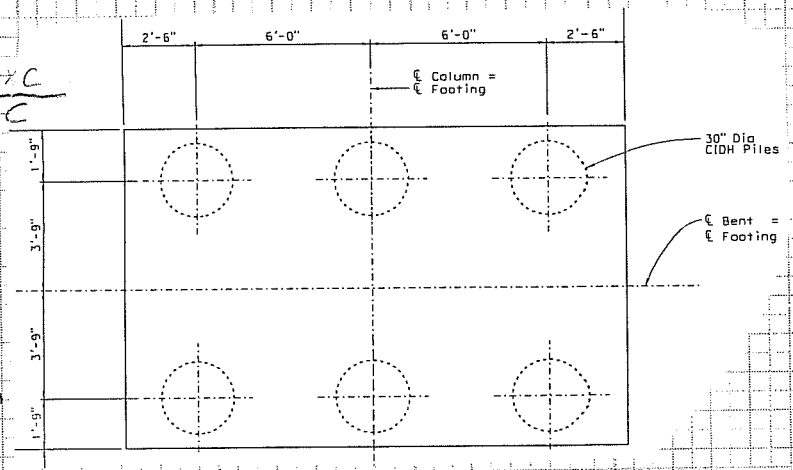
⇒ L = 36' say 35' ⇒ El +172'

– pile group

$$\eta_{day} = \frac{(6+2.5+7.5+2.5)\times 2 \times C}{6\times 2.5\times 7\times 0.25\times C} = 1.63 > 1$$

⇒ $\eta_{day} = 1$

$\eta_{grp} = 0.65$ for c-c spacing = 2.5D



pile group demand = 1764/0.7 = 2520 k

L = 46' ⇒ El +170'

△ Extreme Limit State

– single pile

pile demand = 380 k

⇒ L = 34' say 36' ⇒ El +174'

– pile group

pile group demand = 1500 k

⇒ L = 30' say 16' ⇒ El 196'

– tension $60\times\frac{0.7}{0.75} = 84$ k (the corresponding compression) ⇒ L = 12'

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia UC (widen) Bent 2 - single pile ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 01/30/09

CHECKED BY: DATE:

D_s => 2.5 ft Hw => 100.0 ft Hg => 0.0 ft

p = 7.8540 ft Ho => 0.0 ft Hf => 5.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	3	120	57.6	0.00	29
(2)	3	28	123	60.6	2.50	0
(3)	28	33	120	57.6	0.00	32
(4)	33	58	128	65.6	0.00	38
(5)	58	150	125	62.6	3.00	0
(6)	58	150	125	62.6	3.00	0
(7)	58	150	125	62.6	3.00	0
(8)	58	150	125	62.6	3.00	0

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	Q_s	Q_{final}
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)	(kips)	(kips)
0	0.0	0.0	0.0	120.0	0										
1	5.0	2.5	2.5	120.0	300	0.0				0.0			0.0	0.0	0.0
2	6.0	5.5	5.5	123.0	669	2.5	1.1834	0.0000	0.0	0.0	1.3750	10.8	10.8	10.8	10.7
3	8.0	7.0	7.0	123.0	854	2.5	1.1428	0.0000	0.0	0.0	1.3750	21.6	32.4	32.4	32.1
4	10.0	9.0	9.0	123.0	1100	2.5	1.0950	0.0000	0.0	0.0	1.3750	21.6	54.0	54.0	53.5
5	11.0	10.5	10.5	123.0	1284	2.5	1.0626	0.0000	0.0	0.0	1.3750	10.8	64.8	64.8	64.1
6	12.0	11.5	11.5	123.0	1407	2.5	1.0422	0.0000	0.0	0.0	1.3750	10.8	75.6	75.6	74.8
7	13.0	12.5	12.5	123.0	1530	2.5	1.0227	0.0000	0.0	0.0	1.3750	10.8	86.4	86.4	85.5
8	14.0	13.5	13.5	123.0	1653	2.5	1.0040	0.0000	0.0	0.0	1.3750	10.8	97.2	97.2	96.2
9	15.0	14.5	14.5	123.0	1776	2.5	0.9859	0.0000	0.0	0.0	1.3750	10.8	108.0	108.0	106.9
10	16.0	15.5	15.5	123.0	1899	2.5	0.9685	0.0000	0.0	0.0	1.3750	10.8	118.8	118.8	117.6
11	17.0	16.5	16.5	123.0	2022	2.5	0.9516	0.0000	0.0	0.0	1.3750	10.8	129.6	129.6	128.3
12	18.0	17.5	17.5	123.0	2145	2.5	0.9353	0.0000	0.0	0.0	1.3750	10.8	140.4	140.4	139.0
13	19.0	18.5	18.5	123.0	2268	2.5	0.9193	0.0000	0.0	0.0	1.3750	10.8	151.2	151.2	149.7
14	20.0	19.5	19.5	123.0	2391	2.5	0.9039	0.0000	0.0	0.0	1.3750	10.8	162.0	162.0	160.4
15	22.0	21.0	21.0	123.0	2576	2.5	0.8814	0.0000	0.0	0.0	1.3750	21.6	183.6	183.6	181.8
16	24.0	23.0	23.0	123.0	2822	2.5	0.8526	0.0000	0.0	0.0	1.3750	21.6	205.2	205.2	203.1
17	26.0	25.0	25.0	123.0	3068	2.5	0.8250	0.0000	0.0	0.0	1.3750	21.6	226.8	226.8	224.5
18	28.0	27.0	27.0	123.0	3314	2.5	0.7985	0.0000	0.0	0.0	1.3750	21.6	248.4	248.4	245.9
19	30.0	29.0	29.0	120.0	3554	0.0	0.7730	2.7469	43.1	43.1	0.0000	0.0	248.4	291.5	288.6
20	32.0	31.0	31.0	120.0	3794	0.0	0.7484	2.8389	44.6	87.7	0.0000	0.0	248.4	336.1	332.8
21	34.0	33.0	33.0	128.0	4050	0.0	0.7245	2.9338	46.1	133.8	0.0000	0.0	248.4	382.2	378.4
22	36.0	35.0	35.0	128.0	4306	0.0	0.7013	3.0196	47.4	181.3	0.0000	0.0	248.4	429.6	425.3
23	38.0	37.0	37.0	128.0	4562	0.0	0.6788	3.0965	48.6	229.9	0.0000	0.0	248.4	478.3	473.5
24	40.0	39.0	39.0	128.0	4818	0.0	0.6569	3.1647	49.7	279.6	0.0000	0.0	248.4	528.0	522.7
25	41.0	40.5	40.5	128.0	5010	0.0	0.6409	3.2104	25.2	304.8	0.0000	0.0	248.4	553.2	547.7
26	42.0	41.5	41.5	128.0	5138	0.0	0.6303	3.2383	25.4	330.3	0.0000	0.0	248.4	578.6	572.9
27	43.0	42.5	42.5	128.0	5266	0.0	0.6199	3.2641	25.6	355.9	0.0000	0.0	248.4	604.3	598.2
28	44.0	43.5	43.5	128.0	5394	0.0	0.6096	3.2880	25.8	381.7	0.0000	0.0	248.4	630.1	623.8
29	45.0	44.5	44.5	128.0	5522	0.0	0.5994	3.3098	26.0	407.7	0.0000	0.0	248.4	656.1	649.5
30	46.0	45.5	45.5	128.0	5650	0.0	0.5894	3.3297	26.2	433.9	0.0000	0.0	248.4	682.2	675.4
31	47.0	46.5	46.5	128.0	5778	0.0	0.5794	3.3476	26.3	460.2	0.0000	0.0	248.4	708.5	701.4
32	48.0	47.5	47.5	128.0	5906	0.0	0.5696	3.3636	26.4	486.6	0.0000	0.0	248.4	735.0	727.6
33	49.0	48.5	48.5	128.0	6034	0.0	0.5598	3.3778	26.5	513.1	0.0000	0.0	248.4	761.5	753.9
34	50.0	49.5	49.5	128.0	6162	0.0	0.5502	3.3900	26.6	539.7	0.0000	0.0	248.4	788.1	780.2
35	51.0	50.5	50.5	128.0	6290	0.0	0.5406	3.4004	26.7	566.4	0.0000	0.0	248.4	814.8	806.7
36	52.0	51.5	51.5	128.0	6418	0.0	0.5312	3.4089	26.8	593.2	0.0000	0.0	248.4	841.6	833.2
37	53.0	52.5	52.5	128.0	6546	0.0	0.5218	3.4157	26.8	620.0	0.0000	0.0	248.4	868.4	859.7

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia UC (widen) Bent 2 - pile group ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 05/16/09

CHECKED BY: DATE:

D_s => 2.5 ft Hw => 100.0 ft Hg => 0.0 ft

no. of piles= 6 Ho => 0.0 ft Hf => 5.0 ft

p = 47.12 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>	η
(1)	0	3	120	57.6	0.00	29	0.63
(2)	3	28	123	60.6	2.50	0	1.00
(3)	28	33	120	57.6	0.00	32	0.63
(4)	33	58	128	65.6	0.00	38	0.63
(5)	58	150	125	62.6	3.00	0	1.00
(6)	58	150	125	62.6	3.00	0	1.00
(7)	58	150	125	62.6	3.00	0	1.00
(8)	58	150	125	62.6	3.00	0	1.00

C-C Sp/D	η
2.5	0.65
3.0	0.77
3.5	0.88
4.0	1.00

Current C-C Spacing/D 2.4

Clay group eff 1.00

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	η	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)		(kips)
0	0.0	0.0	0.0	120.0	0					0.0			0.0	0.63	0.0
1	5.0	2.5	2.5	120.0	300	0.0				0.0			0.0	0.63	0.0
2	6.0	5.5	5.5	123.0	669	2.5	1.1834	0.0000	0.0	0.0	1.3750	64.8	64.8	1.00	64.8
3	8.0	7.0	7.0	123.0	854	2.5	1.1428	0.0000	0.0	0.0	1.3750	129.6	194.4	1.00	194.4
4	10.0	9.0	9.0	123.0	1100	2.5	1.0950	0.0000	0.0	0.0	1.3750	129.6	324.0	1.00	324.0
5	12.0	11.0	11.0	123.0	1346	2.5	1.0523	0.0000	0.0	0.0	1.3750	129.6	453.6	1.00	453.6
6	14.0	13.0	13.0	123.0	1592	2.5	1.0133	0.0000	0.0	0.0	1.3750	129.6	583.2	1.00	583.2
7	16.0	15.0	15.0	123.0	1838	2.5	0.9771	0.0000	0.0	0.0	1.3750	129.6	712.7	1.00	712.7
8	18.0	17.0	17.0	123.0	2084	2.5	0.9434	0.0000	0.0	0.0	1.3750	129.6	842.3	1.00	842.3
9	20.0	19.0	19.0	123.0	2330	2.5	0.9115	0.0000	0.0	0.0	1.3750	129.6	971.9	1.00	971.9
10	22.0	21.0	21.0	123.0	2576	2.5	0.8814	0.0000	0.0	0.0	1.3750	129.6	1101.5	1.00	1101.5
11	24.0	23.0	23.0	123.0	2822	2.5	0.8526	0.0000	0.0	0.0	1.3750	129.6	1231.1	1.00	1231.1
12	26.0	25.0	25.0	123.0	3068	2.5	0.8250	0.0000	0.0	0.0	1.3750	129.6	1360.7	1.00	1360.7
13	28.0	27.0	27.0	123.0	3314	2.5	0.7985	0.0000	0.0	0.0	1.3750	129.6	1490.3	1.00	1490.3
14	30.0	29.0	29.0	120.0	3554	0.0	0.7730	2.7469	258.9	162.1	0.0000	0.0	1490.3	0.63	1652.4
15	31.0	30.5	30.5	120.0	3734	0.0	0.7544	2.8167	132.7	245.2	0.0000	0.0	1490.3	0.63	1735.4
16	32.0	31.5	31.5	120.0	3854	0.0	0.7423	2.8605	134.8	329.5	0.0000	0.0	1490.3	0.63	1819.8
17	33.0	32.5	32.5	120.0	3974	0.0	0.7304	2.9022	136.8	415.2	0.0000	0.0	1490.3	0.63	1905.4
18	34.0	33.5	33.5	128.0	4102	0.0	0.7186	2.9475	138.9	502.1	0.0000	0.0	1490.3	0.63	1992.4
19	35.0	34.5	34.5	128.0	4230	0.0	0.7071	2.9905	140.9	590.3	0.0000	0.0	1490.3	0.63	2080.6
20	36.0	35.5	35.5	128.0	4358	0.0	0.6956	3.0313	142.8	679.7	0.0000	0.0	1490.3	0.63	2170.0
21	37.0	36.5	36.5	128.0	4486	0.0	0.6844	3.0699	144.7	770.3	0.0000	0.0	1490.3	0.63	2260.6
22	38.0	37.5	37.5	128.0	4614	0.0	0.6733	3.1063	146.4	861.9	0.0000	0.0	1490.3	0.63	2352.2
23	39.0	38.5	38.5	128.0	4742	0.0	0.6623	3.1405	148.0	954.6	0.0000	0.0	1490.3	0.63	2444.9
24	40.0	39.5	39.5	128.0	4870	0.0	0.6515	3.1727	149.5	1048.2	0.0000	0.0	1490.3	0.63	2538.5
25	41.0	40.5	40.5	128.0	4998	0.0	0.6409	3.2027	150.9	1142.6	0.0000	0.0	1490.3	0.63	2632.9
26	42.0	41.5	41.5	128.0	5126	0.0	0.6303	3.2307	152.2	1238.0	0.0000	0.0	1490.3	0.63	2728.2
27	43.0	42.5	42.5	128.0	5254	0.0	0.6199	3.2567	153.5	1334.0	0.0000	0.0	1490.3	0.63	2824.3
28	44.0	43.5	43.5	128.0	5382	0.0	0.6096	3.2806	154.6	1430.8	0.0000	0.0	1490.3	0.63	2921.1
29	45.0	44.5	44.5	128.0	5510	0.0	0.5994	3.3026	155.6	1528.2	0.0000	0.0	1490.3	0.63	3018.5
30	46.0	45.5	45.5	128.0	5638	0.0	0.5894	3.3226	156.6	1626.2	0.0000	0.0	1490.3	0.63	3116.5
31	47.0	46.5	46.5	128.0	5766	0.0	0.5794	3.3407	157.4	1724.8	0.0000	0.0	1490.3	0.63	3215.1
32	48.0	47.5	47.5	128.0	5894	0.0	0.5696	3.3568	158.2	1823.8	0.0000	0.0	1490.3	0.63	3314.1
33	49.0	48.5	48.5	128.0	6022	0.0	0.5598	3.3710	158.9	1923.3	0.0000	0.0	1490.3	0.63	3413.5
34	50.0	49.5	49.5	128.0	6150	0.0	0.5502	3.3834	159.4	2023.1	0.0000	0.0	1490.3	0.63	3513.4
35	51.0	50.5	50.5	128.0	6278	0.0	0.5406	3.3939	159.9	2123.2	0.0000	0.0	1490.3	0.63	3613.5
36	52.0	51.5	51.5	128.0	6406	0.0	0.5312	3.4026	160.3	2223.6	0.0000	0.0	1490.3	0.63	3713.8
37	53.0	52.5	52.5	128.0	6534	0.0	0.5218	3.4094	160.7	2324.1	0.0000	0.0	1490.3	0.63	3814.4
38	54.0	53.5	53.5	128.0	6662	0.0	0.5126	3.4144	160.9	2424.9	0.0000	0.0	1490.3	0.63	3915.1
39	55.0	54.5	54.5	128.0	6790	0.0	0.5034	3.4177	161.1	2525.7	0.0000	0.0	1490.3	0.63	4016.0
40	56.0	55.5	55.5	128.0	6918	0.0	0.4943	3.4191	161.1	2626.5	0.0000	0.0	1490.3	0.63	4116.8
41	57.0	56.5	56.5	128.0	7046	0.0	0.4853	3.4188	161.1	2727.4	0.0000	0.0	1490.3	0.63	4217.7
42	58.0	57.5	57.5	128.0	7174	0.0	0.4763	3.4168	161.0	2828.2	0.0000	0.0	1490.3	0.63	4318.5
43	59.0	58.5	58.5	125.0	7299	3.0	0.4674	0.0000	0.0	2828.2	1.6500	77.8	1568.0	1.00	4396.2
44	60.0	59.5	59.5	125.0	7424	3.0	0.4587	0.0000	0.0	2828.2	1.6500	77.8	1645.8	1.00	4474.0

L=36' extreme

L=40' strength

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
17660 Newhope Street, Suite E, Fountain Valley, CA 92708
phone: (714)751-3826, Fax (714)751-3928

Project: **Placentia Avenue UC Bent 2 (Widen)** Project No. **08-115**
By CTY Date 5/1/2009 Check by Date Sheet

Settlement Calculation for Pile Group

Pile Top Depth.= 7 ft @ El. 210 ft
Pile Tip Depth= 47 ft @ El. 170 ft
Pile Length= 40 ft
Equivalent Footing
Depth = 34 ft (usually 2/3 of pile length)
Width = 9.5 ft Length= 14.5 ft
Load per Support= 1140 kips
Equivalent Load = 8.3 ksf

Check Settlement:
Method: FHWA Hough Method

Layer	Top Elev. (ft)	Bottom Elev. (ft)	Top Depth (ft)	Bottom Depth (ft)	Soil Type	γ' pcf	(N')	c'
1	217	207	0	10	SM	120	12	45
2	207	182	10	35	SC	123	25	67
3	182	177	35	40	SC	120	18	55
4	177	152	40	65	SM	128	55	129
5	152	145	65	72	CL	125	35	73

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Depth	Layer Thick. (ft)	Mid pt. depth (ft)	γ' kcf	σ_{vo}' (ksf)	depth to Equiv. Footing (ft)	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)	Total ΔS (in)
0										
4	4	2	0.12	0.24	-32	0.00	0.24	45	0.00	0.00
8	4	6	0.12	0.72	-28	0.00	0.72	45	0.00	0.00
10	2	9	0.12	1.08	-25	0.00	1.08	45	0.00	0.00
14	4	12	0.123	1.45	-22	0.00	1.45	67	0.00	0.00
18	4	16	0.123	1.94	-18	0.00	1.94	67	0.00	0.00
22	4	20	0.123	2.43	-14	0.00	2.43	67	0.00	0.00
26	4	24	0.123	2.92	-10	0.00	2.92	67	0.00	0.00
30	4	28	0.123	3.41	-6	0.00	3.41	67	0.00	0.00
34	4	32	0.123	3.91	-2	0.00	3.91	67	0.00	0.00
35	1	34.5	0.123	4.21	0.5	7.86	12.08	67	0.08	0.08
39	4	37	0.12	4.52	3	6.29	10.80	55	0.33	0.41
40	1	39.5	0.12	4.82	5.5	5.24	10.06	55	0.07	0.48
44	4	42	0.128	5.13	8	4.49	9.62	129	0.10	0.58
48	4	46	0.128	5.64	12	3.66	9.30	129	0.08	0.66
52	4	50	0.128	6.16	16	3.08	9.24	129	0.07	0.73
56	4	54	0.128	6.67	20	2.67	9.33	129	0.05	0.78
60	4	58	0.128	7.18	24	2.35	9.53	129	0.05	0.83
64	4	62	0.128	7.69	28	2.10	9.79	129	0.04	0.87
65	1	64.5	0.128	8.01	30.5	1.97	9.98	129	0.01	0.88
69	4	67	0.125	8.33	33	1.85	10.17	73	0.06	0.94
72	3	70.5	0.125	8.76	36.5	1.71	10.47	73	0.04	0.97

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Project Placentia Ave UC Project No. _____

By CTY Date _____ Checked By _____ Date _____ Sheet ____ of ____

Bent 3

Δ Strength Limit State

- Single pile

pile demand = 349/0.7 = 490^k

⇒ L = 40' say 42' ⇒ El. +169'

- pile group (same as Bent 2)

n_day = 1

P_cmd = 0.65 for C-C spacing of ≥ 4D

pile group demand = 1971/0.7 = 2820^k

⇒ L = 51' ⇒ El. +160'

Δ Extreme Limit State

- Single pile

pile demand = 360^k

⇒ L = 36' say 38' ⇒ El. +173'

- pile group

pile group demand = 1500^k

⇒ L = 24'

- tension

tension demand = 60^k

corresponding compression demand = 60 × 0.7/0.5 = 84^k

⇒ L = 24' say 24' ⇒ El. +187'

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia UC (widen) Bents 3 and 4 - single pile ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 01/30/09

CHECKED BY: DATE:

D_s => 2.5 ft Hw => 100.0 ft Hg => 0.0 ft

p = 7.8540 ft Ho => 0.0 ft Hf => 5.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	18	120	57.6	1.10	0
(2)	18	23	123	60.6	2.50	0
(3)	23	28	120	57.6	0.00	31
(4)	28	43	128	65.6	0.00	38
(5)	43	48	129	66.6	1.30	0
(6)	48	58	130	67.6	0.00	40
(7)	58	150	123	60.6	2.50	0
(8)	58	150	123	60.6	2.50	0

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	Q_s	Q_{final}	
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)	(kips)	(kips)	
0	0.0	0.0	0.0	120.0	0											
1	5.0	2.5	2.5	120.0	300	1.1				0.0				0.0	0.0	0.0
2	6.0	5.5	5.5	120.0	660	1.1	1.1834	0.0000	0.0	0.0	0.6050	4.8	4.8	4.8	4.7	
3	8.0	7.0	7.0	120.0	840	1.1	1.1428	0.0000	0.0	0.0	0.6050	9.5	14.3	14.3	14.1	
4	10.0	9.0	9.0	120.0	1080	1.1	1.0950	0.0000	0.0	0.0	0.6050	9.5	23.8	23.8	23.5	
5	11.0	10.5	10.5	120.0	1260	1.1	1.0626	0.0000	0.0	0.0	0.6050	4.8	28.5	28.5	28.2	
6	12.0	11.5	11.5	120.0	1380	1.1	1.0422	0.0000	0.0	0.0	0.6050	4.8	33.3	33.3	32.9	
7	13.0	12.5	12.5	120.0	1500	1.1	1.0227	0.0000	0.0	0.0	0.6050	4.8	38.0	38.0	37.6	
8	14.0	13.5	13.5	120.0	1620	1.1	1.0040	0.0000	0.0	0.0	0.6050	4.8	42.8	42.8	42.3	
9	15.0	14.5	14.5	120.0	1740	1.1	0.9859	0.0000	0.0	0.0	0.6050	4.8	47.5	47.5	47.0	
10	16.0	15.5	15.5	120.0	1860	1.1	0.9685	0.0000	0.0	0.0	0.6050	4.8	52.3	52.3	51.7	
11	17.0	16.5	16.5	120.0	1980	1.1	0.9516	0.0000	0.0	0.0	0.6050	4.8	57.0	57.0	56.4	
12	18.0	17.5	17.5	120.0	2100	1.1	0.9353	0.0000	0.0	0.0	0.6050	4.8	61.8	61.8	61.2	
13	19.0	18.5	18.5	123.0	2223	2.5	0.9193	0.0000	0.0	0.0	1.3750	10.8	72.6	72.6	71.8	
14	20.0	19.5	19.5	123.0	2346	2.5	0.9039	0.0000	0.0	0.0	1.3750	10.8	83.4	83.4	82.5	
15	22.0	21.0	21.0	123.0	2531	2.5	0.8814	0.0000	0.0	0.0	1.3750	21.6	105.0	105.0	103.9	L=22'
16	24.0	23.0	23.0	120.0	2771	0.0	0.8526	2.3620	37.1	37.1	0.0000	0.0	105.0	142.1	140.7	tapfo
17	26.0	25.0	25.0	120.0	3011	0.0	0.8250	2.4837	39.0	76.1	0.0000	0.0	105.0	181.1	179.3	
18	28.0	27.0	27.0	120.0	3251	0.0	0.7985	2.5956	40.8	116.9	0.0000	0.0	105.0	221.9	219.6	
19	30.0	29.0	29.0	128.0	3507	0.0	0.7730	2.7105	42.6	159.5	0.0000	0.0	105.0	264.4	261.8	
20	32.0	31.0	31.0	128.0	3763	0.0	0.7484	2.8157	44.2	203.7	0.0000	0.0	105.0	308.7	305.6	
21	34.0	33.0	33.0	128.0	4019	0.0	0.7245	2.9113	45.7	249.4	0.0000	0.0	105.0	354.4	350.8	
22	36.0	35.0	35.0	128.0	4275	0.0	0.7013	2.9978	47.1	296.5	0.0000	0.0	105.0	401.5	397.5	L=36'
23	38.0	37.0	37.0	128.0	4531	0.0	0.6788	3.0754	48.3	344.8	0.0000	0.0	105.0	449.8	445.3	
24	40.0	39.0	39.0	128.0	4787	0.0	0.6569	3.1444	49.4	394.2	0.0000	0.0	105.0	499.2	494.2	L=40
25	41.0	40.5	40.5	128.0	4979	0.0	0.6409	3.1905	25.1	419.3	0.0000	0.0	105.0	524.2	519.0	stop
26	42.0	41.5	41.5	128.0	5107	0.0	0.6303	3.2187	25.3	444.6	0.0000	0.0	105.0	549.5	544.0	
27	43.0	42.5	42.5	128.0	5235	0.0	0.6199	3.2449	25.5	470.0	0.0000	0.0	105.0	575.0	569.3	
28	44.0	43.5	43.5	129.0	5364	1.3	0.6096	0.0000	0.0	470.0	0.7150	5.6	110.6	580.6	574.8	
29	45.0	44.5	44.5	129.0	5493	1.3	0.5994	0.0000	0.0	470.0	0.7150	5.6	116.2	586.2	580.4	
30	46.0	45.5	45.5	129.0	5622	1.3	0.5894	0.0000	0.0	470.0	0.7150	5.6	121.8	591.9	585.9	
31	47.0	46.5	46.5	129.0	5751	1.3	0.5794	0.0000	0.0	470.0	0.7150	5.6	127.4	597.5	591.5	
32	48.0	47.5	47.5	129.0	5880	1.3	0.5696	0.0000	0.0	470.0	0.7150	5.6	133.0	603.1	597.1	
33	49.0	48.5	48.5	130.0	6010	0.0	0.5598	3.3643	26.4	496.5	0.0000	0.0	133.0	629.5	623.2	
34	50.0	49.5	49.5	130.0	6140	0.0	0.5502	3.3779	26.5	523.0	0.0000	0.0	133.0	656.0	649.5	
35	51.0	50.5	50.5	130.0	6270	0.0	0.5406	3.3896	26.6	549.6	0.0000	0.0	133.0	682.7	675.8	
36	52.0	51.5	51.5	130.0	6400	0.0	0.5312	3.3994	26.7	576.3	0.0000	0.0	133.0	709.4	702.3	
37	53.0	52.5	52.5	130.0	6530	0.0	0.5218	3.4073	26.8	603.1	0.0000	0.0	133.0	736.1	728.8	

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia UC (widen) Bents 3 & 4 - pile group ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 05/16/09

CHECKED BY: DATE:

D_s => 2.5 ft Hw => 100.0 ft Hg => 0.0 ft

no. of piles= 6 Ho => 0.0 ft Hf => 5.0 ft

p = 47.12 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>	η
(1)	0	18	120	57.6	1.10	0	1.00
(2)	18	23	123	60.6	2.50	0	1.00
(3)	23	28	120	57.6	0.00	31	0.63
(4)	28	43	128	65.6	0.00	38	0.63
(5)	43	48	129	66.6	1.30	0	1.00
(6)	48	58	130	67.6	0.00	40	0.63
(7)	58	150	123	60.6	2.50	0	1.00
(8)	58	150	123	60.6	2.50	0	1.00

C-C Sp/D	η
2.5	0.65
3.0	0.77
3.5	0.88
4.0	1.00

Current C-C Spacing/D 2.4

Clay group eff 1.00

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	η	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)		(kips)
0	0.0	0.0	0.0	120.0	0					0.0			0.0	1.00	0.0
1	5.0	2.5	2.5	120.0	300	1.1				0.0			0.0	1.00	0.0
2	6.0	5.5	5.5	120.0	660	1.1	1.1834	0.0000	0.0	0.0	0.6050	28.5	28.5	1.00	28.5
3	8.0	7.0	7.0	120.0	840	1.1	1.1428	0.0000	0.0	0.0	0.6050	57.0	85.5	1.00	85.5
4	10.0	9.0	9.0	120.0	1080	1.1	1.0950	0.0000	0.0	0.0	0.6050	57.0	142.5	1.00	142.5
5	12.0	11.0	11.0	120.0	1320	1.1	1.0523	0.0000	0.0	0.0	0.6050	57.0	199.6	1.00	199.6
6	14.0	13.0	13.0	120.0	1560	1.1	1.0133	0.0000	0.0	0.0	0.6050	57.0	256.6	1.00	256.6
7	16.0	15.0	15.0	120.0	1800	1.1	0.9771	0.0000	0.0	0.0	0.6050	57.0	313.6	1.00	313.6
8	18.0	17.0	17.0	120.0	2040	1.1	0.9434	0.0000	0.0	0.0	0.6050	57.0	370.6	1.00	370.6
9	20.0	19.0	19.0	123.0	2286	2.5	0.9115	0.0000	0.0	0.0	1.3750	129.6	500.2	1.00	500.2
10	22.0	21.0	21.0	123.0	2532	2.5	0.8814	0.0000	0.0	0.0	1.3750	129.6	629.8	1.00	629.8
11	24.0	23.0	23.0	120.0	2772	0.0	0.8526	2.3633	222.7	139.4	0.0000	0.0	629.8	0.63	769.2
12	26.0	25.0	25.0	120.0	3012	0.0	0.8250	2.4849	234.2	286.0	0.0000	0.0	629.8	0.63	915.9
13	28.0	27.0	27.0	120.0	3252	0.0	0.7985	2.5968	244.7	439.2	0.0000	0.0	629.8	0.63	1069.1
14	30.0	29.0	29.0	128.0	3508	0.0	0.7730	2.7117	255.6	599.2	0.0000	0.0	629.8	0.63	1229.0
15	31.0	30.5	30.5	128.0	3700	0.0	0.7544	2.7914	131.5	681.6	0.0000	0.0	629.8	0.63	1311.4
16	32.0	31.5	31.5	128.0	3828	0.0	0.7423	2.8416	133.9	765.4	0.0000	0.0	629.8	0.63	1395.2
17	33.0	32.5	32.5	128.0	3956	0.0	0.7304	2.8894	136.2	850.6	0.0000	0.0	629.8	0.63	1480.5
18	34.0	33.5	33.5	128.0	4084	0.0	0.7186	2.9349	138.3	937.2	0.0000	0.0	629.8	0.63	1567.0
19	35.0	34.5	34.5	128.0	4212	0.0	0.7071	2.9781	140.3	1025.1	0.0000	0.0	629.8	0.63	1654.9
20	36.0	35.5	35.5	128.0	4340	0.0	0.6956	3.0191	142.3	1114.1	0.0000	0.0	629.8	0.63	1743.9
21	37.0	36.5	36.5	128.0	4468	0.0	0.6844	3.0579	144.1	1204.3	0.0000	0.0	629.8	0.63	1834.2
22	38.0	37.5	37.5	128.0	4596	0.0	0.6733	3.0945	145.8	1295.6	0.0000	0.0	629.8	0.63	1925.4
23	39.0	38.5	38.5	128.0	4724	0.0	0.6623	3.1289	147.4	1387.9	0.0000	0.0	629.8	0.63	2017.7
24	40.0	39.5	39.5	128.0	4852	0.0	0.6515	3.1613	149.0	1481.2	0.0000	0.0	629.8	0.63	2111.0
25	41.0	40.5	40.5	128.0	4980	0.0	0.6409	3.1915	150.4	1575.3	0.0000	0.0	629.8	0.63	2205.1
26	42.0	41.5	41.5	128.0	5108	0.0	0.6303	3.2197	151.7	1670.3	0.0000	0.0	629.8	0.63	2300.1
27	43.0	42.5	42.5	128.0	5236	0.0	0.6199	3.2458	153.0	1766.1	0.0000	0.0	629.8	0.63	2395.9
28	44.0	43.5	43.5	129.0	5365	1.3	0.6096	0.0000	0.0	1766.1	0.7150	33.7	663.5	1.00	2429.6
29	45.0	44.5	44.5	129.0	5494	1.3	0.5994	0.0000	0.0	1766.1	0.7150	33.7	697.2	1.00	2463.3
30	46.0	45.5	45.5	129.0	5623	1.3	0.5894	0.0000	0.0	1766.1	0.7150	33.7	730.9	1.00	2497.0
31	47.0	46.5	46.5	129.0	5752	1.3	0.5794	0.0000	0.0	1766.1	0.7150	33.7	764.6	1.00	2530.6
32	48.0	47.5	47.5	129.0	5881	1.3	0.5696	0.0000	0.0	1766.1	0.7150	33.7	798.3	1.00	2564.3
33	49.0	48.5	48.5	130.0	6011	0.0	0.5598	3.3652	158.6	1865.3	0.0000	0.0	798.3	0.63	2663.6
34	50.0	49.5	49.5	130.0	6141	0.0	0.5502	3.3787	159.2	1965.0	0.0000	0.0	798.3	0.63	2763.3
35	51.0	50.5	50.5	130.0	6271	0.0	0.5406	3.3904	159.8	2065.0	0.0000	0.0	798.3	0.63	2863.3
36	52.0	51.5	51.5	130.0	6401	0.0	0.5312	3.4002	160.2	2165.3	0.0000	0.0	798.3	0.63	2963.6
37	53.0	52.5	52.5	130.0	6531	0.0	0.5218	3.4081	160.6	2265.9	0.0000	0.0	798.3	0.63	3064.1
38	54.0	53.5	53.5	130.0	6661	0.0	0.5126	3.4142	160.9	2366.6	0.0000	0.0	798.3	0.63	3164.9
39	55.0	54.5	54.5	130.0	6791	0.0	0.5034	3.4184	161.1	2467.4	0.0000	0.0	798.3	0.63	3265.7
40	56.0	55.5	55.5	130.0	6921	0.0	0.4943	3.4209	161.2	2568.3	0.0000	0.0	798.3	0.63	3366.6
41	57.0	56.5	56.5	130.0	7051	0.0	0.4853	3.4215	161.2	2669.3	0.0000	0.0	798.3	0.63	3467.5
42	58.0	57.5	57.5	130.0	7181	0.0	0.4763	3.4204	161.2	2770.2	0.0000	0.0	798.3	0.63	3568.4
43	59.0	58.5	58.5	123.0	7304	2.5	0.4674	0.0000	0.0	2770.2	1.3750	64.8	863.1	1.00	3633.2
44	60.0	59.5	59.5	123.0	7427	2.5	0.4587	0.0000	0.0	2770.2	1.3750	64.8	927.9	1.00	3698.0

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
17660 Newhope Street, Suite E, Fountain Valley, CA 92708
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Project: **Placentia Avenue UC Bents 3 and 4 (Widen)** Project No. **08-115**
By CTY Date 5/1/2009 Check by Date Sheet

Settlement Calculation for Pile Group

Pile Top Depth.= 7 ft @ El. 211 ft
Pile Tip Depth= 47 ft @ El. 171 ft
Pile Length= 40 ft
Equivalent Footing
Depth = 34 ft (usually 2/3 of pile length)
Width = 9.5 ft Length= 14.5 ft
Load per Support= 1380 kips
Equivalent Load = 10.0 ksf

Check Settlement:
Method: FHWA Hough Method

Layer	Top Elev. (ft)	Bottom Elev. (ft)	Top Depth (ft)	Bottom Depth (ft)	Soil Type	γ' pcf	(N')	c'
1	218	193	0	25	SM	120	11	44
2	193	188	25	30	CL	123	30	65
3	188	183	30	35	SC	120	24	65
4	183	168	35	50	SM	128	55	129
5	168	163	50	55	CL	120	15	43
6	163	153	55	65	SM	130	80	184
7	153	146	65	72	CL	123	30	65

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Depth	Layer Thick. (ft)	Mid pt. depth (ft)	γ' kcf	σ_{vo}' (ksf)	depth to Equiv. Footing (ft)	$\Delta\sigma_v$' (ksf)	σ_{vt} (ksf)	C	ΔS (in)	Total ΔS (in)
0										
4	4	2	0.12	0.24	-32	0.00	0.24	44	0.00	0.00
8	4	6	0.12	0.72	-28	0.00	0.72	44	0.00	0.00
12	4	10	0.12	1.20	-24	0.00	1.20	44	0.00	0.00
16	4	14	0.12	1.68	-20	0.00	1.68	44	0.00	0.00
20	4	18	0.12	2.16	-16	0.00	2.16	44	0.00	0.00
24	4	22	0.12	2.64	-12	0.00	2.64	44	0.00	0.00
25	1	24.5	0.12	2.94	-9.5	0.00	2.94	44	0.00	0.00
29	4	27	0.123	3.25	-7	0.00	3.25	65	0.00	0.00
30	1	29.5	0.123	3.55	-4.5	0.00	3.55	65	0.00	0.00
34	4	32	0.12	3.86	-2	0.00	3.86	65	0.00	0.00
35	1	34.5	0.12	4.16	0.5	9.52	13.67	65	0.10	0.10
39	4	37	0.128	4.47	3	7.61	12.08	129	0.16	0.26
43	4	41	0.128	4.98	7	5.77	10.75	129	0.12	0.38
47	4	45	0.128	5.50	11	4.64	10.14	129	0.10	0.48
50	3	48.5	0.128	5.94	14.5	3.97	9.91	129	0.06	0.54
54	4	52	0.12	6.38	18	3.46	9.84	43	0.21	0.75
55	1	54.5	0.12	6.68	20.5	3.17	9.85	43	0.05	0.80
59	4	57	0.13	7.00	23	2.93	9.92	184	0.04	0.84
63	4	61	0.13	7.52	27	2.61	10.12	184	0.03	0.87
65	2	64	0.13	7.91	30	2.41	10.31	184	0.02	0.89
69	4	67	0.123	8.28	33	2.24	10.52	65	0.08	0.96
72	3	70.5	0.123	8.71	36.5	2.07	10.78	65	0.05	1.02

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Project Placentia Ave UC Project No. _____

By CAY Date _____ Checked By _____ Date _____ Sheet ____ of ____

Bent 4

△ Strength Limit state

- Single pile

pile demand = 350/0.7 = 500 k

⇒ L = 41' say 43' ⇒ El. +169'

- pile group (same as Bents 2 & 3)

$\eta_{clay} = 1$

$\eta_{sand} = 0.63$ for C-C spacing of 2.6D

pile group demand = $\frac{2100}{0.7}$ = 3000 k

⇒ L = 53' ⇒ El. +159'

△ Extreme Limit State

- Single pile

Pile demand = 580 k

⇒ L = 36' say 38' ⇒ El. +174'

- pile group

pile group demand = 1560 k

⇒ L = 34'

- tension

tension demand = 60 k

corresponding compression demand = $60 \times \frac{0.7}{0.5}$ = 84 k

⇒ L = 32' say 34' ⇒ El. +188'

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia UC (widen) Bents 3 and 4 - single pile ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: CY DATE: 01/30/09

CHECKED BY: DATE:

D_s => 2.5 ft Hw => 100.0 ft Hg => 0.0 ft

p = 7.8540 ft Ho => 0.0 ft Hf => 5.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	18	120	57.6	1.10	0
(2)	18	23	123	60.6	2.50	0
(3)	23	28	120	57.6	0.00	31
(4)	28	43	128	65.6	0.00	38
(5)	43	48	129	66.6	1.30	0
(6)	48	58	130	67.6	0.00	40
(7)	58	150	123	60.6	2.50	0
(8)	58	150	123	60.6	2.50	0

Sublayer No.	Depth, z	z_l	New Depth	Soil Unit	Overburden	c'	β	f_l^s	ΔQ_s^s	Q_s^s	f_l^c	ΔQ_s^c	Q_s^c	Q_s	Q_{final}	
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)	(kips)	(kips)	
0	0.0	0.0	0.0	120.0	0											
1	5.0	2.5	2.5	120.0	300	1.1				0.0			0.0	0.0	0.0	
2	6.0	5.5	5.5	120.0	660	1.1	1.1834	0.0000	0.0	0.0	0.6050	4.8	4.8	4.8	4.7	
3	8.0	7.0	7.0	120.0	840	1.1	1.1428	0.0000	0.0	0.0	0.6050	9.5	14.3	14.3	14.1	
4	10.0	9.0	9.0	120.0	1080	1.1	1.0950	0.0000	0.0	0.0	0.6050	9.5	23.8	23.8	23.5	
5	11.0	10.5	10.5	120.0	1260	1.1	1.0626	0.0000	0.0	0.0	0.6050	4.8	28.5	28.5	28.2	
6	12.0	11.5	11.5	120.0	1380	1.1	1.0422	0.0000	0.0	0.0	0.6050	4.8	33.3	33.3	32.9	
7	13.0	12.5	12.5	120.0	1500	1.1	1.0227	0.0000	0.0	0.0	0.6050	4.8	38.0	38.0	37.6	
8	14.0	13.5	13.5	120.0	1620	1.1	1.0040	0.0000	0.0	0.0	0.6050	4.8	42.8	42.8	42.3	
9	15.0	14.5	14.5	120.0	1740	1.1	0.9859	0.0000	0.0	0.0	0.6050	4.8	47.5	47.5	47.0	
10	16.0	15.5	15.5	120.0	1860	1.1	0.9685	0.0000	0.0	0.0	0.6050	4.8	52.3	52.3	51.7	
11	17.0	16.5	16.5	120.0	1980	1.1	0.9516	0.0000	0.0	0.0	0.6050	4.8	57.0	57.0	56.4	
12	18.0	17.5	17.5	120.0	2100	1.1	0.9353	0.0000	0.0	0.0	0.6050	4.8	61.8	61.8	61.2	
13	19.0	18.5	18.5	123.0	2223	2.5	0.9193	0.0000	0.0	0.0	1.3750	10.8	72.6	72.6	71.8	
14	20.0	19.5	19.5	123.0	2346	2.5	0.9039	0.0000	0.0	0.0	1.3750	10.8	83.4	83.4	82.5	
15	22.0	21.0	21.0	123.0	2531	2.5	0.8814	0.0000	0.0	0.0	1.3750	21.6	105.0	105.0	103.9	L=>
16	24.0	23.0	23.0	120.0	2771	0.0	0.8526	2.3620	37.1	37.1	0.0000	0.0	105.0	142.1	140.7	tan
17	26.0	25.0	25.0	120.0	3011	0.0	0.8250	2.4837	39.0	76.1	0.0000	0.0	105.0	181.1	179.3	
18	28.0	27.0	27.0	120.0	3251	0.0	0.7985	2.5956	40.8	116.9	0.0000	0.0	105.0	221.9	219.6	
19	30.0	29.0	29.0	128.0	3507	0.0	0.7730	2.7105	42.6	159.5	0.0000	0.0	105.0	264.4	261.8	
20	32.0	31.0	31.0	128.0	3763	0.0	0.7484	2.8157	44.2	203.7	0.0000	0.0	105.0	308.7	305.6	
21	34.0	33.0	33.0	128.0	4019	0.0	0.7245	2.9113	45.7	249.4	0.0000	0.0	105.0	354.4	350.8	
22	36.0	35.0	35.0	128.0	4275	0.0	0.7013	2.9978	47.1	296.5	0.0000	0.0	105.0	401.5	397.5	L=30
23	38.0	37.0	37.0	128.0	4531	0.0	0.6788	3.0754	48.3	344.8	0.0000	0.0	105.0	449.8	445.3	Rdn
24	40.0	39.0	39.0	128.0	4787	0.0	0.6569	3.1444	49.4	394.2	0.0000	0.0	105.0	499.2	494.2	
25	41.0	40.5	40.5	128.0	4979	0.0	0.6409	3.1905	25.1	419.3	0.0000	0.0	105.0	524.2	519.0	L=>
26	42.0	41.5	41.5	128.0	5107	0.0	0.6303	3.2187	25.3	444.6	0.0000	0.0	105.0	549.5	544.0	Stop
27	43.0	42.5	42.5	128.0	5235	0.0	0.6199	3.2449	25.5	470.0	0.0000	0.0	105.0	575.0	569.3	
28	44.0	43.5	43.5	129.0	5364	1.3	0.6096	0.0000	0.0	470.0	0.7150	5.6	110.6	580.6	574.8	
29	45.0	44.5	44.5	129.0	5493	1.3	0.5994	0.0000	0.0	470.0	0.7150	5.6	116.2	586.2	580.4	
30	46.0	45.5	45.5	129.0	5622	1.3	0.5894	0.0000	0.0	470.0	0.7150	5.6	121.8	591.9	585.9	
31	47.0	46.5	46.5	129.0	5751	1.3	0.5794	0.0000	0.0	470.0	0.7150	5.6	127.4	597.5	591.5	
32	48.0	47.5	47.5	129.0	5880	1.3	0.5696	0.0000	0.0	470.0	0.7150	5.6	133.0	603.1	597.1	
33	49.0	48.5	48.5	130.0	6010	0.0	0.5598	3.3643	26.4	496.5	0.0000	0.0	133.0	629.5	623.2	
34	50.0	49.5	49.5	130.0	6140	0.0	0.5502	3.3779	26.5	523.0	0.0000	0.0	133.0	656.0	649.5	
35	51.0	50.5	50.5	130.0	6270	0.0	0.5406	3.3896	26.6	549.6	0.0000	0.0	133.0	682.7	675.8	
36	52.0	51.5	51.5	130.0	6400	0.0	0.5312	3.3994	26.7	576.3	0.0000	0.0	133.0	709.4	702.3	
37	53.0	52.5	52.5	130.0	6530	0.0	0.5218	3.4073	26.8	603.1	0.0000	0.0	133.0	736.1	728.8	

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Placentia UC (widen) Bents 3 & 4 - pile group ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115
DONE BY: CY DATE: 05/16/09
CHECKED BY: DATE:

D_s => 2.5 ft Hw => 100.0 ft Hg => 0.0 ft
no. of piles= 6 Ho => 0.0 ft Hf => 5.0 ft
p = 47.12 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>	η
(1)	0	18	120	57.6	1.10	0	1.00
(2)	18	23	123	60.6	2.50	0	1.00
(3)	23	28	120	57.6	0.00	31	0.63
(4)	28	43	128	65.6	0.00	38	0.63
(5)	43	48	129	66.6	1.30	0	1.00
(6)	48	58	130	67.6	0.00	40	0.63
(7)	58	150	123	60.6	2.50	0	1.00
(8)	58	150	123	60.6	2.50	0	1.00

C-C Sp/D	η
2.5	0.65
3.0	0.77
3.5	0.88
4.0	1.00

Current C-C Spacing/D 2.4

Clay group eff 1.00

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	η	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)		(kips)
0	0.0	0.0	0.0	120.0	0										
1	5.0	2.5	2.5	120.0	300	1.1				0.0			0.0	1.00	0.0
2	6.0	5.5	5.5	120.0	660	1.1	1.1834	0.0000	0.0	0.0	0.6050	28.5	28.5	1.00	28.5
3	8.0	7.0	7.0	120.0	840	1.1	1.1428	0.0000	0.0	0.0	0.6050	57.0	85.5	1.00	85.5
4	10.0	9.0	9.0	120.0	1080	1.1	1.0950	0.0000	0.0	0.0	0.6050	57.0	142.5	1.00	142.5
5	12.0	11.0	11.0	120.0	1320	1.1	1.0523	0.0000	0.0	0.0	0.6050	57.0	199.6	1.00	199.6
6	14.0	13.0	13.0	120.0	1560	1.1	1.0133	0.0000	0.0	0.0	0.6050	57.0	256.6	1.00	256.6
7	16.0	15.0	15.0	120.0	1800	1.1	0.9771	0.0000	0.0	0.0	0.6050	57.0	313.6	1.00	313.6
8	18.0	17.0	17.0	120.0	2040	1.1	0.9434	0.0000	0.0	0.0	0.6050	57.0	370.6	1.00	370.6
9	20.0	19.0	19.0	123.0	2286	2.5	0.9115	0.0000	0.0	0.0	1.3750	129.6	500.2	1.00	500.2
10	22.0	21.0	21.0	123.0	2532	2.5	0.8814	0.0000	0.0	0.0	1.3750	129.6	629.8	1.00	629.8
11	24.0	23.0	23.0	120.0	2772	0.0	0.8526	2.3633	222.7	139.4	0.0000	0.0	629.8	0.63	769.2
12	26.0	25.0	25.0	120.0	3012	0.0	0.8250	2.4849	234.2	286.0	0.0000	0.0	629.8	0.63	915.9
13	28.0	27.0	27.0	120.0	3252	0.0	0.7985	2.5968	244.7	439.2	0.0000	0.0	629.8	0.63	1069.1
14	30.0	29.0	29.0	128.0	3508	0.0	0.7730	2.7117	255.6	599.2	0.0000	0.0	629.8	0.63	1229.0
15	31.0	30.5	30.5	128.0	3700	0.0	0.7544	2.7914	131.5	681.6	0.0000	0.0	629.8	0.63	1311.4
16	32.0	31.5	31.5	128.0	3828	0.0	0.7423	2.8416	133.9	765.4	0.0000	0.0	629.8	0.63	1395.2
17	33.0	32.5	32.5	128.0	3956	0.0	0.7304	2.8894	136.2	850.6	0.0000	0.0	629.8	0.63	1480.5
18	34.0	33.5	33.5	128.0	4084	0.0	0.7186	2.9349	138.3	937.2	0.0000	0.0	629.8	0.63	1567.0
19	35.0	34.5	34.5	128.0	4212	0.0	0.7071	2.9781	140.3	1025.1	0.0000	0.0	629.8	0.63	1654.9
20	36.0	35.5	35.5	128.0	4340	0.0	0.6956	3.0191	142.3	1114.1	0.0000	0.0	629.8	0.63	1743.9
21	37.0	36.5	36.5	128.0	4468	0.0	0.6844	3.0579	144.1	1204.3	0.0000	0.0	629.8	0.63	1834.2
22	38.0	37.5	37.5	128.0	4596	0.0	0.6733	3.0945	145.8	1295.6	0.0000	0.0	629.8	0.63	1925.4
23	39.0	38.5	38.5	128.0	4724	0.0	0.6623	3.1289	147.4	1387.9	0.0000	0.0	629.8	0.63	2017.7
24	40.0	39.5	39.5	128.0	4852	0.0	0.6515	3.1613	149.0	1481.2	0.0000	0.0	629.8	0.63	2111.0
25	41.0	40.5	40.5	128.0	4980	0.0	0.6409	3.1915	150.4	1575.3	0.0000	0.0	629.8	0.63	2205.1
26	42.0	41.5	41.5	128.0	5108	0.0	0.6303	3.2197	151.7	1670.3	0.0000	0.0	629.8	0.63	2300.1
27	43.0	42.5	42.5	128.0	5236	0.0	0.6199	3.2458	153.0	1766.1	0.0000	0.0	629.8	0.63	2395.9
28	44.0	43.5	43.5	129.0	5365	1.3	0.6096	0.0000	0.0	1766.1	0.7150	33.7	663.5	1.00	2429.6
29	45.0	44.5	44.5	129.0	5494	1.3	0.5994	0.0000	0.0	1766.1	0.7150	33.7	697.2	1.00	2463.3
30	46.0	45.5	45.5	129.0	5623	1.3	0.5894	0.0000	0.0	1766.1	0.7150	33.7	730.9	1.00	2497.0
31	47.0	46.5	46.5	129.0	5752	1.3	0.5794	0.0000	0.0	1766.1	0.7150	33.7	764.6	1.00	2530.6
32	48.0	47.5	47.5	129.0	5881	1.3	0.5696	0.0000	0.0	1766.1	0.7150	33.7	798.3	1.00	2564.3
33	49.0	48.5	48.5	130.0	6011	0.0	0.5598	3.3652	158.6	1865.3	0.0000	0.0	798.3	0.63	2663.6
34	50.0	49.5	49.5	130.0	6141	0.0	0.5502	3.3787	159.2	1965.0	0.0000	0.0	798.3	0.63	2763.3
35	51.0	50.5	50.5	130.0	6271	0.0	0.5406	3.3904	159.8	2065.0	0.0000	0.0	798.3	0.63	2863.3
36	52.0	51.5	51.5	130.0	6401	0.0	0.5312	3.4002	160.2	2165.3	0.0000	0.0	798.3	0.63	2963.6
37	53.0	52.5	52.5	130.0	6531	0.0	0.5218	3.4081	160.6	2265.9	0.0000	0.0	798.3	0.63	3064.1
38	54.0	53.5	53.5	130.0	6661	0.0	0.5126	3.4142	160.9	2366.6	0.0000	0.0	798.3	0.63	3164.9
39	55.0	54.5	54.5	130.0	6791	0.0	0.5034	3.4184	161.1	2467.4	0.0000	0.0	798.3	0.63	3265.7
40	56.0	55.5	55.5	130.0	6921	0.0	0.4943	3.4209	161.2	2568.3	0.0000	0.0	798.3	0.63	3366.6
41	57.0	56.5	56.5	130.0	7051	0.0	0.4853	3.4215	161.2	2669.3	0.0000	0.0	798.3	0.63	3467.5
42	58.0	57.5	57.5	130.0	7181	0.0	0.4763	3.4204	161.2	2770.2	0.0000	0.0	798.3	0.63	3568.4
43	59.0	58.5	58.5	123.0	7304	2.5	0.4674	0.0000	0.0	2770.2	1.3750	64.8	863.1	1.00	3633.2
44	60.0	59.5	59.5	123.0	7427	2.5	0.4587	0.0000	0.0	2770.2	1.3750	64.8	927.9	1.00	3698.0

L = 34' extreme

L=33' strength

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
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phone: (714)751-3826, Fax (714)751-3928

Project: **Placentia Avenue UC Bents 3 and 4 (Widen)** Project No. **08-115**
By CTY Date 5/1/2009 Check by Date Sheet

Settlement Calculation for Pile Group

Pile Top Depth.= 7 ft @ El. 211 ft
Pile Tip Depth= 47 ft @ El. 171 ft
Pile Length= 40 ft
Equivalent Footing
Depth = 34 ft (usually 2/3 of pile length)
Width = 9.5 ft Length= 14.5 ft
Load per Support= 1380 kips
Equivalent Load = 10.0 ksf

Check Settlement:
Method: FHWA Hough Method

Layer	Top Elev. (ft)	Bottom Elev. (ft)	Top Depth (ft)	Bottom Depth (ft)	Soil Type	γ' pcf	(N')	c'
1	218	193	0	25	SM	120	11	44
2	193	188	25	30	CL	123	30	65
3	188	183	30	35	SC	120	24	65
4	183	168	35	50	SM	128	55	129
5	168	163	50	55	CL	120	15	43
6	163	153	55	65	SM	130	80	184
7	153	146	65	72	CL	123	30	65

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Depth	Layer Thick. (ft)	Mid pt. depth (ft)	γ' kcf	σ_{vo}' (ksf)	depth to Equiv. Footing (ft)	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)	Total ΔS (in)
0										
4	4	2	0.12	0.24	-32	0.00	0.24	44	0.00	0.00
8	4	6	0.12	0.72	-28	0.00	0.72	44	0.00	0.00
12	4	10	0.12	1.20	-24	0.00	1.20	44	0.00	0.00
16	4	14	0.12	1.68	-20	0.00	1.68	44	0.00	0.00
20	4	18	0.12	2.16	-16	0.00	2.16	44	0.00	0.00
24	4	22	0.12	2.64	-12	0.00	2.64	44	0.00	0.00
25	1	24.5	0.12	2.94	-9.5	0.00	2.94	44	0.00	0.00
29	4	27	0.123	3.25	-7	0.00	3.25	65	0.00	0.00
30	1	29.5	0.123	3.55	-4.5	0.00	3.55	65	0.00	0.00
34	4	32	0.12	3.86	-2	0.00	3.86	65	0.00	0.00
35	1	34.5	0.12	4.16	0.5	9.52	13.67	65	0.10	0.10
39	4	37	0.128	4.47	3	7.61	12.08	129	0.16	0.26
43	4	41	0.128	4.98	7	5.77	10.75	129	0.12	0.38
47	4	45	0.128	5.50	11	4.64	10.14	129	0.10	0.48
50	3	48.5	0.128	5.94	14.5	3.97	9.91	129	0.06	0.54
54	4	52	0.12	6.38	18	3.46	9.84	43	0.21	0.75
55	1	54.5	0.12	6.68	20.5	3.17	9.85	43	0.05	0.80
59	4	57	0.13	7.00	23	2.93	9.92	184	0.04	0.84
63	4	61	0.13	7.52	27	2.61	10.12	184	0.03	0.87
65	2	64	0.13	7.91	30	2.41	10.31	184	0.02	0.89
69	4	67	0.123	8.28	33	2.24	10.52	65	0.08	0.96
72	3	70.5	0.123	8.71	36.5	2.07	10.78	65	0.05	1.02

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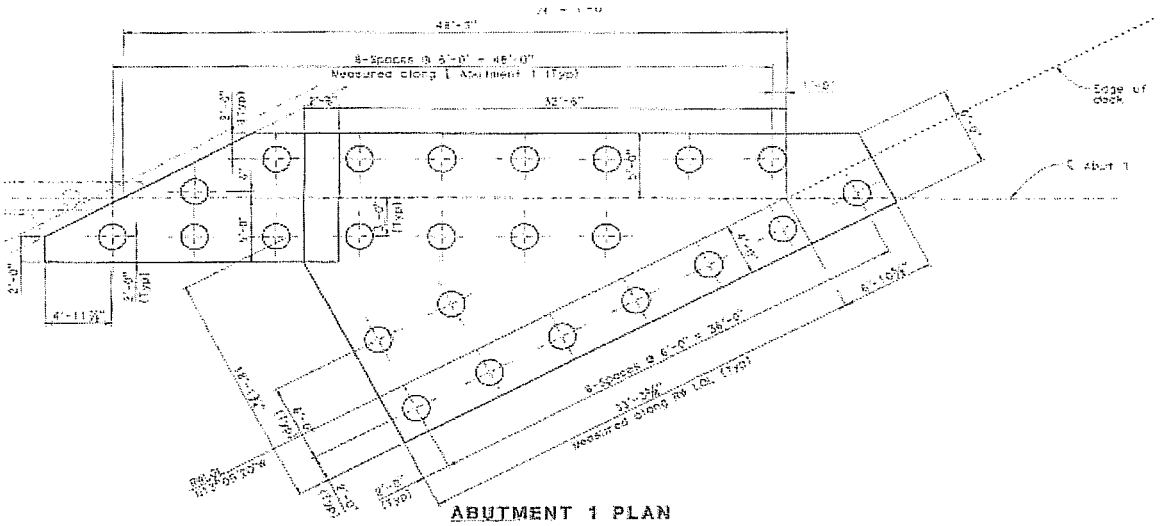
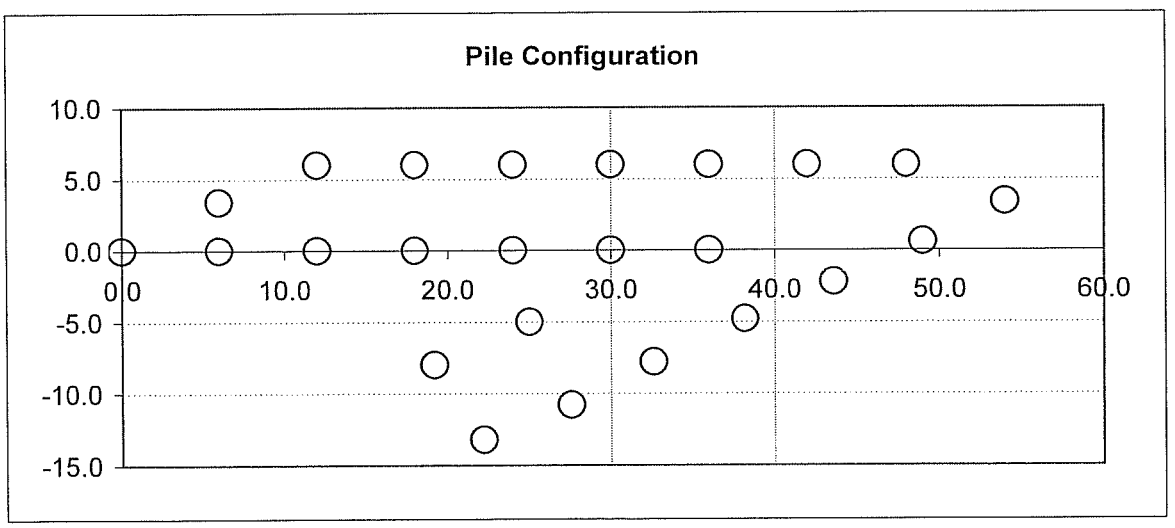
Project: **Placentia OH (WIDEN) - Abutment 1** Project No. **08-115**

By CTY Date 01/29/09 Check by Date Sheet

Proposed Abutment 1 Pile Layout



Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia. (feet): 2
No. of Piles: 24

	X-Dir	Y-Dir
Group Efficiency	0.580	0.599

0.59 = Avg

Coordinates

Pile No.	X	Y
1	0.000	0.00
2	6.000	0.00
3	12.000	0.00
4	18.000	0.00
5	24.000	0.00
6	30.000	0.00

Reduction Factors in X-dir	Reduction Factors in Y-dir
0.564	0.862
0.450	0.466
0.507	0.537
0.486	0.530
0.457	0.473
0.500	0.519

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By CTY Date 01/29/09 Check by Date Sheet

7	36.000	0.00
8	6.000	3.40
9	12.000	6.00
10	18.000	6.00
11	24.000	6.00
12	30.000	6.00
13	36.000	6.00
14	42.000	6.00
15	48.000	6.00
16	19.200	-8.00
17	25.000	-5.00
18	22.200	-13.20
19	27.600	-10.80
20	32.600	-7.80
21	38.200	-4.80
22	43.600	-2.20
23	49.000	0.60
24	54.000	3.40

0.548	0.513
0.446	0.704
0.558	0.829
0.542	0.805
0.545	0.805
0.549	0.805
0.576	0.805
0.586	0.865
0.659	0.809
0.578	0.599
0.536	0.453
0.664	0.586
0.657	0.532
0.692	0.572
0.620	0.513
0.673	0.580
0.648	0.548
0.876	0.849

Fx1 = 0.564 = 0.729 (lbl-21) x 0.948 (lbl-31) x 0.823 (skew-81) x 0.991 (skew-91)
skew-81 = 0.823 = SQRT((0.768*Cos(0.516))^2 + 0.975*Sin(0.516))^2)
skew-91 = 0.991 = SQRT((0.989*Cos(0.464))^2 + 1*Sin(0.464))^2)

Fx2 = 0.45 = 0.931 (lbl-12) x 0.729 (lbl-32) x 0.948 (lbl-42) x 0.767 (sbs-82) x 0.92 (skew-92) x 0.991 (skew-102)
skew-92 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-102 = 0.991 = SQRT((0.989*Cos(0.464))^2 + 1*Sin(0.464))^2)

Fx3 = 0.507 = 0.931 (lbl-23) x 0.729 (lbl-43) x 0.948 (lbl-53) x 0.968 (skew-83) x 0.93 (sbs-93) x 0.92 (skew-103) x 0.991 (skew-113) x 0.961 (skew-163)
skew-83 = 0.968 = SQRT((0.966*Cos(0.516))^2 + 0.975*Sin(0.516))^2)
skew-103 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-113 = 0.991 = SQRT((0.989*Cos(0.464))^2 + 1*Sin(0.464))^2)
skew-163 = 0.961 = SQRT((0.91*Cos(0.838))^2 + 1*Sin(0.838))^2)

Fx4 = 0.486 = 0.931 (lbl-34) x 0.729 (lbl-54) x 0.948 (lbl-64) x 0.93 (sbs-104) x 0.92 (skew-114) x 0.991 (skew-124) x 0.996 (skew-164) x 0.895 (skew-174)
skew-114 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-124 = 0.991 = SQRT((0.989*Cos(0.464))^2 + 1*Sin(0.464))^2)
skew-164 = 0.996 = SQRT((0.816*Cos(1.422))^2 + 1*Sin(1.422))^2)
skew-174 = 0.895 = SQRT((0.836*Cos(0.62))^2 + 1*Sin(0.62))^2)

Fx5 = 0.457 = 0.931 (lbl-45) x 0.729 (lbl-65) x 0.948 (lbl-75) x 0.93 (sbs-115) x 0.92 (skew-125) x 0.991 (skew-135) x 0.873 (skew-175) x 0.993 (skew-195) x 0.966 (skew-205)
skew-125 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-135 = 0.991 = SQRT((0.989*Cos(0.464))^2 + 1*Sin(0.464))^2)
skew-175 = 0.873 = SQRT((0.685*Cos(1.373))^2 + 0.88*Sin(1.373))^2)
skew-195 = 0.993 = SQRT((0.929*Cos(1.249))^2 + 1*Sin(1.249))^2)
skew-205 = 0.966 = SQRT((0.936*Cos(0.737))^2 + 1*Sin(0.737))^2)

Fx6 = 0.5 = 0.931 (lbl-56) x 0.729 (lbl-76) x 0.93 (sbs-126) x 0.92 (skew-136) x 0.991 (skew-146) x 0.978 (skew-176) x 0.984 (skew-206) x 0.903 (skew-216)

skew-136 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-146 = 0.991 = SQRT((0.989*Cos(0.464))^2 + 1*Sin(0.464))^2)
skew-176 = 0.978 = SQRT((0.972*Cos(0.785))^2 + 0.983*Sin(0.785))^2)
skew-206 = 0.984 = SQRT((0.821*Cos(1.249))^2 + 1*Sin(1.249))^2)
skew-216 = 0.903 = SQRT((0.868*Cos(0.53))^2 + 1*Sin(0.53))^2)

Fx7 = 0.548 = 0.931 (lbl-67) x 0.93 (sbs-137) x 0.92 (skew-147) x 0.991 (skew-157) x 0.859 (skew-217) x 0.826 (skew-227) x 0.978 (skew-237)

skew-147 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-157 = 0.991 = SQRT((0.989*Cos(0.464))^2 + 1*Sin(0.464))^2)
skew-217 = 0.859 = SQRT((0.694*Cos(1.141))^2 + 0.89*Sin(1.141))^2)
skew-227 = 0.826 = SQRT((0.809*Cos(0.282))^2 + 1*Sin(0.282))^2)
skew-237 = 0.978 = SQRT((0.978*Cos(0.046))^2 + 1*Sin(0.046))^2)

Fx8 = 0.446 = 0.968 (skew-18) x 0.767 (sbs-28) x 0.823 (skew-38) x 0.965 (skew-48) x 0.789 (skew-98) x 0.959 (skew-108)

skew-18 = 0.968 = SQRT((0.966*Cos(0.516))^2 + 0.975*Sin(0.516))^2)
skew-38 = 0.823 = SQRT((0.768*Cos(0.516))^2 + 0.975*Sin(0.516))^2)
skew-48 = 0.965 = SQRT((0.962*Cos(0.276))^2 + 1*Sin(0.276))^2)
skew-98 = 0.789 = SQRT((0.753*Cos(0.409))^2 + 0.957*Sin(0.409))^2)
skew-108 = 0.959 = SQRT((0.957*Cos(0.213))^2 + 1*Sin(0.213))^2)

Fx9 = 0.558 = 0.93 (sbs-39) x 0.92 (skew-49) x 0.991 (skew-59) x 0.953 (skew-89) x 0.729 (lbl-109) x 0.948 (lbl-119)

skew-49 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-59 = 0.991 = SQRT((0.989*Cos(0.464))^2 + 1*Sin(0.464))^2)
skew-89 = 0.953 = SQRT((0.953*Cos(0.409))^2 + 0.957*Sin(0.409))^2)

Fx10 = 0.542 = 0.93 (sbs-410) x 0.92 (skew-510) x 0.991 (skew-610) x 0.931 (lbl-910) x 0.729 (lbl-1110) x 0.948 (lbl-1210) x 0.994 (skew-1710)

skew-510 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-610 = 0.991 = SQRT((0.989*Cos(0.464))^2 + 1*Sin(0.464))^2)
skew-1710 = 0.994 = SQRT((0.979*Cos(1.004))^2 + 1*Sin(1.004))^2)

Fx11 = 0.545 = 0.93 (sbs-511) x 0.92 (skew-611) x 0.991 (skew-711) x 0.931 (lbl-1011) x 0.729 (lbl-1211) x 0.948 (lbl-1311)

skew-611 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-711 = 0.991 = SQRT((0.989*Cos(0.464))^2 + 1*Sin(0.464))^2)

Fx12 = 0.549 = 0.93 (sbs-612) x 0.92 (skew-712) x 0.931 (lbl-1112) x 0.729 (lbl-1312) x 0.948 (lbl-1412) x 0.998 (skew-2112)

skew-712 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-2112 = 0.998 = SQRT((0.993*Cos(0.921))^2 + 1*Sin(0.921))^2)

Fx13 = 0.576 = 0.93 (sbs-713) x 0.931 (lbl-1213) x 0.729 (lbl-1413) x 0.948 (lbl-1513) x 0.997 (skew-2113) x 0.965 (skew-2213)

skew-2113 = 0.997 = SQRT((0.918*Cos(1.37))^2 + 1*Sin(1.37))^2)
skew-2213 = 0.965 = SQRT((0.923*Cos(0.823))^2 + 1*Sin(0.823))^2)

Fx14 = 0.586 = 0.931 (lbl-1314) x 0.729 (lbl-1514) x 0.994 (skew-2214) x 0.906 (skew-2314) x 0.959 (skew-2414)

skew-2214 = 0.994 = SQRT((0.826*Cos(1.378))^2 + 1*Sin(1.378))^2)
skew-2314 = 0.906 = SQRT((0.844*Cos(0.657))^2 + 1*Sin(0.657))^2)
skew-2414 = 0.959 = SQRT((0.957*Cos(0.213))^2 + 1*Sin(0.213))^2)

Fx15 = 0.659 = 0.931 (lbl-1415) x 0.896 (skew-2315) x 0.789 (skew-2415)

skew-2315 = 0.896 = SQRT((0.705*Cos(1.388))^2 + 0.902*Sin(1.388))^2)
skew-2415 = 0.789 = SQRT((0.753*Cos(0.409))^2 + 0.957*Sin(0.409))^2)

Fx16 = 0.578 = 0.965 (skew-516) x 0.994 (skew-616) x 0.8 (skew-1716) x 0.884 (skew-1816) x 0.862 (skew-1916) x 0.989 (skew-2016)

skew-516 = 0.965 = SQRT((0.862*Cos(1.03))^2 + 1*Sin(1.03))^2)
skew-616 = 0.994 = SQRT((0.99*Cos(0.638))^2 + 1*Sin(0.638))^2)
skew-1716 = 0.8 = SQRT((0.753*Cos(0.477))^2 + 0.957*Sin(0.477))^2)
skew-1816 = 0.884 = SQRT((0.729*Cos(1.048))^2 + 0.93*Sin(1.048))^2)
skew-1916 = 0.862 = SQRT((0.845*Cos(0.322))^2 + 1*Sin(0.322))^2)
skew-2016 = 0.989 = SQRT((0.989*Cos(0.015))^2 + 1*Sin(0.015))^2)

Fx17 = 0.536 = 0.88 (skew-517) x 0.886 (skew-617) x 0.959 (skew-717) x 0.992 (skew-1217) x 0.953 (skew-1617) x 0.917 (skew-1917) x 0.841 (skew-2017) x 0.983 (skew-2117)

skew-517 = 0.88 = SQRT((0.893*Cos(1.373))^2 + 0.88*Sin(1.373))^2)
skew-617 = 0.886 = SQRT((0.776*Cos(0.785))^2 + 0.983*Sin(0.785))^2)
skew-717 = 0.959 = SQRT((0.951*Cos(0.427))^2 + 1*Sin(0.427))^2)
skew-1217 = 0.992 = SQRT((0.951*Cos(1.144))^2 + 1*Sin(1.144))^2)
skew-1617 = 0.953 = SQRT((0.952*Cos(0.477))^2 + 0.957*Sin(0.477))^2)
skew-1917 = 0.917 = SQRT((0.745*Cos(1.149))^2 + 0.948*Sin(1.149))^2)
skew-2017 = 0.841 = SQRT((0.817*Cos(0.353))^2 + 1*Sin(0.353))^2)
skew-2117 = 0.983 = SQRT((0.983*Cos(0.015))^2 + 1*Sin(0.015))^2)

Fx18 = 0.664 = 0.93 (skew-1618) x 0.984 (skew-1718) x 0.761 (skew-1918) x 0.953 (skew-2018)

skew-1618 = 0.93 = SQRT((0.932*Cos(1.048))^2 + 0.93*Sin(1.048))^2)
skew-1718 = 0.984 = SQRT((0.838*Cos(1.242))^2 + 1*Sin(1.242))^2)
skew-1918 = 0.761 = SQRT((0.724*Cos(0.418))^2 + 0.925*Sin(0.418))^2)
skew-2018 = 0.953 = SQRT((0.94*Cos(0.479))^2 + 1*Sin(0.479))^2)

Fx19 = 0.657 = 0.996 (skew-619) x 0.999 (skew-719) x 0.948 (skew-1719) x 0.927 (skew-1819) x 0.779 (skew-2019) x 0.965 (skew-2119)

skew-619 = 0.996 = SQRT((0.919*Cos(1.352))^2 + 1*Sin(1.352))^2)
skew-719 = 0.999 = SQRT((0.997*Cos(0.91))^2 + 1*Sin(0.91))^2)
skew-1719 = 0.948 = SQRT((0.945*Cos(1.149))^2 + 0.948*Sin(1.149))^2)
skew-1819 = 0.927 = SQRT((0.928*Cos(0.418))^2 + 0.925*Sin(0.418))^2)
skew-2019 = 0.779 = SQRT((0.721*Cos(0.54))^2 + 0.921*Sin(0.54))^2)
skew-2119 = 0.965 = SQRT((0.954*Cos(0.515))^2 + 1*Sin(0.515))^2)

Fx20 = 0.692 = 0.975 (skew-720) x 0.924 (skew-1920) x 0.795 (skew-2120) x 0.967 (skew-2220)

skew-720 = 0.975 = SQRT((0.832*Cos(1.16))^2 + 1*Sin(1.16))^2)
skew-1920 = 0.924 = SQRT((0.925*Cos(0.54))^2 + 0.921*Sin(0.54))^2)
skew-2120 = 0.795 = SQRT((0.745*Cos(0.492))^2 + 0.948*Sin(0.492))^2)

skew-2220 = 0.967 = SQRT((0.959*Cos(0.471))^2 + 1*Sin(0.471))^2)

Fx21 = 0.62 = 0.892 (skew-721) x 0.993 (skew-1421) x 0.946 (skew-2021) x 0.77 (skew-2221) x 0.961 (skew-2321)
skew-721 = 0.892 = SQRT((0.901*Cos(1.141))^2 + 0.89*Sin(1.141))^2)
skew-1421 = 0.993 = SQRT((0.931*Cos(1.232))^2 + 1*Sin(1.232))^2)
skew-2021 = 0.946 = SQRT((0.945*Cos(0.492))^2 + 0.948*Sin(0.492))^2)
skew-2221 = 0.77 = SQRT((0.728*Cos(0.449))^2 + 0.929*Sin(0.449))^2)
skew-2321 = 0.961 = SQRT((0.951*Cos(0.464))^2 + 1*Sin(0.464))^2)

Fx22 = 0.673 = 0.971 (skew-1522) x 0.931 (skew-2122) x 0.78 (skew-2322) x 0.956 (skew-2422)
skew-1522 = 0.971 = SQRT((0.861*Cos(1.078))^2 + 1*Sin(1.078))^2)
skew-2122 = 0.931 = SQRT((0.931*Cos(0.449))^2 + 0.929*Sin(0.449))^2)
skew-2322 = 0.78 = SQRT((0.733*Cos(0.478))^2 + 0.934*Sin(0.478))^2)
skew-2422 = 0.956 = SQRT((0.943*Cos(0.494))^2 + 1*Sin(0.494))^2)

Fx23 = 0.648 = 0.903 (skew-1523) x 0.935 (skew-2223) x 0.768 (skew-2423)
skew-1523 = 0.903 = SQRT((0.91*Cos(1.388))^2 + 0.902*Sin(1.388))^2)
skew-2223 = 0.935 = SQRT((0.935*Cos(0.478))^2 + 0.934*Sin(0.478))^2)
skew-2423 = 0.768 = SQRT((0.716*Cos(0.51))^2 + 0.915*Sin(0.51))^2)

Fx24 = 0.876 = 0.953 (skew-1524) x 0.919 (skew-2324)
skew-1524 = 0.953 = SQRT((0.953*Cos(0.409))^2 + 0.957*Sin(0.409))^2)
skew-2324 = 0.919 = SQRT((0.92*Cos(0.51))^2 + 0.915*Sin(0.51))^2)

Fy1 = 0.862 = 0.93 (sbs-21) x 0.929 (skew-81) x 0.998 (skew-91)
skew-81 = 0.929 = SQRT((0.768*Cos(1.055))^2 + 0.975*Sin(1.055))^2)
skew-91 = 0.998 = SQRT((0.989*Cos(1.107))^2 + 1*Sin(1.107))^2)

Fy2 = 0.466 = 0.93 (sbs-12) x 0.93 (sbs-32) x 0.587 (lbl-82) x 0.92 (skew-92) x 0.998 (skew-102)
skew-92 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-102 = 0.998 = SQRT((0.989*Cos(1.107))^2 + 1*Sin(1.107))^2)

Fy3 = 0.537 = 0.93 (sbs-23) x 0.93 (sbs-43) x 0.929 (skew-83) x 0.729 (lbl-93) x 0.92 (skew-103) x 0.998 (skew-113)
skew-83 = 0.929 = SQRT((0.768*Cos(1.055))^2 + 0.975*Sin(1.055))^2)
skew-103 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-113 = 0.998 = SQRT((0.989*Cos(1.107))^2 + 1*Sin(1.107))^2)

Fy4 = 0.53 = 0.93 (sbs-34) x 0.93 (sbs-54) x 0.997 (skew-84) x 0.92 (skew-94) x 0.729 (lbl-104) x 0.92 (skew-114) x 0.998 (skew-124)
skew-84 = 0.997 = SQRT((0.962*Cos(1.295))^2 + 1*Sin(1.295))^2)
skew-94 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-114 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-124 = 0.998 = SQRT((0.989*Cos(1.107))^2 + 1*Sin(1.107))^2)

Fy5 = 0.473 = 0.93 (sbs-45) x 0.93 (sbs-65) x 0.998 (skew-95) x 0.92 (skew-105) x 0.729 (lbl-115) x 0.92 (skew-125) x 0.998 (skew-135) x 0.892 (skew-175)
skew-95 = 0.998 = SQRT((0.989*Cos(1.107))^2 + 1*Sin(1.107))^2)
skew-105 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)

skew-125 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-135 = 0.998 = SQRT((0.989*Cos(1.107))^2 + 1*Sin(1.107))^2)
skew-175 = 0.892 = SQRT((0.893*Cos(0.197))^2 + 0.88*Sin(0.197))^2)

Fy6 = 0.519 = 0.93 (sbs-56) x 0.93 (sbs-76) x 0.998 (skew-106) x 0.92 (skew-116) x 0.729 (lbl-126) x 0.92 (skew-136) x 0.998 (skew-146) x 0.978 (skew-176)
skew-106 = 0.998 = SQRT((0.989*Cos(1.107))^2 + 1*Sin(1.107))^2)
skew-116 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-136 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-146 = 0.998 = SQRT((0.989*Cos(1.107))^2 + 1*Sin(1.107))^2)
skew-176 = 0.978 = SQRT((0.972*Cos(0.785))^2 + 0.983*Sin(0.785))^2)

Fy7 = 0.513 = 0.93 (sbs-67) x 0.998 (skew-117) x 0.92 (skew-127) x 0.729 (lbl-137) x 0.92 (skew-147) x 0.998 (skew-157) x 0.899 (skew-217)
skew-117 = 0.998 = SQRT((0.989*Cos(1.107))^2 + 1*Sin(1.107))^2)
skew-127 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-147 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-157 = 0.998 = SQRT((0.989*Cos(1.107))^2 + 1*Sin(1.107))^2)
skew-217 = 0.899 = SQRT((0.901*Cos(0.43))^2 + 0.89*Sin(0.43))^2)

Fy8 = 0.704 = 0.973 (skew-18) x 0.804 (lbl-28) x 0.973 (skew-38) x 0.928 (skew-98) x 0.998 (skew-108)
skew-18 = 0.973 = SQRT((0.966*Cos(1.055))^2 + 0.975*Sin(1.055))^2)
skew-38 = 0.973 = SQRT((0.966*Cos(1.055))^2 + 0.975*Sin(1.055))^2)
skew-98 = 0.928 = SQRT((0.753*Cos(1.162))^2 + 0.957*Sin(1.162))^2)
skew-108 = 0.998 = SQRT((0.957*Cos(1.357))^2 + 1*Sin(1.357))^2)

Fy9 = 0.829 = 0.931 (lbl-39) x 0.957 (skew-89) x 0.93 (sbs-109)
skew-89 = 0.957 = SQRT((0.953*Cos(1.162))^2 + 0.957*Sin(1.162))^2)

Fy10 = 0.805 = 0.931 (lbl-410) x 0.93 (sbs-910) x 0.93 (sbs-1110)

Fy11 = 0.805 = 0.931 (lbl-511) x 0.93 (sbs-1011) x 0.93 (sbs-1211)

Fy12 = 0.805 = 0.931 (lbl-612) x 0.93 (sbs-1112) x 0.93 (sbs-1312)

Fy13 = 0.805 = 0.931 (lbl-713) x 0.93 (sbs-1213) x 0.93 (sbs-1413)

Fy14 = 0.865 = 0.93 (sbs-1314) x 0.93 (sbs-1514)

Fy15 = 0.809 = 0.93 (sbs-1415) x 0.91 (skew-2315) x 0.957 (skew-2415)
skew-2315 = 0.91 = SQRT((0.91*Cos(0.183))^2 + 0.902*Sin(0.183))^2)
skew-2415 = 0.957 = SQRT((0.953*Cos(1.162))^2 + 0.957*Sin(1.162))^2)

Fy16 = 0.599 = 0.951 (skew-316) x 0.821 (skew-416) x 0.9 (skew-516) x 0.996 (skew-616) x 0.918 (skew-1716) x 0.931 (skew-1816)
skew-316 = 0.951 = SQRT((0.91*Cos(0.733))^2 + 1*Sin(0.733))^2)
skew-416 = 0.821 = SQRT((0.816*Cos(0.149))^2 + 1*Sin(0.149))^2)
skew-516 = 0.9 = SQRT((0.862*Cos(0.54))^2 + 1*Sin(0.54))^2)
skew-616 = 0.996 = SQRT((0.99*Cos(0.933))^2 + 1*Sin(0.933))^2)
skew-1716 = 0.918 = SQRT((0.753*Cos(1.093))^2 + 0.957*Sin(1.093))^2)

skew-1816 = 0.931 = SQRT((0.932*Cos(0.523))^2 + 0.93*Sin(0.523))^2)

Fy17 = 0.453 = 0.948 (skew-417) x 0.694 (skew-517) x 0.886 (skew-617) x 0.992 (skew-717) x 0.985 (skew-1017) x 0.92 (skew-1117) x 0.959 (skew-1217) x 0.956 (skew-1617) x 0.946 (skew-1917)

skew-417 = 0.948 = SQRT((0.836*Cos(0.951))^2 + 1*Sin(0.951))^2)
skew-517 = 0.694 = SQRT((0.685*Cos(0.197))^2 + 0.88*Sin(0.197))^2)
skew-617 = 0.886 = SQRT((0.776*Cos(0.785))^2 + 0.983*Sin(0.785))^2)
skew-717 = 0.992 = SQRT((0.951*Cos(1.144))^2 + 1*Sin(1.144))^2)
skew-1017 = 0.985 = SQRT((0.979*Cos(0.567))^2 + 1*Sin(0.567))^2)
skew-1117 = 0.92 = SQRT((0.919*Cos(0.091))^2 + 1*Sin(0.091))^2)
skew-1217 = 0.959 = SQRT((0.951*Cos(0.427))^2 + 1*Sin(0.427))^2)
skew-1617 = 0.956 = SQRT((0.952*Cos(1.093))^2 + 0.957*Sin(1.093))^2)
skew-1917 = 0.946 = SQRT((0.945*Cos(0.421))^2 + 0.948*Sin(0.421))^2)

Fy18 = 0.586 = 0.987 (skew-518) x 0.784 (skew-1618) x 0.856 (skew-1718) x 0.895 (skew-1918) x 0.988 (skew-2018)

skew-518 = 0.987 = SQRT((0.987*Cos(0.136))^2 + 1*Sin(0.136))^2)
skew-1618 = 0.784 = SQRT((0.729*Cos(0.523))^2 + 0.93*Sin(0.523))^2)
skew-1718 = 0.856 = SQRT((0.838*Cos(0.329))^2 + 1*Sin(0.329))^2)
skew-1918 = 0.895 = SQRT((0.724*Cos(1.153))^2 + 0.925*Sin(1.153))^2)
skew-2018 = 0.988 = SQRT((0.94*Cos(1.092))^2 + 1*Sin(1.092))^2)

Fy19 = 0.532 = 0.937 (skew-519) x 0.923 (skew-619) x 0.998 (skew-719) x 0.986 (skew-1619) x 0.783 (skew-1719) x 0.925 (skew-1819) x 0.872 (skew-2019) x 0.989 (skew-2119)

skew-519 = 0.937 = SQRT((0.929*Cos(0.322))^2 + 1*Sin(0.322))^2)
skew-619 = 0.923 = SQRT((0.919*Cos(0.219))^2 + 1*Sin(0.219))^2)
skew-719 = 0.998 = SQRT((0.997*Cos(0.661))^2 + 1*Sin(0.661))^2)
skew-1619 = 0.986 = SQRT((0.845*Cos(1.249))^2 + 1*Sin(1.249))^2)
skew-1719 = 0.783 = SQRT((0.745*Cos(0.421))^2 + 0.948*Sin(0.421))^2)
skew-1819 = 0.925 = SQRT((0.928*Cos(1.153))^2 + 0.925*Sin(1.153))^2)
skew-2019 = 0.872 = SQRT((0.721*Cos(1.03))^2 + 0.921*Sin(1.03))^2)
skew-2119 = 0.989 = SQRT((0.954*Cos(1.056))^2 + 1*Sin(1.056))^2)

Fy20 = 0.572 = 0.972 (skew-520) x 0.841 (skew-620) x 0.861 (skew-720) x 0.98 (skew-1720) x 0.922 (skew-1920) x 0.907 (skew-2120) x 0.992 (skew-2220)

skew-520 = 0.972 = SQRT((0.936*Cos(0.834))^2 + 1*Sin(0.834))^2)
skew-620 = 0.841 = SQRT((0.821*Cos(0.322))^2 + 1*Sin(0.322))^2)
skew-720 = 0.861 = SQRT((0.832*Cos(0.411))^2 + 1*Sin(0.411))^2)
skew-1720 = 0.98 = SQRT((0.817*Cos(1.218))^2 + 1*Sin(1.218))^2)
skew-1920 = 0.922 = SQRT((0.925*Cos(1.03))^2 + 0.921*Sin(1.03))^2)
skew-2120 = 0.907 = SQRT((0.745*Cos(1.079))^2 + 0.948*Sin(1.079))^2)
skew-2220 = 0.992 = SQRT((0.959*Cos(1.1))^2 + 1*Sin(1.1))^2)

Fy21 = 0.513 = 0.968 (skew-621) x 0.732 (skew-721) x 0.996 (skew-1221) x 0.922 (skew-1321) x 0.939 (skew-1421) x 0.947 (skew-2021) x 0.895 (skew-2221) x 0.99 (skew-2321)

skew-621 = 0.968 = SQRT((0.868*Cos(1.041))^2 + 1*Sin(1.041))^2)
skew-721 = 0.732 = SQRT((0.694*Cos(0.43))^2 + 0.89*Sin(0.43))^2)
skew-1221 = 0.996 = SQRT((0.993*Cos(0.649))^2 + 1*Sin(0.649))^2)
skew-1321 = 0.922 = SQRT((0.918*Cos(0.201))^2 + 1*Sin(0.201))^2)
skew-1421 = 0.939 = SQRT((0.931*Cos(0.338))^2 + 1*Sin(0.338))^2)

skew-2021 = 0.947 = SQRT((0.945*Cos(1.079))^2 + 0.948*Sin(1.079))^2)
skew-2221 = 0.895 = SQRT((0.728*Cos(1.122))^2 + 0.929*Sin(1.122))^2)
skew-2321 = 0.99 = SQRT((0.951*Cos(1.107))^2 + 1*Sin(1.107))^2)

Fy22 = 0.58 = 0.987 (skew-722) x 0.959 (skew-1322) x 0.833 (skew-1422) x 0.894 (skew-1522) x 0.93 (skew-2122) x 0.895 (skew-2322) x 0.987 (skew-2422)
skew-722 = 0.987 = SQRT((0.809*Cos(1.289))^2 + 1*Sin(1.289))^2)
skew-1322 = 0.959 = SQRT((0.923*Cos(0.747))^2 + 1*Sin(0.747))^2)
skew-1422 = 0.833 = SQRT((0.826*Cos(0.193))^2 + 1*Sin(0.193))^2)
skew-1522 = 0.894 = SQRT((0.861*Cos(0.492))^2 + 1*Sin(0.492))^2)
skew-2122 = 0.93 = SQRT((0.931*Cos(1.122))^2 + 0.929*Sin(1.122))^2)
skew-2322 = 0.895 = SQRT((0.733*Cos(1.092))^2 + 0.934*Sin(1.092))^2)
skew-2422 = 0.987 = SQRT((0.943*Cos(1.077))^2 + 1*Sin(1.077))^2)

Fy23 = 0.548 = 0.945 (skew-1423) x 0.712 (skew-1523) x 0.934 (skew-2223) x 0.872 (skew-2423)
skew-1423 = 0.945 = SQRT((0.844*Cos(0.914))^2 + 1*Sin(0.914))^2)
skew-1523 = 0.712 = SQRT((0.705*Cos(0.183))^2 + 0.902*Sin(0.183))^2)
skew-2223 = 0.934 = SQRT((0.935*Cos(1.092))^2 + 0.934*Sin(1.092))^2)
skew-2423 = 0.872 = SQRT((0.716*Cos(1.06))^2 + 0.915*Sin(1.06))^2)

Fy24 = 0.849 = 0.998 (skew-1424) x 0.928 (skew-1524) x 0.917 (skew-2324)
skew-1424 = 0.998 = SQRT((0.957*Cos(1.357))^2 + 1*Sin(1.357))^2)
skew-1524 = 0.928 = SQRT((0.753*Cos(1.162))^2 + 0.957*Sin(1.162))^2)
skew-2324 = 0.917 = SQRT((0.92*Cos(1.06))^2 + 0.915*Sin(1.06))^2)

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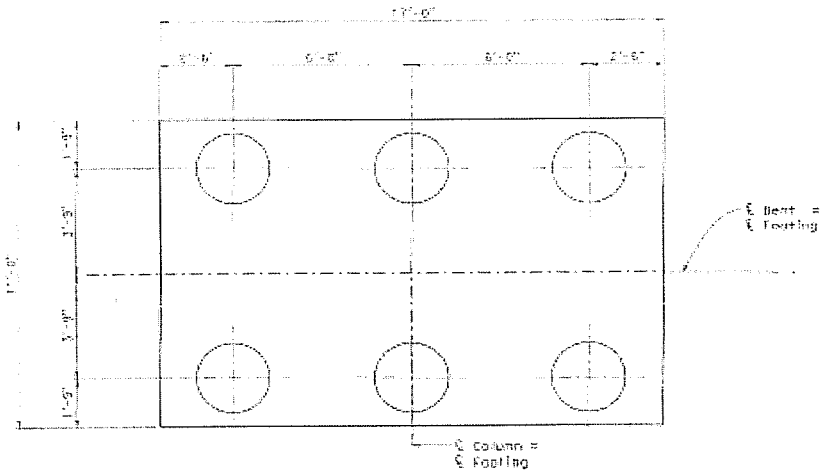
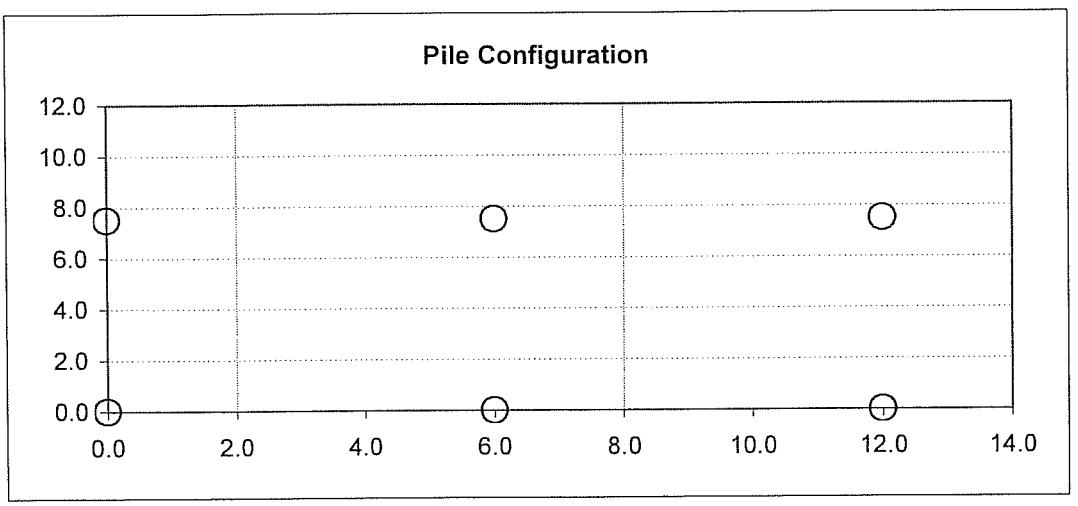
Project: **Placentia Avenue UC (WIDEN) - Bents 2, 3 and 4** Project No. **08-115**
By CTY Date 12/11/08 Check by Date Sheet

Proposed Bents 2, 3 and 4 Pile Layout



Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia. (feet): 2.5
No. of Piles: 6

Group Efficiency	X-Dir	Y-Dir
	0.569	0.578

average = 0.575

Coordinates

Pile No.	X	Y
1	0.0	0.0
2	6.0	0.0
3	12.0	0.0
4	0.0	7.5
5	6.0	7.5
6	12.0	7.5

Reduction Factors in X-dir	Reduction Factors in Y-dir
0.477	0.544
0.506	0.423
0.815	0.544
0.477	0.800
0.506	0.686
0.815	0.800

Fx1 = 0.477 = 0.669 (lbl-21) x 0.871 (lbl-31) x 0.93 (sbs-41) x 0.927 (skew-51) x 0.948 (skew-61)
skew-51 = 0.927 = SQRT((0.801*Cos(0.896))^2 + 1*Sin(0.896))^2)
skew-61 = 0.948 = SQRT((0.928*Cos(0.559))^2 + 1*Sin(0.559))^2)

Fx2 = 0.506 = 0.879 (lbl-12) x 0.669 (lbl-32) x 0.997 (skew-42) x 0.93 (sbs-52) x 0.927 (skew-62)
skew-42 = 0.997 = SQRT((0.993*Cos(0.896))^2 + 1*Sin(0.896))^2)
skew-62 = 0.927 = SQRT((0.801*Cos(0.896))^2 + 1*Sin(0.896))^2)

Fx3 = 0.815 = 1 (lbl-13) x 0.879 (lbl-23) x 1 (skew-43) x 0.997 (skew-53) x 0.93 (sbs-63)
skew-43 = 1 = SQRT((1*Cos(0.559))^2 + 1*Sin(0.559))^2)
skew-53 = 0.997 = SQRT((0.993*Cos(0.896))^2 + 1*Sin(0.896))^2)

Fx4 = 0.477 = 0.93 (sbs-14) x 0.927 (skew-24) x 0.948 (skew-34) x 0.669 (lbl-54) x 0.871 (lbl-64)
skew-24 = 0.927 = SQRT((0.801*Cos(0.896))^2 + 1*Sin(0.896))^2)
skew-34 = 0.948 = SQRT((0.928*Cos(0.559))^2 + 1*Sin(0.559))^2)

Fx5 = 0.506 = 0.997 (skew-15) x 0.93 (sbs-25) x 0.927 (skew-35) x 0.879 (lbl-45) x 0.669 (lbl-65)
skew-15 = 0.997 = SQRT((0.993*Cos(0.896))^2 + 1*Sin(0.896))^2)
skew-35 = 0.927 = SQRT((0.801*Cos(0.896))^2 + 1*Sin(0.896))^2)

Fx6 = 0.815 = 1 (skew-16) x 0.997 (skew-26) x 0.93 (sbs-36) x 1 (lbl-46) x 0.879 (lbl-56)
skew-16 = 1 = SQRT((1*Cos(0.559))^2 + 1*Sin(0.559))^2)
skew-26 = 0.997 = SQRT((0.993*Cos(0.896))^2 + 1*Sin(0.896))^2)

Fx1 = 0.477 = 0.669 (lbl-21) x 0.871 (lbl-31) x 0.93 (sbs-41) x 0.927 (skew-51) x 0.948 (skew-61)
skew-51 = 0.884 = SQRT((0.801*Cos(0.675))^2 + 1*Sin(0.675))^2)
skew-61 = 0.98 = SQRT((0.928*Cos(1.012))^2 + 1*Sin(1.012))^2)

Fx2 = 0.506 = 0.879 (lbl-12) x 0.669 (lbl-32) x 0.997 (skew-42) x 0.93 (sbs-52) x 0.927 (skew-62)
skew-42 = 0.884 = SQRT((0.801*Cos(0.675))^2 + 1*Sin(0.675))^2)
skew-62 = 0.884 = SQRT((0.801*Cos(0.675))^2 + 1*Sin(0.675))^2)

Fx3 = 0.815 = 1 (lbl-13) x 0.879 (lbl-23) x 1 (skew-43) x 0.997 (skew-53) x 0.93 (sbs-63)
skew-43 = 0.98 = SQRT((0.928*Cos(1.012))^2 + 1*Sin(1.012))^2)
skew-53 = 0.884 = SQRT((0.801*Cos(0.675))^2 + 1*Sin(0.675))^2)

Fx4 = 0.477 = 0.93 (sbs-14) x 0.927 (skew-24) x 0.948 (skew-34) x 0.669 (lbl-54) x 0.871 (lbl-64)
skew-24 = 0.996 = SQRT((0.993*Cos(0.675))^2 + 1*Sin(0.675))^2)
skew-34 = 1 = SQRT((1*Cos(1.012))^2 + 1*Sin(1.012))^2)

Fx5 = 0.506 = 0.997 (skew-15) x 0.93 (sbs-25) x 0.927 (skew-35) x 0.879 (lbl-45) x 0.669 (lbl-65)
skew-15 = 0.996 = SQRT((0.993*Cos(0.675))^2 + 1*Sin(0.675))^2)
skew-35 = 0.996 = SQRT((0.993*Cos(0.675))^2 + 1*Sin(0.675))^2)

Fx6 = 0.815 = 1 (skew-16) x 0.997 (skew-26) x 0.93 (sbs-36) x 1 (lbl-46) x 0.879 (lbl-56)
skew-16 = 1 = SQRT((1*Cos(1.012))^2 + 1*Sin(1.012))^2)
skew-26 = 0.996 = SQRT((0.993*Cos(0.675))^2 + 1*Sin(0.675))^2)

where
lbl: line-by-line effect
sbs: side-by-side effect
skew: skew effect

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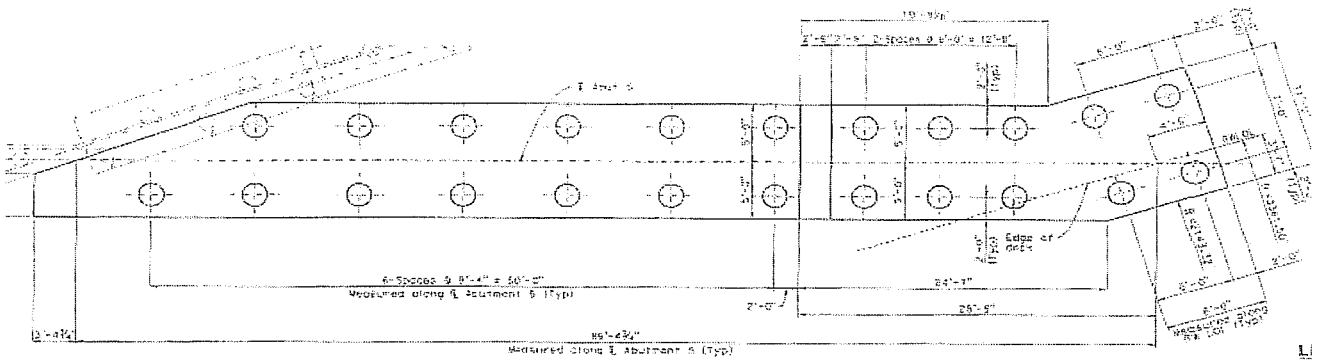
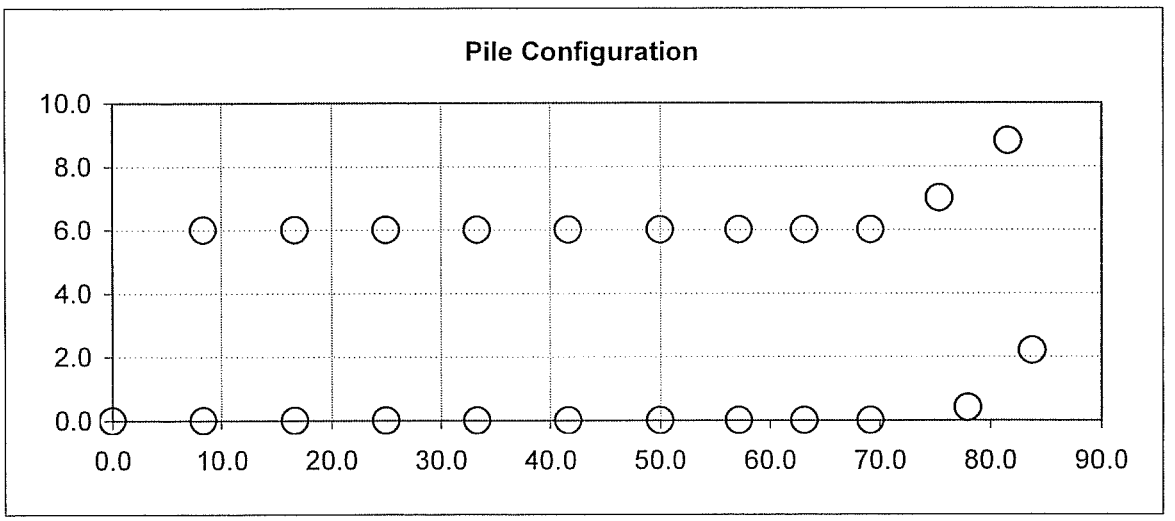
Project: **Placentia Avenue UC (WIDEN) - Abut 5** Project No. **08-115**
By CTY Date 01/28/09 Check by Date Sheet

Proposed Abutment 5 Pile Layout



Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia. (feet): 2
No. of Piles: 23

Group Efficiency	X-Dir	Y-Dir
	0.694	0.779

0.74 = Avg

Coordinates

Pile No.	X	Y
1	0.000	0.00
2	8.333	0.00
3	16.666	0.00
4	24.999	0.00
5	33.332	0.00
6	41.665	0.00

Reduction Factors in X-dir	Reduction Factors in Y-dir
0.769	0.965
0.715	0.703
0.715	0.679
0.715	0.679
0.715	0.679
0.715	0.679

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7	49.998	0.00
8	57.158	0.00
9	63.158	0.00
10	69.158	0.00
11	8.333	6.00
12	16.666	6.00
13	24.999	6.00
14	33.332	6.00
15	41.665	6.00
16	49.998	6.00
17	57.158	6.00
18	63.158	6.00
19	69.158	6.00
20	78.000	0.40
21	83.800	2.20
22	75.400	7.00
23	81.600	8.80

0.656	0.657
0.571	0.580
0.580	0.533
0.689	0.576
0.715	0.931
0.715	0.931
0.715	0.931
0.715	0.931
0.715	0.931
0.656	0.920
0.571	0.855
0.555	0.805
0.586	0.815
0.723	0.634
0.913	0.719
0.630	0.866
0.911	0.923

Fx1 = 0.769 = 0.826 (lbl-21) x 0.931 (skew-111)
skew-111 = 0.931 = SQRT((0.894*Cos(0.624))^2 + 1*Sin(0.624))^2)

Fx2 = 0.715 = 0.826 (lbl-32) x 0.93 (sbs-112) x 0.931 (skew-122)
skew-122 = 0.931 = SQRT((0.894*Cos(0.624))^2 + 1*Sin(0.624))^2)

Fx3 = 0.715 = 0.826 (lbl-43) x 0.93 (sbs-123) x 0.931 (skew-133)
skew-133 = 0.931 = SQRT((0.894*Cos(0.624))^2 + 1*Sin(0.624))^2)

Fx4 = 0.715 = 0.826 (lbl-54) x 0.93 (sbs-134) x 0.931 (skew-144)
skew-144 = 0.931 = SQRT((0.894*Cos(0.624))^2 + 1*Sin(0.624))^2)

Fx5 = 0.715 = 0.826 (lbl-65) x 0.93 (sbs-145) x 0.931 (skew-155)
skew-155 = 0.931 = SQRT((0.894*Cos(0.624))^2 + 1*Sin(0.624))^2)

Fx6 = 0.715 = 0.826 (lbl-76) x 0.93 (sbs-156) x 0.931 (skew-166)
skew-166 = 0.931 = SQRT((0.894*Cos(0.624))^2 + 1*Sin(0.624))^2)

Fx7 = 0.656 = 0.779 (lbl-87) x 0.982 (lbl-97) x 0.93 (sbs-167) x 0.922 (skew-177)
skew-177 = 0.922 = SQRT((0.862*Cos(0.697))^2 + 1*Sin(0.697))^2)

Fx8 = 0.571 = 0.975 (lbl-78) x 0.729 (lbl-98) x 0.948 (lbl-108) x 0.93 (sbs-178) x 0.92 (skew-188) x 0.991 (skew-198)
skew-188 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-198 = 0.991 = SQRT((0.989*Cos(0.464))^2 + 1*Sin(0.464))^2)

Fx9 = 0.58 = 0.931 (lbl-89) x 0.729 (lbl-109) x 0.93 (sbs-189) x 0.92 (skew-199)
skew-199 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)

Fx10 = 0.689 = 0.931 (lbl-910) x 0.93 (sbs-1910) x 0.845 (skew-2010) x 0.942 (skew-2210)
skew-2010 = 0.845 = SQRT((0.845*Cos(0.045))^2 + 1*Sin(0.045))^2)
skew-2210 = 0.942 = SQRT((0.864*Cos(0.843))^2 + 1*Sin(0.843))^2)

Fx11 = 0.715 = 0.93 (sbs-211) x 0.931 (skew-311) x 0.826 (lbl-1211)
skew-311 = 0.931 = SQRT((0.894*Cos(0.624))^2 + 1*Sin(0.624))^2)

Fx12 = 0.715 = 0.93 (sbs-312) x 0.931 (skew-412) x 0.826 (lbl-1312)
skew-412 = 0.931 = SQRT((0.894*Cos(0.624))^2 + 1*Sin(0.624))^2)

Fx13 = 0.715 = 0.93 (sbs-413) x 0.931 (skew-513) x 0.826 (lbl-1413)
skew-513 = 0.931 = SQRT((0.894*Cos(0.624))^2 + 1*Sin(0.624))^2)

Fx14 = 0.715 = 0.93 (sbs-514) x 0.931 (skew-614) x 0.826 (lbl-1514)
skew-614 = 0.931 = SQRT((0.894*Cos(0.624))^2 + 1*Sin(0.624))^2)

Fx15 = 0.715 = 0.93 (sbs-615) x 0.931 (skew-715) x 0.826 (lbl-1615)
skew-715 = 0.931 = SQRT((0.894*Cos(0.624))^2 + 1*Sin(0.624))^2)

Fx16 = 0.656 = 0.93 (sbs-716) x 0.922 (skew-816) x 0.779 (lbl-1716) x 0.982 (lbl-1816)
skew-816 = 0.922 = SQRT((0.862*Cos(0.697))^2 + 1*Sin(0.697))^2)

Fx17 = 0.571 = 0.93 (sbs-817) x 0.92 (skew-917) x 0.991 (skew-1017) x 0.975 (lbl-1617) x 0.729 (lbl-1817) x 0.948 (lbl-1917)
skew-917 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-1017 = 0.991 = SQRT((0.989*Cos(0.464))^2 + 1*Sin(0.464))^2)

Fx18 = 0.555 = 0.93 (sbs-918) x 0.92 (skew-1018) x 0.931 (lbl-1718) x 0.729 (lbl-1918) x 0.957 (skew-2218)
skew-1018 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-2218 = 0.957 = SQRT((0.957*Cos(0.082))^2 + 1*Sin(0.082))^2)

Fx19 = 0.586 = 0.93 (sbs-1019) x 0.931 (lbl-1819) x 0.93 (skew-2019) x 0.749 (skew-2219) x 0.972 (skew-2319)
skew-2019 = 0.93 = SQRT((0.9*Cos(0.565))^2 + 1*Sin(0.565))^2)
skew-2219 = 0.749 = SQRT((0.743*Cos(0.159))^2 + 0.946*Sin(0.159))^2)
skew-2319 = 0.972 = SQRT((0.97*Cos(0.221))^2 + 1*Sin(0.221))^2)

Fx20 = 0.723 = 0.752 (skew-2120) x 0.983 (skew-2220) x 0.979 (skew-2320)
skew-2120 = 0.752 = SQRT((0.732*Cos(0.301))^2 + 0.934*Sin(0.301))^2)
skew-2220 = 0.983 = SQRT((0.973*Cos(1.196))^2 + 0.984*Sin(1.196))^2)
skew-2320 = 0.979 = SQRT((0.855*Cos(1.166))^2 + 1*Sin(1.166))^2)

Fx21 = 0.913 = 0.934 (skew-2021) x 0.977 (skew-2321)
skew-2021 = 0.934 = SQRT((0.934*Cos(0.301))^2 + 0.934*Sin(0.301))^2)
skew-2321 = 0.977 = SQRT((0.968*Cos(1.249))^2 + 0.978*Sin(1.249))^2)

Fx22 = 0.63 = 0.944 (skew-1922) x 0.959 (skew-2022) x 0.906 (skew-2122) x 0.767 (skew-2322)
skew-1922 = 0.944 = SQRT((0.944*Cos(0.159))^2 + 0.946*Sin(0.159))^2)
skew-2022 = 0.959 = SQRT((0.777*Cos(1.196))^2 + 0.984*Sin(1.196))^2)
skew-2122 = 0.906 = SQRT((0.874*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-2322 = 0.767 = SQRT((0.749*Cos(0.283))^2 + 0.953*Sin(0.283))^2)

Fx23 = 0.911 = 0.959 (skew-2123) x 0.95 (skew-2223)

skew-2123 = 0.959 = SQRT((0.771*Cos(1.249))^2 + 0.978*Sin(1.249))^2)
skew-2223 = 0.95 = SQRT((0.949*Cos(0.283))^2 + 0.953*Sin(0.283))^2)

Fy1 = 0.965 = 0.965 (skew-111)
skew-111 = 0.965 = SQRT((0.894*Cos(0.947))^2 + 1*Sin(0.947))^2)

Fy2 = 0.703 = 0.729 (lbl-112) x 0.965 (skew-122)
skew-122 = 0.965 = SQRT((0.894*Cos(0.947))^2 + 1*Sin(0.947))^2)

Fy3 = 0.679 = 0.965 (skew-113) x 0.729 (lbl-123) x 0.965 (skew-133)
skew-113 = 0.965 = SQRT((0.894*Cos(0.947))^2 + 1*Sin(0.947))^2)
skew-133 = 0.965 = SQRT((0.894*Cos(0.947))^2 + 1*Sin(0.947))^2)

Fy4 = 0.679 = 0.965 (skew-124) x 0.729 (lbl-134) x 0.965 (skew-144)
skew-124 = 0.965 = SQRT((0.894*Cos(0.947))^2 + 1*Sin(0.947))^2)
skew-144 = 0.965 = SQRT((0.894*Cos(0.947))^2 + 1*Sin(0.947))^2)

Fy5 = 0.679 = 0.965 (skew-135) x 0.729 (lbl-145) x 0.965 (skew-155)
skew-135 = 0.965 = SQRT((0.894*Cos(0.947))^2 + 1*Sin(0.947))^2)
skew-155 = 0.965 = SQRT((0.894*Cos(0.947))^2 + 1*Sin(0.947))^2)

Fy6 = 0.679 = 0.965 (skew-146) x 0.729 (lbl-156) x 0.965 (skew-166)
skew-146 = 0.965 = SQRT((0.894*Cos(0.947))^2 + 1*Sin(0.947))^2)
skew-166 = 0.965 = SQRT((0.894*Cos(0.947))^2 + 1*Sin(0.947))^2)

Fy7 = 0.657 = 0.987 (sbs-87) x 0.965 (skew-157) x 0.729 (lbl-167) x 0.946 (skew-177)
skew-157 = 0.965 = SQRT((0.894*Cos(0.947))^2 + 1*Sin(0.947))^2)
skew-177 = 0.946 = SQRT((0.862*Cos(0.873))^2 + 1*Sin(0.873))^2)

Fy8 = 0.58 = 0.987 (sbs-78) x 0.93 (sbs-98) x 0.946 (skew-168) x 0.729 (lbl-178) x 0.92 (skew-188) x 0.998 (skew-198)
skew-168 = 0.946 = SQRT((0.862*Cos(0.873))^2 + 1*Sin(0.873))^2)
skew-188 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-198 = 0.998 = SQRT((0.989*Cos(1.107))^2 + 1*Sin(1.107))^2)

Fy9 = 0.533 = 0.93 (sbs-89) x 0.93 (sbs-109) x 0.92 (skew-179) x 0.729 (lbl-189) x 0.92 (skew-199)
skew-179 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-199 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)

Fy10 = 0.576 = 0.93 (sbs-910) x 0.998 (skew-1710) x 0.92 (skew-1810) x 0.729 (lbl-1910) x 0.926 (skew-2210)
skew-1710 = 0.998 = SQRT((0.989*Cos(1.107))^2 + 1*Sin(1.107))^2)
skew-1810 = 0.92 = SQRT((0.831*Cos(0.785))^2 + 1*Sin(0.785))^2)
skew-2210 = 0.926 = SQRT((0.864*Cos(0.728))^2 + 1*Sin(0.728))^2)

Fy11 = 0.931 = 0.931 (lbl-211)

Fy12 = 0.931 = 0.931 (lbl-312)

Fy13 = 0.931 = 0.931 (lbl-413)

Fy14 = 0.931 = 0.931 (lbl-514)

Fy15 = 0.931 = 0.931 (lbl-615)

Fy16 = 0.92 = 0.931 (lbl-716) x 0.987 (sbs-1716)

Fy17 = 0.855 = 0.931 (lbl-817) x 0.987 (sbs-1617) x 0.93 (sbs-1817)

Fy18 = 0.805 = 0.931 (lbl-918) x 0.93 (sbs-1718) x 0.93 (sbs-1918)

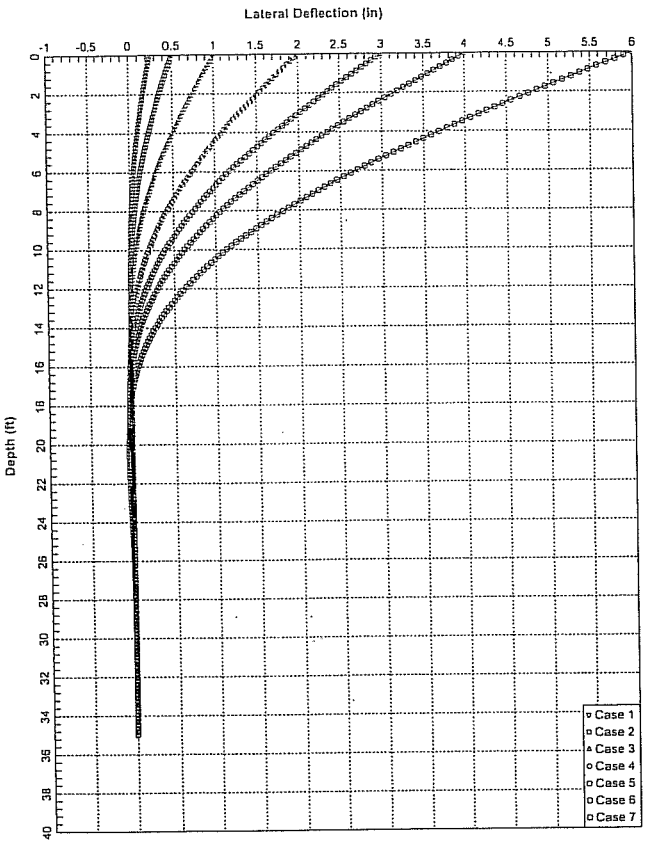
Fy19 = 0.815 = 0.931 (lbl-1019) x 0.93 (sbs-1819) x 0.942 (skew-2219) x 0.999 (skew-2319)
skew-2219 = 0.942 = SQRT((0.743*Cos(1.412))^2 + 0.946*Sin(1.412))^2)
skew-2319 = 0.999 = SQRT((0.97*Cos(1.349))^2 + 1*Sin(1.349))^2)

Fy20 = 0.634 = 0.972 (skew-1920) x 0.918 (skew-2120) x 0.808 (skew-2220) x 0.879 (skew-2320)
skew-1920 = 0.972 = SQRT((0.9*Cos(1.006))^2 + 1*Sin(1.006))^2)
skew-2120 = 0.918 = SQRT((0.732*Cos(1.27))^2 + 0.934*Sin(1.27))^2)
skew-2220 = 0.808 = SQRT((0.777*Cos(0.375))^2 + 0.984*Sin(0.375))^2)
skew-2320 = 0.879 = SQRT((0.855*Cos(0.405))^2 + 1*Sin(0.405))^2)

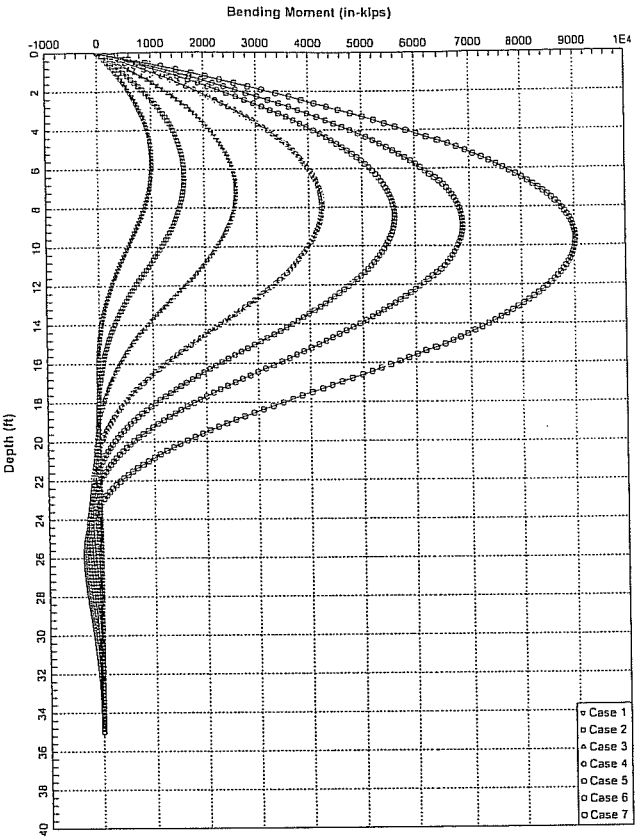
Fy21 = 0.719 = 0.934 (skew-2021) x 0.97 (skew-2221) x 0.794 (skew-2321)
skew-2021 = 0.934 = SQRT((0.934*Cos(1.27))^2 + 0.934*Sin(1.27))^2)
skew-2221 = 0.97 = SQRT((0.874*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-2321 = 0.794 = SQRT((0.771*Cos(0.322))^2 + 0.978*Sin(0.322))^2)

Fy22 = 0.866 = 0.946 (skew-1922) x 0.974 (skew-2022) x 0.939 (skew-2322)
skew-1922 = 0.946 = SQRT((0.944*Cos(1.412))^2 + 0.946*Sin(1.412))^2)
skew-2022 = 0.974 = SQRT((0.973*Cos(0.375))^2 + 0.984*Sin(0.375))^2)
skew-2322 = 0.939 = SQRT((0.749*Cos(1.288))^2 + 0.953*Sin(1.288))^2)

Fy23 = 0.923 = 0.969 (skew-2123) x 0.953 (skew-2223)
skew-2123 = 0.969 = SQRT((0.968*Cos(0.322))^2 + 0.978*Sin(0.322))^2)
skew-2223 = 0.953 = SQRT((0.949*Cos(1.288))^2 + 0.953*Sin(1.288))^2)



Abut 1 - Freehead Condition



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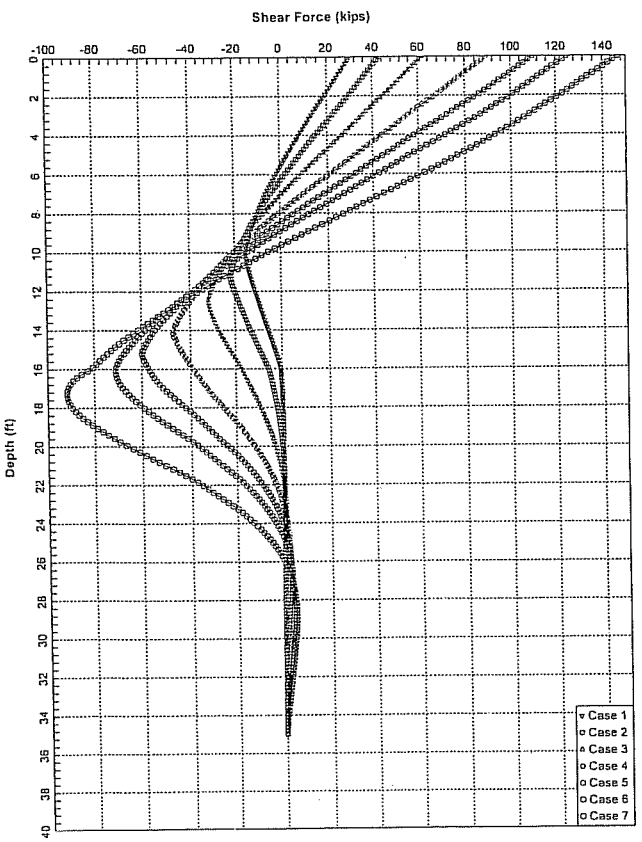

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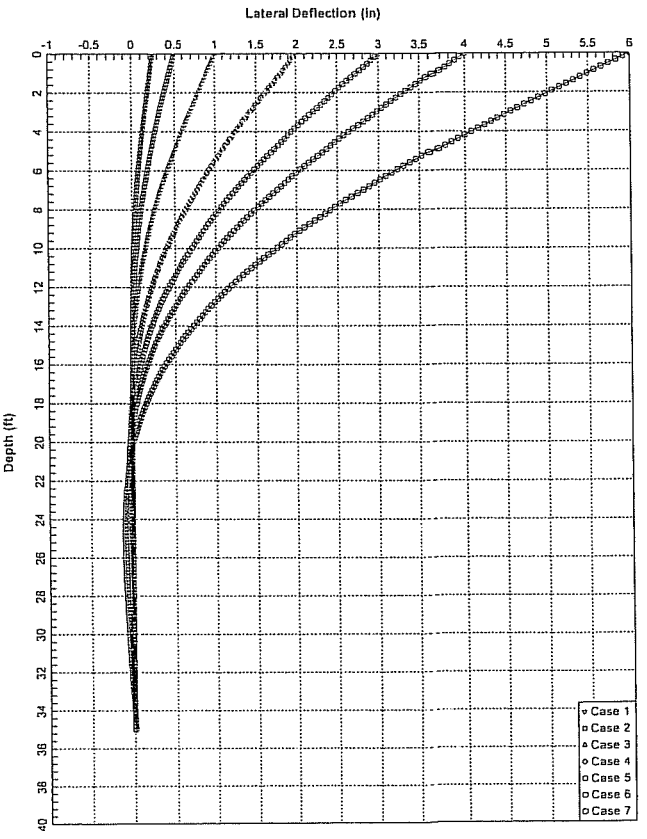

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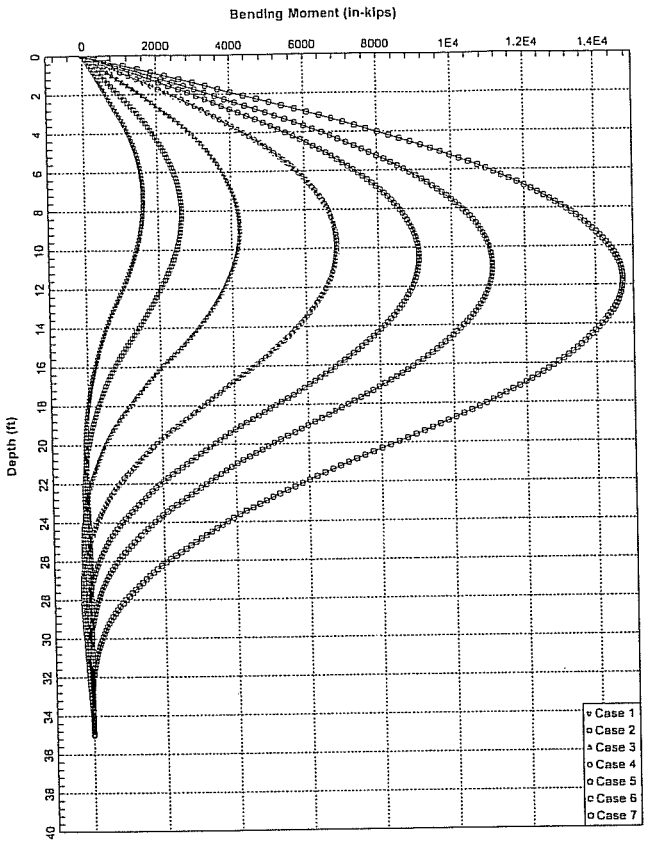

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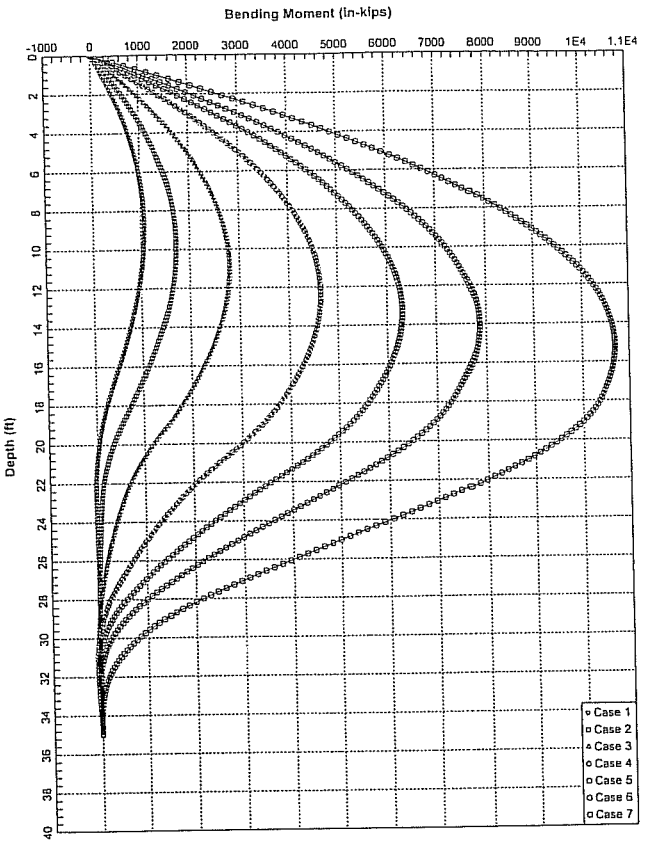
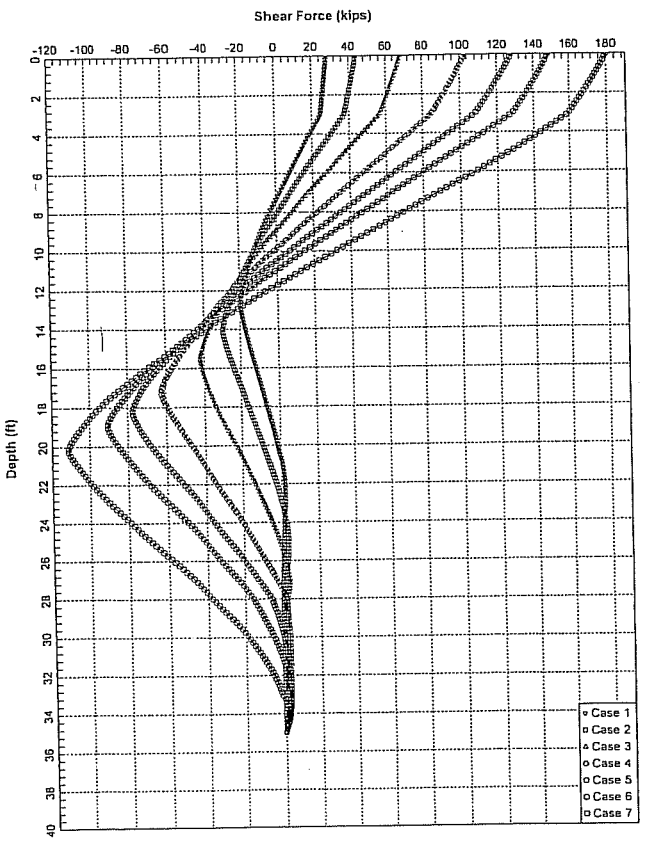


Bents 3&4 - Freehead Condition



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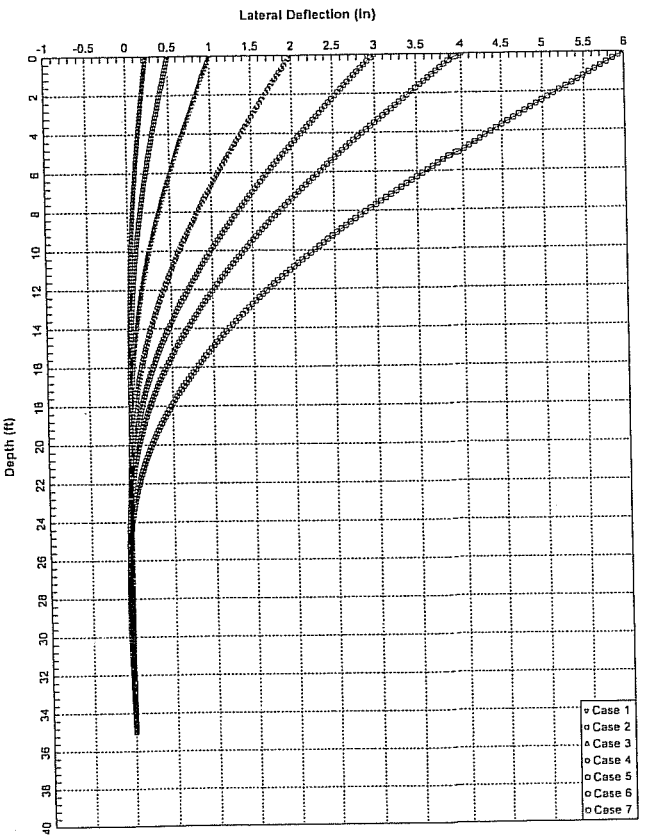
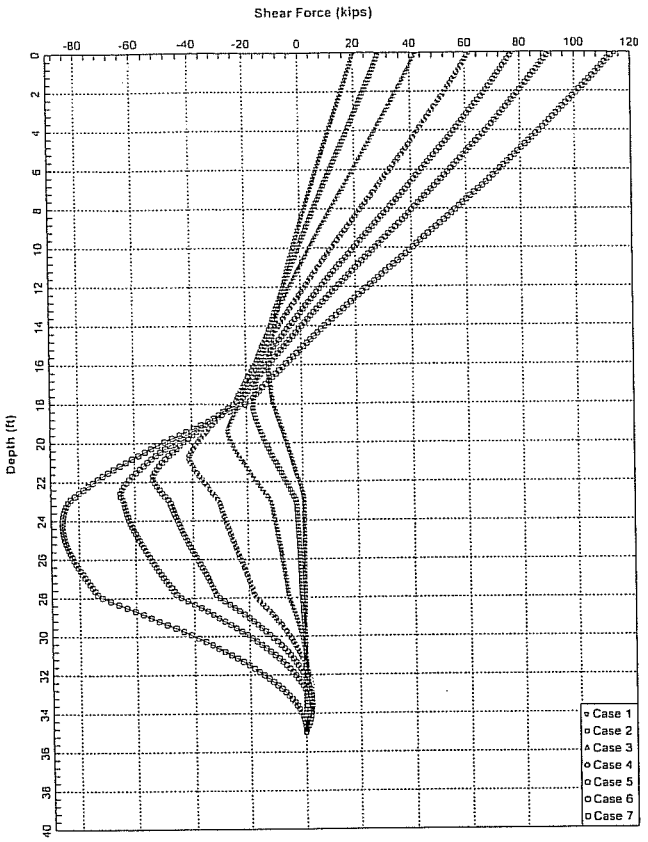
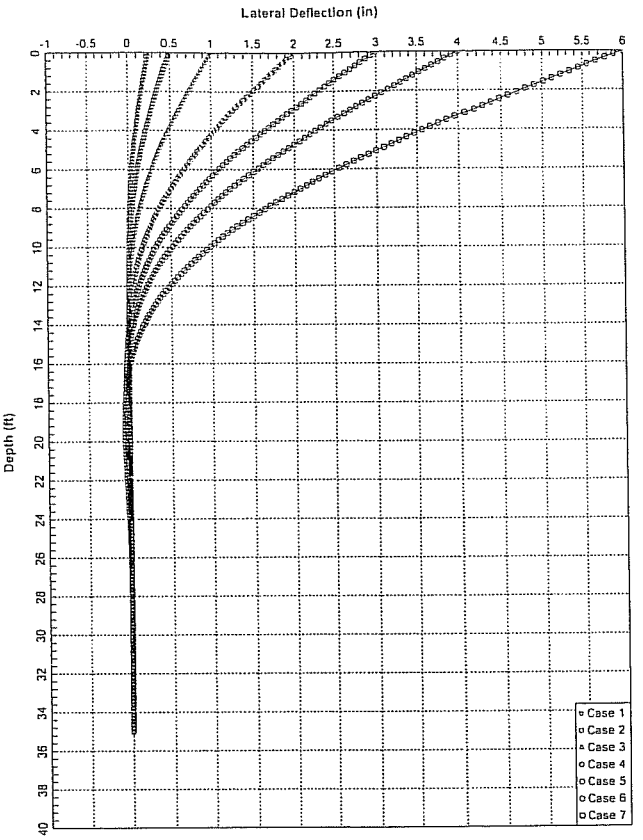


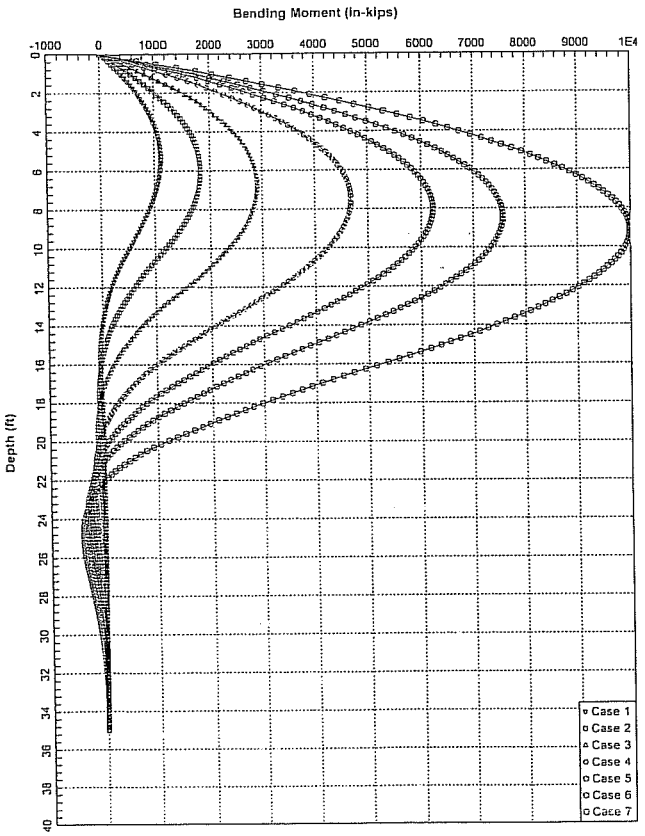
Bents 3&4 - Freehead Condition



Bents 3&4 - Freehead Condition



Abut 5 - Freehead Condition



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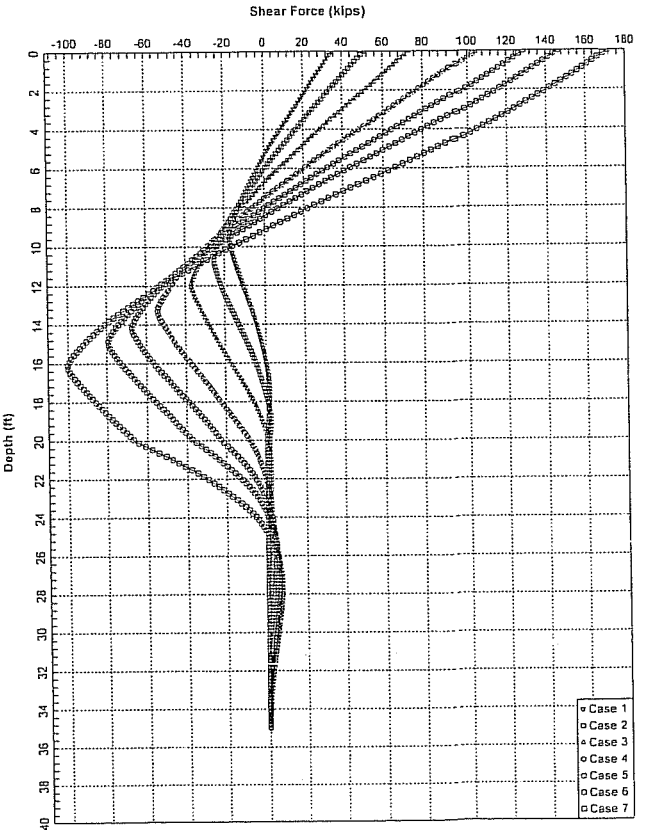

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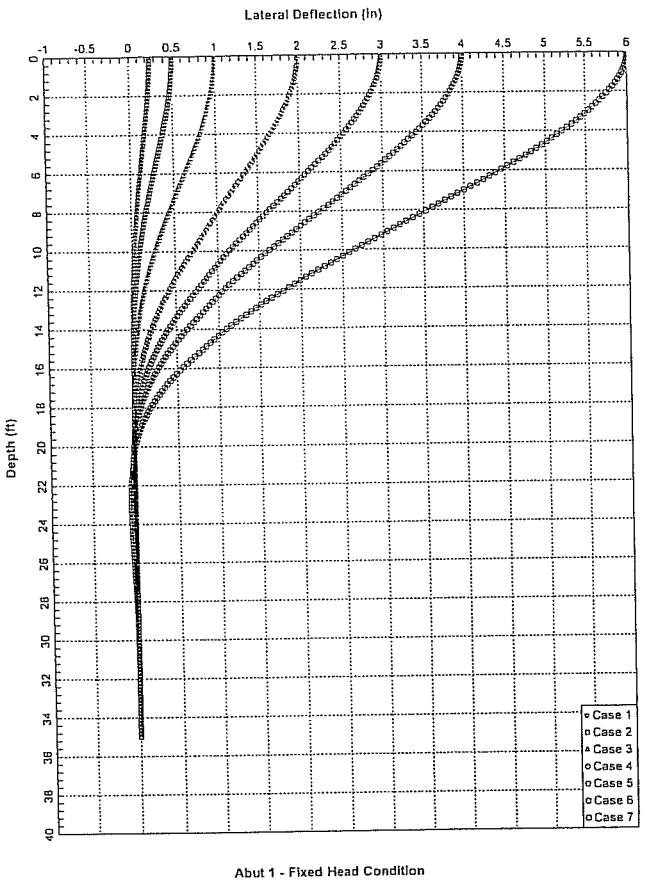
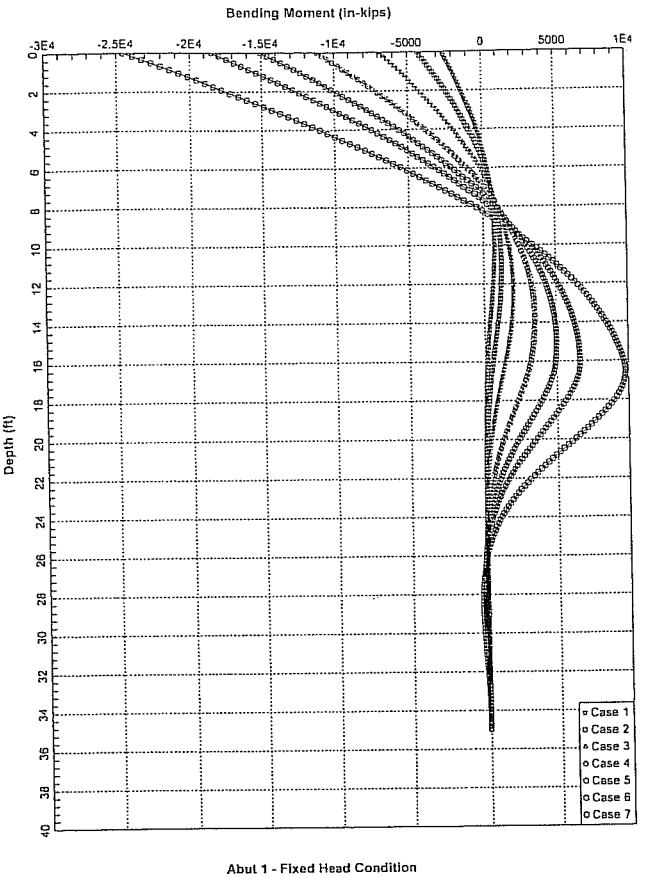


Abut 1 - Fixed Head Condition



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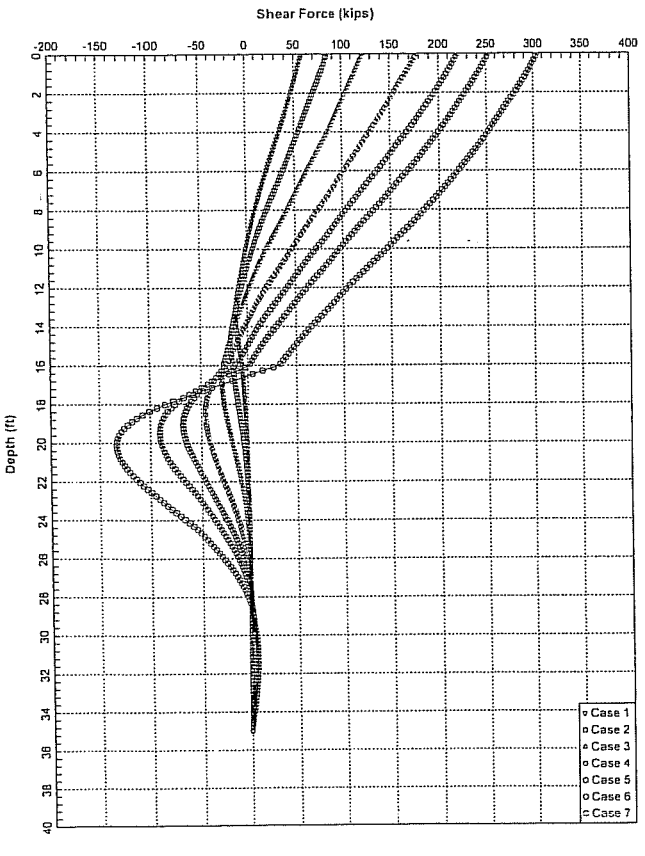

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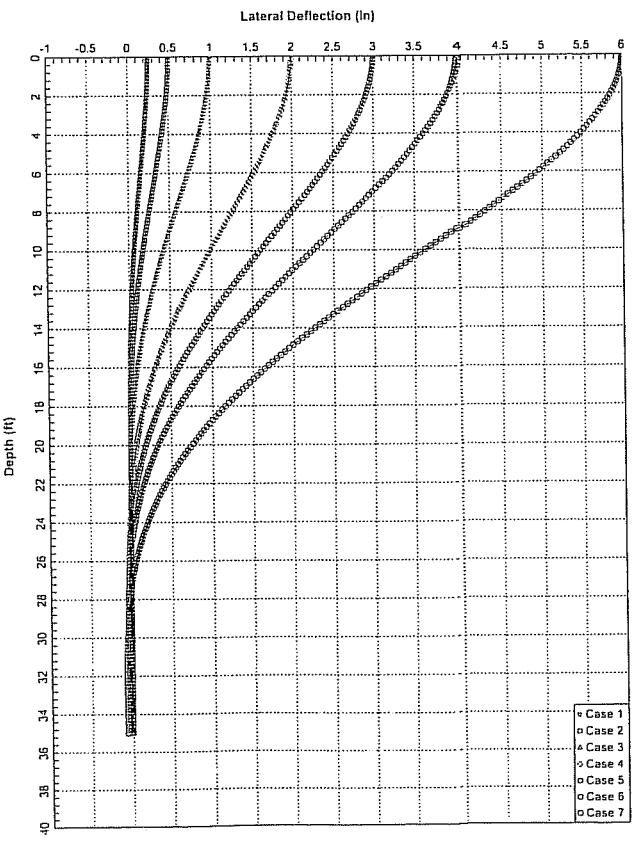
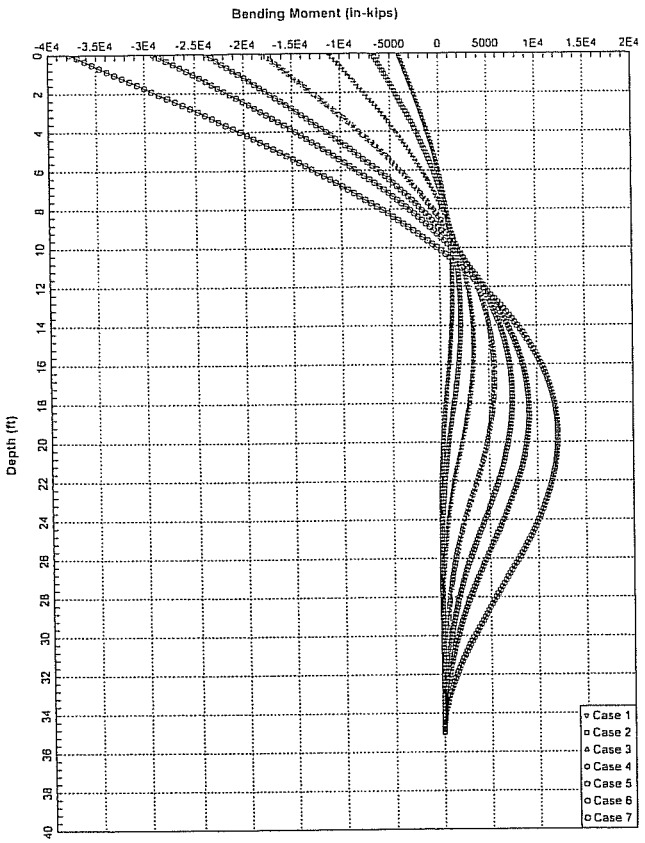


Bent 2 - Fixed Head Condition



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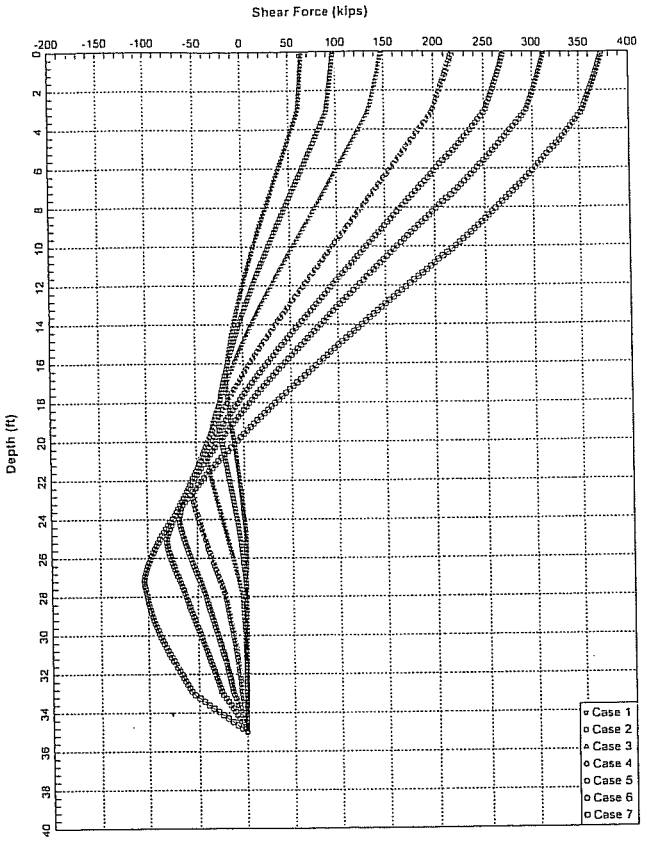

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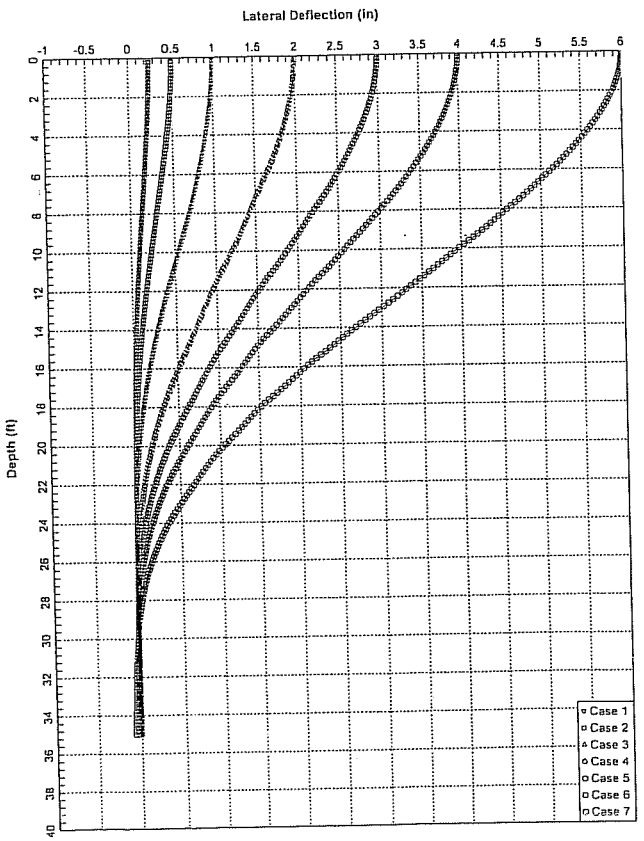
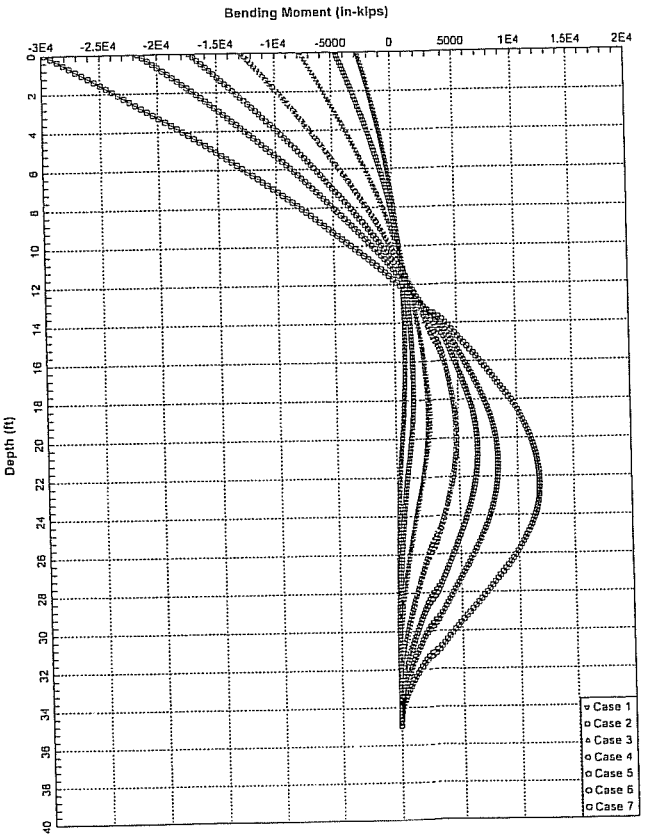


Bent 3 - Fixed Head Condition



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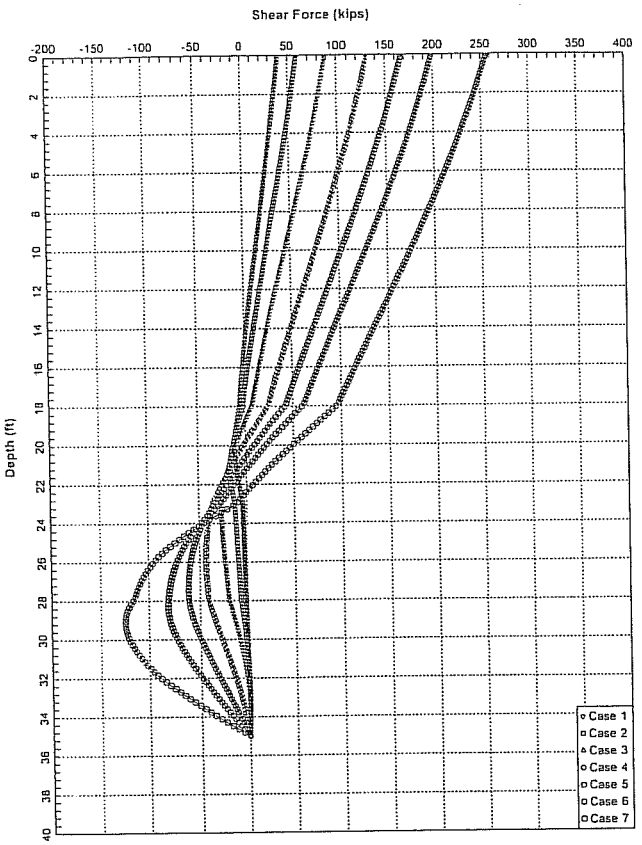

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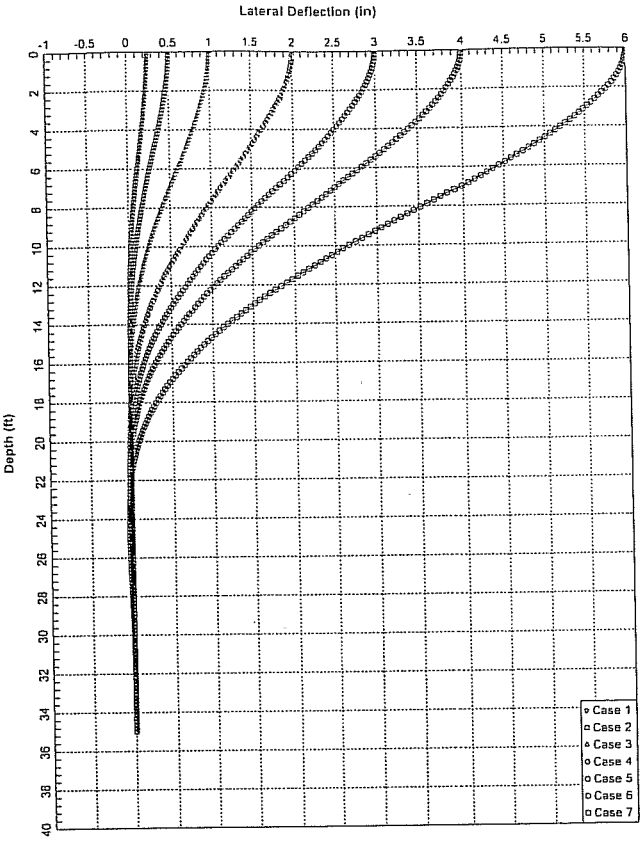
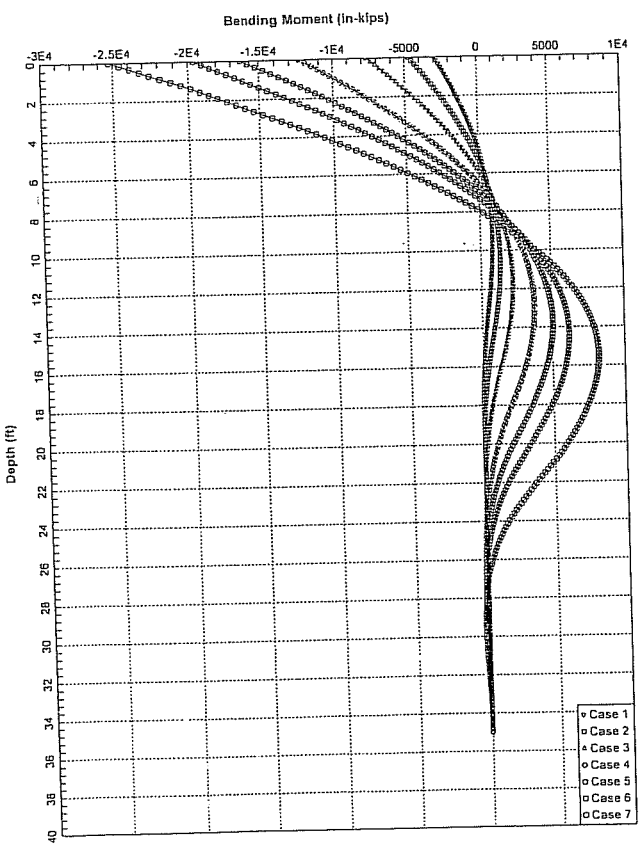
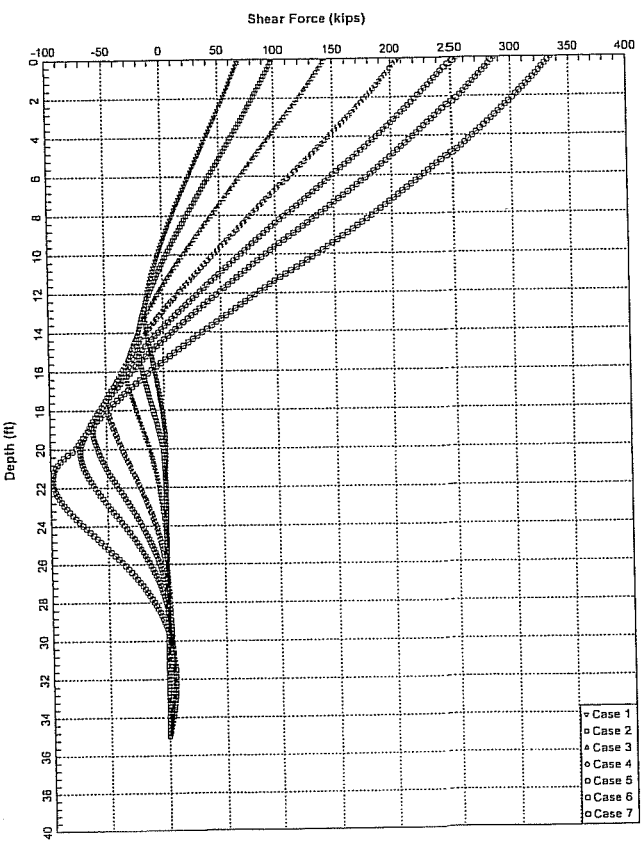


Abut 5 - Fixed Head Condition



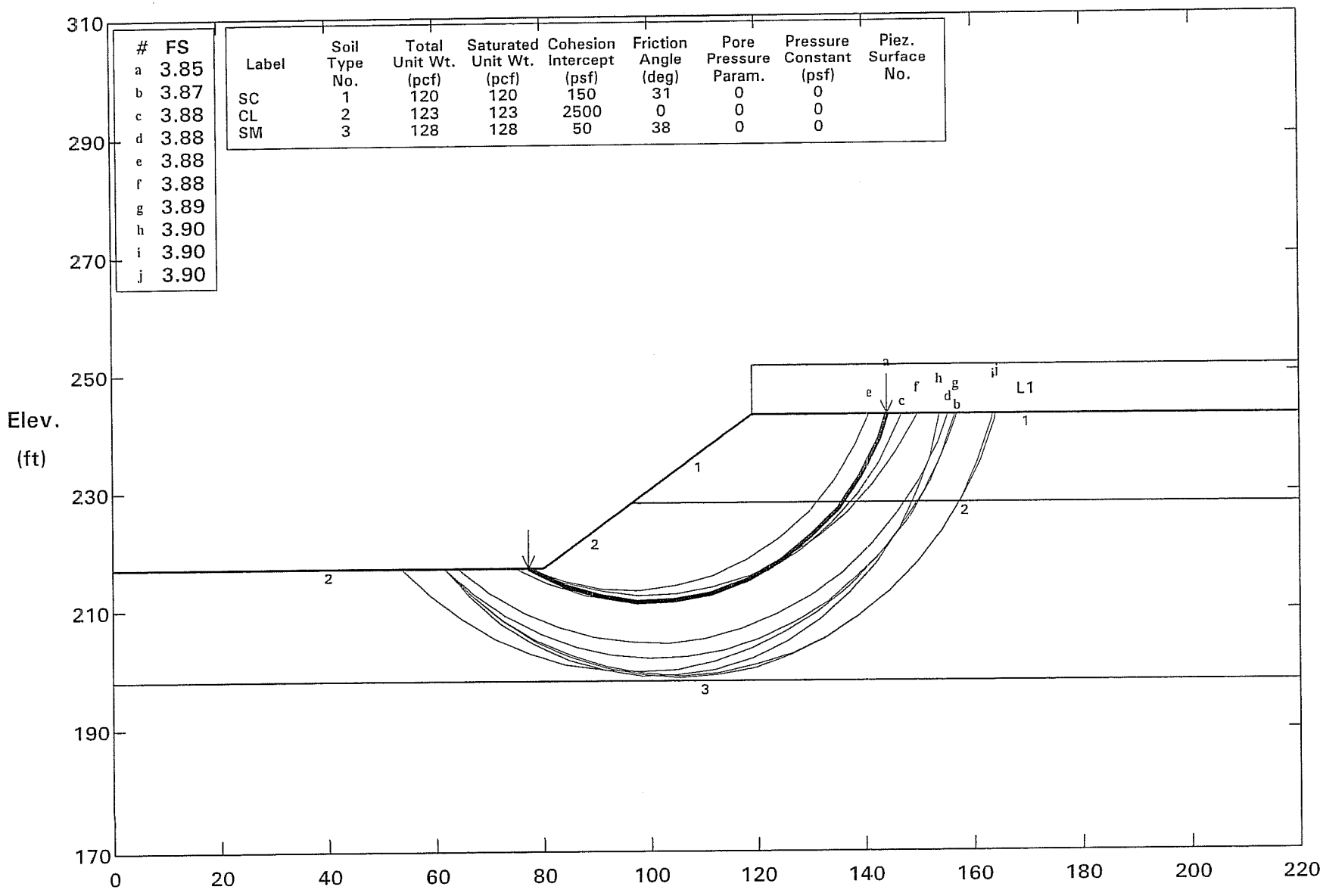
Abut 5 - Fixed Head Condition



Abut 5 - Fixed Head Condition

Placentia Ave UC (Widen) Static Condition

Ten Most Critical. D:PLAVES.PLT 01-21-09 10:39am

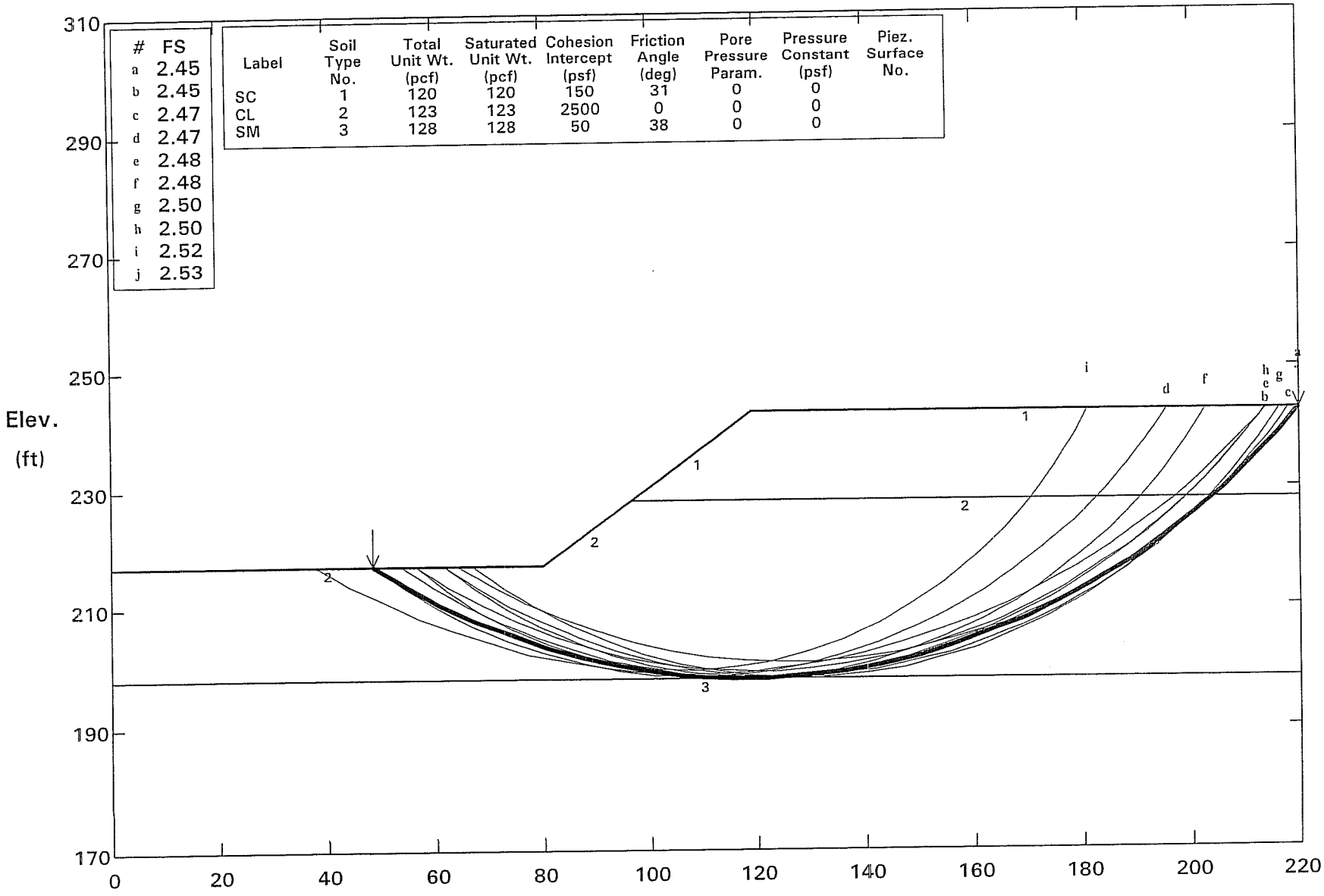


STABL6H FSmin = 3.85 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Placentia Ave UC (Widen) Pseudostatic Condition (kh = 0.2)

Ten Most Critical. D:PLAVED.PLT 01-21-09 10:39am



STABL6H FSmin = 2.45 X-Axis (ft)

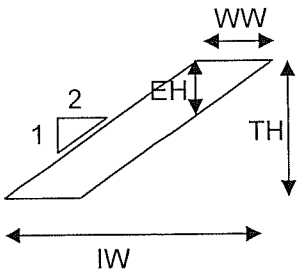
Factors Of Safety Calculated By The Modified Bishop Method

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
17660 Newhope Street, Suite E, Fountain Valley, CA 92708
phone: (714)751-3826, Fax (714)751-3928

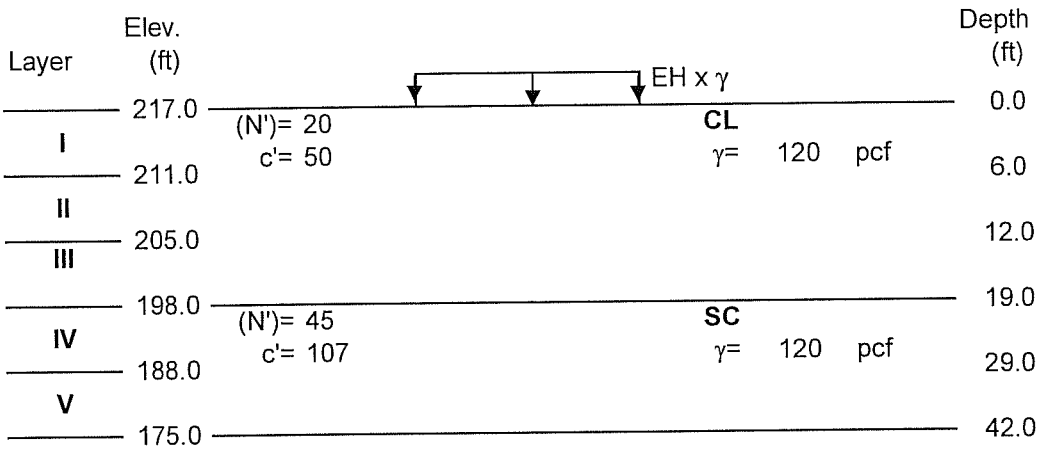
Project: **Placentia Avenue UC (Widen)** Project No. **08-115**
By CTY Date 1/30/09 Check by Date Sheet

Settlement Calculation for Sliver Fill

Total Fill Height, TH=	26	ft	Width of Widening, WW=	23	ft
Effective Fill Height, EH=	11.5	ft			
Loading=	1.38	ksf = EH x unit weight (120 pcf used)			
Influenced Width, IW=	80	ft			



Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-13



Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)
0	6	3	3.0	0.36	0.04	100%	1.38	1.74	50	0.99
II	6	9	9.0	1.08	0.11	98%	1.36	2.44	50	0.51
II	7	15.5	15.5	1.86	0.19	97%	1.33	3.19	50	0.39
III	10	24	24.0	2.88	0.30	95%	1.31	4.19	107	0.18
IV	13	35.5	35.5	4.26	0.44	86%	1.19	5.45	107	0.16
									total=	*2.23*

Abutment Lateral Earth Pressure

$\phi = 32^o$ (compacted fill)
$k_a = \tan^2(45-\phi/2) = 0.30$
$k_a \times g = 120 \times 0.3 = 36$ pcf
$k_o = 1-\sin(\phi)=1-\sin(32^o)=0.47$

APPENDIX D

CALTRANS REVIEW COMMENTS AND EMI RESPONSES

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: May 28, 2009
File: 12-ORA-57-PM 17.1
12-0F0311
Placentia Avenue UC
Bridge No. 55-0460
SR-57 Northbound Widening

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of response to our comments on the Foundation Report

On May 21, 2009, the Office of Geotechnical Design-South 1 received the response to our comments on the Foundation Report prepared by Earth Mechanics Inc. for the Northbound widening of Placentia Avenue Undercrossing, Br. #55-0460. The response has been examined thoroughly and it is our opinion that the report could be finalized after addressing additional comments as below:

- Please remove "Tension" in footnote No. 2 of Table 5-5 and "(b-I) Tension (Strength Limit)" in footnote No. 1 of Table 5-6.

  EMI: We will comply.

- Please correct the typing error in Section 5.5 (sliver fill, not silver fill) and remove (-) before tension load in Table 5-7.

  EMI: We will comply.

- Pile group capacities for Abutment 1 and 5 are overestimated because 2.5 feet diameter CIDH pile was used for the estimations instead of 2.0 feet diameter CIDH pile.

If you have any questions, please contact Chungkeun Lee at (213) 620-2148 or Ted Liu at (213) 620-2136.

EMI: We corrected the pile group capacity calculation for Abutment 1 and 5. The final design pile length is no change since the pile group does not control the design.

Prepared by: Date: 5/28/09

Reviewed by: Date: 5/28/09

REGISTERED PROFESSIONAL ENGINEER
CHUNGKEUN LEE
C69450
Exp. 12-31-10
CIVIL
STATE OF CALIFORNIA

Chungkeun Lee, P.E.
Transportation Engineer
Office of Geotechnical Design South
Branch C

Chi-Tseng Ted Liu, Ph.D.
Senior Transportation Engineer
Office of Geotechnical Design South 1
Branch C

REGISTERED PROFESSIONAL ENGINEER
CHI-TSENG TED LIU
No. 2669
Exp. 6-30-2010
GEOTECHNICAL
STATE OF CALIFORNIA

c: OGDS1 - LA. File (2), GDS1 - SAC. File (1), GS – SAC. File (1)

"Caltrans improves mobility across California"

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

May 20, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Attention: Mr. Steve Huff

Subject: Response to Caltrans Foundation Review Comments on "Foundation Report (dated 2/11/09) Placentia Avenue UC (Widen), Bridge No. 55-0460, SR-57 Northbound Widening"
12-Ora-57, PM 17.1, EA 12-0F0311

Dear Mr. Huff:

Caltrans issued a Foundation Review sheet dated April 13, 2009 for the subject project. A copy of this review sheet is attached at the end. The following are our responses to those comments. ~~Many of these responses require revisions of the foundation report. We have included those revised pages from the foundation report as attachments, and the actual revisions are also identified by a vertical line placed on the right side of the text~~.

2.1 Field Investigation

- The station line (B-Line) is not defined clearly in this section of the report and Log of Test Boring (LOTB) Sheets.

Response: See ~~attached~~ revised LOTB sheet. Table 2-1 was also revised ~~and attached~~ (see ~~attached~~ Page 4).

4.1 Soil Conditions

- Since soil profile presented in A-08-010 at Abutment 1 is different from one in A-08-013 at Abutment 5, subsurface conditions for the abutments should be profiled separately.

Response: Table 4-1 was revised to have individual soil profiles for Abutments 1 and 5 (see ~~attached~~ Pages 11 and 12).

- It is our opinion that subsurface condition at Bent 4 may not be same as Bent 3 revealed by A-08-012. Therefore, additional exploratory boring may be necessary at Bent 4.

Response: It is not necessary to conduct an additional boring at Bent 4 because:

1. Based on our review of the current and as-built LOTB sheets, soils encountered in Boring A-08-012 (at Bent 3) is considered to be the "weakest" materials among all the borings. We conservatively used the Bent-3 soil properties at Bent 4 instead of the "stronger" soil properties in Boring A-08-013 (at Abutment 5); Boring A-08-013 is closer to Bent 4 than Boring A-08-012.

2. The idealized soil strengths listed in Table 4-1 are conservative as compared to the blowcounts and laboratory test results.

3. The pile top (cut-off elevation) is embedded about 7 feet below the ground surface, but this 7- foot of overburden pressure was neglected in our axial capacity calculation. In addition, we ignored skin friction contribution from the upper 5 feet of the pile.

5.4.2 Foundation Data Provided by Structural Designers

- There should be tension load demand per support in Extreme Event Limit State in Table 5-4.
- Please do not use (-) before tension load in Table 5-4, 5-6, 5-7 and Pile Data Table.
- Eliminate Nominal Driving Resistance column from all tables.
- Please explain the reason that there is no tension demand at Bent 4.

Response:

- The tension load demand for Bent 4 was added to Table 5-4 (see ~~attached~~ Page 17).
- The (-) sign was removed from Table 5-4, 5-6, 5-7 (see ~~attached~~ Pages 17, 18 and 19).
- "Nominal Driving Resistance" columns from all tables were eliminated (see ~~attached~~ Pages 18 and 19).
- The structural engineer provided us the tension demand at Bent 4.

5.4.3 Axial Capacity

- According to AASHTO LRFD BRIDGE DESIGN SPECIFICATION (p 10-142), group effect of CIDH pile should be considered if center-to-center spacing of drilled shafts is less than 4.0, not 3.0 times pile diameters.
- According to Table 5 in Caltrans Memo To Designers 3-1 (July 2008), LRFD Service-1 Limit State Total Load and Permanent Load per Support should be included in Table 5-5. Also, Design Tip Elevations for load demands should be determined under the consideration of pile group effect if group efficiency should be applied.
- Abutment 4 in the fifth sentence of this section should be corrected to Abutment 5.
- Tension in foot note is not required in Table 5-5 because design tip elevation for tension demand is not provided.
- Unfactored compression loads for Strength Limit State should be placed in Table 5-6, although design tip elevation should be based on factored load.
- According to AASHTO LRFD BRIDGE DESIGN SPECIFICATION (p 10-130), group effect shall be considered for group of 2 shafts or more for group settlement. Please refer to the specification and calculate the design tip elevation for settlement under the consideration of group effect, especially piles at Bent 3 and 4 tipped near medium stiff clay.

Response:

- We incorporated the group efficiency factors per AASHTO LRFD Bridge Design Specification. Our calculation sheets are attached. The revised tables are attached (see attached Pages 18 and 19).
- LRFD Service-I Limit State Total Load and Permanent Load per Support were added to Table 5-5 (see attached Page 18).
- The paragraph was rewritten and Abutment 4 was deleted (see attached Page 17).
- The "tension" term in foot note in Table 5-5 was deleted (see attached Page 18).
- The unfactored compression loads were used in the attached Table 5-6 (see attached Page 18).
- Pile group settlements were calculated and attached.

5.5 Embankments and Settlement

- Structural approach slab at both abutments should be discussed.
- Abutment wingwalls should be discussed.

Response: The following responses have been added to Section 5.5 (see ~~attached~~ Page 21): "Per Caltrans Memo to Designers 5-3 dated December 1992, structure approach slabs are required for this project. Selection of the approach type will be performed by the structurral designer following the flowchart in Caltrans Memo to Designers 5-3, Attachment A dated May 1996."

The following responses have been added to Section 5.6 (see ~~attached~~ Page 21): "The abutments are adjacent to RW 496 and 512. Both abutment wingwalls are relatively narrow and only extend to the end of the abutment pile caps; two wingwalls sit on the abutment pile caps as a part of the abutment design. Design of RW 496 and 512 is in a separate report."

6.2 Pile Construction

- Wet method of construction should not be recommended for caving control, since it requires additional instrumentation and increase the chance of pile anomaly.

Response: The recommendation for wet method has been deleted. The following paragraph was added to Pile Construction: "For on-center pile spacings less than six times the pile diameter, no two adjacent piles can be constructed concurrently." (see ~~attached~~ Page 22)

Appendix A-Log of Test Boring (LOTB) Sheets and As-Built Log of Test Borings Sheets

- Please refer to the Caltrans Soil and Rock Logging Manual (June 2007), and use an appropriate LOTB border.
- Direction to the nearest cities should be shown on LOTB plan view.
- Centerline Rte 57 should be marked on LOTB plan view similar to General Plan.
- When groundwater is not shown on the borings, explain in a sentence under each boring such as groundwater was not encountered or measured during field investigation.

- Correction/multiplication factor for conversion of 2.4" California Modified ring sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.
- It is required to note datum used for surveying boreholes in LOTB (NGVD 29 or NAVD88).
- The descriptions for apparent density of cohesionless soil in LOTB are not corresponding with SPT blow counts corrected with energy ratio.
  - A-08-011: 5, 40 feet below top of borehole
  - A-08-013: 50, 55 feet below top of borehole
- Please include pocket penetrometer test result in the description of corresponding layer.
- In A-08-010 and A-08-013, subsurface material between pavement and the first sample should be described.
- Separation lines should be drawn in graphic/symbols column where group name changes (e.g. 25 feet below top of A-08-010).
- As-Built Log of Test Borings containing proper title block conforming to Caltrans Soil and Rock Logging Manual should be included in the project plan.
- If As-Built Log of Test Borings was surveyed with different datum, it is required to include conversion factor of the datum to NAVD 88.

Response: The ~~attached~~ LOTB sheets incorporated the following revisions per Caltrans review:

- An appropriate bottom title block is used in the attached LOTB sheets.
- Directions to the nearest cities are added.
- "B-Line" in parenthesis was added to the plan next to the existing SR-57 Centerline mark.
- Conversion factor from 2.4" California Modified Ring sampler blowcount to 1.4" Standard Penetration Test sampler blowcount is added to the "Notes"
- We added "Vertical Datum is NAVD 88".
- Apparent density was revised based on the blowcount and hammer efficiency.
- Pocket penetrometer test results are added and used for classifying cohesive soils.
- The subsurface condition for Boring A-08-013 was revised. The materials in Boring A-08-010 between 7" pavement and the first sample (5' deep) was base material.
- Separation lines are drawn where group ~~name~~ changes. symbol (LOTB 5/29/09)
- Proper title block is now included for as-built LOTB.
- The following sentence has been added to Section 2.1 Field Investigation: "About 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV88)."

Appendix B-Laboratoy Test Results

- It is recommended to include all test results (Direct shear and unconsolidated undrained Test) in Table 1.

Response: Table 1 in Appendix B is quite congested already. We will add the ~~attached~~ Table 2 for the strength test results in Appendix B.

Structure Plan

- Minimum pile spacing of 2.5 pile diameter is not followed at bents.

Response: Per our telephone conference on May 19, 2009, we have used extrapolation of the current guideline (0.65 at 2.5d and 1.0 at 4d, where d is the pile diameter) to determine the group efficiency factor for pile spacings less than 2.5d. In addition, pile sequencing shall be used during construction.

- Soil Legend sheets should be placed at the end of current LOTB sheets.

Response: We will comply in the revised report.

In addition to the above comments, the structural engineers have requested us to add the competent soil and passive resistance of the pile cap into the final report.

The following sentence has been added to Section 5.1 (see ~~attached~~ Page 14): "Based on our soil borings, soils at the bridge site meet the competent soil requirement in SDC Section 6.2.2 (Caltrans, 2006b)."

The following sentences have been added to Section 5.5 (see ~~attached~~ Page 19): "In addition to lateral resistance from the piles, the passive resistance for the pile cap can be simplified as a bi-linear (elastic-perfectly plastic) curve. The maximum pressure is 3.8 ksf at a displacement of 0.05H (where H is the pile cap thickness)."

Sincerely,
EARTH MECHANICS, INC.

Chien-Tai Yang, GE 2827
Project Engineer

Attachments

Attachment 1:
-Revised Report Page 4 for **Conversion Factor for Datum Change and Table 2-1**
-Revised Report Pages 11 and 12 for **Table 4-1**
-Revised Report Page 14 for **Competent Soil**
-Revised Report Page 17 for **Table 5-3, Table 5-4, and Section 5.4.3**
-Revised Report Page 18 for **Table 5-5 and Table 5-6**
-Revised Report Page 19 for **Table 5-7 and Pile Cap Resistance**
-Revised Report Page 21 for **Structural Approach Slab and Abutment Wingwall**
-Revised Report Page 22 for **Pile Construction**
-Revised LOTB Sheets
-Table 2 in Appendix B
-Axial Pile Capacity Calculation Sheets

deleted (See the final report)

Attachment 2:
-Caltrans Foundation Review Comment Sheets dated April 13, 2009

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: April 13, 2009
File: 12-ORA-57-PM 17.1
12-0F0311
Placentia Avenue UC
Bridge No. 55-0460
SR-57 Northbound Widening

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of the Draft Foundation Report

On February 26, 2009, the Office of Geotechnical Design-South 1, Branch C received the Foundation Report (FR) prepared by Earth Mechanics Inc., dated February 11, 2009, and unchecked detail Plans for the Northbound widening of Placentia Avenue Undercrossing, Bridge No. 55-0460. We reviewed the report and plan sheets, and our comments are as follows:

2.1 Field Investigation

- The station line (B-Line) is not defined clearly in this section of the report and Log of Test Boring (LOTB) Sheets.

4.1 Soil Conditions

- Since soil profile presented in A-08-010 at Abutment 1 is different from one in A-08-013 at Abutment 5, subsurface conditions for the abutments should be profiled separately.
- It is our opinion that subsurface condition at Bent 4 may not be same as Bent 3 revealed by A-08-012. Therefore, additional exploratory boring may be necessary at Bent 4.

5.4.2 Foundation Data Provided by Structural Designers

- There should be tension load demand per support in Extreme Event Limit State in Table 5-4.
- Please do not use (-) before tension load in Table 5-4, 5-6, 5-7 and Pile Data Table.
- Eliminate Nominal Driving Resistance column from all tables.
- Please explain the reason that there is no tension demand at Bent 4.

5.4.3 Axial Capacity

- According to AASHTO LRFD BRIDGE DESIGN SPECIFICATION (p 10-142), group effect of CIDH pile should be considered if center-to-center spacing of drilled shafts is less than 4.0, not 3.0 times pile diameters.

- According to Table 5 in Caltrans Memo To Designers 3-1 (July 2008), LRFD Service-1 Limit State Total Load and Permanent Load per Support should be included in Table 5-5. Also, Design Tip Elevations for load demands should be determined under the consideration of pile group effect if group efficiency should be applied.
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- Structural approach slab at both abutments should be discussed.
- Abutment wingwalls should be discussed.

6.2 Pile Construction

- Wet method of construction should not be recommended for caving control, since it requires additional instrumentation and increase the chance of pile anomaly.

Appendix A-Log of Test Boring (LOTB) Sheets and As-Built Log of Test Borings Sheets

- Please refer to the Caltrans Soil and Rock Logging Manual (June 2007), and use an appropriate LOTB border.
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- Centerline Rte 57 should be marked on LOTB plan view similar to General Plan.
- When groundwater is not shown on the borings, explain in a sentence under each boring such as groundwater was not encountered or measured during field investigation.
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- It is required to note datum used for surveying boreholes in LOTB (NGVD 29 or NAVD88).
- The descriptions for apparent density of cohesionless soil in LOTB are not corresponding with SPT blow counts corrected with energy ratio.

- A-08-011: 5, 40 feet below top of borehole
- A-08-013: 50, 55 feet below top of borehole

- Please include pocket penetrometer test result in the description of corresponding layer.
- In A-08-010 and A-08-013, subsurface material between pavement and the first sample should be described.
- Separation lines should be drawn in graphic/symbols column where group name changes (e.g. 25 feet below top of A-08-010).
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- If As-Built Log of Test Borings was surveyed with different datum, it is required to include conversion factor of the datum to NAVD 88.

Appendix B-Laboratoy Test Results

- It is recommended to include all test results (Direct shear and unconsolidated undrained Test) in Table 1.

Structure Plan

- Minimum pile spacing of 2.5 pile diameter is not followed at bents.
- Soil Legend sheets should be placed at the end of current LOTB sheets.

If you have any questions, please contact Chungkeun Lee at (213) 620-2148 or Ted Liu at (213) 620-2136.

Prepared by: Date: 04/13/09

REGISTERED PROFESSIONAL ENGINEER
CHUNGKEUN LEE
C69450
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STATE OF CALIFORNIA

Chungkeun Lee, P.E.
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Reviewed by: Date: 4/13/09

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for FARAMARZ GERAMI, P.G., C.E.G.
Engineering Geologist
Office of Geotechnical Design South 1
Branch C

c: OGDS1 - LA. File (2)
OGDS1 - Sac. File (1)
GS – Sac. File (1)

FINAL FOUNDATION REPORT

Chapman Avenue Undercrossing (WIDEN)
Bridge No. 55-0456
SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 17.3
EA 12-0F0311

EMI Project No. 08-115
Date: June 17, 2009

EARTH MECHANICS, INC.

Geotechnical and Earthquake Engineering

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

June 17, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Attention: Mr. Steve Huff, P.E.

Subject: **Final Foundation Report for Chapman Avenue Undercrossing (WIDEN),**
Bridge No. 55-0456
SR-57 Northbound Improvement Project, Orange County, California
12-Ora-57, PM 17.30, EA 12-0F0311

Dear Mr. Huff:

Attached please find the final Foundation Report for the subject bridge widening project. This report contains the findings and conclusions of our field investigation and laboratory testing program. This report also contains our recommendations for the design and construction of the bridge foundation.

An earlier version of this Foundation Report, dated February 4, 2009, was prepared by EMI and reviewed by Caltrans. Copies of the review sheets and our responses are attached in Appendix D. This report has been revised to incorporate our responses to the review comments.

We appreciate the opportunity to provide geotechnical design services for this project. If you have any questions, please call us.

Sincerely,
EARTH MECHANICS, INC.

Chien-Tai Yang, GE 2827
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
CHIEN-TAI YANG
NO. GE 2827
EXP. 06-30-2010
GEOTECHNICAL
STATE OF CALIFORNIA

Lino Cheang, GE 2345
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17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

FINAL FOUNDATION REPORT

CHAPMAN AVENUE UNDERCROSSING (WIDEN)
BRIDGE NO. 55-0456
SR-57 NORTHBOUND IMPROVEMENT PROJECT
ORANGE COUNTY, CALIFORNIA
12-Ora-57, PM 17.30
EA 12-0F0311

Prepared for:

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Prepared By:

Earth Mechanics, Inc.
17660 Newhope Street, Suite E
Fountain Valley, California 92708

EMI Project No. 08-115

June 17, 2009

TABLE OF CONTENTS

Section	Page
1.0 INTRODUCTION	**1**
1.1 Purpose and Scope of Study	1
1.2 Project Description	1
2.0 FIELD INVESTIGATION AND LABORATORY TESTING	**4**
2.1 Field Investigation	4
2.2 Laboratory Testing	5
3.0 GEOLOGY AND SEISMICITY	**6**
3.1 Topography and Drainage	6
3.2 Physiography	6
3.3 Geologic Structure	6
3.4 Geologic Hazards	8
3.5 Stratigraphy	8
3.6 Seismicity	10
4.0 SUBSURFACE CONDITIONS	**11**
4.1 Soil Conditions	11
4.2 Groundwater Conditions	12
5.0 CONCLUSIONS AND RECOMMENDATIONS	**13**
5.1 Seismic Design Criteria	13
5.2 Liquefaction	15
5.3 Soil Corrosivity	15
5.4 Pile Foundation Design	15
5.4.1 Foundation Type	15
5.4.2 Foundation Data Provided by Structural Designers	15
5.4.3 Axial Capacity	16
5.4.4 Lateral Resistance	17
5.5 Embankments and Settlement	18
5.6 Bridge Abutment Wall Design	18
6.0 CONSTRUCTION RECOMMENDATIONS	**19**
6.1 Earthwork	19
6.2 Pile Construction	19
6.3 Construction Sequence	20
6.4 Backdrain and Backfill Requirements For Abutment Walls	20
6.5 Review of Construction Plans	20
6.6 Geotechnical Observation and Testing	22
7.0 LIMITATIONS	**23**

8.0 REFERENCES 24

List of Tables Page

Table 2-1. Geotechnical Exploration Information 4
Table 4-1. Idealized Soil Profile and Strength Parameters 11
Table 5-1. Local Seismic Sources 13
Table 5-2. Soil Corrosion Test Results 15
Table 5-3. Foundation Design Data Sheet 16
Table 5-4. Foundation Design Loads 16
Table 5-5. Abutment Foundations Design Recommendations 16
Table 5-6. Pile Data Table 17
Table 5-7. Lateral Pile Solutions 17

List of Figures Page

Figure 1-1. Site Location Map 2
Figure 3-1. Regional Fault and Physiographic Map 7
Figure 3-2. Geological Map 9
Figure 5-1. Design ARS Curve 14
Figure 6-1. Low Expansion Material in Bridge Embankment 21

APPENDICES

Appendix A. Log of Test Borings Sheets and As-built Log of Test Borings Sheet
Appendix B. Laboratory Test Results
Appendix C. Design Calculations
Appendix D. Caltrans Review Comments and EMI Responses

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF STUDY

This Foundation Report presents the findings and conclusions of a geotechnical investigation conducted by Earth Mechanics, Inc. (EMI). It presents foundation design and construction recommendations for proposed widening of the Chapman Avenue Undercrossing (UC) in Orange County, California. A site location map is presented in Figure 1-1.

This work was performed for the Orange County Transportation Authority (OCTA) and EMI is a subconsultant to RBF Consulting (RBF). The geotechnical services provided for this project included the following tasks:

- Collection and review of existing geotechnical information;
- Field exploration consisting of drilling and logging exploratory borings;
- Laboratory testing of selected bulk and relatively undisturbed soil samples;
- Engineering calculations (see Appendix C) and analysis to develop foundation design and construction recommendations; and
- Preparation of this report presenting our findings, conclusions, and recommendations.

1.2 PROJECT DESCRIPTION

The Department of Transportation (Caltrans) – District 12, in cooperation with the Orange County Transportation Authority (OCTA), proposed to widen northbound State Route 57 (SR-57) by adding one northbound through lane. The project limits are between 0.2 mile south of Orangethorpe Avenue and 0.2 mile north of Yorba Linda Boulevard along northbound SR-57. Within the project limits, there are interchanges located at Orangethorpe Avenue, Chapman Avenue, Nutwood Avenue and Yorba Linda Boulevard. The entire project involves widening seven existing bridges and a tieback wall at Yorba Linda Boulevard:

- Orangethorpe Avenue Undercrossing (Bridge No. 55-0459)
- South Placentia Overhead (Bridge No. 55-0450)
- Crowther Avenue Undercrossing (Bridge No. 55-0457)
- Placentia Overhead (Bridge No. 55-0449)
- Placentia Avenue Undercrossing (Bridge No. 55-0460)
- Chapman Avenue Undercrossing (Bridge No. 55-0456)
- Nutwood Avenue Undercrossing (Bridge No. 55-04649)
- Tieback Wall at Yorba Linda Boulevard (Bridge No. 55-0468)

This report pertains to Chapman Avenue UC only; separate foundation reports are prepared for each of the above seven remaining structures.

The Chapman Avenue UC is located in the City of Fullerton north of the SR-57/SR-91 interchange. SR-57 in the project area trends in a north-south direction and carries traffic from the "Orange Crush" (I-5/SR-22/SR-57 Interchange) in Orange County to Interstate 210 in Los Angeles County (See Figure 1-1).

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SITE LOCATION MAP Figure 1-1	
CHAPMAN AVENUE UC (WIDEN)	Project No. 08-115	Date: 01-10-09

The existing Chapman Avenue UC carries SR-57 northbound and southbound traffic over Chapman Avenue. The structure was constructed in 1969. The structure has one span with a total span length of 151'-10" and is constructed on a 12° skew. The prestressed concrete box girder has a depth of 6'-3". Total width of the prestressed concrete box girder structure varies from 148'-0" to 158'-0". The box girders are supported on diaphragm abutment walls with 16" CIDH piles connecting directly to the diaphragm abutments.

This project will widen Chapman Avenue UC by approximately 20'-6" on the northbound side to provide an additional 12-foot lane and 10-foot shoulder in that direction. The proposed widening is a precast prestressed box girder with diaphragm-type abutments. The new structure depth is 6'-6". Both abutments will be supported on 24" CIDH piles.

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 FIELD INVESTIGATION

A copy of the As-Built Log-of-Test-Borings (LOTB) sheet is included in Appendix A. About 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV88). According to this As-Built LOTB sheet, one rotary boring and four penetration borings were performed in November and December 1965. The rotary boring was about 50 feet deep and was advanced to about El. +175 feet. The deepest penetration boring reached El. +170 feet. Existing grade at the time of the investigation in 1965 was approximately El. +226 feet. Groundwater was not encountered during drilling in November and December 1965 down to El. +170 feet.

To supplement the existing subsurface data, two soil borings were drilled (one at each abutment). These borings were drilled on September 21 and 24, 2008. Boring information, including exploration number, stations, offsets, ground surface elevations, bottom of hole elevations and water level measurements are summarized in Table 2-1. Locations of the exploratory boring are shown on the LOTB sheet provided in Appendix A.

TABLE 2-1. GEOTECHNICAL EXPLORATION INFORMATION

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-014	SR-57 Main Line (B-Line)	519+03	70RT	+250.1	+158.6	None Encountered During Drilling
A-08-015	SR-57 Main Line (B-Line)	521+09	71RT	+252.1	+160.6	

Exploratory borings were drilled using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. Relatively undisturbed drive samples were obtained using a 3.25-inch outer diameter California split-spoon sampler lined with brass rings. Each of these brass rings is 1-inch long with a 2.5-inch outside diameter. The California Drive sampler was driven into the ground using successive blows of a 140-lb hammer falling a distance of 30 inches. The numbers of blow for the final 12 inches or shorter of driving are shown on the LOTB sheet.

The Standard Penetration Test (SPT) sampler (1.4-inch inside diameter) was also used to obtain soil samples. The sampler was driven into the ground using a 140-lb hammer free falling from a height of 30 inches. The numbers of blow to advance the sampler each 6 inches of penetration or less was recorded. The blow counts required to drive the sampler for the last 12 inches or less was recorded as the Standard Penetration Resistance (N-value) on the LOTB sheet.

Charts published by Winterkorn and Fang (1975) can be used to determine a reduction factor used to convert blowcounts recorded using the California Drive sampler into SPT blowcounts. Using those charts, we obtained a reduction factor of 0.5 and this one-half reduction factor was used for this project.

The sampling interval is usually 5 feet. Sampling was performed by alternating the California Drive sampler and SPT sampler.

2.2 LABORATORY TESTING

Soil samples considered representative of the subsurface conditions were tested to obtain or derive relevant physical and engineering soil properties. The following laboratory tests were conducted to supplement the observations recorded during the field investigation:

- In-situ Moisture Content and Unit Weight
- Pocket Penetrometer
- Percent Passing No. 200 Sieve
- Atterberg Limits
- Direct Shear
- UU Triaxial Test
- Consolidation
- Minimum Resistivity, pH, Sulfate Content and Chloride Content

The laboratory tests were conducted in general accordance with California Test Methods or American Society for Testing and Materials (ASTM) Standards. Laboratory test results are included in Appendix B.

3.0 GEOLOGY AND SEISMICITY

3.1 TOPOGRAPHY AND DRAINAGE

The project corridor is in the eastern part of the Los Angeles Basin along the southern margin of the Coyote Hills and the Puente Hills (Figure 3-1). Just north of the project corridor, the Puente Hills rise to an elevation of about 1,400 feet. The southwestern edge of the Puente Hills is paralleled by a series of low-elevation plains and hills; the Santa Fe Plain and the Coyote Hills are to the west of the project corridor, and the Richfield and Kraemer Hills are to the east. The elevations of these hills range from about 500 feet just west of the project to about 300 feet in the east. The ground upon which the project is located slopes gently to the south. Elevations along the project corridor range from about 280 feet in the north to about 200 feet on the south.

The project corridor traverses the ancient flood plains and alluvial fans of Fullerton Creek and the Santa Ana River. The major drainage in the area is the Santa Ana River which flows westerly south of the site. Fullerton Creek, a tributary to the Santa Ana River, drains southwesterly from the Puente Hills just west of the project corridor.

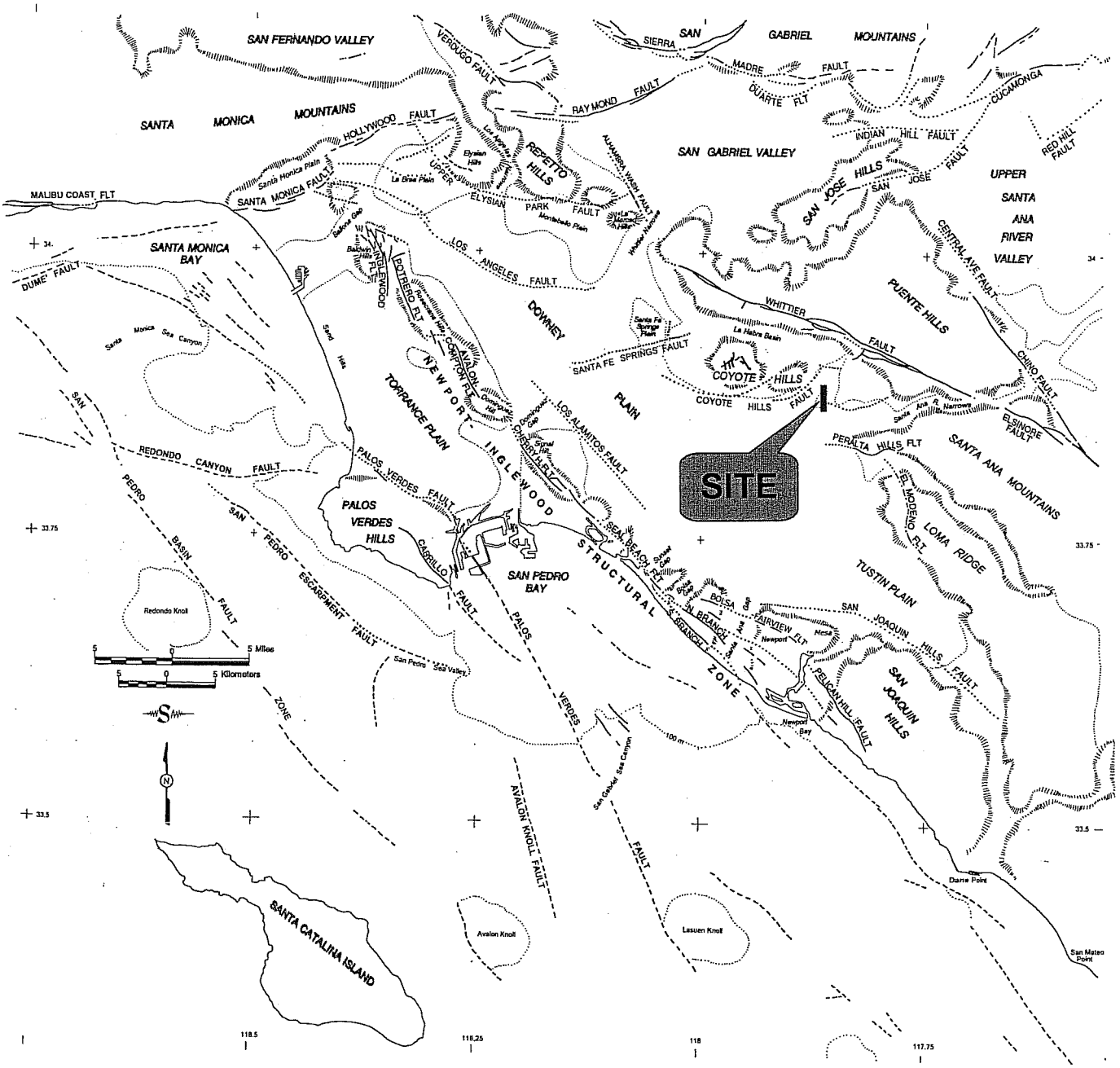
3.2 PHYSIOGRAPHY

The site area is at the eastern edge of the Los Angeles physiographic basin, a large, relatively flat, low-lying, coastal plain surrounded by mountains on the north, east, and southeast (Figure 3-1). The floor of the Los Angeles Basin is relatively flat but slopes gradually southwesterly from an elevated marginal apron to sea level along the coastline. The western margin of the Los Angeles Basin is bordered by the sea and the Palos Verdes Hills. The eastern margin is bordered by the Puente Hills and Santa Ana Mountains. The Coyote Hills, Santa Fe Springs Plain, Richfield Hills, and Kramer Hills are low elevation uplifts along the southern margin of the Puente Hills.

3.3 GEOLOGIC STRUCTURE

The geologic structure at the site is quite simple and is characterized by flat-lying Quaternary sediments overlying gently folded Tertiary sedimentary rocks. These strata rise gently to the Coyote Hills, Richfield Hills, and Kraemer Hills where they are arched upward to form anticlinal folds. The site is on the south limb of these anticlines with the early Pleistocene and Tertiary age strata dipping gently to the south and overlain by younger flat-lying Quaternary sediments.

The nearest active or potentially active surface faults are the Peralta Hills and Whittier faults (Figure 3-1). The low-elevation plains and hills along the eastern margin of the Los Angeles Basin are underlain by a series of east-west trending, en echelon, faults and folds in the subsurface; the major faults within this trend are, from north to south, the Los Angeles (Las Cienegas), Santa Fe Springs, and Coyote Hills faults (Figure 3-1). This group of faults is known as the Puente Hills fault system. Other poorly known segments of this thrust fault system underlie the Richfield and Kramer hills. All of these faults are blind thrust or reverse faults that approach within about a mile or so of the ground surface. They are identified on seismic reflection geophysical data only and are below the depths of oil wells.



CHAPMAN AVENUE UC (WIDEN)

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

REGIONAL FAULT AND PHYSIOGRAPHIC MAP

Figure 3-1

Project No. 08-115

Date: 01-07-09

The Peralta Hills fault may be related to the Puente Hills fault system. The Peralta Hills fault is exposed along the south flank of the Peralta Hills where it displaces Tertiary-age rocks upward and over younger Quaternary alluvium. The fault extends westerly below the Santa Ana River channel where it creates barriers to ground-water flow (Figure 3-2). The barriers extend about to the SR 57 freeway just north of the Lincoln Avenue (Morton and Miller, 1981). The location of the Peralta Hills fault is well up on the flank of the hills rather than at the base of the hills indicating that it is not the only fault responsible for uplift and folding of the Peralta Hills. There must be a deeper unknown blind thrust fault below the Peralta Hills thrust fault but this feature has never been directly identified.

The Whittier fault is a major strike slip fault that extends northwesterly along the southwest flank of the Puente Hills northeast of the site (Figure 3-1). The Whittier fault is associated with the Chino fault and the Elsinore fault and together these faults form a major fault system that extends from the Los Angeles Basin into northern Mexico.

The El Modeno fault is a north-south trending feature within Loma Ridge, one of the foothills of the Santa Ana Mountains, southeast of the site. The feature is poorly known but is known to displace Holocene soil in Loma Ridge. Although the fault is grouped with the Peralta Hills fault on the Caltrans seismic hazard map (Mualchin 1996), it appears to be a discrete normal or strike-slip fault unrelated to the thrust faults of the Peralta Hills. Although the fault must be considered active because it displaces Holocene soil, the feature has a very long (thousands of years) recurrence interval.

3.4 GEOLOGIC HAZARDS

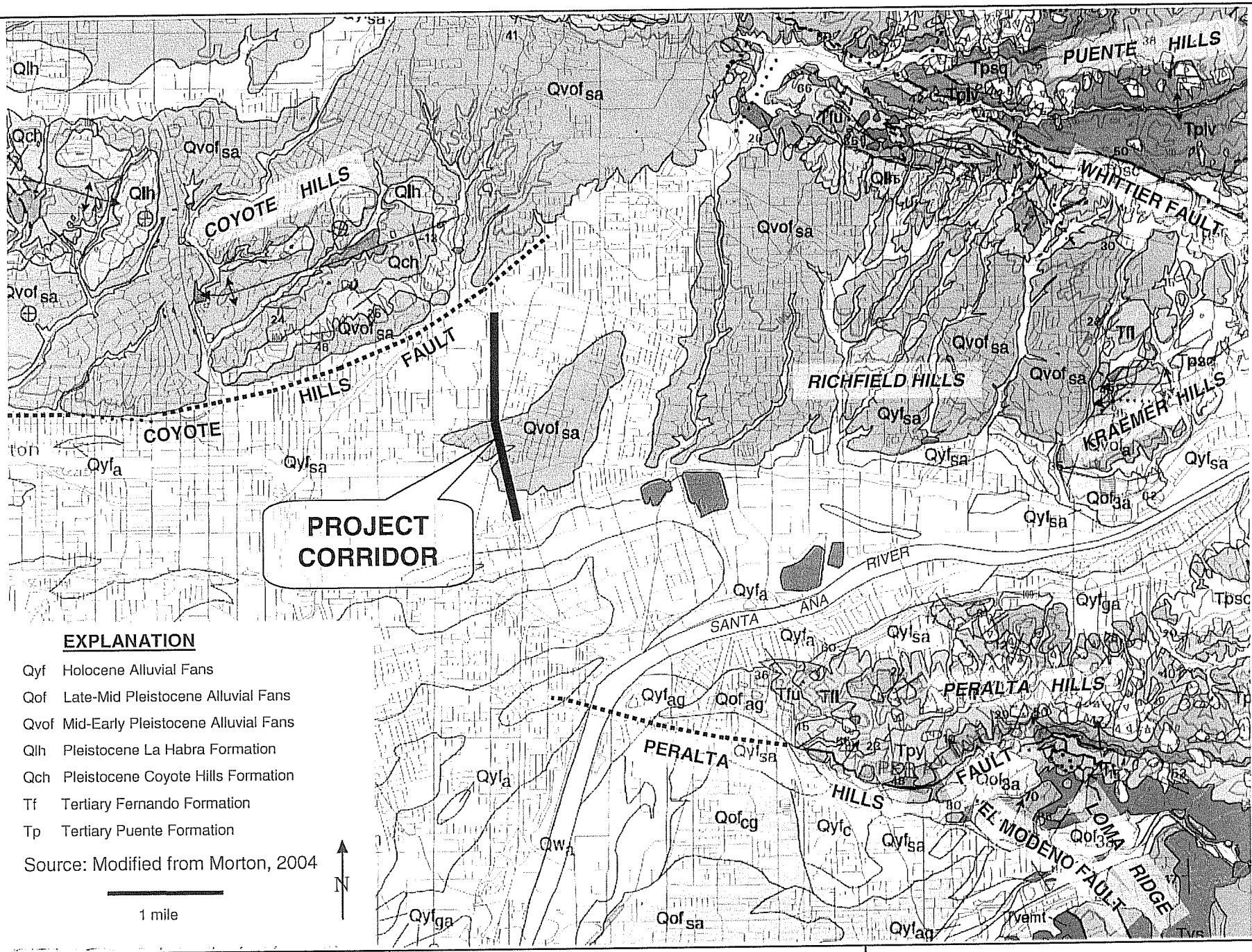
There are no steep slopes within the corridor so landsliding is not likely. There are no active faults so surface fault rupture is not likely. There are no known volcanos in the site region. The site is far from the sea on elevated land so Tsunamis are not a hazard.

The site is not identified on the State seismic hazard maps of the Anaheim and Newport Beach quadrangle as being susceptible to liquefaction (California Geological Survey/Division of Mines and Geology, 1997). This is due primarily to the depth of historically highest ground water being greater than 50 feet.

3.5 STRATIGRAPHY

Regional studies (e.g. Morton, 2004; Morton and Miller, 1981; Durham and Yerkes, 1964; California Department of Water Resources, 1961) indicate that the site area is underlain by Quaternary sediments overlying older Quaternary and Tertiary sediments and sedimentary rocks.

The surficial deposits are primarily Holocene and Pleistocene alluvial fan deposits (Figure 3-2). Older formations exposed in the hills and underlying the corridor are, in descending order, the Pleistocene-age La Habra and Coyote Hills, the Pliocene Fernando, and Pliocene-Miocene-age Puente formations. Along the corridor, the La Habra Formation is at an elevation of about sea level and therefore these older units are well below the level of interest for this project.



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Project No. 08-115 | Date: 01-08-09

GEOLOGICAL MAP

Figure 3-2

3.6 SEISMICITY

The largest historical earthquake within the Los Angeles Basin was the 1933 Long Beach earthquake of M_W=6.4 (M_L = 6.3) which is generally believed to have been associated with the Newport-Inglewood Structural Zone. The association of the 1933 event with the NISZ was based on abundant ground failures along the NISZ trend, but no unequivocal surface rupture was identified. Hauksson and Gross (1991) reevaluated the seismicity data and relocated the 1933 earthquake hypocenter to a depth of about 6 miles below the Huntington Beach-Newport Beach city boundary.

Other damaging earthquakes in the Los Angeles region include the 1971 San Fernando, the 1987 Whittier, and the 1994 Northridge events. The 1971 San Fernando (M_L= 6.4, M_W=6.7) earthquake occurred along the northern margin of the San Fernando Valley and produced a surface rupture which coincided partly with a zone of mapped surface faults along the mountain-valley margin. The more-recent 1987 Whittier earthquake (M_L=5.9, M_W=5.9) and the 1994 Northridge (M_L=6.4, M_W = 6.7) earthquake were not associated with surface faulting. Such events indicate that seismic hazards analysis must consider subsurface faulting as well as surface faulting. The Whittier event occurred at a depth of about 10 miles on a northerly dipping thrust fault dipping from the Coyote Hills area, under the Repetto and Puente Hills, to below the San Gabriel Valley. The Northridge event occurred at a depth of about 12 miles on a south-dipping reverse fault below the San Fernando Valley.

Another significant earthquake in the region was the 1812 earthquake which caused damage at the San Juan Capistrano Mission. The location and magnitude of the 1812 earthquake are unknown but geological studies (Jacoby et al., 1988; Fumal et al., 1993; Weldon et al., 2004) postulated that it did not occur in the Capistrano area, but rather was a large (M> 7.0) distant event on the San Andreas fault in the Wrightwood area of the San Gabriel Mountains.

A recent magnitude 5.4 (M_W) earthquake occurred on 29 July 2008 below the Puente Hills northeast of the site at a depth of about 10 miles. This event was a reverse type fault with a left- lateral component of slip. The causative fault is unknown. The epicenter is between the Whittier and Chino faults. The orientation of the preferred focal plane of the focal mechanism solution is somewhat compatible with the Whittier fault. The Whittier fault may have a reverse component of slip but is believed to be primarily a right-lateral fault. Furthermore dip of the preferred focal plane and the distribution of aftershocks are not very compatible with the Whittier fault. The northerly dipping buried thrust faults under the Peralta Hills, Richfield Hills, or Kraemer Hills could have been source because the preferred focal plane dips northeasterly similar to the northerly dipping faults. However, the distribution of the aftershocks does not seem compatible with the orientations of these faults.

4.0 SUBSURFACE CONDITIONS

4.1 SOIL CONDITIONS

Based on the recent field exploration and the as-built LOTB sheet in Appendix A, the subsurface materials at the site consist primarily of lean clay overlying silty sand and sand with silt. The idealized soil profile and design strength parameters for foundation design are presented in Table 4-1.

TABLE 4-1. IDEALIZED SOIL PROFILE AND STRENGTH PARAMETERS

Approx. Elevation (ft)	Predominant Soil Type	Range of Measured and Converted SPT Blowcount; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion/ Undrained Shear Strength (psf)
Abutment 1					
+250.1 to +230	Sandy Lean Clay	12 to 15 Average = 13	120	-	1,500
+230 to +215	Lean Clay with Sand and Sandy Lean Clay	7 to (13) Average = 10	120	-	1,200
+215 to +177	Lean Clay with Sand	14 to (35) Average = 23	123	-	2,800
+177 to +158.6	Sand with Silt and Silty Sand	(36) to >70 Average = 50	128	40	50
Abutment 2					
+252.1 to +237	Clayey Sand	13 to 24 Average = 19	120	31	150
+237 to +202	Lean Clay with Sand and Sandy Lean Clay	7 to (21) Average = 13	120	-	1,500
+202 to +177	Sandy Lean Clay	(22) to 35 Average = 28	125	-	3,500
+177 to +158.6	Sand with Silt and Silty Sand	(25) to >70 Average = 50	128	40	50

Notes:
(1) SPT = Standard Penetration Test.
(2) Values in ( ) are converted SPT blowcounts corrected for sampler size. Based on Winterkorn and Fang (1975), a correction factor from California sampler blowcounts to SPT blowcounts is 0.5.

The above soil strength parameters are primarily based on published correlations with SPT blowcounts (Lam and Martin, 1986). As compared to the direct shear test results included in Appendix B, the above soil strength parameters for the sandy materials are lower than the ultimate values. The undrained shear strengths for the clayey materials in Table 4-1 are also lower than the UU triaxial test results. Therefore, the above soil strength parameters are conservative for foundation design.

4.2 GROUNDWATER CONDITIONS

During the recent field investigation conducted on September 21 and 24, 2008, groundwater was not encountered down to El. +158.6 feet which is more than 90 feet from the freeway surface. As shown on the as-built LOTB sheet in Appendix A, groundwater was not encountered during drilling in November and December 1965 down to El. +170 feet.

The relatively deep water depth is confirmed by the historical groundwater map published by the California Geological Survey (Seismic Hazard Zones Map - Anaheim and Newport Beach Quadrangle) (CGS, 1997). This map shows the depth to groundwater to be greater than 50 feet.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SEISMIC DESIGN CRITERIA

According to the 1996 Caltrans Seismic Hazard map, the most significant faults relative to the project area are listed in Table 5-1 along with their style of fault, maximum earthquake magnitude, distance to the bridge site and resulting peak bedrock acceleration (PBA).

TABLE 5-1. LOCAL SEISMIC SOURCES

Fault or Fault Zone	Style of Faulting	Maximum Credible Earthquake (MCE) Magnitude	Distance to Site[2] (miles)	Peak Bedrock Acceleration[3] (g)
El Modeno-Peralta Hills (EMP)	Reverse-Thrust[1]	6.50	1.6	0.7
Puente Hills Blind Thrust	Reverse-Thrust	7.25	3.7	0.6
Whittier-Elsinore (WEE)	Strike-Slip	7.50	4.4	0.5

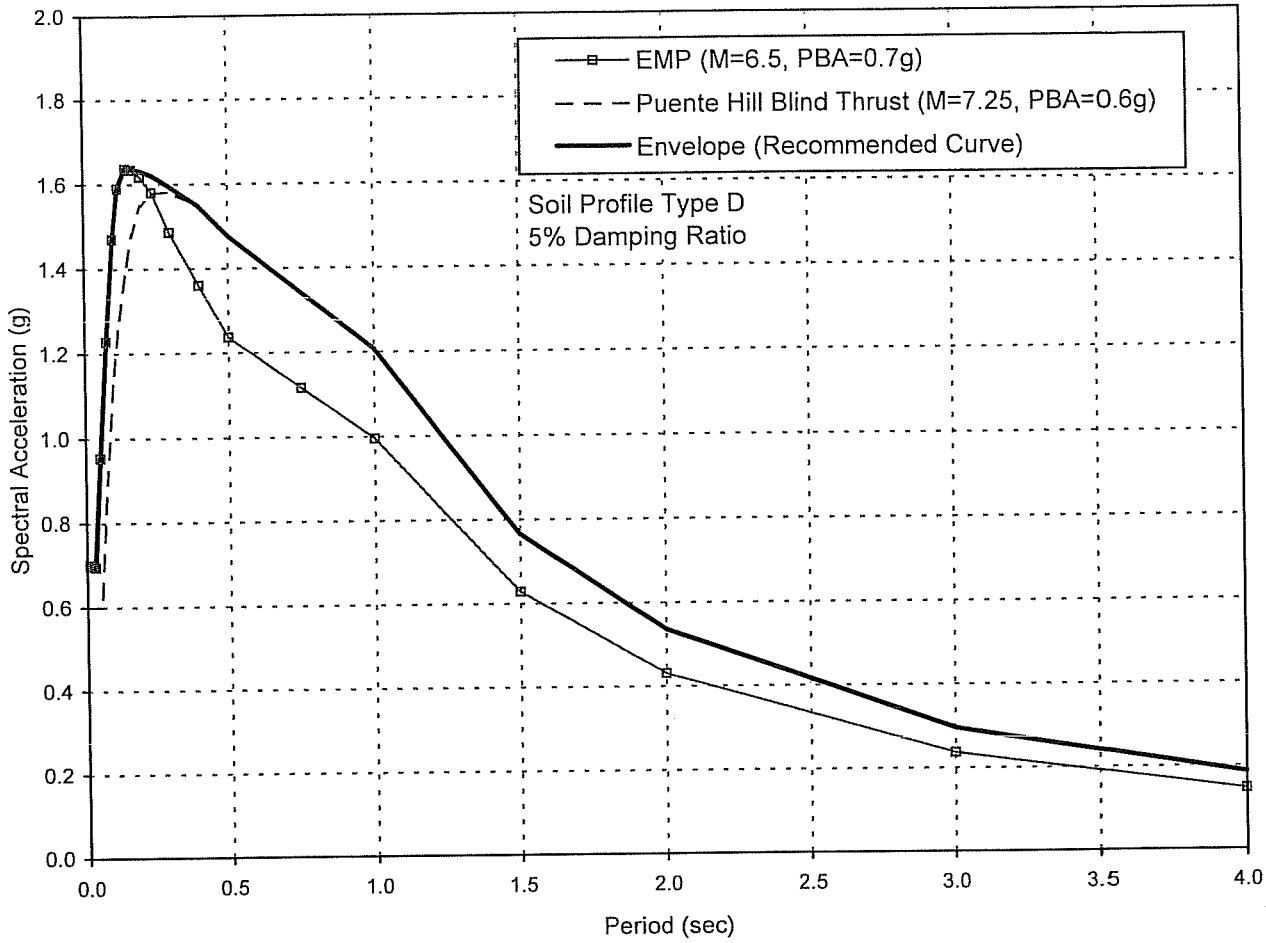
Notes:
(1) Caltrans designates the style of fault for EMP to be "unknown"; we assume a reverse-thrust fault (most conservative).
(2) For the EMP and WEE faults, the distances of each bridge site to these seismic sources were scaled from the 1996 Caltrans Seismic Hazard Map. Distances of each bridge site to the Puente Hills Blind Thrust were obtained from the seismic source model contained within the FRISKSP4.0 computer program (Blake, 2000 and 2004).
(3) The PBA is the larger of the two PBA's obtained from the attenuation relations of Sadigh (1997) and Mualchin (1996).

The ARS curves published in the Caltrans SDC (2006b) for Soil Profile Type "D" are applicable; this applies to Figures B.7 and B.8 for MCE Magnitudes (M) of 6.5±0.25 and 7.5±0.25, respectively. However, ARS curves for M of 6.5±0.25 with PBA's greater than 0.6g are not included in Figure B.7 of the Caltrans SDC (2006b). As a result, we generated an ARS curve for M=6.5±0.25 and a PBA of 0.7g by scaling the 0.6-g curve in Figure B.7 of the Caltrans SDC (2006b).

The design ARS curve envelopes the scaled ARS curve for M=6.5±0.25 and PBA=0.7g, and Figure B.8 for PBA=0.6g. According to Caltrans, this curve must also be modified to account for near-fault effects. For the near-fault effects, Caltrans Seismic Design Criteria (SDC, 2006b) Section 6.1.2.1 recommends the following modifications in the spectral accelerations:

- For periods less than 0.50 second, no change;
- For periods greater than 1.0 second, an increase of 20%;
- For periods between 0.50 and 1.0 second, a linear interpolation between the values at 0.50 and 1.0 second.

The resulting design ARS curve and the digitized coordinates are presented in Figure 5-1.



Spectral Coordinates of Recommended Curve

Period (sec)	Acc. (g)
0.010	0.700
0.020	0.697
0.030	0.696
0.050	0.953
0.075	1.228
0.100	1.470
0.120	1.590
0.150	1.637
0.170	1.636
0.200	1.631

Period (sec)	Acc. (g)
0.240	1.621
0.300	1.595
0.400	1.548
0.500	1.477
0.750	1.342
1.000	1.207
1.500	0.765
2.000	0.536
3.000	0.296
4.000	0.186

5.2 LIQUEFACTION

Based on the available boring information, the subject site has a low liquefaction potential due to absence of groundwater within the depths of interest.

5.3 SOIL CORROSIVITY

Two soil samples were tested for pH, minimum resistivity, soluble chloride content and soluble sulfate content. The test results are summarized in Table 5-2. Minimum resistivities were measured to be 600 and 840 ohm-cm. The pH values were 7.6 and 7.7. The soluble sulfate measurements were 350 and 450 parts per million (ppm), and the soluble chloride measurements were 158 and 182 ppm.

TABLE 5-2. SOIL CORROSION TEST RESULTS

Boring	Station (Offset) / "Station Line"	Sample Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Soluble Sulfate Content (ppm)	Soluble Chloride Content (ppm)
A-08-014	519+03 (70RT) / "B" Line"	10	CL	600	7.7	450	158
A-08-015	521+09 (71RT) / "B" Line"	20	SC	840	7.6	350	182

Based on the Caltrans Corrosion Guidelines (2003), soils are considered corrosive if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm or greater. Based on the test results and the Caltrans criteria, the on-site soils are not considered to be corrosive to bare metals and concrete.

5.4 PILE FOUNDATION DESIGN

5.4.1 Foundation Type

The existing bridge is supported on 16-inch diameter Cast-In-Drilled-Hole (CIDH) piles. We recommend using the same pile type for the proposed widening except the diameter is 24 inches.

5.4.2 Foundation Data Provided by Structural Designers

Per Caltrans policy, the Working Stress Design (WSD) is used for abutment piles. The foundation design data sheet was provided by the structural designers following the latest Caltrans Memo To Designers (Caltrans, 2008), and are shown in Table 5-3 and Table 5-4, respectively.

TABLE 5-3. FOUNDATION DESIGN DATA SHEET

Location	Design Method	Pile Type	Finished Grade El. (ft)	Pile Cut-off El. (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (inch)	Number of Piles per Support
					B	L		
Abutment 1	WSD	24" CIDH	+251.5	+234.75	10	28.688	1	8
Abutment 2			+251.5	+235.75	10	28.688		8

TABLE 5-4. FOUNDATION DESIGN LOADS

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Perma-nent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abutment 1	1200	200	950	-	-	-	-	-	-	-	-
Abutment 2	1200	200	950	-	-	-	-	-	-	-	-

5.4.3 Axial Capacity

The abutment foundations design recommendations are presented in Table 5-5. The Pile Data Table for the contract plans is presented in Table 5-6. The design pile tip elevation for the compression load case was based on skin friction only. The pile capacities are also based on soil resistance only and may be further limited by the pile-head connection details.

TABLE 5-5. ABUTMENT FOUNDATIONS DESIGN RECOMMENDATIONS

Support	Pile Type	Cut-Off Elev. (feet)	LRFD Service-I Limit State per Pile (kips)	Nominal Resistance (kips)	Design Tip Elev. (feet)[1]	Specified Tip Elev. (feet)[2]
Abut 1	24" CIDH	+234.75	200	400	+179 (a) +187 (c) +195 (d)	+179
Abut 2		+235.75			+179 (a) +192 (c) +196 (d)	+179

Notes:
1. Design tip elevation is controlled by the following demands: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for lateral and settlement.

TABLE 5-6. PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)	Specified Tip El. (ft)
		Compression	Tension		
Abutment 1	24" CIDH	400	0	+179 (a) +187 (c) +195 (d)	+179
Abutment 2				+179 (a) +192 (c) +196 (d)	+179

Notes: Design tip elevations are controlled by: (a) Compression, (c) Settlement, and (d) Lateral Load.

5.4.4 Lateral Resistance

Results of lateral pile analysis in terms of pile-head shear and lateral deflection for both free-head and fixed-head condition are presented in Table 5-7. The maximum bending moment and the location of maximum moment are also presented. The solutions presented in Table 5-7 are entirely based on soil resistance and linear pile properties. Therefore, these values may be limited by the flexural strength (plastic moment) of the piles and other connection details. Linear interpolation can be used for solutions between pile-head deflections of 0.25 and 6 inches.

TABLE 5-7. LATERAL PILE SOLUTIONS

Lateral Displacement at Top of Pile (in)	Fixed Head		Free Head		
	Lateral Load at Top of Pile (kips)	Max. Bending Moment (kip-in)	Lateral Load at Top of Pile (kips)	Max. Bending Moment (kip-in)	Depth from Pile Head to Max. Moment (ft)
Abutment 1					
0.25	39.2	1910	20.7	725	6.2
0.5	56.1	3065	29.5	1163	7.0
1	80.4	4923	42.1	1874	8.0
2	115.7	7961	60.1	3027	9.0
3	143.6	10585	74.1	4004	9.6
4	167.5	12978	85.9	4880	10.0
6	202.7	17202	102.9	6443	10.6
Abutment 2					
0.25	42.6	2070	21.7	789	6.2
0.5	61.5	3344	31.2	1272	6.8
1	89.0	5408	44.8	2056	7.6
2	128.8	8746	64.6	3324	8.6
3	159.9	11585	80.0	4406	9.2
4	186.4	14141	93.1	5382	9.6
6	223.2	18492	112.7	7124	10.2

5.5 EMBANKMENTS AND SETTLEMENT

Settlement. About 26 feet of sliver fill will be placed to construct the approach embankments. Based on the onsite soil type, ground subsidence is estimated to be on the order of 2.9 inches. Due to the presence of a sandy lean clay layer immediately below the existing Chapman Avenue ground surface, we recommend a settlement period of at least 14 calendar days for pile installation.

Slope Stability. Global stability analyses were conducted using the computer program PCSTABL (Achilleos, 1988) for both static and pseudostatic conditions for the bridge end slopes. Results of this analysis are presented in Appendix C.

The factor of safety for a deep-seated failure is greater than 1.5 under static condition for the 1V:1.5H end slope with a 2-foot soil surcharge to represent traffic loading. Slope stability analysis under pseudostatic condition was performed using a seismic coefficient equal to 0.2g (which is the smaller of either one-third the horizontal peak ground acceleration or 0.2g) in accordance with guidelines provided in Section 3.12 of the Caltrans Guidelines for Foundation Investigations and Reports (Caltrans, 2006a). Analysis indicates that the factor of safety is greater than 1.1 under pseudostatic condition. The 1V:1.5H end slope has proposed concrete slope paving, therefore surficial stability is not a design issue.

Structural Approach Slab. Per Caltrans Memo to Designers 5-3 dated December 1992, structure approach slabs are required for this project. Selection of the approach type will be performed by the structurral designer following the flowchart in Caltrans Memo to Designers 5-3, Attachment A dated May 1996.

5.6 BRIDGE ABUTMENT WALL DESIGN

Abutment Earth Pressures. If abutment walls are free to move laterally at the top, a static active lateral earth pressure of 36 psf per foot of depth is recommended for a free draining, level and compacted backfill. If lateral movement at the top of abutment walls is restrained, the lateral earth pressure for a free draining, level and compacted backfill should follow Section 5.5.5.11 of the Caltrans BDS dated August 2004. For this condition, we recommend a coefficient of active lateral earth pressure of 0.3, a coefficient of at-rest lateral earth pressure of 0.47 and a soil unit weight of 120 lb/ft^3. If applicable, a uniform lateral pressure of at least 72 psf due to vehicle loads, equivalent to a vertical pressure produced by at least 2 feet of earth, should be added to the above lateral earth pressure.

Passive Resistance of Abutment Backfill. Under seismic loading, an ultimate passive earth pressure of 5 ksf may be used for the approach backfill and abutment walls with a height equal to or greater than 5.5 feet. For abutment walls with heights less than 5.5 feet, the passive pressure may be calculated proportionally (e.g., for a 4-foot high wall, the passive pressure is [4/5.5]x 5 ksf = 3.64 ksf. The horizontal movement at which the maximum passive pressure is expected to be fully mobilized can be determined following the procedure outlined in Section 7.8.1 of the Caltrans SDC (2006b).

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 EARTHWORK

Earthwork should be performed in accordance with Caltrans Standard Specifications, Section 19 (Caltrans, 2006c). Appropriate measures should be taken to prevent damage to adjacent structures and utilities. Any design and construction of temporary sloping, sheeting, or shoring should be made the contractor's responsibility. It should be noted that it is the responsibility of the contractor to oversee the safety of the workers in the field during construction. The contractor shall conform to all applicable occupational and health standards, rules, regulations, and orders established by the State of California. In addition, other State, County, or Municipal regulations may supersede the recommendations presented in this section. If a trench shoring design and safety plan is required, the geotechnical consultant should review the plan to confirm that recommendations presented in this report have been applied to the design.

During the recent field investigation conducted on September 21 and 24, 2008, groundwater was not encountered down to El. +158.6 feet which is more than 90 feet from the freeway surface. As shown on the as-built LOTB sheet in Appendix A, Groundwater was not encountered during drilling in November and December 1965 down to El. +170 feet. Therefore, groundwater is not expected to be encountered during footing construction. However, groundwater level can fluctuate due to seasonal rainfall amount, local irrigation and groundwater recharge program and other man-made conditions. If groundwater is encountered, it should be controlled in accordance with Section 19-3.04 of the Caltrans Standard Specifications (2006c).

6.2 PILE CONSTRUCTION

For on-center pile spacings less than six times the pile diameter, no two adjacent piles can be constructed concurrently.

Loose soils should be cleaned from the bottom of the borings. Pile borings should be inspected and approved by the geotechnical engineer prior to the installation of reinforcement. Extreme care in drilling, placement of steel, and the pouring of concrete is essential to avoid excessive disturbance of pile boring walls. Concrete placement by pumping or tremie tube to the bottom of the pile borings is recommended. Specifications should require that sufficient space be provided in the pile reinforcing cage during fabrication to allow the insertion of a tremie tube for concrete placement. The pile reinforcing cage should be installed and the concrete pumped immediately after drilling is completed.

Sand was encountered in our soil borings and these materials are susceptible to caving. If caving occurs, a temporary casing may be required during construction. Temporary casings should have an inner diameter equal to or exceeding the pile diameter. Temporary casing should be placed tight-in-hole. Vibratory or impact hammer with or without center-relief drilling can be used to install the temporary casing provided the existing structure is monitored for potential movement due to ground vibration; casing installation using this method should be suspended if excessive movement is detected. The temporary casing should be pulled as the concrete is being poured while always maintaining at least a 5-foot head of concrete inside the casing.

6.3 CONSTRUCTION SEQUENCE

Per structural engineers, the bridge will be cast in a high elevation and lowered into the final position. During construction, the abutment piles will initially be loaded with a dead load of 11 kips per pile, then loaded to 174 kips per pile during jacking, and the final Service-I Limit State of 200 kips per pile. Since the jacking load is less than 200 kips, there is no adverse impact to the pile design.

6.4 BACKDRAIN AND BACKFILL REQUIREMENTS FOR ABUTMENT WALLS

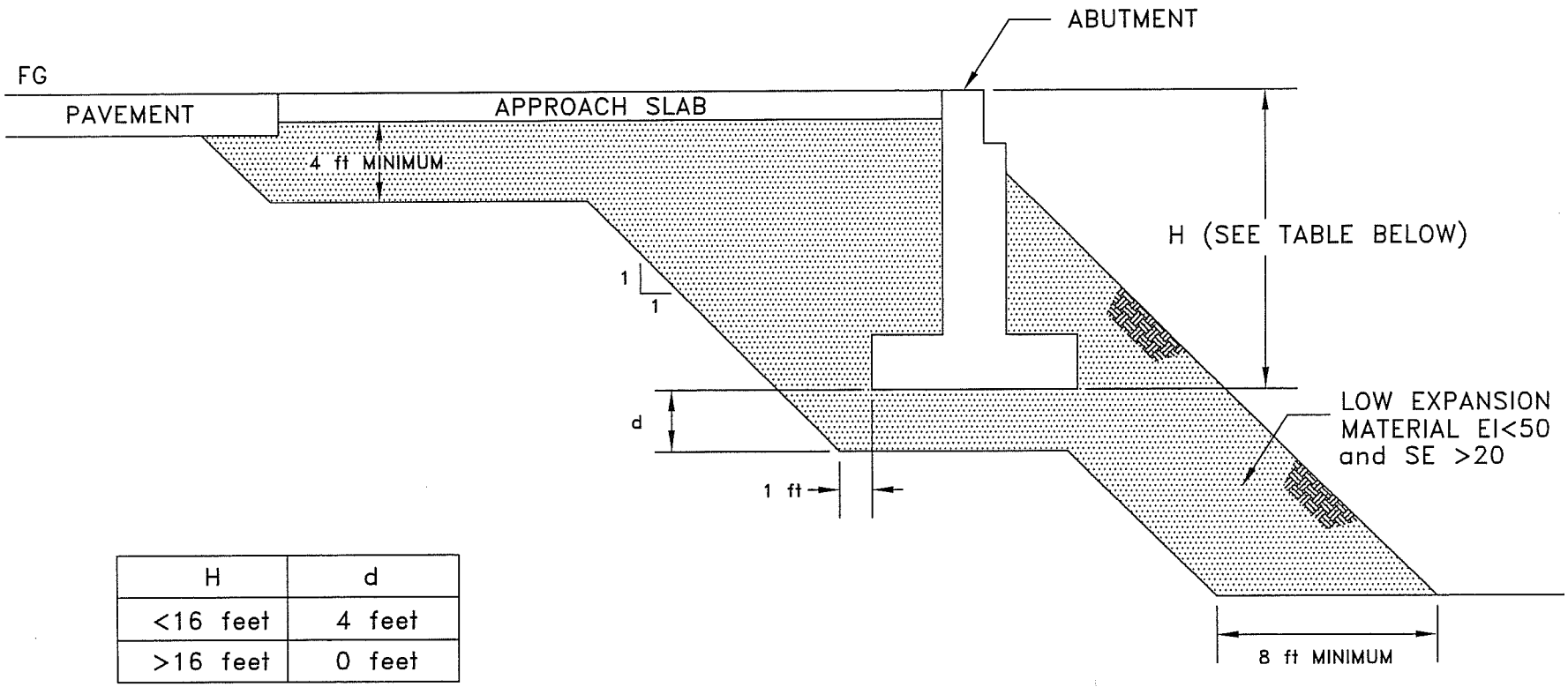
Per Caltrans requirements, expansive soils should not be placed as part of the embankment within the limits of a bridge abutment as shown in Figure 6-1. Materials placed behind abutment wall should be low-expansive soil with an Expansion Index (EI) less than 50 and Sand Equivalent (SE) of more than 20. The low-expansive material requirement should be supplemental to the abutment structure and pervious backfill requirement as described in Caltrans Standard Plans (2006d) and Caltrans Standard Specifications (2006c) under Sections 19-3.06 and 19-3.065, respectively.

Backfill should be compacted in accordance with Section 19-5 of the Caltrans Standard Specifications (2006c). Backfill should be placed in loose lifts not exceeding 8 inches in thickness, moisture-conditioned to near optimum moisture content, and compacted to at least 95 percent relative compaction. The relative compaction should be based on the maximum density determined by California Test 216. Jetting or flooding to compact backfill is not recommended. Heavy compaction equipment, such as vibratory rollers, dozers, or loaders, should not be used adjacent to the abutment walls in order to avoid damaging the walls due to large lateral earth pressures.

Backdrains should be installed behind abutment walls to relieve hydrostatic pressure. Backdrains should be constructed in accordance with Bridge Detail 3-1 on Sheet BO-3 per Caltrans Standard Plans (2006d) or the geocomposite drain alternative per Section 6 of the Caltrans Bridge Design Aids (1992).

6.5 REVIEW OF CONSTRUCTION PLANS

Recommendations contained in this report are based on preliminary plans. The geotechnical consultant should review the final construction plans and specifications in order to confirm that the general intent of the recommendations contained in this report have been incorporated into the final construction documents. Recommendations contained in this report may require modification or additional recommendations may be necessary based on the final design.



H	d
<16 feet	4 feet
>16 feet	0 feet

EXPANSION INDEX TO BE DETERMINED BY ASTM D4829
SAND EQUIVALENT TO BE DETERMINED
BY CALIFORNIA TEST METHOD 217

NO SCALE

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

CHAPMAN AVENUE UC (WIDEN)

EMI Project No. 08-115

Date: 01-10-2009

LOW EXPANSION MATERIAL
IN BRIDGE EMBANKMENT

FIGURE 6-1

6.6 GEOTECHNICAL OBSERVATION AND TESTING

It is recommended that inspections and testing be performed by the geotechnical consultant during the following stages of construction:

- Grading operations, including excavations and placement of compacted fill
- Shoring installation
- Footing excavations
- Pile installation
- Backdrain installation and backfilling of bridge abutment walls.
- Removal or installation of support of buried utilities or structures
- When any unusual subsurface conditions are encountered

7.0 LIMITATIONS

This report is intended for the use of RBF Consulting, Orange County Transportation Authority and Caltrans for the widening of Chapman Avenue Undercrossing. This report is based on the project as described and the information obtained from the exploratory borings at the approximate locations indicated on the attached plans. The findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses. In addition, soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project site. However, subsurface conditions and characteristics of soils between exploratory borings can vary. The findings reflect an interpretation of the direct evidence obtained. The recommendations presented in this report are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained in this report are applicable to the specific design element(s) and location(s) which is (are) the subject of this report. They have no applicability to any other design elements or to any other locations and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

EMI has no responsibility for construction means, methods, techniques, sequences, or procedures; for safety precautions or programs in connection with the construction; for the acts or omissions of the CONTRACTOR or any other person performing any of the construction; or for the failure of any worker to carry out the construction in accordance with the Final Construction Drawings and Specifications.

Services performed by EMI have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

8.0 REFERENCES

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APPENDIX A

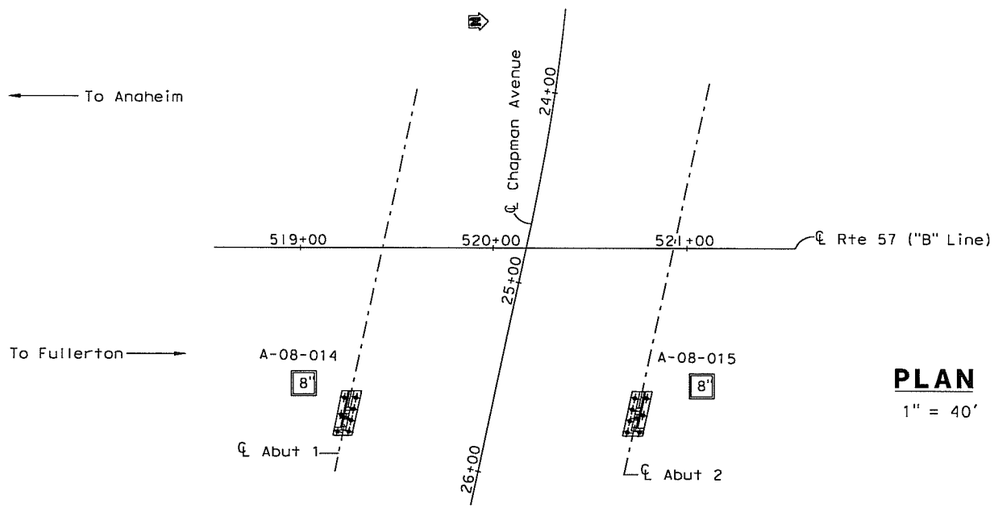
LOG OF TEST BORINGS SHEETS AND AS-BUILT LOG OF TEST BORINGS SHEET

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 40'

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lin Cheang
REGISTERED ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

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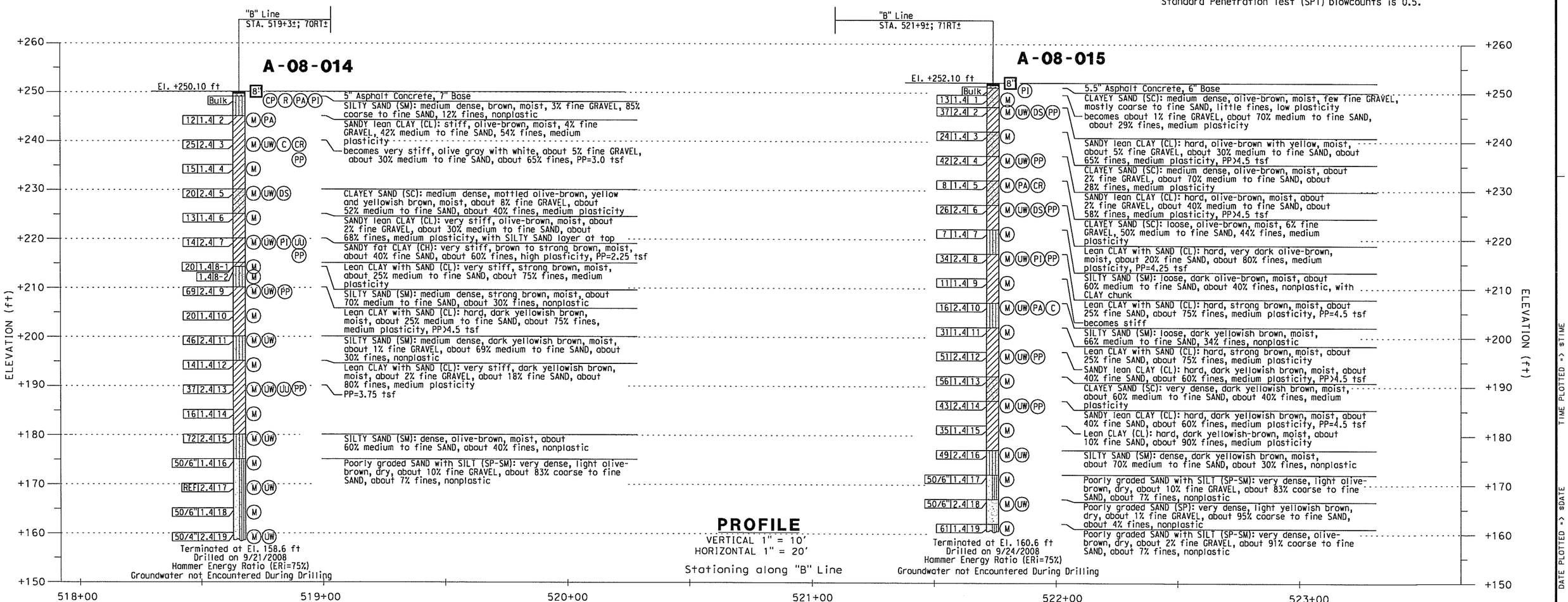
ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'
Stationing along "B" Line

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0456
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 17.3

CHAPMAN AVENUE UC (WIDEN)
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)
ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3
CU 12
EA 0F031I
DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09
SHEET OF

USERNAME = SUSER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lin Cheang
REGISTERED ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

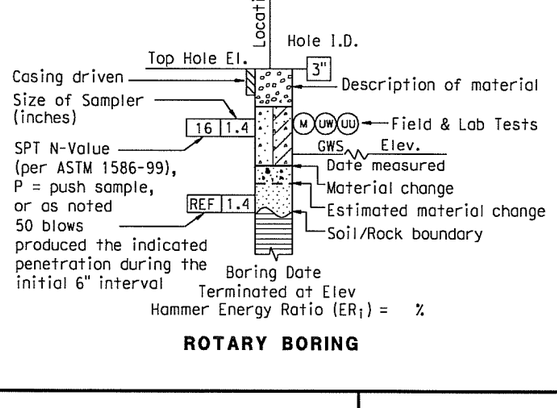
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

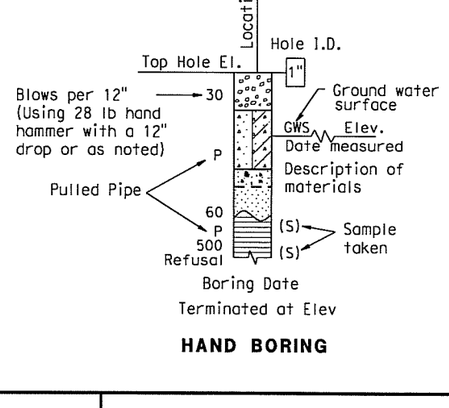
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

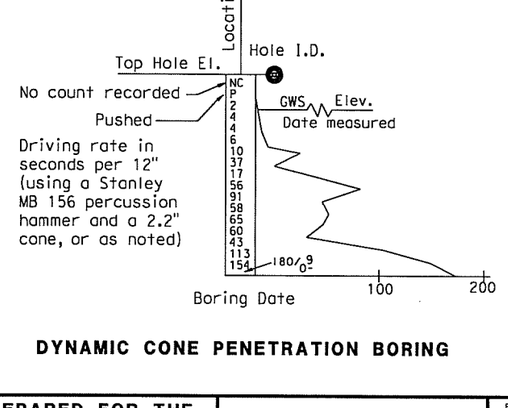
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



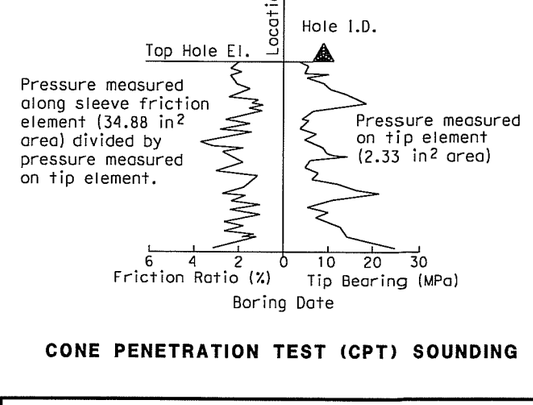
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0456
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 17.3

CHAPMAN AVENUE UC (WIDEN)
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lien Cheang
REGISTERED ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

L. Cheang
PROJECT ENGINEER

BRIDGE NO. 55-0456
POST MILES 17.3

CHAPMAN AVENUE UC (WIDEN)
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
USERNAME => $USER

7	CALIF.				

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	Ora	57	16.2/18.6	185	197

August 28, 1967

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 70000668

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

Lino Cheang
REGISTERED CIVIL ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — LINO C. CHEANG — NO. GE 2345 — EXP. 9/30/69 — GEOTECHNICAL — STATE OF CALIFORNIA

CHAPMAN AVENUE UC (WIDEN)

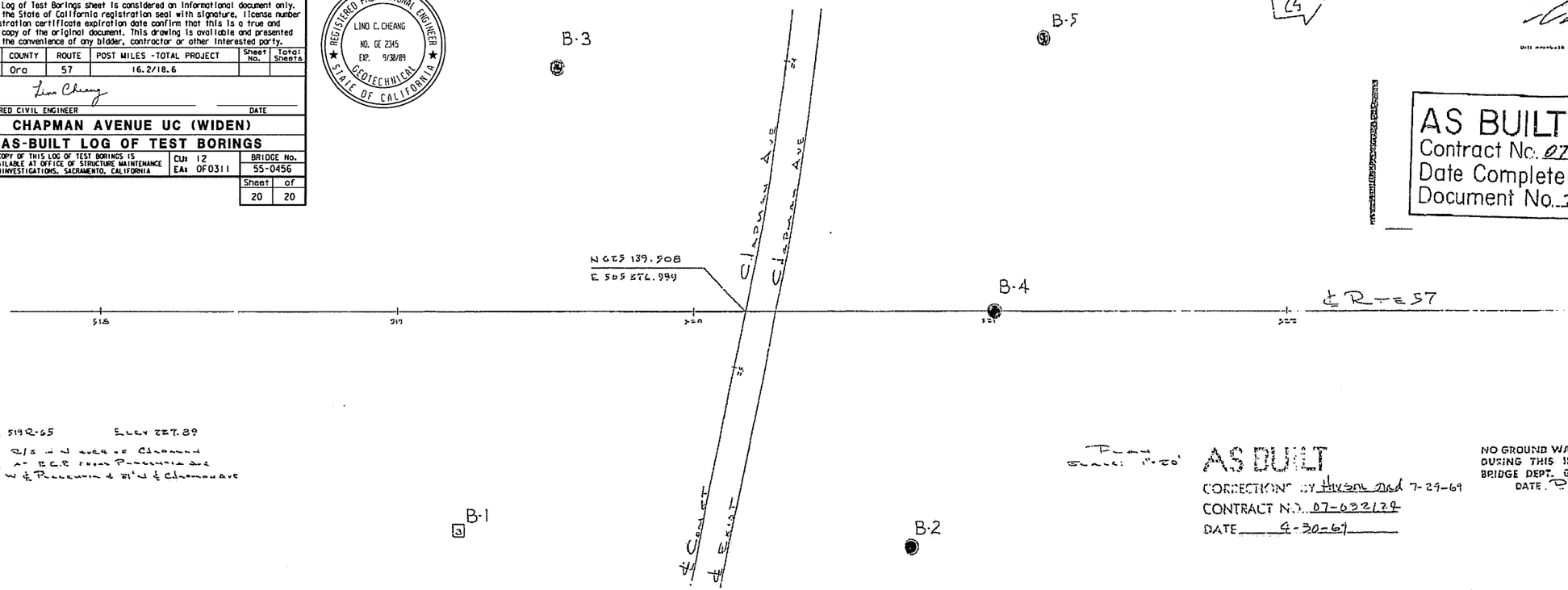
AS-BUILT LOG OF TEST BORINGS

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12
EA: 0F0311

BRIDGE No. 55-0456

Sheet 20 of 20



LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Silty Clay or Clayey Silt
- Peat and Organic Matter
- Fill Material
- Igneous Rock
- Sedimentary Rock
- Sandy Clay or Clayey Sand
- Sandy Silt or Silty Sand
- Metamorphic Rock

- Penetrometer
- 2½" Cone Penetrometer
- Sampler Boring (Dry)
- Rotary Boring (Wet)
- Auger Boring (Dry)
- Jet Boring
- Core Boring
- Test Pit

CLASSIFICATION OF MATERIAL (BASED ON STANDARD GRADE SIZE LIMITS)

Diagram showing the ranges for estimated or grade size distribution used to determine classes names. If gravel is present in appreciable quantities, the term "gravelly" may be added to the class name, viz: "gravelly sand". The terms "coarse", "medium" and "fine" may be added to the class name to describe sand and gravel based on standard grade size limits.

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

DRAWN
CHECKED
Approved Recommended by: A. Ellison, Jr. Bridge Engineer

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

SHEET 12 OF 12

CHAPMAN AVENUE UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 55-456 | FILE | DRAWING 55456-12

APPENDIX B

LABORATORY TEST RESULTS

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : Chapman Avenue UC (Widen)

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Grain Size Distribution GR:SA:FI (%)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-014	S-2	5	CL	18.7			4:42:54					
A-08-014	D-3	10	CL	17.5	137.0	3.0			600	7.7	450	158
A-08-014	S-4	15	CL	18.8								
A-08-014	D-5	20	SC	16.1	124.2							
A-08-014	S-6	25	CL	19.0								
A-08-014	D-7	30	CH	28.2	120.6	2.25		65/28/37				
A-08-014	S-8-1	35	CL	15.2								
A-08-014	S-8-2	35.8	SM	15.0								
A-08-014	D-9	40	CL	26.2	122.9	>4.5						
A-08-014	S-10	45	CL	19.8								
A-08-014	D-11	50	SM	10.3	130.6							
A-08-014	S-12	55	CL	19.1								
A-08-014	D-13	60	CL	20.7	127.3	3.75						
A-08-014	S-14	65	CL	25.8								
A-08-014	D-15	70	SM	8.3	138.1							
A-08-014	S-16	75	SP-SM	1.8								
A-08-014	D-17	80	SP-SM	1.7	115.6							
A-08-014	S-18	85	SP-SM	2.5								
A-08-014	D-19	90	SP-SM	1.8	107.6							
A-08-015	S-1	2.5	SC	12.6								
A-08-015	D-2	5	CL	14.6	121.0	>4.5						
A-08-015	S-3	10	SC	14.0								
A-08-015	D-4	15	CL	18.8	115.0	>4.5						
A-08-015	S-5	20	SC	17.5			6:50:44		840	7.6	350	182
A-08-015	D-6	25	CL	18.0	106.1	4.25						
A-08-015	S-7	30	SM	17.1								
A-08-015	D-8	35	CL	16.2	131.0	4.5		37/15/22				
A-08-015	S-9	40	CL	16.0								
A-08-015	D-10	45	SM	7.6	81.3		0:66:34					
A-08-015	S-11	50	CL	15.2								
A-08-015	D-12	55	CL	12.0	121.5	>4.5						
A-08-015	S-13	60	SC	11.1								
A-08-015	D-14	65	CL	17.0	119.1	4.5						
A-08-015	S-15	70	CL	25.8								
A-08-015	D-16	75	SM	9.0	121.4							
A-08-015	S-17	80	SP-SM	1.8								
A-08-015	D-18	85	SP	1.0	106.8							
A-08-015	S-19	90	SP-SM	2.0								

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

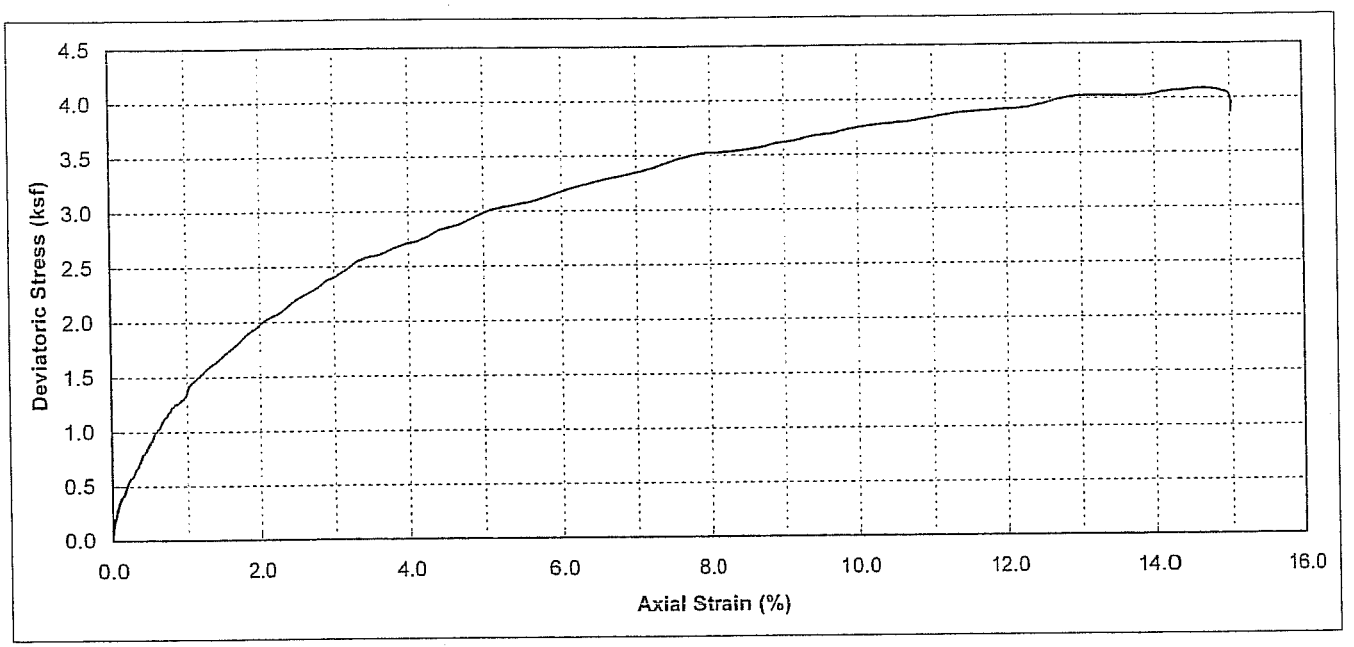
Project No. : 08-115 Project Name : RBF/SR-57 Northbound

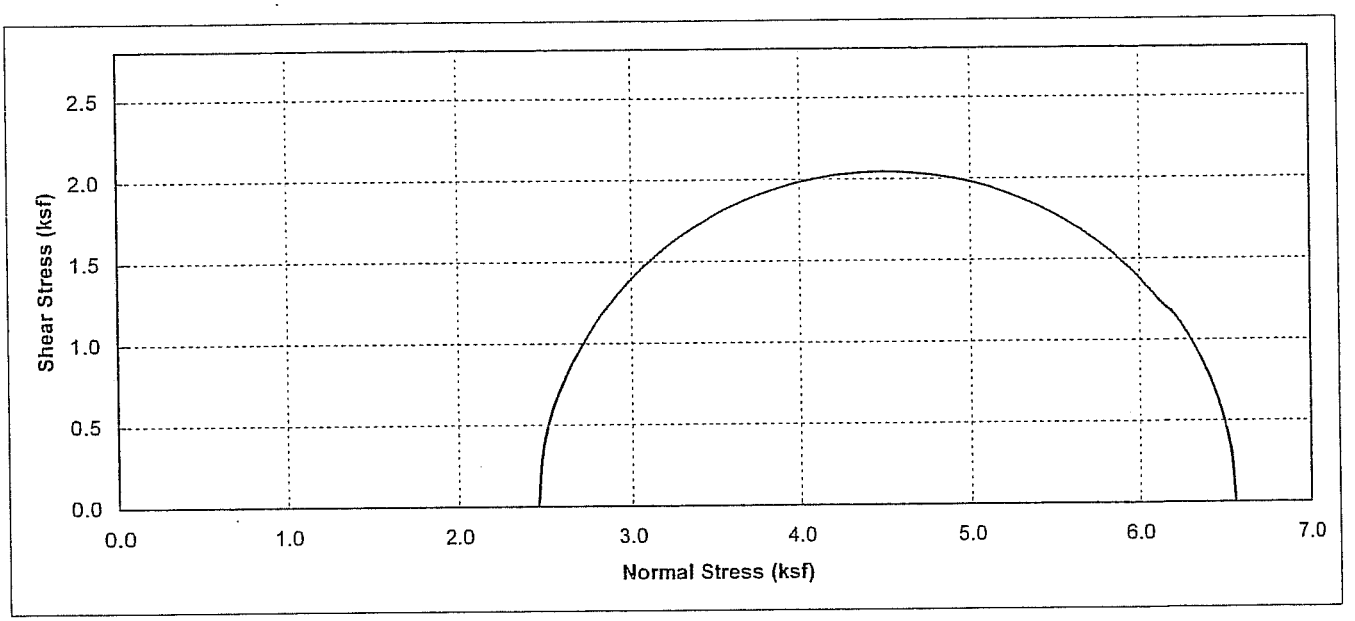
Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-014	BULK	1.0 - 5	SM							20/17/3				
A-08-015	BULK	1.5 - 2.5	SC							25/16/9				

TABLE 2 SUMMARY OF LABORATORY STRENGTH TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth	Soil Identification (group symbol) ASTM D2488/D2487	Unconsolidated Undrained Triaxial Test (ASTM D2850)				Direct Shear Test (ASTM D3080)			
								Peak		Residual	
				Peak Strength S_u	Strain at Peak S_u	Shear Strength at 10% Strain S_u	Confining Pressure	ϕ	C	ϕ	C
		(ft)		(ksf)	(%)	(ksf)	(ksf)	(deg)	(ksf)	(deg)	(ksf)
A-08-014	D-5	20	SC					34.54	0.35	36.27	0
A-08-014	D-7	30	CH	2.05	14.7	1.88	2.45				
A-08-014	D-13	60	CL	4.36	14.6	4.11	4.75				
A-08-015	D-2	5	CL					55.29	0.05	28.9	0.14
A-08-015	D-6	25	CL					23.86	0.96	26.38	0.34





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-014	D-7	30	top Brown, FAT CLAY bot Dark Brown SANDY FAT	93.8	28.24	2.45	4.09	95.7

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

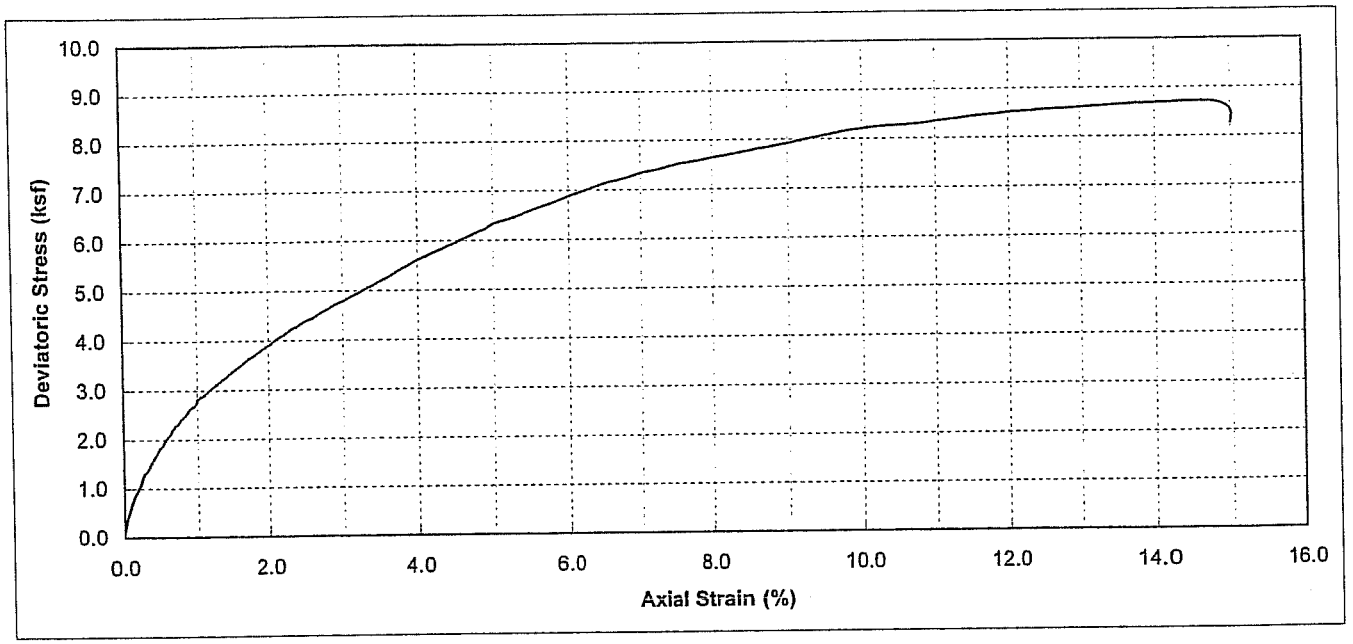
RBF/SR-57 Northbound

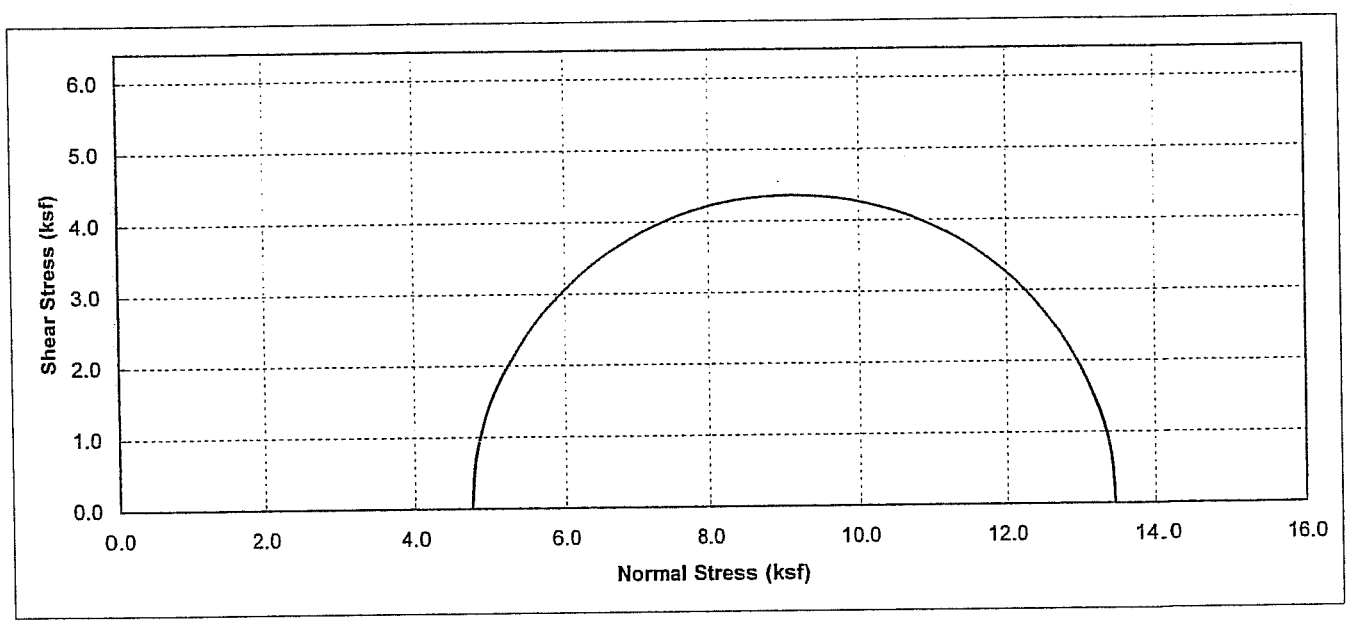
UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/15/08

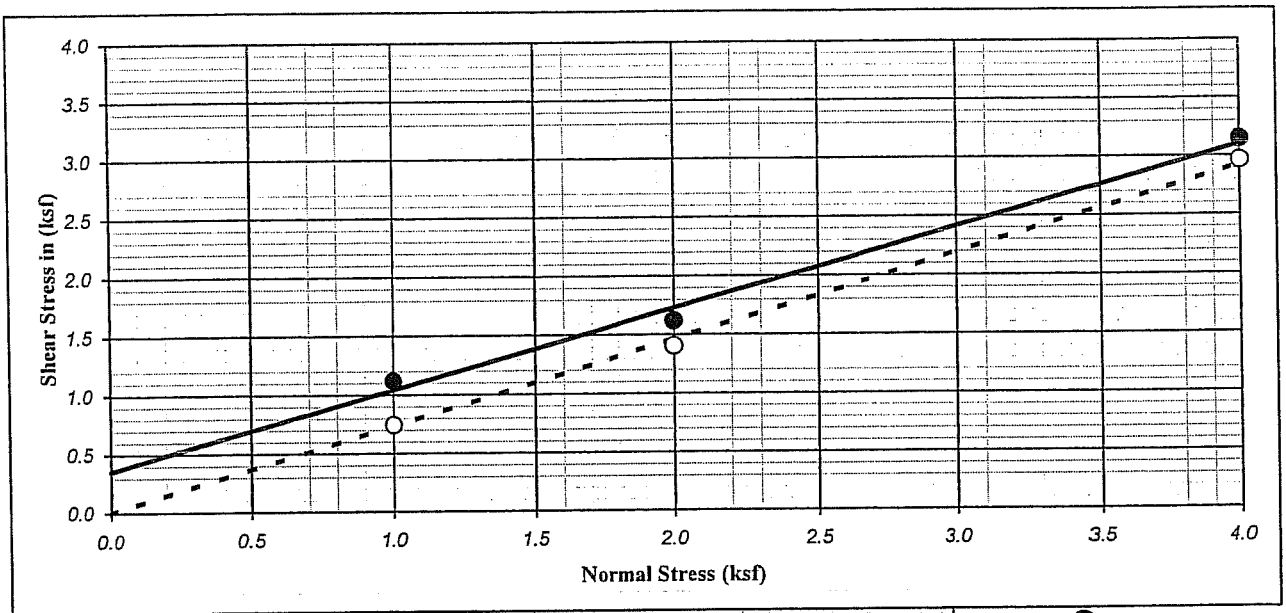
Figure No. :



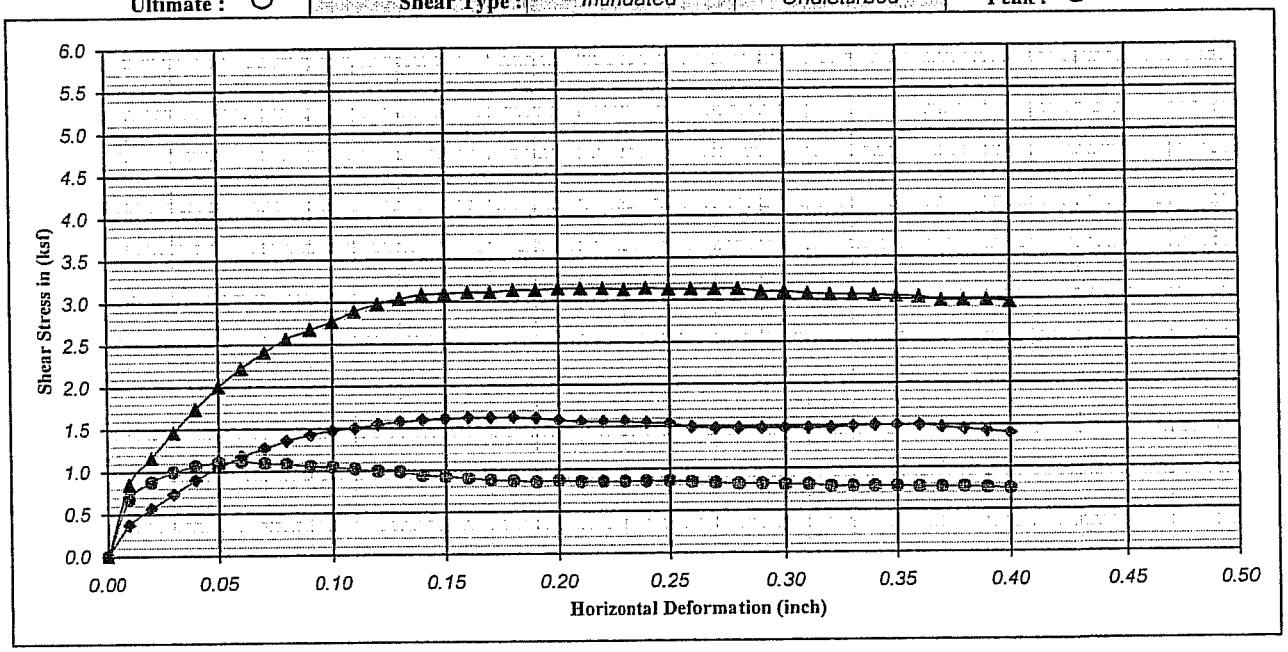


Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-014	D-13	60	Brown, LEAN CLAY With SAND (CL)	103.9	20.75	4.75	8.71	90.2

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound
	UNCONSOLIDATED UNDRAINED TEST (ASTM D2850)
Project No. : 08-115 **Date :** 11/15/08	Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-014		Strength Intercept (C) :	0.35	(ksf)	Peak	0.00	(ksf)	Ultimate
Sample No. : D-5			16.95	(kPa)		0.00	(kPa)	
Depth (ft/m) : 20.0	0.00	Friction Angle (ϕ) :	34.54	Degree		36.27	Degree	
Description : Mottled olive gray, yellowish brown, yellow, CLAYEY SAND(SC)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	26.35	97.26	15.31	0.73	1.00	47.88	1.12	53.43	0.74	35.62
◆	24.96	92.99	14.64	0.81	2.00	95.76	1.62	77.57	1.40	67.22
▲	24.60	98.14	15.45	0.72	4.00	191.52	3.14	150.53	2.96	141.92

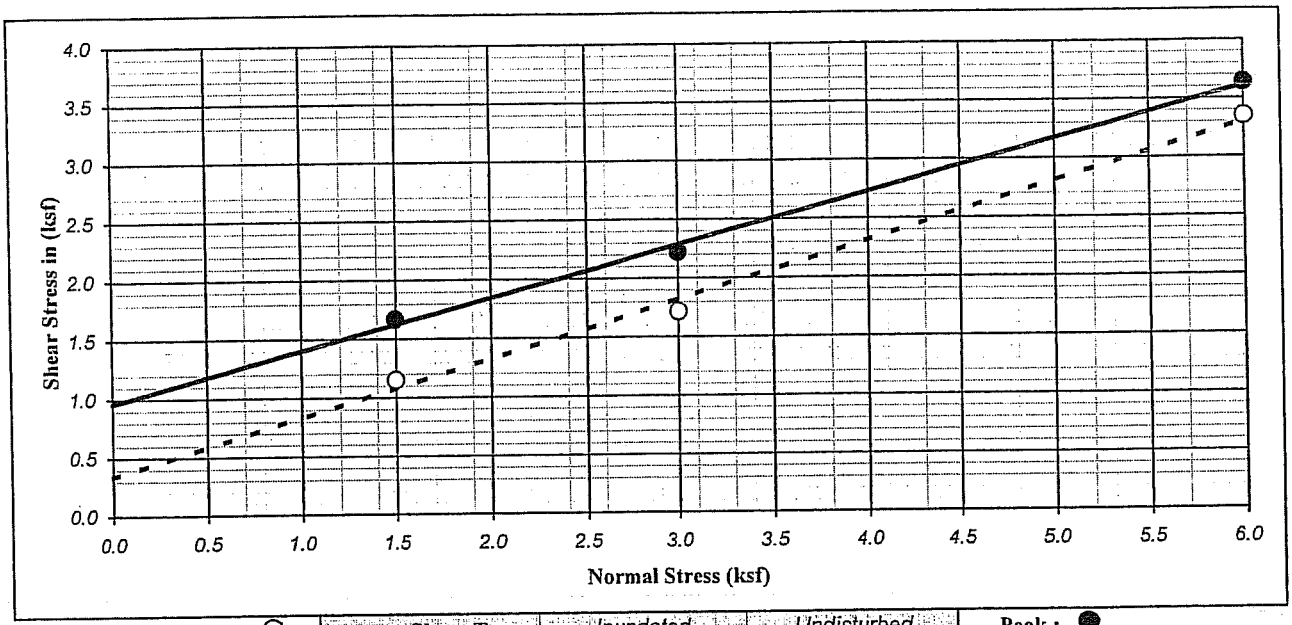
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

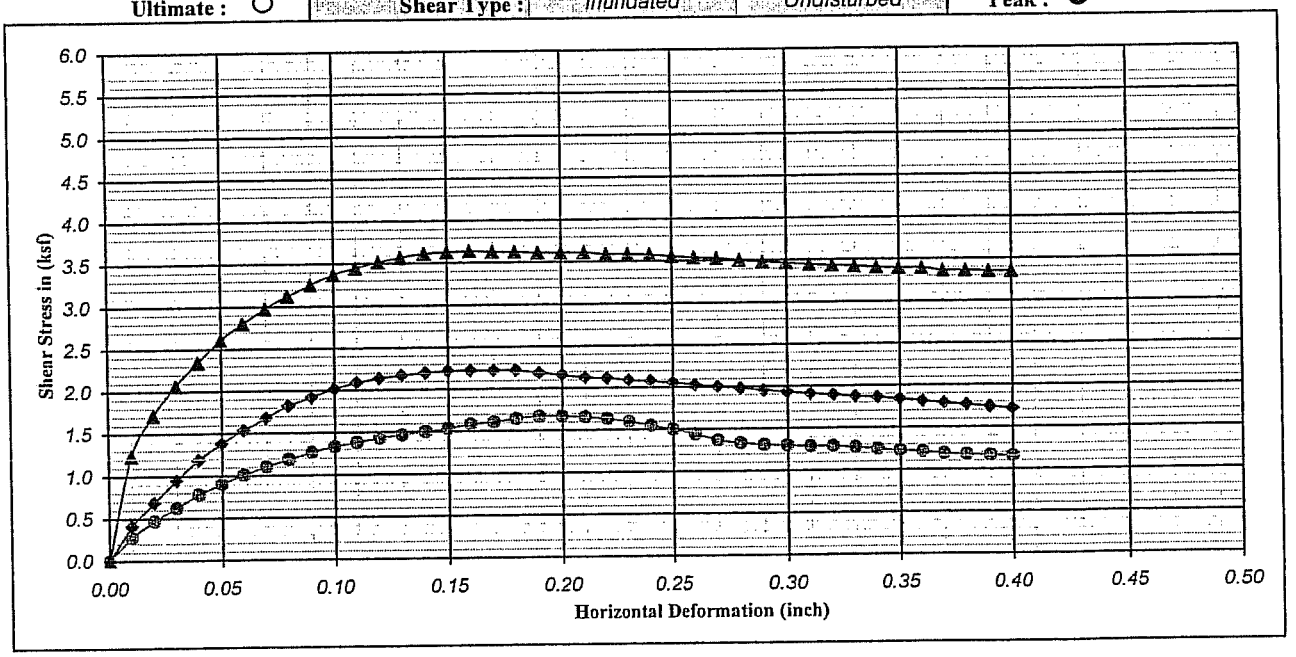
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-015	Strength Intercept (C) :	0.96	(ksf)		0.34	(ksf)		
Sample No. : D-6		45.96	(kPa)	Peak	16.09	(kPa)	Ultimate	
Depth (ft/m) : 25.0 | 0.00	Friction Angle (ϕ) :	23.86	Degree		26.38	Degree		
Description : Very dark olive brown, Lean CLAY with SAND (CL)						Shear Rate (inch/minute) :	0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	28.45	86.81	13.66	0.94	1.50	71.82	1.67	79.86	1.15	55.16
◆	28.71	89.17	14.04	0.89	3.00	143.64	2.22	106.29	1.72	82.16
▲	24.37	94.60	14.89	0.78	6.00	287.28	3.64	174.09	3.35	160.30

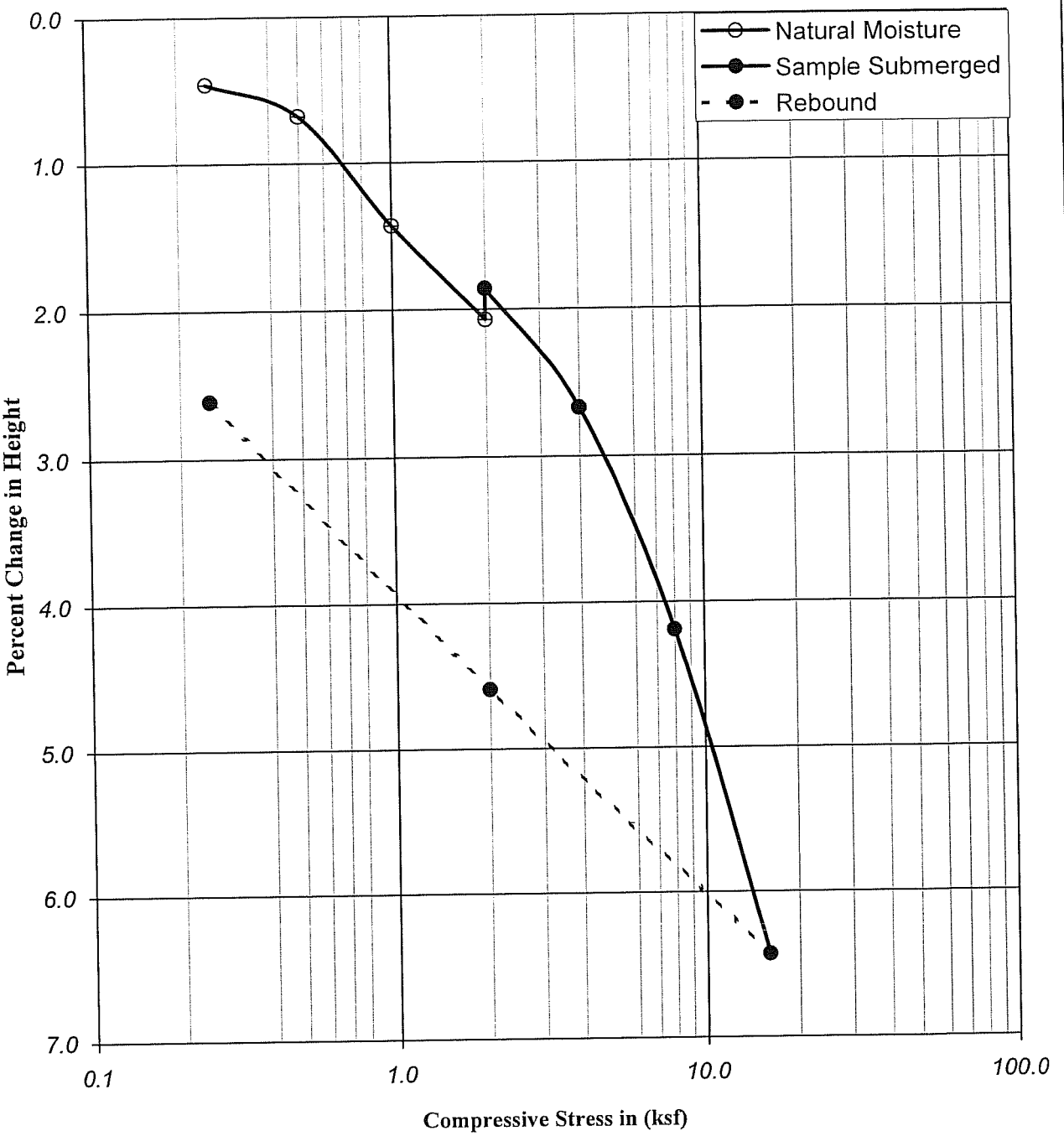
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08

Figure No. :



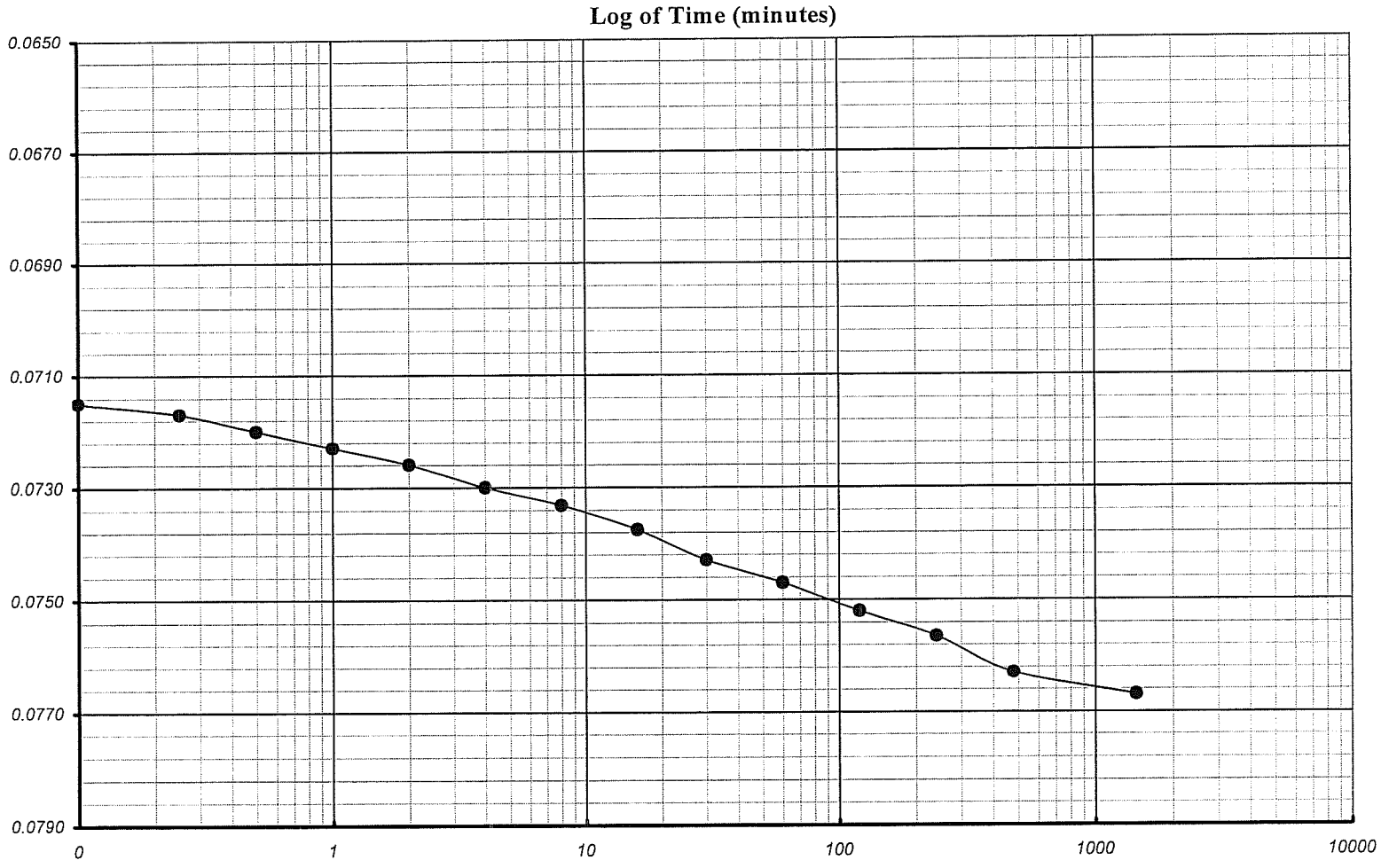
Boring No.	: A-08-014		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-3		Plastic Limit :	-						
Depth (ft)	: 10.0	11.5	Plastic Index :	-	Initial	21.65	106.41	16.75	100.06	0.58
Depth (m)	: 3.05	3.51	Specific Gravity :	2.70	Final	22.30	109.35	17.21	111.20	0.54
Description	: Olive brown mix black, SANDY lean CLAY (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

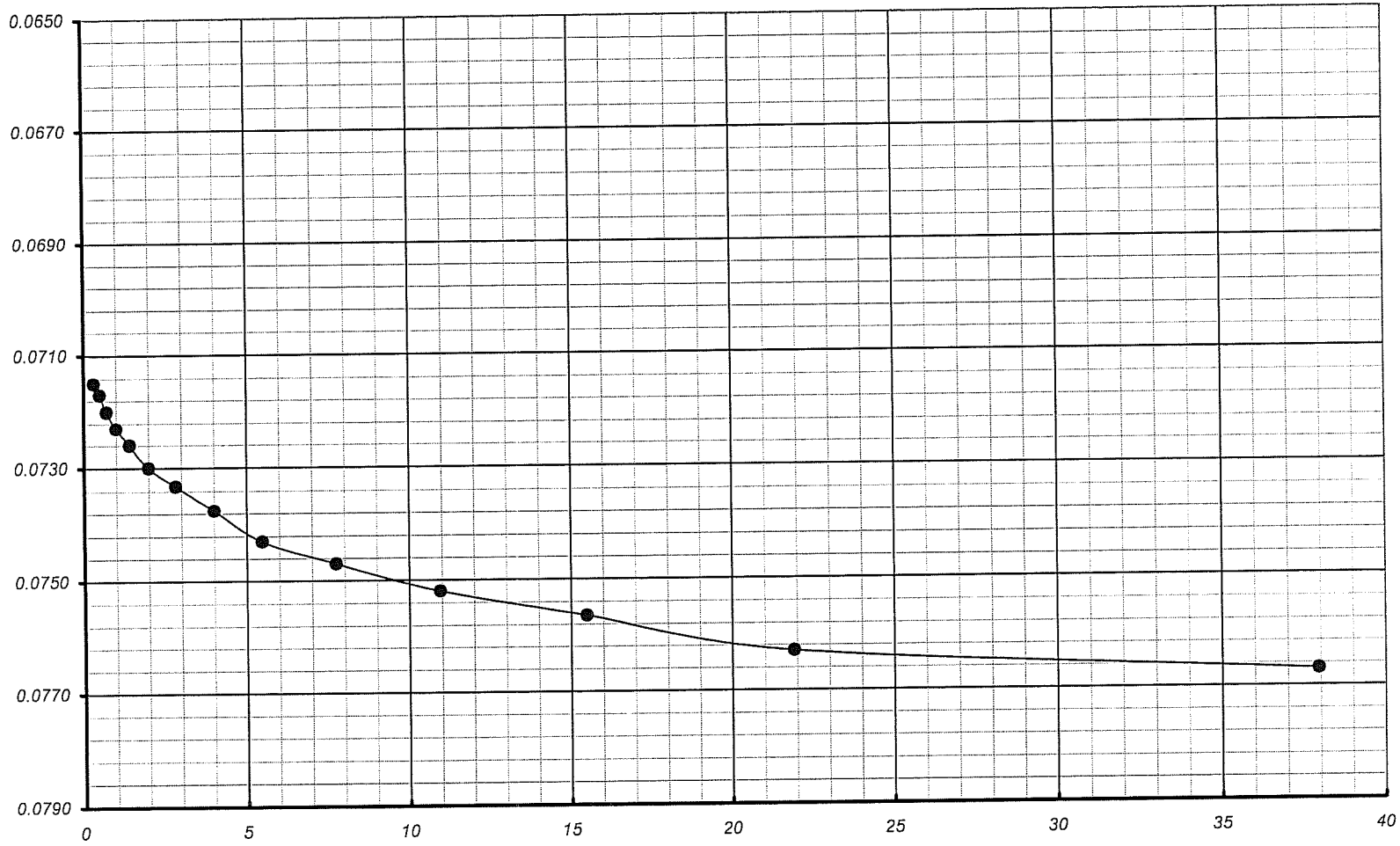
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

Project No. : 08-115 12/05/08

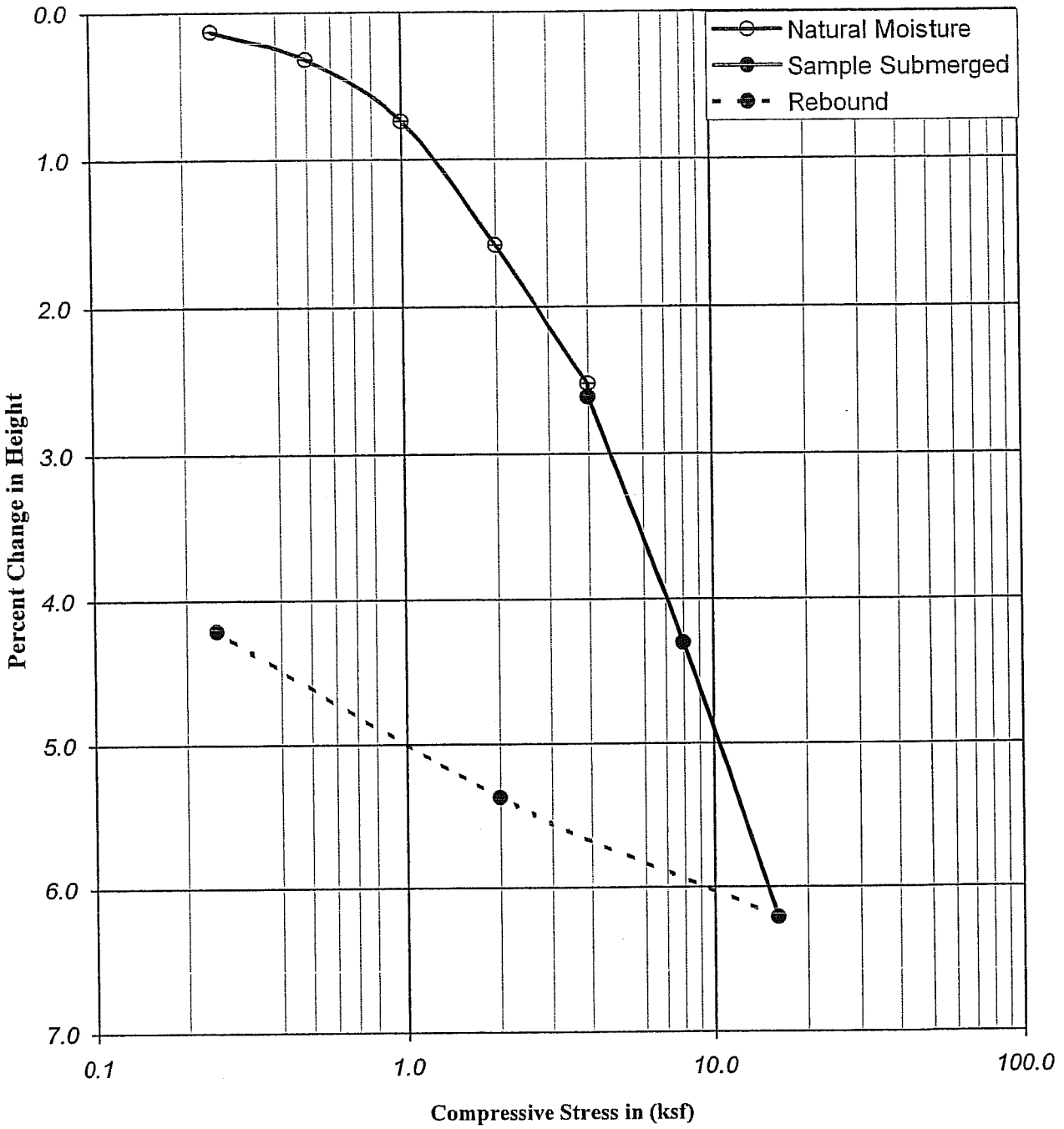


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-014*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-3*	
EMI Project No. : *08-115*		Depth (ft/m) : *10.0* *3.1*	Veritcal Load (ksf/kpa) : *4.00* *191.5*

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-014*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-3*	
EMI Project No. : *08-115*		Depth (ft/m) : *10.0* *3.1*	Veritcal Load (ksf/kpa) : *4.0* *191.5*



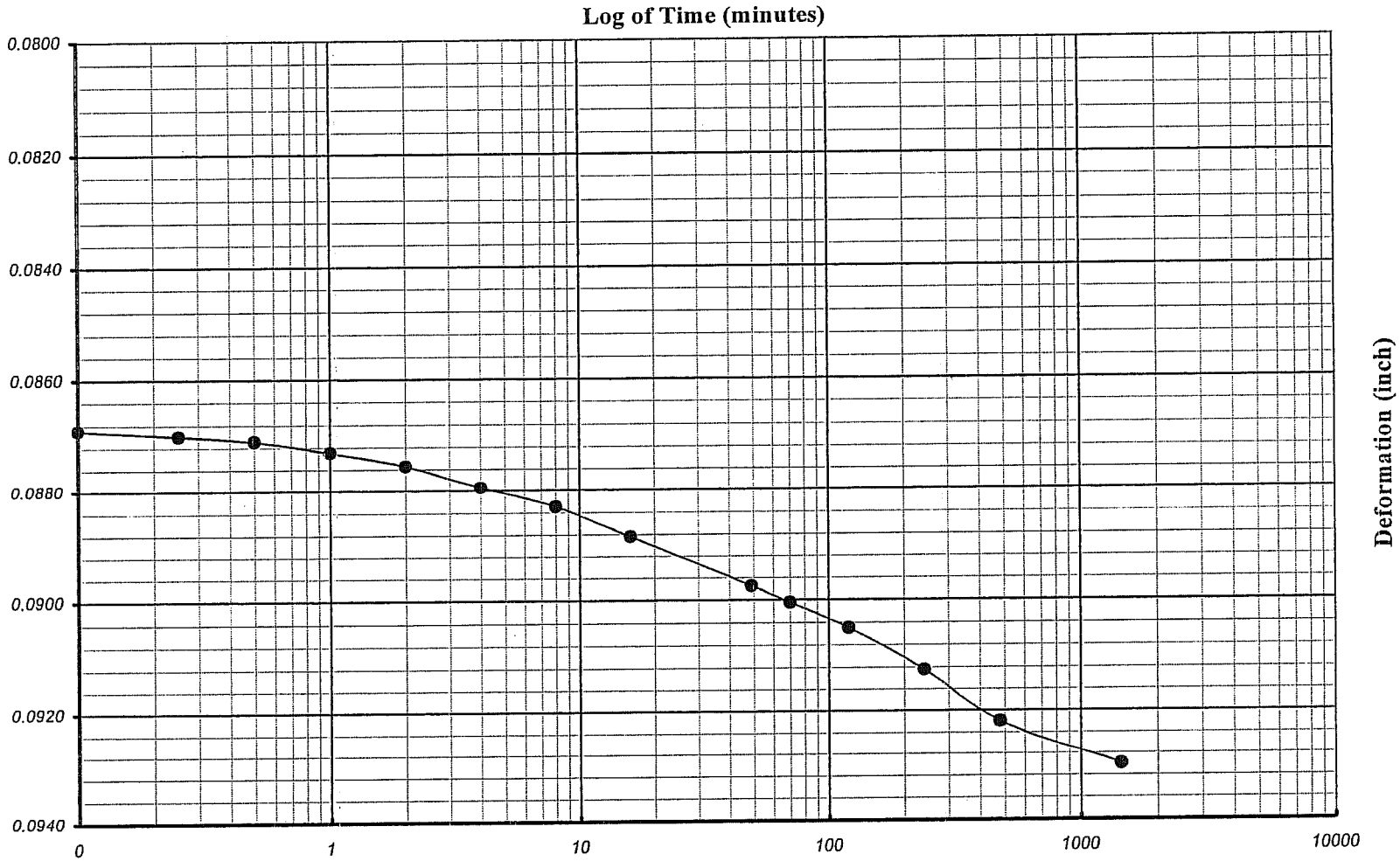
Boring No.	: A-08-015		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-10		Plastic Limit :	-						
Depth (ft)	: 25.0	26.5	Plastic Index :	-	Initial	13.36	96.70	15.22	48.54	0.74
Depth (m)	: 7.63	8.08	Specific Gravity :	2.70	Final	24.67	100.96	15.89	99.46	0.67
Description	: Yellowish brown, SILTY SAND (SM)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

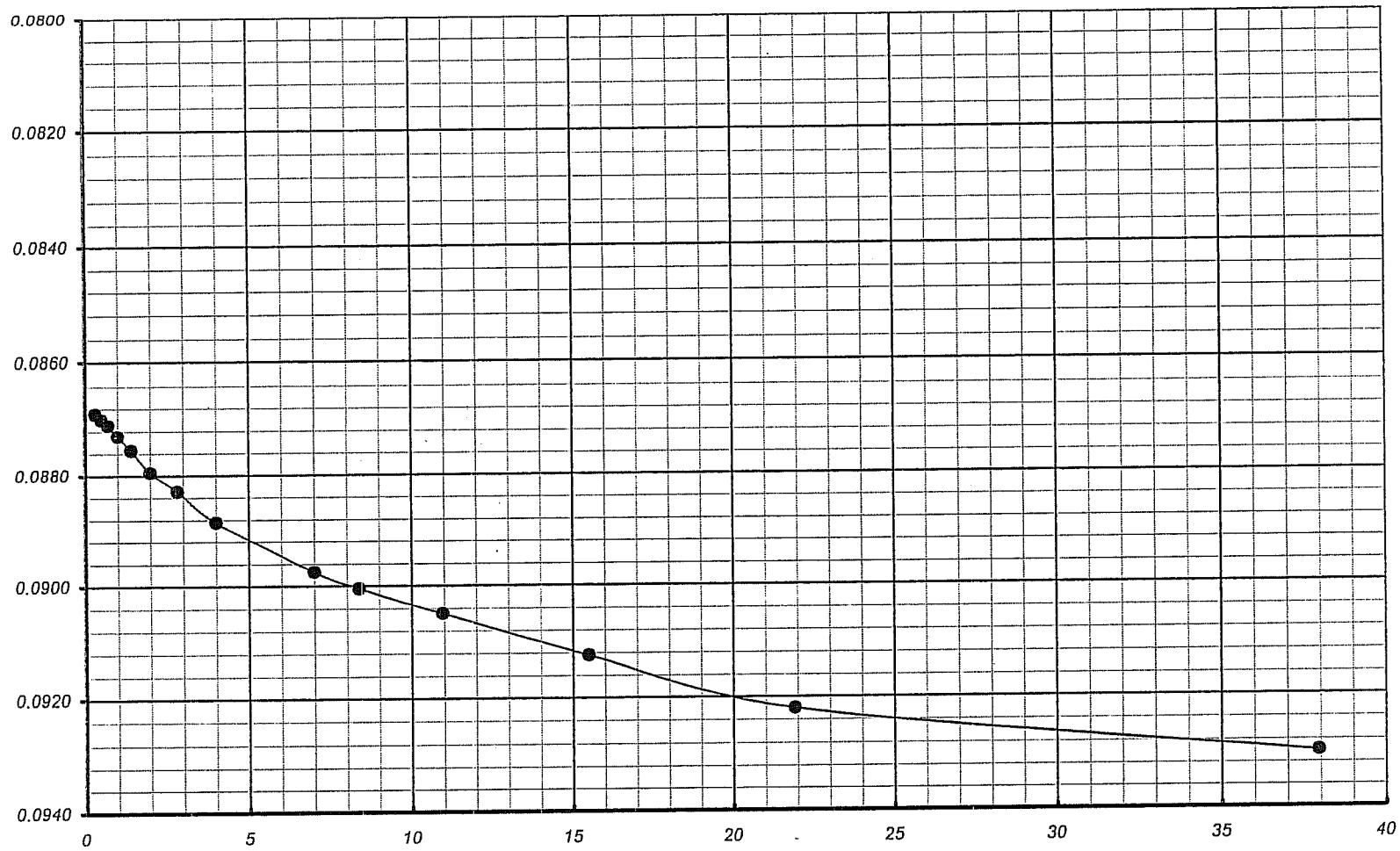
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

Project No. : *08-115* *12/05/08*



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-015*	**One-Dimensional Consolidation of Soil** Time-Deformation Curve (Log of Time Method)
		Sample No. : *D-10*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *8.00* *383.0*

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-015*	**One-Dimensional Consolidation of Soil** Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-10*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *8.0* *383.0*

APPENDIX C

DESIGN CALCULATIONS

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project Chapman Ave UC (Widen) Project No. 08-115

By CTY Date 1/12/09 Checked By _____ Date _____ Sheet ____ of ____

pile properties

$\pi(D) = \pi(2') = 6.28 = ft$

$\frac{\pi}{4}D^2 = \frac{\pi}{4}(2)^2 = 3.14\ ft^2 = 452\ in^2$

$I = \frac{\pi}{64}(24)^4 = 16286\ in^4$

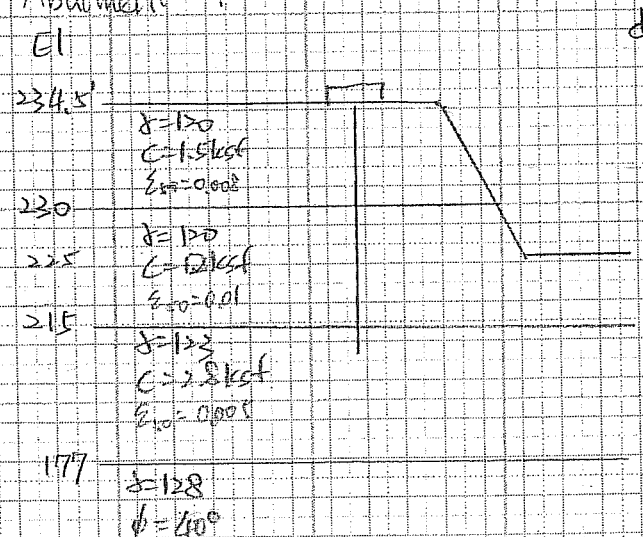
$E_c = 57000\sqrt{f'_c} = 57000\sqrt{3250} = 3.25 \times 10^6\ psi$

$EI_{gross} = 5.29 \times 10^{10}\ lb\text{-}in^2$

$EI_{crack} = \frac{1}{2}EI_{gross} = 2.65 \times 10^{10}\ lb\text{-}in^2$

Idealized Soil Profile

Abutment 1



(3' ft soil cover is used for lateral soil).

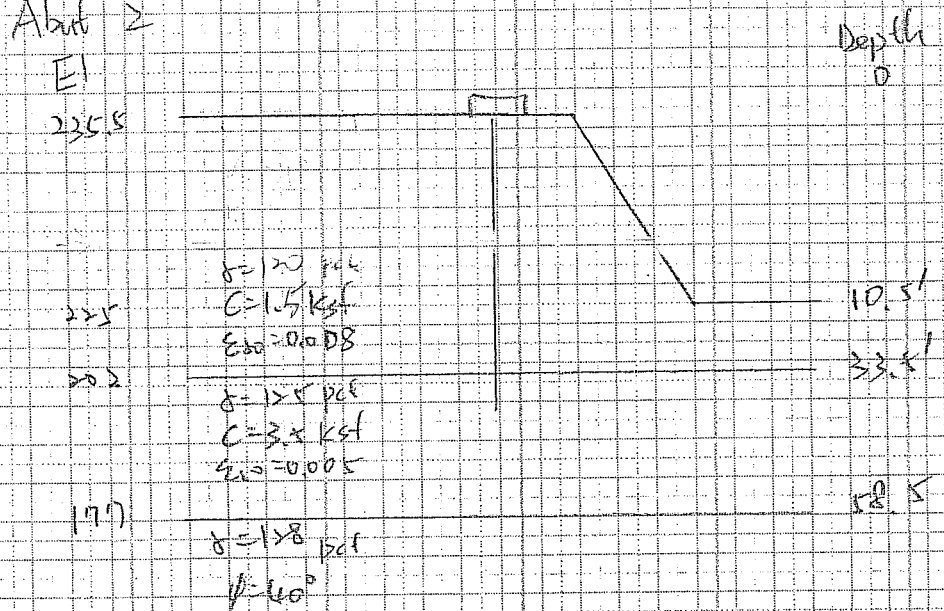
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project Chapman Ave UC (widen) Project No. 08-115

By CTY Date 1/13/09 Checked By _____ Date _____ Sheet ___ of ___

Abut 2



Pile Length

Abutment 1

Service demand = 200 x 2 = 400 k

Reqd length = 56' (single pile)

Pile group demand = 1200 x 2 = 2400 k

→ Reqd length = 45'

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Chapman Avenue UC Abut 1 - single pile ITEM: 2-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: YCT DATE: 01/12/09

CHECKED BY: DATE:

D_s => 2 ft Hw => 100.0 ft Hg => 0.0 ft

p = 6.2832 ft Ho => 0.0 ft Hf => 5.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	4.5	120	57.6	1.50	0
(2)	4.5	9.5	120	57.6	1.20	0
(3)	9.5	19.5	120	57.6	1.20	0
(4)	19.5	57.5	123	60.6	2.80	0
(5)	57.5	150	128	65.6	0.00	40
(6)	80	150	128	65.6	0.00	40
(7)	80	150	128	65.6	0.00	40
(8)	80	150	128	65.6	0.00	40

Sublayer No.	Depth, z	z_l	New Depth	Soil Unit	Overburden	c'	β	f_l^s	ΔQ_s^s	Q_s^s	f_l^c	ΔQ_s^c	Q_s^c	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)	(kips)
0	0.0	0.0	0.0	120.0	0					0.0			0.0	0.0
1	5.0	2.5	2.5	120.0	300	2								
2	6.0	5.5	5.5	120.0	660	1	1.1834	0.0000	0.0	0.0	0.6600	4.1	4.1	4.1
3	7.0	6.5	6.5	120.0	780	1	1.1558	0.0000	0.0	0.0	0.6600	4.1	8.3	8.3
4	8.0	7.5	7.5	120.0	900	1	1.1303	0.0000	0.0	0.0	0.6600	4.1	12.4	12.4
5	9.0	8.5	8.5	120.0	1020	1	1.1064	0.0000	0.0	0.0	0.6600	4.1	16.6	16.6
6	10.0	9.5	9.5	120.0	1140	1	1.0839	0.0000	0.0	0.0	0.6600	4.1	20.7	20.7
7	12.0	11.0	11.0	120.0	1320	1	1.0523	0.0000	0.0	0.0	0.6600	8.3	29.0	29.0
8	14.0	13.0	13.0	120.0	1560	1	1.0133	0.0000	0.0	0.0	0.6600	8.3	37.3	37.3
9	16.0	15.0	15.0	120.0	1800	1	0.9771	0.0000	0.0	0.0	0.6600	8.3	45.6	45.6
10	18.0	17.0	17.0	120.0	2040	1	0.9434	0.0000	0.0	0.0	0.6600	8.3	53.9	53.9
11	20.0	19.0	19.0	120.0	2280	1	0.9115	0.0000	0.0	0.0	0.6600	8.3	62.2	62.2
12	22.0	21.0	21.0	123.0	2526	3	0.8814	0.0000	0.0	0.0	1.5400	19.4	81.6	81.6
13	24.0	23.0	23.0	123.0	2772	3	0.8526	0.0000	0.0	0.0	1.5400	19.4	100.9	100.9
14	26.0	25.0	25.0	123.0	3018	3	0.8250	0.0000	0.0	0.0	1.5400	19.4	120.3	120.3
15	28.0	27.0	27.0	123.0	3264	3	0.7985	0.0000	0.0	0.0	1.5400	19.4	139.6	139.6
16	30.0	29.0	29.0	123.0	3510	3	0.7730	0.0000	0.0	0.0	1.5400	19.4	159.0	159.0
17	32.0	31.0	31.0	123.0	3756	3	0.7484	0.0000	0.0	0.0	1.5400	19.4	178.3	178.3
18	34.0	33.0	33.0	123.0	4002	3	0.7245	0.0000	0.0	0.0	1.5400	19.4	197.7	197.7
19	36.0	35.0	35.0	123.0	4248	3	0.7013	0.0000	0.0	0.0	1.5400	19.4	217.0	217.0
20	38.0	37.0	37.0	123.0	4494	3	0.6788	0.0000	0.0	0.0	1.5400	19.4	236.4	236.4
21	40.0	39.0	39.0	123.0	4740	3	0.6569	0.0000	0.0	0.0	1.5400	19.4	255.7	255.7
22	42.0	41.0	41.0	123.0	4986	3	0.6356	0.0000	0.0	0.0	1.5400	19.4	275.1	275.1
23	44.0	43.0	43.0	123.0	5232	3	0.6147	0.0000	0.0	0.0	1.5400	19.4	294.4	294.4
24	46.0	45.0	45.0	123.0	5478	3	0.5944	0.0000	0.0	0.0	1.5400	19.4	313.8	313.8
25	48.0	47.0	47.0	123.0	5724	3	0.5745	0.0000	0.0	0.0	1.5400	19.4	333.1	333.1
26	50.0	49.0	49.0	123.0	5970	3	0.5550	0.0000	0.0	0.0	1.5400	19.4	352.5	352.5
27	52.0	51.0	51.0	123.0	6216	3	0.5359	0.0000	0.0	0.0	1.5400	19.4	371.8	371.8
28	54.0	53.0	53.0	123.0	6462	3	0.5172	0.0000	0.0	0.0	1.5400	19.4	391.2	391.2
29	56.0	55.0	55.0	123.0	6708	3	0.4988	0.0000	0.0	0.0	1.5400	19.4	410.5	410.5
30	58.0	57.0	57.0	123.0	6954	3	0.4808	0.0000	0.0	0.0	1.5400	19.4	429.9	429.9
31	60.0	59.0	59.0	128.0	7210	0	0.4630	3.3386	42.0	42.0	0.0000	0.0	429.9	471.8
32	62.0	61.0	61.0	128.0	7466	0	0.4456	3.3270	41.8	83.8	0.0000	0.0	429.9	513.7
33	64.0	63.0	63.0	128.0	7722	0	0.4285	3.3087	41.6	125.3	0.0000	0.0	429.9	555.2
34	66.0	65.0	65.0	128.0	7978	0	0.4116	3.2837	41.3	166.6	0.0000	0.0	429.9	596.5
35	68.0	67.0	67.0	128.0	8234	0	0.3950	3.2522	40.9	207.5	0.0000	0.0	429.9	637.4
36	70.0	69.0	69.0	128.0	8490	0	0.3786	3.2144	40.4	247.9	0.0000	0.0	429.9	677.8

C=46'

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Chapman Avenue UC Abut 1 - pile group ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115
DONE BY: CY DATE: 05/01/09
CHECKED BY: DATE:

D_s => 2 ft Hw => 100.0 ft Hg => 0.0 ft
no. of piles= 8 Ho => 0.0 ft Hf => 5.0 ft
p = 50.27 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>	η
(1)	0	4.5	120	57.6	1.50	0	1.00
(2)	4.5	9.5	120	57.6	1.20	0	1.00
(3)	9.5	19.5	120	57.6	1.20	0	1.00
(4)	19.5	57.5	123	60.6	2.80	0	1.00
(5)	57.5	150	128	65.6	0.00	40	0.77
(6)	80	150	128	65.6	0.00	40	0.77
(7)	80	150	128	65.6	0.00	40	0.77
(8)	80	150	128	65.6	0.00	40	0.77

C-C Sp/D	η
2.5	0.65
3.0	0.77
3.5	0.88
4.0	1.00

Current C-C Spacing/D 3.0

Clay group eff 1.0

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	η	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)		(kips)
0	0.0	0.0	0.0	120.0	0										
1	5.0	2.5	2.5	120.0	300	1.5				0.0			0.0	1.00	0.0
2	6.0	5.5	5.5	120.0	660	1.2	1.1834	0.0000	0.0	0.0	0.6600	33.2	33.2	1.00	33.2
3	8.0	7.0	7.0	120.0	840	1.2	1.1428	0.0000	0.0	0.0	0.6600	66.4	99.5	1.00	99.5
4	10.0	9.0	9.0	120.0	1080	1.2	1.0950	0.0000	0.0	0.0	0.6600	66.4	165.9	1.00	165.9
5	12.0	11.0	11.0	120.0	1320	1.2	1.0523	0.0000	0.0	0.0	0.6600	66.4	232.2	1.00	232.2
6	14.0	13.0	13.0	120.0	1560	1.2	1.0133	0.0000	0.0	0.0	0.6600	66.4	298.6	1.00	298.6
7	16.0	15.0	15.0	120.0	1800	1.2	0.9771	0.0000	0.0	0.0	0.6600	66.4	364.9	1.00	364.9
8	18.0	17.0	17.0	120.0	2040	1.2	0.9434	0.0000	0.0	0.0	0.6600	66.4	431.3	1.00	431.3
9	20.0	19.0	19.0	120.0	2280	1.2	0.9115	0.0000	0.0	0.0	0.6600	66.4	497.6	1.00	497.6
10	22.0	21.0	21.0	123.0	2526	2.8	0.8814	0.0000	0.0	0.0	1.5400	154.8	652.4	1.00	652.4
11	24.0	23.0	23.0	123.0	2772	2.8	0.8526	0.0000	0.0	0.0	1.5400	154.8	807.3	1.00	807.3
12	26.0	25.0	25.0	123.0	3018	2.8	0.8250	0.0000	0.0	0.0	1.5400	154.8	962.1	1.00	962.1
13	28.0	27.0	27.0	123.0	3264	2.8	0.7985	0.0000	0.0	0.0	1.5400	154.8	1116.9	1.00	1116.9
14	30.0	29.0	29.0	123.0	3510	2.8	0.7730	0.0000	0.0	0.0	1.5400	154.8	1271.7	1.00	1271.7
15	31.0	30.5	30.5	123.0	3695	2.8	0.7544	0.0000	0.0	0.0	1.5400	77.4	1349.1	1.00	1349.1
16	32.0	31.5	31.5	123.0	3818	2.8	0.7423	0.0000	0.0	0.0	1.5400	77.4	1426.5	1.00	1426.5
17	33.0	32.5	32.5	123.0	3941	2.8	0.7304	0.0000	0.0	0.0	1.5400	77.4	1503.9	1.00	1503.9
18	34.0	33.5	33.5	123.0	4064	2.8	0.7186	0.0000	0.0	0.0	1.5400	77.4	1581.4	1.00	1581.4
19	35.0	34.5	34.5	123.0	4187	2.8	0.7071	0.0000	0.0	0.0	1.5400	77.4	1658.8	1.00	1658.8
20	36.0	35.5	35.5	123.0	4310	2.8	0.6956	0.0000	0.0	0.0	1.5400	77.4	1736.2	1.00	1736.2
21	37.0	36.5	36.5	123.0	4433	2.8	0.6844	0.0000	0.0	0.0	1.5400	77.4	1813.6	1.00	1813.6
22	38.0	37.5	37.5	123.0	4556	2.8	0.6733	0.0000	0.0	0.0	1.5400	77.4	1891.0	1.00	1891.0
23	39.0	38.5	38.5	123.0	4679	2.8	0.6623	0.0000	0.0	0.0	1.5400	77.4	1968.4	1.00	1968.4
24	40.0	39.5	39.5	123.0	4802	2.8	0.6515	0.0000	0.0	0.0	1.5400	77.4	2045.8	1.00	2045.8
25	41.0	40.5	40.5	123.0	4925	2.8	0.6409	0.0000	0.0	0.0	1.5400	77.4	2123.2	1.00	2123.2
26	42.0	41.5	41.5	123.0	5048	2.8	0.6303	0.0000	0.0	0.0	1.5400	77.4	2200.6	1.00	2200.6
27	43.0	42.5	42.5	123.0	5171	2.8	0.6199	0.0000	0.0	0.0	1.5400	77.4	2278.0	1.00	2278.0
28	44.0	43.5	43.5	123.0	5294	2.8	0.6096	0.0000	0.0	0.0	1.5400	77.4	2355.4	1.00	2355.4
29	45.0	44.5	44.5	123.0	5417	2.8	0.5994	0.0000	0.0	0.0	1.5400	77.4	2432.8	1.00	2432.8
30	46.0	45.5	45.5	123.0	5540	2.8	0.5894	0.0000	0.0	0.0	1.5400	77.4	2510.3	1.00	2510.3
31	47.0	46.5	46.5	123.0	5663	2.8	0.5794	0.0000	0.0	0.0	1.5400	77.4	2587.7	1.00	2587.7
32	48.0	47.5	47.5	123.0	5786	2.8	0.5696	0.0000	0.0	0.0	1.5400	77.4	2665.1	1.00	2665.1
33	49.0	48.5	48.5	123.0	5909	2.8	0.5598	0.0000	0.0	0.0	1.5400	77.4	2742.5	1.00	2742.5
34	50.0	49.5	49.5	123.0	6032	2.8	0.5502	0.0000	0.0	0.0	1.5400	77.4	2819.9	1.00	2819.9
35	51.0	50.5	50.5	123.0	6155	2.8	0.5406	0.0000	0.0	0.0	1.5400	77.4	2897.3	1.00	2897.3
36	52.0	51.5	51.5	123.0	6278	2.8	0.5312	0.0000	0.0	0.0	1.5400	77.4	2974.7	1.00	2974.7
37	53.0	52.5	52.5	123.0	6401	2.8	0.5218	0.0000	0.0	0.0	1.5400	77.4	3052.1	1.00	3052.1
38	54.0	53.5	53.5	123.0	6524	2.8	0.5126	0.0000	0.0	0.0	1.5400	77.4	3129.5	1.00	3129.5
39	55.0	54.5	54.5	123.0	6647	2.8	0.5034	0.0000	0.0	0.0	1.5400	77.4	3206.9	1.00	3206.9
40	56.0	55.5	55.5	123.0	6770	2.8	0.4943	0.0000	0.0	0.0	1.5400	77.4	3284.3	1.00	3284.3
41	57.0	56.5	56.5	123.0	6893	2.8	0.4853	0.0000	0.0	0.0	1.5400	77.4	3361.8	1.00	3361.8
42	58.0	57.5	57.5	128.0	7021	0.0	0.4763	3.3439	168.1	129.4	0.0000	0.0	3361.8	0.77	3491.2
43	59.0	58.5	58.5	128.0	7149	0.0	0.4674	3.3416	168.0	258.8	0.0000	0.0	3361.8	0.77	3620.5
44	60.0	59.5	59.5	128.0	7277	0.0	0.4587	3.3374	167.8	387.9	0.0000	0.0	3361.8	0.77	3749.7

LEFT

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
17660 Newhope Street, Suite E, Fountain Valley, CA 92708
phone: (714)751-3826, Fax (714)751-3928

Project: **Chapman Avenue UC Abut 1 (Widen)** Project No. **08-115**
By CTY Date ####### Check by Date Sheet

Settlement Calculation for Pile Group

Pile Top Depth.= 17 ft @ El. 235 ft
Pile Tip Depth= 65 ft @ El. 187 ft
Pile Length= 48 ft
Equivalent Footing
Depth = 49 ft (usually 2/3 of pile length)
Width = 8.0 ft Length= 20.0 ft
Load per Support= 1200 kips
Equivalent Load = 7.5 ksf

Check Settlement:
Method: FHWA Hough Method

Layer	Top Elev. (ft)	Bottom Elev. (ft)	Top Depth (ft)	Bottom Depth (ft)	Soil Type	γ' pcf	(N')	c'	
1	252	230	0	22	CL	120	16	44	
2	230	215	22	37	CL	120	12	39	
3	215	177	37	75	CL	125	22	53	
4	177	100	75	152	SM	128	28	72	Hard Layer

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Depth	Layer Thick. (ft)	Mid pt. depth (ft)	γ' kcf	σ_{vo}' (ksf)	depth to Equiv. Footing (ft)	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)	Total ΔS (in)
0										
4	4	2	0.12	0.24	-47	0.00	0.24	44	0.00	0.00
8	4	6	0.12	0.72	-43	0.00	0.72	44	0.00	0.00
12	4	10	0.12	1.20	-39	0.00	1.20	44	0.00	0.00
16	4	14	0.12	1.68	-35	0.00	1.68	44	0.00	0.00
20	4	18	0.125	2.17	-31	0.00	2.17	44	0.00	0.00
22	2	21	0.125	2.55	-28	0.00	2.55	44	0.00	0.00
26	4	24	0.125	2.92	-25	0.00	2.92	39	0.00	0.00
30	4	28	0.125	3.42	-21	0.00	3.42	39	0.00	0.00
34	4	32	0.125	3.92	-17	0.00	3.92	39	0.00	0.00
37	3	35.5	0.125	4.36	-13.5	0.00	4.36	39	0.00	0.00
41	4	39	0.125	4.80	-10	0.00	4.80	53	0.00	0.00
45	4	43	0.125	5.30	-6	0.00	5.30	53	0.00	0.00
49	4	47	0.125	5.80	-2	0.00	5.80	53	0.00	0.00
53	4	51	0.128	6.30	2	6.00	12.30	53	0.26	0.26
57	4	55	0.128	6.81	6	4.29	11.10	53	0.19	0.46
61	4	59	0.128	7.33	10	3.33	10.66	53	0.15	0.60
65	4	63	0.128	7.84	14	2.73	10.56	53	0.12	0.72
69	4	67	0.128	8.35	18	2.31	10.66	53	0.10	0.82
73	4	71	0.128	8.86	22	2.00	10.86	53	0.08	0.90
75	2	74	0.128	9.25	25	1.82	11.06	53	0.04	0.93
79	4	77	0.128	9.63	28	1.67	11.30	72	0.05	0.98

Earth Mechanics, Inc.
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Project Grampan Ave UC (Widen) Project No. 05-115

By CK Date _____ Checked By _____ Date _____ Sheet ___ of ___

Abutment 2:

single pile demand = 200 x 2 = 400 k

⇒ Reqd = 46'

pile group demand = 600 x 2 = 1200 k

⇒ Reqd length = 46'

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Chapman Avenue UC Abut 2 - single pile ITEM: 2-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115

DONE BY: YCT DATE: 01/12/09

CHECKED BY: DATE:

D_s => 2 ft Hw => 100.0 ft Hg => 0.0 ft

p = 6.2832 ft Ho => 0.0 ft Hf => 5.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	3.5	120	57.6	1.50	0
(2)	3.5	10.5	120	57.6	1.50	0
(3)	10.5	33.5	123	60.6	1.50	0
(4)	33.5	58.5	125	62.6	3.50	0
(5)	58.5	150	128	65.6	0.00	40
(6)	80	150	128	65.6	0.00	40
(7)	80	150	128	65.6	0.00	40
(8)	80	150	128	65.6	0.00	40

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)	(kips)
0	0.0	0.0	0.0	120.0	0					0.0			0.0	0.0
1	5.0	2.5	2.5	120.0	300	2								
2	6.0	5.5	5.5	120.0	660	2	1.1834	0.0000	0.0	0.0	0.8250	5.2	5.2	5.2
3	7.0	6.5	6.5	120.0	780	2	1.1558	0.0000	0.0	0.0	0.8250	5.2	10.4	10.4
4	8.0	7.5	7.5	120.0	900	2	1.1303	0.0000	0.0	0.0	0.8250	5.2	15.6	15.6
5	9.0	8.5	8.5	120.0	1020	2	1.1064	0.0000	0.0	0.0	0.8250	5.2	20.7	20.7
6	10.0	9.5	9.5	120.0	1140	2	1.0839	0.0000	0.0	0.0	0.8250	5.2	25.9	25.9
7	12.0	11.0	11.0	123.0	1325	2	1.0523	0.0000	0.0	0.0	0.8250	10.4	36.3	36.3
8	14.0	13.0	13.0	123.0	1571	2	1.0133	0.0000	0.0	0.0	0.8250	10.4	46.7	46.7
9	16.0	15.0	15.0	123.0	1817	2	0.9771	0.0000	0.0	0.0	0.8250	10.4	57.0	57.0
10	18.0	17.0	17.0	123.0	2063	2	0.9434	0.0000	0.0	0.0	0.8250	10.4	67.4	67.4
11	20.0	19.0	19.0	123.0	2309	2	0.9115	0.0000	0.0	0.0	0.8250	10.4	77.8	77.8
12	22.0	21.0	21.0	123.0	2555	2	0.8814	0.0000	0.0	0.0	0.8250	10.4	88.1	88.1
13	24.0	23.0	23.0	123.0	2801	2	0.8526	0.0000	0.0	0.0	0.8250	10.4	98.5	98.5
14	26.0	25.0	25.0	123.0	3047	2	0.8250	0.0000	0.0	0.0	0.8250	10.4	108.9	108.9
15	28.0	27.0	27.0	123.0	3293	2	0.7985	0.0000	0.0	0.0	0.8250	10.4	119.2	119.2
16	30.0	29.0	29.0	123.0	3539	2	0.7730	0.0000	0.0	0.0	0.8250	10.4	129.6	129.6
17	32.0	31.0	31.0	123.0	3785	2	0.7484	0.0000	0.0	0.0	0.8250	10.4	140.0	140.0
18	34.0	33.0	33.0	123.0	4031	2	0.7245	0.0000	0.0	0.0	0.8250	10.4	150.3	150.3
19	36.0	35.0	35.0	125.0	4281	4	0.7013	0.0000	0.0	0.0	1.9250	24.2	174.5	174.5
20	38.0	37.0	37.0	125.0	4531	4	0.6788	0.0000	0.0	0.0	1.9250	24.2	198.7	198.7
21	40.0	39.0	39.0	125.0	4781	4	0.6569	0.0000	0.0	0.0	1.9250	24.2	222.9	222.9
22	42.0	41.0	41.0	125.0	5031	4	0.6356	0.0000	0.0	0.0	1.9250	24.2	247.1	247.1
23	44.0	43.0	43.0	125.0	5281	4	0.6147	0.0000	0.0	0.0	1.9250	24.2	271.3	271.3
24	46.0	45.0	45.0	125.0	5531	4	0.5944	0.0000	0.0	0.0	1.9250	24.2	295.5	295.5
25	48.0	47.0	47.0	125.0	5781	4	0.5745	0.0000	0.0	0.0	1.9250	24.2	319.7	319.7
26	50.0	49.0	49.0	125.0	6031	4	0.5550	0.0000	0.0	0.0	1.9250	24.2	343.8	343.8
27	52.0	51.0	51.0	125.0	6281	4	0.5359	0.0000	0.0	0.0	1.9250	24.2	368.0	368.0
28	54.0	53.0	53.0	125.0	6531	4	0.5172	0.0000	0.0	0.0	1.9250	24.2	392.2	392.2
29	56.0	55.0	55.0	125.0	6781	4	0.4988	0.0000	0.0	0.0	1.9250	24.2	416.4	416.4
30	58.0	57.0	57.0	125.0	7031	4	0.4808	0.0000	0.0	0.0	1.9250	24.2	440.6	440.6
31	60.0	59.0	59.0	128.0	7287	0	0.4630	3.3740	42.4	42.4	0.0000	0.0	440.6	483.0
32	62.0	61.0	61.0	128.0	7543	0	0.4456	3.3611	42.2	84.6	0.0000	0.0	440.6	525.2
33	64.0	63.0	63.0	128.0	7799	0	0.4285	3.3414	42.0	126.6	0.0000	0.0	440.6	567.2
34	66.0	65.0	65.0	128.0	8055	0	0.4116	3.3152	41.7	168.3	0.0000	0.0	440.6	608.9
35	68.0	67.0	67.0	128.0	8311	0	0.3950	3.2825	41.2	209.5	0.0000	0.0	440.6	650.1
36	70.0	69.0	69.0	128.0	8567	0	0.3786	3.2433	40.8	250.3	0.0000	0.0	440.6	690.9

c=56'

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: Chapman Avenue UC Abut 2 - pile group ITEM: 2.5-FT DIAMETER CIDH PILE

PROJECT NO.: 08-115
DONE BY: CY DATE: 05/01/09
CHECKED BY: DATE:

D_s => 2 ft Hw => 100.0 ft Hg => 0.0 ft
no. of piles= 8 Ho => 0.0 ft Hf => 5.0 ft
p = 50.27 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>	η
(1)	0	3.5	120	57.6	1.50	0	1.00
(2)	3.5	10.5	120	57.6	1.50	0	1.00
(3)	10.5	33.5	123	60.6	1.50	0	1.00
(4)	33.5	58.5	125	62.6	3.50	0	1.00
(5)	58.5	150	128	65.6	0.00	40	0.77
(6)	80	150	128	65.6	0.00	40	0.77
(7)	80	150	128	65.6	0.00	40	0.77
(8)	80	150	128	65.6	0.00	40	0.77

C-C Sp/D	η
2.5	0.65
3.0	0.77
3.5	0.88
4.0	1.00

Current C-C Spacing/D 3.0

Clay group eff 1.0

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i[a]	ΔQ_s[a]	Q_s[a]	f_i[c]	ΔQ_s[c]	Q_s[c]	η	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)		(kips)
0	0.0	0.0	0.0	120.0	0					0.0			0.0	1.00	0.0
1	5.0	2.5	2.5	120.0	300	1.5				0.0	0.8250	41.5	41.5	1.00	41.5
2	6.0	5.5	5.5	120.0	660	1.5	1.1834	0.0000	0.0	0.0	0.8250	82.9	124.4	1.00	124.4
3	8.0	7.0	7.0	120.0	840	1.5	1.1428	0.0000	0.0	0.0	0.8250	82.9	207.3	1.00	207.3
4	10.0	9.0	9.0	120.0	1080	1.5	1.0950	0.0000	0.0	0.0	0.8250	82.9	290.3	1.00	290.3
5	12.0	11.0	11.0	123.0	1326	1.5	1.0523	0.0000	0.0	0.0	0.8250	82.9	373.2	1.00	373.2
6	14.0	13.0	13.0	123.0	1572	1.5	1.0133	0.0000	0.0	0.0	0.8250	82.9	456.2	1.00	456.2
7	16.0	15.0	15.0	123.0	1818	1.5	0.9771	0.0000	0.0	0.0	0.8250	82.9	539.1	1.00	539.1
8	18.0	17.0	17.0	123.0	2064	1.5	0.9434	0.0000	0.0	0.0	0.8250	82.9	622.0	1.00	622.0
9	20.0	19.0	19.0	123.0	2310	1.5	0.9115	0.0000	0.0	0.0	0.8250	82.9	705.0	1.00	705.0
10	22.0	21.0	21.0	123.0	2556	1.5	0.8814	0.0000	0.0	0.0	0.8250	82.9	787.9	1.00	787.9
11	24.0	23.0	23.0	123.0	2802	1.5	0.8526	0.0000	0.0	0.0	0.8250	82.9	870.8	1.00	870.8
12	26.0	25.0	25.0	123.0	3048	1.5	0.8250	0.0000	0.0	0.0	0.8250	82.9	953.8	1.00	953.8
13	28.0	27.0	27.0	123.0	3294	1.5	0.7985	0.0000	0.0	0.0	0.8250	82.9	1036.7	1.00	1036.7
14	30.0	29.0	29.0	123.0	3540	1.5	0.7730	0.0000	0.0	0.0	0.8250	82.9	1036.7	1.00	1078.2
15	31.0	30.5	30.5	123.0	3725	1.5	0.7544	0.0000	0.0	0.0	0.8250	41.5	1078.2	1.00	1119.7
16	32.0	31.5	31.5	123.0	3848	1.5	0.7423	0.0000	0.0	0.0	0.8250	41.5	1119.7	1.00	1161.1
17	33.0	32.5	32.5	123.0	3971	1.5	0.7304	0.0000	0.0	0.0	0.8250	41.5	1161.1	1.00	1161.1
18	34.0	33.5	33.5	125.0	4096	3.5	0.7186	0.0000	0.0	0.0	1.9250	96.8	1257.9	1.00	1257.9
19	35.0	34.5	34.5	125.0	4221	3.5	0.7071	0.0000	0.0	0.0	1.9250	96.8	1354.7	1.00	1354.7
20	36.0	35.5	35.5	125.0	4346	3.5	0.6956	0.0000	0.0	0.0	1.9250	96.8	1451.4	1.00	1451.4
21	37.0	36.5	36.5	125.0	4471	3.5	0.6844	0.0000	0.0	0.0	1.9250	96.8	1548.2	1.00	1548.2
22	38.0	37.5	37.5	125.0	4596	3.5	0.6733	0.0000	0.0	0.0	1.9250	96.8	1644.9	1.00	1644.9
23	39.0	38.5	38.5	125.0	4721	3.5	0.6623	0.0000	0.0	0.0	1.9250	96.8	1741.7	1.00	1741.7
24	40.0	39.5	39.5	125.0	4846	3.5	0.6515	0.0000	0.0	0.0	1.9250	96.8	1838.5	1.00	1838.5
25	41.0	40.5	40.5	125.0	4971	3.5	0.6409	0.0000	0.0	0.0	1.9250	96.8	1935.2	1.00	1935.2
26	42.0	41.5	41.5	125.0	5096	3.5	0.6303	0.0000	0.0	0.0	1.9250	96.8	2032.0	1.00	2032.0
27	43.0	42.5	42.5	125.0	5221	3.5	0.6199	0.0000	0.0	0.0	1.9250	96.8	2128.7	1.00	2128.7
28	44.0	43.5	43.5	125.0	5346	3.5	0.6096	0.0000	0.0	0.0	1.9250	96.8	2225.5	1.00	2225.5
29	45.0	44.5	44.5	125.0	5471	3.5	0.5994	0.0000	0.0	0.0	1.9250	96.8	2322.3	1.00	2322.3
30	46.0	45.5	45.5	125.0	5596	3.5	0.5894	0.0000	0.0	0.0	1.9250	96.8	2419.0	1.00	2419.0
31	47.0	46.5	46.5	125.0	5721	3.5	0.5794	0.0000	0.0	0.0	1.9250	96.8	2515.8	1.00	2515.8
32	48.0	47.5	47.5	125.0	5846	3.5	0.5696	0.0000	0.0	0.0	1.9250	96.8	2612.5	1.00	2612.5
33	49.0	48.5	48.5	125.0	5971	3.5	0.5598	0.0000	0.0	0.0	1.9250	96.8	2709.3	1.00	2709.3
34	50.0	49.5	49.5	125.0	6096	3.5	0.5502	0.0000	0.0	0.0	1.9250	96.8	2806.1	1.00	2806.1
35	51.0	50.5	50.5	125.0	6221	3.5	0.5406	0.0000	0.0	0.0	1.9250	96.8	2902.8	1.00	2902.8
36	52.0	51.5	51.5	125.0	6346	3.5	0.5312	0.0000	0.0	0.0	1.9250	96.8	2999.6	1.00	2999.6
37	53.0	52.5	52.5	125.0	6471	3.5	0.5218	0.0000	0.0	0.0	1.9250	96.8	3096.4	1.00	3096.4
38	54.0	53.5	53.5	125.0	6596	3.5	0.5126	0.0000	0.0	0.0	1.9250	96.8	3193.1	1.00	3193.1
39	55.0	54.5	54.5	125.0	6721	3.5	0.5034	0.0000	0.0	0.0	1.9250	96.8	3289.9	1.00	3289.9
40	56.0	55.5	55.5	125.0	6846	3.5	0.4943	0.0000	0.0	0.0	1.9250	96.8	3386.6	1.00	3386.6
41	57.0	56.5	56.5	125.0	6971	3.5	0.4853	0.0000	0.0	0.0	1.9250	96.8	3483.4	1.00	3483.4
42	58.0	57.5	57.5	125.0	7096	3.5	0.4763	0.0000	0.0	0.0	1.9250	96.8	3580.2	1.00	3580.2
43	59.0	58.5	58.5	128.0	7224	0.0	0.4674	3.3766	169.7	130.7	0.0000	0.0	3580.2	0.77	3710.8
44	60.0	59.5	59.5	128.0	7352	0.0	0.4587	3.3718	169.5	261.2	0.0000	0.0	3580.2	0.77	3841.4

L=46'

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
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phone: (714)751-3826, Fax (714)751-3928

Project: **Chapman Avenue UC Abut 2(Widen)** Project No. **08-115**
By CTY Date ####### Check by Date Sheet

Settlement Calculation for Pile Group

Pile Top Depth.= 17 ft @ El. 235 ft
Pile Tip Depth= 60 ft @ El. 192 ft
Pile Length= 43 ft
Equivalent Footing
Depth = 46 ft (usually 2/3 of pile length)
Width = 8.0 ft Length= 20.0 ft
Load per Support= 1200 kips
Equivalent Load = 7.5 ksf

Check Settlement:
Method: FHWA Hough Method

Layer	Top Elev. (ft)	Bottom Elev. (ft)	Top Depth (ft)	Bottom Depth (ft)	Soil Type	γ' pcf	(N')	c'	
1	252	235	0	17	SM	120	26	69	
2	235	202	17	50	CL	125	12	39	
3	202	177	50	75	CL	128	30	65	
4	177	100	75	152	SM	128	60	140	Hard Layer

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Depth	Layer Thick. (ft)	Mid pt. depth (ft)	γ' kcf	σ_{vo}' (ksf)	depth to Equiv. Footing (ft)	$\Delta\sigma_v'$ (ksf)	σ_{vt} (ksf)	C	ΔS (in)	Total ΔS (in)
0										
4	4	2	0.12	0.24	-44	0.00	0.24	69	0.00	0.00
8	4	6	0.12	0.72	-40	0.00	0.72	69	0.00	0.00
12	4	10	0.12	1.20	-36	0.00	1.20	69	0.00	0.00
16	4	14	0.12	1.68	-32	0.00	1.68	69	0.00	0.00
17	1	16.5	0.12	1.98	-29.5	0.00	1.98	69	0.00	0.00
21	4	19	0.125	2.29	-27	0.00	2.29	39	0.00	0.00
25	4	23	0.125	2.79	-23	0.00	2.79	39	0.00	0.00
29	4	27	0.125	3.29	-19	0.00	3.29	39	0.00	0.00
33	4	31	0.125	3.79	-15	0.00	3.79	39	0.00	0.00
37	4	35	0.125	4.29	-11	0.00	4.29	39	0.00	0.00
41	4	39	0.125	4.79	-7	0.00	4.79	39	0.00	0.00
45	4	43	0.125	5.29	-3	0.00	5.29	39	0.00	0.00
46	1	45.5	0.125	5.60	-0.5	0.00	5.60	39	0.00	0.00
50	4	48	0.125	5.92	2	6.00	11.92	39	0.37	0.37
54	4	52	0.128	6.42	6	4.29	10.71	65	0.16	0.54
58	4	56	0.128	6.93	10	3.33	10.27	65	0.13	0.66
62	4	60	0.128	7.45	14	2.73	10.17	65	0.10	0.76
66	4	64	0.128	7.96	18	2.31	10.26	65	0.08	0.85
70	4	68	0.128	8.47	22	2.00	10.47	65	0.07	0.91
74	4	72	0.128	8.98	26	1.76	10.75	65	0.06	0.97
75	1	74.5	0.128	9.30	28.5	1.64	10.94	65	0.01	0.98

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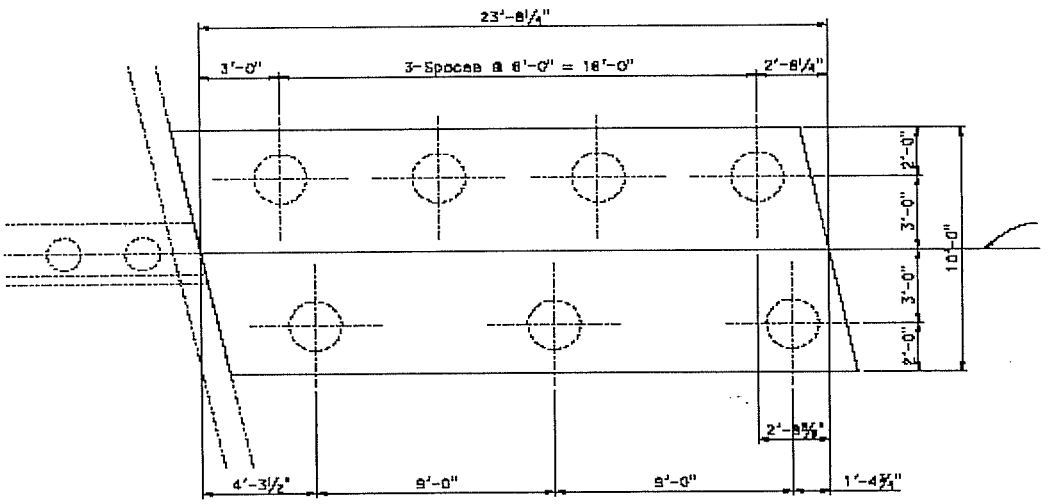
Project: **Chapman Avenue UC (Widen)** Project No. **08-115**

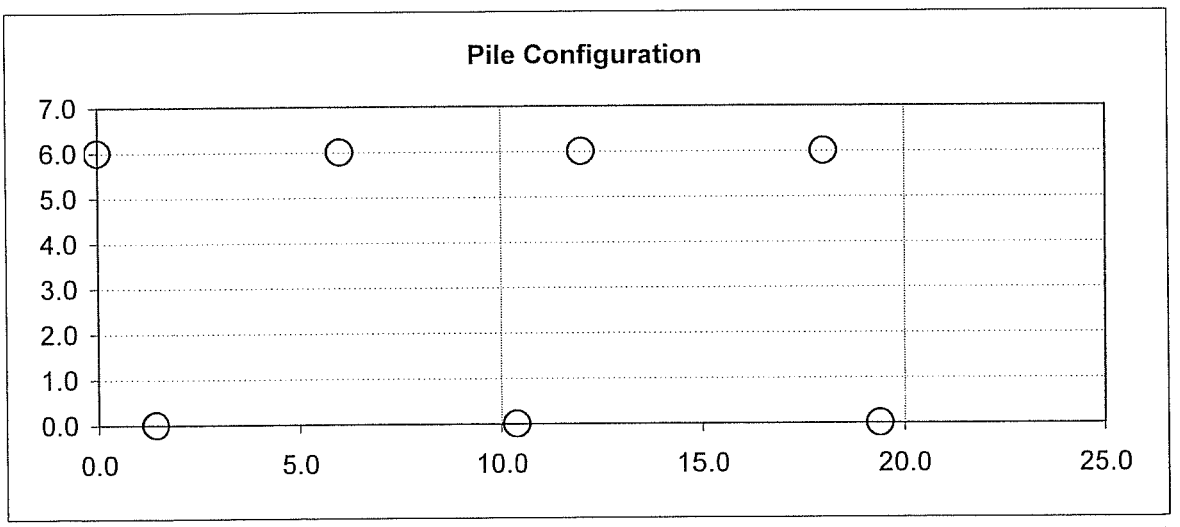
By CTY Date 01/10/09 Check by Date Sheet

Proposed Abutment 1 Pile Layout



ABUTMENT 1 PLAN

Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia. (feet): 2
No. of Piles: 7

Group Efficiency	X-Dir	Y-Dir
	0.749	0.712

Avg 0.73

Coordinates

Pile No.	X	Y
1	1.396	0.00
2	10.396	0.00
3	19.396	0.00
4	0.000	6.00
5	6.000	6.00
6	12.000	6.00
7	18.000	6.00

Reduction Factors in X-dir	Reduction Factors in Y-dir
0.716	0.649
0.726	0.617
0.938	0.710
0.617	0.872
0.598	0.850
0.589	0.813
0.865	0.872

Project: **Chapman Avenue UC (Widen)** Project No. **08-115**
By CTY Date 01/10/09 Check by Date Sheet _____

Fx1 = 0.716 = 0.85 (lbl-21) x 1 (lbl-31) x 0.938 (skew-41) x 0.93 (skew-51) x 0.965 (skew-61) x 1 (skew-71)
skew-41 = 0.938 = SQRT((0.938*Cos(1.342))^2 + 0.938*Sin(1.342))^2)
skew-51 = 0.93 = SQRT((0.796*Cos(0.916))^2 + 1*Sin(0.916))^2)
skew-61 = 0.965 = SQRT((0.954*Cos(0.515))^2 + 1*Sin(0.515))^2)
skew-71 = 1 = SQRT((1*Cos(0.347))^2 + 1*Sin(0.347))^2)

Fx2 = 0.726 = 1 (lbl-12) x 0.85 (lbl-32) x 1 (skew-42) x 0.995 (skew-52) x 0.929 (skew-62) x 0.924 (skew-72)
skew-42 = 1 = SQRT((1*Cos(0.523))^2 + 1*Sin(0.523))^2)
skew-52 = 0.995 = SQRT((0.985*Cos(0.938))^2 + 1*Sin(0.938))^2)
skew-62 = 0.929 = SQRT((0.738*Cos(1.31))^2 + 0.941*Sin(1.31))^2)
skew-72 = 0.924 = SQRT((0.874*Cos(0.668))^2 + 1*Sin(0.668))^2)

Fx3 = 0.938 = 1 (lbl-13) x 1 (lbl-23) x 1 (skew-43) x 1 (skew-53) x 1 (skew-63) x 0.938 (skew-73)
skew-43 = 1 = SQRT((1*Cos(0.3))^2 + 1*Sin(0.3))^2)
skew-53 = 1 = SQRT((1*Cos(0.421))^2 + 1*Sin(0.421))^2)
skew-63 = 1 = SQRT((1*Cos(0.682))^2 + 1*Sin(0.682))^2)
skew-73 = 0.938 = SQRT((0.938*Cos(1.342))^2 + 0.938*Sin(1.342))^2)

Fx4 = 0.617 = 0.929 (skew-14) x 0.962 (skew-24) x 1 (skew-34) x 0.729 (lbl-54) x 0.948 (lbl-64) x 1 (lbl-74)
skew-14 = 0.929 = SQRT((0.736*Cos(1.342))^2 + 0.938*Sin(1.342))^2)
skew-24 = 0.962 = SQRT((0.948*Cos(0.523))^2 + 1*Sin(0.523))^2)
skew-34 = 1 = SQRT((1*Cos(0.3))^2 + 1*Sin(0.3))^2)

Fx5 = 0.598 = 0.996 (skew-15) x 0.932 (skew-25) x 1 (skew-35) x 0.931 (lbl-45) x 0.729 (lbl-65) x 0.948 (lbl-75)
skew-15 = 0.996 = SQRT((0.989*Cos(0.916))^2 + 1*Sin(0.916))^2)
skew-25 = 0.932 = SQRT((0.791*Cos(0.938))^2 + 1*Sin(0.938))^2)
skew-35 = 1 = SQRT((1*Cos(0.421))^2 + 1*Sin(0.421))^2)

Fx6 = 0.589 = 1 (skew-16) x 0.941 (skew-26) x 0.923 (skew-36) x 1 (lbl-46) x 0.931 (lbl-56) x 0.729 (lbl-76)
skew-16 = 1 = SQRT((1*Cos(0.515))^2 + 1*Sin(0.515))^2)
skew-26 = 0.941 = SQRT((0.94*Cos(1.31))^2 + 0.941*Sin(1.31))^2)
skew-36 = 0.923 = SQRT((0.869*Cos(0.682))^2 + 1*Sin(0.682))^2)

Fx7 = 0.865 = 1 (skew-17) x 1 (skew-27) x 0.929 (skew-37) x 1 (lbl-47) x 1 (lbl-57) x 0.931 (lbl-67)
skew-17 = 1 = SQRT((1*Cos(0.347))^2 + 1*Sin(0.347))^2)
skew-27 = 1 = SQRT((1*Cos(0.668))^2 + 1*Sin(0.668))^2)
skew-37 = 0.929 = SQRT((0.736*Cos(1.342))^2 + 0.938*Sin(1.342))^2)

Fx1 = 0.716 = 0.85 (lbl-21) x 1 (lbl-31) x 0.938 (skew-41) x 0.93 (skew-51) x 0.965 (skew-61) x 1 (skew-71)
skew-41 = 0.748 = SQRT((0.736*Cos(0.229))^2 + 0.938*Sin(0.229))^2)
skew-51 = 0.877 = SQRT((0.796*Cos(0.655))^2 + 1*Sin(0.655))^2)
skew-61 = 0.989 = SQRT((0.954*Cos(1.056))^2 + 1*Sin(1.056))^2)
skew-71 = 1 = SQRT((1*Cos(1.224))^2 + 1*Sin(1.224))^2)

Fx2 = 0.726 = 1 (lbl-12) x 0.85 (lbl-32) x 1 (skew-42) x 0.995 (skew-52) x 0.929 (skew-62) x 0.924 (skew-72)
skew-42 = 0.987 = SQRT((0.948*Cos(1.047))^2 + 1*Sin(1.047))^2)
skew-52 = 0.87 = SQRT((0.791*Cos(0.632))^2 + 1*Sin(0.632))^2)
skew-62 = 0.754 = SQRT((0.738*Cos(0.261))^2 + 0.941*Sin(0.261))^2)
skew-72 = 0.954 = SQRT((0.874*Cos(0.903))^2 + 1*Sin(0.903))^2)

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Project: **Chapman Avenue UC (Widen)** Project No. **08-115**
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Fx3 = 0.938 = 1 (lbl-13) x 1 (lbl-23) x 1 (skew-43) x 1 (skew-53) x 1 (skew-63) x 0.938 (skew-73)
skew-43 = 1 = SQRT((1*Cos(1.271))^2 + 1*Sin(1.271))^2)
skew-53 = 1 = SQRT((1*Cos(1.15))^2 + 1*Sin(1.15))^2)
skew-63 = 0.95 = SQRT((0.869*Cos(0.889))^2 + 1*Sin(0.889))^2)
skew-73 = 0.748 = SQRT((0.736*Cos(0.229))^2 + 0.938*Sin(0.229))^2)

Fx4 = 0.617 = 0.929 (skew-14) x 0.962 (skew-24) x 1 (skew-34) x 0.729 (lbl-54) x 0.948 (lbl-64) x 1 (lbl-74)
skew-14 = 0.938 = SQRT((0.938*Cos(0.229))^2 + 0.938*Sin(0.229))^2)
skew-24 = 1 = SQRT((1*Cos(1.047))^2 + 1*Sin(1.047))^2)
skew-34 = 1 = SQRT((1*Cos(1.271))^2 + 1*Sin(1.271))^2)

Fx5 = 0.598 = 0.996 (skew-15) x 0.932 (skew-25) x 1 (skew-35) x 0.931 (lbl-45) x 0.729 (lbl-65) x 0.948 (lbl-75)
skew-15 = 0.993 = SQRT((0.989*Cos(0.655))^2 + 1*Sin(0.655))^2)
skew-25 = 0.99 = SQRT((0.985*Cos(0.632))^2 + 1*Sin(0.632))^2)
skew-35 = 1 = SQRT((1*Cos(1.15))^2 + 1*Sin(1.15))^2)

Fx6 = 0.589 = 1 (skew-16) x 0.941 (skew-26) x 0.923 (skew-36) x 1 (lbl-46) x 0.931 (lbl-56) x 0.729 (lbl-76)
skew-16 = 1 = SQRT((1*Cos(1.056))^2 + 1*Sin(1.056))^2)
skew-26 = 0.94 = SQRT((0.94*Cos(0.261))^2 + 0.941*Sin(0.261))^2)
skew-36 = 1 = SQRT((1*Cos(0.889))^2 + 1*Sin(0.889))^2)

Fx7 = 0.865 = 1 (skew-17) x 1 (skew-27) x 0.929 (skew-37) x 1 (lbl-47) x 1 (lbl-57) x 0.931 (lbl-67)
skew-17 = 1 = SQRT((1*Cos(1.224))^2 + 1*Sin(1.224))^2)
skew-27 = 1 = SQRT((1*Cos(0.903))^2 + 1*Sin(0.903))^2)
skew-37 = 0.938 = SQRT((0.938*Cos(0.229))^2 + 0.938*Sin(0.229))^2)

where
lbl: line-by-line effect
sbs: side-by-side effect
skew: skew effect

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.38)

              Analysis of Individual Piles and Drilled Shafts
            Subjected to Lateral Loading Using the p-y Method

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================================================================================

This program is licensed to:

Earth Mechanics, Inc.
Earth Mechanics, Inc.

Path to file locations:      D:\08-115 SR57NB\report\Chapman\Calc\Lpile\
Name of input data file:     24CIDH Abut1Free.lpd
Name of output file:         24CIDH Abut1Free.lpo
Name of plot output file:    24CIDH Abut1Free.lpp
Name of runtime file:        24CIDH Abut1Free.lpr

--------------------------------------------------------------------------------
                           Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  January 22, 2009     Time:  17:40:30

--------------------------------------------------------------------------------
                                  Problem Title
--------------------------------------------------------------------------------

New LPILE Plus 5.0 Data File

--------------------------------------------------------------------------------
                                  Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments              =          200
- Maximum number of iterations allowed   =          100
- Deflection tolerance for convergence   =   1.0000E-05 in
- Maximum allowable deflection           =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1

--------------------------------------------------------------------------------
                      Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                                 =     480.00 in

Depth of ground surface below top of pile =     -36.00 in

Slope angle of ground surface               =        .00 deg.

Structural properties of pile defined using  2 points

Point     Depth          Pile       Moment of       Pile       Modulus of
            X          Diameter      Inertia        Area       Elasticity
           in             in          in**4        Sq.in       lbs/Sq.in
-----  ---------    -----------    ----------    ----------    -----------
  1        0.0000   24.00000000     8143.0000      452.0000       3250000.
  2      480.0000   24.00000000     8143.0000      452.0000       3250000.

--------------------------------------------------------------------------------
                        Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using  3 layers

Layer  1 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer    =      -36.000 in
Distance from top of pile to bottom of layer =       54.000 in
```

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 54.000 in
Distance from top of pile to bottom of layer = 234.000 in

Layer 3 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 234.000 in
Distance from top of pile to bottom of layer = 600.000 in

(Depth of lowest layer extends 120.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 6 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-36.00	.06944
2	54.00	.06944
3	54.00	.06944
4	234.00	.06944
5	234.00	.07118
6	600.00	.07118

Shear Strength of Soils

Shear strength parameters with depth defined using 6 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-36.000	10.41667	.00	.00800	.0
2	54.000	10.41667	.00	.00800	.0
3	54.000	8.33333	.00	.01000	.0
4	234.000	8.33333	.00	.01000	.0
5	234.000	19.44444	.00	.00500	.0
6	600.000	19.44444	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	.000	.7300	1.0000
2	600.000	.7300	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 7

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .250 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = .000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .500 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = .000 lbs

Load Case Number 3

```
Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =           1.000 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =            .000 lbs

Load Case Number  4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =           2.000 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =            .000 lbs

Load Case Number  5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =           3.000 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =            .000 lbs

Load Case Number  6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =           4.000 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =            .000 lbs

Load Case Number  7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head     =           6.000 in
Bending moment at pile head =            .000 in-lbs
Axial load at pile head     =            .000 lbs


--------------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
                for Lateral Loading for Load Case Number  1
--------------------------------------------------------------------------------

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head   =         .250000 in
Specified moment at pile head       =            .000 in-lbs
Specified axial load at pile head   =            .000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  1:

Pile-head deflection             =      .25000000 in
Computed slope at pile head      =     -.00310606
Maximum bending moment           =   724731.19055 lbs-in
Maximum shear force              =    20707.57237 lbs
Depth of maximum bending moment  =    74.40000000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             15
Number of zero deflection points =              5



--------------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
                for Lateral Loading for Load Case Number  2
--------------------------------------------------------------------------------

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head   =         .500000 in
Specified moment at pile head       =            .000 in-lbs
Specified axial load at pile head   =            .000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  2:

Pile-head deflection             =      .50000000 in
Computed slope at pile head      =     -.00555327
Maximum bending moment           =       1162769. lbs-in
Maximum shear force              =    29489.60753 lbs
Depth of maximum bending moment  =    84.00000000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             17
Number of zero deflection points =              5



--------------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
                for Lateral Loading for Load Case Number  3
--------------------------------------------------------------------------------
```

```
Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head   =        1.000000 in
Specified moment at pile head       =            .000 in-lbs
Specified axial load at pile head   =            .000 lbs

(SKIP)

Output Summary for Load Case No.  3:

Pile-head deflection             =     1.00000000 in
Computed slope at pile head      =     -.00993967
Maximum bending moment           =       1874228. lbs-in
Maximum shear force              =    42081.91450 lbs
Depth of maximum bending moment  =    96.00000000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             18
Number of zero deflection points =              5
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

```
Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head   =        2.000000 in
Specified moment at pile head       =            .000 in-lbs
Specified axial load at pile head   =            .000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  4:

Pile-head deflection             =     2.00000000 in
Computed slope at pile head      =     -.01779217
Maximum bending moment           =       3026879. lbs-in
Maximum shear force              =    60128.73963 lbs
Depth of maximum bending moment  =      108.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             20
Number of zero deflection points =              4
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

```
Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head   =        3.000000 in
Specified moment at pile head       =            .000 in-lbs
Specified axial load at pile head   =            .000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  5:

Pile-head deflection             =     3.00000000 in
Computed slope at pile head      =     -.02500207
Maximum bending moment           =       4003743. lbs-in
Maximum shear force              =    74090.43565 lbs
Depth of maximum bending moment  =      115.20000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             21
Number of zero deflection points =              4
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

```
Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head   =        4.000000 in
Specified moment at pile head       =            .000 in-lbs
Specified axial load at pile head   =            .000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.
```

Output Summary for Load Case No. 6:

Pile-head deflection	=	4.00000000 in
Computed slope at pile head	=	-.03182350
Maximum bending moment	=	4879687. lbs-in
Maximum shear force	=	85887.85569 lbs
Depth of maximum bending moment	=	120.00000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	19
Number of zero deflection points	=	4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

Specified deflection at pile head	=	6.000000 in
Specified moment at pile head	=	.000 in-lbs
Specified axial load at pile head	=	.000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection	=	6.00000000 in
Computed slope at pile head	=	-.04466471
Maximum bending moment	=	6442892. lbs-in
Maximum shear force	=	102941.92630 lbs
Depth of maximum bending moment	=	127.20000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	20
Number of zero deflection points	=	3

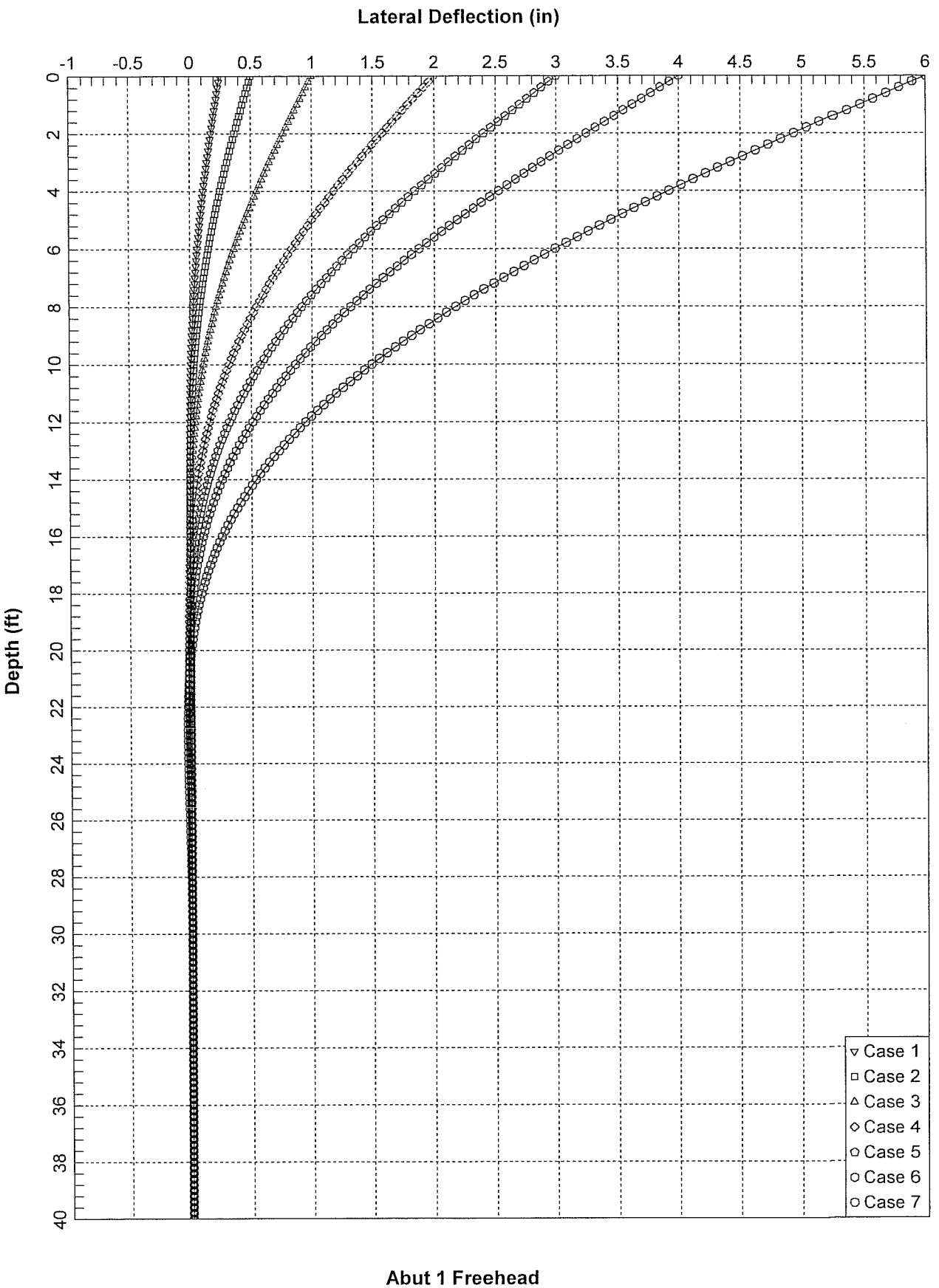
Summary of Pile Response(s)

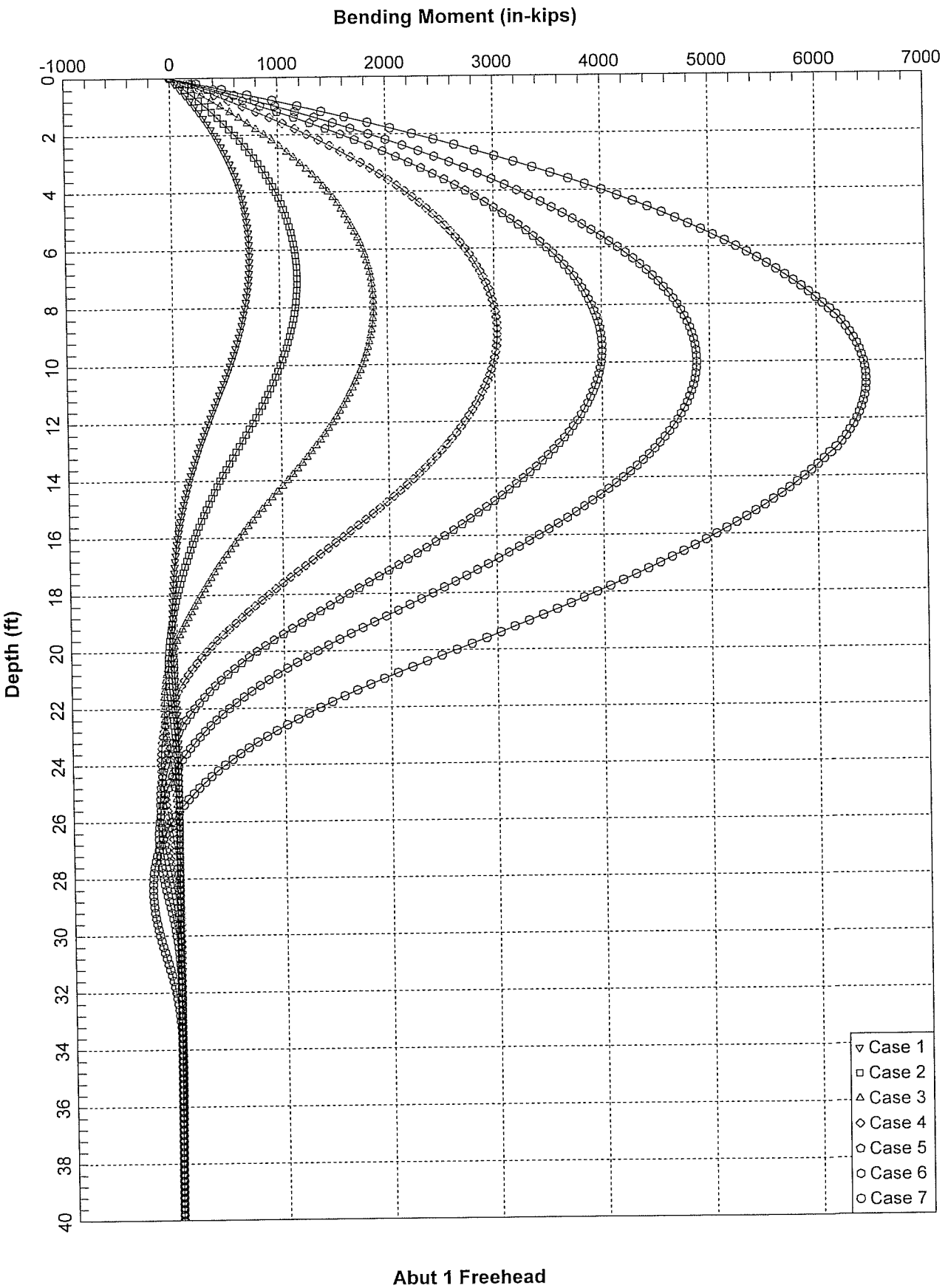
Definition of Symbols for Pile-Head Loading Conditions:

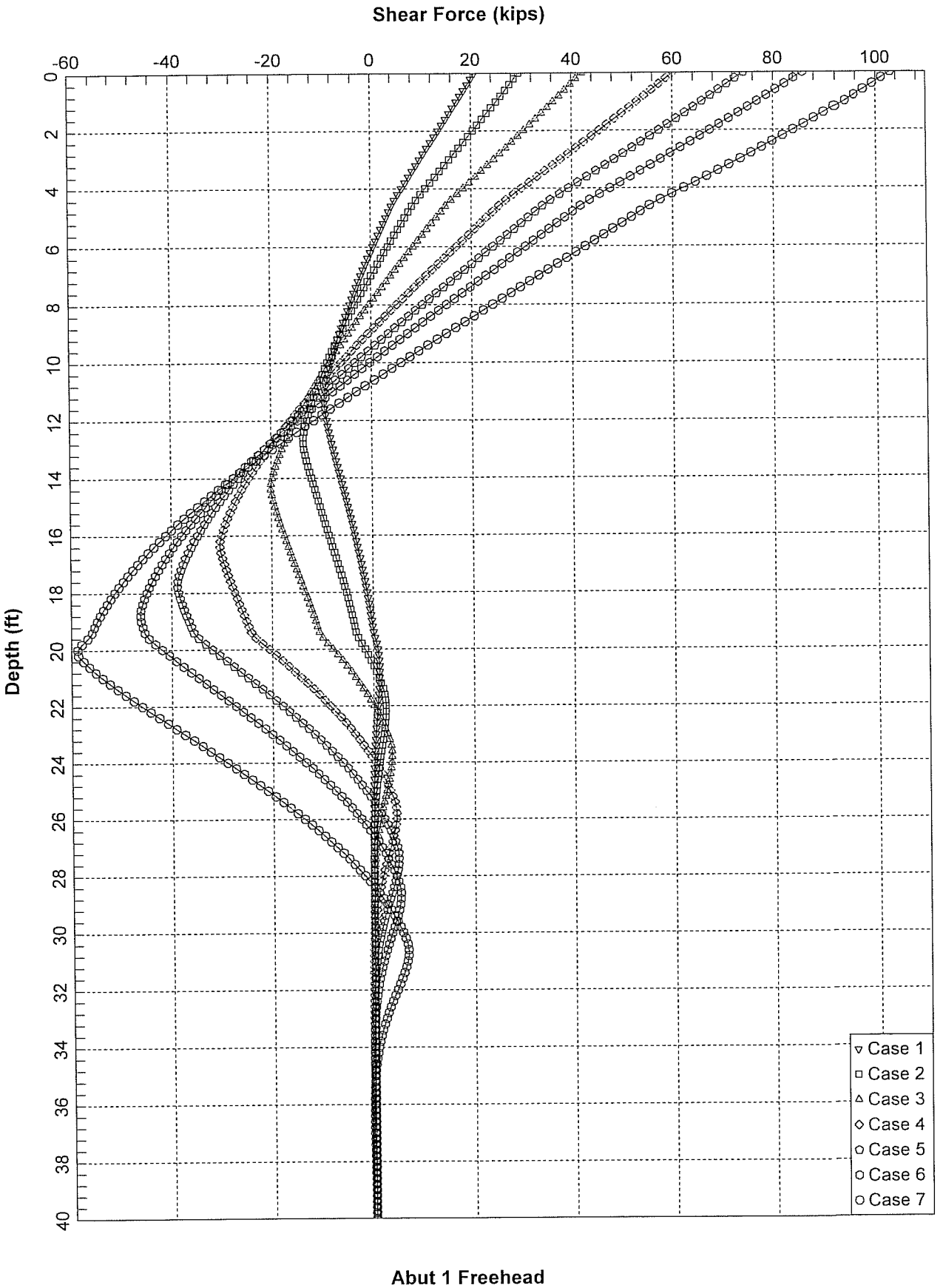
Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .250000	M= 0.000	0.0000	.2500000	724731.	20707.5724
4	y= .500000	M= 0.000	0.0000	.5000000	1162769.	29489.6075
4	y= 1.000000	M= 0.000	0.0000	1.0000000	1874228.	42081.9145
4	y= 2.000	M= 0.000	0.0000	2.0000	3026879.	60128.7396
4	y= 3.000	M= 0.000	0.0000	3.0000	4003743.	74090.4356
4	y= 4.000	M= 0.000	0.0000	4.0000	4879687.	85887.8557
4	y= 6.000	M= 0.000	0.0000	6.0000	6442892.	102942.

The analysis ended normally.


Lateral Deflection (in)
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Abut 1 Freehead


Bending Moment (in-kips)
-1000
0
1000
2000
3000
4000
5000
6000
7000
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Abut 1 Freehead


Shear Force (kips)
-60
-40
-20
0
20
40
60
80
100
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Abut 1 Freehead

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.38)

              Analysis of Individual Piles and Drilled Shafts
            Subjected to Lateral Loading Using the p-y Method

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                             All Rights Reserved

================================================================================

This program is licensed to:

Earth Mechanics, Inc.
Earth Mechanics, Inc.

Path to file locations:      D:\08-115 SR57NB\report\Chapman\Calc\Lpile\
Name of input data file:     24CIDH Abut1Fix.lpd
Name of output file:         24CIDH Abut1Fix.lpo
Name of plot output file:    24CIDH Abut1Fix.lpp
Name of runtime file:        24CIDH Abut1Fix.lpr

--------------------------------------------------------------------------------
                           Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  January 22, 2009     Time:  17:40: 7

--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

New LPILE Plus 5.0 Data File

--------------------------------------------------------------------------------
                                Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments            =          200
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1

--------------------------------------------------------------------------------
                    Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                                 =     480.00 in

Depth of ground surface below top of pile =     -36.00 in

Slope angle of ground surface               =        .00 deg.

Structural properties of pile defined using  2 points

Point     Depth         Pile       Moment of       Pile       Modulus of
            X         Diameter      Inertia        Area       Elasticity
           in            in          in**4        Sq.in       lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   24.00000000    8143.0000     452.0000      3250000.
  2     480.0000   24.00000000    8143.0000     452.0000      3250000.

--------------------------------------------------------------------------------
                      Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using  3 layers

Layer  1 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer    =      -36.000 in
Distance from top of pile to bottom of layer =       54.000 in
```

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 54.000 in
Distance from top of pile to bottom of layer = 234.000 in

Layer 3 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 234.000 in
Distance from top of pile to bottom of layer = 600.000 in

(Depth of lowest layer extends 120.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 6 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-36.00	.06944
2	54.00	.06944
3	54.00	.06944
4	234.00	.06944
5	234.00	.07118
6	600.00	.07118

Shear Strength of Soils

Shear strength parameters with depth defined using 6 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-36.000	10.41667	.00	.00800	.0
2	54.000	10.41667	.00	.00800	.0
3	54.000	8.33333	.00	.01000	.0
4	234.000	8.33333	.00	.01000	.0
5	234.000	19.44444	.00	.00500	.0
6	600.000	19.44444	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	.000	.7300	1.0000
2	600.000	.7300	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 7

Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .250 in
Slope at pile head = .000 in/in
Axial load at pile head = .000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .500 in
Slope at pile head = .000 in/in
Axial load at pile head = .000 lbs

Load Case Number 3

```
Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           1.000 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =            .000 lbs

Load Case Number  4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           2.000 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =            .000 lbs

Load Case Number  5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           3.000 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =            .000 lbs

Load Case Number  6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           4.000 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =            .000 lbs

Load Case Number  7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =           6.000 in
Slope at pile head          =            .000 in/in
Axial load at pile head     =            .000 lbs


------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
                for Lateral Loading for Load Case Number  1
------------------------------------------------------------------------

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =         .250000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =            .000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  1:

Pile-head deflection              =      .25000000 in
Computed slope at pile head       =     -.00000423
Maximum bending moment            =     -1909923. lbs-in
Maximum shear force               =    39222.69910 lbs
Depth of maximum bending moment   =        0.00000 in
Depth of maximum shear force      =        0.00000 in
Number of iterations              =             14
Number of zero deflection points  =              5


------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
                for Lateral Loading for Load Case Number  2
------------------------------------------------------------------------

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =         .500000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =            .000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  2:

Pile-head deflection              =      .50000000 in
Computed slope at pile head       =     -.00000606
Maximum bending moment            =     -3064680. lbs-in
Maximum shear force               =    56109.07242 lbs
Depth of maximum bending moment   =        0.00000 in
Depth of maximum shear force      =        0.00000 in
Number of iterations              =             15
Number of zero deflection points  =              5


------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
                for Lateral Loading for Load Case Number  3
------------------------------------------------------------------------
```

```
Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =        1.000000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =            .000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  3:

Pile-head deflection             =     1.00000000 in
Computed slope at pile head      =     -.00000868
Maximum bending moment           =      -4922954. lbs-in
Maximum shear force              =    80360.93604 lbs
Depth of maximum bending moment  =        0.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             16
Number of zero deflection points =              4



--------------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
                for Lateral Loading for Load Case Number  4
--------------------------------------------------------------------------------

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =        2.000000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =            .000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  4:

Pile-head deflection             =     2.00000000 in
Computed slope at pile head      =     -.00001251
Maximum bending moment           =      -7960550. lbs-in
Maximum shear force              =   115664.56037 lbs
Depth of maximum bending moment  =        0.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             20
Number of zero deflection points =              3



--------------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
                for Lateral Loading for Load Case Number  5
--------------------------------------------------------------------------------

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =        3.000000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =            .000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  5:

Pile-head deflection             =     3.00000000 in
Computed slope at pile head      =     -.00001554
Maximum bending moment           =     -10585264. lbs-in
Maximum shear force              =   143596.66228 lbs
Depth of maximum bending moment  =        0.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             20
Number of zero deflection points =              3



--------------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
                for Lateral Loading for Load Case Number  6
--------------------------------------------------------------------------------

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =        4.000000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =            .000 lbs

(SKIP)
```

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	4.00000000 in
Computed slope at pile head	=	-.00001813
Maximum bending moment	=	-12977711. lbs-in
Maximum shear force	=	167506.48276 lbs
Depth of maximum bending moment	=	0.00000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	22
Number of zero deflection points	=	3

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head = 6.000000 in
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = .000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

Pile-head deflection	=	6.00000000 in
Computed slope at pile head	=	-.00002196
Maximum bending moment	=	-17201915. lbs-in
Maximum shear force	=	202665.89494 lbs
Depth of maximum bending moment	=	0.00000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	22
Number of zero deflection points	=	3

Summary of Pile Response(s)

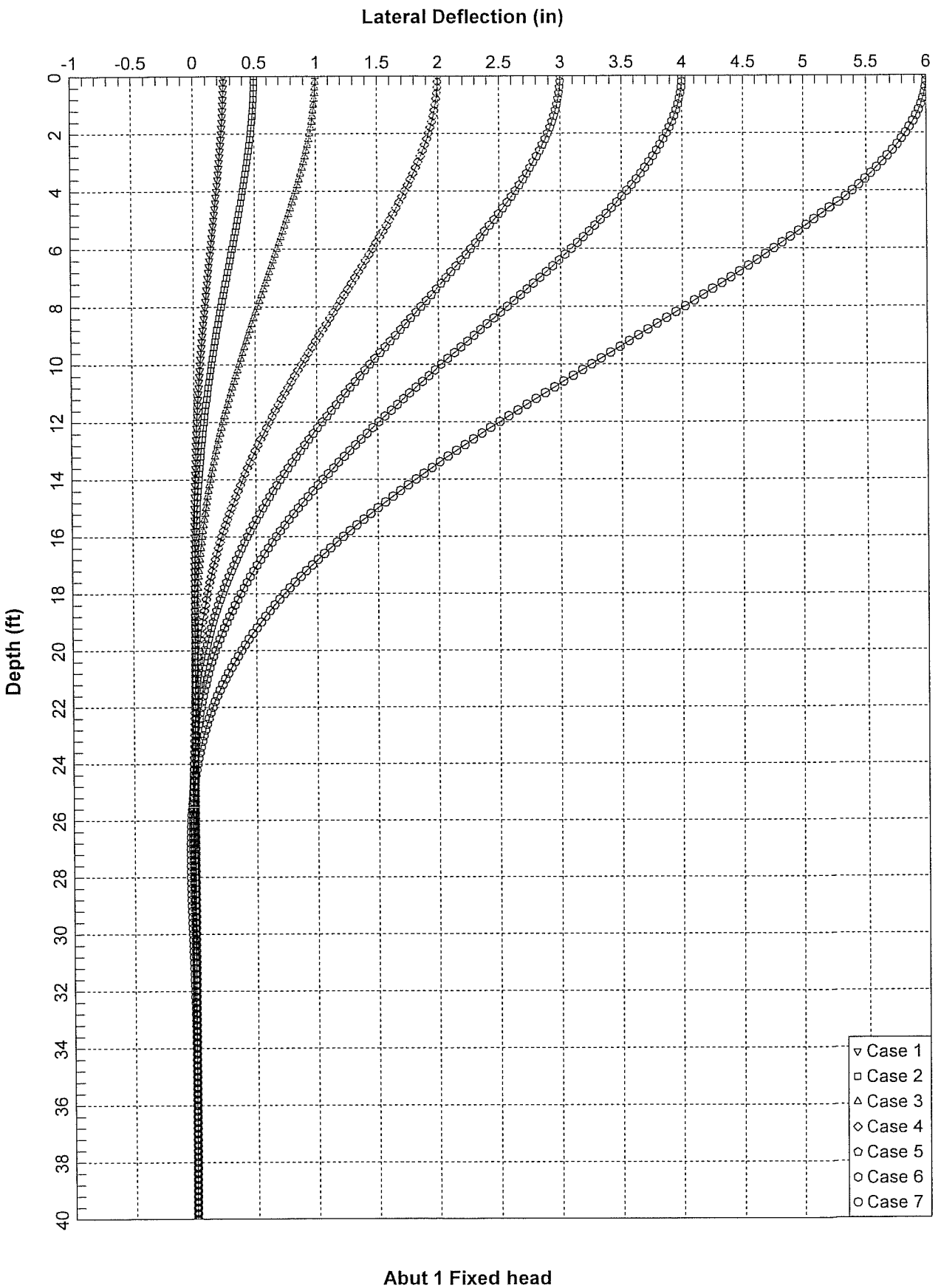
Definition of Symbols for Pile-Head Loading Conditions:

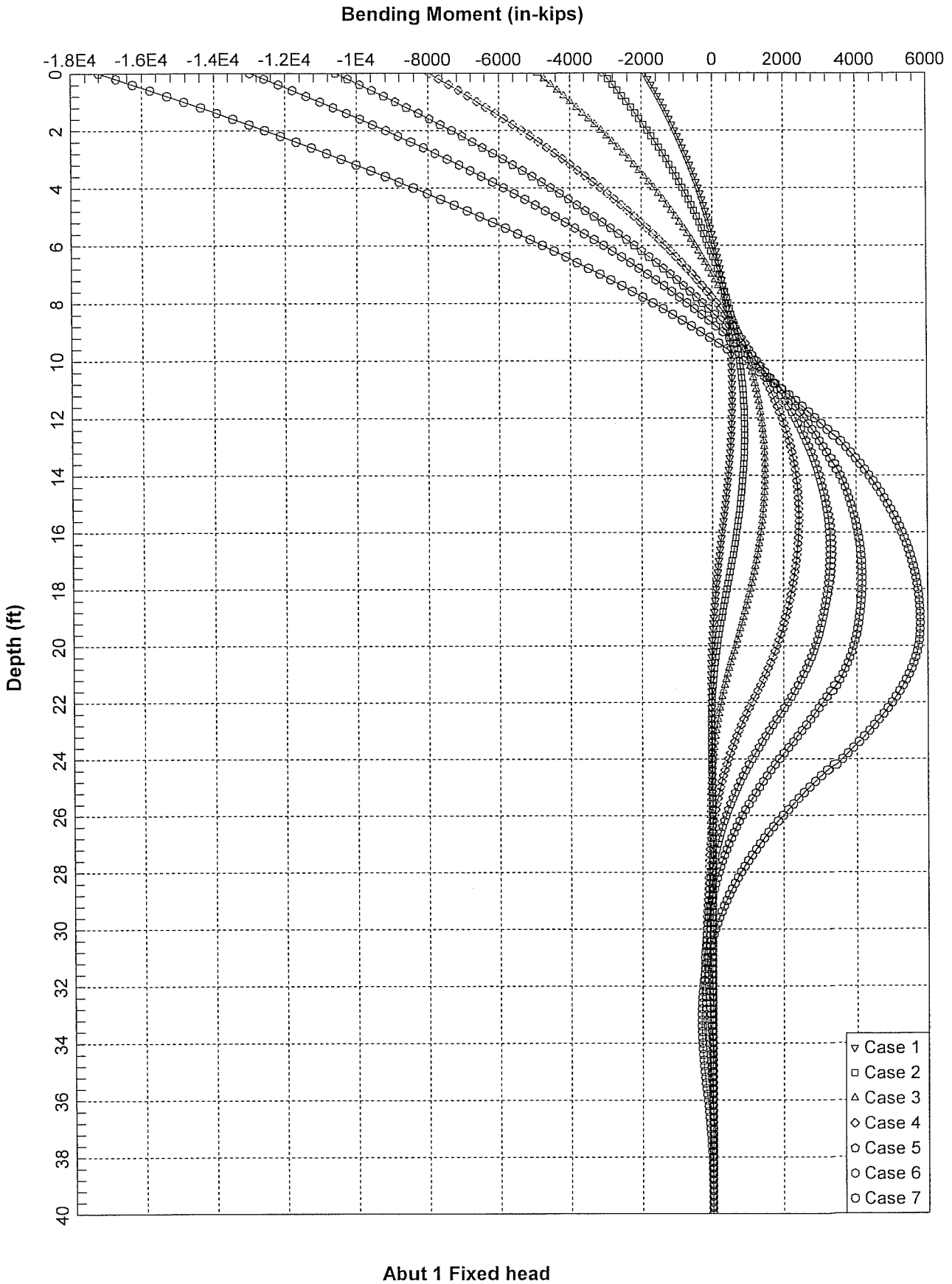
Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

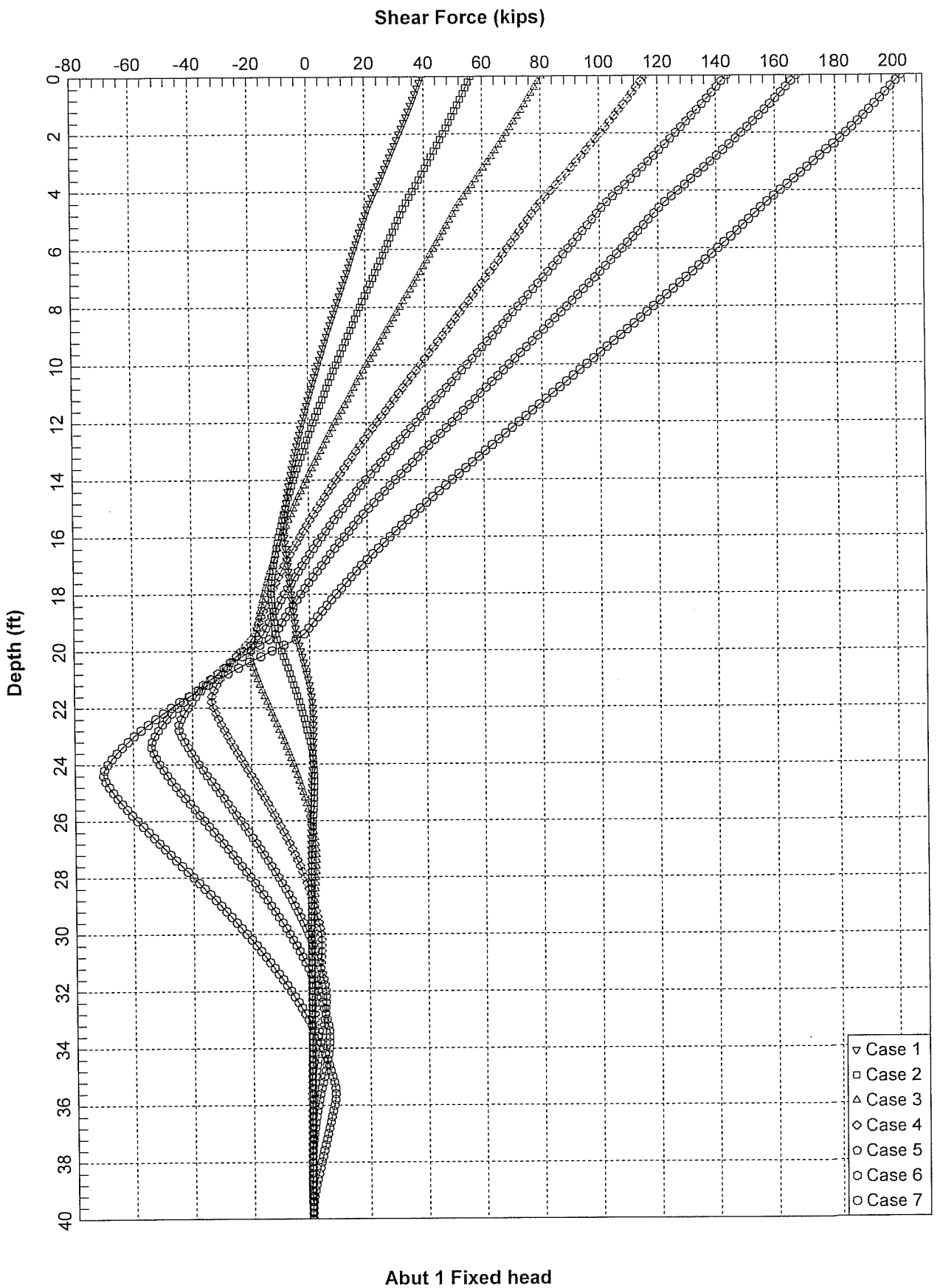
Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
5	y= .250000	S= 0.000	0.0000	.2500000	-1909923.	39222.6991
5	y= .500000	S= 0.000	0.0000	.5000000	-3064680.	56109.0724
5	y= 1.000000	S= 0.000	0.0000	1.0000000	-4922954.	80360.9360
5	y= 2.000	S= 0.000	0.0000	2.0000	-7960550.	115665.
5	y= 3.000	S= 0.000	0.0000	3.0000	-1.0585E+07	143597.
5	y= 4.000	S= 0.000	0.0000	4.0000	-1.2978E+07	167506.
5	y= 6.000	S= 0.000	0.0000	6.0000	-1.7202E+07	202666.

The analysis ended normally.

Summary of Warning Messages


Lateral Deflection (in)
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Abut 1 Fixed head


Bending Moment (in-kips)
-1.8E4
-1.6E4
-1.4E4
-1.2E4
-1E4
-8000
-6000
-4000
-2000
0
2000
4000
6000
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Abut 1 Fixed head


Shear Force (kips)
-80
-60
-40
-20
0
20
40
60
80
100
120
140
160
180
200
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Abut 1 Fixed head

```
Computed slope at pile head      =     -.00002018
Maximum bending moment           =    -14140966. lbs-in
Maximum shear force              =   186353.13744 lbs
Depth of maximum bending moment  =        0.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             22
Number of zero deflection points =              3
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

```
Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =        6.000000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =            .000 lbs
```

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

```
Pile-head deflection             =     6.00000000 in
Computed slope at pile head      =     -.00002419
Maximum bending moment           =    -18491960. lbs-in
Maximum shear force              =   223172.59893 lbs
Depth of maximum bending moment  =        0.00000 in
Depth of maximum shear force     =        0.00000 in
Number of iterations             =             21
Number of zero deflection points =              2
```

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
5	y= .250000	S= 0.000	0.0000	.2500000	-2070325.	42590.2198
5	y= .500000	S= 0.000	0.0000	.5000000	-3344419.	61510.4212
5	y= 1.000000	S= 0.000	0.0000	1.0000000	-5407673.	88959.2866
5	y= 2.000	S= 0.000	0.0000	2.0000	-8745842.	128778.
5	y= 3.000	S= 0.000	0.0000	3.0000	-1.1585E+07	159930.
5	y= 4.000	S= 0.000	0.0000	4.0000	-1.4141E+07	186353.
5	y= 6.000	S= 0.000	0.0000	6.0000	-1.8492E+07	223173.

The analysis ended normally.

Summary of Warning Messages

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.38)

              Analysis of Individual Piles and Drilled Shafts
            Subjected to Lateral Loading Using the p-y Method

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                            All Rights Reserved

================================================================================

This program is licensed to:

Earth Mechanics, Inc.
Earth Mechanics, Inc.

Path to file locations:       D:\08-115 SR57NB\report\Chapman\Calc\Lpile\
Name of input data file:      24CIDH Abut2Free.lpd
Name of output file:          24CIDH Abut2Free.lpo
Name of plot output file:     24CIDH Abut2Free.lpp
Name of runtime file:         24CIDH Abut2Free.lpr

--------------------------------------------------------------------------------
                           Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  January 22, 2009      Time:  17:38:45

--------------------------------------------------------------------------------
                                  Problem Title
--------------------------------------------------------------------------------

New LPILE Plus 5.0 Data File

--------------------------------------------------------------------------------
                                  Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments             =          200
- Maximum number of iterations allowed  =          100
- Deflection tolerance for convergence  =   1.0000E-05 in
- Maximum allowable deflection          =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1

--------------------------------------------------------------------------------
                      Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                                 =     480.00 in

Depth of ground surface below top of pile =     -36.00 in

Slope angle of ground surface               =        .00 deg.

Structural properties of pile defined using  2 points

Point     Depth          Pile       Moment of       Pile       Modulus of
            X          Diameter      Inertia        Area       Elasticity
           in             in          in**4        Sq.in       lbs/Sq.in
-----  ----------   -----------   ----------   ----------   -----------
  1       0.0000    24.00000000     8143.0000     452.0000      3250000.
  2     480.0000    24.00000000     8143.0000     452.0000      3250000.

--------------------------------------------------------------------------------
                        Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using  2 layers

Layer  1 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer    =      -36.000 in
Distance from top of pile to bottom of layer =      402.000 in
```

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 402.000 in
Distance from top of pile to bottom of layer = 600.000 in

(Depth of lowest layer extends 120.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 4 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-36.00	.06944
2	402.00	.06944
3	402.00	.07234
4	600.00	.07234

Shear Strength of Soils

Shear strength parameters with depth defined using 4 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-36.000	10.41667	.00	.00800	.0
2	402.000	10.41667	.00	.00800	.0
3	402.000	24.30556	.00	.00500	.0
4	600.000	24.30556	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	.000	.7300	1.0000
2	600.000	.7300	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 7

Load Case Number 1

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .250 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = .000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = .500 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = .000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head = 1.000 in
Bending moment at pile head = .000 in-lbs
Axial load at pile head = .000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

```
Deflection at pile head      =           2.000 in
Bending moment at pile head  =            .000 in-lbs
Axial load at pile head      =            .000 lbs

Load Case Number  5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head      =           3.000 in
Bending moment at pile head  =            .000 in-lbs
Axial load at pile head      =            .000 lbs

Load Case Number  6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head      =           4.000 in
Bending moment at pile head  =            .000 in-lbs
Axial load at pile head      =            .000 lbs

Load Case Number  7

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Deflection at pile head      =           6.000 in
Bending moment at pile head  =            .000 in-lbs
Axial load at pile head      =            .000 lbs


-------------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
                for Lateral Loading for Load Case Number  1
-------------------------------------------------------------------------------

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head   =         .250000 in
Specified moment at pile head       =            .000 in-lbs
Specified axial load at pile head   =            .000 lbs

 (SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  1:

Pile-head deflection              =      .25000000 in
Computed slope at pile head       =     -.00320564
Maximum bending moment            =   788598.88453 lbs-in
Maximum shear force               =    21693.97515 lbs
Depth of maximum bending moment   =    74.40000000 in
Depth of maximum shear force      =        0.00000 in
Number of iterations              =             14
Number of zero deflection points  =              5


-------------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
                for Lateral Loading for Load Case Number  2
-------------------------------------------------------------------------------

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head   =         .500000 in
Specified moment at pile head       =            .000 in-lbs
Specified axial load at pile head   =            .000 lbs

 (SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  2:

Pile-head deflection              =      .50000000 in
Computed slope at pile head       =     -.00575350
Maximum bending moment            =      1272450. lbs-in
Maximum shear force               =    31167.98962 lbs
Depth of maximum bending moment   =    81.60000000 in
Depth of maximum shear force      =        0.00000 in
Number of iterations              =             16
Number of zero deflection points  =              5


-------------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
                for Lateral Loading for Load Case Number  3
-------------------------------------------------------------------------------

Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head   =        1.000000 in
Specified moment at pile head       =            .000 in-lbs
Specified axial load at pile head   =            .000 lbs

 (SKIP)
```

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	-.01033515
Maximum bending moment	=	2055750. lbs-in
Maximum shear force	=	44838.77001 lbs
Depth of maximum bending moment	=	91.20000000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	18
Number of zero deflection points	=	4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

Specified deflection at pile head	=	2.000000 in
Specified moment at pile head	=	.000 in-lbs
Specified axial load at pile head	=	.000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection	=	2.00000000 in
Computed slope at pile head	=	-.01857506
Maximum bending moment	=	3324241. lbs-in
Maximum shear force	=	64587.11168 lbs
Depth of maximum bending moment	=	103.20000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	21
Number of zero deflection points	=	4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

Specified deflection at pile head	=	3.000000 in
Specified moment at pile head	=	.000 in-lbs
Specified axial load at pile head	=	.000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	3.00000000 in
Computed slope at pile head	=	-.02618718
Maximum bending moment	=	4406496. lbs-in
Maximum shear force	=	80018.12286 lbs
Depth of maximum bending moment	=	110.40000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	21
Number of zero deflection points	=	4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Moment (BC Type 4)

Specified deflection at pile head	=	4.000000 in
Specified moment at pile head	=	.000 in-lbs
Specified axial load at pile head	=	.000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 6:

Pile-head deflection	=	4.00000000 in

```
Computed slope at pile head       =      -.03340825
Maximum bending moment            =       5381933. lbs-in
Maximum shear force               =     93146.37746 lbs
Depth of maximum bending moment   =       115.20000 in
Depth of maximum shear force      =         0.00000 in
Number of iterations              =              20
Number of zero deflection points  =               3
```

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 7

```
Pile-head boundary conditions are Displacement and Moment (BC Type 4)
Specified deflection at pile head   =        6.000000 in
Specified moment at pile head       =            .000 in-lbs
Specified axial load at pile head   =            .000 lbs
```

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 7:

```
Pile-head deflection              =      6.00000000 in
Computed slope at pile head       =      -.04700285
Maximum bending moment            =       7124477. lbs-in
Maximum shear force               =    112683.62589 lbs
Depth of maximum bending moment   =       122.40000 in
Depth of maximum shear force      =         0.00000 in
Number of iterations              =              18
Number of zero deflection points  =               3
```

Summary of Pile Response(s)

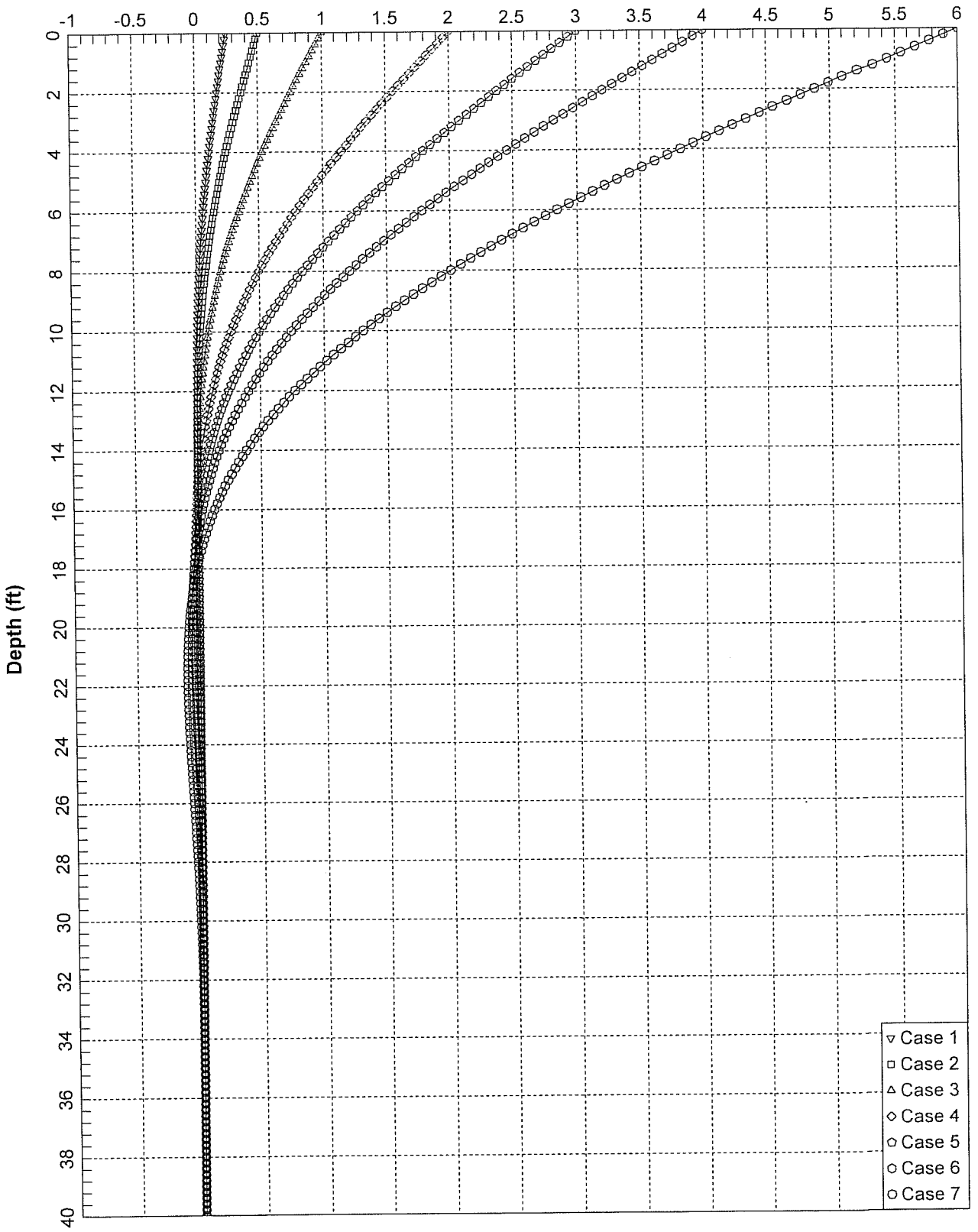
Definition of Symbols for Pile-Head Loading Conditions:

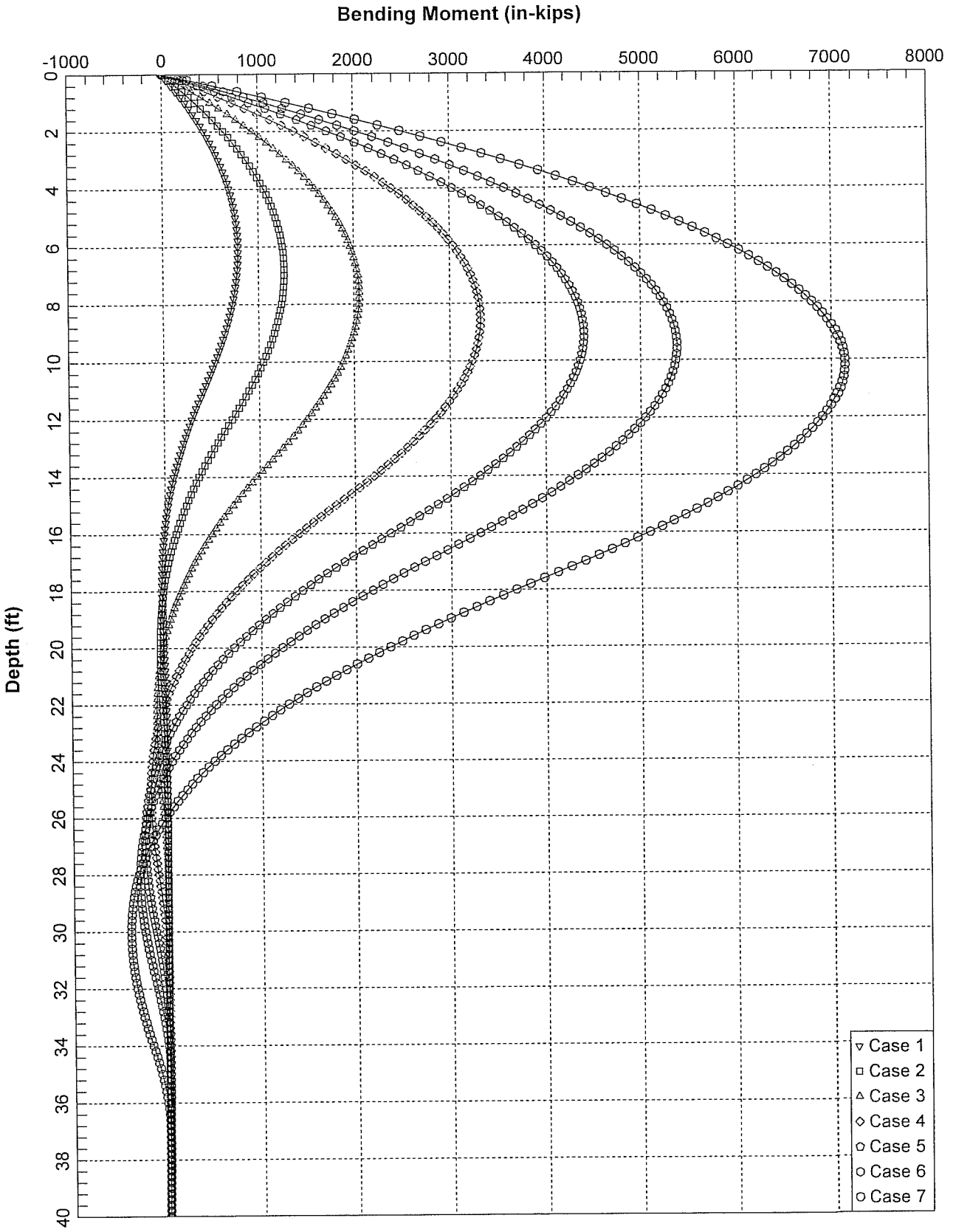
```
Type 1 = Shear and Moment,          y = pile-head displacment in
Type 2 = Shear and Slope,           M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,  V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,     S = Pile-head Slope, radians
Type 5 = Deflection and Slope,      R = Rot. Stiffness of Pile-head in-lbs/rad
```

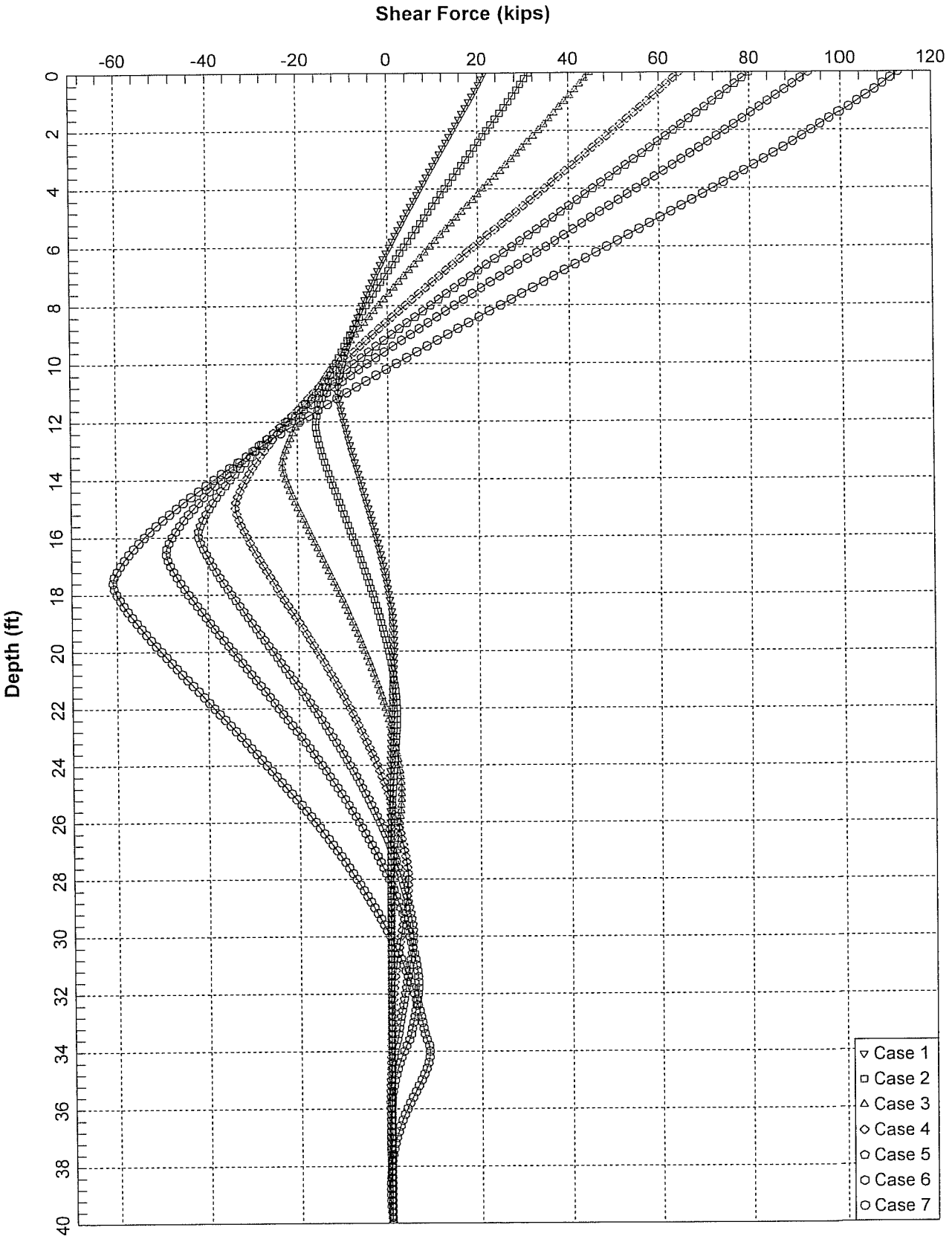
Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .250000	M= 0.000	0.0000	.2500000	788599.	21693.9752
4	y= .500000	M= 0.000	0.0000	.5000000	1272450.	31167.9896
4	y= 1.000000	M= 0.000	0.0000	1.0000000	2055750.	44838.7700
4	y= 2.000	M= 0.000	0.0000	2.0000	3324241.	64587.1117
4	y= 3.000	M= 0.000	0.0000	3.0000	4406496.	80018.1229
4	y= 4.000	M= 0.000	0.0000	4.0000	5381933.	93146.3775
4	y= 6.000	M= 0.000	0.0000	6.0000	7124477.	112684.

The analysis ended normally.

Summary of Warning Messages


Lateral Deflection (in)
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Abut 2 Freehead


Bending Moment (in-kips)
-1000
0
1000
2000
3000
4000
5000
6000
7000
8000
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Abut 2 Freehead


Shear Force (kips)
-60
-40
-20
0
20
40
60
80
100
120
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Abut 2 Freehead

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.38)

              Analysis of Individual Piles and Drilled Shafts
            Subjected to Lateral Loading Using the p-y Method

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                            All Rights Reserved

================================================================================

This program is licensed to:

Earth Mechanics, Inc.
Earth Mechanics, Inc.

Path to file locations:       D:\08-115 SR57NB\report\Chapman\Calc\Lpile\
Name of input data file:      24CIDH Abut2Fix.lpd
Name of output file:          24CIDH Abut2Fix.lpo
Name of plot output file:     24CIDH Abut2Fix.lpp
Name of runtime file:         24CIDH Abut2Fix.lpr

--------------------------------------------------------------------------------
                           Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  January 22, 2009     Time:  17:39:50

--------------------------------------------------------------------------------
                                  Problem Title
--------------------------------------------------------------------------------

New LPILE Plus 5.0 Data File

--------------------------------------------------------------------------------
                                  Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments            =          200
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1

--------------------------------------------------------------------------------
                      Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                                 =     480.00 in

Depth of ground surface below top of pile =     -36.00 in

Slope angle of ground surface               =        .00 deg.

Structural properties of pile defined using  2 points

Point     Depth          Pile       Moment of       Pile      Modulus of
            X          Diameter      Inertia        Area      Elasticity
           in             in          in**4        Sq.in      lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   24.00000000    8143.0000     452.0000      3250000.
  2     480.0000   24.00000000    8143.0000     452.0000      3250000.

--------------------------------------------------------------------------------
                      Soil and Rock Layering Information
--------------------------------------------------------------------------------

The soil profile is modelled using  2 layers

Layer  1 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer    =      -36.000 in
Distance from top of pile to bottom of layer =      402.000 in
```

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 402.000 in
Distance from top of pile to bottom of layer = 600.000 in

(Depth of lowest layer extends 120.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 4 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	-36.00	.06944
2	402.00	.06944
3	402.00	.07234
4	600.00	.07234

Shear Strength of Soils

Shear strength parameters with depth defined using 4 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	-36.000	10.41667	.00	.00800	.0
2	402.000	10.41667	.00	.00800	.0
3	402.000	24.30556	.00	.00500	.0
4	600.000	24.30556	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	.000	.7300	1.0000
2	600.000	.7300	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 7

Load Case Number 1

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .250 in
Slope at pile head = .000 in/in
Axial load at pile head = .000 lbs

Load Case Number 2

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = .500 in
Slope at pile head = .000 in/in
Axial load at pile head = .000 lbs

Load Case Number 3

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head = 1.000 in
Slope at pile head = .000 in/in
Axial load at pile head = .000 lbs

Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)

```
Deflection at pile head     =          2.000 in
Slope at pile head          =           .000 in/in
Axial load at pile head     =           .000 lbs

Load Case Number  5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =          3.000 in
Slope at pile head          =           .000 in/in
Axial load at pile head     =           .000 lbs

Load Case Number  6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =          4.000 in
Slope at pile head          =           .000 in/in
Axial load at pile head     =           .000 lbs

Load Case Number  7

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Deflection at pile head     =          6.000 in
Slope at pile head          =           .000 in/in
Axial load at pile head     =           .000 lbs


--------------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
               for Lateral Loading for Load Case Number  1
--------------------------------------------------------------------------------

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =         .250000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =            .000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  1:

Pile-head deflection              =      .25000000 in
Computed slope at pile head       =     -.00000460
Maximum bending moment            =      -2070325. lbs-in
Maximum shear force               =    42590.21982 lbs
Depth of maximum bending moment   =        0.00000 in
Depth of maximum shear force      =        0.00000 in
Number of iterations              =             14
Number of zero deflection points  =              5


--------------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
               for Lateral Loading for Load Case Number  2
--------------------------------------------------------------------------------

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =         .500000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =            .000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.


Output Summary for Load Case No.  2:

Pile-head deflection              =      .50000000 in
Computed slope at pile head       =     -.00000664
Maximum bending moment            =      -3344419. lbs-in
Maximum shear force               =    61510.42118 lbs
Depth of maximum bending moment   =        0.00000 in
Depth of maximum shear force      =        0.00000 in
Number of iterations              =             19
Number of zero deflection points  =              4


--------------------------------------------------------------------------------
            Computed Values of Load Distribution and Deflection
               for Lateral Loading for Load Case Number  3
--------------------------------------------------------------------------------

Pile-head boundary conditions are Displacement and Slope (BC Type 5)
Specified deflection at pile head   =        1.000000 in
Specified slope at pile head        =       0.000E+00 in/in
Specified axial load at pile head   =            .000 lbs

(SKIP)
```

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 3:

Pile-head deflection	=	1.00000000 in
Computed slope at pile head	=	-.00000962
Maximum bending moment	=	-5407673. lbs-in
Maximum shear force	=	88959.28660 lbs
Depth of maximum bending moment	=	0.00000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	19
Number of zero deflection points	=	4

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 4

Pile-head boundary conditions are Displacement and Slope (BC Type 5)

Specified deflection at pile head	=	2.000000 in
Specified slope at pile head	=	0.000E+00 in/in
Specified axial load at pile head	=	.000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 4:

Pile-head deflection	=	2.00000000 in
Computed slope at pile head	=	-.00001394
Maximum bending moment	=	-8745842. lbs-in
Maximum shear force	=	128778.17239 lbs
Depth of maximum bending moment	=	0.00000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	20
Number of zero deflection points	=	3

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 5

Pile-head boundary conditions are Displacement and Slope (BC Type 5)

Specified deflection at pile head	=	3.000000 in
Specified slope at pile head	=	0.000E+00 in/in
Specified axial load at pile head	=	.000 lbs

(SKIP)

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 5:

Pile-head deflection	=	3.00000000 in
Computed slope at pile head	=	-.00001732
Maximum bending moment	=	-11584780. lbs-in
Maximum shear force	=	159929.86884 lbs
Depth of maximum bending moment	=	0.00000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	21
Number of zero deflection points	=	3

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 6

Pile-head boundary conditions are Displacement and Slope (BC Type 5)

Specified deflection at pile head	=	4.000000 in
Specified slope at pile head	=	0.000E+00 in/in
Specified axial load at pile head	=	.000 lbs

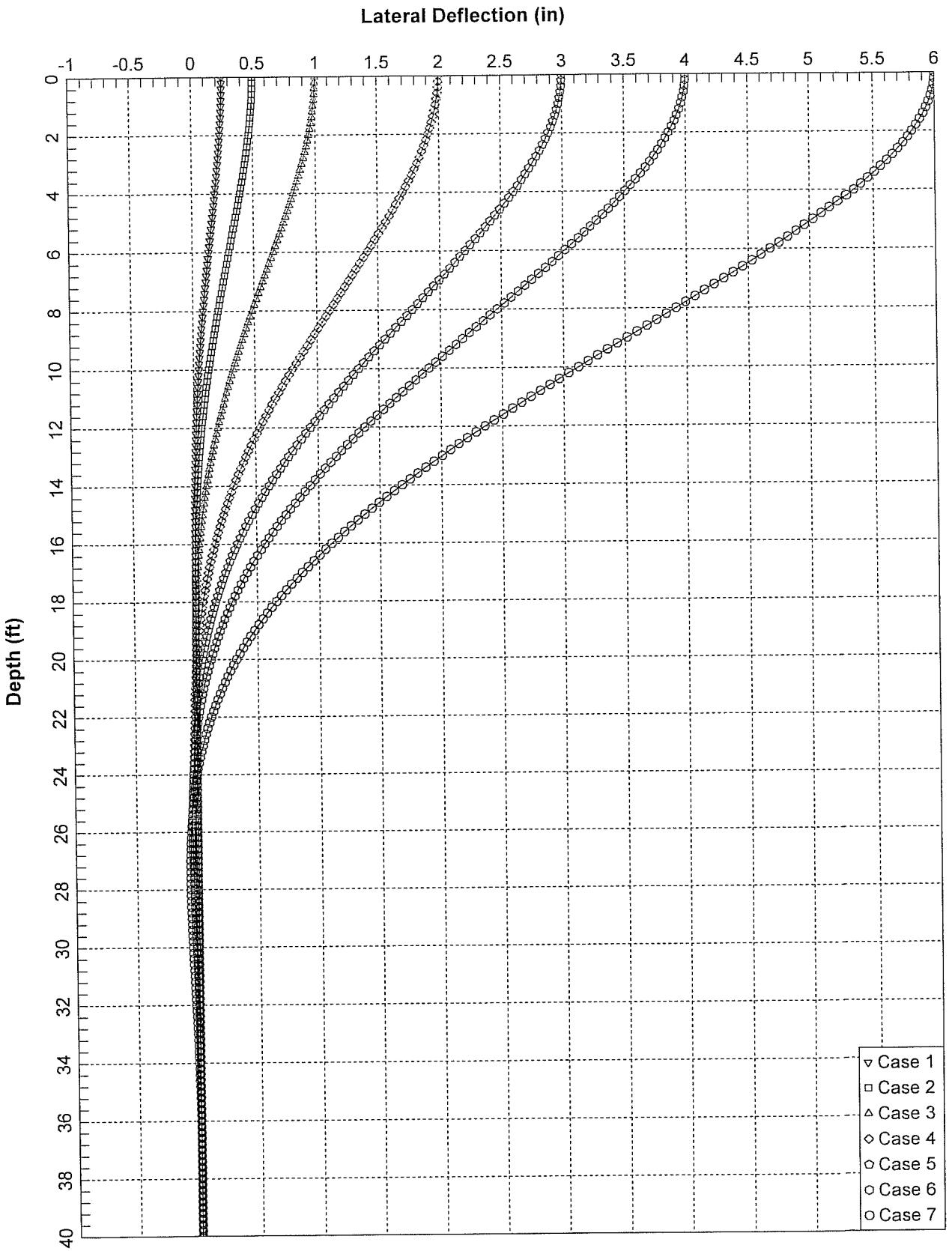
(SKIP)

Output Verification:

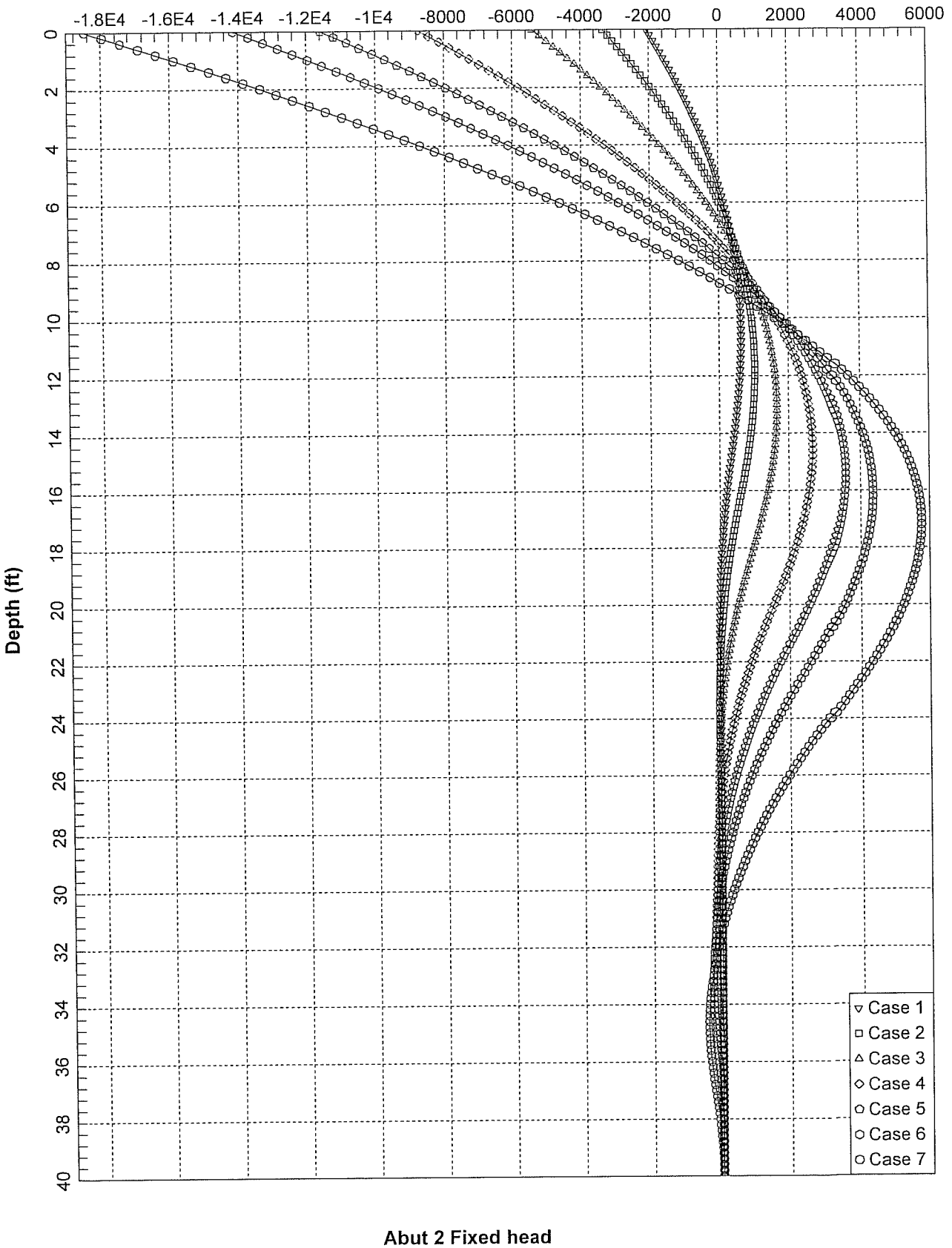
Computed forces and moments are within specified convergence limits.

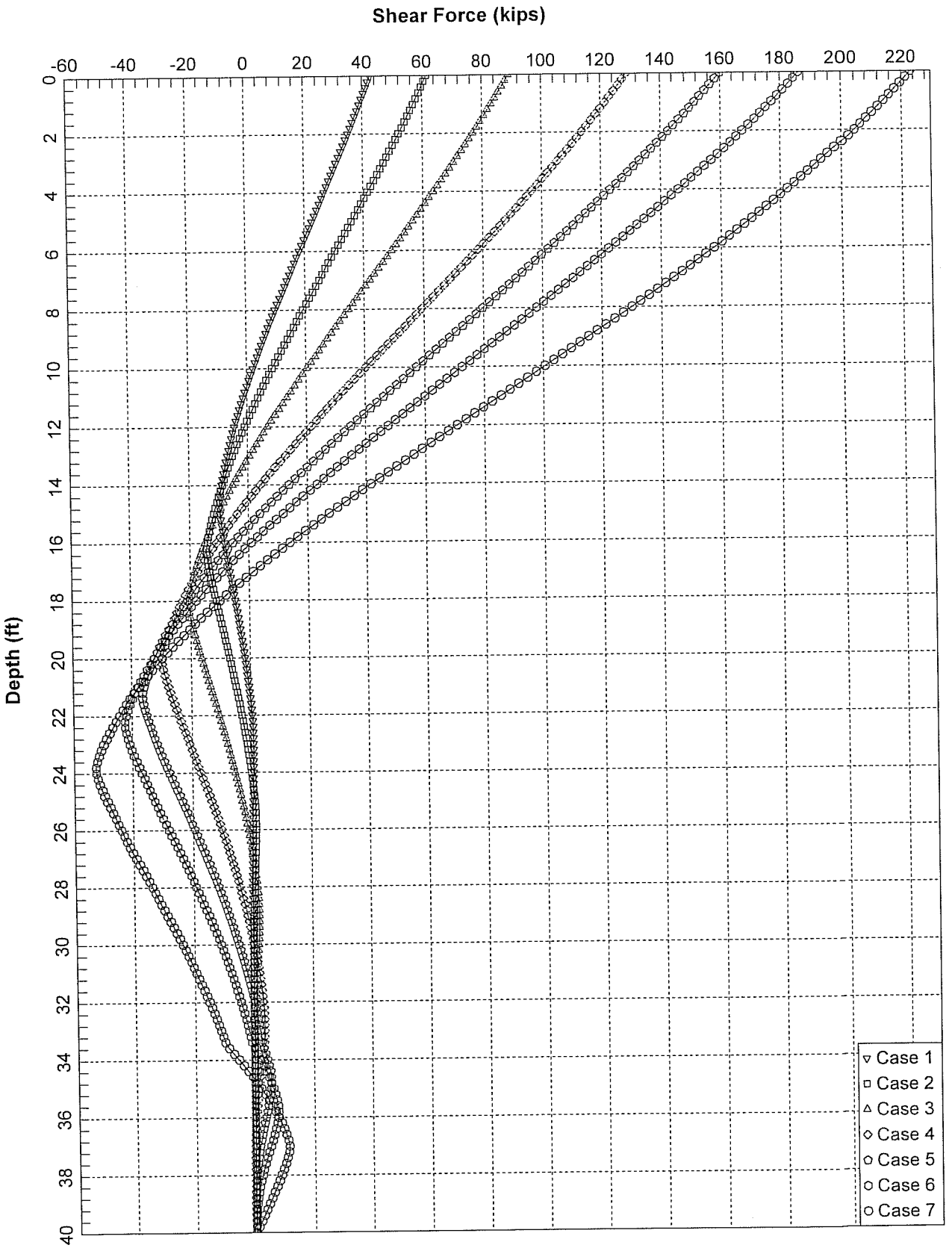
Output Summary for Load Case No. 6:

Pile-head deflection	=	4.00000000 in



Abut 2 Fixed head

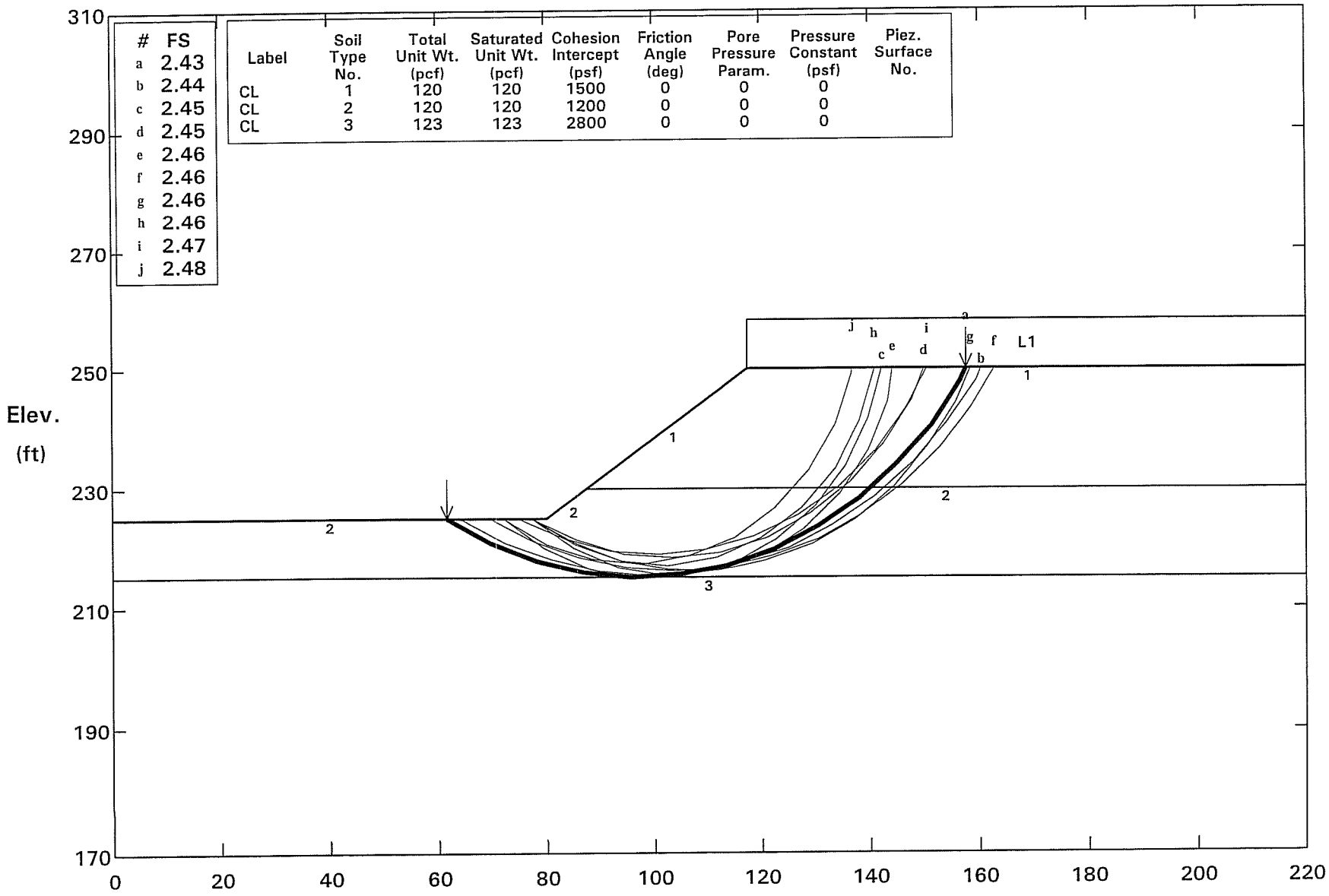

Bending Moment (in-kips)
-1.8E4
-1.6E4
-1.4E4
-1.2E4
-1E4
-8000
-6000
-4000
-2000
0
2000
4000
6000
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Case 1
Case 2
Case 3
Case 4
Case 5
Case 6
Case 7
Abut 2 Fixed head



Abut 2 Fixed head

Chapman Ave UC (Widen) Abut 1 Static Condition

Ten Most Critical. D:CHAPA1S.PLT 01-13-09 2:49pm

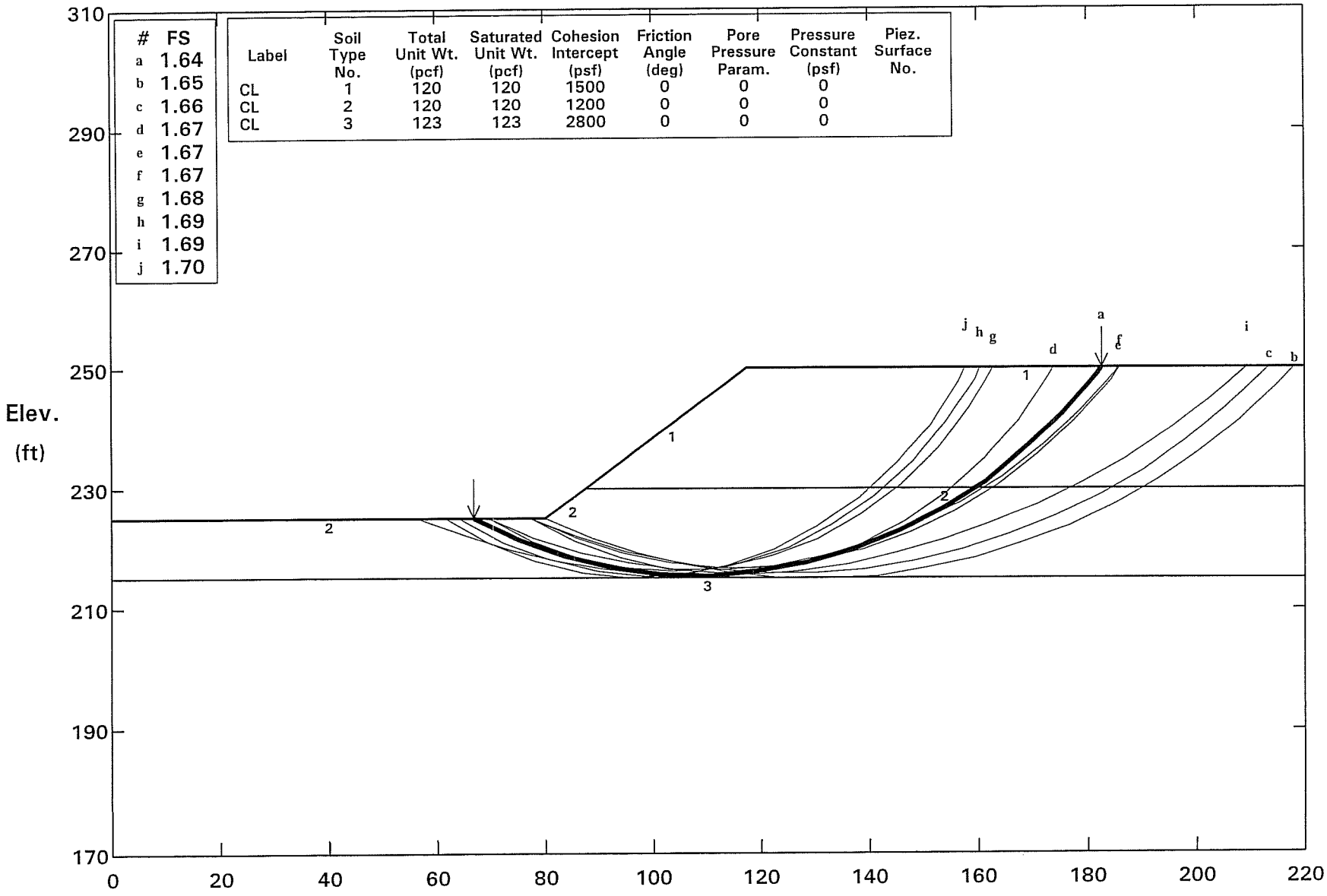


STABL6H FSmin = 2.43 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Chapman Ave UC (Widen) Abut 1 Pseudostatic Condition (kh = 0.2)

Ten Most Critical. D:CHAPA1D.PLT 01-13-09 2:50pm

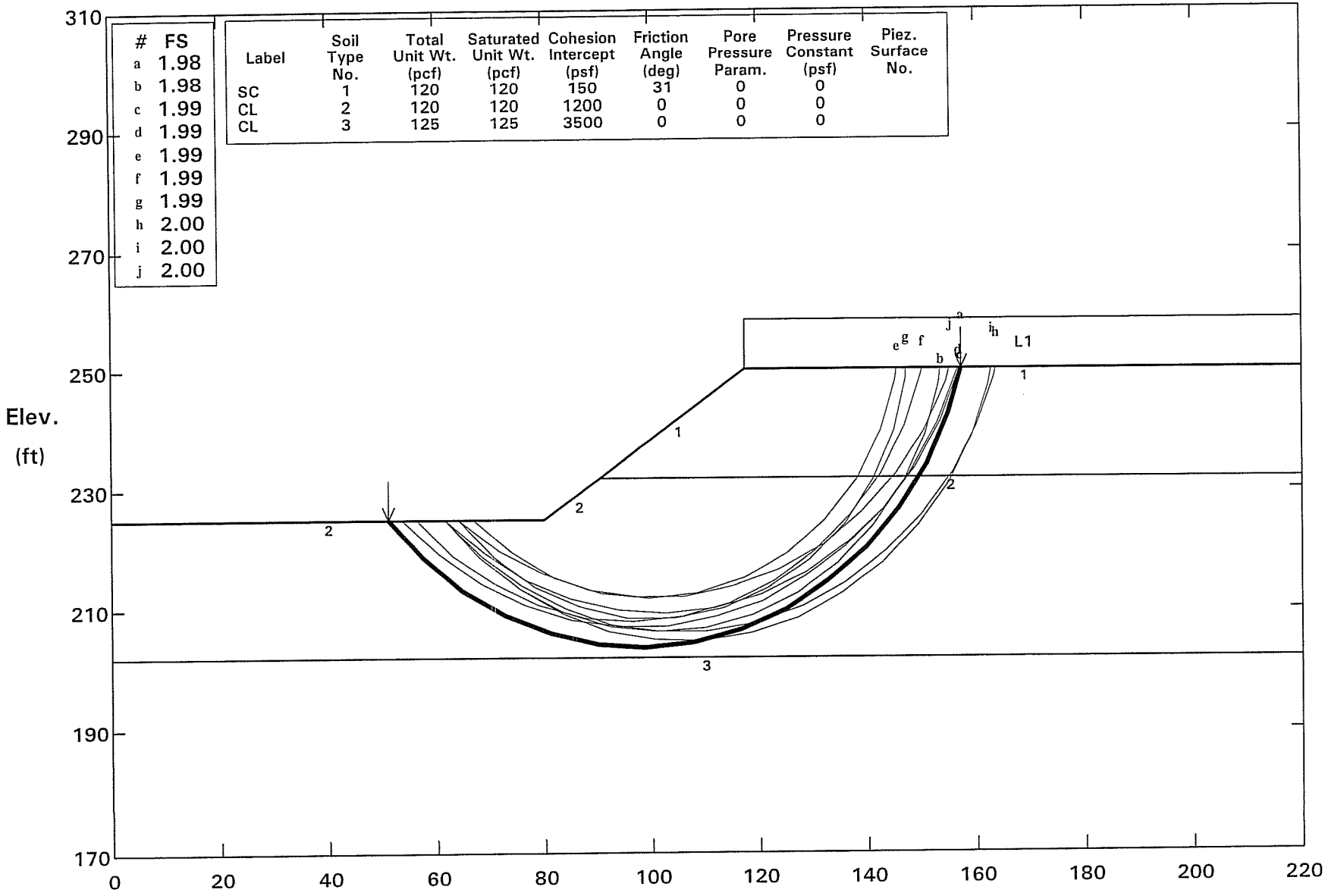


STABL6H FSmin = 1.64 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Chapman Ave UC (Widen) Abut 2 Static Condition

Ten Most Critical. D:CHAPA2S.PLT 01-13-09 2:51pm

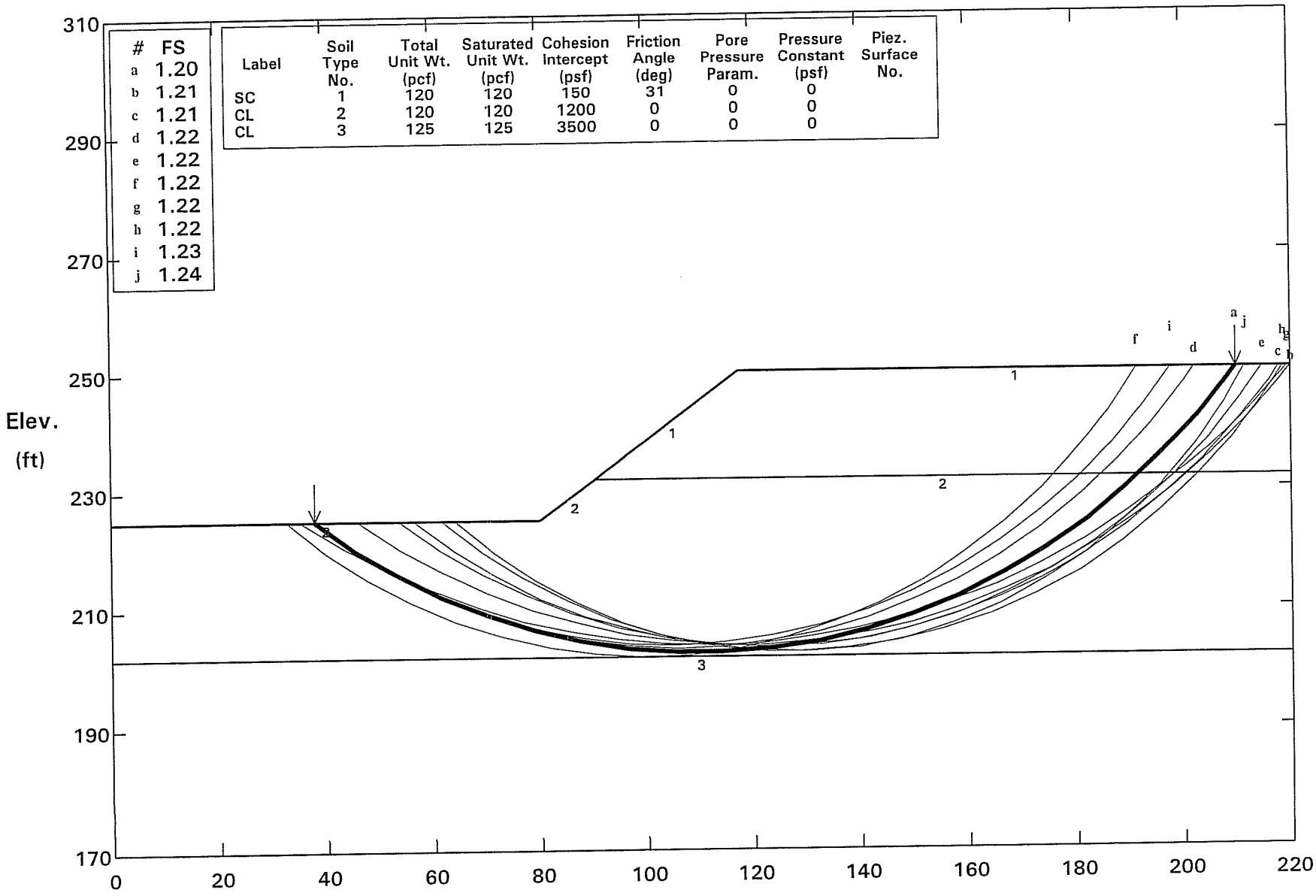


STABL6H FSmin = 1.98 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

Chapman Ave UC (Widen) Abut 2 Pseudostatic Condition (kh = 0.2)

Ten Most Critical. D:CHAPA2D.PLT 01-13-09 2:52pm



#	FS
a	1.20
b	1.21
c	1.21
d	1.22
e	1.22
f	1.22
g	1.22
h	1.22
i	1.23
j	1.24

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SC	1	120	120	150	31	0	0	
CL	2	120	120	1200	0	0	0	
CL	3	125	125	3500	0	0	0	

STABL6H FSmin = 1.20 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

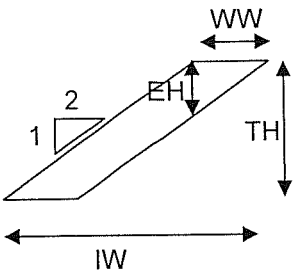
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
phone: (714)751-3826, Fax (714)751-3928

Project: **Chapman Avenue UC (Widen)** Project No. **08-115**
By CTY Date 01/11/09 Check by Date Sheet

Settlement Calculation for Sliver Fill

Total Fill Height, TH=	26	ft	Width of Widening, WW=	20	ft
Effective Fill Height, EH=	10	ft			
Loading=	1.2	ksf = EH x unit weight (120 pcf used)			
Influenced Width, IW=	80	ft			



Check Settlement:
Method: FHWA Soil & Foundation Workshop Manual, 1982. (Pertinent Pages are attached)
Based on Boring A-08-15

Layer	Elev. (ft)			Depth (ft)
	225.0	EH x γ		0.0
I		(N')= 7	**SM**	
	220.0	c'= 38	γ= 120 pcf	5.0
II		(N')= 14	**CL**	
	210.0	c'= 42	γ= 120 pcf	15.0
III		(N')= 8	**SM**	
	202.0	c'= 39	γ= 120 pcf	23.0
IV		(N')= 25	**CL**	
	195.0	c'= 58	γ= 120 pcf	30.0
V				
	180.0			45.0

Note: 1. c'= bearing capacity index
2. N'= average corrected SPT blowcount

Layer	Layer Thick. (ft)	Mid pt. depth (ft)	Mid pt. depth to FB (ft)	σ_{vo}' (ksf)	Z/B	$\Delta\sigma$ %	$\Delta\sigma_v'$ (ksf)	σ_{vf} (ksf)	C	ΔS (in)
0	5	2.5	2.5	0.30	0.03	100%	1.20	1.50	38	1.10
II	10	10	10.0	1.20	0.13	98%	1.18	2.38	42	0.85
II	8	19	19.0	2.28	0.24	97%	1.16	3.44	39	0.44
III	7	26.5	26.5	3.18	0.33	95%	1.14	4.32	58	0.19
IV	15	37.5	37.5	4.50	0.47	86%	1.04	5.54	58	0.28
									total=	*2.86*

Abutment Lateral Earth Pressure

$\phi = 32^\circ$ (compacted fill)
$k_a = \tan^2(45-\phi/2) = 0.30$
$k_a \times g = 120 \times 0.3 = 36$ pcf
$k_o = 1-\sin(\phi)=1-\sin(32^\circ)=0.47$

APPENDIX D

CALTRANS REVIEW COMMENTS AND EMI RESPONSES

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: May 27, 2009
File: 12-ORA-57-PM 17.3
12-0F0311
Chapman Avenue UC
Bridge No. 55-0456
SR-57 Northbound Widening

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

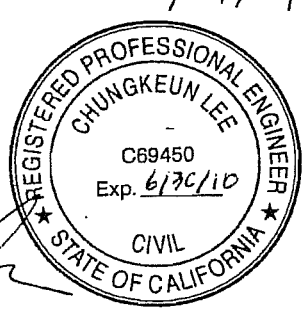
Subject: Review of response to our comment on the Foundation Report

On May 21, 2009, the Office of Geotechnical Design-South 1 received the response to our comments on Foundation Report prepared by Earth Mechanics Inc. for widening of the Chapman Avenue Undercrossing, Br. No. 55-0456. The response has been examined thoroughly and it is our opinion that the Foundation Report could be finalized after considering additional comments as below:

- Please correct the typing error in Section 5.5 (sliver fill, not silver fill). EMI: We will comply.
- Please eliminate "Tension" in footnote No. 2 of Table 5-5. EMI: We will comply.

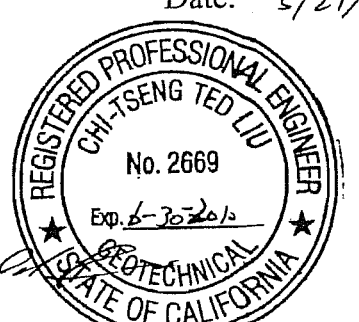
If you have any questions please contact Chungkeun Lee at (213) 620-2148 or Chi-Tseng Ted Liu at (213) 620-2136.

Prepared by: Date: 5/27/09



Chungkeun Lee, P.E.
Transportation Engineer
Office of Geotechnical Design South 1
Branch C

Reviewed by: Date: 5/27/09



Chi-Tseng Ted Liu, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design South 1
Branch C

c: OGDS1 - LA. File (2)
OGDS1 - SAC. File (1)
GS – SAC. File (1)

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

May 19, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Attention: Mr. Steve Huff

Subject: Response to Caltrans Foundation Review Comments on "Foundation Report (dated 2/04/09) Chapman Avenue UC (Widen), Bridge No. 55-0456, SR-57 Northbound Widening"
12-ORA-57, PM 17.3, EA 12-0F0311

Dear Mr. Huff:

Caltrans issued a Foundation Review sheet dated April 20, 2009 for the subject project. A copy of this review sheet is attached at the end. The following are our responses to those comments. ~~Many of these responses require revisions of the foundation report. We have included those revised pages from the foundation report as attachments, and the actual revisions are also identified by a vertical line place on the right side of the text.~~

2.1 Field Investigation

- The station line (B-Line) is not defined clearly in this section of the report and Log of Test Boring (LOTB) Sheets.

Response: See attached revised LOTB sheet. Table 2-1 was also revised and attached (see ~~attached~~ Page 4).

5.4.2 Foundation Data Provided by Structural Designers

- Eliminate Nominal Driving Resistance column from all tables.

Response: We eliminated "Nominal Driving Resistance" columns from Tables 5-5 and 5-6 (see ~~attached~~ Pages 16 and 17).

5.4.3 Axial Capacity

- Tension in foot note is not required in Table 5-5 because design tip elevation for tension demand is not provided.

Response: We eliminated Tension in foot note in Table 5-5 (see ~~attached~~ Page 16).

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

5.4.4 Lateral Resistance

- Please attach output file for lateral pile analysis at Appendix C, Design Calculations to show input for the analysis.

Response: Lpile output files will be added to Appendix C in the revised report. The revised report will be submitted after Caltrans accepts these responses.

5.5 Embankments and Settlement

- Structural approach slab at both abutments should be discussed.

Response: The following responses have been added to Section 5.5 (see attached Page 18): "Per Caltrans Memo to Designers 5-3 dated December 1992, structure approach slabs are required for this project. Selection of the approach type will be performed by the structurral designer following the flowchart in Caltrans Memo to Designers 5-3, Attachment A dated May 1996."

- Abutment wingwalls should be discussed.

There is no abutment wingwalls since both abutments are adjacent to RW 514 and 522. There is a small return wall connecting the abutment to the retaining walls. This return wall sits on the abutment pile cap as a part of the abutment design. Design of RW 514 and 522 is in the separate report.

6.2 Pile Construction

- Wet method of construction should not be recommended for caving control, since it requires additional instrumentation and increase the chance of pile anomaly.

Response: The recommendation for wet method has been deleted. The following paragraph was added to Pile Construction: "For on-center pile spacings less than six times the pile diameter, no two adjacent piles can be constructed concurrently." (see ~~attached~~ Page 19)

Appendix A-Log of Test Boring (LOTB) and As-Built Log of Test Borings Sheets

- Please refer to the Caltrans Soil and Rock Logging Manual (June 2007), and use an appropriate bottom title block for LOTB and soil legend sheets.
- Direction to the nearest cities should be shown on LOTB plan view.
- When groundwater is not shown on the borings, explain in a sentence under each boring such as groundwater was not encountered or measured during field investigation.
- Correction/multiplication factor for conversion of 2.4" California Modified ring sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.

- It is required to note datum used for surveying boreholes in LOTB (NGVD 29 or NAVD88).
- Please include pocket penetrometer test result in the description of corresponding layer.
- Separation lines should be drawn in graphic/symbols column where group name changes (e.g. 55 feet below top of A-08-015).
- As-Built Log of Test Borings with title block conforming to Caltrans Soil and Rock Logging Manual should be included in the structure plans.
- If As-Built Log of Test Borings was surveyed with different datum, it is required to include conversion factor of the datum to NAVD 88.

Response: The ~~attached~~ LOTB sheets incorporated the following revisions per Caltrans review:

- An appropriate border is used in the attached LOTB sheets.
- Directions to the nearest cities are added.
- Groundwater Not Encountered during drilling is added under each boring.
- Conversion factor from 2.4" California Modified Ring sampler blowcount to 1.4" Standard Penetration Test sampler blowcount is added to the "Notes"
- We added Vertical Datum is NAVD 88.
- Pocket penetrometer test results are added.
- Separation lines are drawn where group ~~name~~ symbol changes. (LOTB, 5/29/09)
- Proper title block is now included for as-built LOTB.
- The following sentence has been added to Section 2.1 Field Investigation: "About 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV88)."

Appendix B-Laboratoy Test Results

- It is recommended to include all test results (Direct shear and unconsolidated undrained Test) in Table 1.

Response: Table 1 in Appendix B is quite congested already. We will add the ~~attached~~ Table 2 for the strength test results in Appendix B.

Structure Plan

- Soil Legend sheets should be placed at the end of current LOTB sheets.

Response: We will comply in the revised report.

In addition to the above comments, the structural engineers have requested us to add the following section (see attached Page 20) into the final report.

"Per structural engineers, the bridge will be cast in a high elevation and lowered into the final position. During construction, the abutment piles will initially be loaded with a dead load of 11 kips per pile, then loaded to 174 kips per pile during jacking, and the final Service-I Limit State of 200 kips per pile. Since the jacking load is less than 200 kips, there is no adverse impact to the pile design."

Sincerely,
EARTH MECHANICS, INC.

Chien-Tai Yang, GE 2827
Project Engineer

Attachments

Attachment 1:
-Revised Report Page 4 for **Table 2-1**
-Revised Report Page 16 for **Table 5-3, 5-4 and 5-5**
-Revised Report Page 17 for **Table 5-6**
-Revised Report Page 18 for **Structural Approach Slab**
-Revised Report Page 19 for **Pile Construction**
-Revised Report Page 20 for **Construction Sequence**
-Revised LOTB Sheets
-Table 2 in Appendix B

deleted
(See the final report)

Attachment 2:
-Caltrans Foundation Review Sheet dated April 20, 2009

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: April 20, 2009
File: 12-ORA-57-PM 17.3
12-0F0311
Chapman Avenue UC
Bridge No. 55-0456
SR-57 Northbound Widening
(Southern Segment)

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of the Foundation Report

On February 26, 2009, the Office of Geotechnical Design-South 1, Branch C received the Foundation Report prepared by Earth Mechanics Inc, dated February 4, 2009, and Unchecked Details Plans for the Northbound widening of Chapman Avenue Undercrossing, Bride No. 55-0456. We reviewed the report and plan sheets, and our comments are as follows:

2.1 Field Investigation

- The station line (B-Line) is not defined clearly in this section of the report and Log of Test Boring (LOTB) Sheets.

5.4.2 Foundation Data Provided by Structural Designers

- Eliminate Nominal Driving Resistance column from all tables.

5.4.3 Axial Capacity

- Tension in foot note is not required in Table 5-5 because design tip elevation for tension demand is not provided.

5.4.4 Lateral Resistance

- Please attach output file for lateral pile analysis at Appendix C, Design Calculations to show input for the analysis.

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- Structural approach slab at both abutments should be discussed.
- Abutment wingwalls should be discussed.

6.2 Pile Construction

- Wet method of construction should not be recommended for caving control, since it requires additional instrumentation and increase the chance of pile anomaly.

Appendix A-Log of Test Boring (LOTB) and As-Built Log of Test Borings Sheets

- Please refer to the Caltrans Soil and Rock Logging Manual (June 2007), and use an appropriate bottom title block for LOTB and soil legend sheets.
- Direction to the nearest cities should be shown on LOTB plan view.
- When groundwater is not shown on the borings, explain in a sentence under each boring such as groundwater was not encountered or measured during field investigation.
- Correction/multiplication factor for conversion of 2.4" California Modified ring sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.
- It is required to note datum used for surveying boreholes in LOTB (NGVD 29 or NAVD88).
- Please include pocket penetrometer test result in the description of corresponding layer.
- Separation lines should be drawn in graphic/symbols column where group name changes (e.g. 55 feet below top of A-08-015).
- As-Built Log of Test Borings with title block conforming to Caltrans Soil and Rock Logging Manual should be included in the structure plans.
- If As-Built Log of Test Borings was surveyed with different datum, it is required to include conversion factor of the datum to NAVD 88.

Appendix B-Laboratoy Test Results

- It is recommended to include all test results (Direct shear and unconsolidated undrained Test) in Table 1.

Structure Plan

- Soil Legend sheets should be placed at the end of current LOTB sheets.

If you have any questions, please contact Chungkeun Lee at (213) 620-2148 or Ted Liu at (213) 620-2136.

Prepared by: Date: 04/20/09 Reviewed by: Date: 4/20/09

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c: OGDS1 - LA. File (2)
OGDS1 - Sac. File (1)
GS – Sac. File (1)

FINAL FOUNDATION REPORT

Nutwood Avenue UC (WIDEN)
Bridge No. 55-0464
SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 17.6
EA 12-0F0311

EMI Project No. 08-115
Date: June 17, 2009

EARTH MECHANICS, INC.

Geotechnical and Earthquake Engineering

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

June 17, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Attention: Mr. Steve Huff, P.E.

Subject: **Final Foundation Report for Nutwood Avenue Undercrossing (WIDEN)**, Bridge No. 55-0464
SR-57 Northbound Improvement Project, Orange County, California
12-Ora-57, PM 17.6, EA 12-0F0311

Dear Mr. Huff:

Attached please find the final Foundation Report for the subject bridge widening project. This report contains the findings and conclusions of our field investigation and laboratory testing program. This report also contains our recommendations for the design and construction of the bridge foundation.

A draft version of this report dated February 4, 2009 was submitted to Caltrans for their review. Review comments and our responses are included in Appendix D. Our responses are all incorporated into this final report.

We appreciate the opportunity to provide geotechnical design services for this project. If you have any questions, please call us.

Sincerely,
EARTH MECHANICS, INC.

Amir Zand, RCE 73910
Staff Engineer

Lino Cheang, GE 2345
Project Manager

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FINAL FOUNDATION REPORT

NUTWOOD AVENUE UNDERCROSSING (WIDEN)
BRIDGE NO. 55-464
SR-57 NORTHBOUND IMPROVEMENT PROJECT
ORANGE COUNTY, CALIFORNIA
12-Ora-57, PM 17.6
EA 12-0F0311

Prepared for:

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Prepared By:

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EMI Project No. 08-115

June 17, 2009

TABLE OF CONTENTS

Section	Page
1.0 INTRODUCTION	**1**
1.1 Purpose and Scope of Study	1
1.2 Project Description	1
2.0 FIELD INVESTIGATION AND LABORATORY TESTING	**4**
2.1 Field Investigation	4
2.2 Laboratory Testing	5
3.0 GEOLOGY AND SEISMICITY	**6**
3.1 Topography and Drainage	6
3.2 Physiography	6
3.3 Geologic Structure	6
3.4 Geologic Hazards	8
3.5 Stratigraphy	8
3.6 Seismicity	10
4.0 SUBSURFACE CONDITIONS	**11**
4.1 Soil Conditions	11
4.2 Groundwater Conditions	12
5.0 CONCLUSIONS AND RECOMMENDATIONS	**13**
5.1 Seismic Design Criteria	13
5.2 Liquefaction	15
5.3 Soil Corrosivity	15
5.4 Pile Foundation Design	15
5.4.1 Foundation Type	15
5.4.2 Foundation Data Provided by Structural Designers	15
5.4.3 Axial Capacity	16
5.4.4 Lateral Resistance	17
5.5 Embankments and Settlement	17
5.6 Bridge Abutment Wall Design	18
6.0 CONSTRUCTION RECOMMENDATIONS	**19**
6.1 Earthwork	19
6.2 Pile Construction	19
6.3 Backdrain and Backfill Requirements For Abutment Walls	20
6.4 Review of Construction Plans	20
6.5 Geotechnical Observation and Testing	20
7.0 LIMITATIONS	**22**
8.0 REFERENCES	**23**

List of Tables Page

Table 2-1. Geotechnical Exploration Information 4
Table 4-1. Idealized Soil Profile and Strength Parameters 11
Table 5-1. Local Seismic Sources 13
Table 5-2. Soil Corrosion Test Results 15
Table 5-3. Foundation Design Data Sheet 16
Table 5-4. Foundation Design Loads 16
Table 5-5. Abutment Foundations Design Recommendations 16
Table 5-6. Pile Data Table 17
Table 5-7. Lateral Pile Solutions 17

List of Figures Page

Figure 1-1. Site Location Map 2
Figure 3-1. Regional Fault and Physiographic Map 7
Figure 3-2. Geological Map 9
Figure 5-1. Design ARS Curve 14
Figure 6-1. Low Expansion Material in Bridge Embankment 21

APPENDICES

Appendix A. Log of Test Borings Sheets and As-built Log of Test Borings Sheet
Appendix B. Laboratory Test Results
Appendix C. Design Calculations
Appendix D. Caltrans Review Comments and EMI Responses

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF STUDY

This Foundation Report presents the findings and conclusions of a geotechnical investigation conducted by Earth Mechanics, Inc. (EMI). It presents foundation design and construction recommendations for proposed widening of the Nutwood Avenue Undercrossing (UC) in Orange County, California. A site location map is presented in Figure 1-1.

This work was performed for the Orange County Transportation Authority (OCTA) and EMI is a subconsultant to RBF Consulting (RBF). The geotechnical services provided for this project included the following tasks:

- Collection and review of existing geotechnical information;
- Field exploration consisting of drilling and logging exploratory borings;
- Laboratory testing of selected bulk and relatively undisturbed soil samples;
- Engineering calculations (see Appendix C) and analysis to develop foundation design and construction recommendations; and
- Preparation of this report presenting our findings, conclusions, and recommendations.

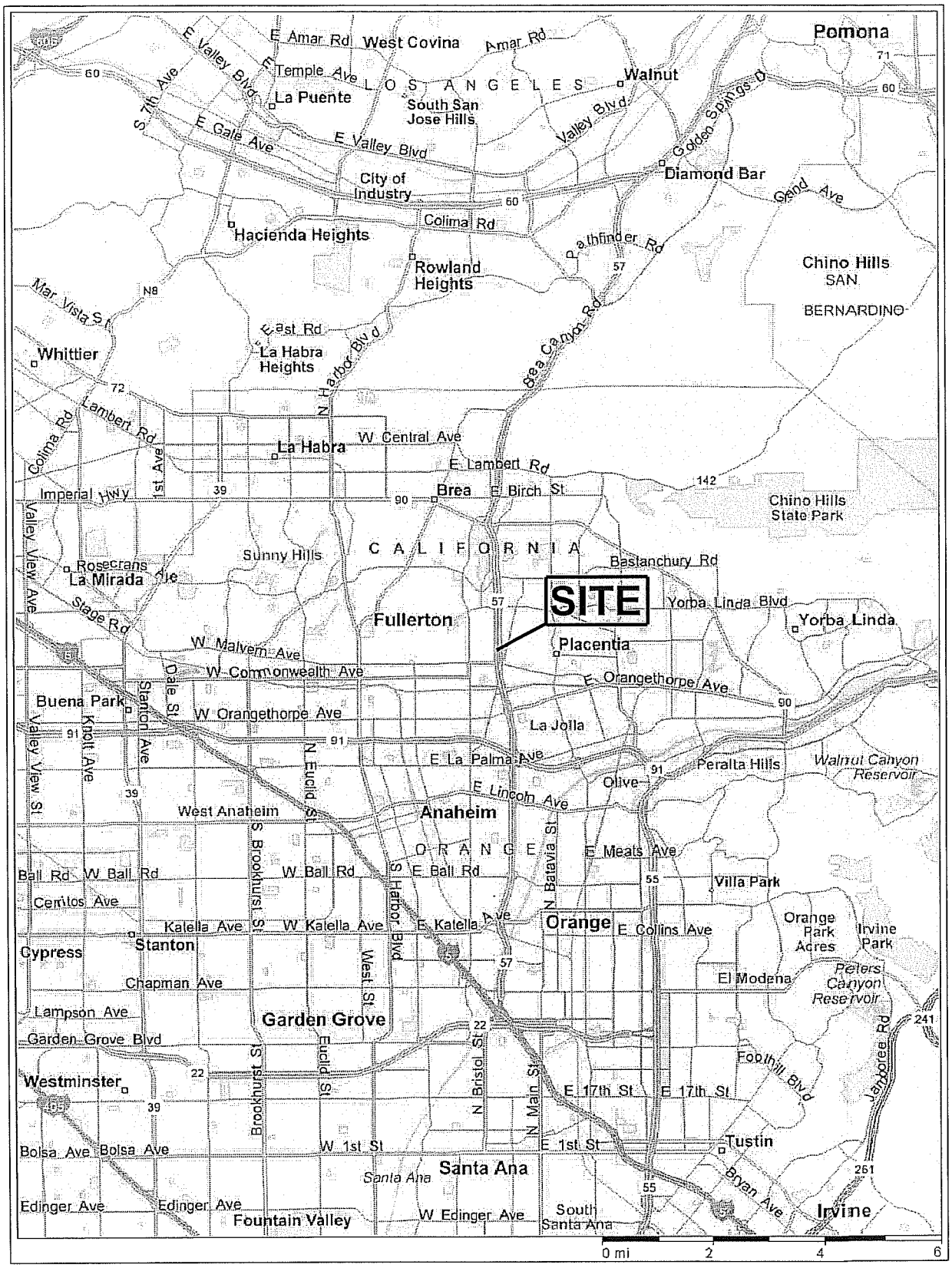
1.2 PROJECT DESCRIPTION

The Department of Transportation (Caltrans) – District 12, in cooperation with the Orange County Transportation Authority (OCTA), proposed to widen northbound State Route 57 (SR-57) by adding one northbound through lane. The project limits are between 0.2 mile south of Orangethorpe Avenue and 0.2 mile north of Yorba Linda Boulevard along northbound SR-57. Within the project limits, there are interchanges located at Orangethorpe Avenue, Chapman Avenue, Nutwood Avenue and Yorba Linda Boulevard. The entire project involves widening seven existing bridges and a tieback wall at Yorba Linda Boulevard:

- Orangethorpe Avenue Undercrossing (Bridge No. 55-0459)
- South Placentia Overhead (Bridge No. 55-0450)
- Crowther Avenue Undercrossing (Bridge No. 55-0457)
- Placentia Overhead (Bridge No. 55-0449)
- Placentia Avenue Undercrossing (Bridge No. 55-0460)
- Chapman Avenue Undercrossing (Bridge No. 55-0456)
- Nutwood Avenue Undercrossing (Bridge No. 55-0464)
- Tieback Wall at Yorba Linda Boulevard (Bridge No. 55-0468)

This report pertains to Nutwood Avenue UC only; separate foundation reports are prepared for each of the above seven remaining structures.

The Nutwood Avenue UC is located in the City of Fullerton north of the SR-57/SR-91 interchange. SR-57 in the project area trends in a north-south direction and carries traffic from the "Orange Crush" (I-5/SR-22/SR-57 Interchange) in Orange County to Interstate 210 in Los Angeles County (See Figure 1-1).



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SITE LOCATION MAP

Figure 1-1

NUTWOOD AVENUE UC (WIDEN)

Project No. 08-115 | Date: 01-05-09

The existing bridge supports five lanes of northbound and five lanes of southbound traffic on SR-57 over Nutwood Avenue in the City of Fullerton. Nutwood Avenue is a seven-lane local city street with two eastbound lanes and two left turn lanes, two westbound lanes and one left turn lane and a raised median. Parking is prohibited on both sides of Nutwood Avenue, and sidewalks exist on both sides of the street.

The existing Nutwood Avenue UC is a two span structure that carries SR-57 northbound and southbound traffic over Nutwood Avenue. The structure was originally constructed in 1969. The structure has one span with a total span length of 151'-10"+/-. The structure is a Cast-In-Place reinforced concrete box girder with a depth of 6'-3". Total width of the structure is 148'-0" maximum and varies, and it consists of two identical box girders, one for the northbound and one for the southbound of SR-57. The two box girders are separated with ½ inch wide longitudinal expansion joint filler. The box girders are supported on diaphragm abutment walls connected directly to 16-inch diameter (45 ton) CIDH concrete piles. This structure has not been widened since the initial construction.

This project will widen Nutwood Avenue Undercrossing by approximately 24'-6" on the northbound side to provide an additional 12-foot lane and a 10-foot shoulder in that direction.

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 FIELD INVESTIGATION

Copies of the As-Built Log-of-Test-Borings (LOTB) sheets are included in Appendix A; about 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV 88). According to these As-Built LOTB sheets, two penetration borings and one rotary-wash boring were performed in June 1966. During the exploration in 1966, the rotary boring was the deepest boring and was advanced to about El. +178 feet. Existing grade at the borehole location at the time of the investigation in 1966 was approximately El. +234 feet. Groundwater was not encountered during drilling in November 1966 down to El. +178 feet.

To supplement the existing subsurface data, two soil borings were drilled (one at each abutment). These borings were drilled on September 21 and October 1, 2008. Boring information, including exploration number, stations, offsets, ground surface elevations, bottom of hole elevations and water level measurements are summarized in Table 2-1. Locations of the exploratory boring are shown on the LOTB sheet provided in Appendix A.

TABLE 2-1. GEOTECHNICAL EXPLORATION INFORMATION

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-016	SR-57 (B-Line)	533+58	68 RT	+259.0	+167.5	None Encountered During Drilling
A-08-017		535+70	66 RT	+258.0	+166.5	

Exploratory borings were drilled using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. Relatively undisturbed drive samples were obtained using a 3.25-inch outer diameter California split-spoon sampler lined with brass rings. Each of these brass rings is 1-inch long with a 2.5-inch outside diameter. The California Drive sampler was driven into the ground using successive blows of a 140-lb hammer falling a distance of 30 inches. The numbers of blow for the final 12 inches or shorter of driving are shown on the LOTB sheet.

The Standard Penetration Test (SPT) sampler (1.4-inch inside diameter) was also used to obtain soil samples. The sampler was driven into the ground using a 140-lb hammer free falling from a height of 30 inches. The numbers of blow to advance the sampler each 6 inches of penetration or less was recorded. The blow counts required to drive the sampler for the last 12 inches or less was recorded as the Standard Penetration Resistance (N-value) on the LOTB sheet.

Charts published by Winterkorn and Fang (1975) can be used to determine a reduction factor used to convert blowcounts recorded using the California Drive sampler into SPT blowcounts. Using those charts, we obtained a reduction factor of 0.5 and this one-half reduction factor was used for this project.

The sampling interval is usually 5 feet. Sampling was performed by alternating the California Drive sampler and SPT sampler.

2.2 LABORATORY TESTING

Soil samples considered representative of the subsurface conditions were tested to obtain or derive relevant physical and engineering soil properties. The following laboratory tests were conducted to supplement the observations recorded during the field investigation:

- In-situ Moisture Content and Unit Weight
- Particle Size Analysis and Percent Passing No. 200 Sieve
- Direct Shear
- Plasticity Index, Liquid Limit
- Unconsolidated Undrained Triaxial
- Minimum Resistivity, pH, Sulfate Content and Chloride Content
- R-Value
- Consolidation

The laboratory tests were conducted in general accordance with California Test Methods or American Society for Testing and Materials (ASTM) Standards. Laboratory test results are included in Appendix B.

3.0 GEOLOGY AND SEISMICITY

3.1 TOPOGRAPHY AND DRAINAGE

The project corridor is in the eastern part of the Los Angeles Basin along the southern margin of the Coyote Hills and the Puente Hills (Figure 3-1). Just north of the project corridor, the Puente Hills rise to an elevation of about 1,400 feet. The southwestern edge of the Puente Hills is paralleled by a series of low-elevation plains and hills; the Santa Fe Plain and the Coyote Hills are to the west of the project corridor, and the Richfield and Kraemer Hills are to the east. The elevations of these hills range from about 500 feet just west of the project to about 300 feet in the east. The ground upon which the project is located slopes gently to the south. Elevations along the project corridor range from about 280 feet in the north to about 200 feet on the south.

The project corridor traverses the ancient flood plains and alluvial fans of Fullerton Creek and the Santa Ana River. The major drainage in the area is the Santa Ana River which flows westerly south of the site. Fullerton Creek, a tributary to the Santa Ana River, drains southwesterly from the Puente Hills just west of the project corridor.

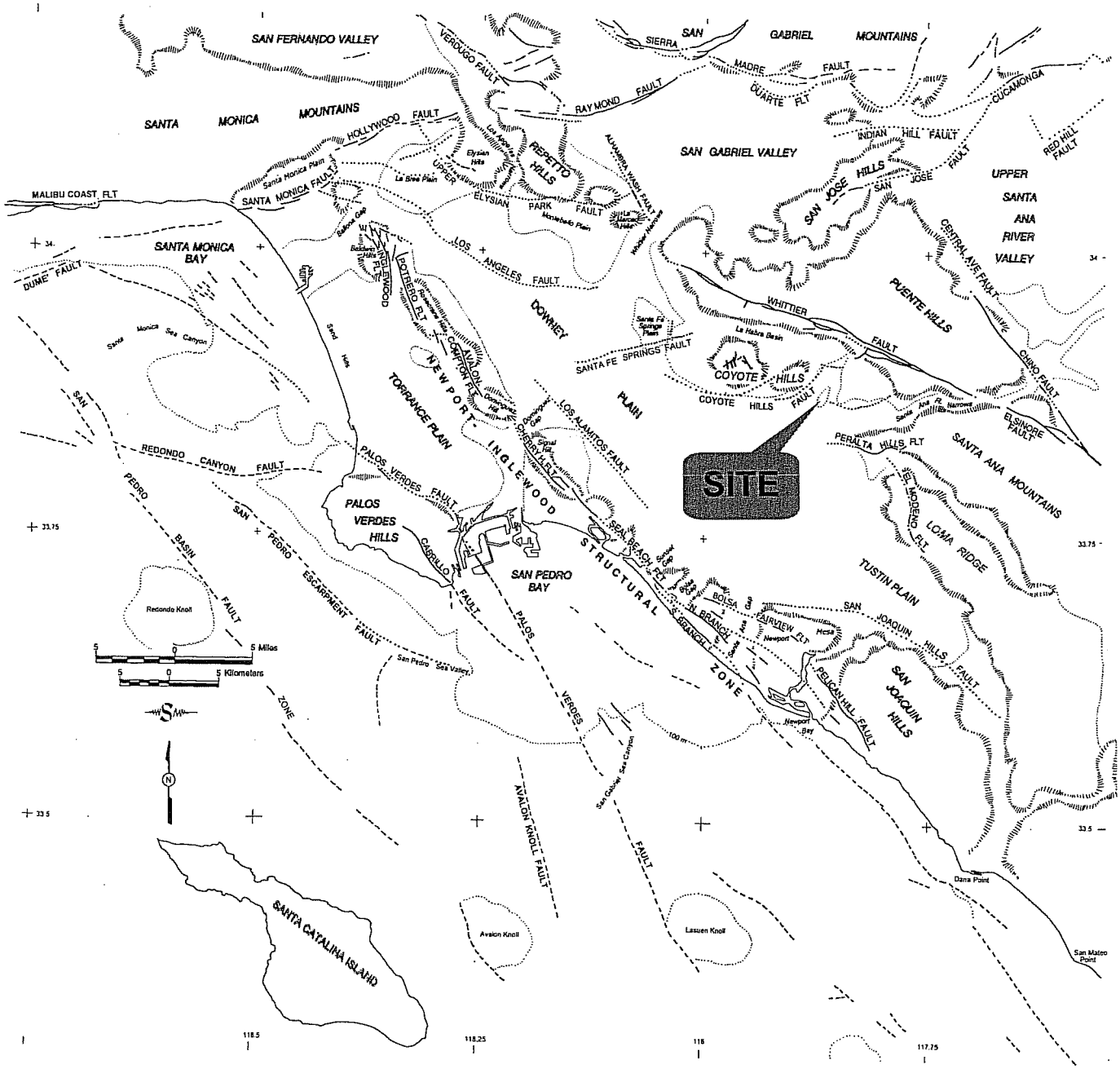
3.2 PHYSIOGRAPHY

The site area is at the eastern edge of the Los Angeles physiographic basin, a large, relatively flat, low-lying, coastal plain surrounded by mountains on the north, east, and southeast (Figure 3-1). The floor of the Los Angeles Basin is relatively flat but slopes gradually southwesterly from an elevated marginal apron to sea level along the coastline. The western margin of the Los Angeles Basin is bordered by the sea and the Palos Verdes Hills. The eastern margin is bordered by the Puente Hills and Santa Ana Mountains. The Coyote Hills, Santa Fe Springs Plain, Richfield Hills, and Kramer Hills are low elevation uplifts along the southern margin of the Puente Hills.

3.3 GEOLOGIC STRUCTURE

The geologic structure at the site is quite simple and is characterized by flat-lying Quaternary sediments overlying gently folded Tertiary sedimentary rocks. These strata rise gently to the Coyote Hills, Richfield Hills, and Kraemer Hills where they are arched upward to form anticlinal folds. The site is on the south limb of these anticlines with the early Pleistocene and Tertiary age strata dipping gently to the south and overlain by younger flat-lying Quaternary sediments.

The nearest active or potentially active surface faults are the Peralta Hills and Whittier faults (Figure 3-1). The low-elevation plains and hills along the eastern margin of the Los Angeles Basin are underlain by a series of east-west trending, en echelon, faults and folds in the subsurface; the major faults within this trend are, from north to south, the Los Angeles (Las Cienegas), Santa Fe Springs, and Coyote Hills faults (Figure 3-1). This group of faults is known as the Puente Hills fault system. Other poorly known segments of this thrust fault system underlie the Richfield and Kramer hills. All of these faults are blind thrust or reverse faults that approach within about a mile or so of the ground surface. They are identified on seismic reflection geophysical data only and are below the depths of oil wells.



NUTWOOD AVENUE UC (WIDEN)

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REGIONAL FAULT AND PHYSIOGRAPHIC MAP

Figure 3-1

Project No. 08-115

Date: 01-05-09

The Peralta Hills fault may be related to the Puente Hills fault system. The Peralta Hills fault is exposed along the south flank of the Peralta Hills where it displaces Tertiary-age rocks upward and over younger Quaternary alluvium. The fault extends westerly below the Santa Ana River channel where it creates barriers to ground-water flow (Figure 3-2). The barriers extend about to the SR 57 freeway just north of the Lincoln Avenue (Morton and Miller, 1981). The location of the Peralta Hills fault is well up on the flank of the hills rather than at the base of the hills indicating that it is not the only fault responsible for uplift and folding of the Peralta Hills. There must be a deeper unknown blind thrust fault below the Peralta Hills thrust fault but this feature has never been directly identified.

The Whittier fault is a major strike slip fault that extends northwesterly along the southwest flank of the Puente Hills northeast of the site (Figure 3-1). The Whittier fault is associated with the Chino fault and the Elsinore fault and together these faults form a major fault system that extends from the Los Angeles Basin into northern Mexico.

The El Modeno fault is a north-south trending feature within Loma Ridge, one of the foothills of the Santa Ana Mountains, southeast of the site. The feature is poorly known but is known to displace Holocene soil in Loma Ridge. Although the fault is grouped with the Peralta Hills fault on the Caltrans seismic hazard map (Mualchin 1996), it appears to be a discrete normal or strike-slip fault unrelated to the thrust faults of the Peralta Hills. Although the fault must be considered active because it displaces Holocene soil, the feature has a very long (thousands of years) recurrence interval.

3.4 GEOLOGIC HAZARDS

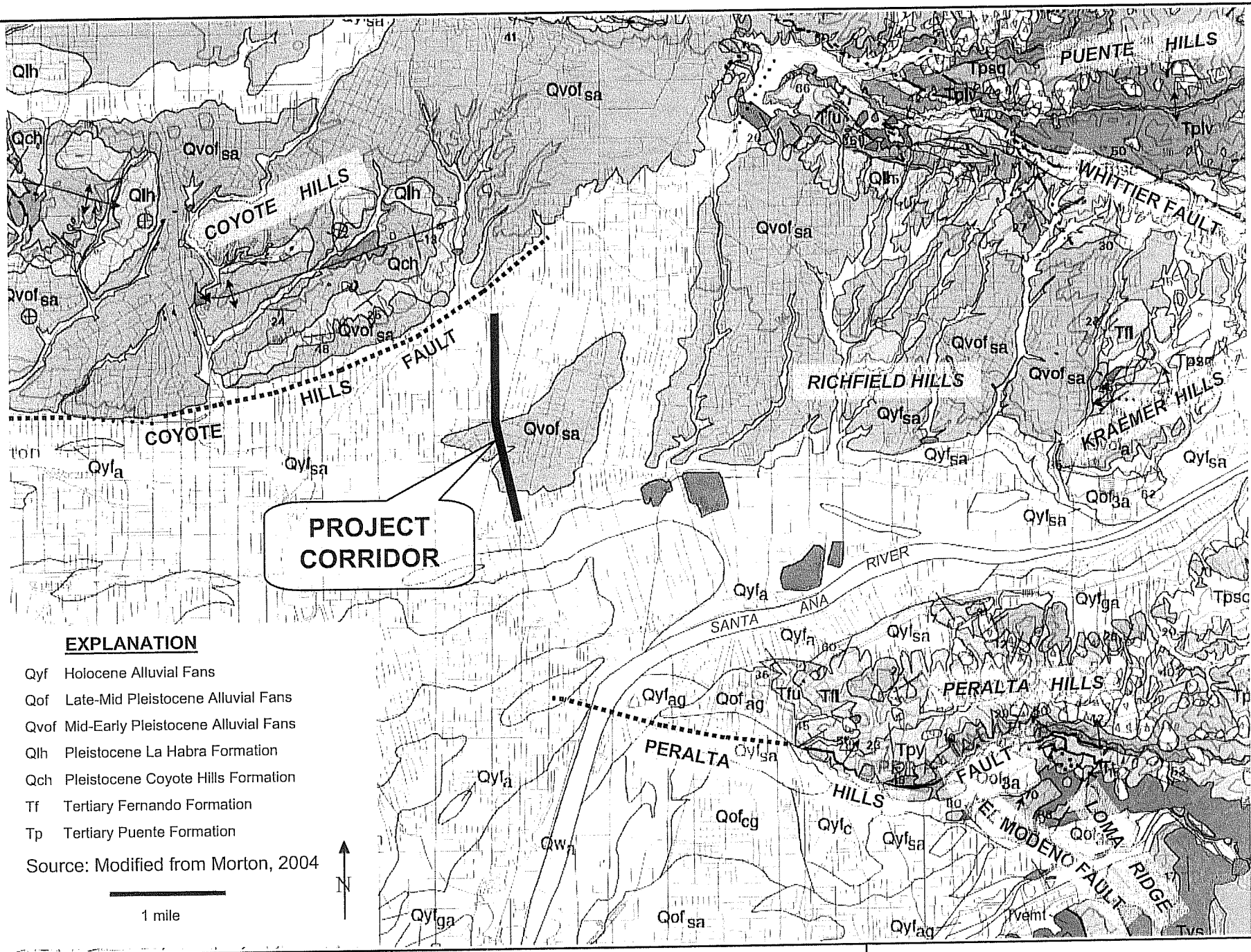
There are no steep slopes within the corridor so landsliding is not likely. There are no active faults so surface fault rupture is not likely. There are no known volcanos in the site region. The site is far from the sea on elevated land so Tsunamis are not a hazard.

The site is not identified on the State seismic hazard maps of the La Habra quadrangle as being susceptible to liquefaction (California Geological Survey/Division of Mines and Geology, 1997). This is due primarily to the depth of historically highest ground water being greater than 50 feet.

3.5 STRATIGRAPHY

Regional studies (e.g. Morton, 2004; Morton and Miller, 1981; Durham and Yerkes, 1964; California Department of Water Resources, 1961) indicate that the site area is underlain by Quaternary sediments overlying older Quaternary and Tertiary sediments and sedimentary rocks.

The surficial deposits are primarily Holocene and Pleistocene alluvial fan deposits (Figure 3-2). Older formations exposed in the hills and underlying the corridor are, in descending order, the Pleistocene-age La Habra and Coyote Hills, the Pliocene Fernando, and Pliocene-Miocene-age Puente formations. Along the corridor, the La Habra Formation is at an elevation of about sea level and therefore these older units are well below the level of interest for this project.



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NUTWOOD AVENUE UC (WIDEN)

Project No. 08-115 | Date: 01-05-09

GEOLOGICAL MAP

Figure 3-2

3.6 SEISMICITY

The largest historical earthquake within the Los Angeles Basin was the 1933 Long Beach earthquake of M_W=6.4 (M_L = 6.3) which is generally believed to have been associated with the Newport-Inglewood Structural Zone. The association of the 1933 event with the NISZ was based on abundant ground failures along the NISZ trend, but no unequivocal surface rupture was identified. Hauksson and Gross (1991) reevaluated the seismicity data and relocated the 1933 earthquake hypocenter to a depth of about 6 miles below the Huntington Beach-Newport Beach city boundary.

Other damaging earthquakes in the Los Angeles region include the 1971 San Fernando, the 1987 Whittier, and the 1994 Northridge events. The 1971 San Fernando (M_L= 6.4, M_W=6.7) earthquake occurred along the northern margin of the San Fernando Valley and produced a surface rupture which coincided partly with a zone of mapped surface faults along the mountain-valley margin. The more-recent 1987 Whittier earthquake (M_L=5.9, M_W=5.9) and the 1994 Northridge (M_L=6.4, M_W = 6.7) earthquake were not associated with surface faulting. Such events indicate that seismic hazards analysis must consider subsurface faulting as well as surface faulting. The Whittier event occurred at a depth of about 10 miles on a northerly dipping thrust fault dipping from the Coyote Hills area, under the Repetto and Puente Hills, to below the San Gabriel Valley. The Northridge event occurred at a depth of about 12 miles on a south-dipping reverse fault below the San Fernando Valley.

Another significant earthquake in the region was the 1812 earthquake which caused damage at the San Juan Capistrano Mission. The location and magnitude of the 1812 earthquake are unknown but geological studies (Jacoby et al., 1988; Fumal et al., 1993; Weldon et al., 2004) postulated that it did not occur in the Capistrano area, but rather was a large (M> 7.0) distant event on the San Andreas fault in the Wrightwood area of the San Gabriel Mountains.

A recent magnitude 5.4 (M_W) earthquake occurred on 29 July 2008 below the Puente Hills northeast of the site at a depth of about 10 miles. This event was a reverse type fault with a left- lateral component of slip. The causative fault is unknown. The epicenter is between the Whittier and Chino faults. The orientation of the preferred focal plane of the focal mechanism solution is somewhat compatible with the Whittier fault. The Whittier fault may have a reverse component of slip but is believed to be primarily a right-lateral fault. Furthermore dip of the preferred focal plane and the distribution of aftershocks are not very compatible with the Whittier fault. The northerly dipping buried thrust faults under the Peralta Hills, Richfield Hills, or Kraemer Hills could have been source because the preferred focal plane dips northeasterly similar to the northerly dipping faults. However, the distribution of the aftershocks does not seem compatible with the orientations of these faults.

4.0 SUBSURFACE CONDITIONS

4.1 SOIL CONDITIONS

Based on the recent field exploration and the as-built LOTB sheet in Appendix A, the subsurface materials at the site consist primarily of sandy lean clay, lean clay with sand, clayey sand, silty sand, and sand with silt; consistency of the soil generally is uniform above elevation +175, and increases below that elevation. The idealized soil profile and design strength parameters for foundation design are presented in Table 4-1.

TABLE 4-1. IDEALIZED SOIL PROFILE AND STRENGTH PARAMETERS

Approx. Elevation (ft)	Predominant Soil Type	Range of Measured and Converted SPT Blowcount; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion/ Undrained Shear Strength (psf)
+258 to +244	Clayey Sand (Fill)	18 to (49/10") Average = 26	120	32	150
+244 to +235	Sandy Lean Clay	18 to (47/11") Average = 30	113	0	2100
+235 to +230	Sandy Clay	14 to (29) Average = 21	112	0	1800
+230 to +225	Clayey and Silty Sand	10 to (28) Average = 19	122	32	50
+225 to +220	Sandy Clay and Clay	14 to (25/5") Average = 37	115	0	1800
+220 to +215	Clayey Sand	14 to (30) Average = 22	125	36	50
+215 to +200	Lean Clay with Sand	12 to (43/5") Average = 35	125	0	1800
+200 to +195	Clayey and Silty Sand	15 to (40) Average = 27	125	33	50
+195 to +175	Lean Clay with Sand	10 to (25/5.5") Average = 24	120	0	2100
+175 to +166	Poor Graded Sand and Silt	67 to (25/3") Average > 50	125	40	50

Notes:
(1) SPT = Standard Penetration Test.
(2) Values in ( ) are converted SPT blowcounts corrected for sampler size; correction factor from California sampler blowcounts to SPT blowcounts is 0.5.

The above soil strength parameters are primarily based on published correlations with SPT blowcounts (Lam and Martin, 1986). A comparison of the above soil strength parameters with direct shear test results included in Appendix B indicates they are slightly higher than the ultimate values but significantly lower that the peak values obtained from the laboratory test results. In addition, the undrained shear strength obtained from unconsolidated undrained triaxial test is higher than the value obtained from SPT correlations. We believe the strength values obtained using the SPT correlation

are more reliable and should be used for foundation design because the laboratory test results are affected by soil disturbance during sampling.

4.2 GROUNDWATER CONDITIONS

During the recent field investigation conducted on September 21 and October 1, 2008, groundwater was not encountered down to El. +166 feet which is more than 90 feet from the freeway surface. As shown on the as-built LOTB sheet in Appendix A, groundwater was not encountered during drilling in June 1966 down to El. +178 feet.

The relatively deep water depth is confirmed by the historical groundwater map published by the California Geological Survey (Seismic Hazard Zones Map – La Habra Quadrangle) (CGS, 1997). This map shows the depth to groundwater to be greater than 50 feet.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SEISMIC DESIGN CRITERIA

According to the 1996 Caltrans Seismic Hazard map, the most significant faults relative to the project area are listed in Table 5-1 along with their style of fault, maximum earthquake magnitude, distance to the bridge site and resulting peak bedrock acceleration (PBA).

TABLE 5-1. LOCAL SEISMIC SOURCES

Fault or Fault Zone	Style of Faulting	Maximum Credible Earthquake (MCE) Magnitude	Distance to Site[2] (miles)	Peak Bedrock Acceleration[3] (g)
El Modeno-Peralta Hills (EMP)	Reverse-Thrust[1]	6.50	1.8	0.7
Puente Hills Blind Thrust	Reverse-Thrust	7.25	3.4	0.6
Whittier-Elsinore (WEE)	Strike-Slip	7.50	4.1	0.6

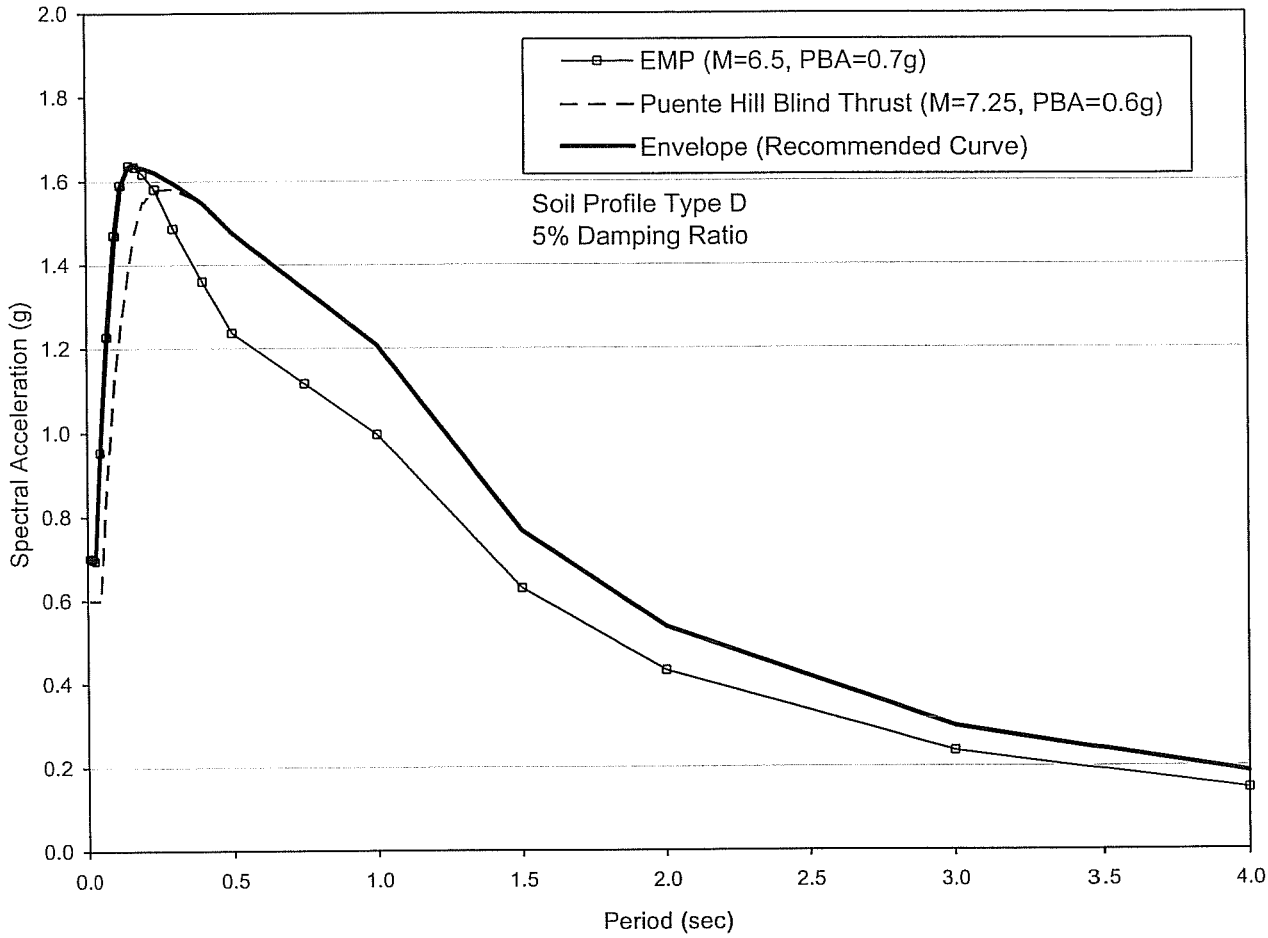
Notes:
(1) Caltrans designates the style of fault for EMP to be "unknown"; we assume a reverse-thrust fault (most conservative).
(2) For the EMP and WEE faults, the distances of each bridge site to these seismic sources were scaled from the 1996 Caltrans Seismic Hazard Map. Distances of each bridge site to the Puente Hills Blind Thrust were obtained from the seismic source model contained within the FRISKSP4.0 computer program (Blake, 2000 and 2004).
(3) The PBA is the larger of the two PBA's obtained from the attenuation relations of Sadigh (1997) and Mualchin (1996).

The ARS curves published in the Caltrans SDC (2006b) for Soil Profile Type "D" are applicable; this applies to Figures B.7 and B.8 for MCE Magnitudes (M) of 6.5±0.25 and 7.5±0.25, respectively. However, ARS curves for M of 6.5±0.25 with PBA's greater than 0.6g are not included in Figure B.7 of the Caltrans SDC (2006b). As a result, we generated an ARS curve for M=6.5±0.25 and a PBA of 0.7g by scaling the 0.6-g curve in Figure B.7 of the Caltrans SDC (2006b).

The design ARS curve envelopes the scaled ARS curve for M=6.5±0.25 and PBA=0.7g, and Figure B.8 for PBA=0.6g. According to Caltrans, this curve must also be modified to account for near-fault effects. For the near-fault effects, Caltrans Seismic Design Criteria (SDC, 2006b) Section 6.1.2.1 recommends the following modifications in the spectral accelerations:

- For periods less than 0.50 second, no change;
- For periods greater than 1.0 second, an increase of 20%;
- For periods between 0.50 and 1.0 second, a linear interpolation between the values at 0.50 and 1.0 second.

The resulting design ARS curve and the digitized coordinates are presented in Figure 5-1.



Spectral Coordinates of Recommended Curve

Period (sec)	Acc. (g)
0.010	0.700
0.020	0.697
0.030	0.696
0.050	0.953
0.075	1.228
0.100	1.470
0.120	1.590
0.150	1.637
0.170	1.636
0.200	1.631

Period (sec)	Acc. (g)
0.240	1.621
0.300	1.595
0.400	1.548
0.500	1.477
0.750	1.342
1.000	1.207
1.500	0.765
2.000	0.536
3.000	0.296
4.000	0.186

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	Nutwood Avenue UC (Widen)	ARS Design Spectrum
	Project No.: 08-115 / Date: 1/12/09	Figure 5-1

5.2 LIQUEFACTION

Based on the available boring information, the subject site has a low liquefaction potential due to absence of groundwater within the depths of interest.

5.3 SOIL CORROSIVITY

Three soil samples were tested for pH, minimum resistivity, soluble chloride content and soluble sulfate content. The test results are summarized in Table 5-2. Minimum resistivities ranged from 490 to 1,040 ohm-cm. The pH ranged from 7.3 to 7.7. The soluble sulfate ranged from 120 to 250 parts per million (ppm), and the soluble chloride ranged from 312 to 364 ppm.

TABLE 5-2. SOIL CORROSION TEST RESULTS

Boring	Station (Offset) / "Station Line"	Sample Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Soluble Sulfate Content (ppm)	Soluble Chloride Content (ppm)
A-08-016	533+58 (68 RT) / "B-Line"	25	CL	1040	7.7	150	312
A-08-016	533+58 (68 RT) / "B-Line"	35	CH	530	7.5	120	364
A-08-017	535+70 (66 RT) / "B-Line"	20	CL	490	7.3	250	362

Based on the Caltrans Corrosion Guidelines (2003), soils are considered corrosive if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm or greater. Based on the test results and the Caltrans criteria, the on-site soils are not considered to be corrosive to bare metals and concrete.

5.4 PILE FOUNDATION DESIGN

5.4.1 Foundation Type

The original bridge is supported on 16-inch diameter Cast-In-Drilled-Hole (CIDH) piles. We recommend using the same pile type for the proposed widening except the diameter is 24 inches.

5.4.2 Foundation Data Provided by Structural Designers

Per Caltrans policy, the Working Stress Design (WSD) is used for abutment piles. The foundation design data sheet and factored foundation loads were provided by the structural designers following the latest Caltrans Memo To Designers (Caltrans, 2008), and are shown in Table 5-3 and Table 5-4, respectively.

TABLE 5-3. FOUNDATION DESIGN DATA SHEET

Location	Design Method	Pile Type	Finished Grade El. (ft)	Pile Cut-off El. (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (inch)	Number of Piles per Support
					B	L		
Abutment 1	WSD	24" CIDH	251.20	243.25	10	23	1	7
Abutment 2	WSD		250.10	241.75	10	23	1	7

TABLE 5-4. FOUNDATION DESIGN LOADS

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Permanent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abutment 1	1400	200	1130	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Abutment 2	1400	200	1130	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

5.4.3 Axial Capacity

The abutment foundations design recommendations are presented in Table 5-5. The Pile Data Table for the contract plans is presented in Table 5-6. The design pile tip elevation for the compression load case was based on skin friction only. The pile capacities are also based on soil resistance only and may be further limited by the pile-head connection details. Pile group effects based on the layout provided by the structural engineers and the guidelines published in the AASHTO LRFD Bridge Design Specifications (2007) were included in these results.

TABLE 5-5. ABUTMENT FOUNDATIONS DESIGN RECOMMENDATIONS

Support	Pile Type	Cut-Off Elev. (feet)	LRFD Service-I Limit State Load per Support (kips)		LRFD Service-I Limit State per Pile (kips)	Nominal Resistance (kips)	Design Tip Elev. (feet)[1]	Specified Tip Elev. (feet)[2]
			Total	Permanent				
Abut 1	24" CIDH	243.25	1400	1130	200	400	+193 (a) +209 (c) +213 (d)	+193
Abut 2		241.75	1400	1130	200	400	+191 (a) +207 (c) +211 (d)	+191

Notes:
1. Design tip elevation is controlled by the following demands: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for lateral load and settlement.

TABLE 5-6. PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)	Specified Tip El. (ft)
		Compression	Tension		
Abutment 1	24" CIDH	400	0	+193 (a) +209 (c) +213 (d)	+193
Abutment 2		400	0	+191 (a) +207 (c) +211 (d)	+191

Note: Design tip elevations are controlled by: (a) Compression, (c) Settlement, and (d) Lateral Load.

5.4.4 Lateral Resistance

Results of lateral pile analysis in terms of pile-head shear and lateral deflection for a free-head condition are presented in Table 5-7. The maximum bending moment and the location of maximum moment are also presented. The solutions presented in Table 5-7 are entirely based on soil resistance and linear pile properties. Therefore, these values may be limited by the flexural strength (plastic moment) of the piles and other connection details. Linear interpolation can be used for solutions between pile-head deflections of 0.25 and 5 inches.

TABLE 5-7. LATERAL PILE SOLUTIONS

Location	Lateral Displacement at Top of Pile (in)	Lateral Load at Top of Pile (kips)	Maximum Moment (kip-in)	Depth from Pile Head to Max. Moment (ft)
Abutments	¼	26	906	6
	½	37	1463	6
	1	53	2376	7
	3	94	5098	8
	5	116	7252	9

5.5 EMBANKMENTS AND SETTLEMENT

Settlement. About 23 feet of sliver fill will be placed to construct the approach embankments. Based on the onsite soil type, ground subsidence is estimated to be on the order of 3 inches. We recommend a settlement period of at least 10 calendar days for pile installation at the abutments.

Slope Stability. Global stability analyses were conducted for both static and pseudostatic conditions for the bridge end slopes. Results of this analysis are presented in Appendix C.

The factor of safety for a deep-seated failure is greater than 1.5 under static condition for the 1V:1.5H end slope with a 2-foot soil surcharge to represent traffic loading. Slope stability analysis under pseudostatic condition was performed using a seismic coefficient equal to 0.2g (which is the smaller of either one-third the horizontal peak ground acceleration or 0.2g) in accordance with

guidelines provided in Section 3.12 of the Caltrans Guidelines for Foundation Investigations and Reports (Caltrans, 2006a). Analysis indicates that the factor of safety is greater than 1.1 under pseudostatic condition. The 1V:1.5H end slope has proposed concrete slope paving, therefore surficial stability is not a design issue.

Per Caltrans Memo to Designers 5-3 dated December 1992 (Caltrans, 1992a), structure approach slabs are required for this project. Selection of the approach type will be performed by the structural designer following the flowchart in Caltrans Memo to Designers 5-3, Attachment A, dated May 1996 (Caltrans, 1996).

5.6 BRIDGE ABUTMENT WALL DESIGN

Abutment Earth Pressures. If abutment walls are free to move laterally at the top, a static active lateral earth pressure of 36 psf per foot of depth is recommended for a free draining, level and compacted backfill. If lateral movement at the top of abutment walls is restrained, the lateral earth pressure for a free draining, level and compacted backfill should follow Section 5.5.5.11 of the Caltrans BDS dated August 2004. For this condition, we recommend a coefficient of active lateral earth pressure of 0.3, a coefficient of at-rest lateral earth pressure of 0.47 and a soil unit weight of 120 lb/ft^3. If applicable, a uniform lateral pressure of at least 72 psf due to vehicle loads, equivalent to a vertical pressure produced by at least 2 feet of earth, should be added to the above lateral earth pressure.

Passive Resistance of Abutment Backfill. Under seismic loading, an ultimate passive earth pressure of 5 ksf may be used for the approach backfill and abutment walls with a height equal to or greater than 5.5 feet. For abutment walls with heights less than 5.5 feet, the passive pressure may be calculated proportionally (e.g., for a 4-foot high wall, the passive pressure is [4/5.5]x 5 ksf = 3.64 ksf. The horizontal movement at which the maximum passive pressure is expected to be fully mobilized can be determined following the procedure outlined in Section 7.8.1 of the Caltrans SDC (2006b).

There are no abutment wingwalls since both abutments are adjacent to RW 526 and 536. There is a small return wall connecting the abutment to the retaining walls. This return wall sits on the abutment pile cap as a part of the abutment design. Design of RW 526 and 536 is in the roadway plans.

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 EARTHWORK

Earthwork should be performed in accordance with Caltrans Standard Specifications, Section 19 (Caltrans, 2006c). Appropriate measures should be taken to prevent damage to adjacent structures and utilities. Any design and construction of temporary sloping, sheeting, or shoring should be made the contractor's responsibility. It should be noted that it is the responsibility of the contractor to oversee the safety of the workers in the field during construction. The contractor shall conform to all applicable occupational and health standards, rules, regulations, and orders established by the State of California. In addition, other State, County, or Municipal regulations may supersede the recommendations presented in this section. If a trench shoring design and safety plan is required, the geotechnical consultant should review the plan to confirm that recommendations presented in this report have been applied to the design.

During the recent field investigation conducted on September 21 and October 1, 2008, groundwater was not encountered down to El. +166 feet which is more than 90 feet from the freeway surface. As shown on the as-built LOTB sheets in Appendix A, groundwater was not encountered during drilling in June 1966 down to El. +178 feet. Therefore, groundwater is not expected to be encountered during footing construction. However, groundwater level can fluctuate due to seasonal rainfall amount, local irrigation and groundwater recharge program and other man-made conditions. If groundwater is encountered, it should be controlled in accordance with Section 19-3.04 of the Caltrans Standard Specifications (2006c).

6.2 PILE CONSTRUCTION

For on-center pile spacing less than six times the pile diameter, no two adjacent piles can be constructed concurrently.

Loose soils should be cleaned from the bottom of the borings. Pile borings should be inspected and approved by the geotechnical engineer prior to the installation of reinforcement. Extreme care in drilling, placement of steel, and the pouring of concrete is essential to avoid excessive disturbance of pile boring walls. Concrete placement by pumping or tremie tube to the bottom of the pile borings is recommended. Specifications should require that sufficient space be provided in the pile reinforcing cage during fabrication to allow the insertion of a tremie tube for concrete placement. The pile reinforcing cage should be installed and the concrete pumped immediately after drilling is completed.

Sandy soils were encountered in our soil borings and these materials are susceptible to caving. If caving occurs, a temporary casing may be required during construction. Casings should have an outer diameter equal to or exceeding the pile diameter. Temporary casing should be placed tight-in-hole. Vibratory or impact hammer with or without center-relief drilling can be used to install the temporary casing provided the existing structure is monitored for potential movement due to ground vibration; casing installation using this method should be suspended if excessive movement is detected. The temporary casing should be pulled as the concrete is being poured while always maintaining at least a 5-foot head of concrete inside the casing.

6.3 BACKDRAIN AND BACKFILL REQUIREMENTS FOR ABUTMENT WALLS

Per Caltrans requirements, expansive soils should not be placed as part of the embankment within the limits of a bridge abutment as shown in Figure 6-1. Materials placed behind abutment wall should be low-expansive soil with an Expansion Index (EI) less than 50 and Sand Equivalent (SE) of more than 20. The low-expansive material requirement should be supplemental to the abutment structure and pervious backfill requirement as described in Caltrans Standard Plans (2006d) and Caltrans Standard Specifications (2006c) under Sections 19-3.06 and 19-3.065, respectively.

Backfill should be compacted in accordance with Section 19-5 of the Caltrans Standard Specifications (2006c). Backfill should be placed in loose lifts not exceeding 8 inches in thickness, moisture-conditioned to near optimum moisture content, and compacted to at least 95 percent relative compaction. The relative compaction should be based on the maximum density determined by California Test 216. Jetting or flooding to compact backfill is not recommended. Heavy compaction equipment, such as vibratory rollers, dozers, or loaders, should not be used adjacent to the abutment walls in order to avoid damaging the walls due to large lateral earth pressures.

Backdrains should be installed behind abutment walls to relieve hydrostatic pressure. Backdrains should be constructed in accordance with Bridge Detail 3-1 on Sheet BO-3 per Caltrans Standard Plans (2006d) or the geocomposite drain alternative per Section 6 of the Caltrans Bridge Design Aids (1992b).

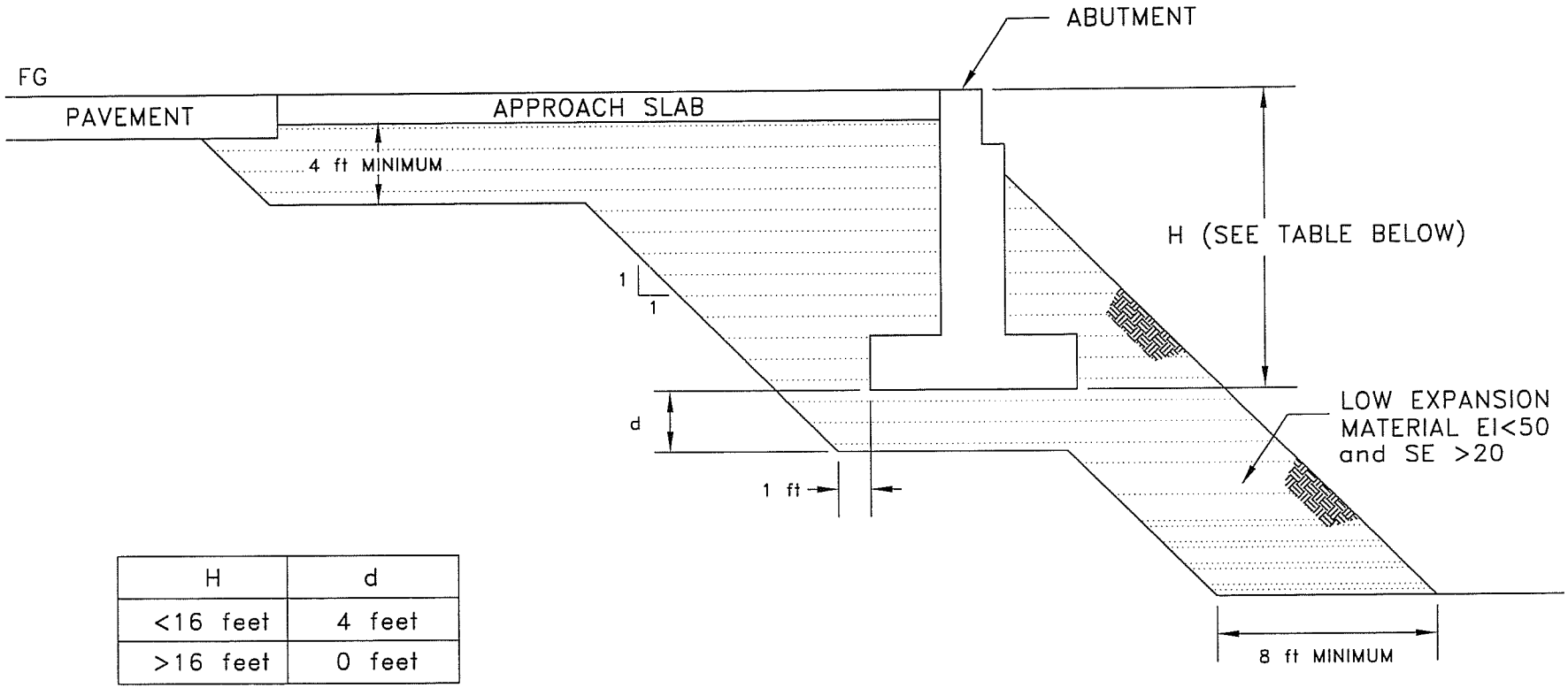
6.4 REVIEW OF CONSTRUCTION PLANS

Recommendations contained in this report are based on preliminary plans. The geotechnical consultant should review the final construction plans and specifications in order to confirm that the general intent of the recommendations contained in this report have been incorporated into the final construction documents. Recommendations contained in this report may require modification or additional recommendations may be necessary based on the final design.

6.5 GEOTECHNICAL OBSERVATION AND TESTING

It is recommended that inspections and testing be performed by the geotechnical consultant during the following stages of construction:

- Grading operations, including excavations and placement of compacted fill
- Shoring installation
- Footing excavations
- Pile installation
- Backdrain installation and backfilling of bridge abutment walls.
- Removal or installation of support of buried utilities or structures
- When any unusual subsurface conditions are encountered



H	d
<16 feet	4 feet
>16 feet	0 feet

EXPANSION INDEX TO BE DETERMINED BY ASTM D4829
SAND EQUIVALENT TO BE DETERMINED
BY CALIFORNIA TEST METHOD 217

NO SCALE

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

NUTWOOD AVENUE UC (WIDEN)

EMI Project No. 08-115

Date: 01-12-2009

LOW EXPANSION MATERIAL
IN BRIDGE EMBANKMENT

FIGURE 6-1

7.0 LIMITATIONS

This report is intended for the use of RBF Consulting, Orange County Transportation Authority and Caltrans for the widening of Nutwood Avenue Undercrossing. This report is based on the project as described and the information obtained from the exploratory borings at the approximate locations indicated on the attached plans. The findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses. In addition, soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project site. However, subsurface conditions and characteristics of soils between exploratory borings can vary. The findings reflect an interpretation of the direct evidence obtained. The recommendations presented in this report are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained in this report are applicable to the specific design element(s) and location(s) which is (are) the subject of this report. They have no applicability to any other design elements or to any other locations and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

EMI has no responsibility for construction means, methods, techniques, sequences, or procedures; for safety precautions or programs in connection with the construction; for the acts or omissions of the CONTRACTOR or any other person performing any of the construction; or for the failure of any worker to carry out the construction in accordance with the Final Construction Drawings and Specifications.

Services performed by EMI have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

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APPENDIX A

LOG OF TEST BORINGS SHEETS AND AS-BUILT LOG OF TEST BORINGS SHEETS

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lin Cheang
REGISTERED ENGINEER — DATE

PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

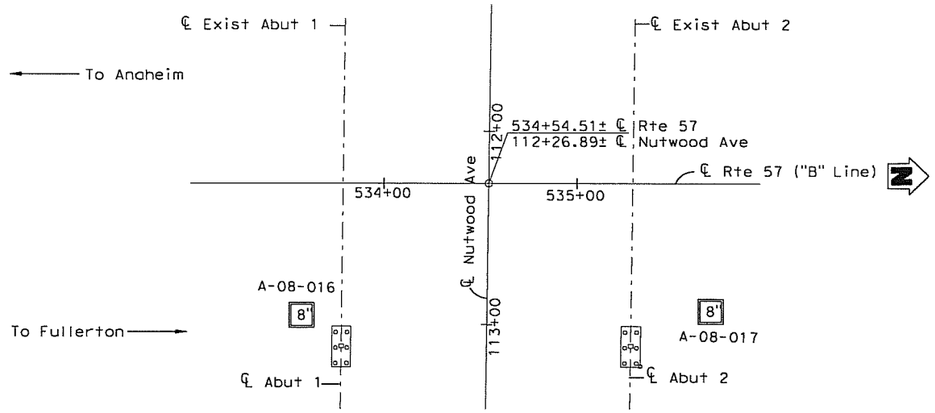
EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 40'

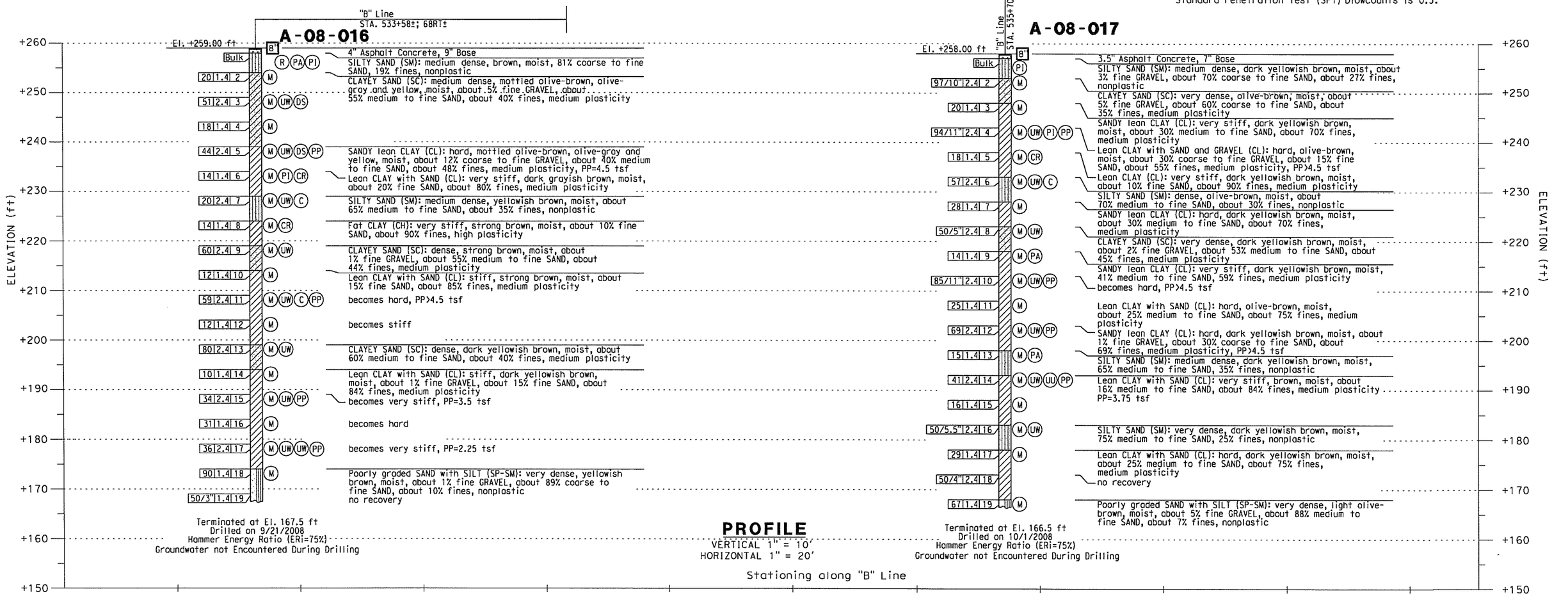
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang	BRIDGE NO. 55-0464
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie		PROJECT ENGINEER	POST MILES 17.6

NUTWOOD AVENUE UC (WIDEN)
LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F0311

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 4/30/09

SHEET OF

USERNAME -> $USER
DATE PLOTTED -> $DATE
TIME PLOTTED -> $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lina Cheang
REGISTERED ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
	D	Dynamic Cone Penetration Boring
	CPT	Cone Penetration Test (ASTM D 5778-95)
	O	Other

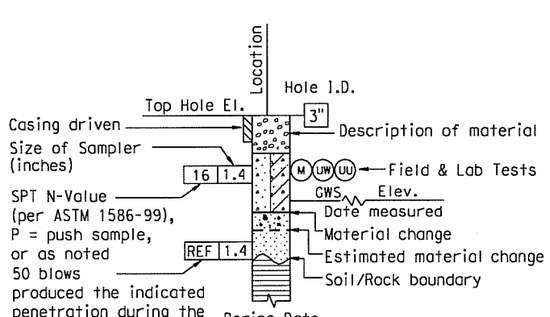
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

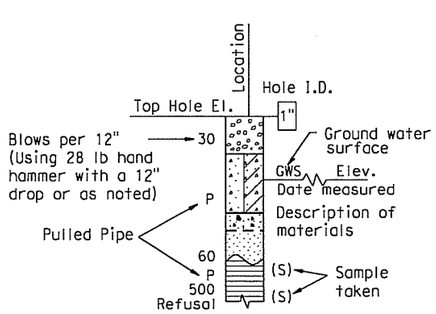
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

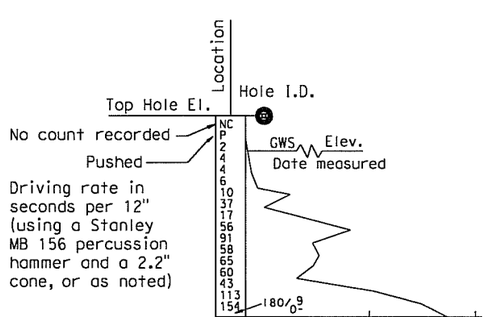
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



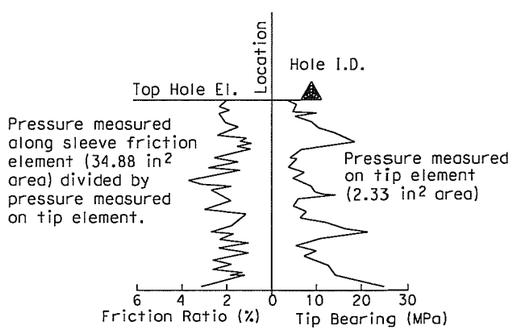
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0464 POST MILES 17.6

NUTWOOD AVENUE UC (WIDEN)
LOG OF TEST BORINGS NO. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER
DATE PLOTTED => $DATE
TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lina Cheang
REGISTERED ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

L. Cheang
PROJECT ENGINEER

BRIDGE NO. 55-0464
POST MILES 17.6

NUTWOOD AVENUE UC (WIDEN)
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FED. ROAD DIV. NO.	STATE	F. A. PROJECT No.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	15.6/18	197	197

Date Approved: August 28, 1967

BENCH MARK

BM "519.2-65" Elev. 267.59
Set B/B in N. curb of Chapman Ave.
0 E.C.R. from Placentia Ave 46' W. of
Placentia & 31' N. of ℄ Chapman

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

Lino Cheang
REGISTERED CIVIL ENGINEER — DATE

NUTWOOD AVENUE UC (WIDEN)

AS-BUILT LOG OF TEST BORINGS

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CU: 12 EA: 0F0311 — BRIDGE No. 55-0464

Sheet	of
X	X

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/69
GEOTECHNICAL
STATE OF CALIFORNIA

B-3 [3]

N 626,575.396
E 505,410.087

B-2 [2]

℄ FWY RTE 57

534 — 535

℄ NUTWOOD AVE

112 — 113

B-1 [1]

PLAN
Scale 1"=20'

AS BUILT PLANS
Contract No. 07-032124
Date Completed
Document No. 7000668

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE June 1966

AS BUILT
CORRECTIONS BY Hudson Glass 7-29-69
CONTRACT NO. 07-032124
DATE 9-30-69

PROFILE
Scale Vert. 1"=10'
Horiz. 1"=20'

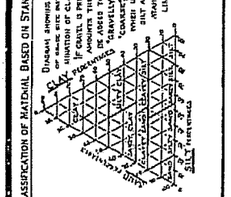
LEGEND OF BORING OPERATIONS

- Penetrometer
- 2½" Cone Penetrometer
- Sampler Boring (Dry)
- Rotary Boring (Wet)
- Auger Boring (Dry)
- Jet Boring
- Cone Boring
- Test Pit

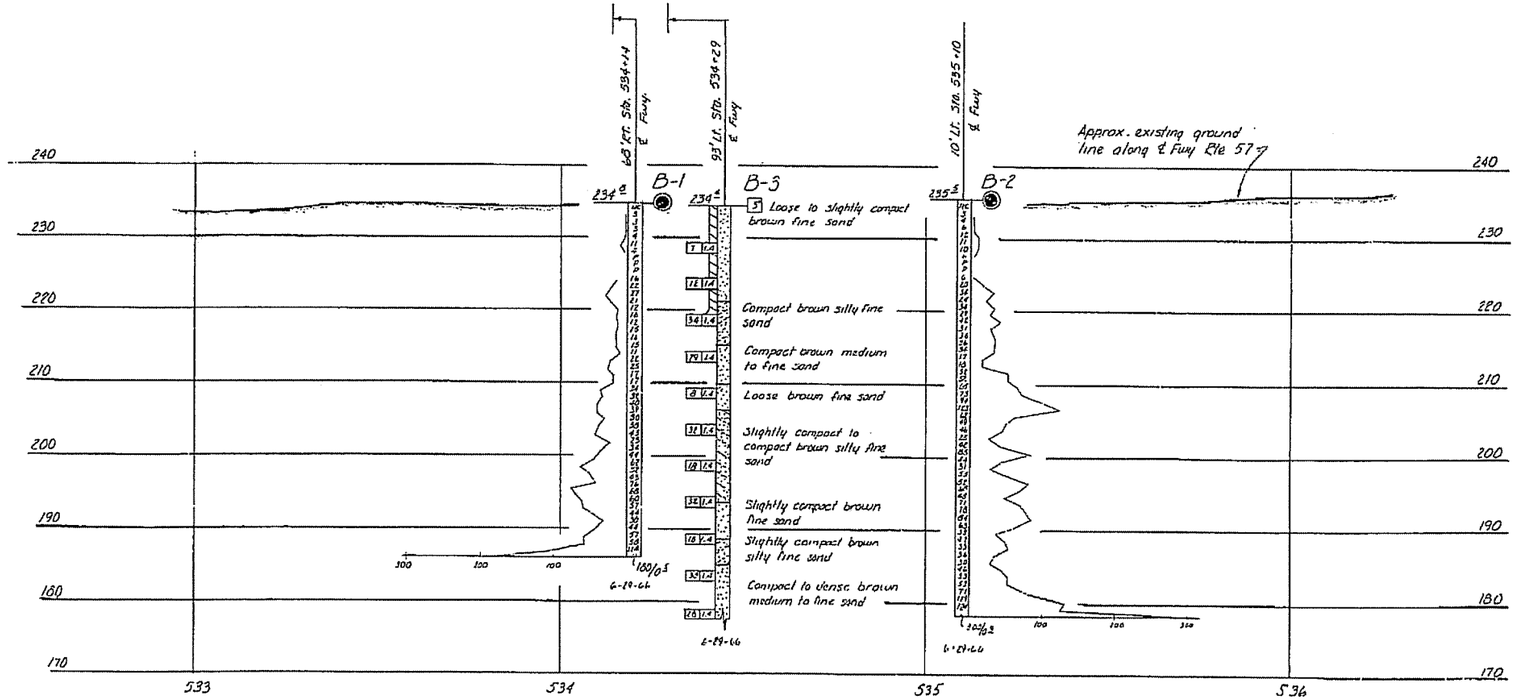
LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Sandy Clay or Clayey Sand
- Silty Clay or Clayey Silt
- Peat and/or Organic Matter
- Fill Material
- Igneous Rock
- Sedimentary Rock
- Metamorphic Rock
- Sandy Silt or Silty Sand

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS



NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.



SHEET	OF
12	12

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

NUTWOOD AVENUE UNDERCROSSING

LOG OF TEST BORINGS

SCALE As Noted	BRIDGE 55-464	FILE	DRAWING 55464-1/2

Disregard prints bearing earlier numbers → PREL. DRAWING NO. PR- 9/67

Charge 07208
W. A. 032131

BRIDGE DEPARTMENT
ENGINEERING GEOLOGY SECTION

	By	Date
FIELD STUDY	R. COBBLE	2-27-66
DRAWN	R. Cobble	2-27-66
CHECKED	R. C. Reavis	3-29-66

Approved Recommended: Charles E. West, Engineering Geologist

197

APPENDIX B

LABORATORY TEST RESULTS

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 **Project Name :** RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-016	S-2	5	SC	13.9										
A-08-016	D-3	10	SC	15.5	126.8									
A-08-016	S-4	15	SC	17.2										
A-08-016	D-5	20	SC	20.2	130.3	4.5								
A-08-016	S-6	25	CL	19.8						35/17/18	1040	7.7	150	312
A-08-016	D-7	30	SM	9.7	124.2									
A-08-016	S-8	35	CH	17.5							530	7.5	120	364
A-08-016	D-9	40	SC	11.3	137.7									
A-08-016	S-10	45	CL	23.7										
A-08-016	D-11	50	CL	15.1	133.9	>4.5								
A-08-016	S-12	55	CL	19.0										
A-08-016	D-13	60	SC	13.1	138.2									
A-08-016	S-14	65	CL	26.2										
A-08-016	D-15	70	CL	18.2	125.1	3.5								
A-08-016	S-16	75	CL	16.2										
A-08-016	D-17	80	CL	20.2	126.7	2.25								
A-08-016	S-18	85	SP-SM	4.3										
A-08-017	D-2	5	SC	10.4										
A-08-017	S-3	10	CL	12.3										
A-08-017	D-4	15	CL	12.8	92.0	>4.5				30/20/10				
A-08-017	S-5	20	CL	19.9							490	7.3	250	362
A-08-017	D-6	25	SM	4.7	123.4									
A-08-017	S-7	30	CL	14.1										
A-08-017	D-8	35	SC	9.1	124.9									
A-08-017	S-9	40	CL	10.2				0:41:59						
A-08-017	D-10	45	CL	12.5	129.5	>4.5								
A-08-017	S-11	50	CL	13.8										
A-08-017	D-12	55	CL	17.4	129.9	>4.5								
A-08-017	S-13	60	SM	7.7				0:65:35						
A-08-017	D-14	65	CL	29.4	124.3	3.75								
A-08-017	S-15	70	CL	17.5										
A-08-017	D-16	75	SM	6.1	106.2									
A-08-017	S-17	80	CL	22.2										
A-08-017	S-19	90	SP-SM	1.0										

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

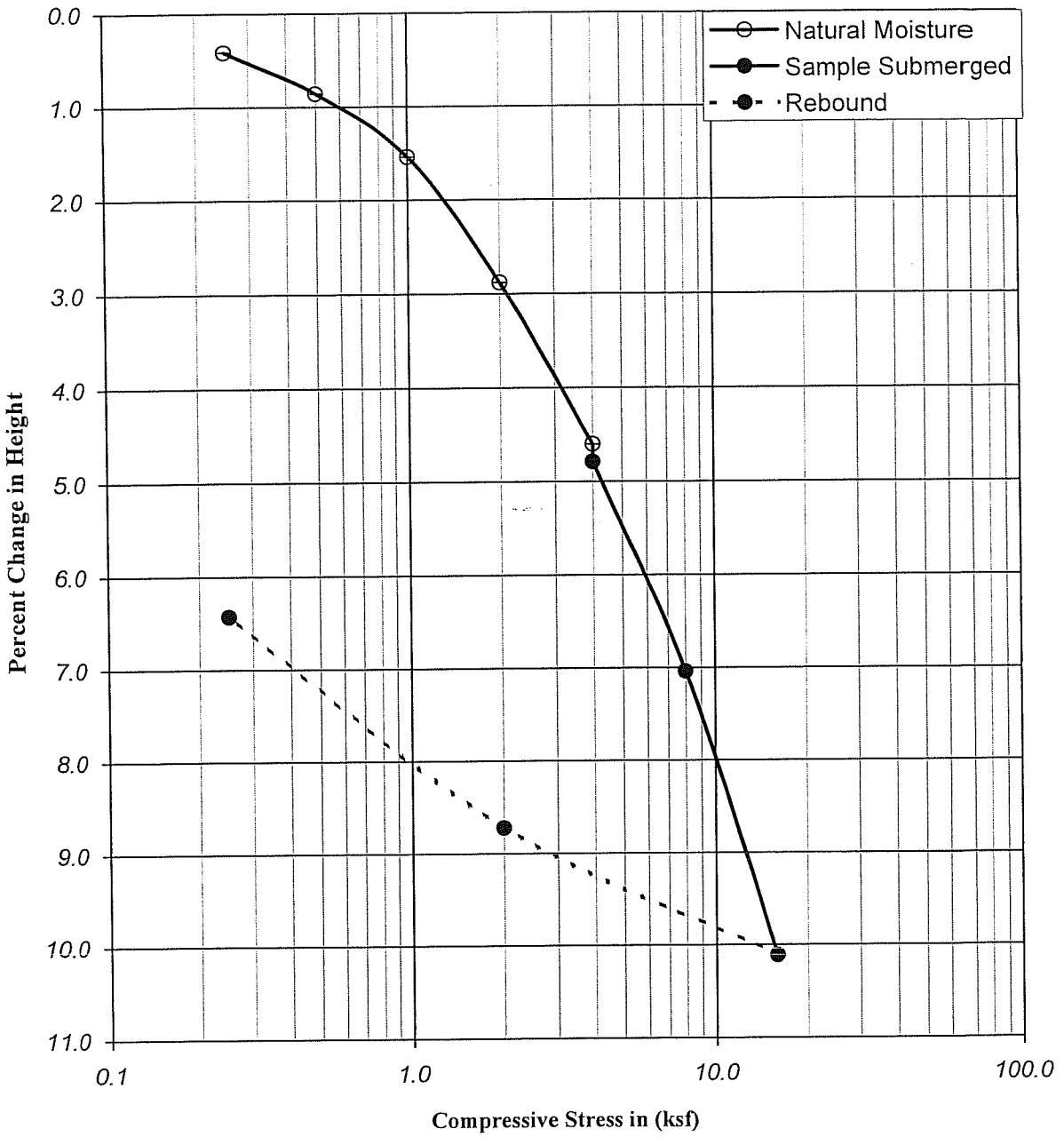
Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No .	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-016	BULK	1.0 - 5	SM							Non-Plastic				
A-08-017	BULK	1.5 - 5	SM							Non-Plastic				

TABLE 2 SUMMARY OF LABORATORY STRENGTH TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No .	Sample No.	Sample Depth	Soil Identification (group symbol) ASTM D2488/D2487	Unconsolidated Undrained Triaxial Test (ASTM D2850)				Direct Shear Test (ASTM D3080)			
								Peak		Residual	
				Peak Strength S_u	Strain at Peak S_u	Shear Strength at 10% Strain S_u	Confining Pressure	ϕ	C	ϕ	C
		(ft)		(ksf)	(%)	(ksf)	(ksf)	(deg)	(ksf)	(deg)	(ksf)
A-08-016	D-3	10	SC					40.49	0.42	24.51	0.31
A-08-016	D-5	20	SC					23.98	0.95	29.61	0.27
A-08-017	D-14	65	CL	3.93	10.09	3.93	5.19				



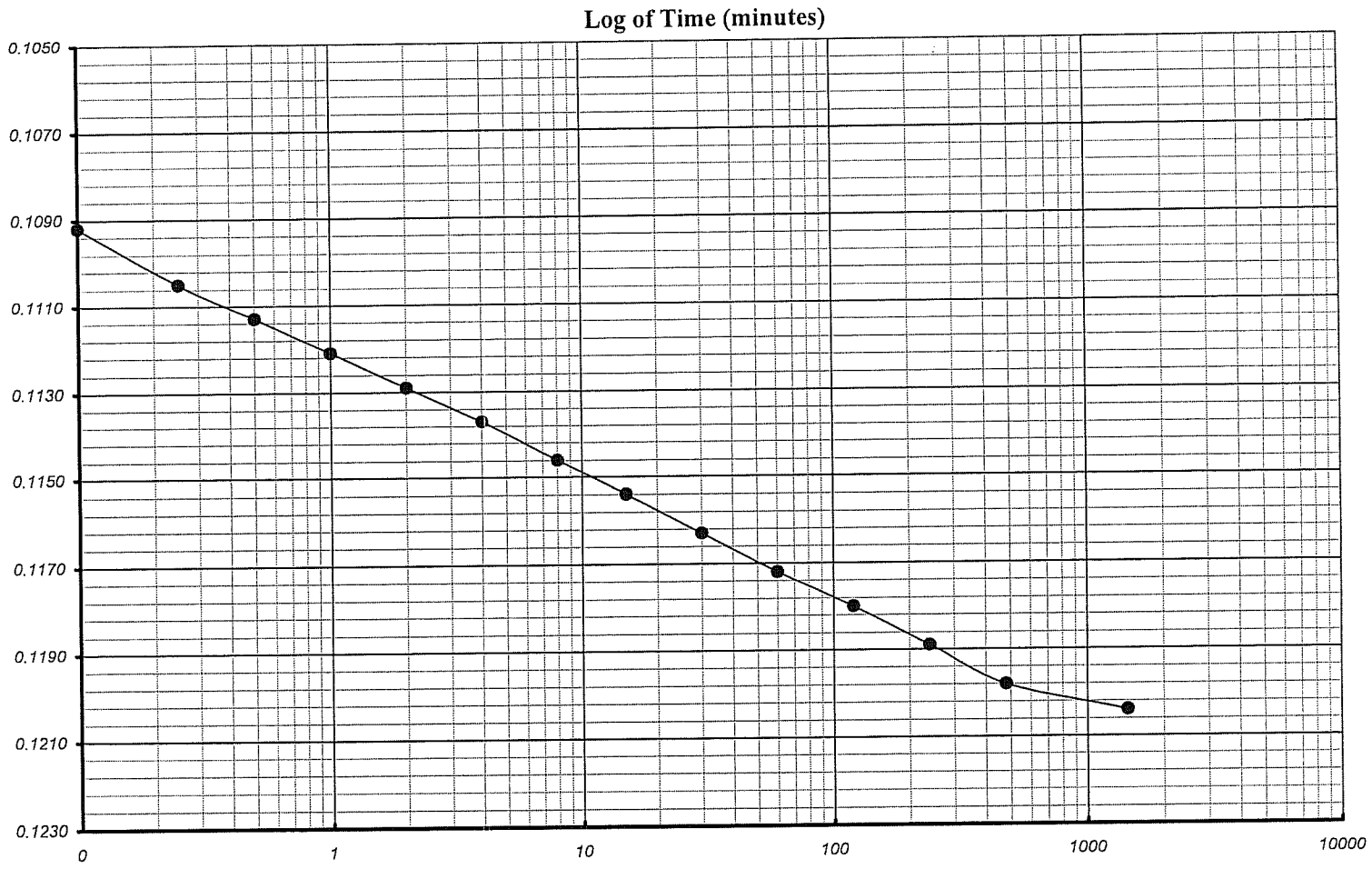
Boring No.	: A-08-016		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-7		Plastic Limit :	-						
Depth (ft)	: 30.0	31.5	Plastic Index :	-	Initial	18.78	103.85	16.35	81.38	0.62
Depth (m)	: 9.15	9.61	Specific Gravity :	2.70	Final	19.40	111.00	17.47	100.98	0.52
Description	: Dark yellowish brown, lean CLAY with SAND (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

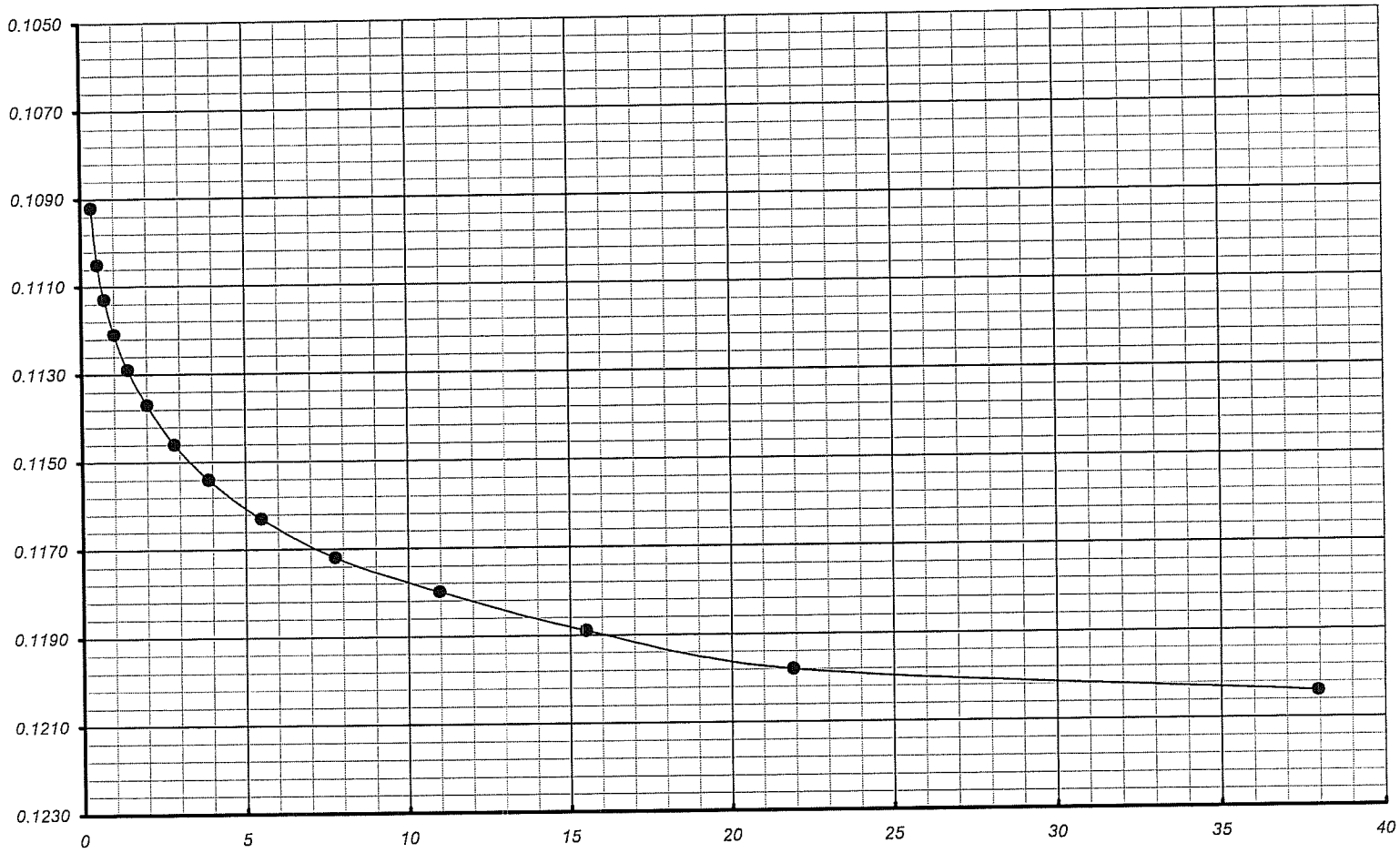
Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

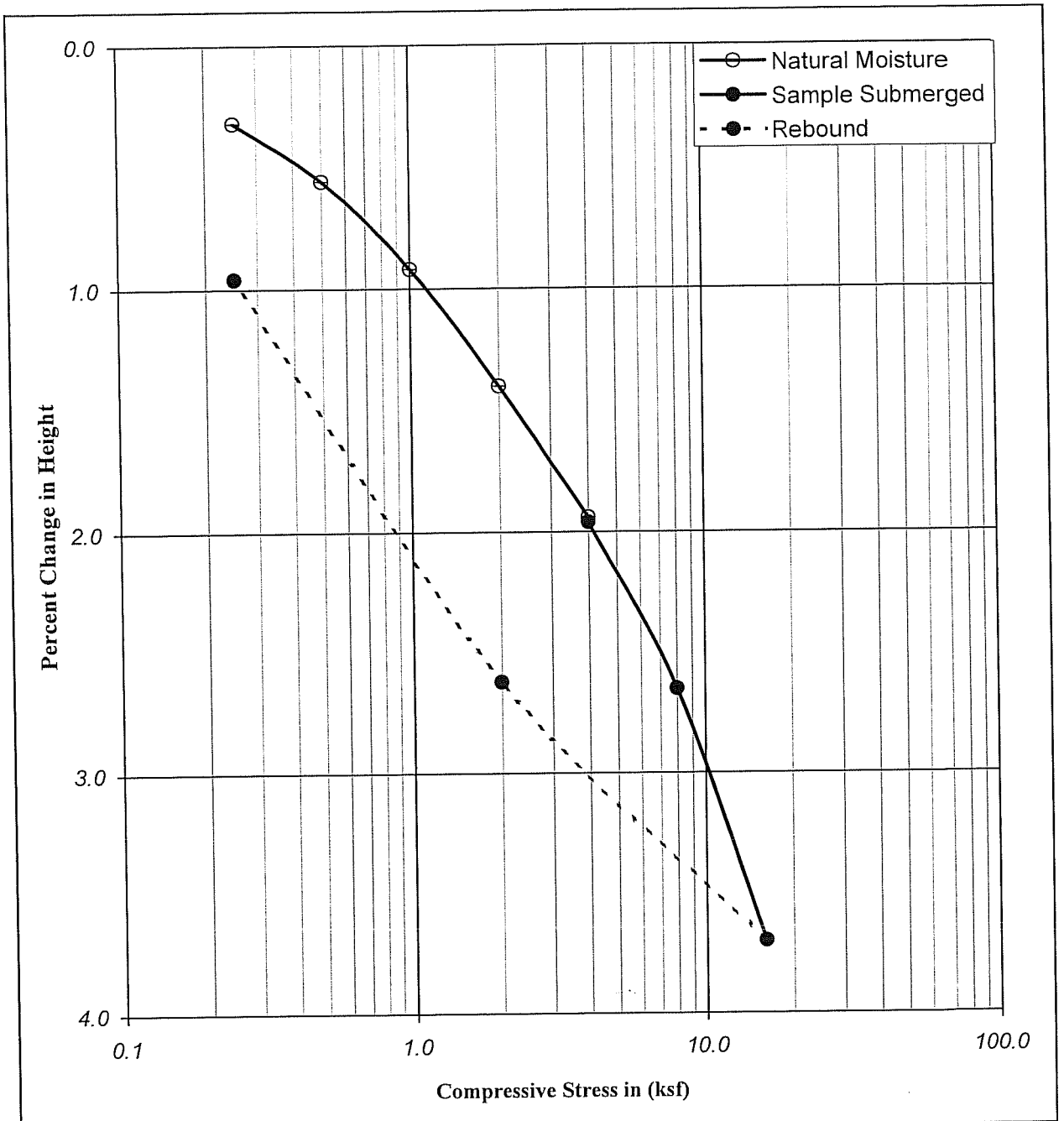


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound	Boring No. : A-08-016	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : D-7	
EMI Project No. : 08-115		Depth (ft/m) : 30.0 9.2	Veritcal Load (ksf/kpa) : 8.00 383.0

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-016*	**One-Dimensional Consolidation of Soil** Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-7*	
EMI Project No. : *08-115*		Depth (ft/m) : *30.0* *9.2*	Veritcal Load (ksf/kpa) : *8.0* *383.0*



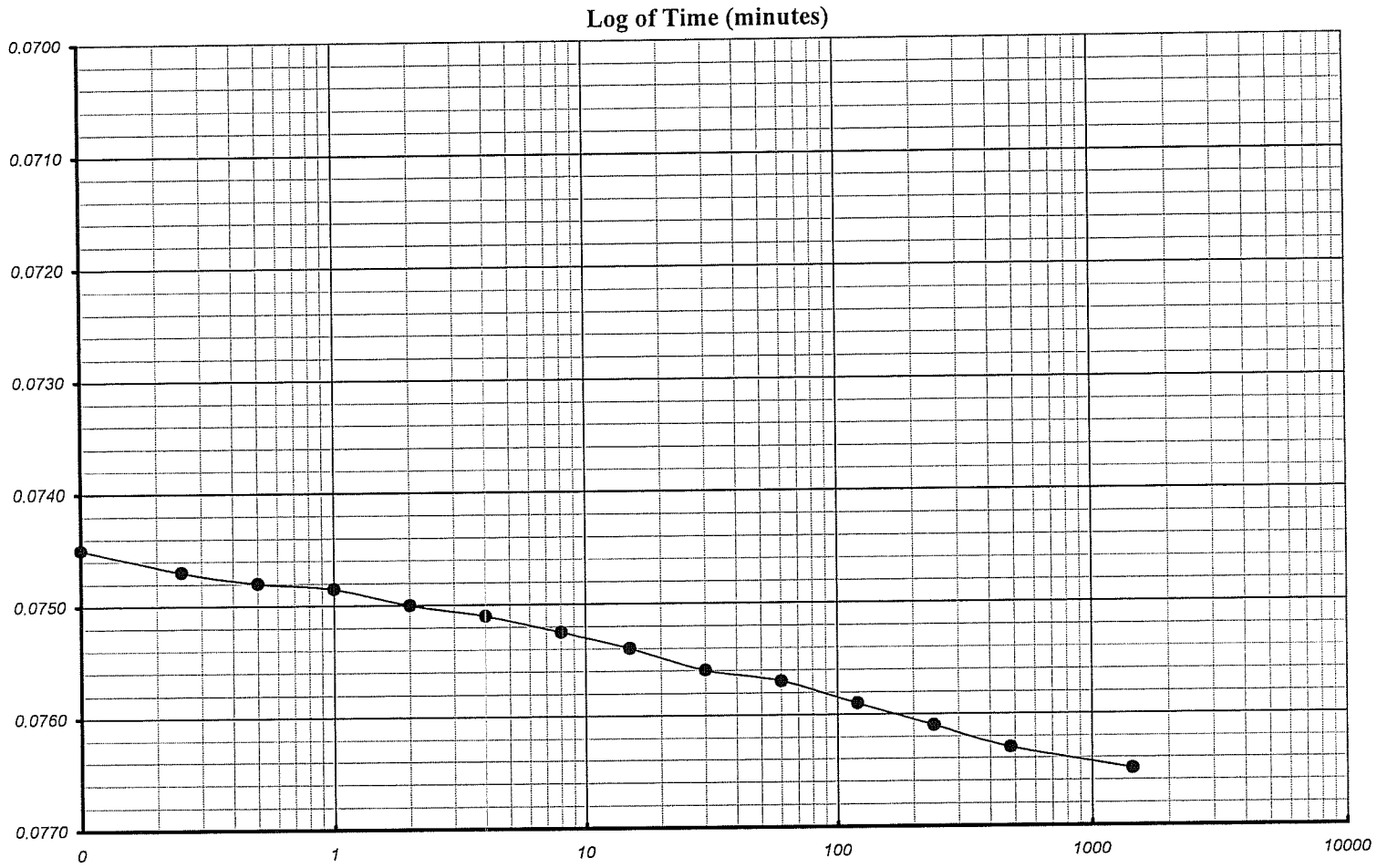
Boring No.	: A-08-016		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-11		Plastic Limit :	-						
Depth (ft)	: 50.0	51.5	Plastic Index :	-	Initial	15.23	113.96	17.94	85.79	0.48
Depth (m)	: 15.25	15.71	Specific Gravity :	2.70	Final	16.92	115.25	18.14	98.75	0.46
Description	: Dark yellowish brown, Lean CLAY With SAND (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

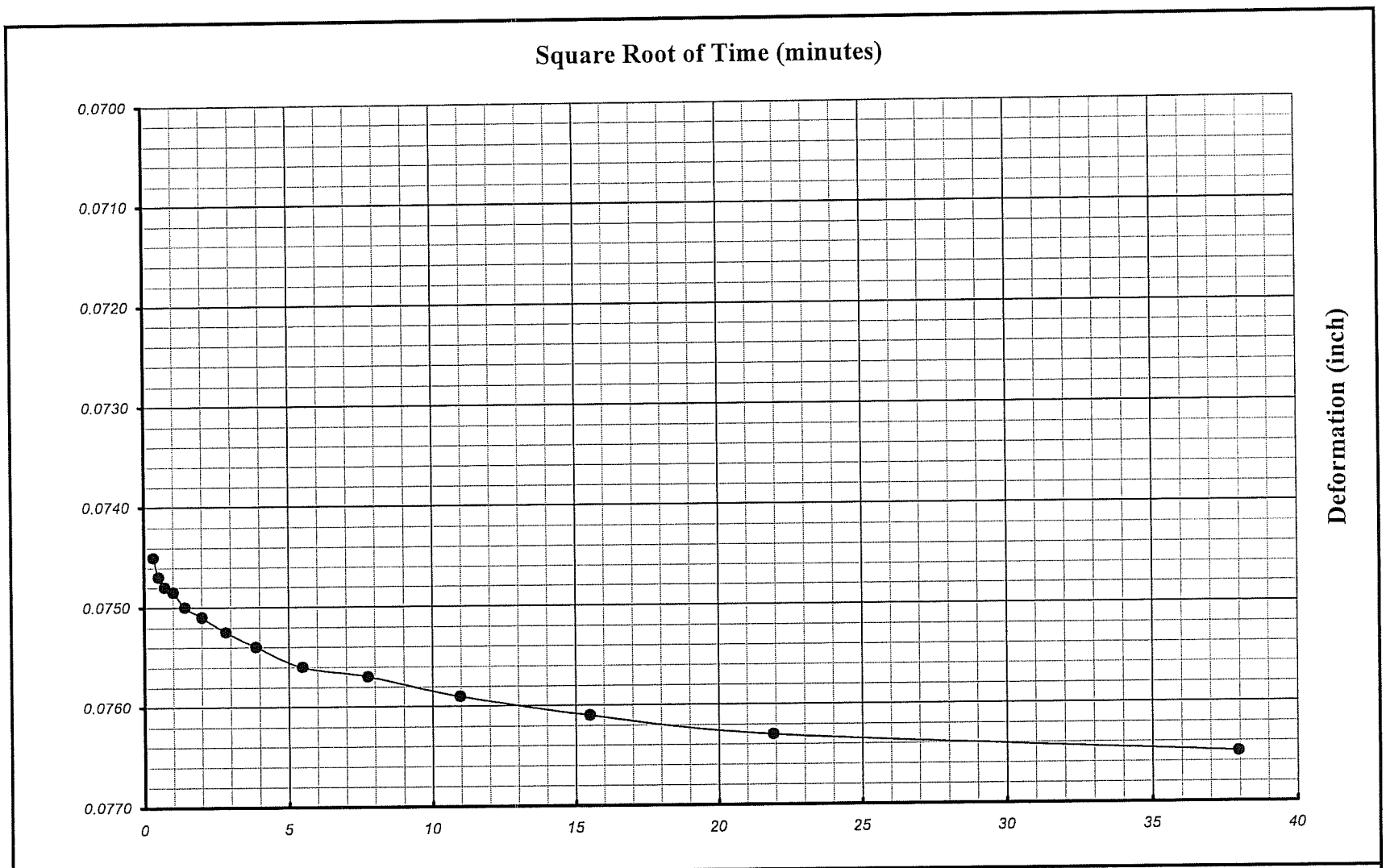
RBF/SR-57 Northbound

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

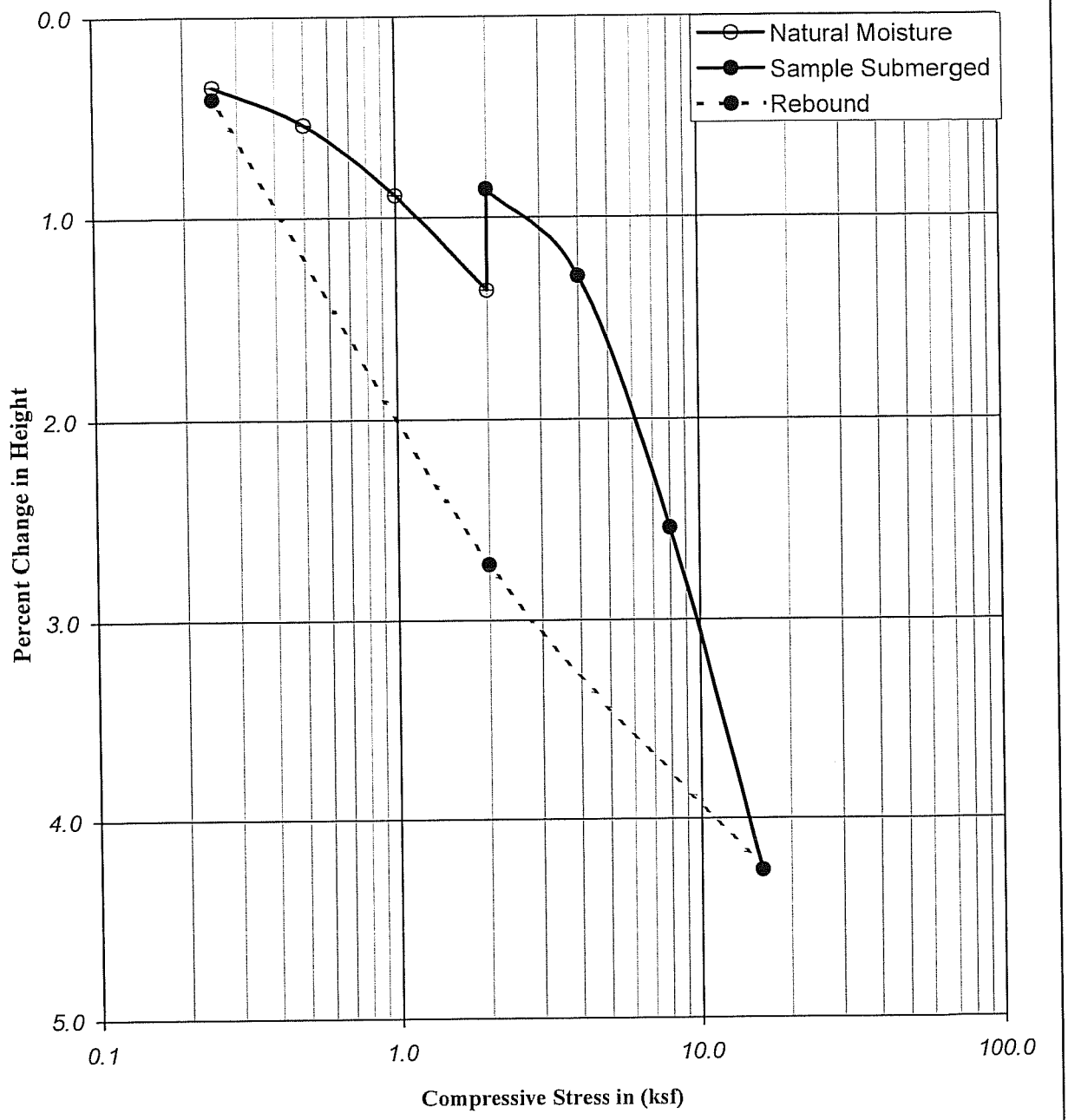
Project No. : 08-115 12/05/08



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound	Boring No. : A-08-016	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : D-11	
EMI Project No. : 08-115		Depth (ft/m) : 50.0 15.3	Veritcal Load (ksf/kpa) : 8.00 383.0



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound	Boring No. : A-08-016	One-Dimensional Consolidation of Soil
		Sample No. : D-11	Time-Deformation Curve (Square Root of Time Method)
EMI Project No. : 08-115		Depth (ft/m) : 50.0 15.3	Veritcal Load (ksf/kpa) : 8.0 383.0



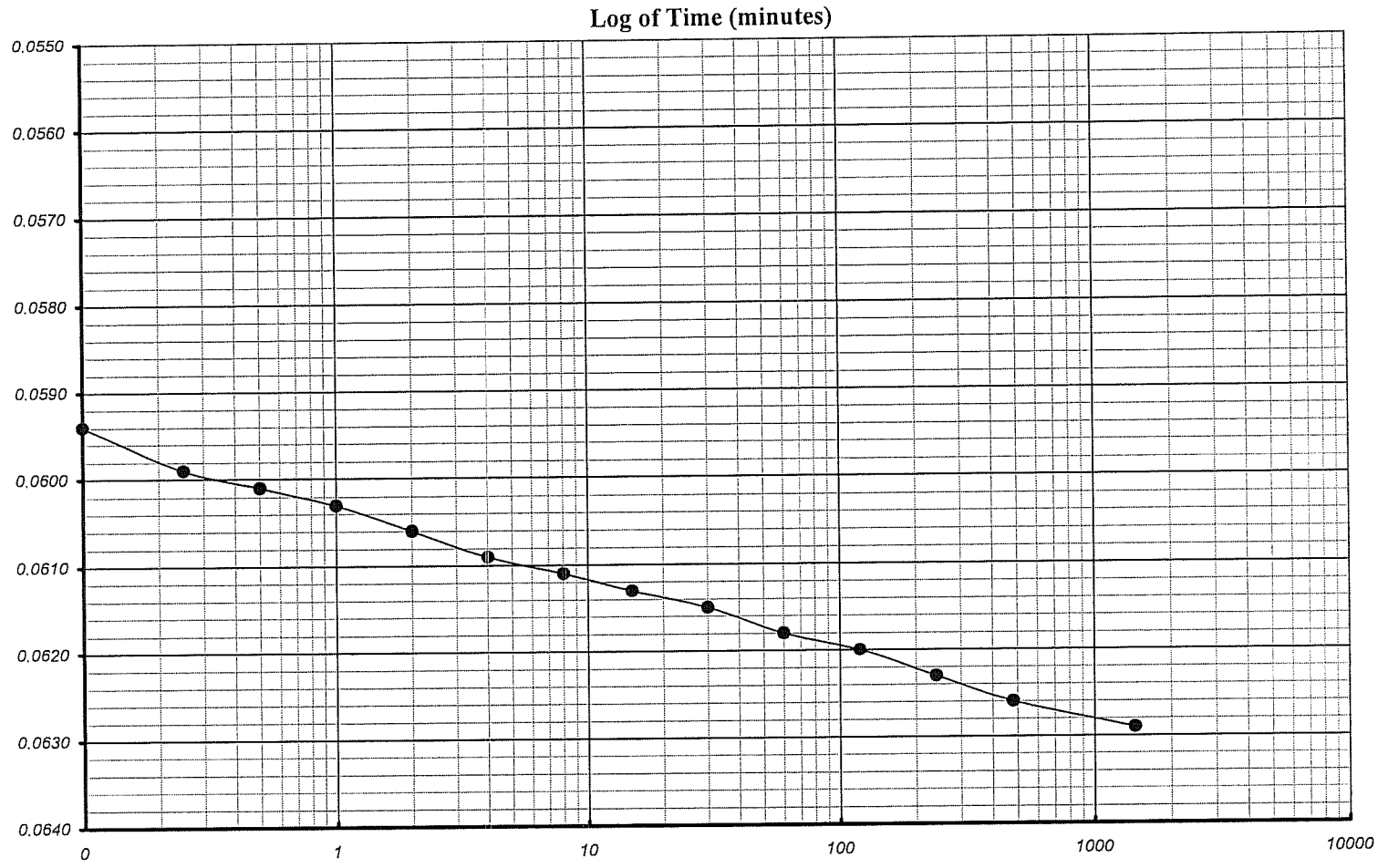
Boring No.	: A-08-017		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-6		Plastic Limit :	-						
Depth (ft)	: 25.0	26.5	Plastic Index :	-	Initial	14.38	110.80	17.44	74.49	0.52
Depth (m)	: 7.63	8.08	Specific Gravity :	2.70	Final	18.30	111.29	17.52	96.01	0.51
Description	: Dark brown, lean CLAY with SAND (CL)									

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

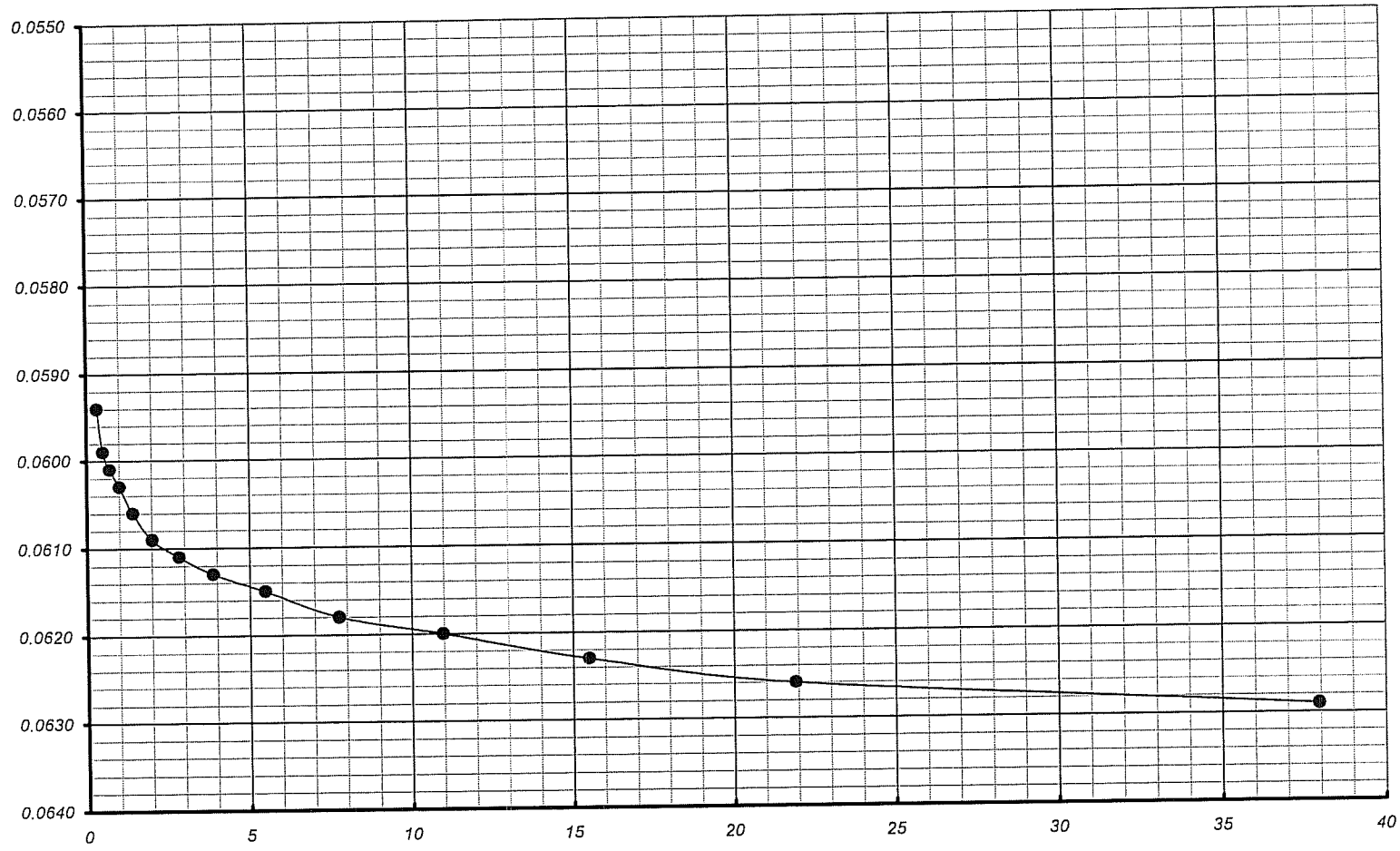
Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

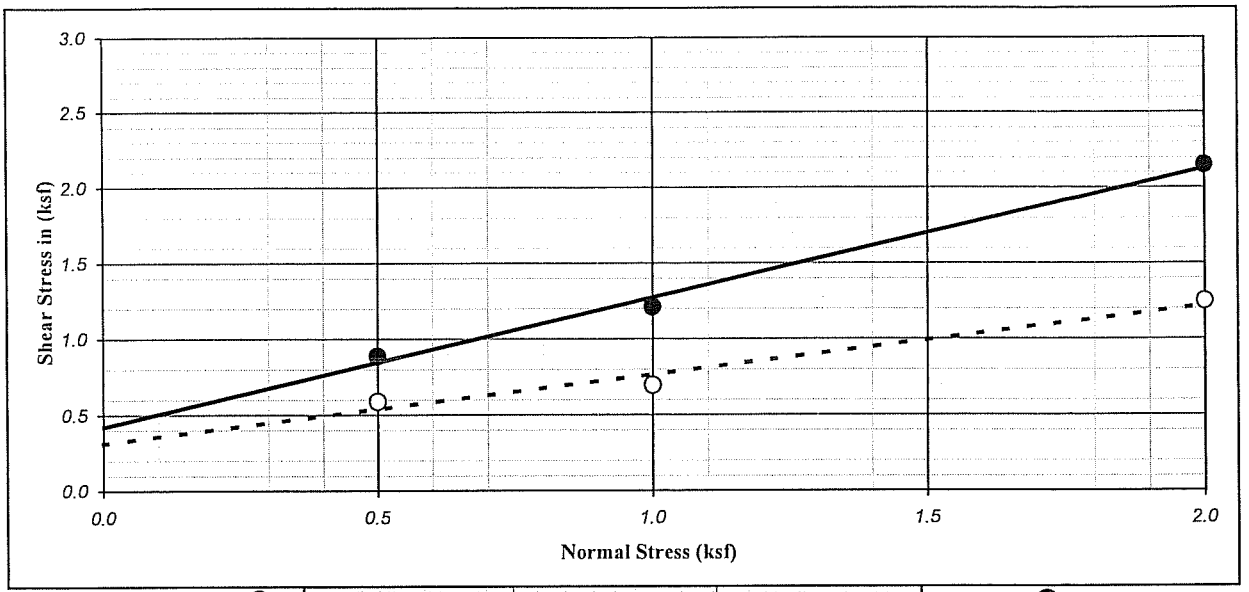


Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound	Boring No. : A-08-017	One-Dimensional Consolidation of Soil
		Sample No. : D-6	Time-Deformation Curve (Log of Time Method)
EMI Project No. : 08-115		Depth (ft/m) : 25.0 7.6	Veritcal Load (ksf/kpa) : 4.00 191.5

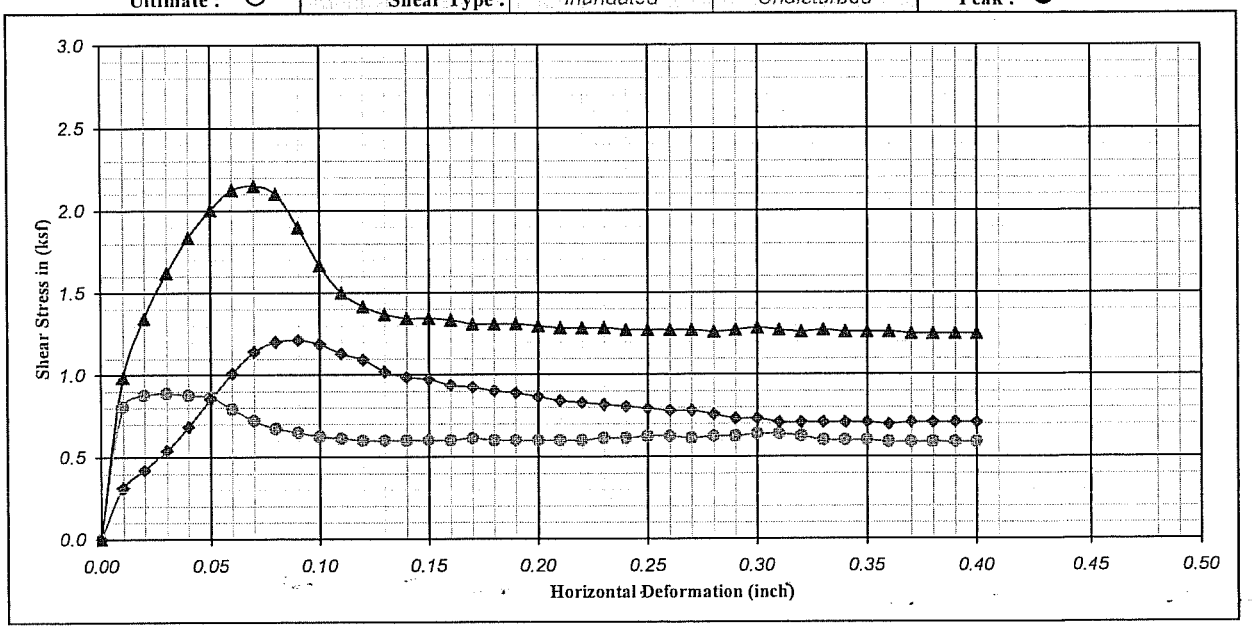
Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound	Boring No. : A-08-017	One-Dimensional Consolidation of Soil Time-Deformation Curve (Square Root of Time Method)
		Sample No. : D-6	
EMI Project No. : 08-115		Depth (ft/m) : 25.0 7.6	Veritcal Load (ksf/kpa) : 4.0 191.5



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-016		Strength Intercept (C) :	0.42	(ksf)		0.31	(ksf)		
Sample No. : D-3			20.11	(kPa)	Peak	14.94	(kPa)	Ultimate	
Depth (ft/m) : 10.0	0.00	Friction Angle (ϕ) :	40.49	Degree		24.51	Degree		
Description : Mottled olive gray, olive brown and yellow, CLAYEY SAND (SC)						Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	24.50	99.71	15.69	0.69	0.50	23.94	0.89	42.52	0.59	28.15
◆	21.80	99.86	15.72	0.69	1.00	47.88	1.21	58.03	0.70	33.32
▲	21.72	99.56	15.67	0.69	2.00	95.76	2.15	102.85	1.25	59.75

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

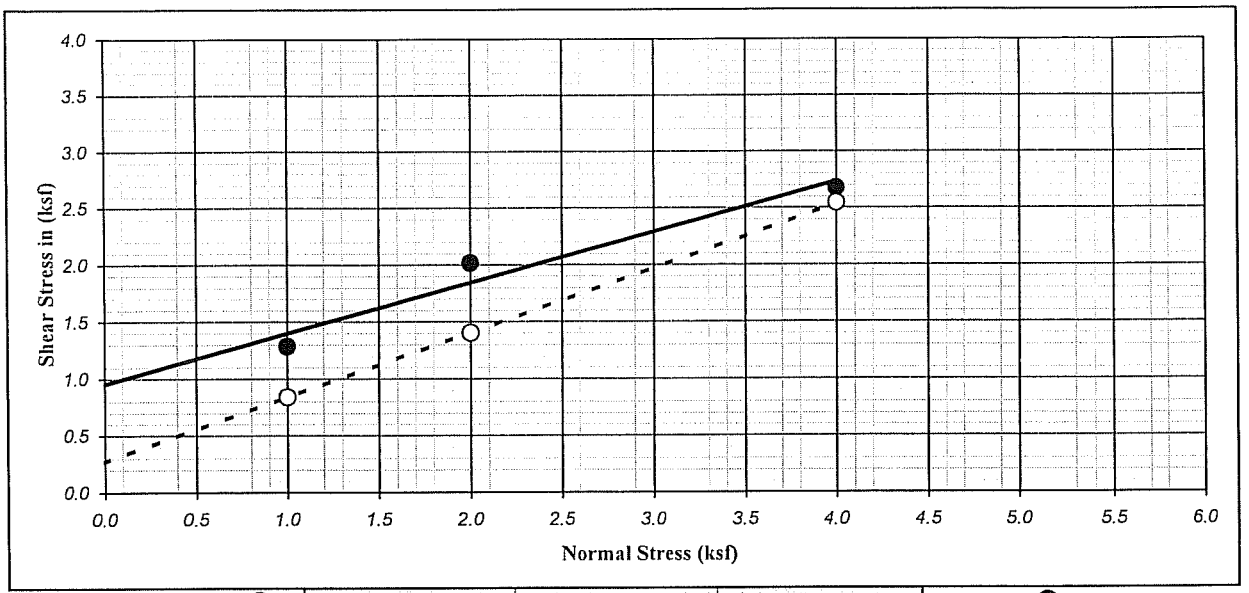
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

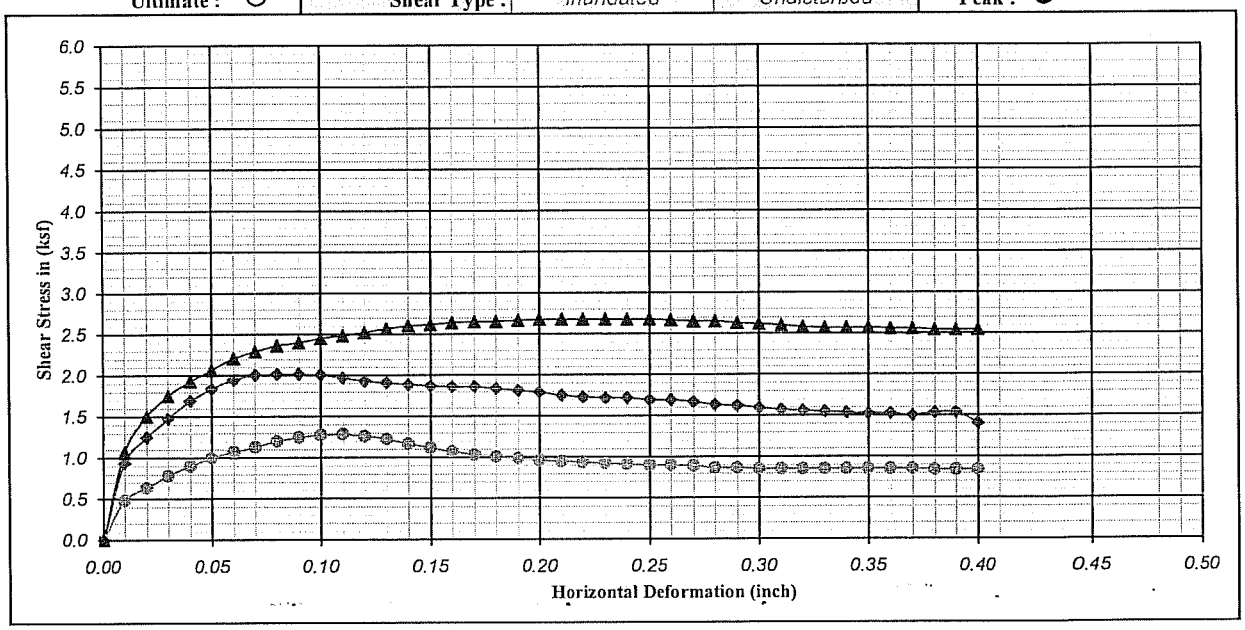
Project No. : 08-115

Date : 11/23/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No.	: A-08-016	Strength Intercept (C) :	0.95	(ksf)	Peak	0.27	(ksf)	Ultimate
Sample No.	: D-5		45.68	(kPa)		12.93	(kPa)	
Depth (ft/m)	: 20.0 / 0.00	Friction Angle (ϕ) :	23.98	Degree		29.61	Degree	
Description	: Mottled olive gray, olive brown and yellow, CLAYEY SAND (SC)					Shear Rate (inch/minute):		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	22.35	104.57	16.46	0.61	1.00	47.88	1.28	61.48	0.84	40.22
◆	23.20	102.74	16.17	0.64	2.00	95.76	2.02	96.53	1.40	67.22
▲	24.59	100.39	15.80	0.68	4.00	191.52	2.68	128.13	2.54	121.81

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

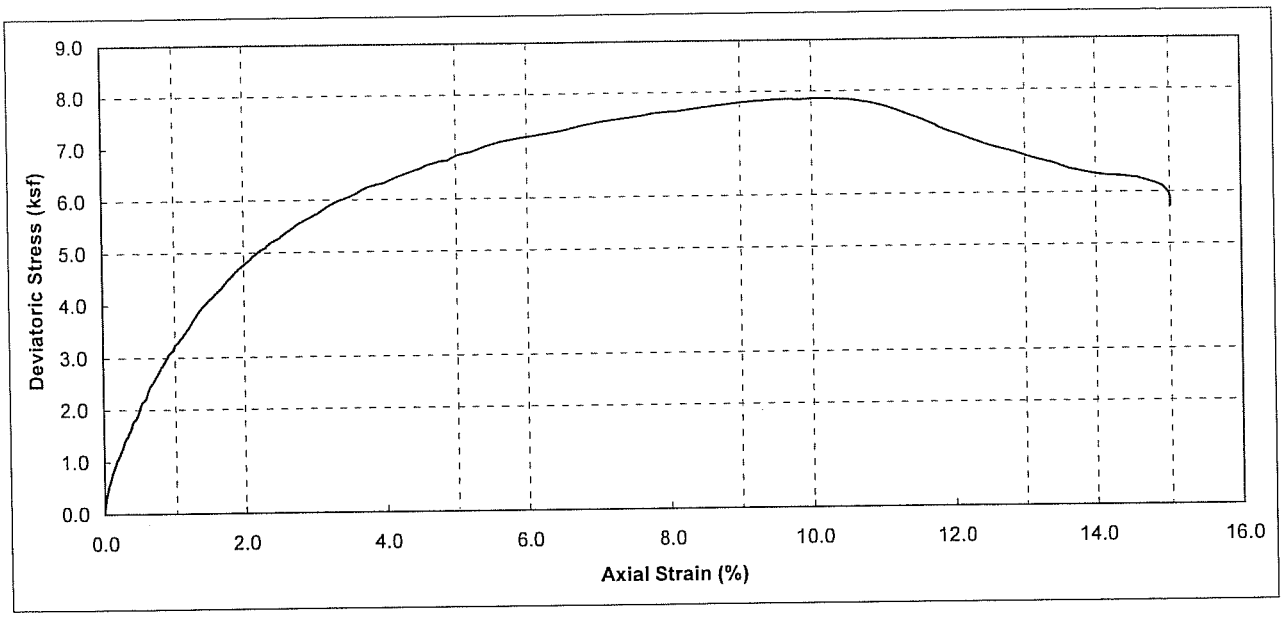
RBF/SR-57 Northbound

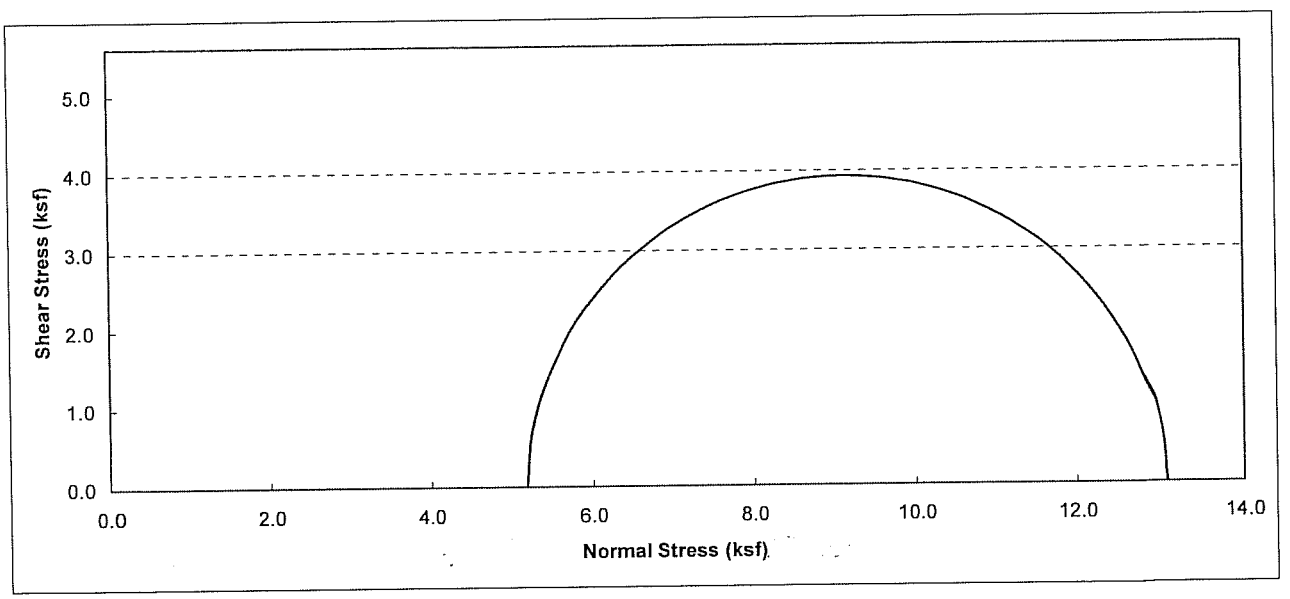
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115

Date : 11/24/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-017	D-14	65	Brown, LEAN CLAY With SAND (CL)	93.3	29.37	5.19	7.86	98.3

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/15/08

Figure No. :

APPENDIX C

DESIGN CALCULATIONS

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project SR-57 N/B Nutwood Ave. UC Project No. 08-115

By _____ Date 02/01/09 Checked By _____ Date _____ Sheet ____ of ____

Pile Properties: 24" ϕ CIDH

$P = \pi D = \pi(2) = 6.283$ ft

$A = \frac{\pi}{4} D^2 = 3.14$ ft^2 $= 452.16$ in^2

$I = \frac{\pi}{64}(24)^4 = 16\,286$ in^4

$E_c = 57000\sqrt{f'_c} = 57000\sqrt{3250} = 3.25 * 10^6$ lb/in^2

$EI = 5.29 * 10^{10}$ lb-in^2

$\frac{1}{2} EI = 2.65 * 10^{10}$ lb-in^2

Axial Capacity:

Both Abutments:

El.

258 — Fill $\gamma = 120$ pcf, $\phi = 32°$

244 — CL SPT = 18 → C = 2.1 ksf, $\gamma = 113$ pcf

235 — CL

230 — SPT = 13 → C = 1.8 ksf, $\gamma = 112$ pcf

SC

225 — SPT = 15 → $\phi = 32°$, $\gamma = 122$ pcf

CL

220 — SPT = 13 → C = 1.8 ksf, $\gamma = 115$ pcf

SC

215 — SPT = 30 → $\phi = 36°$, $\gamma = 125$ pcf

CL

200 — SPT = 13 → C = 1.8 ksf, $\gamma = 125$ pcf

SC/SM

195 — SPT = 15 → $\phi = 33°$, $\gamma = 125$ pcf

CL

SPT = 18 → C = 2.1 ksf

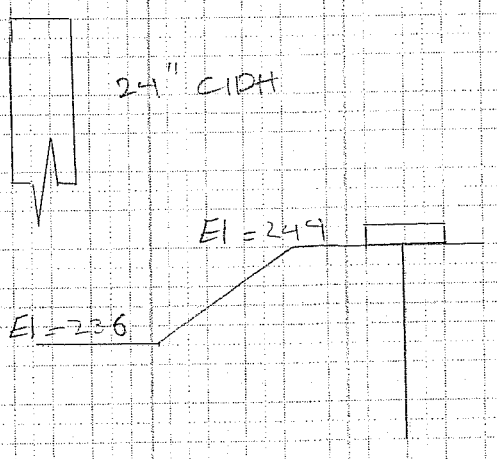
$\gamma = 120$ pcf

175 — SP/SP-SM

SPT = 50 → $\phi = 40°$

$\gamma = 125$

Cut-off El. = 244



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project SR-57 NB Nutwood Ave. UC (widen) Project No. 08-115

By AZ Date 05/11/09 Checked By _____ Date _____ Sheet ___ of ___

Abutment Pile Length

Service Demand = 200 x 2 = 400 kips

Pile spacing = 6 ft = 3 diameter → axial load group efficiency

	for Sand	for Clay
3d spacing	$0.65+\frac{0.5}{1.5}\times 0.35 = 0.77$	

Compare Single pile vs. eq. Pier

Equivalent Pier Perimeter:

No. Piles: 7 (2 rows in longitudinal direction and 4 rows in transverse direction)

C.C in longitudinal direction = 72 in → X = 72 in = 6 ft

C.C in transverse direction = 72 in → Y = 216 in = 18 ft

$P = 2\times(1\times 72 + 3\times 72) = 576$ in Equivalent Pier Perimeter

Compare w/ Single Pile Perimeter:

7 Single Piles	eq. Pier
$7\times\pi\times 24 = 528$ in	< 576 in

Use group reduction factor of 1.0 for clay layers.

Pile length = 49' → use 50'

See the following Pages for axial load calculations based on SHAFT output.

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

Project SR-57 NB Nutwood Ave. UC (Widen) Project No. 08-115

By AZ Date 5/11/09 Checked By _____ Date _____ Sheet ____ of ____

Pile Group Axial Capacity (Block Failure)

Since pile tips are above a clay layer, block failure mechanism is checked for the pile group.

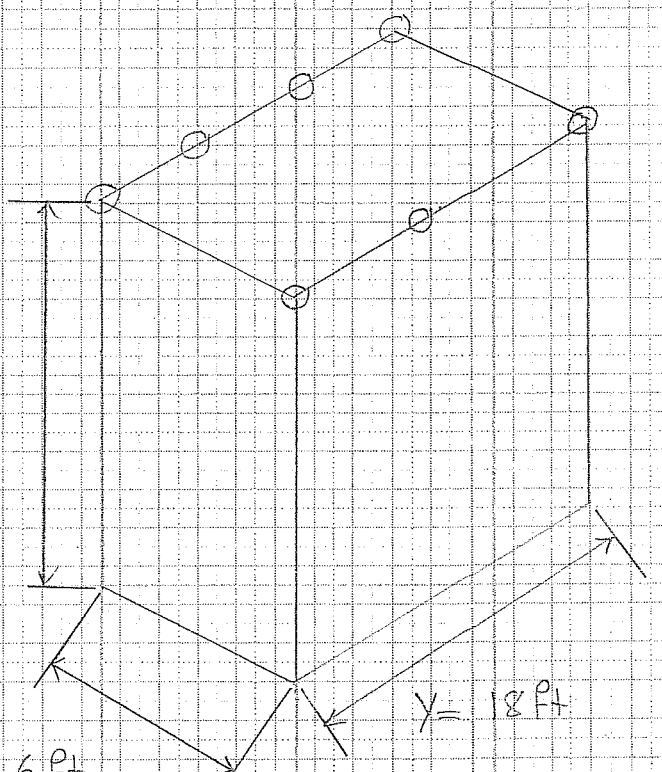
For this calculations it was assumed the undrained shear strength along the piles $\overline{S_u} = 1.8$ ksf and undrained shear strength at the base of the group $S_u = 2.1$ ksf.

$$Q_g = (2X + 2Y)\, Z\, \overline{S_u} + X\, Y\, N_c\, S_u$$

$$\frac{Z}{X} = \frac{50}{6} = 8.33 > 2.5$$

$$\Rightarrow N_c = 7.5\left(1 + \frac{0.2X}{Y}\right)$$

$$N_c = 7.5\left(1 + \frac{0.2 \times 6}{18}\right) = 8$$



$$Q_g = (2\times6 + 2\times18)50\times1.8 + 6\times18\times8\times2.1$$

$$Q_g = 6134 \text{ kips} > 400\times7 = 2800 \text{ kips}$$

Block failure does not control the design.

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering
17660 Newhope Street, Suite E, Fountain Valley, CA 92708
phone: (714)751-3826, Fax (714)751-3928

Project: Nutwood Avenue UC (WIDEN) Project No. 08-115

By AZ Date _____ Check by _____ Date _____ Sheet _____

Drilled shaft axial capacity with group reduction factor (η)

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)	η	QS(group) (TONS)
1	0.12	3.63	0	3.63	3.63	1.81	31.19	1.00	3.63
2	0.23	7.26	0	7.26	7.26	3.63	31.19	1.00	7.26
3	0.35	10.89	0	10.89	10.89	5.44	31.19	1.00	10.89
4	0.47	14.52	0	14.52	14.52	7.26	31.19	1.00	14.52
5	0.58	18.15	0	18.15	18.15	9.07	31.19	1.00	18.15
6	0.7	21.77	0	21.77	21.77	10.89	31.19	1.00	21.77
7	0.81	25.4	0	25.4	25.4	12.7	31.19	1.00	25.40
8	0.93	29.03	0	29.03	29.03	14.52	31.19	1.00	29.03
9	1.05	32.66	0	32.66	32.66	16.33	31.19	1.00	32.66
10	1.16	35.77	0	35.77	35.77	17.89	30.74	1.00	35.77
11	1.28	38.88	0	38.88	38.88	19.44	30.38	1.00	38.88
12	1.4	41.99	0	41.99	41.99	21	30.07	1.00	41.99
13	1.51	45.1	0	45.1	45.1	22.55	29.81	1.00	45.10
14	1.63	48.21	0	48.21	48.21	24.11	29.59	1.00	48.21
15	1.75	53.88	0	53.88	53.88	26.94	30.87	0.77	52.58
16	1.86	59.82	0	59.82	59.82	29.91	32.13	0.77	57.15
17	1.98	66.02	0	66.02	66.02	33.01	33.37	0.77	61.92
18	2.09	72.47	0	72.47	72.47	36.23	34.6	0.77	66.89
19	2.21	79.16	0	79.16	79.16	39.58	35.8	0.77	72.04
20	2.33	82.27	0	82.27	82.27	41.13	35.35	1.00	75.15
21	2.44	85.38	0	85.38	85.38	42.69	34.94	1.00	78.26
22	2.56	88.49	0	88.49	88.49	44.24	34.56	1.00	81.37
23	2.68	91.6	0	91.6	91.6	45.8	34.22	1.00	84.48
24	2.79	94.71	0	94.71	94.71	47.35	33.91	1.00	87.59
25	2.91	102.58	0	102.58	102.58	51.29	35.26	0.77	93.65
26	3.03	110.64	0	110.64	110.64	55.32	36.57	0.77	99.86
27	3.14	118.88	0	118.88	118.88	59.44	37.83	0.77	106.20
28	3.26	127.29	0	127.29	127.29	63.65	39.07	0.77	112.68
29	3.37	135.88	0	135.88	135.88	67.94	40.26	0.77	119.29
30	3.49	138.99	0	138.99	138.99	69.5	39.81	1.00	122.40
31	3.61	142.1	0	142.1	142.1	71.05	39.39	1.00	125.51
32	3.72	145.21	0	145.21	145.21	72.61	39	1.00	128.62
33	3.84	148.32	0	148.32	148.32	74.16	38.62	1.00	131.73
34	3.96	151.43	0	151.43	151.43	75.72	38.27	1.00	134.84
35	4.07	154.54	0	154.54	154.54	77.27	37.94	1.00	137.95
36	4.19	157.65	0	157.65	157.65	78.83	37.63	1.00	141.06
37	4.31	160.77	0	160.77	160.77	80.38	37.34	1.00	144.18
38	4.42	163.88	0	163.88	163.88	81.94	37.06	1.00	147.29
39	4.54	166.99	0	166.99	166.99	83.49	36.79	1.00	150.40
40	4.65	170.1	0	170.1	170.1	85.05	36.54	1.00	153.51
41	4.77	173.21	0	173.21	173.21	86.6	36.3	1.00	156.62
42	4.89	176.32	0	176.32	176.32	88.16	36.07	1.00	159.73
43	5	179.43	0	179.43	179.43	89.71	35.86	1.00	162.84
44	5.12	182.54	0	182.54	182.54	91.27	35.65	1.00	165.95
45	5.24	192.88	0	192.88	192.88	96.44	36.83	0.77	173.91
46	5.35	203.27	0	203.27	203.27	101.63	37.97	0.77	181.91
47	5.47	213.71	0	213.71	213.71	106.86	39.07	0.77	189.95
48	5.59	224.2	0	224.2	224.2	112.1	40.14	0.77	198.03
49	5.7	234.72	0	234.72	234.72	117.36	41.16	0.77	206.13
50	5.82	238.35	0	238.35	238.35	119.17	40.96	1.00	209.76
51	5.93	241.98	0	241.98	241.98	120.99	40.77	1.00	213.39
52	6.05	245.61	0	245.61	245.61	122.8	40.59	1.00	217.02
53	6.17	249.24	0	249.24	249.24	124.62	40.41	1.00	220.65
54	6.28	252.87	0	252.87	252.87	126.43	40.24	1.00	224.28
55	6.4	256.49	0	256.49	256.49	128.25	40.07	1.00	227.90
56	6.52	260.12	0	260.12	260.12	130.06	39.92	1.00	231.53
57	6.63	263.75	0	263.75	263.75	131.88	39.76	1.00	235.16
58	6.75	267.38	0	267.38	267.38	133.69	39.62	1.00	238.79
59	6.87	271.01	0	271.01	271.01	135.51	39.47	1.00	242.42
60	6.98	274.64	0	274.64	274.64	137.32	39.33	1.00	246.05
61	7.1	278.27	0	278.27	278.27	139.13	39.2	1.00	249.68

VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 5.0 (C) COPYRIGHT ENSOFT,INC. 1989,1995,1998,2001,2003

SR-57 NB Nutwood Ave. UC - Abut 1&2 (24-in CIDH)

PROPOSED DEPTH = 61.0 FT

NUMBER OF LAYERS = 9

WATER TABLE DEPTH = 60.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 2.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 2.00

SOIL INFORMATION

LAYER NO 1----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.600E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.210E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.210E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.900E+01

LAYER NO 2----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.180E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.900E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.180E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.140E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.995E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.122E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.140E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.912E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.320E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.122E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.190E+02

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.180E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.115E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.190E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.180E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.115E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.240E+02

LAYER NO 5----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.839E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.240E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.773E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.360E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.290E+02

LAYER NO 6----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.180E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.290E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.180E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.440E+02

LAYER NO 7----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.605E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.330E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.440E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.555E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.330E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.490E+02

LAYER NO 8----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.210E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00

BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.490E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA	= 0.550E+00
END BEARING COEFFICIENT-Nc	= 0.900E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.210E+04
INTERNAL FRICTION ANGLE, DEG.	= 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.120E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.690E+02

LAYER NO 9----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.379E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.400E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.690E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.400E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.150E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM	=	2.000	FT.
DIAMETER OF BASE	=	2.000	FT.
END OF STEM TO BASE	=	0.000	FT.
ANGLE OF BELL	=	0.000	DEG.
IGNORED TOP PORTION	=	0.000	FT.
IGNORED BOTTOM PORTION	=	0.000	FT.
AREA OF ONE PERCENT STEEL	=	4.524	SQ.IN.
ELASTIC MODULUS, Ec	=	0.325E+07	LB/SQ IN
VOLUME OF UNDERREAM	=	0.000	CU.YDS.

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY
APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY
APPLIED TO THE ULTIMATE SIDE RESISTANCE AND
THE ULTIMATE BASE RESISTANCE.

LENGTH (FEET)	VOLUME (CU.YDS)	QS (TONS)	QB (TONS)	QU (TONS)	QBD (TONS)	QDN (TONS)	QU/VOLUME (TONS/CU.YDS)
1.0	0.12	3.63	0.00	3.63	3.63	1.81	31.19
2.0	0.23	7.26	0.00	7.26	7.26	3.63	31.19
3.0	0.35	10.89	0.00	10.89	10.89	5.44	31.19
4.0	0.47	14.52	0.00	14.52	14.52	7.26	31.19
5.0	0.58	18.15	0.00	18.15	18.15	9.07	31.19
6.0	0.70	21.77	0.00	21.77	21.77	10.89	31.19
7.0	0.81	25.40	0.00	25.40	25.40	12.70	31.19
8.0	0.93	29.03	0.00	29.03	29.03	14.52	31.19
9.0	1.05	32.66	0.00	32.66	32.66	16.33	31.19
10.0	1.16	35.77	0.00	35.77	35.77	17.89	30.74
11.0	1.28	38.88	0.00	38.88	38.88	19.44	30.38
12.0	1.40	41.99	0.00	41.99	41.99	21.00	30.07
13.0	1.51	45.10	0.00	45.10	45.10	22.55	29.81
14.0	1.63	48.21	0.00	48.21	48.21	24.11	29.59
15.0	1.75	53.88	0.00	53.88	53.88	26.94	30.87
16.0	1.86	59.82	0.00	59.82	59.82	29.91	32.13
17.0	1.98	66.02	0.00	66.02	66.02	33.01	33.37
18.0	2.09	72.47	0.00	72.47	72.47	36.23	34.60
19.0	2.21	79.16	0.00	79.16	79.16	39.58	35.80
20.0	2.33	82.27	0.00	82.27	82.27	41.13	35.35
21.0	2.44	85.38	0.00	85.38	85.38	42.69	34.94
22.0	2.56	88.49	0.00	88.49	88.49	44.24	34.56
23.0	2.68	91.60	0.00	91.60	91.60	45.80	34.22
24.0	2.79	94.71	0.00	94.71	94.71	47.35	33.91
25.0	2.91	102.58	0.00	102.58	102.58	51.29	35.26
26.0	3.03	110.64	0.00	110.64	110.64	55.32	36.57
27.0	3.14	118.88	0.00	118.88	118.88	59.44	37.83
28.0	3.26	127.29	0.00	127.29	127.29	63.65	39.07
29.0	3.37	135.88	0.00	135.88	135.88	67.94	40.26
30.0	3.49	138.99	0.00	138.99	138.99	69.50	39.81
31.0	3.61	142.10	0.00	142.10	142.10	71.05	39.39
32.0	3.72	145.21	0.00	145.21	145.21	72.61	39.00
33.0	3.84	148.32	0.00	148.32	148.32	74.16	38.62
34.0	3.96	151.43	0.00	151.43	151.43	75.72	38.27
35.0	4.07	154.54	0.00	154.54	154.54	77.27	37.94
36.0	4.19	157.65	0.00	157.65	157.65	78.83	37.63
37.0	4.31	160.77	0.00	160.77	160.77	80.38	37.34
38.0	4.42	163.88	0.00	163.88	163.88	81.94	37.06
39.0	4.54	166.99	0.00	166.99	166.99	83.49	36.79

40.0	4.65	170.10	0.00	170.10	170.10	85.05	36.54
41.0	4.77	173.21	0.00	173.21	173.21	86.60	36.30
42.0	4.89	176.32	0.00	176.32	176.32	88.16	36.07
43.0	5.00	179.43	0.00	179.43	179.43	89.71	35.86
44.0	5.12	182.54	0.00	182.54	182.54	91.27	35.65
45.0	5.24	192.88	0.00	192.88	192.88	96.44	36.83
46.0	5.35	203.27	0.00	203.27	203.27	101.63	37.97
47.0	5.47	213.71	0.00	213.71	213.71	106.86	39.07
48.0	5.59	224.20	0.00	224.20	224.20	112.10	40.14
49.0	5.70	234.72	0.00	234.72	234.72	117.36	41.16
50.0	5.82	238.35	0.00	238.35	238.35	119.17	40.96
51.0	5.93	241.98	0.00	241.98	241.98	120.99	40.77
52.0	6.05	245.61	0.00	245.61	245.61	122.80	40.59
53.0	6.17	249.24	0.00	249.24	249.24	124.62	40.41
54.0	6.28	252.87	0.00	252.87	252.87	126.43	40.24
55.0	6.40	256.49	0.00	256.49	256.49	128.25	40.07
56.0	6.52	260.12	0.00	260.12	260.12	130.06	39.92
57.0	6.63	263.75	0.00	263.75	263.75	131.88	39.76
58.0	6.75	267.38	0.00	267.38	267.38	133.69	39.62
59.0	6.87	271.01	0.00	271.01	271.01	135.51	39.47
60.0	6.98	274.64	0.00	274.64	274.64	137.32	39.33
61.0	7.10	278.27	0.00	278.27	278.27	139.13	39.20

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.9876E+00	0.4761E-03	0.2291E-08	0.1000E-03
0.9876E+01	0.4761E-02	0.2291E-07	0.1000E-02
0.2492E+02	0.1194E-01	0.5728E-07	0.2500E-02
0.5012E+02	0.2397E-01	0.1146E-06	0.5000E-02
0.7261E+02	0.3584E-01	0.1718E-06	0.7500E-02
0.9179E+02	0.4719E-01	0.2291E-06	0.1000E-01
0.1693E+03	0.1023E+00	0.5728E-06	0.2500E-01
0.2182E+03	0.1575E+00	0.1146E-05	0.5000E-01
0.2416E+03	0.1980E+00	0.1718E-05	0.7500E-01
0.2504E+03	0.2283E+00	0.2291E-05	0.1000E+00
0.2601E+03	0.3861E+00	0.5603E-05	0.2500E+00
0.2462E+03	0.6285E+00	0.9040E-05	0.5000E+00
0.2461E+03	0.8784E+00	0.1176E-04	0.7500E+00
0.2459E+03	0.1128E+01	0.1418E-04	0.1000E+01
0.2451E+03	0.2528E+01	0.2294E-04	0.2400E+01

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Project SR-57 NB Nutwood Ave. UC (widen) Project No. 08-115

By AZ Date 05/12/09 Checked By _____ Date _____ Sheet ____ of ____

Pile Group Settlement:

Due to presence of clay layer below pile tip, the settlement is evaluated using equivalent pier method.

Soil Profile type: (8) "AASHTO LRFD BDS"

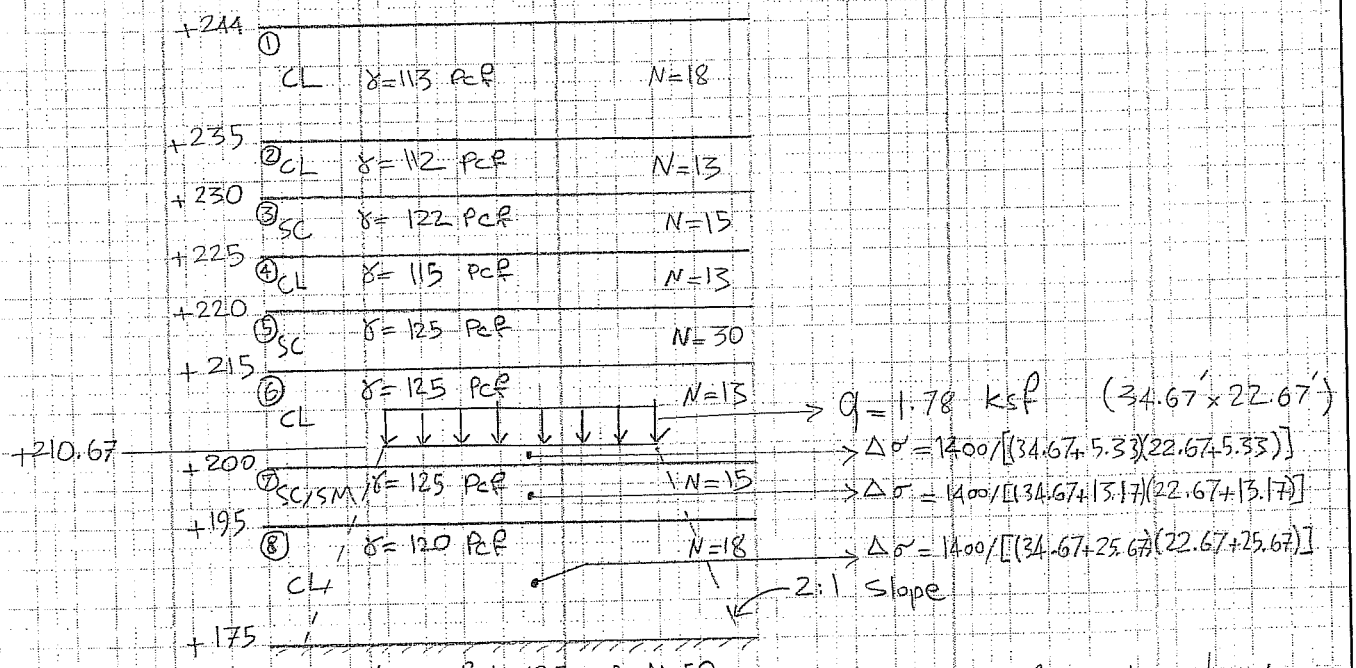
Equivalent Pire is at depth $\frac{2}{3}D$ (D: Pile length)

D = 50' ⇒ Equivalent Pier length = $B_1 = B + \frac{1}{2}(\frac{2}{3}D) = \frac{216}{12} + \frac{1}{2}(\frac{2}{3}50) = 54.67'$

Equivalent Pier width = $Y_1 = Y + \frac{1}{2}(\frac{2}{3}D) = \frac{72}{12} + \frac{1}{2}(\frac{2}{3}50) = 22.67'$

Equivalent Pressure = $\frac{Q}{B_1 \cdot Y_1} = \frac{1400}{34.67 \times 22.67} = 1.78$ ksf

Eq. Pier depth = 35.33' Eq. Pier EL. = 210.67



→ Sec fill settlement calcs.

Point	Depth (ft)	Layer H (ft)	σ_{vo} (ksf)	$\Delta\sigma$ (ksf)	σ_{vf} (ksf)	C' *	Settlement (in)
6	38.67	10.67	4.60	1.25	5.85	40	0.334
7	46.5	5	5.57	0.617	6.39	42	0.0848
8	59.0	20	7.09	0.480	7.57	40	0.1707

Layer settlement = $S = H \cdot \frac{1}{C'} \log \frac{\sigma_{vf}}{\sigma_{vo}}$ $S_{total} = 0.59$ in.

Immediate settlement is evaluated in the following Page

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Project SR-57 NB Nutwood Ave. UC (Widen) Project No. 08-115

By AZ Date 05/12/09 Checked By _____ Date _____ Sheet ___ of ___

Pile Group Immediate Settlement:

$S_{vd} = C_s \, q \, B \left(\frac{1-\nu^2}{E_u}\right)$

Assume clay between EL. 210.67 and EL. 175.

$L = 34.67'$ $B = 22.67'$

$D = 35.67'$

$\frac{L}{B} = 1.53$

Estimate C_s for clay layer w/ limited depth $D = 35.67'$:

$\frac{D}{B} = \frac{35.67}{22.67} \approx 1.5 \rightarrow C_s \approx 0.21$ *Reference: Table 10-5, Essentials of Soil Mechanics and Foundations, 5th ed. D.F. McCarthy.

C_s was estimated using linear interpolation.

$\nu = 0.5$ (for saturated clay)

$E_u = 500\,c_u$ to $1500\,c_u$ (Same reference). Use $E_u = 1000\,c_u$

$E_u = 1000 \times \left(\frac{1800+2100}{2}\right) = 1{,}950{,}000$ PSF

immediate settlement of clay layer:

$S_{vd} = 0.21 \times 1780 \times 22.67 \times \left(\frac{1-0.5^2}{1{,}950{,}000}\right) = 0.0033$ ft $=$ 0.04 in.

→ total settlement $= 0.59 + 0.04 =$ 0.63 in. $<$ 1in. O.K.

Using similar procedure, the pile tip el. corresponding to an allowable settlement of 1 inch was 210 ft. The equivalent pier dimensions and pressure for this case are as follows:

$L = 29.33'$ $B = 17.33'$ $q = 2754$ PSF

the consolidation settlement was 0.94 in. and immediate settlement was 0.07 in.

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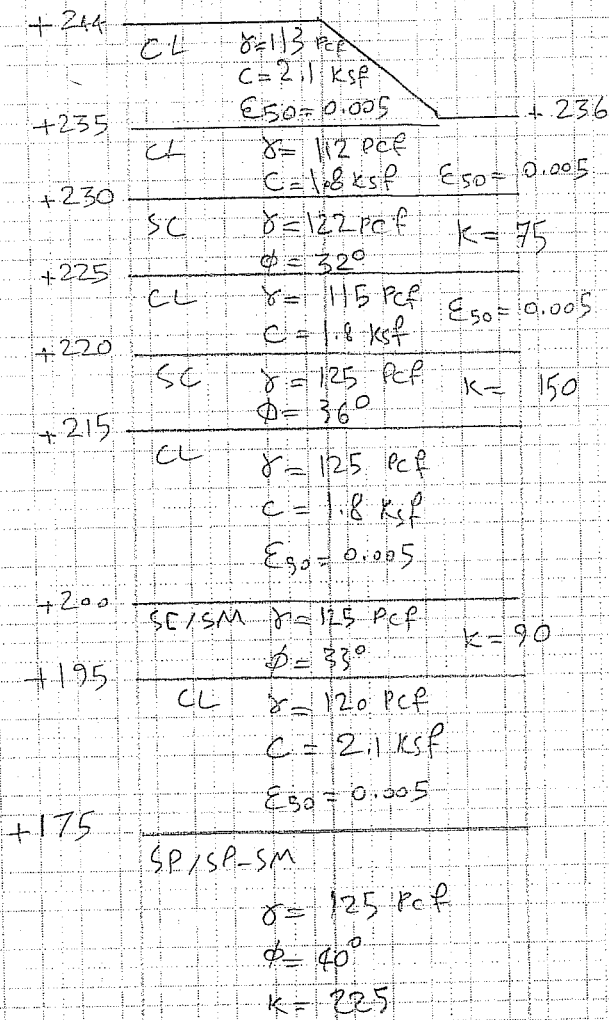
Project Nutwood Ave. UC (widen) Project No. 08-115

By AZ Date 1-8-09 Checked By _____ Date _____ Sheet ____ of ____

Lateral Pile Solutions

Abutments:



Group Efficiency Factor:

GEF = 0.76

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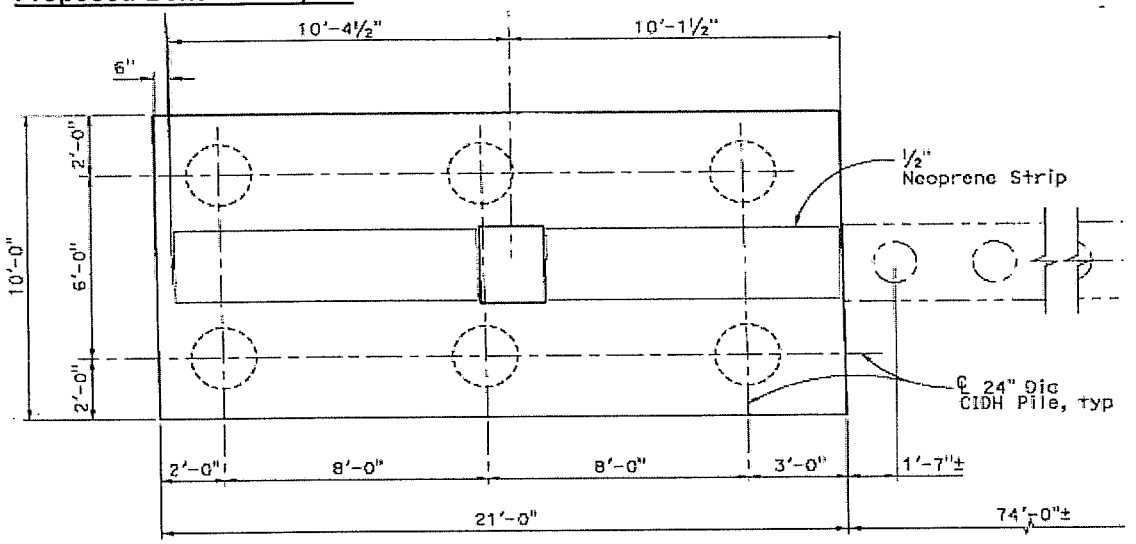
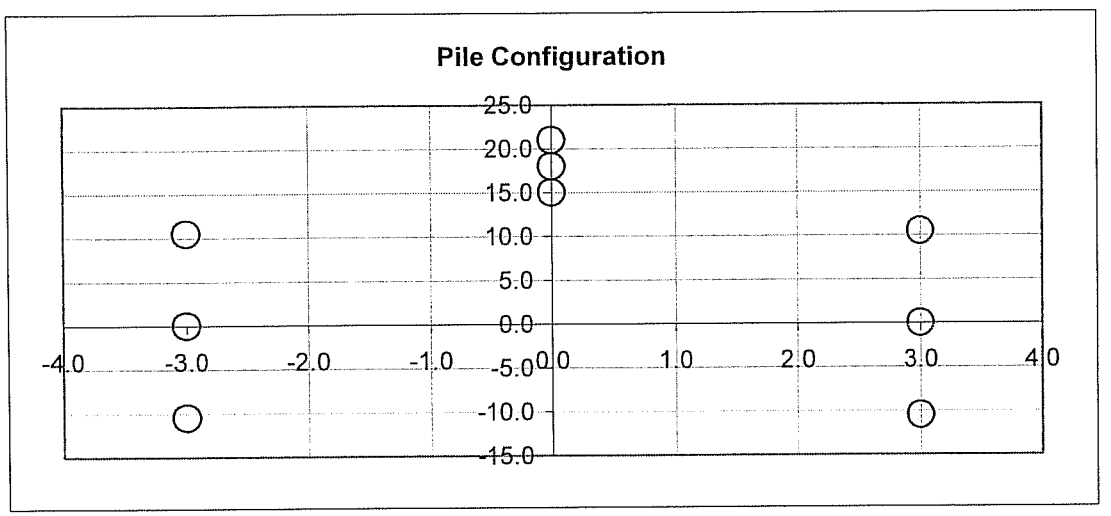
Project: **Nutwood Avenue UC (WIDEN)** Project No. **08-115**
By AZ Date 01/08/09 Check by Date Sheet

Proposed Bent Pile Layout



Calculation of Pile Group Efficiency (using formula in Group 7.0 Technical Manual)



Pile Dia. (feet): 2
No. of Piles: 9

Group Efficiency	X-Dir	Y-Dir
	0.787	0.723

Pile No.	X	Y
1	-3.000	-10.50
2	3.000	-10.50
3	-3.000	0.00
4	3.000	0.00
5	-3.000	10.50
6	3.000	10.50
7	0.000	15.00
8	0.000	18.00
9	0.000	21.00

Reduction Factors in X-dir	Reduction Factors in Y-dir
0.720	0.807
0.931	0.807
0.712	0.807
0.931	0.807
0.588	0.554
0.839	0.554
0.518	0.333
0.527	0.436
0.679	0.724

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Project: **Nutwood Avenue UC (WIDEN)** Project No. **08-115**
By AZ Date 01/08/09 Check by Date Sheet

Fx1 = 0.72 = 0.729 (lbl-21) x 1 (sbs-31) x 0.988 (skew-41) x 1 (sbs-51) x 1 (skew-61) x 1 (skew-71) x 1 (skew-81) x 1 (skew-91)

skew-41 = 0.988 = SQRT((0.951*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-61 = 1 = SQRT((1*Cos(1.292))^2 + 1*Sin(1.292))^2)
skew-71 = 1 = SQRT((1*Cos(1.454))^2 + 1*Sin(1.454))^2)
skew-81 = 1 = SQRT((1*Cos(1.466))^2 + 1*Sin(1.466))^2)
skew-91 = 1 = SQRT((1*Cos(1.476))^2 + 1*Sin(1.476))^2)

Fx2 = 0.931 = 0.931 (lbl-12) x 1 (skew-32) x 1 (sbs-42) x 1 (skew-52) x 1 (sbs-62) x 1 (skew-72) x 1 (skew-82) x 1 (skew-92)

skew-32 = 1 = SQRT((1*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-52 = 1 = SQRT((1*Cos(1.292))^2 + 1*Sin(1.292))^2)
skew-72 = 1 = SQRT((1*Cos(1.454))^2 + 1*Sin(1.454))^2)
skew-82 = 1 = SQRT((1*Cos(1.466))^2 + 1*Sin(1.466))^2)
skew-92 = 1 = SQRT((1*Cos(1.476))^2 + 1*Sin(1.476))^2)

Fx3 = 0.712 = 1 (sbs-13) x 0.988 (skew-23) x 0.729 (lbl-43) x 1 (sbs-53) x 0.988 (skew-63) x 1 (skew-73) x 1 (skew-83) x 1 (skew-93)

skew-23 = 0.988 = SQRT((0.951*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-63 = 0.988 = SQRT((0.951*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-73 = 1 = SQRT((1*Cos(1.373))^2 + 1*Sin(1.373))^2)
skew-83 = 1 = SQRT((1*Cos(1.406))^2 + 1*Sin(1.406))^2)
skew-93 = 1 = SQRT((1*Cos(1.429))^2 + 1*Sin(1.429))^2)

Fx4 = 0.931 = 1 (skew-14) x 1 (sbs-24) x 0.931 (lbl-34) x 1 (skew-54) x 1 (sbs-64) x 1 (skew-74) x 1 (skew-84) x 1 (skew-94)

skew-14 = 1 = SQRT((1*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-54 = 1 = SQRT((1*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-74 = 1 = SQRT((1*Cos(1.373))^2 + 1*Sin(1.373))^2)
skew-84 = 1 = SQRT((1*Cos(1.406))^2 + 1*Sin(1.406))^2)
skew-94 = 1 = SQRT((1*Cos(1.429))^2 + 1*Sin(1.429))^2)

Fx5 = 0.588 = 1 (sbs-15) x 1 (skew-25) x 1 (sbs-35) x 0.988 (skew-45) x 0.729 (lbl-65) x 0.842 (skew-75) x 0.977 (skew-85) x 0.994 (skew-95)

skew-25 = 1 = SQRT((1*Cos(1.292))^2 + 1*Sin(1.292))^2)
skew-45 = 0.988 = SQRT((0.951*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-75 = 0.842 = SQRT((0.701*Cos(0.983))^2 + 0.898*Sin(0.983))^2)
skew-85 = 0.977 = SQRT((0.816*Cos(1.19))^2 + 1*Sin(1.19))^2)
skew-95 = 0.994 = SQRT((0.915*Cos(1.292))^2 + 1*Sin(1.292))^2)

Fx6 = 0.839 = 1 (skew-16) x 1 (sbs-26) x 1 (skew-36) x 1 (sbs-46) x 0.931 (lbl-56) x 0.9 (skew-76) x 1 (skew-86) x 1 (skew-96)

skew-16 = 1 = SQRT((1*Cos(1.292))^2 + 1*Sin(1.292))^2)
skew-36 = 1 = SQRT((1*Cos(1.052))^2 + 1*Sin(1.052))^2)
skew-76 = 0.9 = SQRT((0.907*Cos(0.983))^2 + 0.898*Sin(0.983))^2)
skew-86 = 1 = SQRT((1*Cos(1.19))^2 + 1*Sin(1.19))^2)
skew-96 = 1 = SQRT((1*Cos(1.292))^2 + 1*Sin(1.292))^2)

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Project: **Nutwood Avenue UC (WIDEN)** Project No. **08-115**
By AZ Date 01/08/09 Check by Date Sheet _____

Fx7 = 0.518 = 1 (skew-17) x 1 (skew-27) x 1 (skew-37) x 1 (skew-47) x 0.9 (skew-57) x 0.842 (skew-67) x 0.735 (sbs-87) x 0.93 (sbs-97)

skew-17 = 1 = SQRT((1*Cos(1.454))^2 + 1*Sin(1.454))^2)
skew-27 = 1 = SQRT((1*Cos(1.454))^2 + 1*Sin(1.454))^2)
skew-37 = 1 = SQRT((1*Cos(1.373))^2 + 1*Sin(1.373))^2)
skew-47 = 1 = SQRT((1*Cos(1.373))^2 + 1*Sin(1.373))^2)
skew-57 = 0.9 = SQRT((0.907*Cos(0.983))^2 + 0.898*Sin(0.983))^2)
skew-67 = 0.842 = SQRT((0.701*Cos(0.983))^2 + 0.898*Sin(0.983))^2)

Fx8 = 0.527 = 1 (skew-18) x 1 (skew-28) x 1 (skew-38) x 1 (skew-48) x 1 (skew-58) x 0.977 (skew-68) x 0.735 (sbs-78) x 0.735 (sbs-98)

skew-18 = 1 = SQRT((1*Cos(1.466))^2 + 1*Sin(1.466))^2)
skew-28 = 1 = SQRT((1*Cos(1.466))^2 + 1*Sin(1.466))^2)
skew-38 = 1 = SQRT((1*Cos(1.406))^2 + 1*Sin(1.406))^2)
skew-48 = 1 = SQRT((1*Cos(1.406))^2 + 1*Sin(1.406))^2)
skew-58 = 1 = SQRT((1*Cos(1.19))^2 + 1*Sin(1.19))^2)
skew-68 = 0.977 = SQRT((0.816*Cos(1.19))^2 + 1*Sin(1.19))^2)

Fx9 = 0.679 = 1 (skew-19) x 1 (skew-29) x 1 (skew-39) x 1 (skew-49) x 1 (skew-59) x 0.994 (skew-69) x 0.93 (sbs-79) x 0.735 (sbs-89)

skew-19 = 1 = SQRT((1*Cos(1.476))^2 + 1*Sin(1.476))^2)
skew-29 = 1 = SQRT((1*Cos(1.476))^2 + 1*Sin(1.476))^2)
skew-39 = 1 = SQRT((1*Cos(1.429))^2 + 1*Sin(1.429))^2)
skew-49 = 1 = SQRT((1*Cos(1.429))^2 + 1*Sin(1.429))^2)
skew-59 = 1 = SQRT((1*Cos(1.292))^2 + 1*Sin(1.292))^2)
skew-69 = 0.994 = SQRT((0.915*Cos(1.292))^2 + 1*Sin(1.292))^2)

Fy1 = 0.72 = 0.93 (sbs-21) x 0.901 (lbl-31) x 0.963 (skew-41) x 1 (lbl-51) x 1 (skew-61) x 1 (skew-71) x 1 (skew-81) x 1 (skew-91)

skew-41 = 0.963 = SQRT((0.951*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-61 = 1 = SQRT((1*Cos(0.278))^2 + 1*Sin(0.278))^2)
skew-71 = 1 = SQRT((1*Cos(0.117))^2 + 1*Sin(0.117))^2)
skew-81 = 1 = SQRT((1*Cos(0.105))^2 + 1*Sin(0.105))^2)
skew-91 = 1 = SQRT((1*Cos(0.095))^2 + 1*Sin(0.095))^2)

Fy2 = 0.931 = 0.93 (sbs-12) x 0.963 (skew-32) x 0.901 (lbl-42) x 1 (skew-52) x 1 (lbl-62) x 1 (skew-72) x 1 (skew-82) x 1 (skew-92)

skew-32 = 0.963 = SQRT((0.951*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-52 = 1 = SQRT((1*Cos(0.278))^2 + 1*Sin(0.278))^2)
skew-72 = 1 = SQRT((1*Cos(0.117))^2 + 1*Sin(0.117))^2)
skew-82 = 1 = SQRT((1*Cos(0.105))^2 + 1*Sin(0.105))^2)
skew-92 = 1 = SQRT((1*Cos(0.095))^2 + 1*Sin(0.095))^2)

Fy3 = 0.712 = 1 (lbl-13) x 1 (skew-23) x 0.93 (sbs-43) x 0.901 (lbl-53) x 0.963 (skew-63) x 1 (skew-73) x 1 (skew-83) x 1 (skew-93)

skew-23 = 1 = SQRT((1*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-63 = 0.963 = SQRT((0.951*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-73 = 1 = SQRT((1*Cos(0.197))^2 + 1*Sin(0.197))^2)
skew-83 = 1 = SQRT((1*Cos(0.165))^2 + 1*Sin(0.165))^2)

skew-93 = 1 = SQRT((1*Cos(0.142))^2 + 1*Sin(0.142))^2)

Fy4 = 0.931 = 1 (skew-14) x 1 (lbl-24) x 0.93 (sbs-34) x 0.963 (skew-54) x 0.901 (lbl-64) x 1 (skew-74) x 1 (skew-84) x 1 (skew-94)

skew-14 = 1 = SQRT((1*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-54 = 0.963 = SQRT((0.951*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-74 = 1 = SQRT((1*Cos(0.197))^2 + 1*Sin(0.197))^2)
skew-84 = 1 = SQRT((1*Cos(0.165))^2 + 1*Sin(0.165))^2)
skew-94 = 1 = SQRT((1*Cos(0.142))^2 + 1*Sin(0.142))^2)

Fy5 = 0.588 = 1 (lbl-15) x 1 (skew-25) x 1 (lbl-35) x 1 (skew-45) x 0.93 (sbs-65) x 0.767 (skew-75) x 0.844 (skew-85) x 0.922 (skew-95)

skew-25 = 1 = SQRT((1*Cos(0.278))^2 + 1*Sin(0.278))^2)
skew-45 = 1 = SQRT((1*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-75 = 0.767 = SQRT((0.701*Cos(0.588))^2 + 0.898*Sin(0.588))^2)
skew-85 = 0.844 = SQRT((0.816*Cos(0.381))^2 + 1*Sin(0.381))^2)
skew-95 = 0.922 = SQRT((0.915*Cos(0.278))^2 + 1*Sin(0.278))^2)

Fy6 = 0.839 = 1 (skew-16) x 1 (lbl-26) x 1 (skew-36) x 1 (lbl-46) x 0.93 (sbs-56) x 0.767 (skew-76) x 0.844 (skew-86) x 0.922 (skew-96)

skew-16 = 1 = SQRT((1*Cos(0.278))^2 + 1*Sin(0.278))^2)
skew-36 = 1 = SQRT((1*Cos(0.519))^2 + 1*Sin(0.519))^2)
skew-76 = 0.767 = SQRT((0.701*Cos(0.588))^2 + 0.898*Sin(0.588))^2)
skew-86 = 0.844 = SQRT((0.816*Cos(0.381))^2 + 1*Sin(0.381))^2)
skew-96 = 0.922 = SQRT((0.915*Cos(0.278))^2 + 1*Sin(0.278))^2)

Fy7 = 0.518 = 1 (skew-17) x 1 (skew-27) x 1 (skew-37) x 1 (skew-47) x 0.904 (skew-57) x 0.904 (skew-67) x 0.56 (lbl-87) x 0.729 (lbl-97)

skew-17 = 1 = SQRT((1*Cos(0.117))^2 + 1*Sin(0.117))^2)
skew-27 = 1 = SQRT((1*Cos(0.117))^2 + 1*Sin(0.117))^2)
skew-37 = 1 = SQRT((1*Cos(0.197))^2 + 1*Sin(0.197))^2)
skew-47 = 1 = SQRT((1*Cos(0.197))^2 + 1*Sin(0.197))^2)
skew-57 = 0.904 = SQRT((0.907*Cos(0.588))^2 + 0.898*Sin(0.588))^2)
skew-67 = 0.904 = SQRT((0.907*Cos(0.588))^2 + 0.898*Sin(0.588))^2)

Fy8 = 0.527 = 1 (skew-18) x 1 (skew-28) x 1 (skew-38) x 1 (skew-48) x 1 (skew-58) x 1 (skew-68) x 0.778 (lbl-78) x 0.56 (lbl-98)

skew-18 = 1 = SQRT((1*Cos(0.105))^2 + 1*Sin(0.105))^2)
skew-28 = 1 = SQRT((1*Cos(0.105))^2 + 1*Sin(0.105))^2)
skew-38 = 1 = SQRT((1*Cos(0.165))^2 + 1*Sin(0.165))^2)
skew-48 = 1 = SQRT((1*Cos(0.165))^2 + 1*Sin(0.165))^2)
skew-58 = 1 = SQRT((1*Cos(0.381))^2 + 1*Sin(0.381))^2)
skew-68 = 1 = SQRT((1*Cos(0.381))^2 + 1*Sin(0.381))^2)

Fy9 = 0.679 = 1 (skew-19) x 1 (skew-29) x 1 (skew-39) x 1 (skew-49) x 1 (skew-59) x 1 (skew-69) x 0.931 (lbl-79) x 0.778 (lbl-89)

skew-19 = 1 = SQRT((1*Cos(0.095))^2 + 1*Sin(0.095))^2)
skew-29 = 1 = SQRT((1*Cos(0.095))^2 + 1*Sin(0.095))^2)
skew-39 = 1 = SQRT((1*Cos(0.142))^2 + 1*Sin(0.142))^2)

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skew-49 = 1 = SQRT((1*Cos(0.142))^2 + 1*Sin(0.142))^2)
skew-59 = 1 = SQRT((1*Cos(0.278))^2 + 1*Sin(0.278))^2)
skew-69 = 1 = SQRT((1*Cos(0.278))^2 + 1*Sin(0.278))^2)

where
lbl: line-by-line effect
sbs: side-by-side effect
skew: skew effect

LPILE Plus for Windows, Version 5.0 (5.0.31)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This program is licensed to:

AZ
Earth Mechanics, Inc.

Path to file locations: C:\Amir Files\Projects\Lino\SR-57\Nutwood\LPile\
Name of input data file: Nutwood Ave.lpd
Name of output file: Nutwood Ave.lpo
Name of plot output file: Nutwood Ave.lpp
Name of runtime file: Nutwood Ave.lpr

Time and Date of Analysis

Date: January 9, 2009 Time: 11: 3: 7

Problem Title

SR-57 NB Nutwood Ave. UC - Abut 1&2 (24-in CIDH)

Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis uses p-y multiplers for group action
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 576.00 in
Depth of ground surface below top of pile = .00 in
Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	24.00000000	8143.0000	452.0000	3250000.
2	576.0000	24.00000000	8143.0000	452.0000	3250000.

Soil and Rock Layering Information

The soil profile is modelled using 9 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = .000 in
Distance from top of pile to bottom of layer = 108.000 in

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 108.000 in
Distance from top of pile to bottom of layer = 168.000 in

Layer 3 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 168.000 in
Distance from top of pile to bottom of layer = 228.000 in
p-y subgrade modulus k for top of soil layer = 75.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 75.000 lbs/in**3

Layer 4 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 228.000 in
Distance from top of pile to bottom of layer = 288.000 in

Layer 5 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 288.000 in
Distance from top of pile to bottom of layer = 348.000 in
p-y subgrade modulus k for top of soil layer = 150.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 150.000 lbs/in**3

Layer 6 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 348.000 in
Distance from top of pile to bottom of layer = 528.000 in

Layer 7 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 528.000 in
Distance from top of pile to bottom of layer = 588.000 in
p-y subgrade modulus k for top of soil layer = 90.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 8 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 588.000 in
Distance from top of pile to bottom of layer = 828.000 in

Layer 9 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 828.000 in
Distance from top of pile to bottom of layer = 1500.000 in
p-y subgrade modulus k for top of soil layer = 225.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 225.000 lbs/in**3

(Depth of lowest layer extends 924.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Distribution of effective unit weight of soil with depth
is defined using 18 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	.00	.06540
2	108.00	.06540
3	108.00	.06480
4	168.00	.06480
5	168.00	.07060
6	228.00	.07060
7	228.00	.06650
8	288.00	.06650
9	288.00	.07230
10	348.00	.07230
11	348.00	.07230
12	528.00	.07230
13	528.00	.07230
14	588.00	.07230
15	588.00	.06940
16	828.00	.06940
17	828.00	.07230
18	1500.00	.07230

Shear Strength of Soils

Distribution of shear strength parameters with depth
defined using 18 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	14.58000	.00	.00500	.0
2	108.000	14.58000	.00	.00500	.0
3	108.000	12.50000	.00	.00500	.0
4	168.000	12.50000	.00	.00500	.0
5	168.000	.00000	32.00	------	------
6	228.000	.00000	32.00	------	------
7	228.000	12.50000	.00	.00500	.0
8	288.000	12.50000	.00	.00500	.0
9	288.000	.00000	36.00	------	------
10	348.000	.00000	36.00	------	------
11	348.000	12.50000	.00	.00500	.0
12	528.000	12.50000	.00	.00500	.0
13	528.000	.00000	33.00	------	------
14	588.000	.00000	33.00	------	------
15	588.000	14.58000	.00	.00500	.0
16	828.000	14.58000	.00	.00500	.0
17	828.000	.00000	40.00	------	------
18	1500.000	.00000	40.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

---

p-y Modification Factors

Distribution of p-y multipliers with depth defined using 2 points

Point No.	Depth X in	p-mult	y-mult
1	.000	.7600	1.0000
2	576.000	.7600	1.0000

Loading Type

Static loading criteria was used for computation of p-y curves

****
*
* NOTE: PAGES REMOVED TO REDUCE OUTPUT SIZE *
*
****

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
4	y= .250000	M= 0.000	185000.	.2500000	906044.	26033.0398
4	y= .500000	M= 0.000	185000.	.5000000	1463040.	37259.8959
4	y= 1.000000	M= 0.000	185000.	1.0000000	2375812.	53457.7027
4	y= 3.000	M= 0.000	185000.	3.0000	5098483.	93725.5747
4	y= 5.000	M= 0.000	185000.	5.0000	7251513.	115727.

The analysis ended normally.

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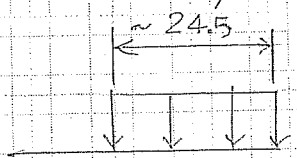
Project Nutwood Ave. UC (Widen) Project No. 08-115

By AZ Date 01-08-09 Checked By _____ Date _____ Sheet ____ of ____

Settlement:

Loading: 23' of Silver fill



(23) x (0.120) = 2.76 ksf

+244 ① CL γ=113 pcf N=18 N' = 1.99 x 18 = 36

+235 ② CL γ=112 pcf N=13 N' = 1.11 x 13 = 14

+230 ③ SC γ=122 pcf N=15 N' = 0.95 x 15 = 14

+225 ④ CL γ=115 pcf N=13 N' = 0.88 x 15 = 11

+220 ⑤ SC γ=125 pcf N=30 N' = 0.82 x 30 = 25

+215 ⑥ CL γ=125 pcf N=13 N' = 0.73 x 13 = 9

+200 ⑦ SC/SM γ=125 pcf N=15 N' = 0.66 x 15 = 10

+195 ⑧ CL γ=120 pcf N=18 N' = 0.58 x 18 = 10

+175 Φ=40° γ=125 pcf N=50

Stress distribution was calculated from elastic solutions.

Point	Depth (ft)	Layer H (ft)	σ_{vo} (ksf)	$\Delta\sigma$ (ksf)	σ_{vf} (ksf)	C'*	Settlement (in)
1	4.5	9	0.509	2.71	3.22	70	1.2
2	11.5	5	1.30	2.31	3.61	45	0.6
3	16.5	5	1.88	1.97	3.85	49	0.4
4	21.5	5	2.47	1.67	4.14	40	0.3
5	26.5	5	3.07	1.43	4.51	67	0.2
6	36.5	15	4.32	1.10	5.43	40	0.4
7	46.5	5	5.57	0.89	6.46	42	0.1
8	59.0	20	7.09	0.71	7.80	40	0.3

Layer Settlement: $S = H \frac{1}{C'} \log \frac{\sigma_{vf}}{\sigma_{vo}}$ $S_{total} = 3.5$ in

* Note: Bering capacity index (C') for clay layers was estimated from consolidation tests, for sand layers from Fig. 13 in FHWA (1982).

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Project Nutwood Ave. UC (widen) Project No. 08-115

By AZ Date 1-8-08 Checked By _____ Date _____ Sheet ____ of ____

Abutment Lateral Earth Pressures

$\phi = 32^\circ$ (Compacted Fill)

$K_a = \tan^2(45^\circ - \frac{\phi}{2}) = 0.30$

$K_a \cdot \gamma = (0.30)(120) = 36$ pcf

$K_o = 1 - \sin\phi = 1 - \sin 32^\circ = 0.47$

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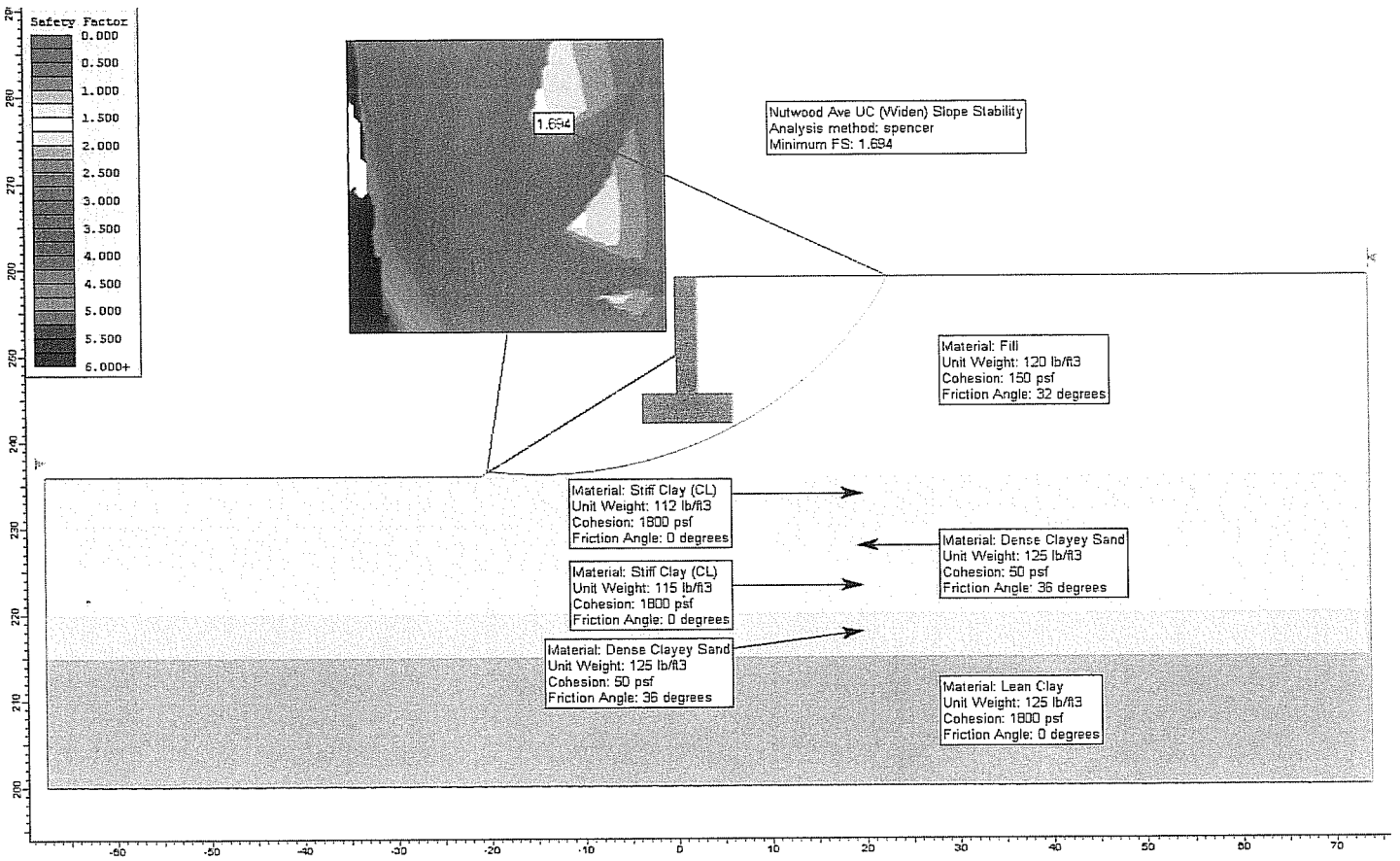
Project: **Nutwood Avenue UC (WIDEN)** Project No. **08-115**

By AZ Date 01/09/09 Check by Date Sheet

Static Slope Stability



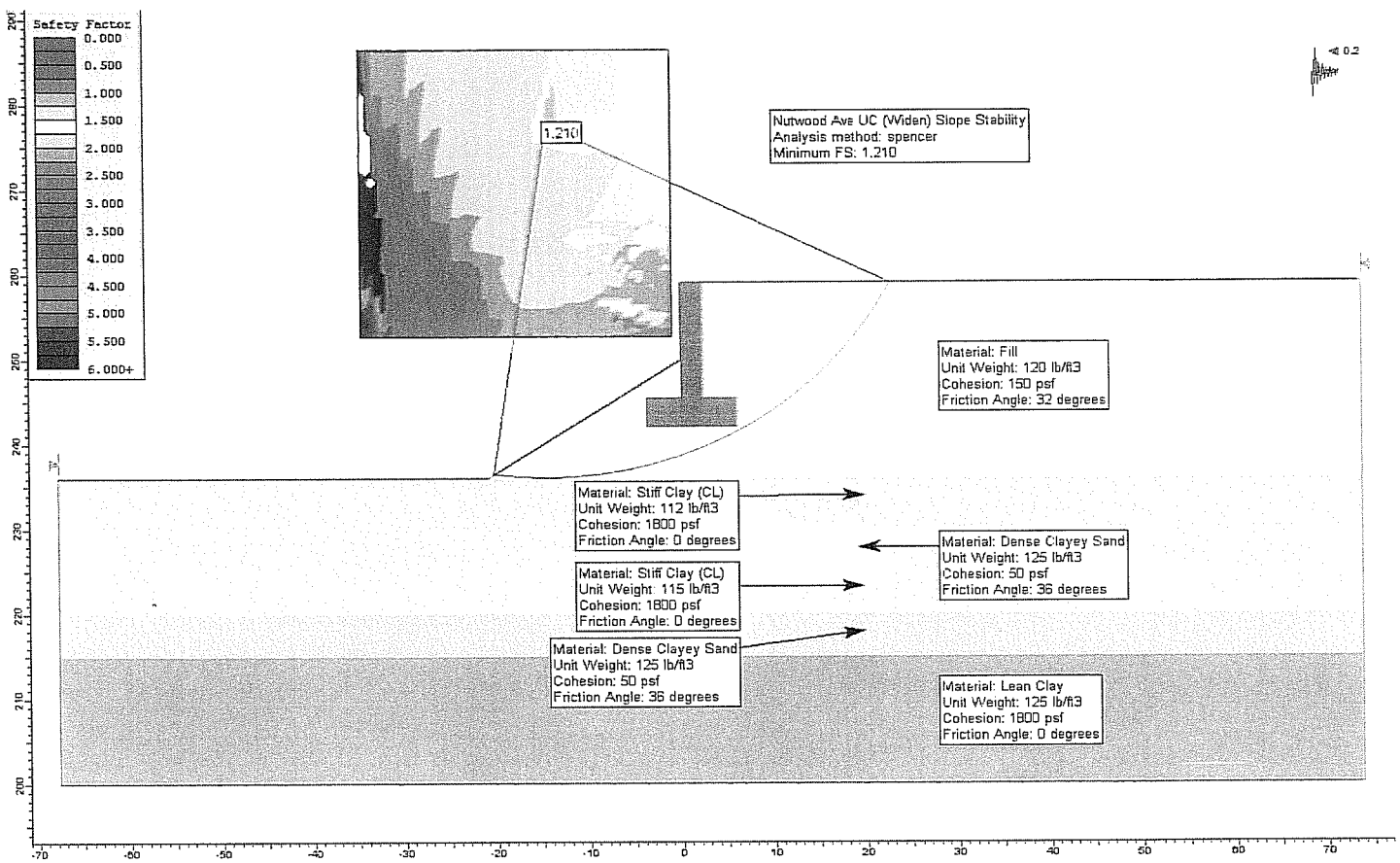
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
phone: (714)751-3826, Fax (714)751-3928

Project: **Nutwood Avenue UC (WIDEN)** Project No. **08-115**

By AZ Date 01/09/09 Check by Date Sheet

Seismic Slope Stability



APPENDIX D

CALTRANS REVIEW COMMENTS AND EMI RESPONSES

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: May 27, 2009
File: 12-ORA-57-PM 17.6
12-0F0311
Nutwood Avenue UC
Bridge No. 55-0464
SR-57 Northbound Widening

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of response to our comments on Foundation Report

On May 21, 2009, the Office of Geotechnical Design-South 1 received the response to our comments on Foundation Report prepared by Earth Mechanics Inc. for widening of the Nutwood Avenue Undercrossing, Br. No. 55-0464. The response has been examined thoroughly and it is our opinion that the Foundation Report could be finalized after considering additional comment as below:

- Please correct the typing error in Section 5.5 (sliver fill, not silver fill).

If you have any questions please contact Chungkeun Lee at (213) 620-2148 or Chi-Tseng Ted Liu at (213) 620-2136.

Prepared by: Date: 5/27/09

REGISTERED PROFESSIONAL ENGINEER
CHUNGKEUN LEE
C69450
Exp. 6/30/10
CIVIL
STATE OF CALIFORNIA

Chungkeun Lee, P.E.
Transportation Engineer
Office of Geotechnical Design South 1
Branch C

Reviewed by: Date:

REGISTERED PROFESSIONAL ENGINEER
CHI-TSENG TED LIU
No. 2669
Exp. 6-30-09
GEOTECHNICAL
STATE OF CALIFORNIA

Chi-Tseng Ted Liu, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design South 1
Branch C

c: OGDS1 - LA. File (2)
OGDS1 - SAC. File (1)
GS – SAC. File (1)

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

May 12, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Attention: Mr. Steve Huff

Subject: Response to Caltrans Foundation Review Comments on "Foundation Report (dated 2/04/09) Nutwood Avenue UC (Widen), Bridge No. 55-0464, SR-57 Northbound Widening"
12-Ora-57, PM 17.6, EA 12-0F0311

Dear Mr. Huff:

Caltrans issued a Foundation Review sheet dated April 20, 2009 for the subject project. A copy of this review sheet is attached. The following are our responses to those comments:

Section 2.1, Field Investigation

Response: See attached revised LOTB sheets. We have clarified the station line (B-Line) in the revised Table 2-1:

TABLE 2-1. GEOTECHNICAL EXPLORATION INFORMATION

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-016	Rte 57 ("B-Line")	533+58	68 RT	+259.0	+167.5	None Encountered During Drilling
A-08-017	Rte 57 ("B-Line")	535+70	66 RT	+258.0	+166.5	

Section 5.4.2, Foundation Data Provided by Structural Designers

Response: The revised Table 5-3 is presented on Page 2.

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

TABLE 5-3. FOUNDATION DESIGN DATA SHEET

Location	Design Method	Pile Type	Finished Grade El. (ft)	Pile Cut-off El. (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (inch)	Number of Piles per Support
					B	L		
Abutment 1	WSD	24" CIDH	251.20	243.25	10	23	1	7
Abutment 2	WSD		250.10	241.75	10	23	1	7

See revised Table 5-5 on Page 3. Nominal Driving Resistance column is eliminated from all tables.

Section 5.4.3, Axial Capacity

Response: The revised Table 5-4 is presented below:

TABLE 5-4. FOUNDATION DESIGN LOADS

Support No.	Service-I Limit State (kips)			Strength Limit State (Controlling Group, kips)				Extreme Event Limit State (Controlling Group, kips)			
	Total Load		Permanent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abutment 1	1400	200	1130	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Abutment 2	1400	200	1130	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

We incorporated the group efficiency factors per AASHTO LRFD Bridge Design Specification. The block failure mechanism for pile group is also evaluated. We found the nominal resistance of the individual piles controls the design. Our calculation sheets are attached. As shown, pile lengths were increased by 2 feet as compared to our previous recommendation. In Tables 5-5 and 5-6, pile tip elevations were revised to reflect the change in pile length and cut-off elevations.

Equivalent Pier method was used to estimate the settlement of pile group. Total settlement was evaluated as sum of consolidation settlement and immediate settlement. The calculations are attached. The settlement of equivalent pier under service load (200 kips per pile) was 0.63 inch for pile length of 50 feet and 1.0 inch for pile length of 34 feet.

We removed "tension" in footnote; the revised Table 5-5 and Table 5-6 are presented on Page 3.

TABLE 5-5. ABUTMENT FOUNDATIONS DESIGN RECOMMENDATIONS

Support	Pile Type	Cut-Off Elev. (feet)	LRFD Service-I Limit State Load per Support (kips)		LRFD Service-I Limit State per Pile (kips)	Nominal Resistance (kips)	Design Tip Elev. (feet)[1]	Specified Tip Elev. (feet)[2]
			Total	Perma-nent				
Abut 1	24" CIDH	243.25	1400	1130	200	400	+193 (a) +209 (c) +213 (d)	+193
Abut 2		241.75	1400	1130	200	400	+191 (a) +207 (c) +211 (d)	+191

Notes:
1. Design tip elevation is controlled by the following demands: (a) Compression, (c) Settlement, and (d) Lateral Load.
2. The specified tip elevation shall not be raised above the design tip elevations for lateral load and settlement.

TABLE 5-6. PILE DATA TABLE

Location	Pile Type	Nominal Resistance (kips)		Design Tip El. (ft)	Specified Tip El. (ft)
		Compression	Tension		
Abutment 1	24" CIDH	400	0	+193 (a) +209 (c) +213 (d)	+193
Abutment 2		400	0	+191 (a) +207 (c) +211 (d)	+191

Note:
1. Design tip elevations are controlled by: (a) Compression, (c) Settlement, and (d) Lateral Load.

Section 5.5, Embankment and Settlement

Response: We will add the following paragraph in Section 5.5, Embankment and Settlement: "Per Caltrans Memo to Designers 5-3 dated December 1992, structure approach slabs are required for this project. Selection of the approach type will be performed by the structurral designer following the flowchart in Caltrans Memo to Designers 5-3, Attachment A, dated May 1996."

There are no abutment wingwalls since both abutments are adjacent to RW 526 and 536. There is a small return wall connecting the abutment to the retaining walls. This return wall sits on the abutment pile cap as a part of the abutment design. Design of RW 526 and 536 is in the roadway plans.

Section 6.2, Pile Construction

Response: We will remove wet method recommendations from this section.

Appendix A-Log of Test Borings (LOTB) Sheets and As-Built Log of Test Borings Sheets

Response: The attached LOTB sheets incorporated the following revisions per Caltrans review:

- Proper title block is now included.
- Direction to the nearest cities is shown on LOTB plan views.
- Groundwater Not Encountered during drilling is added under each boring.
- Conversion factor from 2.4" California Modified Ring sampler blowcount to 1.4" Standard Penetration Test sampler blowcount is added to the "Notes"
- We added Vertical Datum is NAVD 88.
- Apparent densities are revised to correspond to SPT blowcounts corrected with energy ratio.
- Pocket penetrometer results added to description of layers wherever applicable.
- Separation lines were added where group ~~name~~ changes. symbol 5/20/09 LCC
- Proper title block for As-Built Log of Test Borings is now included.
- The note "Add about 2.00 feet to the As-Built elevation to match Vertical Datum NAVD 88" will be included in Section 2-1.

Appendix B-Laboratory Test Results

Response: Table 1 in Appendix B is quite congested already. We will add the attached Table 2 (Strength test results) in Appendix B.

Structure Plan

Response: Soil legend sheets will be placed at the end of current LOTB sheets.

Similar font was used for benchmark in the attached LOTB sheets.

We will add the following sentence at the beginning of Section 6.2, Pile Construction:
"For on-center pile spacing less than six times the pile diameter, no two adjacent piles can be constructed concurrently."

Sincerely,
EARTH MECHANICS, INC.

Lino Cheang

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

Lino Cheang, GE 2345
Project Manager

Attachments
-Caltrans Foundation Review sheet dated April 2, 2009
-Axial Pile Capacity Calculation Sheets
-Equivalent Pier Settlement Calculation Sheet
-Revised LOTB Sheets
-Table 2

← in foundation Report

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: April 20, 2009
File: 12-ORA-57-PM 17.6
12-0F0311
Nutwood Avenue UC
Bridge No. 55-0464
SR-57 Northbound Widening
(Southern Segment)

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of the Foundation Report

On February 26, 2009, the Office of Geotechnical Design-South 1, Branch C received the Foundation Report prepared by Earth Mechanics Inc, dated February 4, 2009, and Unchecked Details Plans for the Northbound widening of Nutwood Avenue Undercrossing, Bridge No. 55-0464. We reviewed the report and plan sheets, and our comments are as follows:

2.1 Field Investigation

- The station line (B-Line) is not defined clearly in this section of the report and Log of Test Boring (LOTB) Sheets.

5.4.2 Foundation Data Provided by Structural Designers

- Pile cut-off elevations in Table 5-3 and 5-5 do not match the plan.
- Eliminate Nominal Driving Resistance column from all tables.

5.4.3 Axial Capacity

- Based on Appendix C, Design Calculations, it appears that pile group effect has been considered to determine design tip elevation for lateral load demand, but not for compression load demand. Please explain the reason that the group effect is not considered for compression load demand.

- Since the CIDH piles will be tipped into relatively thin medium dense sand layer (5.0 feet) overlying thick medium stiff clay layer, it is recommended to use equivalent pier analogy for group settlement instead of estimating settlement of single pile.
- Tension in foot note is not required in Table 5-5 because design tip elevation for tension demand is not provided.

5.5 Embankments and Settlement

- Structural approach slab at both abutments should be discussed.
- Abutment wingwalls should be discussed.

6.2 Pile Construction

- Wet method of construction should not be recommended for caving control, since it requires additional instrumentation and increase the chance of pile anomaly.

Appendix A-Log of Test Boring (LOTB) and As-Built Log of Test Borings Sheets

- Please refer to the Caltrans Soil and Rock Logging Manual (June 2007), and use an appropriate bottom title block for LOTB and soil legend sheets.
- Direction to the nearest cities should be shown on LOTB plan view.
- When groundwater is not shown on the borings, explain in a sentence under each boring such as groundwater was not encountered or measured during field investigation.
- Correction/multiplication factor for conversion of 2.4" California Modified ring sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.
- It is required to note datum used for surveying boreholes in LOTB (NGVD 29 or NAVD88).
- The descriptions for apparent density of cohesionless soil in LOTB are not corresponding with SPT blow counts corrected with energy ratio.
  - A-08-016: 10, 30 feet below top of borehole
  - A-08-017: 25 feet below top of borehole
- Please include pocket penetrometer test result in the description of corresponding layer.

- Separation lines should be drawn in graphic/symbols column where group name changes (e.g. 25 feet below top of A-08-016).
- As-Built Log of Test Borings with title block conforming to Caltrans Soil and Rock Logging Manual should be included in the structure plans.
- If As-Built Log of Test Borings was surveyed with different datum, it is required to include conversion factor of the datum to NAVD 88.

Appendix B-Laboratoy Test Results

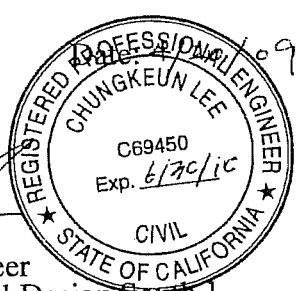
- It is recommended to include all test results (Direct shear and unconsolidated undrained Test) in Table 1.

Structure Plan

- Soil Legend sheets should be placed at the end of current LOTB sheet.
- Please use similar letter weight/color for benchmark in LOTB sheet.

If you have any questions, please contact Chungkeun Lee at (213) 620-2148 or Ted Liu at (213) 620-2136.

Prepared by: Date: 4/20/09



Chungkeun Lee, P.E.
Transportation Engineer
Office of Geotechnical Design South 1
Branch C

Reviewed by: Date: 4/20/09

Chi-Tseng Ted Liu, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design South 1
Branch C

FARAMARZ GERAMI, P.G., C.E.G.
Engineering Geologist
Office of Geotechnical Design South 1
Branch C

c: OGDS1 - LA. File (2)
OGDS1 - Sac. File (1)
GS – Sac. File (1)

FINAL FOUNDATION REPORT

Yorba Linda Boulevard OC (Modify)
Bridge No. 55-0468
SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 18.4
EA 12-0F0311

EMI Project No. 08-115
Date: June 17, 2009

EARTH MECHANICS, INC.

Geotechnical and Earthquake Engineering

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

June 17, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Attention: Mr. Steve Huff

Subject: Final Foundation Report for Yorba Linda Boulevard Overcrossing (Modify),
Bridge No. 55-0468
SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 18.4; EA 12-0F0311

Dear Mr. Huff:

Attached is our Final Foundation Report for a tieback wall proposed at the Yorba Linda Boulevard Overcrossing (OC) at the SR-57 freeway. The tieback wall will be used to retain portions of the east abutment end slope of the existing OC structure. This report presents the findings and conclusions of our geotechnical investigation, and presents our recommendations intended to aid RBF in preparing the project plans, specifications, and cost estimates.

A draft version of this report dated February 4, 2009 was submitted to Caltrans for their review. Review comments and our responses are included in Appendix E. Our responses are all incorporated into this final report.

If you have any questions regarding the information contained herein or require additional information, please call our office.

Sincerely,
EARTH MECHANICS, INC.

Lino Cheang, GE 2345
Project Manager

LCC:lcc

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

FINAL FOUNDATION REPORT
Yorba Linda Boulevard Overcrossing (Modify)
Bridge No. 55-0468
SR-57 Northbound Improvement Project
12-Ora-57, PM 18.4
EA 12-0F0311

Prepared for:

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Prepared by:

Earth Mechanics, Inc.
17660 Newhope Street, Suite E
Fountain Valley, California 92708

EMI Project Number: 08-115

June 17, 2009

TABLE OF CONTENTS

Section			Page
1.0	**INTRODUCTION**		**1**
	1.1	Purpose	1
	1.2	Scope of work	1
	1.3	Project Description	1
	1.4	Review of Existing Data	1
2.0	**FIELD INVESTIGATION AND LABORATORY TESTING**		**3**
	2.1	Field Investigation	3
	2.2	Laboratory Testing	4
3.0	**GEOLOGY AND SEISMICITY**		**5**
	3.1	Topography and Drainage	5
	3.2	Physiography	5
	3.3	Geologic Structure	5
	3.4	Geologic Hazards	7
	3.5	Stratigraphy	7
	3.6	Seismicity	9
4.0	**SUBSURFACE CONDITIONS**		**10**
	4.1	Subsurface Soil Conditions	10
	4.2	Idealized Subsurface Profile and Engineering Parameters	10
	4.3	Groundwater Conditions	10
5.0	**CONCLUSIONS AND RECOMMENDATIONS**		**11**
	5.1	Design Ground Motion	11
	5.2	Soil Liquefaction	11
	5.3	Tieback Wall Design	11
		5.3.1 Lateral Pressures	11
		5.3.2 Unbonded Length	13
		5.3.3 Bonded Length	13
		5.3.4 Spacing of Tieback Anchors	13
		5.3.5 Bearing Capacity and Wall Friction	13
		5.3.6 Passive Soil Resistance	13
	5.4	Slope Stability	15
	5.5	Soil Corrosivity	15
6.0	**CONSTRUCTION CONSIDERATIONS**		**16**
	6.1	General Earthwork	16
	6.2	Temporary Excavations	16
	6.3	Tieback Installation	17
	6.4	Construction Dewatering	17
	6.5	Geotechnical Review of Construction Plans	17
	6.6	Geotechnical Observation and Testing	17

7.0 LIMITATIONS 18
8.0 REFERENCES 19

Page

TABLES

Table 2-1. Geotechnical Exploration Information 3
Table 4-1. Idealized Subsurface Profiles 10

FIGURES

Figure 1-1. Site Location Map 2
Figure 3-1. Regional Fault and Physiographic Map 6
Figure 3-2. Geological Map 8
Figure 5-1. Lateral Earth Pressures Against Tieback Wall 12
Figure 5-2. Variation of Passive Soil Resistance Versus Wall Movement 14

APPENDICES

Appendix A. As-Built LOTB Sheet
Appendix B. Log-of-Test-Boring Sheets for Current Investigation
Appendix C. EMI Laboratory Soil Test Results
Appendix D. Results of Slope Stability Analysis
Appendix E. Caltrans Review Comments and EMI Responses

1.0 INTRODUCTION

1.1 PURPOSE

Earth Mechanics, Inc. (EMI) performed a geotechnical investigation for the proposed tieback wall located adjacent to Abutment 3 of the existing Yorba Linda Boulevard Overcrossing (OC) (Bridge No. 55-0468). The purpose of the geotechnical investigation was to obtain subsurface information and develop design and construction recommendations to aid RBF Consulting (RBF) in preparing the project Plans, Specifications, and Estimates (PS&E).

This retaining wall is part of the SR-57 Northbound Improvement project. The entire project consists of various improvements; this report contains findings, conclusions, and recommendations for the proposed tieback wall only.

1.2 SCOPE OF WORK

Geotechnical tasks performed for the proposed tieback wall included:

- Field investigation including drilling, sampling, and logging two exploratory borings.
- Laboratory soil tests on selected soil samples.
- Geotechnical engineering analyses and development of lateral pressures.
- Preparation of this report presenting our findings, conclusions, and recommendations.

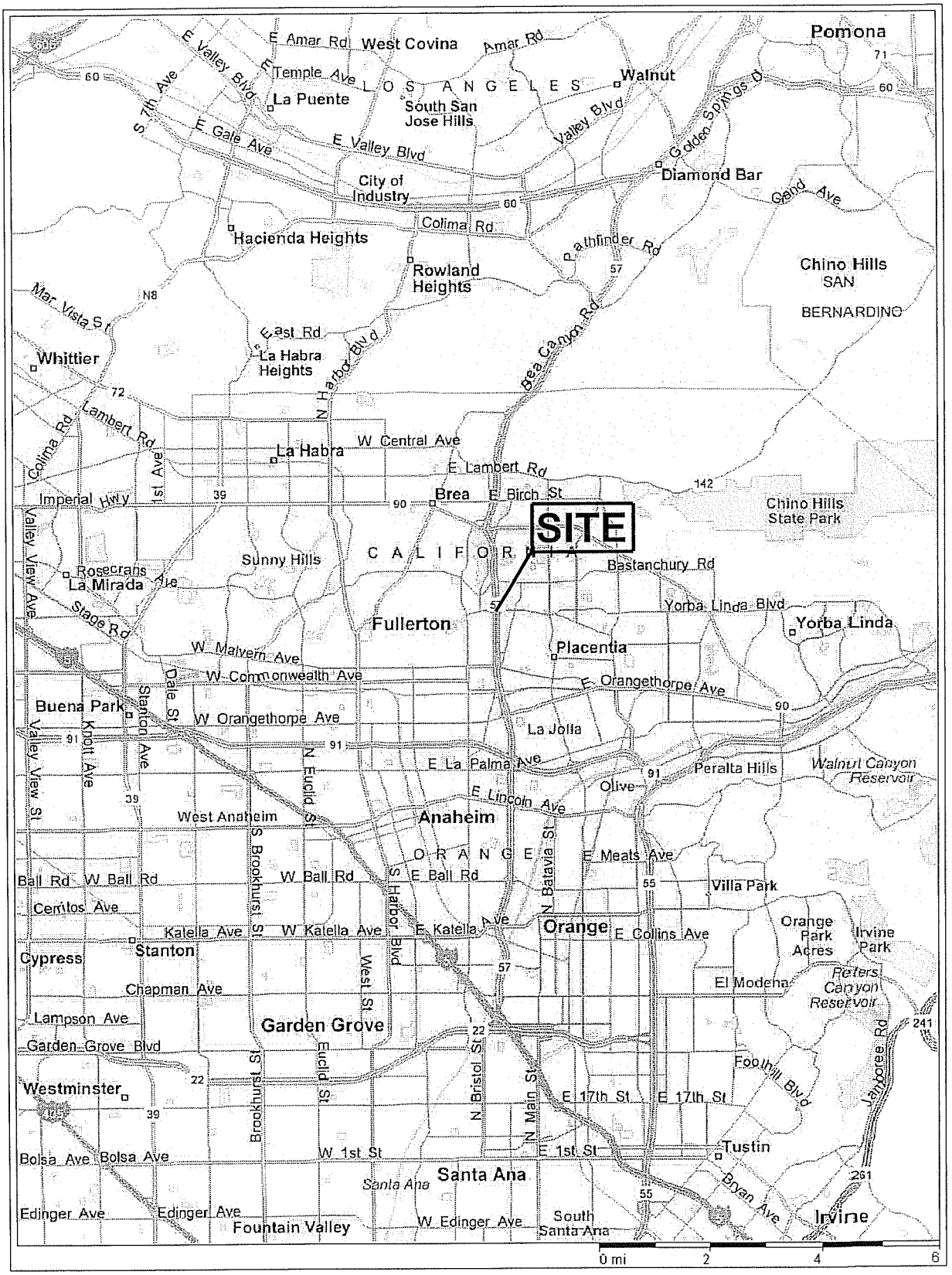
1.3 PROJECT DESCRIPTION

The Department of Tansportation (Caltrans) – District 12, in cooperation with the Orange County Transportation Authority (OCTA), proposed to widen northbound State Route 57 (SR-57) by adding one northbound through lane. The project limits are between 0.2 mile south of Orangethorpe Avenue and 0.2 mile north of Yorba Linda Boulevard along northbound SR-57. Within the project limits, there are interchanges located at Orangethorpe Avenue, Chapman Avenue, Nutwood Avenue and Yorba Linda Boulevard. The entire project involves widening seven existing bridges and a tieback wall at Yorba Linda Boulevard. Location of the tieback wall is shown on Figure 1-1.

The proposed wall, aligned parallel to SR-57, will be constructed by cutting into the existing abutment end slope. The proposed tieback wall is about 188 feet long and the height ranges from about 5 to 20 feet (measured from the bottom of the tieback wall).

1.4 REVIEW OF EXISTING DATA

The 1968 as-built Log-of-Test-Borings (LOTB) sheet for the Yorba Linda Boulevard OC was reviewed to gain knowledge of subsurface materials and conditions. This as-built LOTB sheet is provided in Appendix A. However, soil borings shown on this LOTB sheet were drilled from the same ground elevation as the SR-57 freeway and properties of the approach embankment fill are missing. As a result, the data on this LOTB sheet is not useful for the tieback design.



Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SITE LOCATION MAP

Figure 1-1

YORBA LINDA BLVD OC (MODIFY)

Project No. 08-115

Date: 06-17-09

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 FIELD INVESTIGATION

The as-built LOTB sheet is included in Appendix A; about 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV 88). To supplement the existing subsurface data, two soil borings were drilled at the approach to Abutment 3 on Yorba Linda Boulevard. These borings were drilled on August 25, 2008. Boring information, including exploration number, stations, offsets, ground surface elevations, bottom of hole elevations and water level measurements are summarized in Table 2-1. Locations of the exploratory boring are shown on the LOTB sheet provided in Appendix B.

Table 2-1. Geotechnical Exploration Information

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-018	SR-57 (B-Line)	573+88	127RT	+301.1	+239.6	None Encountered During Drilling
A-08-019	SR-57 (B-Line)	574+55	127 RT	+301.1	+239.6	

Exploratory borings were drilled using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. Relatively undisturbed drive samples were obtained using a 3.25-inch outer diameter California split-spoon sampler lined with brass rings. Each of these brass rings is 1-inch long with a 2.5-inch outside diameter. The California Drive sampler was driven into the ground using successive blows of a 140-lb hammer falling a distance of 30 inches. The numbers of blow for the final 12 inches or shorter of driving are shown on the LOTB sheet.

The Standard Penetration Test (SPT) sampler (1.4-inch inside diameter) was also used to obtain soil samples. The sampler was driven into the ground using a 140-lb hammer free falling from a height of 30 inches. The numbers of blow to advance the sampler each 6 inches of penetration or less was recorded. The blow counts required to drive the sampler for the last 12 inches or less was recorded as the Standard Penetration Resistance (N-value) on the LOTB sheet.

Charts published by Winterkorn and Fang (1975) can be used to determine a reduction factor used to convert blowcounts recorded using the California Drive sampler into SPT blowcounts. Using those charts, we obtained a reduction factor of 0.5 and this one-half reduction factor was used for this project.

The sampling interval is usually 5 feet. Sampling was performed by alternating the California Drive sampler and SPT sampler.

2.2 LABORATORY TESTING

Soil samples considered representative of the subsurface conditions were tested to obtain or derive relevant physical and engineering soil properties. The following laboratory tests were conducted to supplement the observations recorded during the field investigation:

- In-situ Moisture Content and Unit Weight
- Percent Passing No. 200 Sieve
- Atterberg Limits
- Direct Shear
- Unconsolidated-Undrained Triaxial
- Consolidation
- Minimum Resistivity, pH, Sulfate Content and Chloride Content

The laboratory tests were conducted in general accordance with California Test Methods or American Society for Testing and Materials (ASTM) Standards. Laboratory test results are included in Appendix C.

3.0 GEOLOGY AND SEISMICITY

3.1 TOPOGRAPHY AND DRAINAGE

The project corridor is in the eastern part of the Los Angeles Basin along the southern margin of the Coyote Hills and the Puente Hills (Figure 3-1). Just north of the project corridor, the Puente Hills rise to an elevation of about 1,400 feet. The southwestern edge of the Puente Hills is paralleled by a series of low-elevation plains and hills; the Santa Fe Plain and the Coyote Hills are to the west of the project corridor, and the Richfield and Kraemer Hills are to the east. The elevations of these hills range from about 500 feet just west of the project to about 300 feet in the east. The ground upon which the project is located slopes gently to the south. Elevations along the project corridor range from about 280 feet in the north to about 200 feet on the south.

The project corridor traverses the ancient flood plains and alluvial fans of Fullerton Creek and the Santa Ana River. The major drainage in the area is the Santa Ana River which flows westerly south of the site. Fullerton Creek, a tributary to the Santa Ana River, drains southwesterly from the Puente Hills just west of the project corridor.

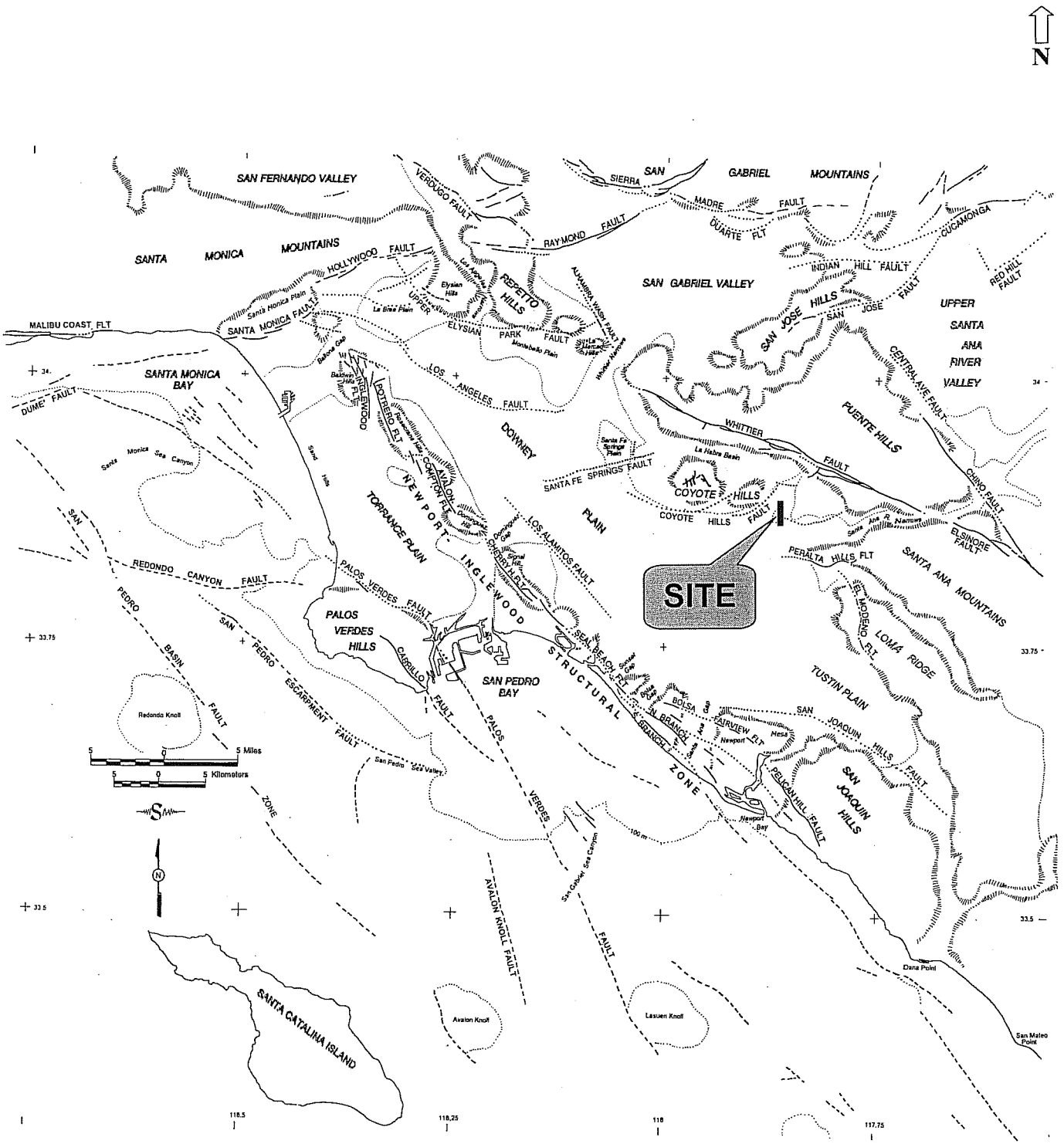
3.2 PHYSIOGRAPHY

The site area is at the eastern edge of the Los Angeles physiographic basin, a large, relatively flat, low-lying, coastal plain surrounded by mountains on the north, east, and southeast (Figure 3-1). The floor of the Los Angeles Basin is relatively flat but slopes gradually southwesterly from an elevated marginal apron to sea level along the coastline. The western margin of the Los Angeles Basin is bordered by the sea and the Palos Verdes Hills. The eastern margin is bordered by the Puente Hills and Santa Ana Mountains. The Coyote Hills, Santa Fe Springs Plain, Richfield Hills, and Kramer Hills are low elevation uplifts along the southern margin of the Puente Hills.

3.3 GEOLOGIC STRUCTURE

The geologic structure at the site is quite simple and is characterized by flat-lying Quaternary sediments overlying gently folded Tertiary sedimentary rocks. These strata rise gently to the Coyote Hills, Richfield Hills, and Kraemer Hills where they are arched upward to form anticlinal folds. The site is on the south limb of these anticlines with the early Pleistocene and Tertiary age strata dipping gently to the south and overlain by younger flat-lying Quaternary sediments.

The nearest active or potentially active surface faults are the Peralta Hills and Whittier faults (Figure 3-1). The low-elevation plains and hills along the eastern margin of the Los Angeles Basin are underlain by a series of east-west trending, en echelon, faults and folds in the subsurface; the major faults within this trend are, from north to south, the Los Angeles (Las Cienegas), Santa Fe Springs, and Coyote Hills faults (Figure 3-1). This group of faults is known as the Puente Hills fault system. Other poorly known segments of this thrust fault system underlie the Richfield and Kramer hills. All of these faults are blind thrust or reverse faults that approach within about a mile or so of the ground surface. They are identified on seismic reflection geophysical data only and are below the depths of oil wells.



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REGIONAL FAULT AND PHYSIOGRAPHIC MAP

Figure 3-1

Project No. 08-115

Date: 6-17-09

The Peralta Hills fault may be related to the Puente Hills fault system. The Peralta Hills fault is exposed along the south flank of the Peralta Hills where it displaces Tertiary-age rocks upward and over younger Quaternary alluvium. The fault extends westerly below the Santa Ana River channel where it creates barriers to ground-water flow (Figure 3-2). The barriers extend about to the SR 57 freeway just north of the Lincoln Avenue (Morton and Miller, 1981). The location of the Peralta Hills fault is well up on the flank of the hills rather than at the base of the hills indicating that it is not the only fault responsible for uplift and folding of the Peralta Hills. There must be a deeper unknown blind thrust fault below the Peralta Hills thrust fault but this feature has never been directly identified.

The Whittier fault is a major strike slip fault that extends northwesterly along the southwest flank of the Puente Hills northeast of the site (Figure 3-1). The Whittier fault is associated with the Chino fault and the Elsinore fault and together these faults form a major fault system that extends from the Los Angeles Basin into northern Mexico.

The El Modeno fault is a north-south trending feature within Loma Ridge, one of the foothills of the Santa Ana Mountains, southeast of the site. The feature is poorly known but is known to displace Holocene soil in Loma Ridge. Although the fault is grouped with the Peralta Hills fault on the Caltrans seismic hazard map (Mualchin 1996), it appears to be a discrete normal or strike-slip fault unrelated to the thrust faults of the Peralta Hills. Although the fault must be considered active because it displaces Holocene soil, the feature has a very long (thousands of years) recurrence interval.

3.4 GEOLOGIC HAZARDS

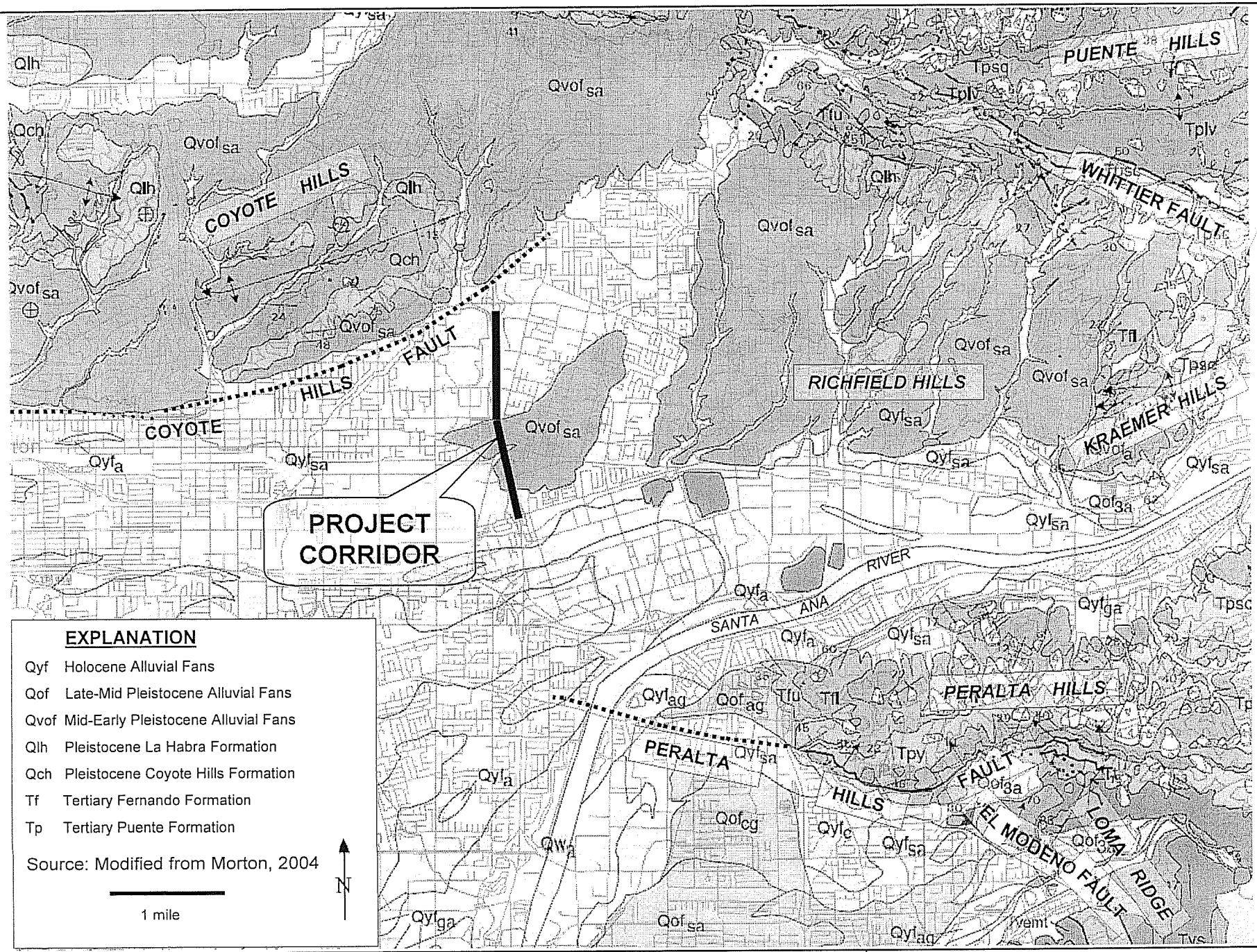
There are no steep slopes within the corridor so landsliding is not likely. There are no active faults so surface fault rupture is not likely. There are no known volcanos in the site region. The site is far from the sea on elevated land so Tsunamis are not a hazard.

The site is not identified on the State seismic hazard maps of the La Habra quadrangle as being susceptible to liquefaction (California Geological Survey/Division of Mines and Geology, 1997). This is due primarily to the depth of historically highest ground water being greater than 50 feet.

3.5 STRATIGRAPHY

Regional studies (e.g. Morton, 2004; Morton and Miller, 1981; Durham and Yerkes, 1964; California Department of Water Resources, 1961) indicate that the site area is underlain by Quaternary sediments overlying older Quaternary and Tertiary sediments and sedimentary rocks.

The surficial deposits are primarily Holocene and Pleistocene alluvial fan deposits (Figure 3-2). Older formations exposed in the hills and underlying the corridor are, in descending order, the Pleistocene-age La Habra and Coyote Hills, the Pliocene Fernando, and Pliocene-Miocene-age Puente formations. Along the corridor, the La Habra Formation is at an elevation of about sea level and therefore these older units are well below the level of interest for this project.



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Project No. 08-115 | Date: 6-17-09

GEOLOGICAL MAP

Figure 3-2

3.6 SEISMICITY

The largest historical earthquake within the Los Angeles Basin was the 1933 Long Beach earthquake of M_W=6.4 (M_L = 6.3) which is generally believed to have been associated with the Newport-Inglewood Structural Zone. The association of the 1933 event with the NISZ was based on abundant ground failures along the NISZ trend, but no unequivocal surface rupture was identified. Hauksson and Gross (1991) reevaluated the seismicity data and relocated the 1933 earthquake hypocenter to a depth of about 6 miles below the Huntington Beach-Newport Beach city boundary.

Other damaging earthquakes in the Los Angeles region include the 1971 San Fernando, the 1987 Whittier, and the 1994 Northridge events. The 1971 San Fernando (M_L= 6.4, M_W=6.7) earthquake occurred along the northern margin of the San Fernando Valley and produced a surface rupture which coincided partly with a zone of mapped surface faults along the mountain-valley margin. The more-recent 1987 Whittier earthquake (M_L=5.9, M_W=5.9) and the 1994 Northridge (M_L=6.4, M_W = 6.7) earthquake were not associated with surface faulting. Such events indicate that seismic hazards analysis must consider subsurface faulting as well as surface faulting. The Whittier event occurred at a depth of about 10 miles on a northerly dipping thrust fault dipping from the Coyote Hills area, under the Repetto and Puente Hills, to below the San Gabriel Valley. The Northridge event occurred at a depth of about 12 miles on a south-dipping reverse fault below the San Fernando Valley.

Another significant earthquake in the region was the 1812 earthquake which caused damage at the San Juan Capistrano Mission. The location and magnitude of the 1812 earthquake are unknown but geological studies (Jacoby et al., 1988; Fumal et al., 1993; Weldon et al., 2004) postulated that it did not occur in the Capistrano area, but rather was a large (M> 7.0) distant event on the San Andreas fault in the Wrightwood area of the San Gabriel Mountains.

A recent magnitude 5.4 (M_W) earthquake occurred on 29 July 2008 below the Puente Hills northeast of the site at a depth of about 10 miles. This event was a reverse type fault with a left- lateral component of slip. The causative fault is unknown. The epicenter is between the Whittier and Chino faults. The orientation of the preferred focal plane of the focal mechanism solution is somewhat compatible with the Whittier fault. The Whittier fault may have a reverse component of slip but is believed to be primarily a right-lateral fault. Furthermore dip of the preferred focal plane and the distribution of aftershocks are not very compatible with the Whittier fault. The northerly dipping buried thrust faults under the Peralta Hills, Richfield Hills, or Kraemer Hills could have been source because the preferred focal plane dips northeasterly similar to the northerly dipping faults. However, the distribution of the aftershocks does not seem compatible with the orientations of these faults.

4.0 SUBSURFACE CONDITIONS

4.1 SUBSURFACE SOIL CONDITIONS

Stratigraphy behind Abutment 3 of the existing structure, where the tieback wall is proposed, consists of artificial fill overlying alluvium within the reach of the borings. The fill materials are predominantly lean clay with sand. Native materials below the artificial fill consist primarily of alternating layers of silty sand and lean clay with sand.

4.2 IDEALIZED SUBSURFACE PROFILE AND ENGINEERING PARAMETERS

An idealized soil profiles were established based on the exploratory borings. Table 4-1 presents the idealized soil profiles and the estimated soil strength parameters. Shear strength parameters for the fill materials were determined based on laboratory direct shear tests (see Appendix C); shear strength parameters for the deeper clay layer (from El. +266 to +255 feet) are based on a direct shear test of comparable materials from an adjacent boring (EMI, 2009). Published correlations of SPT blowcounts versus soil strengths (Lam and Martin, 1986) were used to estimate the range of shear strength for granular soils from SPT blowcounts.

Table 4-1. Idealized Subsurface Profiles

Approximate Elevation (ft)	Predominant Soil Type	Range of Uncorrected SPT Blowcount* (blows per ft)	Total Unit Weight (pcf)	Friction Angle (degrees)	Cohesion/ Undrained Shear Strength (psf)
+301 to +271	Lean Clay with Sand (Fill)	6 to (14) Average = 10	120	26	200
+271 to +266	Silty Sand	(8) to (12) Average = 10	120	30	100
+266 to +255	Lean Clay	5 to >70 Average = 33	130	-	4000
+255 to +240	Silty Sand	11 to (36) Average = 21	125	32	100

*Values in ( ) are converted Standard Penetration Test (SPT) blowcounts corrected for sampler size; correction factor from California sampler blowcounts to SPT blowcounts is 0.5.

4.3 GROUNDWATER CONDITIONS

During the recent field investigation conducted on August 27 and September 25, 2008, groundwater was not encountered down to El. +134 feet which is more than 90 feet from the freeway surface. As shown on the as-built LOTB sheets in Appendix A, groundwater was not encountered during drilling in November 1965 and February 1993 down to El. +161 feet and +133 feet, respectively.

The relatively deep water depth is confirmed by the historical groundwater map published by the California Geological Survey (Seismic Hazard Zones Map - Anaheim and Newport Beach Quadrangle) (CGS, 1997). This map shows the depth to groundwater to be greater than 50 feet.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 DESIGN GROUND MOTION

Deterministic ground motion analysis was performed in accordance with Caltrans criteria. The controlling fault is the Puente Hills Blind Thurst fault with a maximum magnitude of 7.25±0.25. The fault is located about 2.6 miles from the project site. The resulting peak bedrock acceleration based on the larger of the attenuation equations by Mualchin (1996) and Sadigh et al (1997) is 0.7 g.

5.2 SOIL LIQUEFACTION

Liquefaction is the loss of shear strength in generally cohesionless, saturated soils when the pore-water pressure induced in the soil by a seismic event becomes equal to or exceeds the overburden pressure. The primary factors influencing the potential for liquefaction include: groundwater elevation, soil type and grain-size characteristics, relative density of the soil, initial confining pressure, and intensity and duration of ground shaking. Soils most susceptible to liquefaction are saturated low-density sands and silty sands situated within 50 feet of the ground surface.

Due to the deep depth to groundwater (more than 50 feet), liquefaction potential at the site is low.

5.3 TIEBACK WALL DESIGN

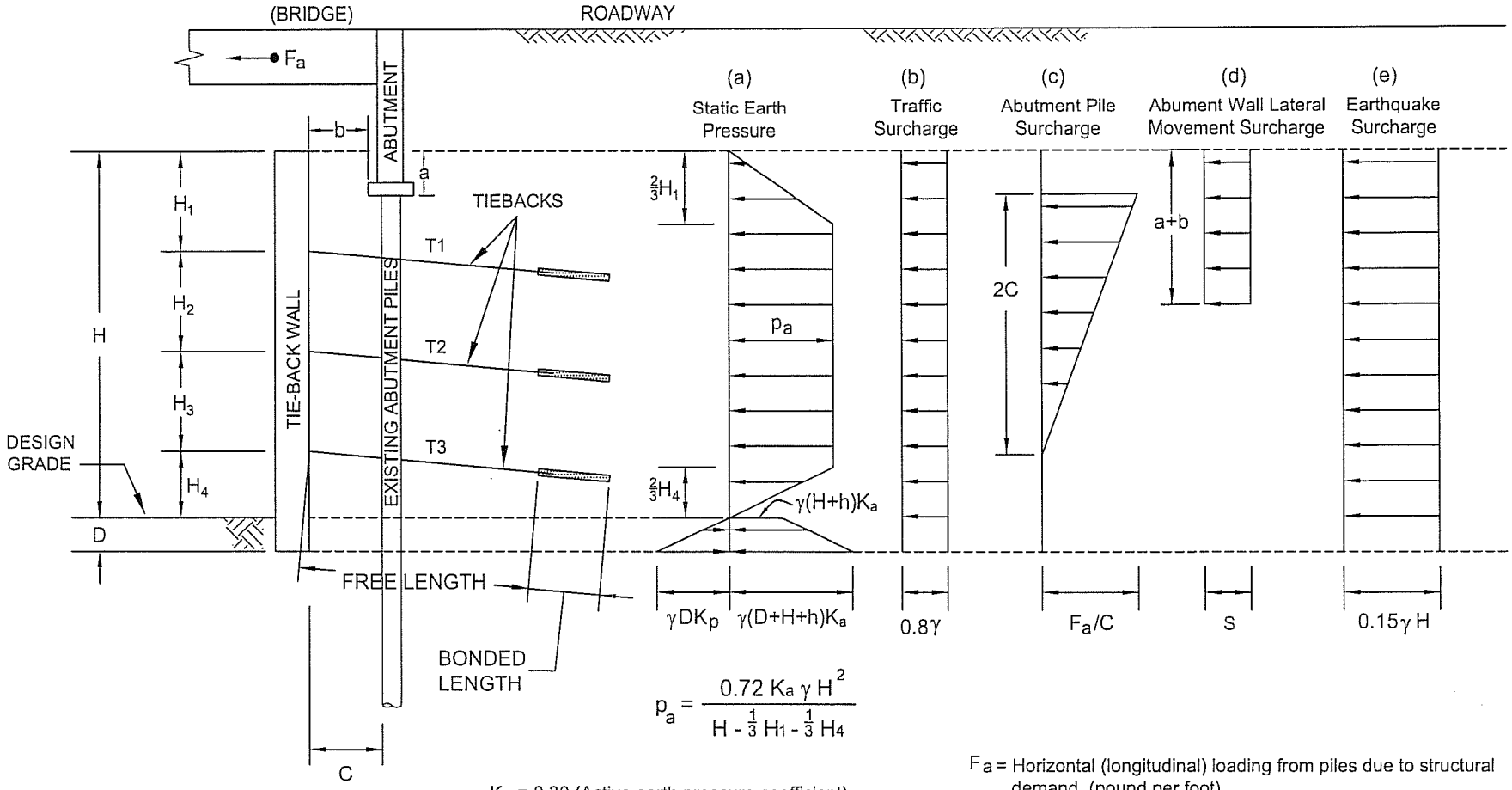
To widen SR-57 beneath the Yorba Linda OC, the bottom portion of the existing end slope at the east abutment (Abutment 3) must be removed and replaced with a tieback wall.

Based on the General Plan provided by RBF, up to three rows of tieback anchors will be used. Height of the tieback wall ranges from 5 to 20 feet.

5.3.1 Lateral Pressures

Tieback anchors should be designed to resist all lateral pressures against the tieback wall. For the purpose of estimating lateral pressures, the following soil parameters are recommended: a soil unit weight of 120 lb/ft^3; an internal friction angle of 26°; and cohesion of 200 psf. Lateral pressures against the tieback wall include static and seismic pressures, pressures from the approach embankment, pressure from traffic loading, and pressure from the existing abutment wall and piles.

The lateral pressures against the tieback wall are shown in Figure 5-1 and include the following: (a) the active earth pressure in accordance with Caltrans Bridge Design Specifications (Caltrans, 2004) and the passive pressure at the bottom of the wall; (b) lateral static pressure due to traffic loading; (c) pressure from the existing piles resulting from the horizontal structural load; (d) pressure from the existing abutment wall moving towards the proposed tieback wall; and (e) the seismic lateral earth pressure increment. Traffic loading at the ground surface is represented by a 2-foot thick soil surcharge. For service loading, pressures (a), (b) and (c) should be used. For seismic design, pressures (a), (c), (d) and (e) should be used.



$$p_a = \frac{0.72\, K_a\, \gamma\, H^2}{H - \frac{1}{3}H_1 - \frac{1}{3}H_4}$$

K_a = 0.30 (Active earth pressure coefficient)

K_p = 2.5 (Passive earth pressure coefficient)

γ = Soil density = 120 pcf

F_a = Horizontal (longitudinal) loading from piles due to structural demand (pound per foot)

C = Distance in feet between tieback wall and abutment piles

a = Abutment footing embedment in feet

b = Distance in feet between tieback wall and abutment footing

S = 560 psf if $b \leq 1.6a$

S = 0 if $b > 1.6a$

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	YORBA LINDA BOULEVARD OC (MODIFY)	LATERAL EARTH PRESSURES AGAINST TIEBACK WALL
	Project No. 08-115 / Date: 6-17-09	FIGURE 5-1

5.3.2 Unbonded Length

The unbonded length (or "free length") of the anchor is that portion of the anchor which is not grouted. The unbonded length should fall outside the Rankine wedge, which is defined by the ground surface, the tieback wall, and an assumed failure plane. This failure plane extends from the bottom of the tieback wall up at an angle of 32° measured from the vertical. In any case, the unbonded length should not be less than 15 feet.

The angle of inclination of the anchors should be at least 10° to facilitate tendon installation and grouting.

5.3.3 Bonded Length

The bonded length of tieback anchors is that portion which is grouted and provides the lateral resistance due to friction between the soil and concrete.

The maximum allowable anchor design load is computed by multiplying the bonded length by the ultimate transfer load and dividing by a factor of safety. The contractor is responsible for determining the bonded length of the tieback anchors; however, the bonded length of the anchors should not be less than 15 feet.

5.3.4 Spacing of Tieback Anchors

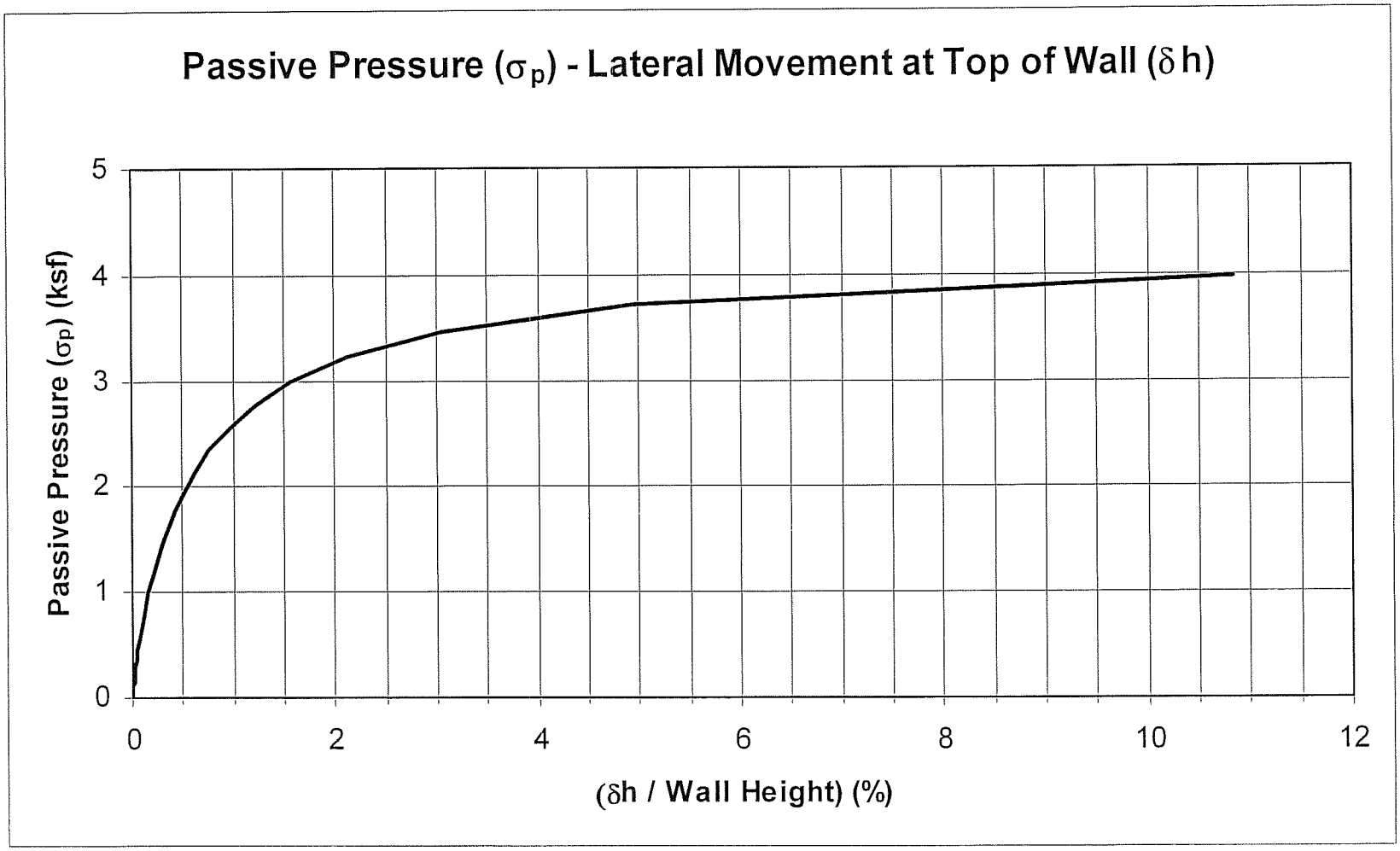
Tieback anchors should not be spaced closer than five diameters of the bonded zone or 5 feet, whichever is greater. The tieback anchors should be located to maximize their distance from the abutment piles.

5.3.5 Bearing Capacity and Wall Friction

The allowable bearing capacity for the footing (or leveling pad) at the bottom of the tieback wall is 1.5 kips per square foot (ksf), which is based on a minimum embedment depth and footing width of 2 feet and 1.67 feet, respectively. A friction coefficient of 0.25 and 0.33 can be used between the vertical concrete wall and the soil behind the wall for the permanent and temporary (during construction) condition, respectively.

5.3.6 Passive Soil Resistance

The tiebacks will be proof-tested in the field following Caltrans procedures. It is our understanding that the maximum test load is 1.5 times the tieback design loading as shown on the design drawings. During testing, the bearing surface will develop passive soil resistance to counteract the test load. The magnitude of this passive soil resistance is a function of the wall movement. We computed this relationship and the results are presented in Figure 3. In Figure 3, the ultimate passive resistance is calculated using the trial wedge method (Bowles, 1996) and the value of movement required to reach the ultimate passive condition is based on recommendations published by AASHTO (2007). We also elected to model the soil as a clayey material with an undrained shear strength of 1500 psf and a total unit weight of 120 pcf.



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	YORBA LINDA BOULEVARD OC (MODIFY)	VARIATION OF PASSIVE SOIL RESISTANCE VERSUS WALL MOVEMENT
	Project No. 08-115 / Date: 6-17-09	FIGURE 5-2

5.4 SLOPE STABILITY

Global stability of the tieback wall was evaluated for static and pseudo static condition using the computer program, SLIDE (RocScience, 2007). Results of this analysis are presented in Appendix D.

The factor of safety for a deep-seated failure is greater than 1.5 under static condition for the with a 2-foot soil surcharge to represent traffic loading. Slope stability analysis under pseudostatic condition was performed using a seismic coefficient equal to 0.2g (which is the smaller of either one-third the horizontal peak ground acceleration or 0.2g) in accordance with guidelines provided in Section 3.12 of the Caltrans Guidelines for Foundation Investigations and Reports (Caltrans, 2006b). Analysis indicates that the factor of safety is greater than 1.1 under pseudostatic condition.

5.5 SOIL CORROSIVITY

Three soil samples were tested for minimum resistivity, pH, soluble sulfate content, and soluble chloride content. The minimum resistivities were from 750 to 900 ohm-cm. The pH was determined to be from 7.9 to 8.5. Soluble sulfate content ranged from 80 to 280 parts per million (ppm), and soluble chloride ranged from 181 to 296 ppm.

Based on Caltrans Corrosion Guidelines (2003), soils are considered corrosive if the pH is 5.5 or less, or the sulfate concentration is 2,000 ppm or greater, or the chloride concentration is 500 ppm or greater. Based on the test results and the Caltrans criteria, the on-site soils are not considered to be corrosive to concrete and bare metal.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 GENERAL EARTHWORK

Any earthwork performed for the project should be conducted in accordance with all applicable Caltrans Standard Specifications (2006a).

Qualified geotechnical personnel should monitor earthwork operations on a full-time basis. Compacted fill placed for the project should be observed, monitored, and tested by qualified geotechnical personnel during construction. Field and laboratory tests should be conducted in accordance with California Test (CT) methods and any other applicable testing requirements.

Prior to placing compacted fill, the exposed subgrade should be scarified to a minimum depth of 8 inches, moisture conditioned as necessary to near optimum moisture content, and compacted to at least 95 percent relative compaction based on maximum densities determined in accordance with CT methods. Fill should be placed in uniform horizontal loose lifts not exceeding 8 inches in thickness, moisture conditioned to near optimum moisture content, and compacted to at least 95 percent relative compaction. If hand-directed mechanical tampers are used for compaction, the loose lift thickness should not exceed 6 inches. Observation, probing, and testing must be performed by qualified geotechnical personnel to verify degree of compaction.

Areas that are excavated below finish grade or that are disturbed by construction activities should be overexcavated to a depth where undisturbed material is exposed. Finish grades should be reestablished using fill properly compacted to a minimum of 95 percent relative compaction.

6.2 TEMPORARY EXCAVATIONS

Temporary excavations must be properly sloped or shored in accordance with all applicable codes and regulations including OSHA standards.

Qualified geotechnical personnel should inspect temporary slopes for erosion and sloughing, and should inspect temporary shoring for signs of instability and deformations, during construction on a daily basis.

Soil or other construction materials should not be stockpiled adjacent to excavations. Stockpiles should be set back a minimum distance which is equal to the height of the excavation. Shoring should be designed for site specific conditions using input from qualified geotechnical personnel during construction.

The contractor is responsible for worker safety in the field during construction. The contractor should conform to all applicable occupational safety and health standards, rules, regulations, and orders established by the State of California. Also, other state, county, or municipal agency requirements may supercede recommendations presented in this report. If a trench shoring design and safety plan is required, the geotechnical consultant should review the plan to confirm that recommendations presented herein were used for design or provide additional recommendations.

6.3 TIEBACK INSTALLATION

Since the proposed tieback wall is relatively close to the existing Yorba Linda OC abutment foundation, we recommend that the maximum length of tieback wall in front of the abutment foundation, constructed at any given time, not exceed one-third the length of the existing abutment foundation (pile cap).

Tieback anchors should be constructed and proof-tested in the field in accordance with Caltrans procedures and specifications. The contractor is responsible for determining the bonded length of tieback anchors. Minimum bonded length is 15 feet. The unbonded length should not be less than 15 feet.

The anchors should be inclined at least 10° to facilitate tendon installation and grouting. Tieback anchors should not be spaced closer than five diameters of the bonded zone or 5 feet, whichever is greater. The tieback anchors should be located to maximize their distance from the existing abutment piles.

The contractor should exercise care to minimize impact to the existing abutment and piles due to the installation of tieback anchors and construction of the tieback wall. We recommend that a monitoring program be implemented during construction to monitor movement of the abutment. If the measured vertical or lateral movement is excessive, construction should be stopped immediately and measures to mitigate the movement should be implemented.

6.4 CONSTRUCTION DEWATERING

As indicated previously, groundwater was not encountered in our borings. Consequently, groundwater is not likely to be encountered in the proposed excavations. However, contractors should be prepared to control groundwater per Caltrans requirements, if groundwater is encountered during construction.

6.5 GEOTECHNICAL REVIEW OF CONSTRUCTION PLANS

Recommendations contained herein are based on preliminary plans. Final construction plans should be reviewed by EMI to verify that the general intent of the recommendations has been applied to the design. Recommendations contained in this report may require modification or additional recommendations may be necessary based on the final design.

6.6 GEOTECHNICAL OBSERVATION AND TESTING

Qualified geotechnical personnel should perform inspections and testing during:

- Grading operations – temporary and permanent excavations and compacted fill placement.
- Drilling of holes for and installation of tieback anchors.
- Removal or support of buried utilities or structures.
- Installation of temporary shoring.
- When any unusual conditions are observed.

7.0 LIMITATIONS

This report is intended for use by RBF Consulting, Orange County Transportation Authority, and the California Department of Transportation for the proposed tieback wall at Abutment 3 of the Yorba Linda Boulevard Overcrossing at the SR-57 freeway. This report is based on the project as described herein and the information obtained from the exploratory borings at the approximate locations indicated on the enclosed plans. Findings and recommendations contained herein are based on the results of the field investigation, laboratory tests, and the geotechnical engineering analyses. Soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project area. However, subsurface conditions and characteristics of subsurface materials between exploratory borings can vary. Findings reflect an interpretation of the direct evidence obtained. Recommendations presented herein are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Changes to the plans or subsurface variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained herein are applicable to the specific design elements and locations that are the subject of this report. Data, opinions, and recommendations contained herein have no applicability to any other design elements or to any other locations, and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

EMI is not responsible for construction means, methods, techniques, sequences, procedures, or safety programs in connection with the construction, for the acts or omissions of the Contractor, or any other person performing any of the design or construction, or for the failure of any worker to carry out the construction in accordance with Final construction drawings and specifications.

Services performed by EMI have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee are included or intended.

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Appendix A. As-Built LOTB Sheet

DIST.	COUNTY	ROUTE	SECTION	SHEET NO.	TOTAL SHEETS
07	ORA	57	17.1/20.2	139	180

DIST. ENGR. _____ DATE APPROVED September 30, 1968

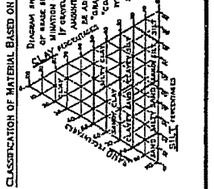
LEGEND OF BORING OPERATIONS

- Penetrometer
- 2½" Core Penetrometer
- Sampler Boring (Dry)
- Rotary Boring (Wet)
- Auger Boring (Dry)
- Jet Boring
- Core Boring
- Test Pit

LEGEND OF EARTH MATERIALS

- Gravel
- Sand
- Silt
- Clay
- Shaly Clay or Clayey Sand
- Sandy Silt or Silty Sand
- Silty Clay or Clayey Silt
- Peat and/or Organic Matter
- Fill Material
- Igneous Rock
- Sedimentary Rock
- Metamorphic Rock

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS



NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.

BENCH MARK

BM 34-19A-56 ELEV. 272.11
CHC BRASS CAP IN CONC. IN 2" I.P. DIST. 1.363' E. OF STA. 525+11.43 "P" P.I. #35, 1800'± E. OF INTER. OF PIONEER AVE. & ASSOCIATED RD. & 3' S. OF PP #1024090 E.

DIVISION OF ENGINEERING SERVICES - GEOTECHNICAL SERVICES

As-Built Log of Test Borings sheet is considered an informational document only. As such, the State of California registration seal with signature, license number and registration certificate expiration date confirm that this is a true and accurate copy of the original document. This drawing is available and presented only for the convenience of any bidder, contractor or other interested party.

DIST.	COUNTY	ROUTE	POST MILES - TOTAL PROJECT	Sheet No.	Total Sheets
12	Ora	57	16.2/18.6		

Lino Cheang
REGISTERED GEOTECHNICAL ENGINEER _____ DATE _____

REGISTERED PROFESSIONAL ENGINEER ★ LINO C. CHEANG NO. GE 2345 EXP. 9/30/89 ★ GEOTECHNICAL STATE OF CALIFORNIA

YORBA LINDA BLVD OC (MODIFY)

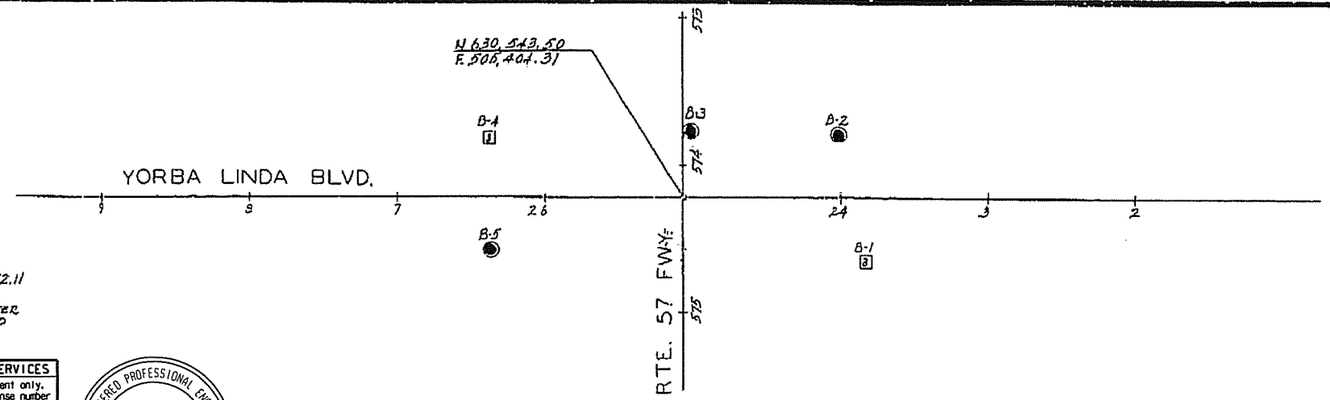
AS-BUILT LOG OF TEST BORINGS

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

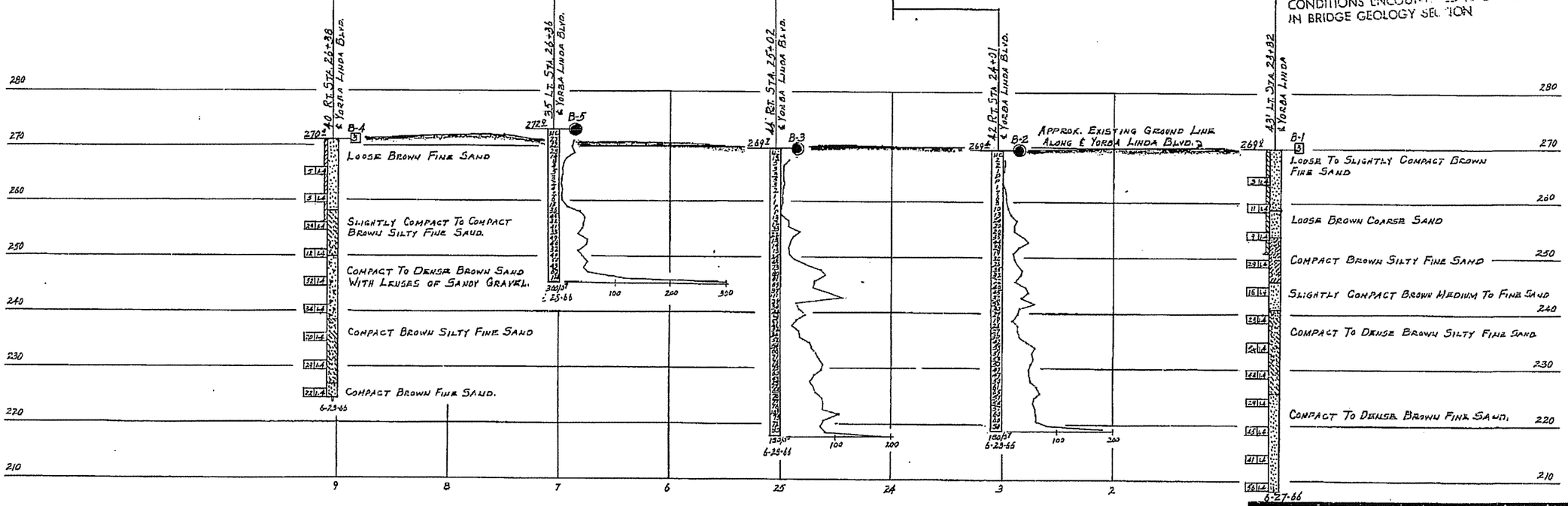
CU: 12
EA: 0F0311

BRIDGE No. 55-0468

Sheet	of
X	X



PLAN
SCALE: 1"=50'



PROFILE
SCALE: VERT. 1"=10'
HORIZ. 1"=50'

INFORMATION ON ACTUAL FOUNDATION CONDITIONS ENCOUNTERED IS ON FILE IN BRIDGE GEOLOGY SECTION

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION DATE JUNE 1966

AS BUILT PLANS
Contract No. 07-032134
Date Completed _____
Document No. 7000578

CHARGE: 07208

SHEET	OF
10	10

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

YORBA LINDA BOULEVARD OVERCROSSING

LOG OF TEST BORINGS

SCALE AS NOTED	BRIDGE 55-468	FILE	DRAWING 55467-10

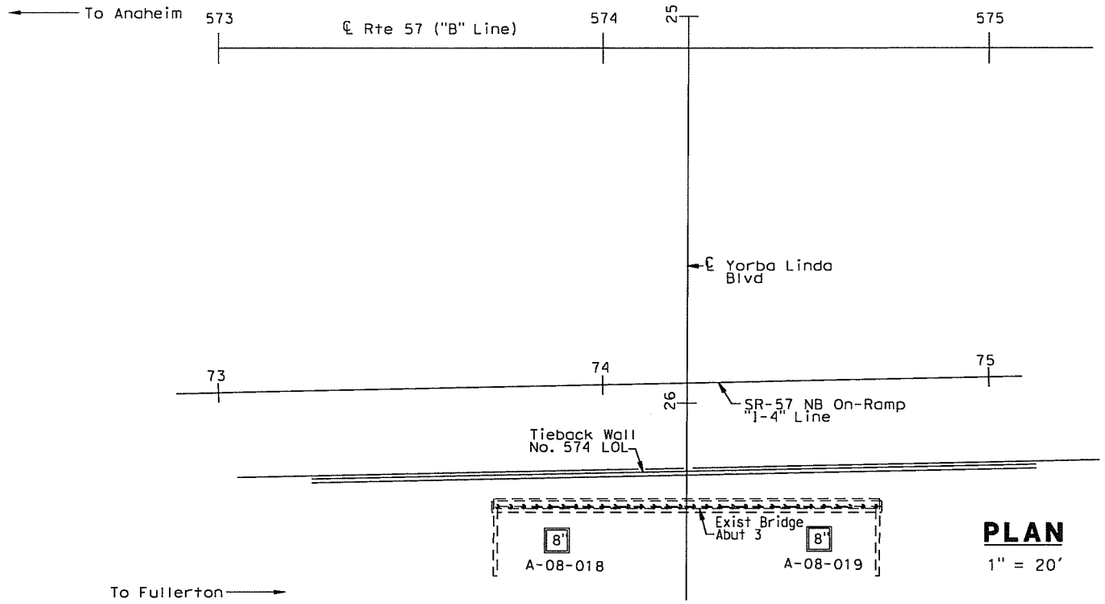
Appendix B. Log-of-Test-Boring Sheets for Current Investigation

BENCHMARKS:

Vertical Datum NAVD 88

Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¾" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.



PLAN
1" = 20'

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lino Cheang
REGISTERED ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

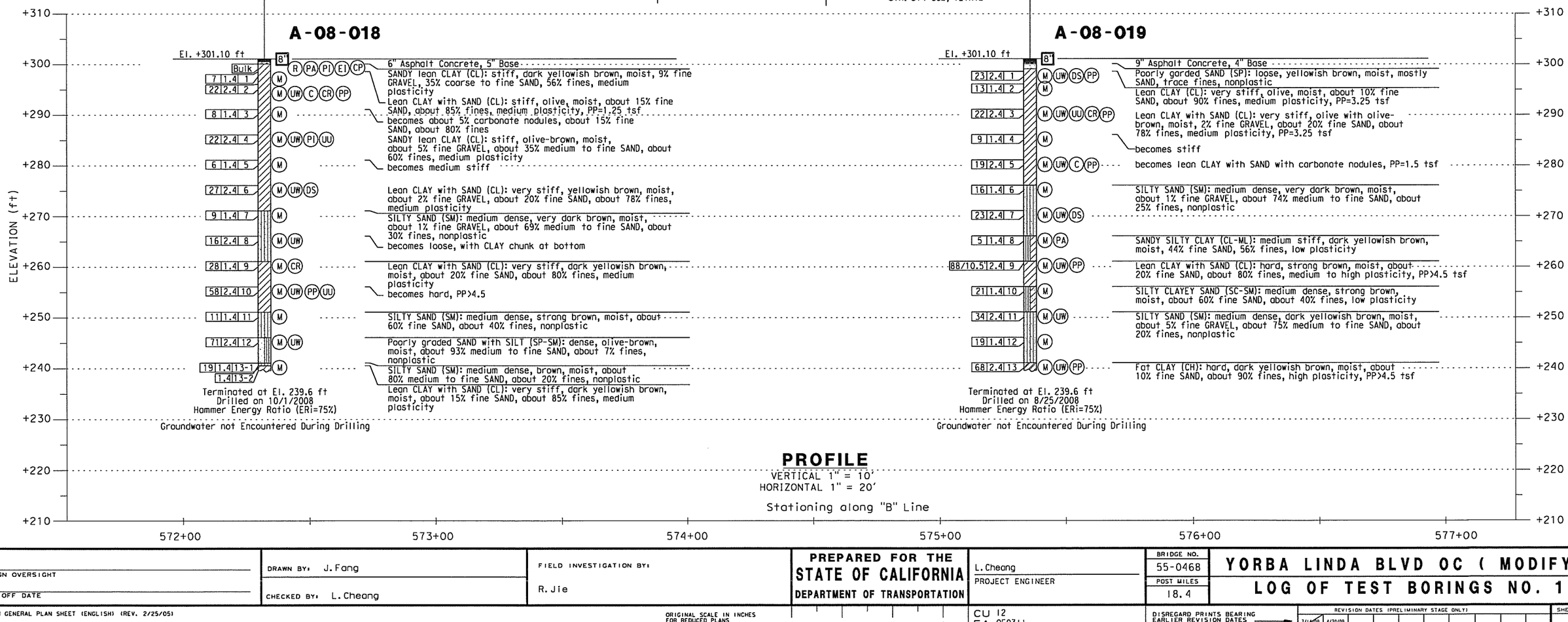
NOTES:

(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)

(2) 2.4" samples were taken using a California Modified Sampler.

(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.

(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 20'

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0468 / POST MILES 18.4
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			YORBA LINDA BLVD OC (MODIFY)
					LOG OF TEST BORINGS NO. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY) 3/16/09 4/30/09

SHEET OF

TIME PLOTTED => $TIME
DATE PLOTTED => $DATE
USERNAME => $USER

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lina Cheang
REGISTERED ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ORANGE COUNTY TRANSPORTATION AUTHORITY
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ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

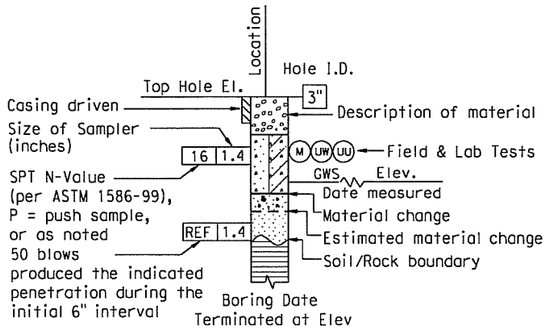
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

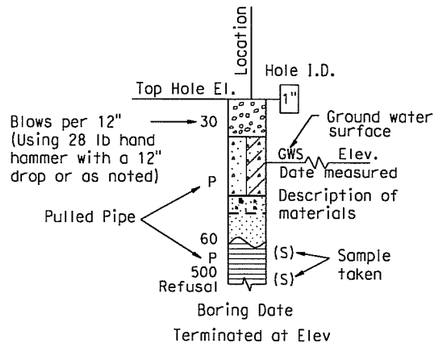
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

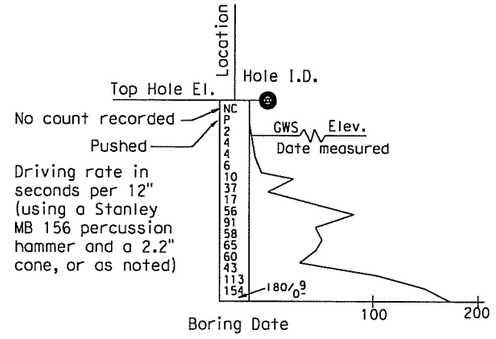
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



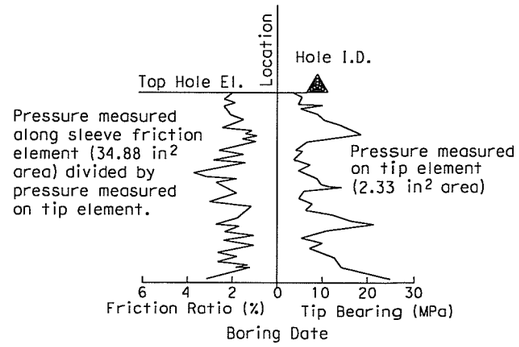
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT	DRAWN BY: J. Fang	FIELD INVESTIGATION BY:	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	L. Cheang PROJECT ENGINEER	BRIDGE NO. 55-0468	YORBA LINDA BLVD OC (MODIFY)
SIGN OFF DATE	CHECKED BY: L. Cheang	R. Jie			POST MILES 18.4	LOG OF TEST BORINGS NO. 2
DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)	ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3			CU 12 EA 0F0311	DISREGARD PRINTS BEARING EARLIER REVISION DATES →	REVISION DATES (PRELIMINARY STAGE ONLY) — SHEET — OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
12	Ora	57	16.2/18.6		

Lino Cheang
REGISTERED ENGINEER — DATE

REGISTERED PROFESSIONAL ENGINEER — L. CHEANG — NO. GE 2345 — EXP. 9-30-09 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

L. Cheang
PROJECT ENGINEER

BRIDGE NO. 55-0468
POST MILES 18.4

YORBA LINDA BLVD OC (MODIFY)
LOG OF TEST BORINGS NO. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Appendix C. EMI Laboratory Soil Test Results

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

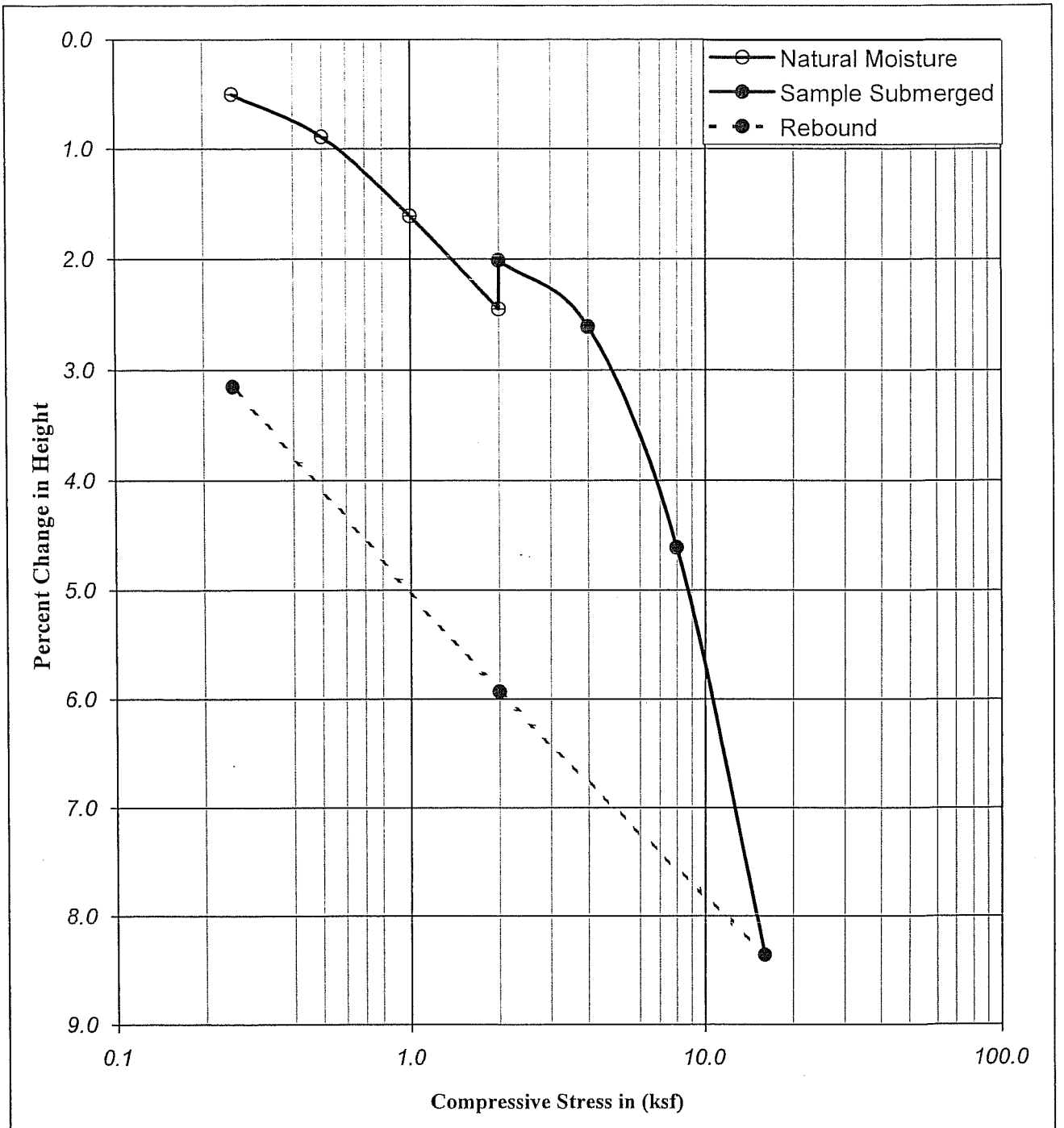
Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Torvane Shear (Kg/cm2)	Grain Size Distribution GR:SA:FI (%)	Sand Equivalent (CT-217)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-018	BULK	1-5	CL							42/16/26				
A-08-018	S-1	2.5	CL	28.7										
A-08-018	D-2	5	CL	24.4	120.2	1.25					760	8.4	250	223
A-08-018	S-3	10	CL	19.4										
A-08-018	D-4	15	CL	25.0	125.4					43/21/22				
A-08-018	S-5	20	CL	18.2										
A-08-018	D-6	25	CL	16.4	126.2									
A-08-018	S-7	30	SM	12.5										
A-08-018	D-8	35	SM	13.6	116.8									
A-08-018	S-9	40	CL	15.5							900	7.9	80	296
A-08-018	D-10	45	CL	14.9	133.4	>4.5								
A-08-018	S-11	50	SM	15.7										
A-08-018	D-12	55	SP-SM	2.0	106.4									
A-08-018	S-13-1	60	SM	3.8										
A-08-018	S-13-2	60.5	CL	23.1										
A-08-019	D-1	2.5	CL	23.6	122.5	3.25								
A-08-019	S-2	5	CL	28.5										
A-08-019	D-3	10	CL	22.8	119.3	3.25					750	8.5	280	181
A-08-019	S-4	15	CL	23.6										
A-08-019	D-5	20	CL	21.7	120.4	1.5								
A-08-019	S-6	25	SM	3.7										
A-08-019	D-7	30	SM	6.6	118.8									
A-08-019	S-8	35	CL-ML	17.1				0:44:56						
A-08-019	D-9	40	CL	15.8	134.4	>4.5								
A-08-019	S-10	45	SC-SM	12.6										
A-08-019	D-11	50	SM	18.3	128.8									
A-08-019	S-12	55	SM	4.8										
A-08-019	D-13	60	CH	23.0	125.6	>4.5								

TABLE 2 SUMMARY OF LABORATORY STRENGTH TEST RESULTS

Project No. : 08-115 Project Name : RBF/SR-57 Northbound

Boring No.	Sample No.	Sample Depth	Soil Identification (group symbol) ASTM D2488/D2487	Unconsolidated Undrained Triaxial Test (ASTM D2850)				Direct Shear Test (ASTM D3080)			
								Peak		Residual	
				Peak Strength S_u	Strain at Peak S_u	Shear Strength at 10% Strain S_u	Confining Pressure	ϕ	C	ϕ	C
		(ft)		(ksf)	(%)	(ksf)	(ksf)	(deg)	(ksf)	(deg)	(ksf)
A-08-018	D-4	15	CL	2.44	13.57	2.34	1.16				
A-08-018	D-6	25	CL					21.12	1.04	21.8	0.56
A-08-018	D-10	45	CL	8.82	14.62	8.24	3.57				
A-08-019	D-1	2.5	CL					45.23	0.85	29.05	0.16
A-08-019	D-3	10	CL	2.72	7.27	2.54	0.86				
A-08-019	D-7	30	SM					30.04	0.4	29.84	0.17



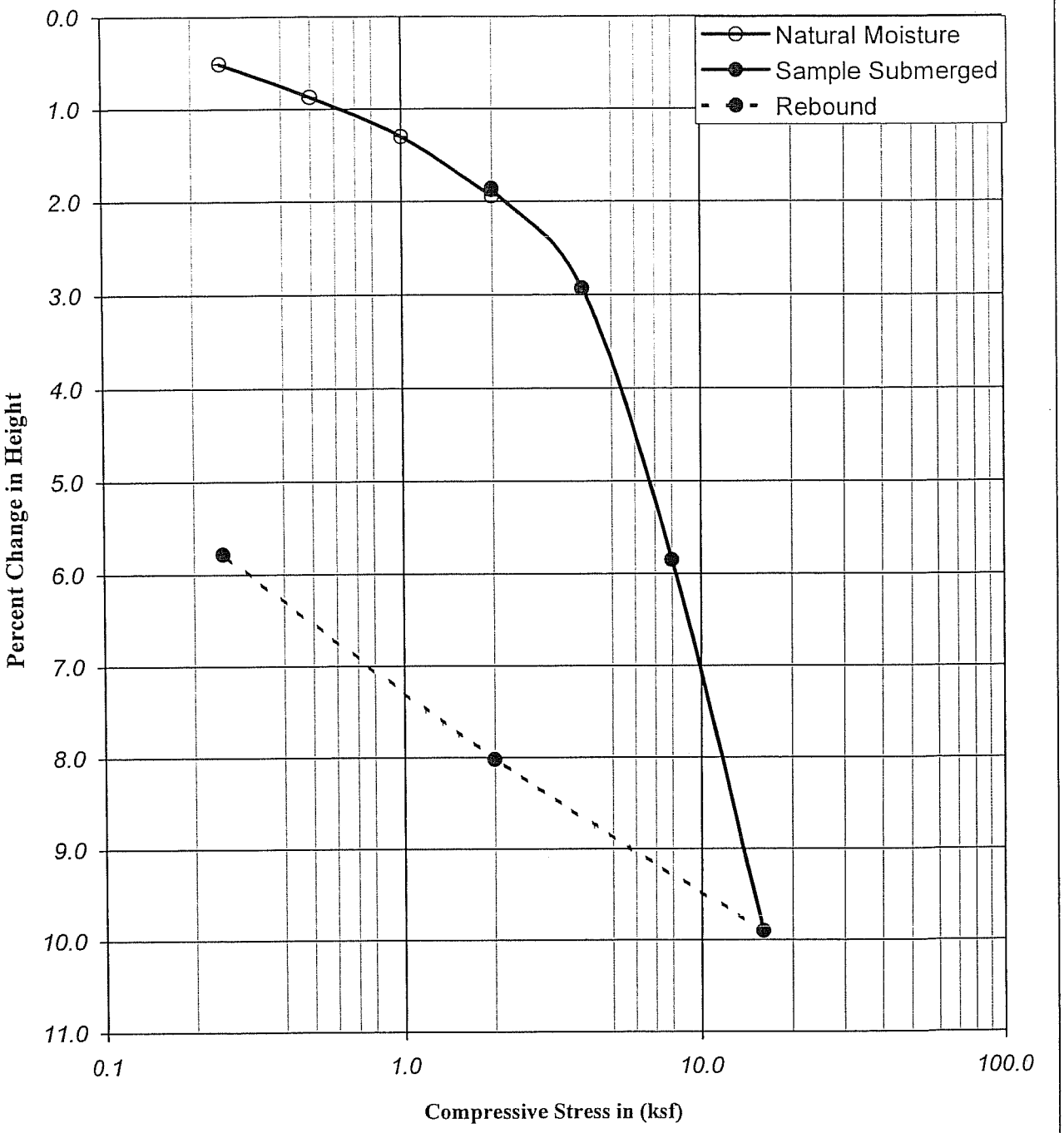
Boring No.	: A-08-018			Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No.	: D-2			Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft) :	5.0	6.5	Plastic Index :	-	Initial	26.10	96.70	15.22	94.85	0.74
	(m) :	1.53	1.98	Specific Gravity :	2.70	Final	26.84	99.94	15.73	105.55	0.69
Description : Olive brown, lean CLAY with SAND (CL)											

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)



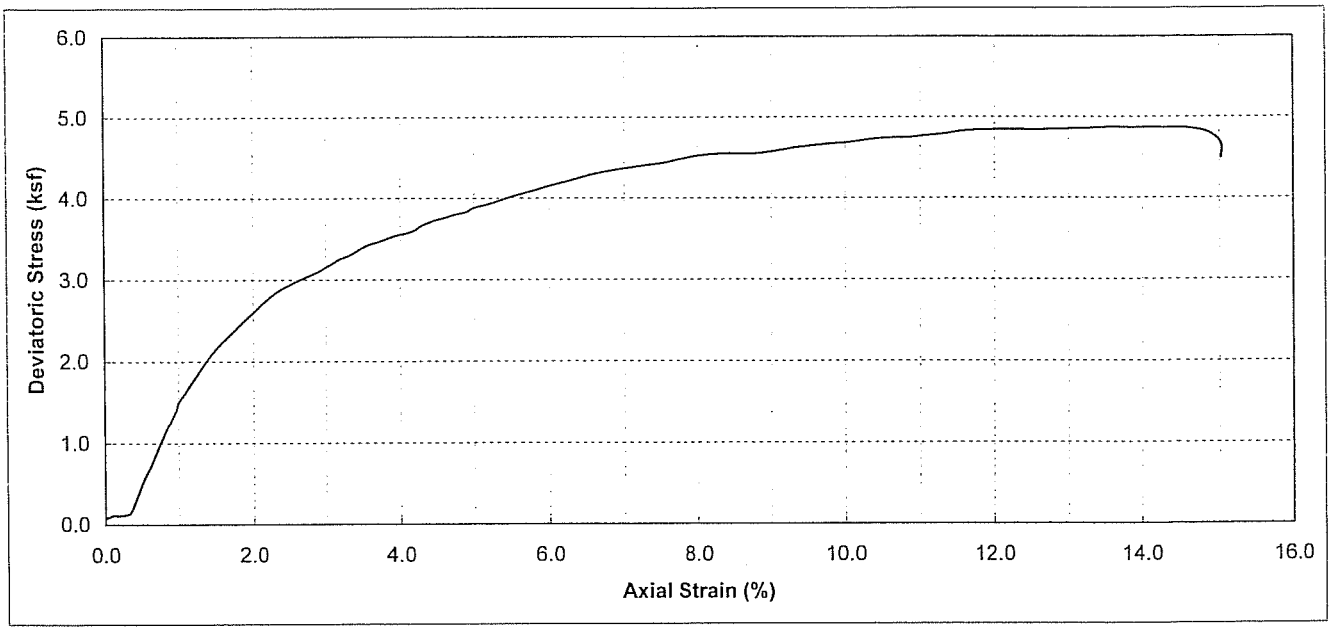
Boring No.	: A-08-019		Liquid Limit :	-		Moisture Content (%)	Dry Density (pcf)	Dry Density (kN/m³)	Percent Saturation	Void Ratio
Sample No.	: D-5		Plastic Limit :	-						
Depth (ft)	: 20.0	21.5	Plastic Index :	-	Initial	26.28	94.14	14.82	89.76	0.79
Depth (m)	: 6.10	6.56	Specific Gravity :	2.70	Final	25.19	100.06	15.75	99.33	0.68
Description	: Mottled olive gray, olive brown and brown, lean CLAY(CL)									

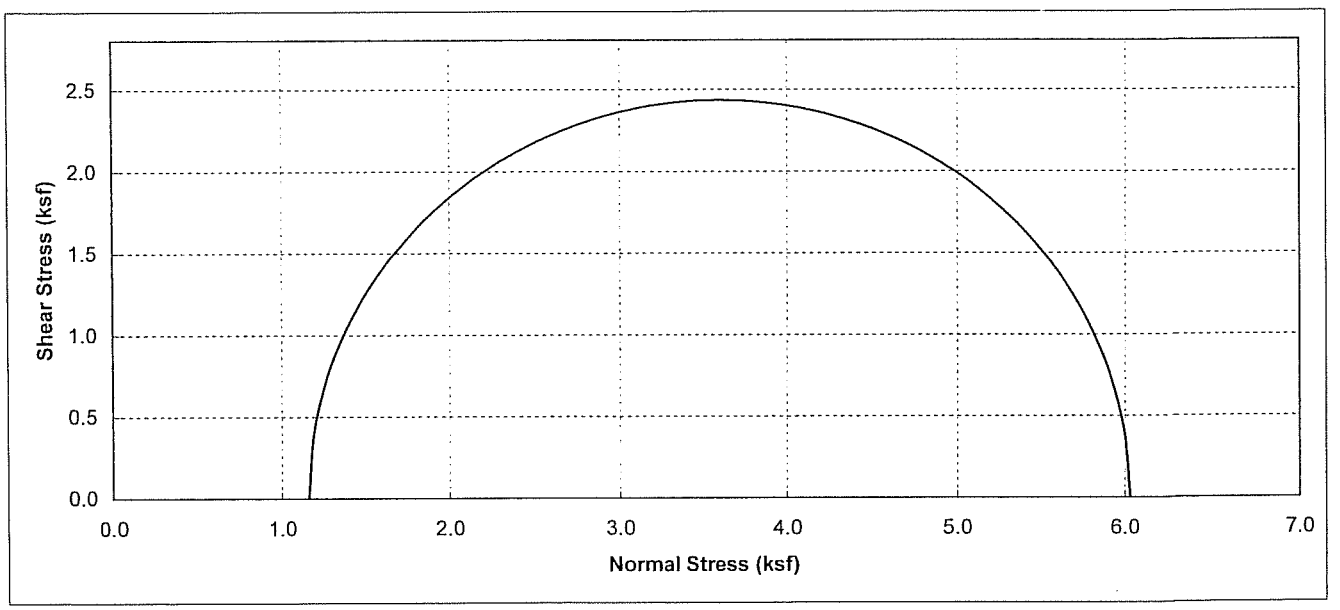
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

Project No. : 08-115 12/05/08

CONSOLIDATION TEST
(ASTM D-2435 / CT-219)





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-018	D-4	15	Olive Brown With Olive, SANDY LEAN CLAY (CL)	99.8	24.98	1.16	4.87	98.0

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

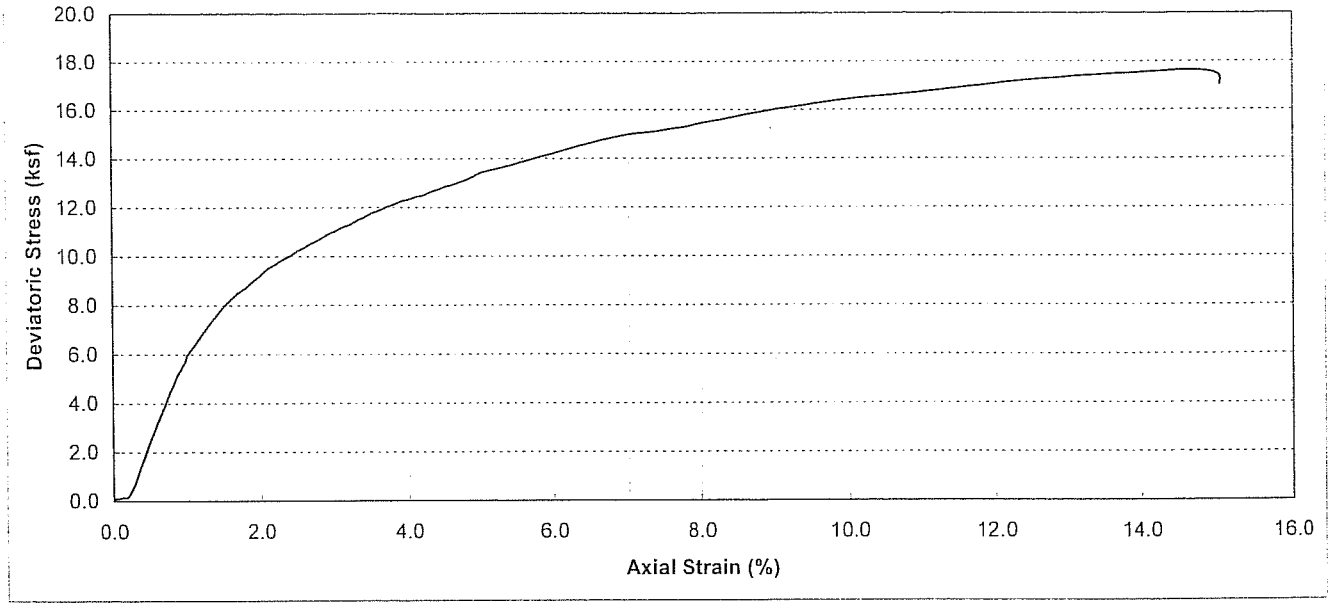
RBF/SR-57 Northbound

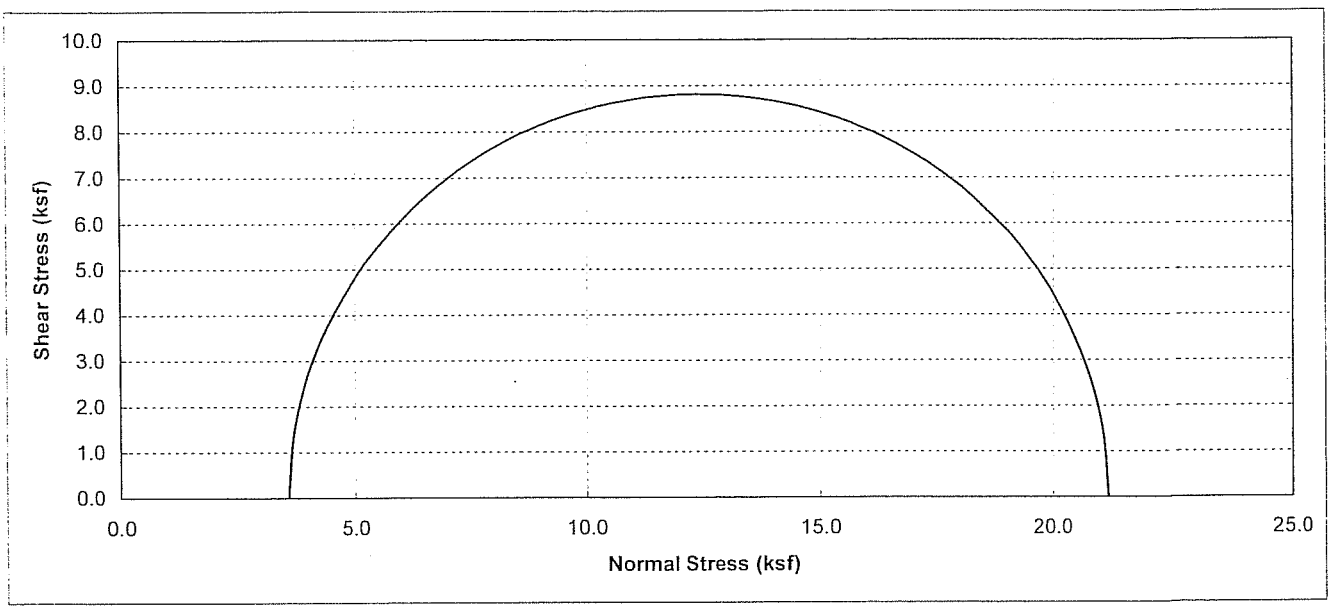
UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115

Date : 11/15/08

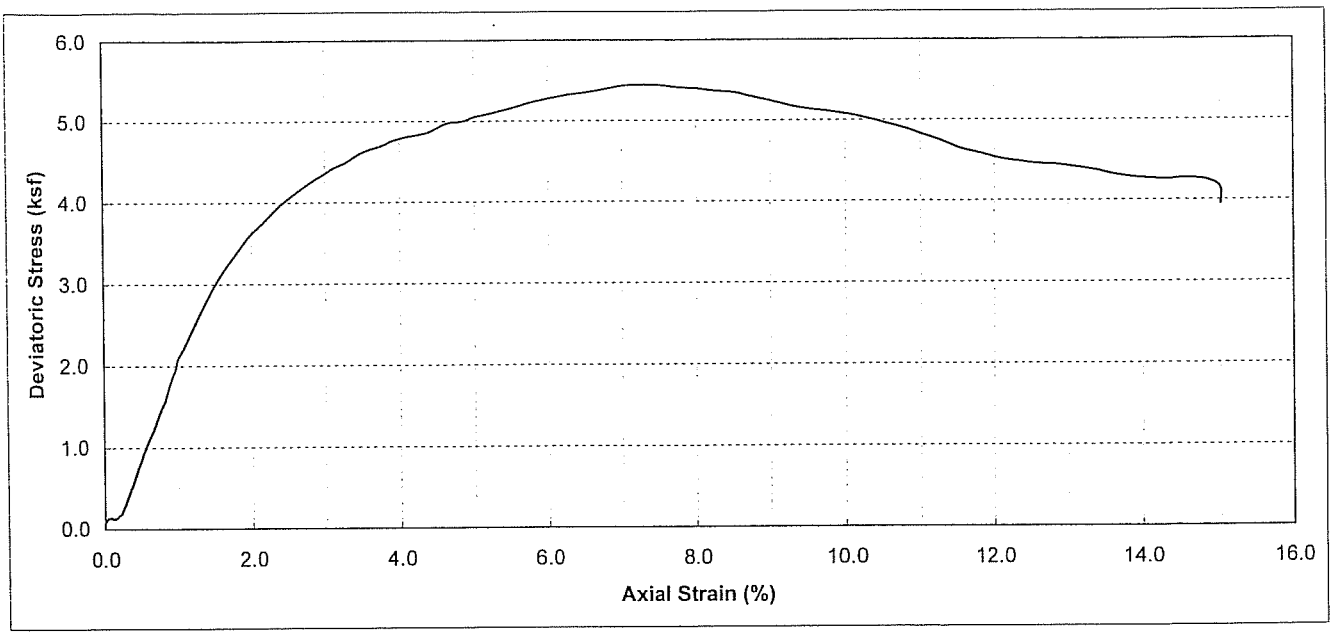
Figure No. :

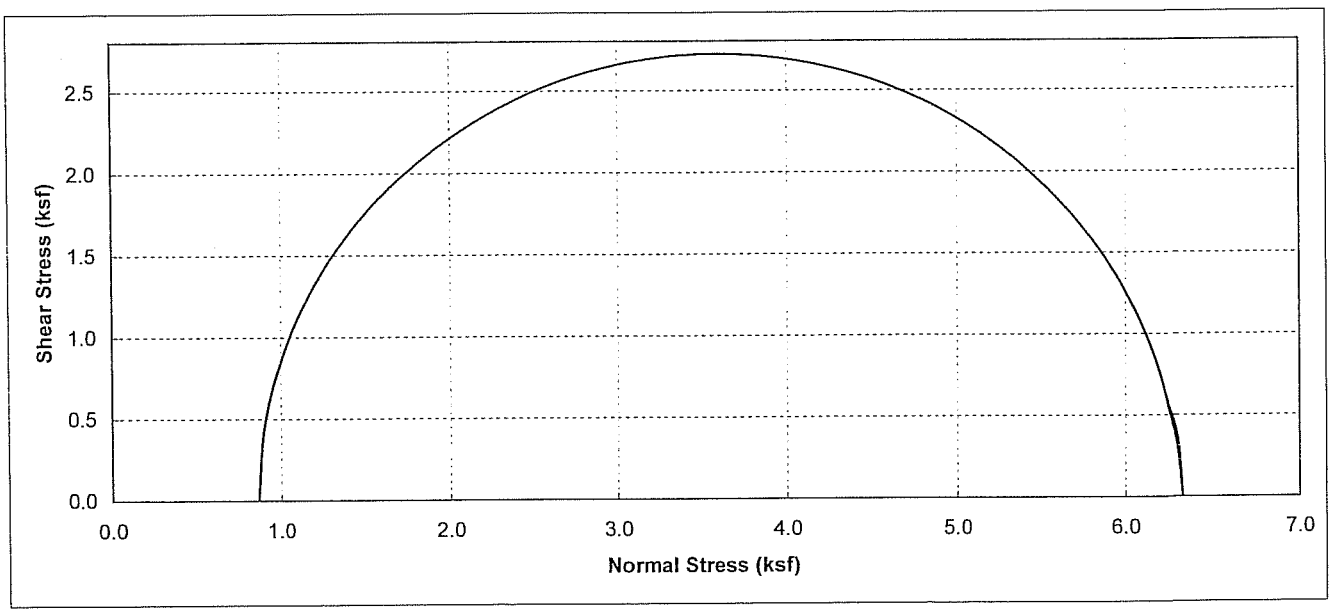




Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-018	D-10	45	Strong Brown, Lean CLAY With SAND (CL)	116.3	14.89	3.57	17.63	89.5

Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound
	UNCONSOLIDATED UNDRAINED TEST
Project No. : 08-115 **Date :** 03/16/09	(ASTM D2850) Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-019	D-3	10	Olive With Olive Brown, LEAN CLAY With SAND (CL)	97.4	22.77	0.86	5.44	84.2

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

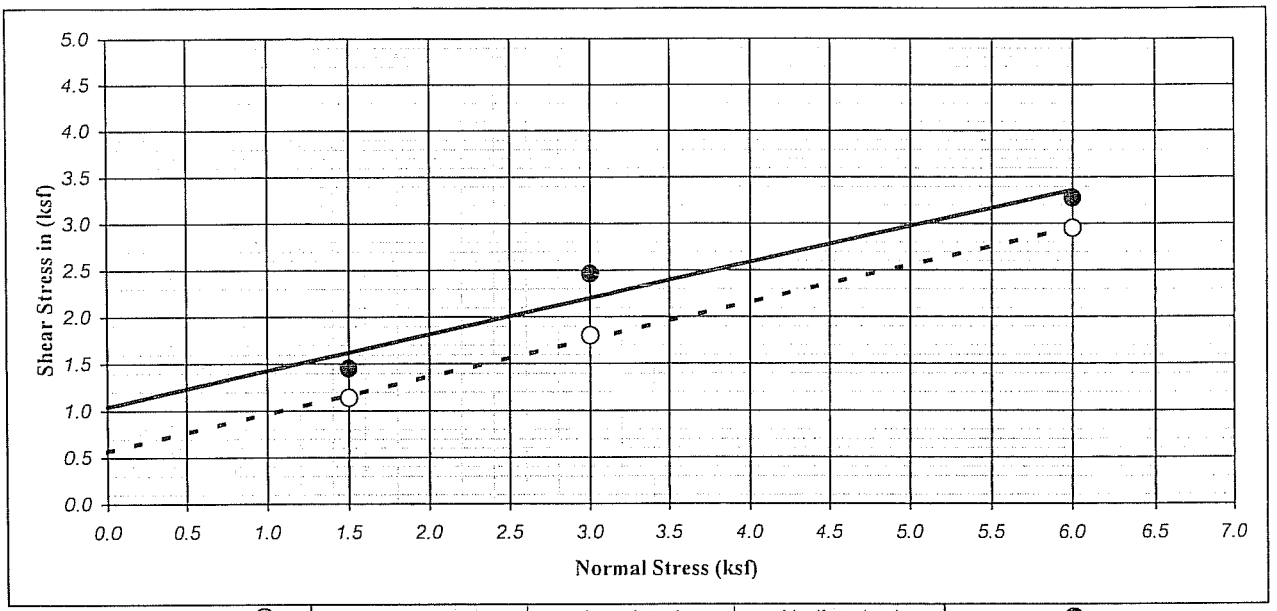
RBF/SR-57 Northbound

UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

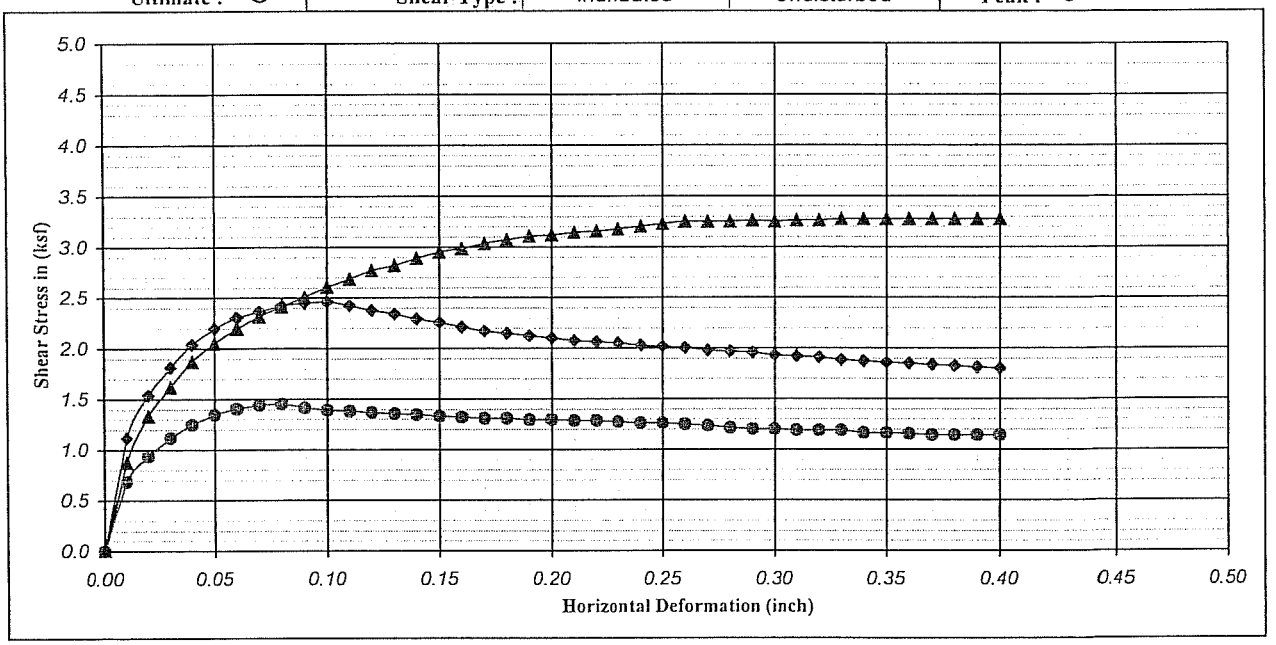
Project No. : 08-115

Date : 11/15/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-018		Strength Intercept (C) :	1.04	(ksf)	Peak	0.56	(ksf)	Ultimate
Sample No. : D-6			49.99	(kPa)		27.00	(kPa)	
Depth (ft/m) : 25.0	0.00	Friction Angle (ϕ) :	21.12	Degree		21.80	Degree	
Description : Yellow brown, Lean CLAY with SAND (CL)						Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	22.82	102.68	16.16	0.64	1.50	71.82	1.45	69.52	1.14	54.58
◆	23.06	101.31	15.95	0.66	3.00	143.64	2.46	117.78	1.80	86.18
▲	21.75	101.79	16.02	0.66	6.00	287.28	3.28	156.85	2.95	141.34

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

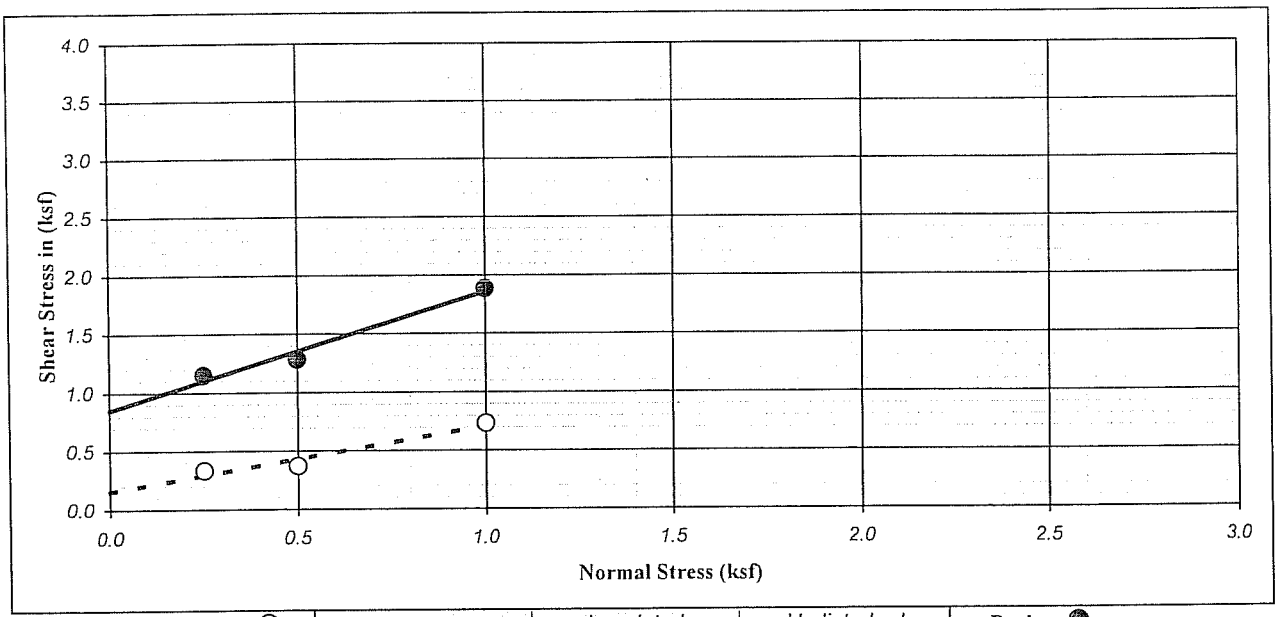
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

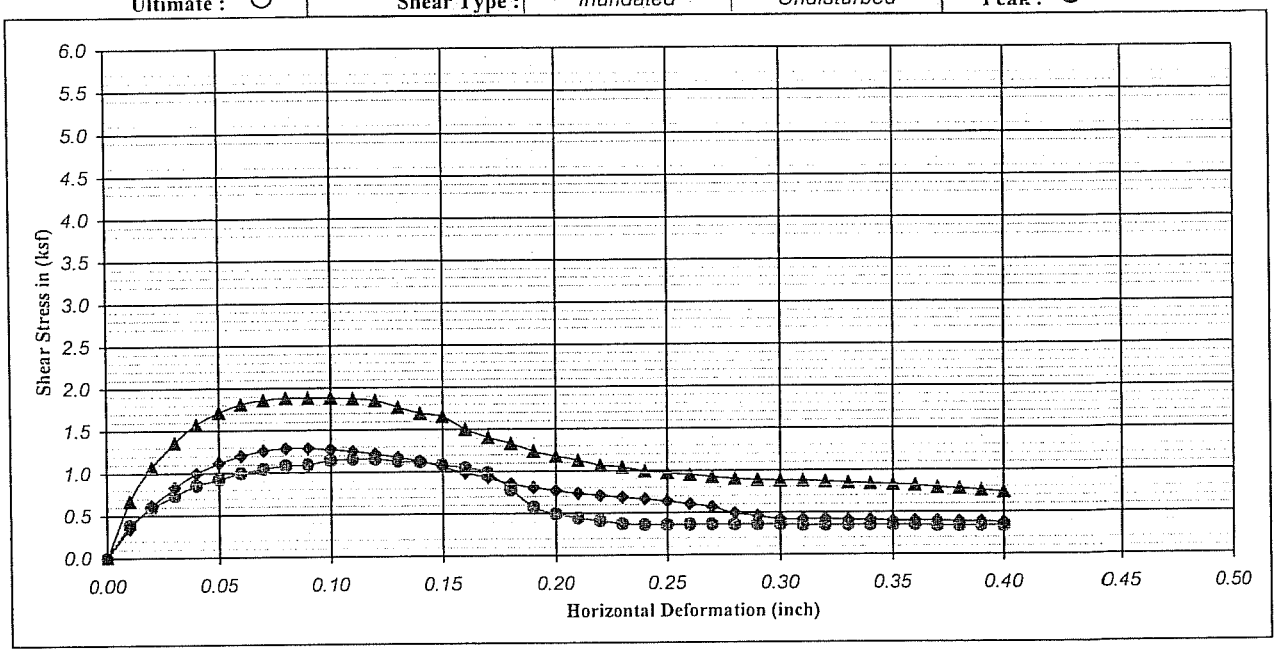
Project No. : 08-115

Date : 11/23/08

Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No. : A-08-019		Strength Intercept (C) :	0.85	(ksf)	Peak	0.16	(ksf)	Ultimate
Sample No. : D-1			40.79	(kPa)		7.47	(kPa)	
Depth (ft/m) : 2.5	0.00	Friction Angle (ϕ) :	45.23	Degree		29.05	Degree	
Description : Olive, Lean CLAY (CL)						Shear Rate (inch/minute) :		0.02

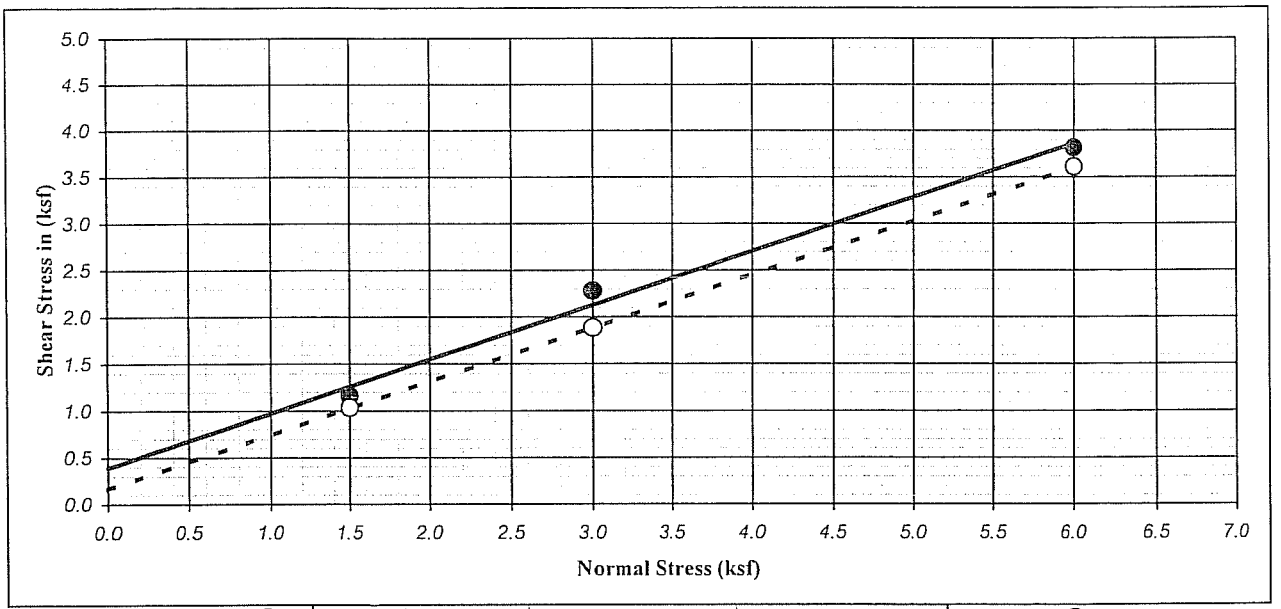
SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	28.15	96.35	15.17	0.75	0.25	11.97	1.15	55.16	0.34	16.09
◆	28.70	93.93	14.78	0.79	0.50	23.94	1.28	61.48	0.37	17.81
▲	27.26	97.26	15.31	0.73	1.00	47.88	1.88	90.21	0.73	35.05

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

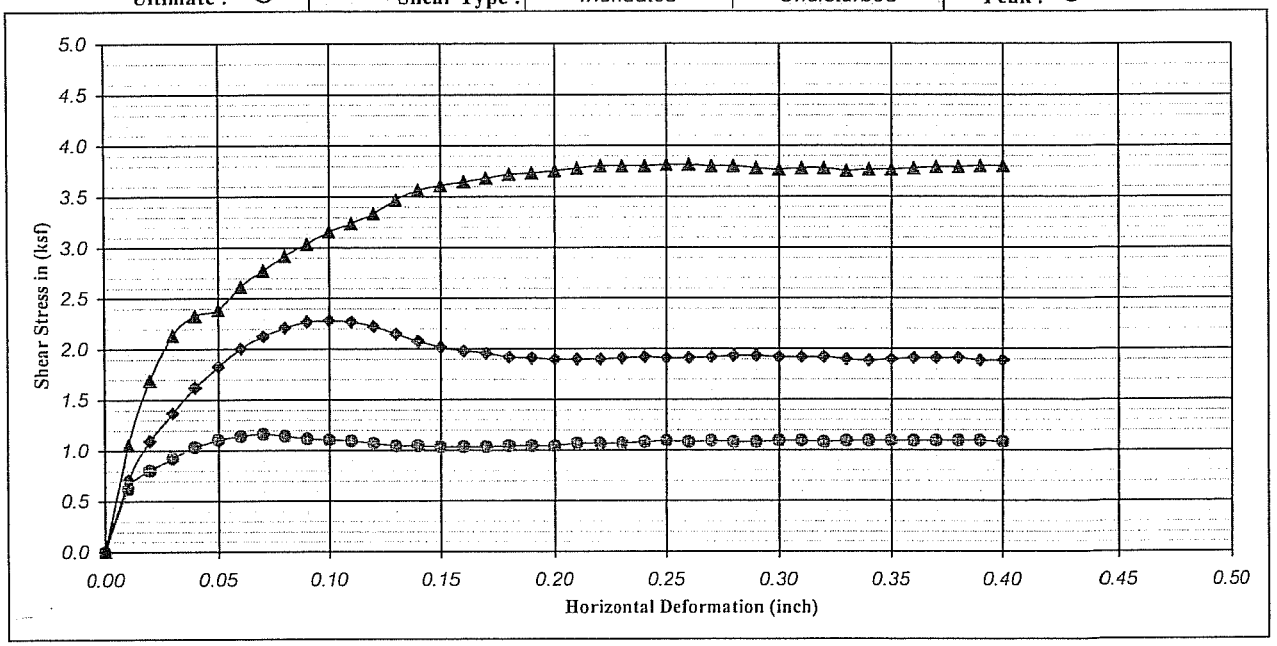
RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/24/08 | Figure No. :



Ultimate : ○	Shear Type :	Inundated	Undisturbed	Peak : ●



Boring No.	: A-08-019	Strength Intercept (C) :	0.40	(ksf)	Peak	0.17	(ksf)	Ultimate
Sample No.	: D-7		18.96	(kPa)		8.04	(kPa)	
Depth (ft/m)	: 30.0 | 0.00	Friction Angle (ϕ) :	30.04	Degree		29.84	Degree	
Description	: Yellow brown, SILTY SAND (SM)					Shear Rate (inch/minute) :		0.02

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	15.82	104.09	16.38	0.62	1.50	71.82	1.16	55.73	1.03	49.41
◆	16.53	100.50	15.82	0.68	3.00	143.64	2.28	109.17	1.88	90.21
▲	16.19	96.58	15.20	0.75	6.00	287.28	3.82	182.71	3.61	172.94

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

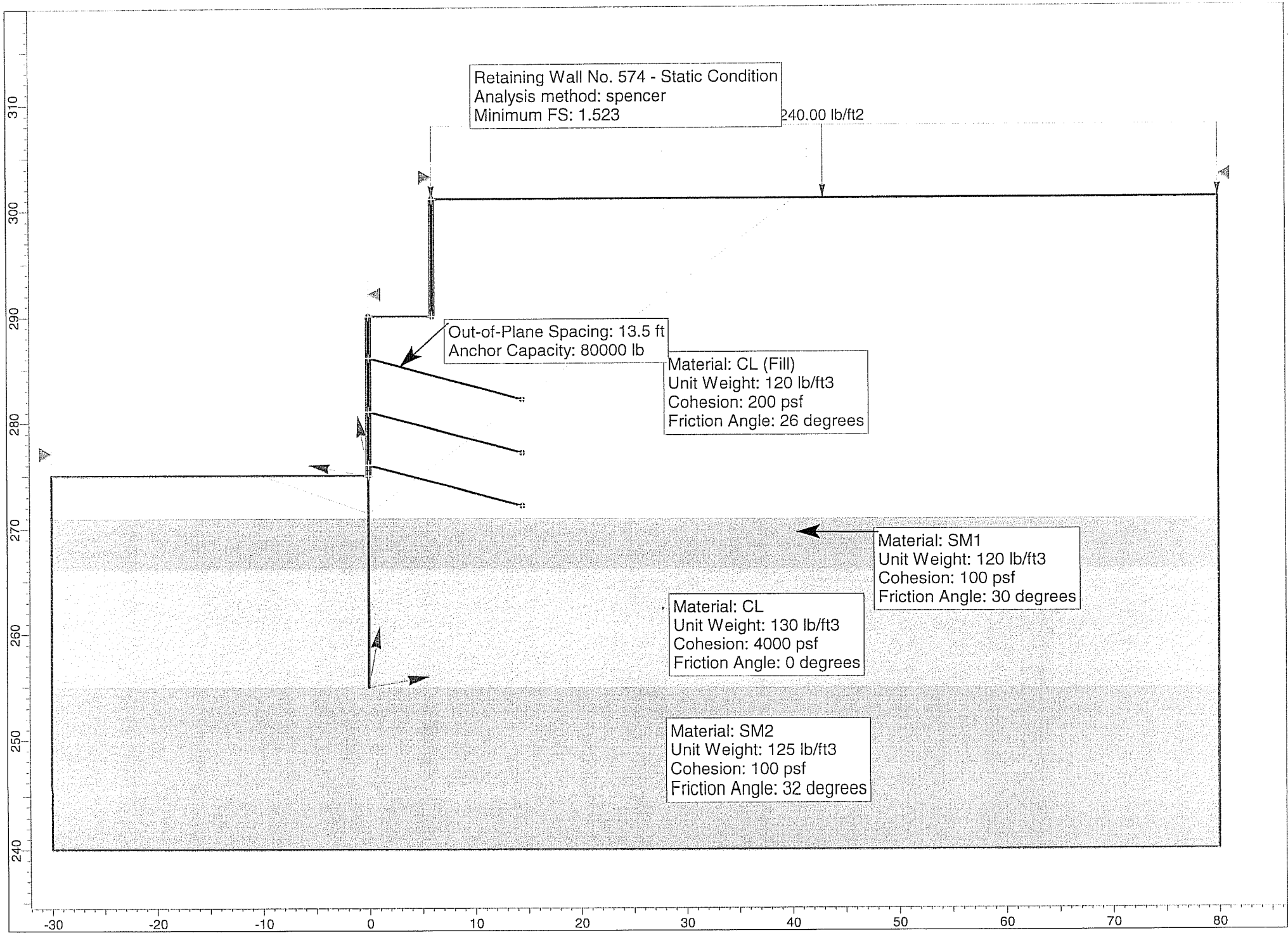
RBF/SR-57 Northbound

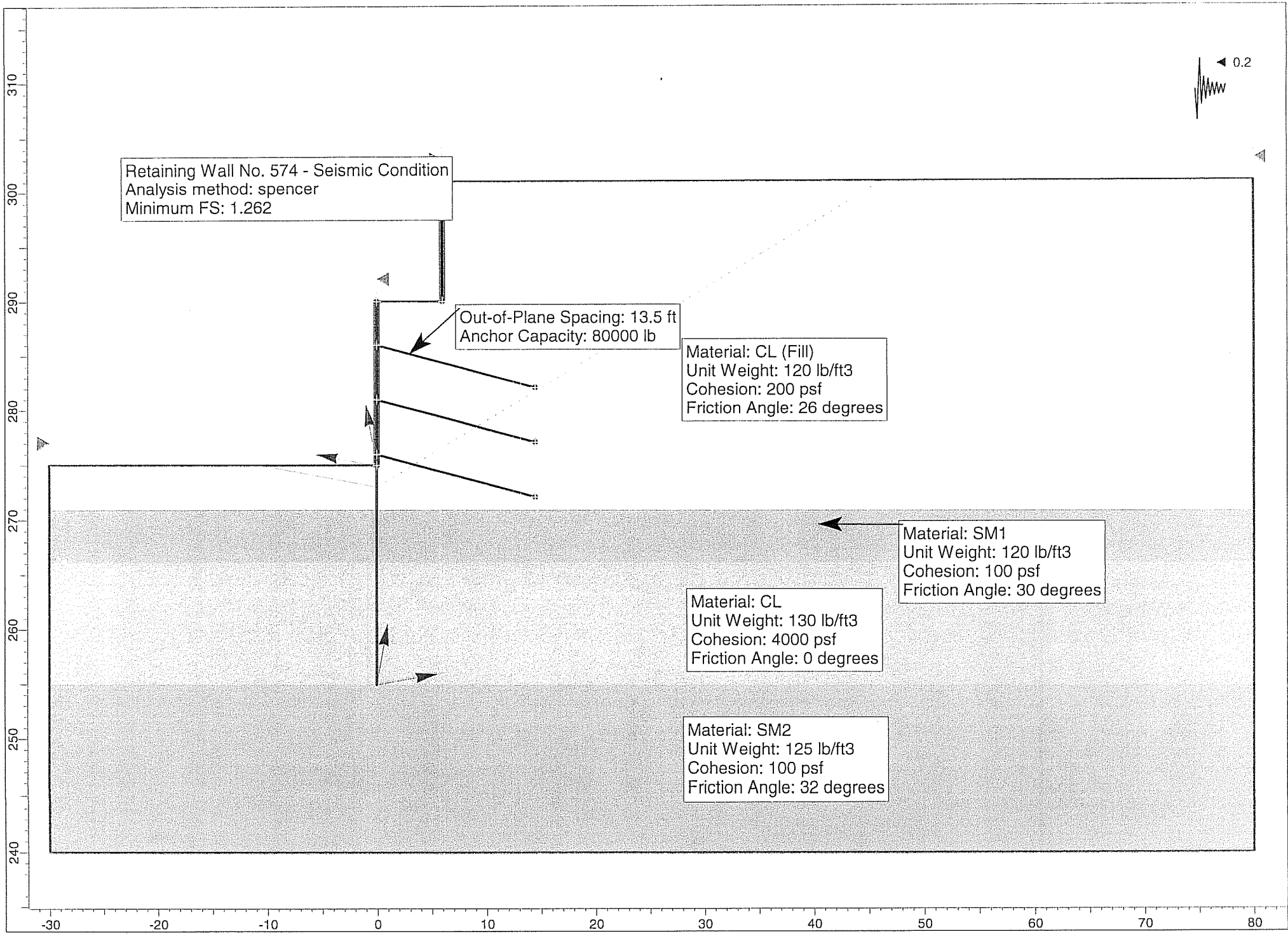
DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :

Appendix D. Results of Slope Stability Analysis


Retaining Wall No. 574 - Static Condition
Analysis method: spencer
Minimum FS: 1.523
240.00 lb/ft2
Out-of-Plane Spacing: 13.5 ft
Anchor Capacity: 80000 lb
Material: CL (Fill)
Unit Weight: 120 lb/ft3
Cohesion: 200 psf
Friction Angle: 26 degrees
Material: SM1
Unit Weight: 120 lb/ft3
Cohesion: 100 psf
Friction Angle: 30 degrees
Material: CL
Unit Weight: 130 lb/ft3
Cohesion: 4000 psf
Friction Angle: 0 degrees
Material: SM2
Unit Weight: 125 lb/ft3
Cohesion: 100 psf
Friction Angle: 32 degrees
310
300
290
280
270
260
250
240
-30
-20
-10
0
10
20
30
40
50
60
70
80


0.2
Retaining Wall No. 574 - Seismic Condition
Analysis method: spencer
Minimum FS: 1.262
Out-of-Plane Spacing: 13.5 ft
Anchor Capacity: 80000 lb
Material: CL (Fill)
Unit Weight: 120 lb/ft3
Cohesion: 200 psf
Friction Angle: 26 degrees
Material: SM1
Unit Weight: 120 lb/ft3
Cohesion: 100 psf
Friction Angle: 30 degrees
Material: CL
Unit Weight: 130 lb/ft3
Cohesion: 4000 psf
Friction Angle: 0 degrees
Material: SM2
Unit Weight: 125 lb/ft3
Cohesion: 100 psf
Friction Angle: 32 degrees
310
300
290
280
270
260
250
240
-30
-20
-10
0
10
20
30
40
50
60
70
80

Appendix E. Caltrans Review Comments and EMI Responses

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

May 20, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Attention: Mr. Steve Huff

Subject: Response to 2nd Caltrans Foundation Review Comments on "Foundation Report (dated 2/04/09) Retaining Wall No. 574, Bridge No. 55-0468, SR-57 Northbound Widening", 12-ORA-57, PM 18.4, EA 12-0F0311

Dear Mr. Huff:

Caltrans issued a 2nd Foundation Review sheet dated May 20, 2009 for the subject project. A copy of this review sheet is attached. The following are our responses to those comments:

Response: We will use consistent project name in final foundation report and Structure Plans. Per agreement with Caltrans Design Oversight, the project name is "Yorba Linda Blvd OC (Modify)".

The final LOTB sheets will be included in the 100% Structure Plans.

5.1, Design Ground Motion

Response: We will change maximum magnitude from 7.25 to 7.25±0.25 in the final foundation report.

5.3.3, Bonded Length

Response: We will remove the ultimate transfer load of 2 kips/foot from the final foundation report.

Log of Test Borings Sheets

Response: The attached LOTB sheets incorporated the following revisions per Caltrans review:

- Stationing and offset have been changed to reference SR-57 centerline.
- Soil Legend sheets will be included as the end sheets of LOTB in the final foundation report and 100% Structure Plans.
- As-Built LOTB sheet with proper title block will be included in the 100% Structure Plans.
- Direction to the nearest city has been added on the Plan View.
- We added Vertical Datum is NAVD 88.

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

- The following sentence will be added to Section 2.1 Field Investigation of the final foundation report:
  "About 2 feet should be added to the elevation on the as-built LOTB sheet to match the current vertical datum (NAV 88)."

Sincerely,
EARTH MECHANICS, INC.

Lino Cheang

Lino Cheang, GE 2345
Project Manager

Attachments
-Caltrans Foundation Review sheet dated May 20, 2009
- Revised LOTB Sheets ← in final report

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: May 20, 2009
File: 12-ORA-57-PM 18.4
12-0F0311
Retaining Wall No. 574
SR-57 Northbound Widening
(Southern Segment)

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of Foundation Report Resubmittal

On April 30, 2009, the Office of Geotechnical Design-South 1 received the response from the consultants, RBF Consulting and Earth Mechanics, Inc., to our comment on the Draft Foundation Report and unchecked Plans for the Retaining (Tieback) Wall No. 574 at Abutment 3 of Yorba Linda Boulevard Overcrossing, Br. # 55-0468. The responses were examined thoroughly and it is our opinion that the foundation report could be finalized after addressing below additional comments.

- Please use consistent project name in Foundation Report and Structure Plans. (e.g. Tieback Wall No. 574)
- The Log of Test Borings in the resubmitted structure plans has not been revised.

5.1 Design Ground Motion

- The maximum magnitude of 7.25 should be expressed as 7.25±0.25.

5.3.3 Bonded Length

- The ultimate transfer load (2 kips/foot) should not be recommended from contractual point of view.

Log of Test Boring Sheets

- All borings should be located based on stationing and offset of the centerline of SR-57 instead of on-ramp stationing, I-4 Line.
- Soil legend sheets should be included as the end sheets of LOTB.

- In order to disclose all available subsurface data to prospective contractors, as-built LOTB with proper title block should be included in structure plans.
- Direction to the nearest cities should be shown on LOTB plan view.
- It is required to note datum used for surveying boreholes in LOTB (NGVD 29 or NAVD88).
- If As-Built Log of Test Borings was surveyed with different datum, it is required to include conversion factor of the datum to NAVD 88 in the foundation report.

Any questions regarding the comments should be directed to Chungkeun Lee at (213) 620-2148.

Prepared by: Date: 5/20/09

Chungkeun Lee, P.E.
Transportation Engineer
Office of Geotechnical Design South 1
Branch C

Reviewed by: Date: 5/20/09

Chi-Tseng Ted Liu, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design South 1
Branch C

Faramarz Gerami, P.G., C.E.G.
Engineering Geologist
Office of Geotechnical Design South 1
Branch C

c: OGDS1 - LA. File (2)
OGDS1 - Sac. File (1)
GS – Sac. File (1)

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

March 23, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Attention: Mr. Steve Huff

Subject: Response to Caltrans Foundation Review Comments on "Foundation Report (dated 2/04/09) Retaining Wall No. 574, SR-57 Northbound Widening"
12-ORA-57, PM 18.4, EA 12-0F0311

Dear Mr. Huff:

Caltrans issued a Foundation Review sheet dated March 11, 2009 for the subject project. A copy of this review sheet is atached. The following are our responses to those comments:

Section 1.4, Review of Existing Data

Response: We will remove the as-built LOTB sheet from our report.

Section 2.1, Field Investigation

Response: Table 2-1 will be modified as follows:

Table 2-1. Geotechnical Exploration Information

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-18	I-4 Line	73+87	40RT	+301.1	+239.6	None Encountered During Drilling
A-08-19	I-4 Line	74+55	41RT	+301.1	+239.6	

Section 4.2, Idealized subsurface profile and engineering parameters

Response: The friction angle (ϕ) of 26° and cohesion (c) of 200 psf were obtained from the average of two direct shear tests conducted on similar soils within the same stratum: Sample D-6 at 25 feet from Boring A-08-18 shows residual (ultimate) ϕ of 22° and c of 560 psf, and Sample D-1 at 2.5 feet from Boring A-08-19 shows residual ϕ of 29° and c of 160 psf.

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

We decided not to include the other soil boring, instead to conduct a UU-test for a sample obtained from the deeper clay layer (from El. +266 to +255 feet) and the attached results show an undrained shear strength of 8240 psf at an axial strain of 10%. We will modify Table 4-1 as follows:

Table 4-1. Idealized Subsurface Profile

Approximate Elevation (ft)	Predominant Soil Type	Range of Uncorrected SPT Blowcount* (blows per ft)	Total Unit Weight (pcf)	Friction Angle (degrees)	Cohesion/ Undrained Shear Strength (psf)
+301 to +271	Lean Clay with Sand (Fill)	6 to (14) Average = 10	120	26	200
+271 to +266	Silty Sand	(8) to (12) Average = 10	120	30	100
+266 to +255	Lean Clay	5 to >70 Average = 33	130	-	4000
+255 to +240	Silty Sand	11 to (36) Average = 21	125	32	100

*Values in ( ) are converted Standard Penetration Test (SPT) blowcounts corrected for sampler size; correction factor from California sampler blowcounts to SPT blowcounts is 0.5.

Section 5.0, Conclusions and Recommendations

Response: Results of global stability analysis are attached. As shown, both the static and pseudo-static factor of safety meets Caltrans minimum requirements. These results will be included in the revised foundation report.

Section 5.3.1, Lateral Pressures

Response: RBF will revise General Plan No. 2 to show the same friction angle and cohesion in the foundation report as well as the year of the Caltrans BDS reference.

Section 5.3.2, Unbonded Length

Response: RBF will respond.

Section 5.3.3, Bonded Length

Response: RBF will eliminate the ultimate unit bond strength and change the allowable bearing pressure to 1500 psf in General Plan No. 2.

6.1, General Earthwork

Response: We will add the following paragraph to Section 6.3:

Since the proposed tieback wall is relatively close to the existing Yorba Linda OC abutment foundation, we recommend that the maximum length of tieback wall in front of the abutment foundation, constructed at any given time, not exceed one-third the length of the existing abutment foundation (pile cap).

Appendix B-Log of Test Boring (LOTB) Sheets for current investigation

Response: We have made all the changes requested by Caltrans; the revised LOTB sheet is attached.

Appendix B-EMI Laboratory Soil Test Results

Response: We will add the attached Table 2 in Appendix C.

Sincerely,
EARTH MECHANICS, INC.

Lino Cheang

Lino Cheang, GE 2345
Project Manager

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

Attachments
-Caltrans Foundation Review sheet dated March 11, 2009
-UU-Test Results on Sample D-10 at 45 feet from Boring B-08-018
-Results of Global Slope Stability Analysis
-Revised LOTB Sheet
-Table 2 Summary of Laboratory Strength Test Results

← in final report

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JON HAMAGUCHI
Office of Special Funded Projects

Date: March 11, 2009
File: 12-ORA-57-PM 18.4
12-0F0311
Retaining Wall No. 574
SR-57 Northbound Widening

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of the Draft Foundation Report

On February 26, 2009, we received draft Foundation Report and unchecked Plans for the Retaining (Tieback) Wall No. 574 at Abutment 3 of Yorba Linda Boulevard Overcrossing, Br. # 55-0468. Review comments on the report dated February 4, 2009 have been prepared as below:

1.4 Review of Existing Data

- If As-built Log of Test Borings (LOTB) is not used for tieback design, it should not be included in this report.

2.1 Field Investigation

- The stationing, offset and reference line in Table 2-1 doesn't match the LOTB.

4.2 Idealized subsurface profile and engineering parameters

- According to the description in this section, the engineering parameters for soil retained by this wall has been determined based on laboratory direct shear tests in Appendix C. However, it appears that the parameters (friction angle=26 deg and cohesion=200 psf) presented in Table 4-1 are not supported by any of the testing.
- Since shear strength parameters for the deeper clay layer (from EL. 266 to 255 feet) are based on another field exploration performed on 2009, the Log of Test Boring and test results for the referenced boring should be included in this report.

5.0 Conclusions and Recommendations

- Global stability analysis for static and Pseudo-static case should be performed to make sure that this wall is capable of retaining soil in front of the abutment.

5.3.1 Lateral Pressures

- The friction angle and cohesion presented in the General Plan No. 2 are not consistent with ones recommended in the report.

- The 2004 version of Caltrans Bridge Design Specification in the report is not consistent with the General Plan No. 2.

5.3.2 Unbonded Length

- Please explain the reason that the maximum 45 feet of unbonded length has been used for tiebacks at the bottom row in the project plan, whereas the tiebacks in top row have been designed with 15 feet of unbonded length in Tieback Wall Details No. 1.

5.3.3 Bonded Length

- The ultimate unit bond strength in the General Plan No. 2 should be eliminated because contractors should estimate it based on subsurface information provided by Geotechnical consultant.
- Allowable bearing pressure presented in the General Plan No. 2 is not consistent with one in this report.

6.1 General Earthwork

- For wall excavation, special case such as slot excavation should be addressed in the report since this wall will be constructed very close to bridge abutment.

Appendix B-Log of Test Boring (LOTB) Sheets for Current Investigation

- The consistency of top sandy lean clay (CL) in A-08-018 and apparent density of top poorly graded sand (SP) in A-08-019 should be estimated and included in the description of material.
- Since group name changes at 15 and 25 feet below top of boring in A-08-018 and 10 feet below top of boring in A-08-019, separation lines should be drawn in graphic/symbols column.
- The apparent density for silty sand at 30 feet below top of boring in A-08-018 should be loose according to SPT number and Caltrans Soil and Rock Logging Manual (2007). The description of "becomes loose" at 35 feet below top of boring should be eliminated, accordingly.
- When groundwater is not shown on the borings, explain in a sentence under each boring such as groundwater was not encountered or measured during field investigation.
- Correction/multiplication factor for conversion of 2.4" California Modified ring sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.

Appendix C-EMI Laboratory Soil Test Results

- It is highly recommended to present all laboratory test results including direct shear and unconfined compression in Table 1 in Appendix C.

Any questions regarding the above comments should be directed to Chungkeun Lee at (213) 620-2148 or Ted Liu at (213) 620-2136.

Prepared by: Date: 03/11/09

REGISTERED PROFESSIONAL ENGINEER
CHUNGKEUN LEE
C69450
Exp. 6/30/10
CIVIL
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c: OGDS1 - LA. File (2)
OGDS1 - Sac. File (1)
GS – Sac. File (1)

FINAL FOUNDATION REPORT

Sign Structures

SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 16.2/18.6
EA 12-0F0311

EMI Project No. 08-115
Date: June 17, 2009

EARTH MECHANICS, INC.

Geotechnical and Earthquake Engineering

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

June 17, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Attention: Mr. Steve Huff, P.E.

Subject: **Final Foundation Report for Sign Structures**
SR-57 Northbound Improvement Project, Orange County, California
12-Ora-57, PM 16.2/18.6; EA 12-0F0311

Dear Mr. Huff:

Attached is our final Foundation Report for the proposed sign structures. This report presents the results of our analyses and recommendations for design and construction of the foundations for the proposed sign structures.

A draft version of this report dated February 11, 2009 was submitted to Caltrans for their review. Review comments and our responses are included in Appendix D. Our responses are all incorporated into this final report.

We appreciate the opportunity to provide geotechnical design services for this project. If you have any questions, please call us.

Sincerely,
EARTH MECHANICS, INC.

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FINAL FOUNDATION REPORT
SIGN STRUCTURES
SR-57 NORTHBOUND IMPROVEMENT PROJECT
ORANGE COUNTY, CALIFORNIA
12-Ora-57, PM 16.2/18.6
EA 12-0F0311

Prepared for:

RBF Consulting
14725 Alton Parkway
Irvine, California 92618-2027

Prepared By:

Earth Mechanics, Inc.
17660 Newhope Street, Suite E
Fountain Valley, California 92708

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TABLE OF CONTENTS

Section	Page
1.0 INTRODUCTION	**1**
1.1 Purpose and Scope of Study	1
1.2 Project Description	1
2.0 FIELD INVESTIGATION AND LABORATORY TESTING	**3**
2.1 Field Investigation	3
2.2 Laboratory Testing	4
3.0 GEOLOGY AND SEISMICITY	**5**
3.1 Topography and Drainage	5
3.2 Physiography	5
3.3 Geologic Structure	5
3.4 Geologic Hazards	7
3.5 Stratigraphy	7
3.6 Seismicity	9
4.0 SUBSURFACE CONDITIONS	**10**
4.1 Soil Conditions	10
4.2 Groundwater Conditions	11
5.0 CONCLUSIONS AND RECOMMENDATIONS	**12**
5.1 Seismic Design Criteria	12
5.2 Liquefaction	12
5.3 Soil Corrosivity	12
5.4 Pile Foundation Design	13
5.4.1 Foundation Type	13
5.4.2 Foundation Demands Provided by Structural Designers	13
5.4.3 Pile Design	14
5.4.4 Results	15
6.0 CONSTRUCTION RECOMMENDATIONS	**17**
6.1 Earthwork	17
6.2 Pile Construction	17
6.3 Review of Construction Plans	18
6.4 Geotechnical Observation and Testing	18
7.0 LIMITATIONS	**19**
8.0 REFERENCES	**20**

List of Tables Page

Table 2-1. Geotechnical Exploration Information 3
Table 4-1. Idealized Soil Profile and Strength Parameters 10
Table 5-1. Local Seismic Sources 12
Table 5-2. Soil Corrosion Test Results 13
Table 5-3. Sign Structure Foundation Demands 13
Table 5-4. LPILE Input Parameters 15
Table 5-5. Pile-Head Deflections and Rotations 15
Table 5-6. Ultimate Axial and Torionsal Capacities 16

List of Figures Page

Figure 1-1. Site Location Map 2
Figure 3-1. Regional Fault and Physiographic Map 6
Figure 3-2. Geological Map 8

APPENDICES

Appendix A. Log of Test Borings Sheets
Appendix B. Laboratory Test Results
Appendix C. Design Calculations
Appendix D. Caltrans Review Comments and EMI Responses

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE OF STUDY

This Sign Structures Foundation Report presents the findings and conclusions of a geotechnical investigation conducted by Earth Mechanics, Inc. (EMI) for the proposed overhead (OH) sign structures as a part of the State Route (SR)-57 Northbound Improvement project located in Orange County, California. A site location map is presented in Figure 1-1.

This work was performed for the Orange County Transportation Authority (OCTA) and EMI is a subconsultant to RBF Consulting (RBF). The geotechnical services provided for this project included the following tasks:

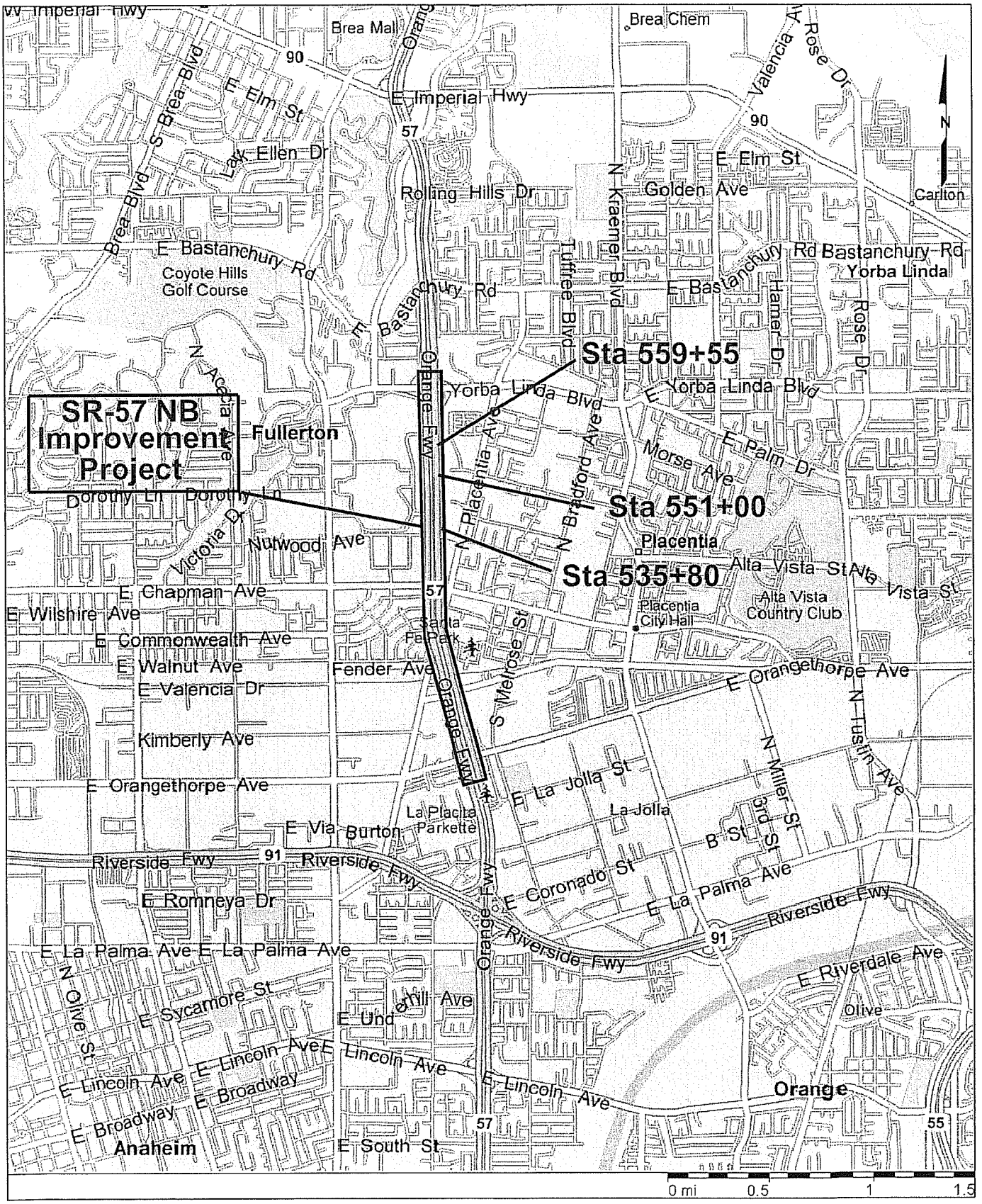
- Field exploration consisting of drilling and logging exploratory borings;
- Laboratory testing of selected bulk and relatively undisturbed soil samples;
- Engineering calculations (see Appendix C) and analysis to develop foundation design and construction recommendations; and
- Preparation of this report presenting our findings, conclusions, and recommendations.

1.2 PROJECT DESCRIPTION

The Department of Transportation (Caltrans) – District 12, in cooperation with the Orange County Transportation Authority (OCTA), proposed to widen northbound SR-57 by adding one northbound through lane. The project limits are between 0.2 mile south of Orangethorpe Avenue and 0.2 mile north of Yorba Linda Boulevard along northbound SR-57. Within the project limits, there are interchanges located at Orangethorpe Avenue, Chapman Avenue, Nutwood Avenue and Yorba Linda Boulevard.

The project includes seven bridge structures, a tieback wall, retaining walls, mechanically stabilized earth (MSE) walls, sound walls, sound walls on retaining walls, drainage facilities, sign structures, and pavement widenings. This report is prepared for the proposed OH sign structures in the project area.

A total of three (3) cantilever type single-post structures, located at Stations 535+80, 551+00 and 559+55, are proposed to be constructed within the project limit. These OH sign structures will be constructed on flat grades and supported on the standard Cast-in-Drilled-Hole (CIDH) piles per Caltrans Standard Plans (Caltrans, 2006b). The remaining OH sign structures will be supported on walls and these sign structures do not require special foundation design.



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SITE LOCATION MAP

Figure 1-1

SR-57 Northbound Improvement Project

Project No. 08-115

Date: 02-03-09

2.0 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 FIELD INVESTIGATION

Three soil borings and one CPT sounding were drilled near the three proposed sign structures. These borings and the sounding were drilled between August 28 and October 1, 2008. Soil exploration information, including exploration number, stations, offsets, ground surface elevations, bottom of hole elevations and water level measurements are summarized in Table 2-1. Locations of the exploratory boring are shown on the LOTB sheet provided in Appendix A.

TABLE 2-1. GEOTECHNICAL EXPLORATION INFORMATION

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-017	SR-57 (B-Line)	535+70	66 RT	+258.0	+166.5	None Encountered During Drilling
A-08-128		546+84	102RT	+251.0	+219.5	
A-08-129		553+15	94RT	+255.8	+244.3	
CPT-08-131		561+88	116RT	+263.6	+183.4	

Exploratory soil borings were drilled using a truck-mounted drill rig equipped with 8-inch diameter hollow-stem augers. Relatively undisturbed drive samples were obtained using a 3.25-inch outer diameter California split-spoon sampler lined with brass rings. Each of these brass rings is 1-inch long with a 2.5-inch outside diameter. The California Drive sampler was driven into the ground using successive blows of a 140-lb hammer falling a distance of 30 inches. The numbers of blow for the final 12 inches or shorter of driving are shown on the LOTB sheet. The Standard Penetration Test (SPT) sampler (1.4-inch inside diameter) was also used to obtain soil samples. The sampler was driven into the ground using a 140-lb hammer free falling from a height of 30 inches. The numbers of blow to advance the sampler each 6 inches of penetration or less was recorded. The blow counts required to drive the sampler for the last 12 inches or less was recorded as the Standard Penetration Resistance (N-value) on the LOTB sheet. The sampling interval is usually 5 feet. Sampling was performed by alternating the California Drive sampler and SPT sampler.

The CPT soundings were performed using an electronic cone penetrometer in general accordance with current ASTM Standards (ASTM D5778 and ASTM D3441). The CPT equipment consisted of a cone penetrometer assembly mounted at the end of a series of hollow sounding rods. The cone penetrometer assembly consisted of a conical tip with a 60° apex angle and a projected cross sectional area of 1.55 in^2 (10 cm^2) and a cylindrical friction sleeve with a surface area of 23.25 in^2 (150 cm^2). The interior of the cone penetrometer is instrumented with strain gauges that allow simultaneous measurements of cone tip and friction sleeve resistance during penetration. The cone penetrometer assembly is continuously pushed into the soil by a set of hydraulic rams at a standard rate of 0.79 inch per second (20 mm per second) while the cone tip resistance and sleeve friction resistance are recorded every 1.967 inches (50 mm) and stored in digital form. A specially designed all-wheel drive 25-ton truck provides the required reaction weight for pushing the cone assembly and is also used to transport and house the testing equipment. The computer generated graphical logs include tip resistance, friction resistance, and friction ratio. Soil behavior type interpretations are

based on guidelines by Robertson and Campanella (1989).

2.2 LABORATORY TESTING

Soil samples considered representative of the subsurface conditions were tested to obtain or derive relevant physical and engineering soil properties. The following laboratory tests were conducted to supplement the observations recorded during the field investigation:

- In-situ Moisture Content and Unit Weight
- Pocket Penetrometer
- Percent Passing No. 200 Sieve
- Atterberg Limits
- Direct Shear
- UU Triaxial Test
- Consolidation
- Minimum Resistivity, pH, Sulfate Content and Chloride Content

The laboratory tests were conducted in general accordance with California Test Methods or American Society for Testing and Materials (ASTM) Standards. Laboratory test results are included in Appendix B.

3.0 GEOLOGY AND SEISMICITY

3.1 TOPOGRAPHY AND DRAINAGE

The project corridor is in the eastern part of the Los Angeles Basin along the southern margin of the Coyote Hills and the Puente Hills (Figure 3-1). Just north of the project corridor, the Puente Hills rise to an elevation of about 1,400 feet. The southwestern edge of the Puente Hills is paralleled by a series of low-elevation plains and hills; the Santa Fe Plain and the Coyote Hills are to the west of the project corridor, and the Richfield and Kraemer Hills are to the east. The elevations of these hills range from about 500 feet just west of the project to about 300 feet in the east. The ground upon which the project is located slopes gently to the south. Elevations along the project corridor range from about 280 feet in the north to about 200 feet on the south.

The project corridor traverses the ancient flood plains and alluvial fans of Fullerton Creek and the Santa Ana River. The major drainage in the area is the Santa Ana River which flows westerly south of the site. Fullerton Creek, a tributary to the Santa Ana River, drains southwesterly from the Puente Hills just west of the project corridor.

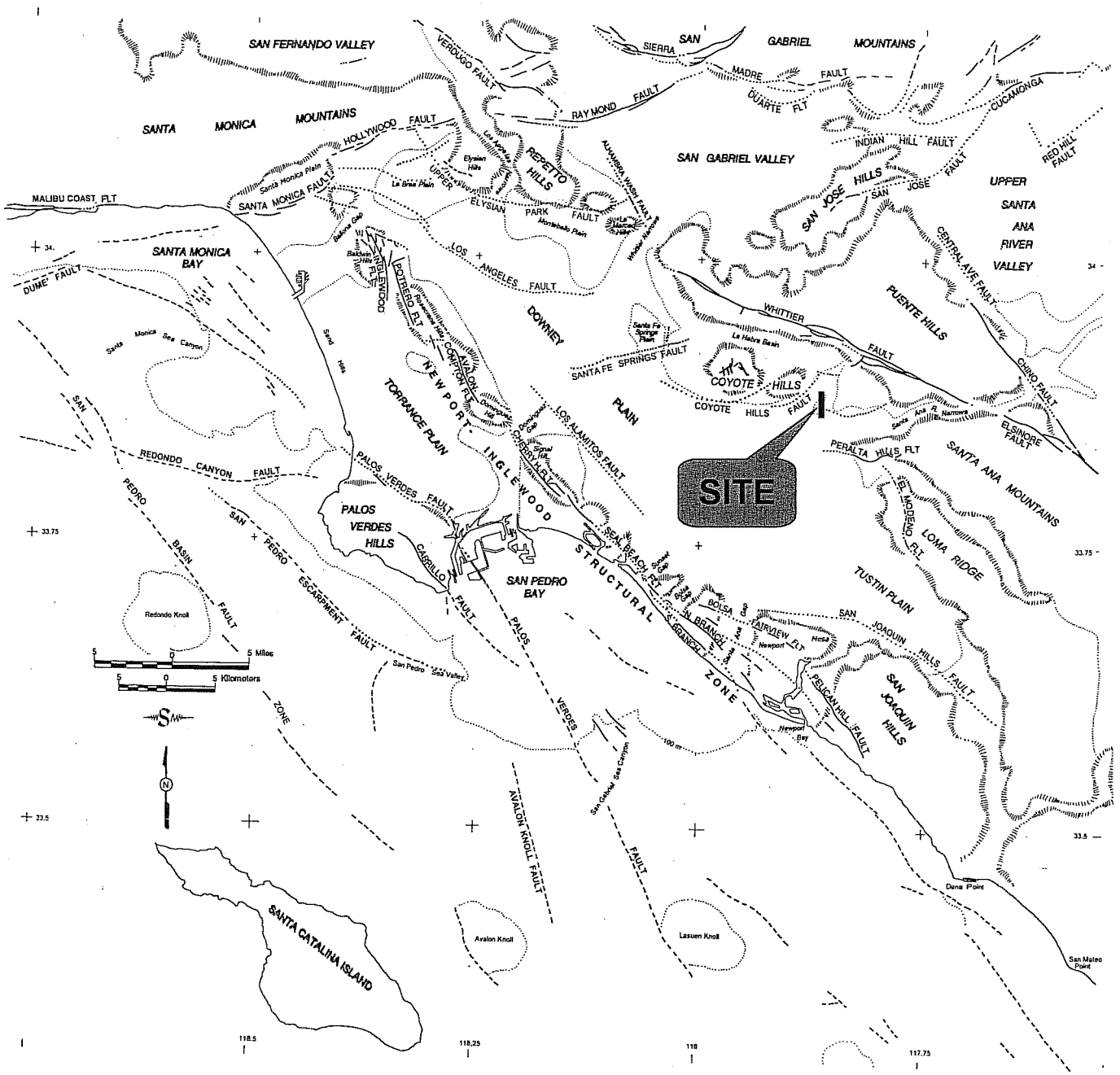
3.2 PHYSIOGRAPHY

The site area is at the eastern edge of the Los Angeles physiographic basin, a large, relatively flat, low-lying, coastal plain surrounded by mountains on the north, east, and southeast (Figure 3-1). The floor of the Los Angeles Basin is relatively flat but slopes gradually southwesterly from an elevated marginal apron to sea level along the coastline. The western margin of the Los Angeles Basin is bordered by the sea and the Palos Verdes Hills. The eastern margin is bordered by the Puente Hills and Santa Ana Mountains. The Coyote Hills, Santa Fe Springs Plain, Richfield Hills, and Kramer Hills are low elevation uplifts along the southern margin of the Puente Hills.

3.3 GEOLOGIC STRUCTURE

The geologic structure at the site is quite simple and is characterized by flat-lying Quaternary sediments overlying gently folded Tertiary sedimentary rocks. These strata rise gently to the Coyote Hills, Richfield Hills, and Kraemer Hills where they are arched upward to form anticlinal folds. The site is on the south limb of these anticlines with the early Pleistocene and Tertiary age strata dipping gently to the south and overlain by younger flat-lying Quaternary sediments.

The nearest active or potentially active surface faults are the Peralta Hills and Whittier faults (Figure 3-1). The low-elevation plains and hills along the eastern margin of the Los Angeles Basin are underlain by a series of east-west trending, en echelon, faults and folds in the subsurface; the major faults within this trend are, from north to south, the Los Angeles (Las Cienegas), Santa Fe Springs, and Coyote Hills faults (Figure 3-1). This group of faults is known as the Puente Hills fault system. Other poorly known segments of this thrust fault system underlie the Richfield and Kramer hills. All of these faults are blind thrust or reverse faults that approach within about a mile or so of the ground surface. They are identified on seismic reflection geophysical data only and are below the depths of oil wells.



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REGIONAL FAULT AND PHYSIOGRAPHIC MAP

Figure 3-1

Project No. 08-115

Date: 01-17-09

The Peralta Hills fault may be related to the Puente Hills fault system. The Peralta Hills fault is exposed along the south flank of the Peralta Hills where it displaces Tertiary-age rocks upward and over younger Quaternary alluvium. The fault extends westerly below the Santa Ana River channel where it creates barriers to ground-water flow (Figure 3-2). The barriers extend about to the SR 57 freeway just north of the Lincoln Avenue (Morton and Miller, 1981). The location of the Peralta Hills fault is well up on the flank of the hills rather than at the base of the hills indicating that it is not the only fault responsible for uplift and folding of the Peralta Hills. There must be a deeper unknown blind thrust fault below the Peralta Hills thrust fault but this feature has never been directly identified.

The Whittier fault is a major strike slip fault that extends northwesterly along the southwest flank of the Puente Hills northeast of the site (Figure 3-1). The Whittier fault is associated with the Chino fault and the Elsinore fault and together these faults form a major fault system that extends from the Los Angeles Basin into northern Mexico.

The El Modeno fault is a north-south trending feature within Loma Ridge, one of the foothills of the Santa Ana Mountains, southeast of the site. The feature is poorly known but is known to displace Holocene soil in Loma Ridge. Although the fault is grouped with the Peralta Hills fault on the Caltrans seismic hazard map (Mualchin 1996), it appears to be a discrete normal or strike-slip fault unrelated to the thrust faults of the Peralta Hills. Although the fault must be considered active because it displaces Holocene soil, the feature has a very long (thousands of years) recurrence interval.

3.4 GEOLOGIC HAZARDS

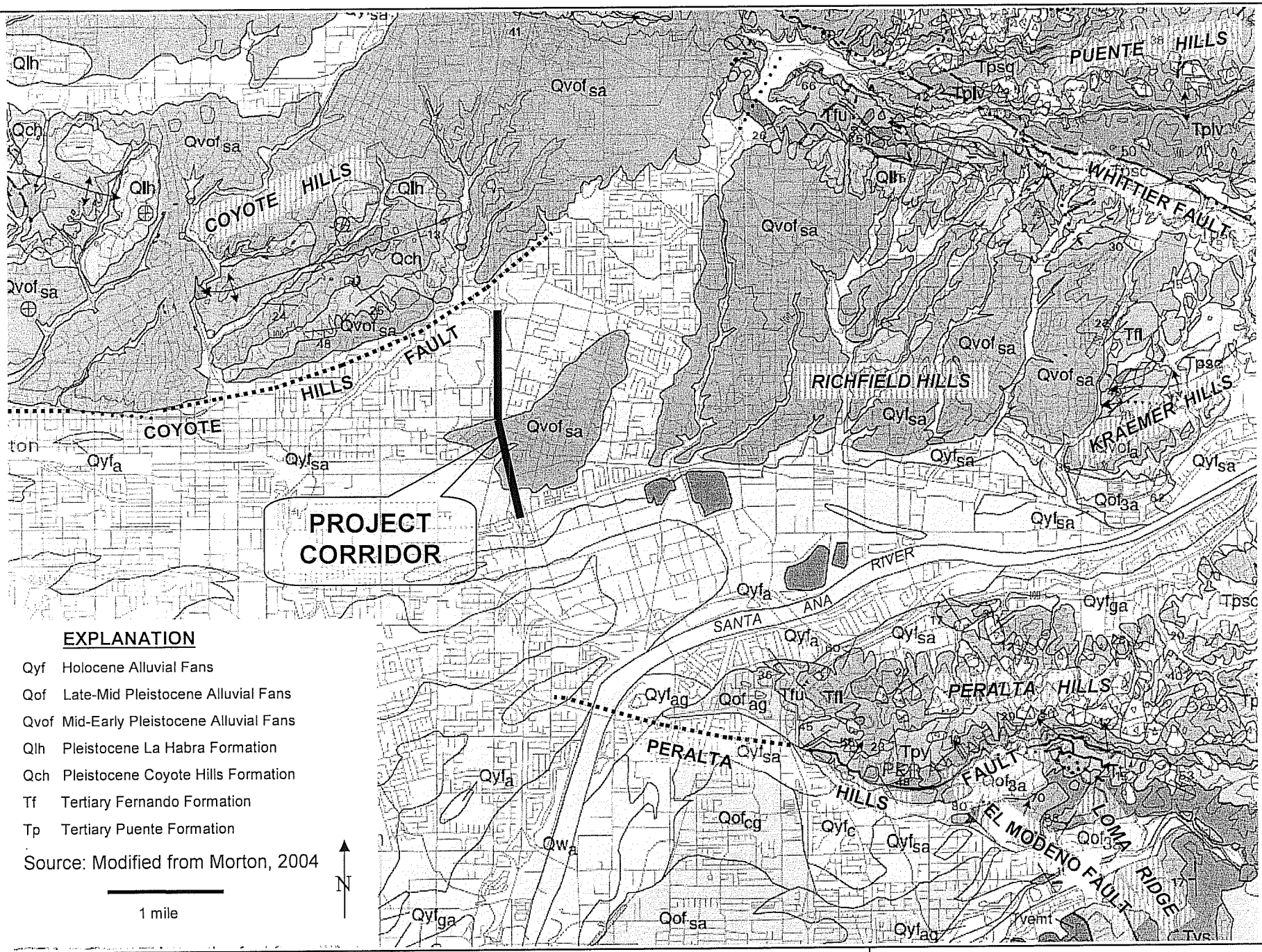
There are no steep slopes within the corridor so landsliding is not likely. There are no active faults so surface fault rupture is not likely. There are no known volcanos in the site region. The site is far from the sea on elevated land so Tsunamis are not a hazard.

The site is not identified on the State seismic hazard map of the La Habra quadrangle as being susceptible to liquefaction (California Geological Survey/Division of Mines and Geology, 1997). This is due primarily to the depth of historically highest ground water being greater than 50 feet.

3.5 STRATIGRAPHY

Regional studies (e.g. Morton, 2004; Morton and Miller, 1981; Durham and Yerkes, 1964; California Department of Water Resources, 1961) indicate that the site area is underlain by Quaternary sediments overlying older Quaternary and Tertiary sediments and sedimentary rocks.

The surficial deposits are primarily Holocene and Pleistocene alluvial fan deposits (Figure 3-2). Older formations exposed in the hills and underlying the corridor are, in descending order, the Pleistocene-age La Habra and Coyote Hills, the Pliocene Fernando, and Pliocene-Miocene-age Puente formations. Along the corridor, the La Habra Formation is at an elevation of about sea level and therefore these older units are well below the level of interest for this project.



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SR-57 Northbound Improvement Project

Project No. 08-115 | Date: 01-18-09

GEOLOGICAL MAP

Figure 3-2

3.6 SEISMICITY

The largest historical earthquake within the Los Angeles Basin was the 1933 Long Beach earthquake of M_W=6.4 (M_L = 6.3) which is generally believed to have been associated with the Newport-Inglewood Structural Zone. The association of the 1933 event with the NISZ was based on abundant ground failures along the NISZ trend, but no unequivocal surface rupture was identified. Hauksson and Gross (1991) reevaluated the seismicity data and relocated the 1933 earthquake hypocenter to a depth of about 6 miles below the Huntington Beach-Newport Beach city boundary.

Other damaging earthquakes in the Los Angeles region include the 1971 San Fernando, the 1987 Whittier, and the 1994 Northridge events. The 1971 San Fernando (M_L= 6.4, M_W=6.7) earthquake occurred along the northern margin of the San Fernando Valley and produced a surface rupture which coincided partly with a zone of mapped surface faults along the mountain-valley margin. The more-recent 1987 Whittier earthquake (M_L=5.9, M_W=5.9) and the 1994 Northridge (M_L=6.4, M_W = 6.7) earthquake were not associated with surface faulting. Such events indicate that seismic hazards analysis must consider subsurface faulting as well as surface faulting. The Whittier event occurred at a depth of about 10 miles on a northerly dipping thrust fault dipping from the Coyote Hills area, under the Repetto and Puente Hills, to below the San Gabriel Valley. The Northridge event occurred at a depth of about 12 miles on a south-dipping reverse fault below the San Fernando Valley.

Another significant earthquake in the region was the 1812 earthquake which caused damage at the San Juan Capistrano Mission. The location and magnitude of the 1812 earthquake are unknown but geological studies (Jacoby et al., 1988; Fumal et al., 1993; Weldon et al., 2004) postulated that it did not occur in the Capistrano area, but rather was a large (M> 7.0) distant event on the San Andreas fault in the Wrightwood area of the San Gabriel Mountains.

A recent magnitude 5.4 (M_W) earthquake occurred on 29 July 2008 below the Puente Hills northeast of the site at a depth of about 10 miles. This event was a reverse type fault with a left- lateral component of slip. The causative fault is unknown. The epicenter is between the Whittier and Chino faults. The orientation of the preferred focal plane of the focal mechanism solution is somewhat compatible with the Whittier fault. The Whittier fault may have a reverse component of slip but is believed to be primarily a right-lateral fault. Furthermore dip of the preferred focal plane and the distribution of aftershocks are not very compatible with the Whittier fault. The northerly dipping buried thrust faults under the Peralta Hills, Richfield Hills, or Kraemer Hills could have been source because the preferred focal plane dips northeasterly similar to the northerly dipping faults. However, the distribution of the aftershocks does not seem compatible with the orientations of these faults.

4.0 SUBSURFACE CONDITIONS

4.1 SOIL CONDITIONS

The idealized soil profile for the sign structure at Station 535+80 was based on Boring A-08-17. The idealized soil profiles for the sign structures located at Stations 551+00 and 559+55 were based on interpolation of adjacent borings (Borings A-08-128 and A-08-129) and CPT-08-131. The resulting idealized soil profiles and design strength parameters for foundation design are presented in Table 4-1. Since sign structure foundations are controlled by lateral capacities and the maximum foundation depth is 25 feet based on Caltrans Standard Plans (Caltrans, 2006b), the following idealized soil profiles only cover the top 30 feet.

TABLE 4-1. IDEALIZED SOIL PROFILE AND STRENGTH PARAMETERS

Approx. Elevation (ft)	Predominant Soil Type	Range of Measured and Converted SPT Blowcount; Average (blows/foot)	Total Unit Weight (pcf)	Friction Angle (degree)	Cohesion/ Undrained Shear Strength (psf)
Sign Structure at Sta. 535+80					
+258 to +248	Clayey and Silty Sand	(58)	123	34	100
+248 to +233	Lean Clay with Sand and Sandy Lean Clay	18 to (51) Average = 22	123	-	2,500
+233 to +228	Silty Sand	(29)	123	34	100
Sign Structure at Sta. 551+00					
+253 to +248	Clayey and Silty Sand	17 and 23 Average = 20	120	32	150
+248 to +243	Lean Clay with Sand and Sandy Lean Clay	14 and 16 Average = 15	120	-	1,500
+243 to +238	Sand with Silt and Silty Sand	(8) and 9 Average = 8	120	29	100
+238 to +223	Lean Clay with Sand and Sandy Lean Clay	3 to (28) Average = 7	120	-	700
Sign Structure at Sta. 559+55					
+262 to +252	Lean Clay with Sand and Sandy Lean Clay	[8] to [28] Average = 12	120	-	1,200
+252 to +247	Lean Clay	[4] to [8] Average = 6	120	-	600
+247 to +232	Lean Clay	[13] to [54] Average = 23	123	-	2,500

Notes:
(1) SPT = Standard Penetration Test.
(2) Values in ( ) are converted SPT blowcounts from the California sampler corrected for sampler size. Based on Winterkorn and Fang (1975), a correction factor from California sampler blowcounts to SPT blowcounts is 0.5.
(3) Values in [ ] are converted SPT blowcounts from the CPT sounding.

The above soil strength parameters are primarily based on published correlations with SPT blowcounts (Lam and Martin, 1986) with added conservatism. The resulting soil strength parameters for the sandy materials are lower than the ultimate values obtained from the direct shear test results included in Appendix B. The undrained shear strengths for the clayey materials in Table 4-1 are also lower than the UU triaxial test results. For the sign structure at Station 559+55, the undrained shear strength in Tale 4-1 are also much lower than the undrained shear strength obtained using the CPT correlation (Robertson and Campanella, 1989).

4.2 GROUNDWATER CONDITIONS

During the recent field investigation conducted between August 28 and October 1, 2008, groundwater was not encountered down to El. +166.5 feet which is more than 90 feet from the freeway surface.

The relatively deep water depth is confirmed by the historical groundwater map published by the California Geological Survey (Seismic Hazard Zones Map – La Habra Quadrangle) (CGS, 1997). This map shows the depth to groundwater to be greater than 50 feet.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SEISMIC DESIGN CRITERIA

According to the 1996 Caltrans Seismic Hazard map, the most significant faults relative to the project area are listed in Table 5-1 along with their style of fault, maximum earthquake magnitude, distance to the site and resulting peak bedrock acceleration (PBA).

TABLE 5-1. LOCAL SEISMIC SOURCES

Fault or Fault Zone	Style of Faulting	Maximum Credible Earthquake (MCE) Magnitude	Distance to Site[2] (miles)	Peak Bedrock Acceleration[3] (g)
El Modeno-Peralta Hills (EMP)	Reverse-Thrust[1]	6.50	1.88-2.69	0.6-0.7
Puente Hills Blind Thrust	Reverse-Thrust	7.25	2.69-3.44	0.6-0.7
Whittier-Elsinore (WEE)	Strike-Slip	7.50	3.50-4.13	0.6

Notes:
(1) Caltrans designates the style of fault for EMP to be "unknown"; we assume a reverse-thrust fault (most conservative).
(2) For the EMP and WEE faults, the distances of each bridge site to these seismic sources were scaled from the 1996 Caltrans Seismic Hazard Map. Distances of each bridge site to the Puente Hills Blind Thrust were obtained from the seismic source model contained within the FRISKSP4.0 computer program (Blake, 2000 and 2004).
(3) The PBA is the larger of the two PBA's obtained from the attenuation relations of Sadigh (1997) and Mualchin (1996).

The resulting design peak bedrock accelerations for the three sign structures are 0.7g.

5.2 LIQUEFACTION

Based on the available boring information, the subject site has a low liquefaction potential due to absence of groundwater within the depths of interest.

5.3 SOIL CORROSIVITY

Two soil samples were tested for pH, minimum resistivity, soluble chloride content and soluble sulfate content. The test results are summarized in Table 5-2. Minimum resistivities were measured to be 490 and 1500 ohm-cm. The pH values were 7.3 and 7.9. The soluble sulfate measurements were 50 and 250 parts per million (ppm), and the soluble chloride measurements were 153 and 362 ppm.

TABLE 5-2. SOIL CORROSION TEST RESULTS

Boring	Station (Offset) / "Station Line"	Sample Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Soluble Sulfate Content (ppm)	Soluble Chloride Content (ppm)
A-08-017	535+70 (66 RT) / "B-Line"	20	CL	490	7.3	250	362
A-08-128	546+84 (102RT) / "B-Line"	5	CL	1500	7.9	50	153

Based on the Caltrans Corrosion Guidelines (2003), soils are considered corrosive if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm or greater. Based on the test results and the Caltrans criteria, the on-site soils are not considered to be corrosive to bare metals and concrete.

5.4 PILE FOUNDATION DESIGN

5.4.1 Foundation Type

Three (3) "cantilever" type single-post OH sign structures are proposed for the project. All sign structures are Post Type VII. Based on Caltrans Standard Plans S8 (Caltrans, 2006b), a 5-foot-diameter CIDH pile with a foundation depth of 23 feet are recommended for all sign structures with Post Type VII. We recommend using the same pile type and diameter.

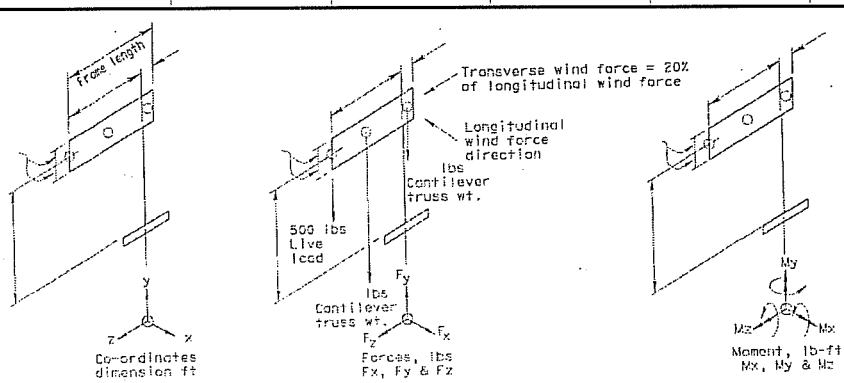
5.4.2 Foundation Demands Provided by Structural Designers

Per the structural designers, the foundation demands at the CIDH pile head are listed in Table 5-3.

TABLE 5-3. SIGN STRUCTURE FOUNDATION DEMANDS

Locations	Fx (lb)	Fy (lb)	Fz (lb)	Mx (lb-ft)	My (lb-ft)	Mz (lb-ft)
Station 535+80	10,071	14,427	2,015	193,365	151,125	246,001
Station 551+00	11,414	15,921	2,283	244,757	171,207	275,947
Station 559+55	9,735	14,039	1,947	181,584	141,162	230,526

Note:



5.4.3 Pile Design

Caltrans Standard Plan Assumption. Based on Caltrans Standard Plans S8 (Caltrans, 2006b), the CIDH pile foundation designs are based on the 2001 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, Traffic Signals, article 13.6, and Broms' approximate procedure for cohesionless material with an angle of internal friction (ϕ) of 30 degrees and unit weight (γ) of 120 lb/ft^3 (pcf).

Design Philosophy. Lateral pile capacity of a single CIDH pile was evaluated using the computer program LPILE (Ensoft, 2007). The p-y curves for sandy soils were estimated using the API criteria (API, 2000) whereas the p-y curves for clayey soil were estimated using the Matlock criteria (1970).

We performed lateral pile analyses for 2 cases:

- Case 1: Each of the three sign structures foundation using the soil parameters listed in Table 4-1 for a 5-foot diameter CIDH pile with a length of 23 feet long (same as the dimensions shown on Caltrans Standard Plans S8 for Post Type VII), and load demands in Table 5-3, and

- Case 2: the Caltrans Standard Plans case (ϕ =30° and γ=120 pcf) for the same foundation demands.

If the pile-head deflection and rotation from Case 1 is less than those obtained for Case 2 then the Caltrans Standard Plans Sheet S8 can be used for the proposed sign structures. A similar design approach was used for the I-405/I-605 HOV Connector Segment in OCTA West County Connector Project.

Ultimate axial and torsional capacities based on the soil's skin friction resistance were estimated using the soil parameters listed in Table 4-1. These ultimate capacities were compared with the foundation demands listed in Table 5-3 to determine that a minimum safety factor of 2.0 is met.

Parameters for Lateral Pile Analysis. The CIDH pile used in the analysis has a 5-foot diameter and a length of 23 feet long (same as the dimensions shown on Caltrans Standard Plans S8). A concrete compression stress (f'c) of 3,250 psi and a cracked moment of inertia equal to one-half the gross moment of inertia were used for pile design properties.

Soil input parameters for lateral pile analysis are presented in Table 5-4 for the computer program LPILE^{PLUS} 5.0 (Reese et al, 2007). The soil input parameters in Table 5-4 is based on the soil parameters listed in Table 4-1, which are conservative compared to the laboratory results and CPT interpretation.

TABLE 5-4. LPILE INPUT PARAMETERS

Layer No	Soil Type	Layer Top Depth (ft)	Layer Bottom Depth (ft)	LPILE Soil Code	Soil Unit Weight (pcf)	Soil Friction Angle	Modulus of Subgrade Reaction (pci)	Undrained Shear Strength (psf)	e_{50}
Caltrans Standard Plans									
1	Sand	0	25	8	120	30°	45	-	-
Station 535+80									
1	Sand	0	10	8	123	34°	100	-	-
2	Clay	10	25	1	123	-	-	2500	0.005
Station 551+00									
1	Sand	0	5	8	120	32°	70	-	-
2	Clay	5	10	1	120	-	-	1500	0.01
3	Sand	10	15	8	120	29°	20	-	-
4	Clay	15	25	1	120	-	-	700	0.015
Station 539+55									
1	Clay	0	10	1	120	-	-	1200	0.01
2	Clay	10	15	1	120	-	-	600	0.015
3	Clay	15	25	1	123	-	-	2500	0.005

To simplify the analysis and it is also conservative, the worst loading condition in Table 5-3 was used. The worst loading condition is located at Station 551+00 and the corresponding horizontal force (Fx) and overturning moment (Mz) are 11.4 kips and 276 kips-ft, respectively.

5.4.4 Results

The LPILE output for the lateral pile analyses is included in Appendix C. The pile-head deflections and rotations under the prescribed lateral loading condition are presented in Table 5-5. The results clearly indicate that the pile-head deflections and rotations using the site-specific soil parameters are less than those using the Caltrans Standard Plans (ϕ =30° and γ=120 pcf).

TABLE 5-5. PILE-HEAD DEFLECTIONS AND ROTATIONS

Locations	Deflection (in)	Rotation (radian)
Caltrans Standard Plans	0.1760	0.00126
Station 535+80	0.0718	0.00071
Station 551+00	0.1257	0.00104
Station 559+55	0.0546	0.00059

Ultimate axial and torsional pile capacities are presented in Table 5-6 and the calculations are included in Appendix C. The results in Table 5-6 indicates the ultimate capacities are at least 3.5 times of the foundation demands given in Table 5-3.

TABLE 5-6. ULTIMATE AXIAL AND TORIONSAL CAPACITIES

Locations	Ultimate Axial Capacity (kips)	Ultimate Torsional Capacity (kips-ft)
Station 535+80	391	978
Station 551+00	261	654
Station 559+55	250	626

Based on the results presented in Tables 5-5 and 5-6, we conclude it is suitable to use the Caltrans Standard Plans S8 (Caltrans, 2006b) to select the CIDH pile diameter and depth for the proposed Post Type VII Overhead sign structures.

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 EARTHWORK

Earthwork should be performed in accordance with Caltrans Standard Specifications, Section 19 (Caltrans, 2006a). Appropriate measures should be taken to prevent damage to adjacent structures and utilities. Any design and construction of temporary sloping, sheeting, or shoring should be made the contractor's responsibility. It should be noted that it is the responsibility of the contractor to oversee the safety of the workers in the field during construction. The contractor shall conform to all applicable occupational and health standards, rules, regulations, and orders established by the State of California. In addition, other State, County, or Municipal regulations may supersede the recommendations presented in this section. If a trench shoring design and safety plan is required, the geotechnical consultant should review the plan to confirm that recommendations presented in this report have been applied to the design.

During the recent field investigation conducted between August 28 and October 1, 2008, groundwater was not encountered down to El. +166.5 feet which is more than 90 feet from the freeway surface. Therefore, groundwater is not expected to be encountered during footing construction. However, groundwater level can fluctuate due to seasonal rainfall amount, local irrigation and groundwater recharge program and other man-made conditions. If groundwater is encountered, it should be controlled in accordance with Section 19-3.04 of the Caltrans Standard Specifications (2006a).

6.2 PILE CONSTRUCTION

Loose soils should be cleaned from the bottom of the borings. Pile borings should be inspected and approved by the geotechnical engineer prior to the installation of reinforcement. Extreme care in drilling, placement of steel, and the pouring of concrete is essential to avoid excessive disturbance of pile boring walls. Concrete placement by pumping or tremie tube to the bottom of the pile borings is recommended. Specifications should require that sufficient space be provided in the pile reinforcing cage during fabrication to allow the insertion of a tremie tube for concrete placement. The pile reinforcing cage should be installed and the concrete pumped immediately after drilling is completed.

Sand was encountered in our soil borings and these materials are susceptible to caving. If caving occurs, a temporary casing may be required during construction. Temporary casings should have an inner diameter equal to or exceeding the pile diameter. Temporary casing should be placed tight-in-hole. Vibratory or impact hammer with or without center-relief drilling can be used to install the temporary casing. The temporary casing should be pulled as the concrete is being poured while always maintaining at least a 5-foot head of concrete inside the casing.

6.3 REVIEW OF CONSTRUCTION PLANS

Recommendations contained in this report are based on preliminary plans. The geotechnical consultant should review the final construction plans and specifications in order to confirm that the general intent of the recommendations contained in this report have been incorporated into the final construction documents. Recommendations contained in this report may require modification or additional recommendations may be necessary based on the final design.

6.4 GEOTECHNICAL OBSERVATION AND TESTING

It is recommended that inspections and testing be performed by the geotechnical consultant during the following stages of construction:

- Grading operations, including excavations and placement of compacted fill
- Shoring installation
- Footing excavations
- Pile installation
- When any unusual subsurface conditions are encountered

7.0 LIMITATIONS

This report is intended for the use of RBF Consulting, Orange County Transportation Authority and Caltrans for the proposed Sign Structures on CIDH pile foundation within the SR-57 Northbound Improvement Project. This report is based on the project as described and the information obtained from the exploratory borings at the approximate locations indicated on the attached plans. The findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses. In addition, soils and subsurface conditions encountered in the exploratory borings are presumed to be representative of the project site. However, subsurface conditions and characteristics of soils between exploratory borings can vary. The findings reflect an interpretation of the direct evidence obtained. The recommendations presented in this report are based on the assumption that an appropriate level of quality control and quality assurance (inspections and tests) will be provided during construction. EMI should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations contained in this report are applicable to the specific design element(s) and location(s) which is (are) the subject of this report. They have no applicability to any other design elements or to any other locations and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

EMI has no responsibility for construction means, methods, techniques, sequences, or procedures; for safety precautions or programs in connection with the construction; for the acts or omissions of the CONTRACTOR or any other person performing any of the construction; or for the failure of any worker to carry out the construction in accordance with the Final Construction Drawings and Specifications.

Services performed by EMI have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

8.0 REFERENCES

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APPENDIX A

LOG OF TEST BORINGS SHEETS

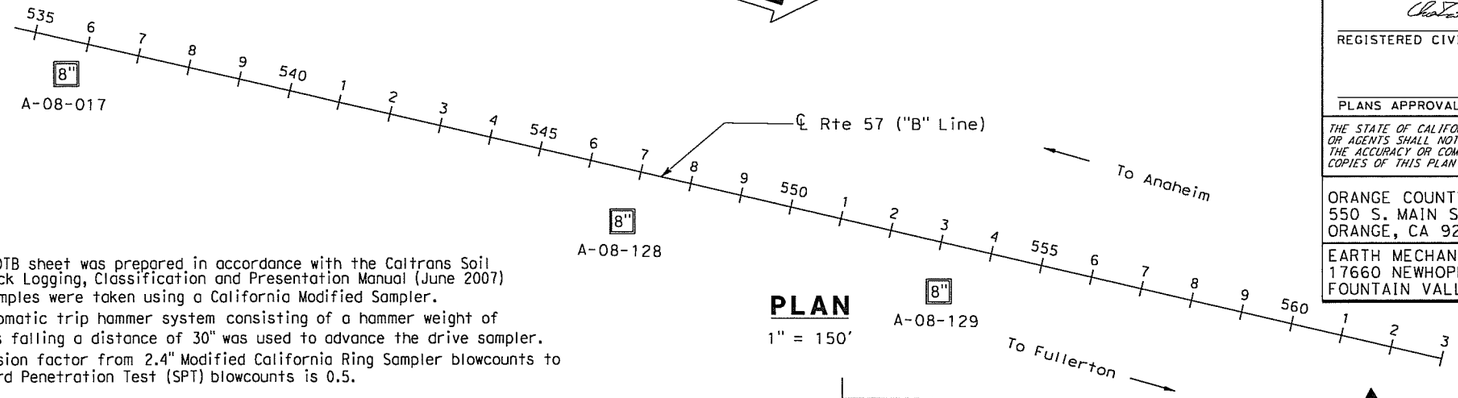
BENCHMARKS:

Vertical Datum NAVD 88

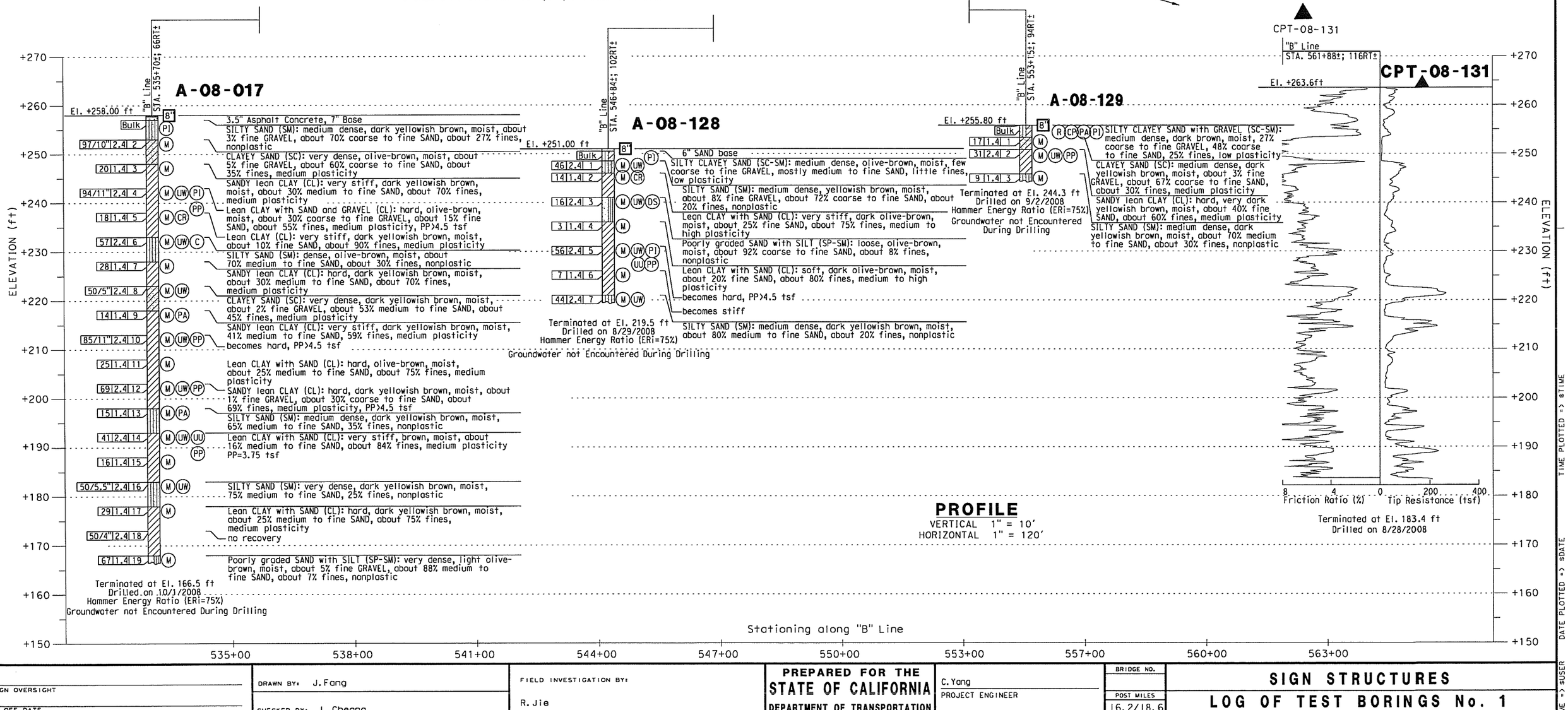
Designation: 1L-54-82 Elev = 153.171
Described by OCS 2002 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "1L-54-82", set in the Top of a 6 in. by 6 in. Concrete Post. Monument is located along the Westerly Levee of the Santa Ana River, 0.25 Miles Northerly along Levee from the Centerline of Orangewood Avenue, 200 ft. Northeasterly of the Easterly Leg of the Anaheim Angels 200 ft. tall sign, 69 ft. Westerly of the Centerline of the Bike Trail and 1.5 ft. Westerly of a Steel OCS Witness Post. Monument is set 0.3 below the Ground.

Designation: 2G-25-70 Elev = 275.872
Described by OCS 2003 - Found 3¼" OCS Aluminum Benchmark Disk Stamped "2G-25-70", set in the Southeasterly Corner of a 4 ft by 6 ft Concrete Catch Basin. Monument is Located in the Northwesterly Corner of the Intersection of Yorba Linda Boulevard and Deerpark Drive, 75 ft Westerly of the Centerline of Deerpark and 46 ft Northerly of the Centerline of Yorba Linda. Monument is set Level with the Sidewalk.

NOTES:
(1) This LOTB sheet was prepared in accordance with the Caltrans Soil and Rock Logging, Classification and Presentation Manual (June 2007)
(2) 2.4" samples were taken using a California Modified Sampler.
(3) An automatic trip hammer system consisting of a hammer weight of 140 lbs falling a distance of 30" was used to advance the drive sampler.
(4) Conversion factor from 2.4" Modified California Ring Sampler blowcounts to Standard Penetration Test (SPT) blowcounts is 0.5.



PLAN
1" = 150'



PROFILE
VERTICAL 1" = 10'
HORIZONTAL 1" = 120'

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

Chien-Tai Yang No. C 66394 Exp. 6-30-10 CIVIL STATE OF CALIFORNIA — REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: J. Fang
CHECKED BY: L. Cheang

FIELD INVESTIGATION BY:
R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.
POST MILES 16.2/18.6

SIGN STRUCTURES
LOG OF TEST BORINGS No. 1

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

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DATE PLOTTED => $DATE
TIME PLOTTED => $TIME
USERNAME => $USER

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — Chien-Tai Yang — No. C 66394 — Exp. 6-30-10 — CIVIL — STATE OF CALIFORNIA

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ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

BOREHOLE IDENTIFICATION

Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (1-inch soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

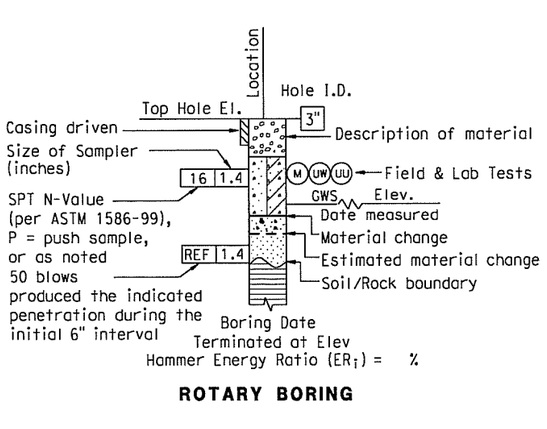
Note: Size in inches.

CONSISTENCY OF COHESIVE SOILS

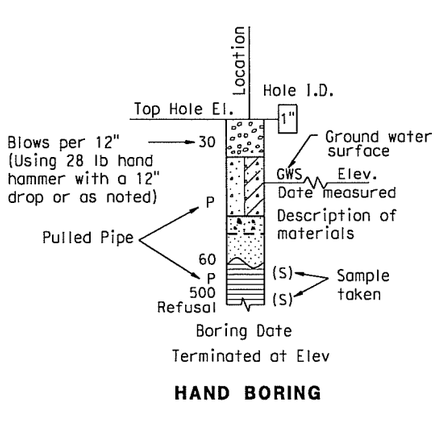
Description	Unconfined Compressive Strength (tsf)	Pocket Penetrometer Measurement (tsf)	Torvane Measurement (tsf)	Field Approximation
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 to 0.50	0.25 to 0.50	0.12 to 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	0.50 to 1.0	0.25 to 0.50	Penetrated several inches by thumb with moderate effort
Stiff	1 to 2	1 to 2	0.50 to 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2 to 4	2 to 4	1.0 to 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

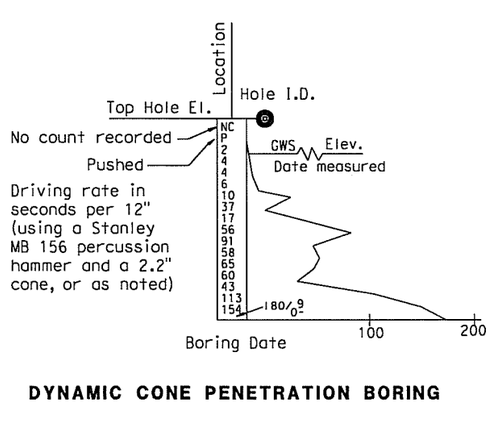
Description	Criteria
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.



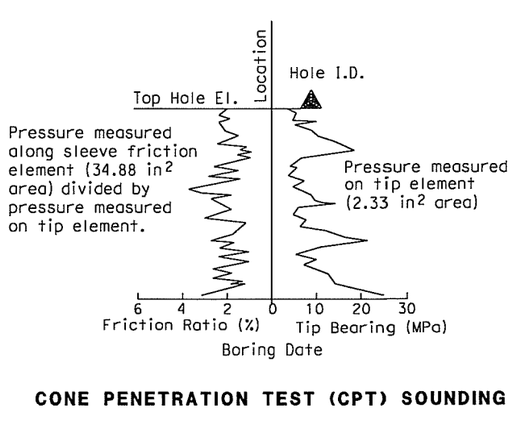
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

DESIGN OVERSIGHT SIGN OFF DATE	DRAWN BY: J. Fang CHECKED BY: L. Cheang	FIELD INVESTIGATION BY: R. Jie	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. Yang PROJECT ENGINEER	BRIDGE NO. POST MILES 16.2/18.6

SIGN STRUCTURES

LOG OF TEST BORINGS No. 2

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

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DATE PLOTTED => $DATE
TIME PLOTTED => $TIME

REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

GROUP SYMBOLS AND NAMES

Graphic/Symbol		Group Names
	GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
	GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
	GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
	GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
	GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
	GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
	GM	SILTY GRAVEL SILTY GRAVEL with SAND
	GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
	GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
	SW	Well-graded SAND Well-graded SAND with GRAVEL
	SP	Poorly graded SAND Poorly graded SAND with GRAVEL
	SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
	SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
	SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
	SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
	SM	SILTY SAND SILTY SAND with GRAVEL
	SC	CLAYEY SAND CLAYEY SAND with GRAVEL
	SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
	PT	PEAT
		COBBLES COBBLES and BOULDERS BOULDERS

Graphic/Symbol		Group Names
	CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
	CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
	ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
	OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
	OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
	CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
	MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
	OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
	OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY ORGANIC elastic SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
	OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTING

- (C) Consolidation (ASTM D 2435)
- (CL) Collapse Potential (ASTM D 5333)
- (CP) Compaction Curve (CTM 216)
- (CR) Corrosivity Testing (CTM 643, CTM 422, CTM 417)
- (CU) Consolidated Undrained Triaxial (ASTM D 4767)
- (DS) Direct Shear (ASTM D 3080)
- (EI) Expansion Index (ASTM D 4829)
- (M) Moisture Content (ASTM D 2216)
- (OC) Organic Content-% (ASTM D 2974)
- (P) Permeability (CTM 220)
- (PA) Particle Size Analysis (ASTM D 422)
- (PI) Plasticity Index (AASHTO T 90) Liquid Limit (AASHTO T 89)
- (PL) Point Load Index (ASTM D 5731)
- (PM) Pressure Meter
- (PP) Pocket Penetrometer
- (R) R-Value (CTM 301)
- (SE) Sand Equivalent (CTM 217)
- (SG) Specific Gravity (AASHTO T 100)
- (SL) Shrinkage Limit (ASTM D 427)
- (SW) Swell Potential (ASTM D 4546)
- (TV) Pocket Torvane
- (UC) Unconfined Compression-Soil (ASTM D 2166) Unconfined Compression-Rock (ASTM D 2938)
- (UU) Unconsolidated Undrained Triaxial (ASTM D 2850)
- (UW) Unit Weight (ASTM D 4767)
- (VS) Vane Shear (AASHTO T 223)

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
12	Ora	57	16.2/18.6		

REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER
Chien-Tai Yang
No. C 66394
Exp. 6-30-10
CIVIL
STATE OF CALIFORNIA

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

ORANGE COUNTY TRANSPORTATION AUTHORITY
550 S. MAIN STREET
ORANGE, CA 92863-1584

EARTH MECHANICS, INC.
17660 NEWHOPE STREET, SUITE E
FOUNTAIN VALLEY, CA 92708

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 12 inches)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

MOISTURE

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

PERCENT OR PROPORTION OF SOILS

Description	Criteria
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE

Description		Size
Boulder		> 12"
Cobble		3" to 12"
Gravel	Coarse	3/4" to 3"
	Fine	No. 4 to 3/4"
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY: J. Fang

CHECKED BY: L. Cheang

FIELD INVESTIGATION BY: R. Jie

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. Yang
PROJECT ENGINEER

BRIDGE NO.

POST MILES 16.2/18.6

SIGN STRUCTURES
LOG OF TEST BORINGS No. 3

DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 2/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 12
EA 0F031I

DISREGARD PRINTS BEARING EARLIER REVISION DATES →

REVISION DATES (PRELIMINARY STAGE ONLY)

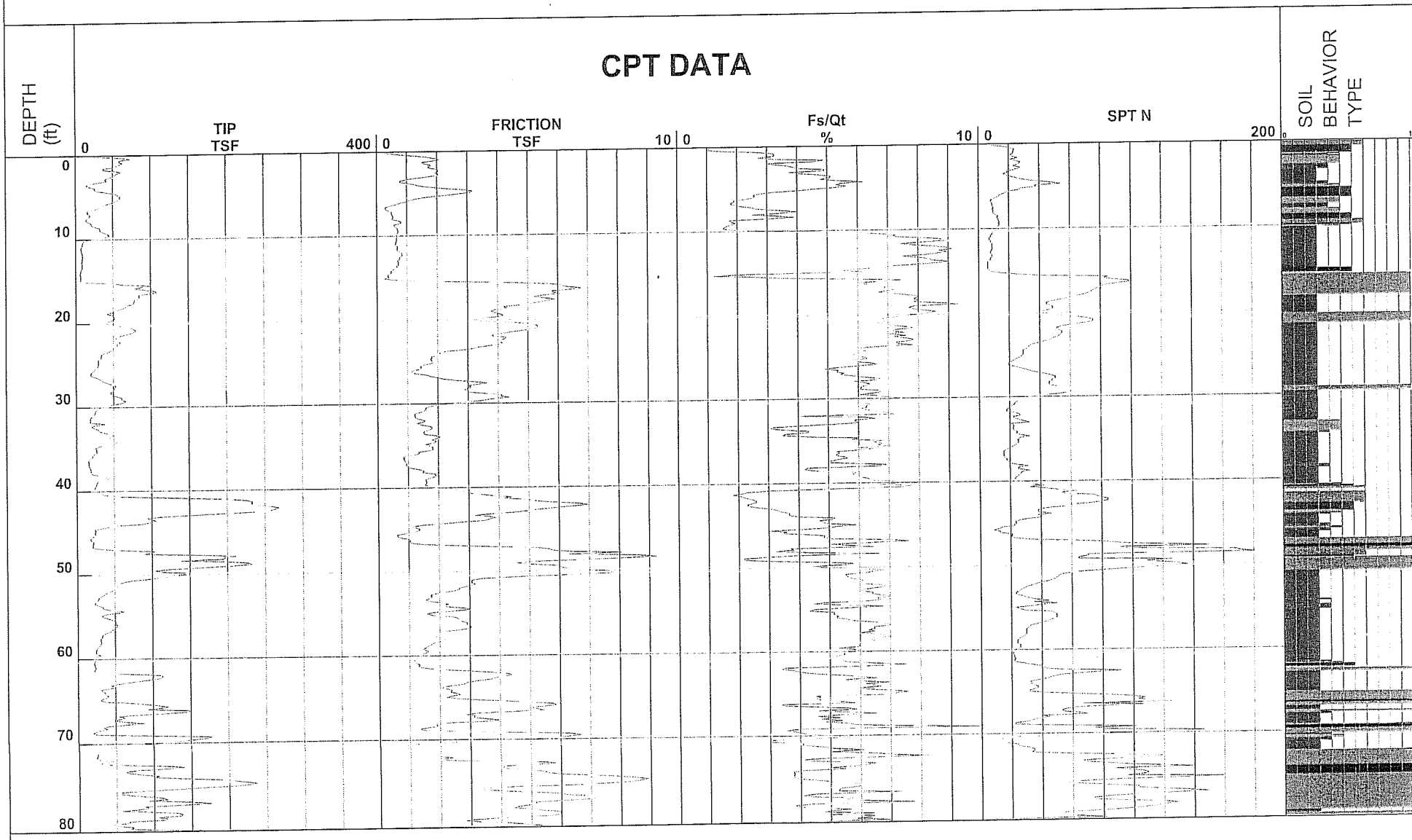
SHEET X OF X

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Earth Mechanics

Location	57 Freeway Expansion	Operator	VO/ML	Filename	SDF(183).cpt
Job Number	08-115	Cone Number	DSG1023	GPS	
Hole Number	C-08-131	Date and Time	8/29/2008 12:45:19 PM	Maximum Depth	80.22 ft
Water Table Depth		80.00+ ft			

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Depth Increment

*Soil behavior type and SPT based on data from UBC-1983

57 Freeway Expansion

Project ID: Earth Mechanics
Data File: SDF(183).cpt
CPT Date: 8/29/2008 12:45:19 PM
GW During Test: 80 ft

Sounding ID: C-08-131
Project No: 08-115
Cone/Rig: DSG1023

Depth ft	qc PS tsf	*qcln PS -	qlncs PS -	Slv Stss tsf	pore prss (psi)	Frct Rato %	Material Behavior Description	Unit Wght pcf	Qc to N	*SPT R-N1 60%	SPT R-N 60%	*Rel Den %	Ftn Ang deg	Und Shr tsf	*Nk -
0.33	62.2	99.8	119.4	0.6	0.2	1.0	clean SAND to silty SAND	125	5.0	20	12	67	48	-	16
0.49	73.3	117.6	148.9	1.1	0.2	1.5	clean SAND to silty SAND	125	5.0	24	15	72	48	-	16
0.66	59.7	95.8	165.0	1.6	0.2	2.7	silty SAND to sandy SILT	120	4.0	24	15	66	48	-	16
0.82	58.5	93.7	178.1	1.9	0.2	3.2	silty SAND to sandy SILT	120	4.0	23	15	65	48	-	16
0.98	63.7	102.2	189.0	2.1	0.2	3.3	silty SAND to sandy SILT	120	4.0	26	16	68	48	-	16
1.15	58.5	93.8	178.3	1.9	0.2	3.2	silty SAND to sandy SILT	120	4.0	23	15	65	48	-	16
1.31	55.0	88.3	158.4	1.5	0.2	2.7	silty SAND to sandy SILT	120	4.0	22	14	63	48	-	16
1.48	49.0	78.6	163.7	1.6	0.2	3.2	silty SAND to sandy SILT	120	4.0	20	12	59	48	-	16
1.64	37.2	59.7	182.1	1.8	0.2	4.9	clayy SILT to silty CLAY	115	2.0	30	19	-	-	2.6	15
1.80	38.1	61.1	177.3	1.7	0.2	4.6	clayy SILT to silty CLAY	115	2.0	31	19	-	-	2.7	15
1.97	56.3	90.3	169.7	1.7	0.2	3.0	silty SAND to sandy SILT	120	4.0	23	14	64	48	-	16
2.13	60.8	97.5	183.2	2.0	0.2	3.2	silty SAND to sandy SILT	120	4.0	24	15	66	48	-	16
2.30	55.2	88.5	187.0	2.0	0.2	3.7	clayy SILT to silty CLAY	115	2.0	44	28	-	-	3.9	15
2.46	53.0	84.9	189.1	2.1	0.3	3.9	clayy SILT to silty CLAY	115	2.0	42	26	-	-	3.7	15
2.62	49.0	78.6	183.8	1.9	0.2	4.0	clayy SILT to silty CLAY	115	2.0	39	25	-	-	3.5	15
2.79	42.1	67.4	193.7	2.1	0.2	4.9	clayy SILT to silty CLAY	115	2.0	34	21	-	-	3.0	15
2.95	39.8	63.8	189.4	2.0	0.2	4.9	clayy SILT to silty CLAY	115	2.0	32	20	-	-	2.8	15
3.12	42.2	67.6	165.1	1.6	0.2	3.7	clayy SILT to silty CLAY	115	2.0	34	21	-	-	3.0	15
3.28	27.8	44.6	144.3	1.1	0.2	4.1	clayy SILT to silty CLAY	115	2.0	22	14	-	-	1.9	15
3.45	17.6	28.2	-	0.8	0.2	4.8	silty CLAY to CLAY	115	1.5	19	12	-	-	1.2	15
3.61	14.6	23.4	-	0.7	0.2	5.2	silty CLAY to CLAY	115	1.5	16	10	-	-	1.0	15
3.77	18.8	30.1	-	1.0	0.2	5.1	silty CLAY to CLAY	115	1.5	20	13	-	-	1.3	15
3.94	26.4	42.4	-	1.3	0.1	4.8	clayy SILT to silty CLAY	115	2.0	21	13	-	-	1.9	15
4.10	25.9	41.5	-	1.4	0.2	5.4	silty CLAY to CLAY	115	1.5	28	17	-	-	1.8	15
4.27	29.0	46.6	-	1.8	0.2	6.3	silty CLAY to CLAY	115	1.5	31	19	-	-	2.0	15
4.43	41.2	66.0	205.1	2.2	0.2	5.5	clayy SILT to silty CLAY	115	2.0	33	21	-	-	2.9	15
4.59	53.4	85.7	229.4	2.8	0.2	5.3	very stiff fine SOIL	120	2.0	43	27	62	45	-	30
4.76	56.2	90.2	244.7	3.2	0.2	5.7	very stiff fine SOIL	120	2.0	45	28	64	45	-	30
4.92	58.9	94.5	240.7	3.1	0.2	5.3	very stiff fine SOIL	120	2.0	47	29	65	45	-	30
5.09	60.4	96.8	221.2	2.7	0.2	4.5	very stiff fine SOIL	120	2.0	48	30	66	45	-	30
5.25	58.6	94.1	201.4	2.3	0.2	4.0	clayy SILT to silty CLAY	115	2.0	47	29	-	-	4.1	15
5.41	57.2	91.8	176.6	1.8	0.2	3.2	silty SAND to sandy SILT	120	4.0	23	14	64	45	-	16
5.58	53.2	85.3	157.0	1.5	0.2	2.7	silty SAND to sandy SILT	120	4.0	21	13	62	44	-	16
5.74	47.4	76.1	142.9	1.2	0.2	2.6	silty SAND to sandy SILT	120	4.0	19	12	58	44	-	16
5.91	41.3	66.3	135.1	1.1	0.2	2.6	silty SAND to sandy SILT	120	4.0	17	10	53	43	-	16
6.07	36.1	58.0	125.3	0.9	0.2	2.6	silty SAND to sandy SILT	120	4.0	14	9	49	42	-	16
6.23	32.5	52.0	112.9	0.7	0.2	2.3	silty SAND to sandy SILT	120	4.0	13	8	45	41	-	16
6.40	30.3	47.9	100.4	0.6	0.2	1.9	silty SAND to sandy SILT	120	4.0	12	8	43	41	-	16
6.56	21.0	32.8	86.3	0.4	0.2	1.9	silty SAND to sandy SILT	120	4.0	8	5	30	39	-	16
6.73	15.3	23.6	75.2	0.3	0.2	1.8	clayy SILT to silty CLAY	115	2.0	12	8	-	-	1.1	15
6.89	16.0	24.4	77.3	0.3	0.2	1.9	clayy SILT to silty CLAY	115	2.0	12	8	-	-	1.1	15
7.05	18.4	27.7	85.4	0.4	0.2	2.1	clayy SILT to silty CLAY	115	2.0	14	9	-	-	1.3	15
7.22	20.1	29.9	95.5	0.5	0.2	2.5	clayy SILT to silty CLAY	115	2.0	15	10	-	-	1.4	15
7.38	18.1	29.1	-	0.5	0.2	2.7	clayy SILT to silty CLAY	115	2.0	15	9	-	-	1.3	15
7.55	15.1	24.3	-	0.5	0.2	3.5	clayy SILT to silty CLAY	115	2.0	12	8	-	-	1.0	15
7.71	13.5	21.7	-	0.5	0.3	4.1	silty CLAY to CLAY	115	1.5	14	9	-	-	0.9	15
7.87	15.5	24.9	-	0.5	0.3	3.5	clayy SILT to silty CLAY	115	2.0	12	8	-	-	1.1	15
8.04	19.7	31.6	98.5	0.5	0.3	2.6	clayy SILT to silty CLAY	115	2.0	16	10	-	-	1.4	15
8.20	21.2	34.0	-	0.7	0.3	3.3	clayy SILT to silty CLAY	115	2.0	17	11	-	-	1.5	15
8.37	21.3	34.1	-	0.8	0.3	4.0	clayy SILT to silty CLAY	115	2.0	17	11	-	-	1.5	15
8.53	25.7	35.2	113.2	0.8	0.3	3.1	clayy SILT to silty CLAY	115	2.0	18	13	-	-	1.8	15
8.69	32.3	43.9	93.0	0.6	0.3	1.8	silty SAND to sandy SILT	120	4.0	11	8	40	40	-	16
8.86	32.9	44.3	94.4	0.6	0.3	1.8	silty SAND to sandy SILT	120	4.0	11	8	40	40	-	16
9.02	33.1	44.2	98.4	0.6	0.3	2.0	silty SAND to sandy SILT	120	4.0	11	8	40	40	-	16
9.19	36.8	48.6	99.9	0.7	0.3	1.9	silty SAND to sandy SILT	120	4.0	12	9	43	41	-	16
9.35	41.8	54.8	99.9	0.7	0.3	1.7	silty SAND to sandy SILT	120	4.0	14	10	47	41	-	16
9.51	44.8	58.2	100.9	0.7	0.3	1.6	silty SAND to sandy SILT	120	4.0	15	11	49	42	-	16
9.68	44.8	57.7	99.3	0.7	0.3	1.6	silty SAND to sandy SILT	120	4.0	14	11	49	42	-	16
9.84	35.3	45.0	95.9	0.6	0.3	1.8	silty SAND to sandy SILT	120	4.0	11	9	41	40	-	16
10.01	21.0	33.7	-	0.7	0.3	3.2	clayy SILT to silty CLAY	115	2.0	17	11	-	-	1.5	15
10.17	11.7	18.8	-	0.7	0.3	6.1	silty CLAY to CLAY	115	1.5	13	8	-	-	0.8	15
10.34	10.5	16.8	-	0.6	0.3	6.5	silty CLAY to CLAY	115	1.5	11	7	-	-	0.7	15
10.50	9.4	15.1	-	0.6	0.3	7.3	silty CLAY to CLAY	115	1.5	10	6	-	-	0.6	15
10.66	9.1	14.5	-	0.7	0.3	7.8	silty CLAY to CLAY	115	1.5	10	6	-	-	0.6	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Project ID: Earth Mechanics
Data File: SDF(183).cpt
CPT Date: 8/29/2008 12:45:19 PM
GW During Test: 80 ft

Sounding ID: C-08-131
Project No: 08-115
Cone/Rig: DSG1023

Depth ft	qc PS tsf	qc1n PS -	qi1ncs PS -	Slv Stss tsf	pore prss (psi)	Frct Rato %	Material Behavior Description	Unit Wght pcf	Qc to N	SPT R-N1 60%	SPT R-N 60%	Rel Den %	Ftn Ang deg	Und Shr tsf	Nk -
10.83	8.9	14.0	-	0.6	0.3	7.6	silty CLAY to CLAY	115	1.5	9	6	-	-	0.6	15
10.99	7.4	11.5	-	0.6	0.3	9.0	silty CLAY to CLAY	115	1.5	8	5	-	-	0.5	15
11.16	7.2	11.0	-	0.6	0.3	9.7	silty CLAY to CLAY	115	1.5	7	5	-	-	0.5	15
11.32	7.8	11.7	-	0.7	0.3	9.9	silty CLAY to CLAY	115	1.5	8	5	-	-	0.5	15
11.48	8.3	12.3	-	0.7	0.3	8.9	silty CLAY to CLAY	115	1.5	8	6	-	-	0.6	15
11.65	8.9	13.0	-	0.7	0.2	8.1	silty CLAY to CLAY	115	1.5	9	6	-	-	0.6	15
11.81	9.1	13.1	-	0.7	0.1	8.5	silty CLAY to CLAY	115	1.5	9	6	-	-	0.6	15
11.98	9.3	13.2	-	0.8	0.1	9.3	silty CLAY to CLAY	115	1.5	9	6	-	-	0.6	15
12.14	9.4	13.2	-	0.8	0.1	9.7	silty CLAY to CLAY	115	1.5	9	6	-	-	0.6	15
12.30	9.2	12.7	-	0.8	0.0	9.9	silty CLAY to CLAY	115	1.5	8	6	-	-	0.6	15
12.47	9.2	12.5	-	0.8	0.0	9.4	silty CLAY to CLAY	115	1.5	8	6	-	-	0.6	15
12.63	8.4	11.3	-	0.8	0.0	9.8	silty CLAY to CLAY	115	1.5	8	6	-	-	0.6	15
12.80	8.7	11.6	-	0.7	0.0	9.4	silty CLAY to CLAY	115	1.5	8	6	-	-	0.6	15
12.96	8.4	11.1	-	0.7	0.0	9.1	silty CLAY to CLAY	115	1.5	7	6	-	-	0.6	15
13.12	9.3	12.1	-	0.7	-0.1	8.2	silty CLAY to CLAY	115	1.5	8	6	-	-	0.6	15
13.29	9.1	11.7	-	0.7	-0.1	8.7	silty CLAY to CLAY	115	1.5	8	6	-	-	0.6	15
13.45	8.5	10.8	-	0.7	-0.1	9.3	silty CLAY to CLAY	115	1.5	7	6	-	-	0.6	15
13.62	7.9	10.0	-	0.7	-0.1	9.4	silty CLAY to CLAY	115	1.5	7	5	-	-	0.5	15
13.78	7.1	8.8	-	0.6	-0.1	9.9	silty CLAY to CLAY	115	1.5	6	5	-	-	0.5	15
13.94	6.7	8.2	-	0.6	-0.1	9.9	Organic SOILS - Peats	100	1.0	8	7	-	-	0.7	10
14.11	6.3	7.6	-	0.5	-0.1	9.2	Organic SOILS - Peats	100	1.0	8	6	-	-	0.6	10
14.27	6.5	7.8	-	0.5	-0.2	8.2	silty CLAY to CLAY	115	1.5	5	4	-	-	0.4	15
14.44	6.7	8.0	-	0.5	-0.2	7.9	silty CLAY to CLAY	115	1.5	5	4	-	-	0.4	15
14.60	6.7	7.9	-	0.4	-0.2	6.9	silty CLAY to CLAY	115	1.5	5	4	-	-	0.4	15
14.76	6.3	7.4	-	0.3	-0.2	6.3	silty CLAY to CLAY	115	1.5	5	4	-	-	0.4	15
14.93	6.6	7.5	-	0.4	-0.2	7.2	silty CLAY to CLAY	115	1.5	5	4	-	-	0.4	15
15.09	10.3	11.7	-	0.2	-0.2	2.5	silty CLAY to CLAY	115	1.5	8	7	-	-	0.7	15
15.26	52.5	54.1	88.0	0.6	-0.1	1.2	silty SAND to sandy SILT	120	4.0	14	13	47	41	-	16
15.42	61.3	62.8	133.8	1.6	0.1	2.7	silty SAND to sandy SILT	120	4.0	16	15	52	41	-	16
15.58	101.1	103.0	197.6	3.5	0.1	3.5	silty SAND to sandy SILT	120	4.0	26	25	68	44	-	16
15.75	87.1	88.2	248.7	5.1	0.1	5.9	very stiff fine SOIL	120	2.0	44	44	63	43	-	30
15.91	78.6	84.7	-	5.9	0.1	7.5	very stiff fine SOIL	120	2.0	42	39	62	43	-	30
16.08	91.7	92.0	277.7	6.2	0.1	6.8	very stiff fine SOIL	120	2.0	46	46	64	43	-	30
16.24	106.1	105.8	276.8	6.3	0.2	6.0	very stiff fine SOIL	120	2.0	53	53	69	44	-	30
16.40	108.1	107.3	289.7	6.8	0.2	6.4	very stiff fine SOIL	120	2.0	54	54	69	44	-	30
16.57	94.6	93.4	282.3	6.4	0.2	6.9	very stiff fine SOIL	120	2.0	47	47	65	43	-	30
16.73	83.8	82.3	267.7	5.8	0.2	7.0	very stiff fine SOIL	120	2.0	41	42	61	43	-	30
16.90	85.2	83.3	268.2	5.9	0.2	7.0	very stiff fine SOIL	120	2.0	42	43	61	43	-	30
17.06	84.3	83.0	-	6.1	0.3	7.3	very stiff fine SOIL	120	2.0	41	42	61	43	-	30
17.23	78.8	78.2	-	5.5	0.3	7.1	very stiff fine SOIL	120	2.0	39	39	59	42	-	30
17.39	78.0	75.8	251.4	5.2	0.3	6.8	very stiff fine SOIL	120	2.0	38	39	58	42	-	30
17.55	77.2	75.2	-	5.6	0.3	7.4	very stiff fine SOIL	120	2.0	38	39	58	42	-	30
17.72	77.3	74.5	-	5.9	0.3	7.7	very stiff fine SOIL	120	2.0	37	39	57	42	-	30
17.88	70.0	66.9	-	5.6	0.3	8.1	very stiff fine SOIL	120	2.0	33	35	54	41	-	30
18.05	67.5	63.9	-	5.4	0.3	8.1	very stiff fine SOIL	120	2.0	32	34	52	41	-	30
18.21	64.3	60.3	-	5.0	0.3	8.0	very stiff fine SOIL	120	2.0	30	32	50	41	-	30
18.37	58.2	54.1	-	4.7	0.3	8.2	silty CLAY to CLAY	115	1.5	36	39	-	-	4.1	15
18.54	53.2	49.1	-	4.2	0.4	8.0	silty CLAY to CLAY	115	1.5	33	35	-	-	3.7	15
18.70	49.2	44.9	-	4.3	0.3	9.0	silty CLAY to CLAY	115	1.5	30	33	-	-	3.4	15
18.87	41.9	37.9	-	3.9	0.3	9.6	silty CLAY to CLAY	115	1.5	25	28	-	-	2.9	15
19.03	48.0	43.1	-	3.8	0.3	8.1	silty CLAY to CLAY	115	1.5	29	32	-	-	3.4	15
19.19	50.4	44.9	-	3.9	0.3	7.9	silty CLAY to CLAY	115	1.5	30	34	-	-	3.5	15
19.36	51.9	45.8	-	4.1	0.3	8.0	silty CLAY to CLAY	115	1.5	31	35	-	-	3.6	15
19.52	51.0	44.6	-	4.2	0.3	8.4	silty CLAY to CLAY	115	1.5	30	34	-	-	3.6	15
19.69	46.6	40.5	-	4.0	0.3	8.8	silty CLAY to CLAY	115	1.5	27	31	-	-	3.3	15
19.85	42.1	36.2	-	3.5	0.3	8.6	silty CLAY to CLAY	115	1.5	24	28	-	-	2.9	15
20.01	40.3	34.4	-	3.2	0.3	8.2	silty CLAY to CLAY	115	1.5	23	27	-	-	2.8	15
20.18	46.4	39.4	-	3.5	0.3	7.6	silty CLAY to CLAY	115	1.5	26	31	-	-	3.2	15
20.34	60.4	50.8	-	4.2	0.3	7.1	silty CLAY to CLAY	115	1.5	34	40	-	-	4.2	15
20.51	71.7	59.9	-	4.9	0.3	6.9	silty CLAY to CLAY	115	1.5	40	48	-	-	5.0	15
20.67	75.5	62.5	-	5.2	0.3	7.0	very stiff fine SOIL	120	2.0	31	38	51	41	-	30
20.83	78.5	64.4	-	5.3	0.3	6.9	very stiff fine SOIL	120	2.0	32	39	52	41	-	30
21.00	80.3	65.4	-	5.3	0.3	6.7	very stiff fine SOIL	120	2.0	33	40	53	41	-	30
21.16	75.6	61.1	-	5.2	0.3	7.0	silty CLAY to CLAY	115	1.5	41	50	-	-	5.3	15
21.33	69.9	56.0	-	5.0	0.3	7.2	silty CLAY to CLAY	115	1.5	37	47	-	-	4.9	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Project ID: Earth Mechanics
Data File: SDF(183).cpt
CPT Date: 8/29/2008 12:45:19 PM
GW During Test: 80 ft

Sounding ID: C-08-131
Project No: 08-115
Cone/Rig: DSG1023

Depth ft	qc PS tsf	qcln PS -	qlncs PS -	Slv Stss tsf	pore prss (psi)	Frct Ratio %	Material Behavior Description	Unit Wght pcf	Qc to N	SPT R-N1 60%	SPT R-N 60%	Rel Den %	Ftn Ang deg	Und Shr tsf	Nk -
21.49	60.2	48.0	-	4.6	0.3	7.7	silty CLAY to CLAY	115	1.5	32	40	-	-	4.2	15
21.65	54.1	42.7	-	4.2	0.3	8.0	silty CLAY to CLAY	115	1.5	28	36	-	-	3.8	15
21.82	53.4	41.9	-	3.9	0.3	7.4	silty CLAY to CLAY	115	1.5	28	36	-	-	3.7	15
21.98	53.3	41.5	-	3.8	0.3	7.3	silty CLAY to CLAY	115	1.5	28	36	-	-	3.7	15
22.15	56.4	43.6	-	4.3	0.2	7.7	silty CLAY to CLAY	115	1.5	29	38	-	-	3.9	15
22.31	60.3	46.3	-	4.2	0.3	7.2	silty CLAY to CLAY	115	1.5	31	40	-	-	4.2	15
22.47	54.1	41.2	-	4.1	0.3	7.8	silty CLAY to CLAY	115	1.5	27	36	-	-	3.8	15
22.64	55.7	42.1	-	4.0	0.3	7.4	silty CLAY to CLAY	115	1.5	28	37	-	-	3.9	15
22.80	54.6	41.0	-	4.2	0.3	7.8	silty CLAY to CLAY	115	1.5	27	36	-	-	3.8	15
22.97	52.1	38.8	-	4.1	0.3	8.0	silty CLAY to CLAY	115	1.5	26	35	-	-	3.6	15
23.13	48.2	35.7	-	3.7	0.3	8.0	silty CLAY to CLAY	115	1.5	24	32	-	-	3.4	15
23.30	46.3	34.0	-	3.4	0.3	7.5	silty CLAY to CLAY	115	1.5	23	31	-	-	3.2	15
23.46	43.7	31.9	-	3.2	0.3	7.5	silty CLAY to CLAY	115	1.5	21	29	-	-	3.0	15
23.62	36.9	26.8	-	2.9	0.3	8.1	silty CLAY to CLAY	115	1.5	18	25	-	-	2.6	15
23.79	34.4	24.8	-	2.3	0.3	7.1	silty CLAY to CLAY	115	1.5	17	23	-	-	2.4	15
23.95	34.0	24.3	-	2.1	0.3	6.3	silty CLAY to CLAY	115	1.5	16	23	-	-	2.3	15
24.12	33.9	24.1	-	2.1	0.3	6.4	silty CLAY to CLAY	115	1.5	16	23	-	-	2.3	15
24.28	32.5	23.0	-	2.0	0.3	6.5	silty CLAY to CLAY	115	1.5	15	22	-	-	2.2	15
24.44	29.6	20.8	-	1.8	0.3	6.4	silty CLAY to CLAY	115	1.5	14	20	-	-	2.0	15
24.61	29.9	20.8	-	1.8	0.3	6.4	silty CLAY to CLAY	115	1.5	14	20	-	-	2.1	15
24.77	30.2	20.9	-	1.8	0.3	6.1	silty CLAY to CLAY	115	1.5	14	20	-	-	2.1	15
24.94	30.3	20.9	-	1.8	0.3	6.3	silty CLAY to CLAY	115	1.5	14	20	-	-	2.1	15
25.10	30.0	20.5	-	1.9	0.3	6.5	silty CLAY to CLAY	115	1.5	14	20	-	-	2.1	15
25.26	28.1	19.1	-	1.8	0.3	6.7	silty CLAY to CLAY	115	1.5	13	19	-	-	1.9	15
25.43	26.2	17.6	-	1.5	0.3	6.2	silty CLAY to CLAY	115	1.5	12	17	-	-	1.8	15
25.59	24.5	16.4	-	1.4	0.3	6.2	silty CLAY to CLAY	115	1.5	11	16	-	-	1.7	15
25.76	22.7	15.1	-	1.5	0.3	6.9	silty CLAY to CLAY	115	1.5	10	15	-	-	1.5	15
25.92	20.5	13.6	-	1.4	0.3	7.2	silty CLAY to CLAY	115	1.5	9	14	-	-	1.4	15
26.08	19.1	12.6	-	1.2	0.3	6.6	silty CLAY to CLAY	115	1.5	8	13	-	-	1.3	15
26.25	21.0	13.7	-	1.1	0.3	5.8	silty CLAY to CLAY	115	1.5	9	14	-	-	1.4	15
26.41	26.7	17.3	-	1.3	0.3	5.2	silty CLAY to CLAY	115	1.5	12	18	-	-	1.8	15
26.58	30.8	19.9	-	1.6	0.3	5.6	silty CLAY to CLAY	115	1.5	13	21	-	-	2.1	15
26.74	33.6	21.5	-	1.8	0.3	5.5	silty CLAY to CLAY	115	1.5	14	22	-	-	2.3	15
26.90	36.5	23.3	-	2.0	0.3	5.8	silty CLAY to CLAY	115	1.5	16	24	-	-	2.5	15
27.07	40.9	25.9	-	2.2	0.3	5.6	silty CLAY to CLAY	115	1.5	17	27	-	-	2.8	15
27.23	44.9	28.3	-	2.6	0.3	6.0	silty CLAY to CLAY	115	1.5	19	30	-	-	3.1	15
27.40	51.9	32.5	-	3.2	0.3	6.4	silty CLAY to CLAY	115	1.5	22	35	-	-	3.6	15
27.56	53.8	33.5	-	3.6	0.3	6.9	silty CLAY to CLAY	115	1.5	22	36	-	-	3.7	15
27.72	50.3	31.1	-	3.3	0.3	6.8	silty CLAY to CLAY	115	1.5	21	34	-	-	3.5	15
27.89	51.4	31.6	-	3.0	0.3	6.1	silty CLAY to CLAY	115	1.5	21	34	-	-	3.6	15
28.05	49.8	30.5	-	3.1	0.3	6.4	silty CLAY to CLAY	115	1.5	20	33	-	-	3.5	15
28.22	47.6	29.0	-	3.0	0.3	6.6	silty CLAY to CLAY	115	1.5	19	32	-	-	3.3	15
28.38	45.8	27.7	-	2.9	0.3	6.5	silty CLAY to CLAY	115	1.5	18	31	-	-	3.2	15
28.54	49.1	29.6	-	3.0	0.3	6.3	silty CLAY to CLAY	115	1.5	20	33	-	-	3.4	15
28.71	50.4	30.1	-	3.1	0.3	6.3	silty CLAY to CLAY	115	1.5	20	34	-	-	3.5	15
28.87	58.8	35.0	-	3.6	0.3	6.2	silty CLAY to CLAY	115	1.5	23	39	-	-	4.1	15
29.04	61.3	36.3	-	4.1	0.3	6.9	silty CLAY to CLAY	115	1.5	24	41	-	-	4.3	15
29.20	60.8	35.7	-	4.1	0.3	6.9	silty CLAY to CLAY	115	1.5	24	41	-	-	4.2	15
29.36	66.9	39.2	-	4.4	0.3	6.7	silty CLAY to CLAY	115	1.5	26	45	-	-	4.7	15
29.53	62.9	36.6	-	3.8	0.3	6.2	silty CLAY to CLAY	115	1.5	24	42	-	-	4.4	15
29.69	53.3	30.9	-	3.5	0.3	6.9	silty CLAY to CLAY	115	1.5	21	36	-	-	3.7	15
29.86	42.5	24.5	-	3.0	0.3	7.3	silty CLAY to CLAY	115	1.5	16	28	-	-	2.9	15
30.02	32.9	18.8	-	2.4	0.3	7.9	silty CLAY to CLAY	115	1.5	13	22	-	-	2.3	15
30.19	29.2	16.6	-	1.9	0.3	6.9	silty CLAY to CLAY	115	1.5	11	19	-	-	2.0	15
30.35	27.7	15.7	-	1.8	0.3	6.8	silty CLAY to CLAY	115	1.5	10	18	-	-	1.9	15
30.51	25.8	14.5	-	1.6	0.3	6.6	silty CLAY to CLAY	115	1.5	10	17	-	-	1.8	15
30.68	24.8	13.9	-	1.6	0.3	6.9	silty CLAY to CLAY	115	1.5	9	17	-	-	1.7	15
30.84	24.4	13.6	-	1.5	0.3	6.8	silty CLAY to CLAY	115	1.5	9	16	-	-	1.7	15
31.01	22.6	12.6	-	1.4	0.3	6.8	silty CLAY to CLAY	115	1.5	8	15	-	-	1.5	15
31.17	20.6	11.3	-	1.3	0.3	6.7	silty CLAY to CLAY	115	1.5	8	14	-	-	1.4	15
31.33	19.0	10.5	-	1.2	0.3	7.0	silty CLAY to CLAY	115	1.5	7	13	-	-	1.3	15
31.50	18.4	10.0	-	1.2	0.3	7.5	silty CLAY to CLAY	115	1.5	7	12	-	-	1.2	15
31.66	18.1	9.8	-	1.3	0.3	7.7	silty CLAY to CLAY	115	1.5	7	12	-	-	1.2	15
31.83	18.8	10.2	-	1.4	0.3	8.0	silty CLAY to CLAY	115	1.5	7	13	-	-	1.3	15
31.99	38.8	20.8	-	1.6	0.3	4.3	silty CLAY to CLAY	115	1.5	14	26	-	-	2.7	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
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Project ID: Earth Mechanics
Data File: SDF(183).cpt
CPT Date: 8/29/2008 12:45:19 PM
GW During Test: 80 ft

Sounding ID: C-08-131
Project No: 08-115
Cone/Rig: DSG1023

Depth ft	qc PS tsf	qcln* PS -	qIncs PS -	Slv Stss tsf	pore prss (psi)	Frct Rato %	Material Behavior Description	Unit Wght pcf	Qc to N	SPT R-N1 60%*	SPT R-N 60%	Rel Den %	Ftn Ang deg	Und Shr tsf	Nk -
32.15	24.8	13.3	-	1.5	0.3	6.6	silty CLAY to CLAY	115	1.5	9	17	-	-	1.7	15
32.32	19.8	10.5	-	1.3	0.3	7.2	silty CLAY to CLAY	115	1.5	7	13	-	-	1.3	15
32.48	23.7	12.6	-	1.4	0.3	6.4	silty CLAY to CLAY	115	1.5	8	16	-	-	1.6	15
32.65	29.2	15.4	-	1.7	0.3	6.3	silty CLAY to CLAY	115	1.5	10	19	-	-	2.0	15
32.81	29.7	15.6	-	1.8	0.3	6.4	silty CLAY to CLAY	115	1.5	10	20	-	-	2.0	15
32.97	34.3	17.9	-	1.8	0.3	5.5	silty CLAY to CLAY	115	1.5	12	23	-	-	2.4	15
33.14	40.4	21.0	-	1.7	0.3	4.3	silty CLAY to CLAY	115	1.5	14	27	-	-	2.8	15
33.30	48.5	25.1	-	1.5	0.3	3.3	clayy SILT to silty CLAY	115	2.0	13	24	-	-	3.4	15
33.47	48.6	25.0	-	1.5	0.3	3.2	clayy SILT to silty CLAY	115	2.0	12	24	-	-	3.4	15
33.63	44.2	22.6	-	1.5	0.3	3.7	clayy SILT to silty CLAY	115	2.0	11	22	-	-	3.1	15
33.79	44.0	22.4	-	1.9	0.3	4.5	silty CLAY to CLAY	115	1.5	15	29	-	-	3.0	15
33.96	47.6	24.1	-	2.1	0.3	4.5	silty CLAY to CLAY	115	1.5	16	32	-	-	3.3	15
34.12	54.6	27.5	-	2.0	0.3	3.7	clayy SILT to silty CLAY	115	2.0	14	27	-	-	3.8	15
34.29	51.7	26.0	-	1.8	0.3	3.6	clayy SILT to silty CLAY	115	2.0	13	26	-	-	3.6	15
34.45	44.2	22.1	-	1.9	0.3	4.6	silty CLAY to CLAY	115	1.5	15	29	-	-	3.1	15
34.61	31.4	15.6	-	1.9	0.3	6.4	silty CLAY to CLAY	115	1.5	10	21	-	-	2.1	15
34.78	27.4	13.5	-	1.6	0.3	6.2	silty CLAY to CLAY	115	1.5	9	18	-	-	1.9	15
34.94	24.9	12.3	-	1.7	0.3	7.4	silty CLAY to CLAY	115	1.5	8	17	-	-	1.7	15
35.11	27.6	13.5	-	1.8	0.4	7.0	silty CLAY to CLAY	115	1.5	9	18	-	-	1.9	15
35.27	26.7	13.0	-	1.8	0.3	7.4	silty CLAY to CLAY	115	1.5	9	18	-	-	1.8	15
35.43	27.9	13.6	-	1.8	0.3	7.2	silty CLAY to CLAY	115	1.5	9	19	-	-	1.9	15
35.60	24.0	11.6	-	1.7	0.3	7.7	silty CLAY to CLAY	115	1.5	8	16	-	-	1.6	15
35.76	22.5	10.8	-	1.3	0.3	6.6	silty CLAY to CLAY	115	1.5	7	15	-	-	1.5	15
35.93	21.4	10.2	-	1.4	0.3	7.2	silty CLAY to CLAY	115	1.5	7	14	-	-	1.4	15
36.09	20.9	10.0	-	1.2	0.3	6.6	silty CLAY to CLAY	115	1.5	7	14	-	-	1.4	15
36.26	17.3	8.2	-	0.9	0.3	6.0	silty CLAY to CLAY	115	1.5	5	12	-	-	1.1	15
36.42	15.7	7.4	-	0.8	0.3	6.2	silty CLAY to CLAY	115	1.5	5	10	-	-	1.0	15
36.58	16.2	7.6	-	0.9	0.3	6.1	silty CLAY to CLAY	115	1.5	5	11	-	-	1.1	15
36.75	16.7	7.8	-	0.9	0.3	6.0	silty CLAY to CLAY	115	1.5	5	11	-	-	1.1	15
36.91	16.3	7.6	-	0.9	0.3	6.4	silty CLAY to CLAY	115	1.5	5	11	-	-	1.1	15
37.08	16.7	7.7	-	0.9	0.3	6.5	silty CLAY to CLAY	115	1.5	5	11	-	-	1.1	15
37.24	17.8	8.2	-	0.9	0.3	6.0	silty CLAY to CLAY	115	1.5	5	12	-	-	1.2	15
37.40	18.6	8.5	-	0.9	0.3	5.8	silty CLAY to CLAY	115	1.5	6	12	-	-	1.2	15
37.57	19.6	9.0	-	1.0	0.3	5.6	silty CLAY to CLAY	115	1.5	6	13	-	-	1.3	15
37.73	18.9	8.6	-	1.1	0.3	6.7	silty CLAY to CLAY	115	1.5	6	13	-	-	1.3	15
37.90	19.9	9.0	-	1.4	0.3	7.9	silty CLAY to CLAY	115	1.5	6	13	-	-	1.3	15
38.06	22.9	10.4	-	1.5	0.3	7.4	silty CLAY to CLAY	115	1.5	7	15	-	-	1.5	15
38.22	34.1	15.4	-	1.5	0.3	4.6	silty CLAY to CLAY	115	1.5	10	23	-	-	2.3	15
38.39	44.8	20.1	-	1.9	0.3	4.4	silty CLAY to CLAY	115	1.5	13	30	-	-	3.1	15
38.55	42.0	18.8	-	1.9	0.3	4.8	silty CLAY to CLAY	115	1.5	13	28	-	-	2.9	15
38.72	31.4	14.0	-	1.9	0.3	6.4	silty CLAY to CLAY	115	1.5	9	21	-	-	2.1	15
38.88	29.0	12.8	-	1.7	0.3	6.4	silty CLAY to CLAY	115	1.5	9	19	-	-	2.0	15
39.04	27.5	12.2	-	1.6	0.3	6.2	silty CLAY to CLAY	115	1.5	8	18	-	-	1.9	15
39.21	26.6	11.7	-	1.6	0.3	6.5	silty CLAY to CLAY	115	1.5	8	18	-	-	1.8	15
39.37	26.0	11.4	-	1.6	0.3	6.8	silty CLAY to CLAY	115	1.5	8	17	-	-	1.8	15
39.54	25.1	11.0	-	1.6	0.3	7.0	silty CLAY to CLAY	115	1.5	7	17	-	-	1.7	15
39.70	23.7	10.3	-	1.5	0.3	7.2	silty CLAY to CLAY	115	1.5	7	16	-	-	1.6	15
39.86	23.7	10.2	-	1.7	0.3	8.0	silty CLAY to CLAY	115	1.5	7	16	-	-	1.6	15
40.03	26.7	11.5	-	2.0	0.3	8.0	silty CLAY to CLAY	115	1.5	8	18	-	-	1.8	15
40.19	34.1	14.6	-	2.3	0.3	7.1	silty CLAY to CLAY	115	1.5	10	23	-	-	2.3	15
40.36	34.5	14.7	-	2.7	0.3	8.3	silty CLAY to CLAY	115	1.5	10	23	-	-	2.4	15
40.52	38.9	16.6	-	2.9	0.3	7.9	silty CLAY to CLAY	115	1.5	11	26	-	-	2.7	15
40.68	57.8	24.5	-	3.0	0.4	5.5	silty CLAY to CLAY	115	1.5	16	39	-	-	4.0	15
40.85	111.1	70.1	153.6	3.4	0.4	3.1	silty SAND to sandy SILT	120	4.0	18	28	55	40	-	16
41.01	166.4	104.8	163.2	3.8	0.4	2.3	silty SAND to sandy SILT	120	4.0	26	42	69	42	-	16
41.18	207.9	130.6	181.6	4.4	0.4	2.1	silty SAND to sandy SILT	120	4.0	33	52	76	43	-	16
41.34	228.8	143.5	183.9	4.2	0.4	1.8	clean SAND to silty SAND	125	5.0	29	46	79	44	-	16
41.50	233.9	146.3	194.7	4.9	0.4	2.1	silty SAND to sandy SILT	120	4.0	37	58	80	44	-	16
41.67	231.9	144.8	197.8	5.1	0.6	2.2	silty SAND to sandy SILT	120	4.0	36	58	79	44	-	16
41.83	237.6	148.1	207.9	5.7	0.6	2.4	silty SAND to sandy SILT	120	4.0	37	59	80	44	-	16
42.00	256.9	159.8	223.4	6.5	0.6	2.6	silty SAND to sandy SILT	120	4.0	40	64	82	44	-	16
42.16	268.6	166.7	231.9	7.0	0.6	2.6	silty SAND to sandy SILT	120	4.0	42	67	84	44	-	16
42.32	263.5	163.2	224.0	6.5	0.6	2.5	silty SAND to sandy SILT	120	4.0	41	66	83	44	-	16
42.49	256.9	158.8	213.1	5.9	0.7	2.3	silty SAND to sandy SILT	120	4.0	40	64	82	44	-	16
42.65	226.7	139.9	197.7	5.3	0.7	2.4	silty SAND to sandy SILT	120	4.0	35	57	78	44	-	16

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Project ID: Earth Mechanics
Data File: SDF(183).cpt
CPT Date: 8/29/2008 12:45:19 PM
GW During Test: 80 ft

Sounding ID: C-08-131
Project No: 08-115
Cone/Rig: DSG1023

Depth ft	qc PS tsf	qcln* PS -	qlncs* PS -	Slv Stss tsf	pore prss (psi)	Frct Rato %	Material Behavior Description	Unit Wght pcf	Qc to N	SPT* R-N1 60%	SPT R-N 60%	Rel* Den %	Ftn* Ang deg	Und Shr tsf	Nk* -
42.82	185.0	113.9	183.4	4.9	0.7	2.7	silty SAND to sandy SILT	120	4.0	28	46	71	43	-	16
42.98	143.8	88.4	173.0	4.5	0.7	3.2	silty SAND to sandy SILT	120	4.0	22	36	63	41	-	16
43.15	109.6	67.2	158.0	3.7	0.8	3.4	clayy SILT to silty CLAY	115	2.0	34	55	-	-	7.7	15
43.31	94.1	57.6	149.7	3.2	0.9	3.5	clayy SILT to silty CLAY	115	2.0	29	47	-	-	6.6	15
43.47	101.1	61.8	161.0	3.7	0.9	3.8	clayy SILT to silty CLAY	115	2.0	31	51	-	-	7.1	15
43.64	105.7	64.5	164.1	3.9	0.9	3.8	clayy SILT to silty CLAY	115	2.0	32	53	-	-	7.4	15
43.80	99.1	39.0	-	3.7	1.0	3.8	clayy SILT to silty CLAY	115	2.0	19	50	-	-	6.9	15
43.97	87.3	34.2	-	3.5	1.0	4.2	clayy SILT to silty CLAY	115	2.0	17	44	-	-	6.1	15
44.13	53.6	20.9	-	2.8	1.0	5.5	silty CLAY to CLAY	115	1.5	14	36	-	-	3.7	15
44.29	42.1	16.4	-	2.2	1.0	5.4	silty CLAY to CLAY	115	1.5	11	28	-	-	2.9	15
44.46	31.6	12.2	-	1.5	1.0	5.1	silty CLAY to CLAY	115	1.5	8	21	-	-	2.1	15
44.62	23.2	9.0	-	1.1	0.9	5.4	silty CLAY to CLAY	115	1.5	6	15	-	-	1.5	15
44.79	25.9	9.9	-	1.3	0.3	5.4	silty CLAY to CLAY	115	1.5	7	17	-	-	1.7	15
44.95	23.2	8.9	-	1.4	0.3	6.7	silty CLAY to CLAY	115	1.5	6	15	-	-	1.5	15
45.11	24.8	9.4	-	1.3	0.3	5.9	silty CLAY to CLAY	115	1.5	6	17	-	-	1.7	15
45.28	23.4	8.9	-	1.2	0.3	5.6	silty CLAY to CLAY	115	1.5	6	16	-	-	1.6	15
45.44	21.3	8.1	-	0.9	0.3	4.8	silty CLAY to CLAY	115	1.5	5	14	-	-	1.4	15
45.61	20.1	7.6	-	0.6	0.3	3.5	silty CLAY to CLAY	115	1.5	5	13	-	-	1.3	15
45.77	17.6	6.7	-	0.6	0.3	4.2	silty CLAY to CLAY	115	1.5	4	12	-	-	1.2	15
45.93	19.6	7.4	-	0.7	0.3	4.0	silty CLAY to CLAY	115	1.5	5	13	-	-	1.3	15
46.10	22.1	8.3	-	1.0	0.3	5.0	silty CLAY to CLAY	115	1.5	6	15	-	-	1.5	15
46.26	21.6	8.2	-	1.0	0.3	5.5	silty CLAY to CLAY	115	1.5	5	14	-	-	1.4	15
46.43	21.6	8.1	-	1.0	0.2	5.5	silty CLAY to CLAY	115	1.5	5	14	-	-	1.4	15
46.59	21.4	8.1	-	1.1	0.2	5.8	silty CLAY to CLAY	115	1.5	5	14	-	-	1.4	15
46.75	21.0	7.9	-	1.5	0.2	8.0	silty CLAY to CLAY	115	1.5	5	14	-	-	1.4	15
46.92	34.1	12.9	-	2.6	0.2	8.3	silty CLAY to CLAY	115	1.5	9	23	-	-	2.3	15
47.08	58.6	22.1	-	3.8	0.3	6.7	silty CLAY to CLAY	115	1.5	15	39	-	-	4.0	15
47.25	103.4	39.0	-	5.2	0.3	5.2	silty CLAY to CLAY	115	1.5	26	69	-	-	7.2	15
47.41	98.6	37.2	-	5.7	0.3	5.9	silty CLAY to CLAY	115	1.5	25	66	-	-	6.9	15
47.57	88.8	33.5	-	5.8	0.3	6.7	silty CLAY to CLAY	115	1.5	22	59	-	-	6.2	15
47.74	172.2	100.5	204.7	6.4	0.3	3.8	silty SAND to sandy SILT	120	4.0	25	43	67	42	-	16
47.90	211.0	122.9	231.0	8.1	0.3	3.9	stiff SAND to clayy SAND	115	1.0	100	100	-	-	13.9	16
48.07	196.2	114.0	202.0	6.3	0.3	3.3	silty SAND to sandy SILT	120	4.0	29	49	71	42	-	16
48.23	194.5	112.9	238.3	8.5	0.3	4.4	very stiff fine SOIL	120	2.0	56	97	71	42	-	30
48.39	138.9	52.4	-	9.2	0.5	6.8	silty CLAY to CLAY	115	1.5	35	93	-	-	9.7	15
48.56	203.3	117.6	234.8	8.3	0.5	4.2	very stiff fine SOIL	120	2.0	59	100	72	42	-	30
48.72	228.0	131.7	212.4	6.9	0.5	3.0	silty SAND to sandy SILT	120	4.0	33	57	76	43	-	16
48.89	232.3	133.9	186.3	5.0	0.5	2.2	silty SAND to sandy SILT	120	4.0	33	58	77	43	-	16
49.05	207.4	119.4	174.1	4.6	0.5	2.2	silty SAND to sandy SILT	120	4.0	30	52	73	42	-	16
49.22	166.8	95.8	178.4	5.1	0.5	3.1	silty SAND to sandy SILT	120	4.0	24	42	66	41	-	16
49.38	123.6	46.6	-	5.9	0.5	4.9	clayy SILT to silty CLAY	115	2.0	23	62	-	-	8.6	15
49.54	104.2	39.3	-	6.0	0.5	6.0	silty CLAY to CLAY	115	1.5	26	69	-	-	7.3	15
49.71	112.6	42.5	-	6.2	0.6	5.7	silty CLAY to CLAY	115	1.5	28	75	-	-	7.9	15
49.87	153.2	87.4	210.3	6.8	0.6	4.5	clayy SILT to silty CLAY	115	2.0	44	77	-	-	10.7	15
50.04	145.8	83.1	222.6	7.3	0.6	5.1	very stiff fine SOIL	120	2.0	42	73	61	41	-	30
50.20	128.2	48.4	-	7.9	0.7	6.3	silty CLAY to CLAY	115	1.5	32	85	-	-	9.0	15
50.36	112.8	42.6	-	7.7	0.7	7.0	silty CLAY to CLAY	115	1.5	28	75	-	-	7.9	15
50.53	95.6	36.1	-	6.1	0.7	6.6	silty CLAY to CLAY	115	1.5	24	64	-	-	6.7	15
50.69	73.7	27.8	-	4.6	0.7	6.5	silty CLAY to CLAY	115	1.5	19	49	-	-	5.1	15
50.86	62.4	23.6	-	3.5	0.7	5.8	silty CLAY to CLAY	115	1.5	16	42	-	-	4.3	15
51.02	55.9	21.1	-	3.1	0.7	5.9	silty CLAY to CLAY	115	1.5	14	37	-	-	3.8	15
51.18	54.3	20.5	-	3.0	0.7	5.9	silty CLAY to CLAY	115	1.5	14	36	-	-	3.7	15
51.35	53.4	20.1	-	3.1	0.7	6.1	silty CLAY to CLAY	115	1.5	13	36	-	-	3.7	15
51.51	52.3	19.7	-	3.2	0.6	6.5	silty CLAY to CLAY	115	1.5	13	35	-	-	3.6	15
51.68	50.4	19.0	-	3.0	0.6	6.4	silty CLAY to CLAY	115	1.5	13	34	-	-	3.5	15
51.84	46.6	17.6	-	2.8	0.2	6.5	silty CLAY to CLAY	115	1.5	12	31	-	-	3.2	15
52.00	42.9	16.2	-	2.7	0.2	6.7	silty CLAY to CLAY	115	1.5	11	29	-	-	2.9	15
52.17	38.7	14.6	-	2.6	0.2	7.4	silty CLAY to CLAY	115	1.5	10	26	-	-	2.6	15
52.33	35.6	13.4	-	2.4	0.2	7.5	silty CLAY to CLAY	115	1.5	9	24	-	-	2.4	15
52.50	32.3	12.2	-	2.1	0.2	7.2	silty CLAY to CLAY	115	1.5	8	22	-	-	2.2	15
52.66	29.3	11.1	-	1.8	0.2	6.8	silty CLAY to CLAY	115	1.5	7	20	-	-	2.0	15
52.82	28.1	10.6	-	1.7	0.2	6.8	silty CLAY to CLAY	115	1.5	7	19	-	-	1.9	15
52.99	27.5	10.4	-	1.8	0.2	7.2	silty CLAY to CLAY	115	1.5	7	18	-	-	1.8	15
53.15	25.9	9.8	-	1.7	0.2	7.3	silty CLAY to CLAY	115	1.5	7	17	-	-	1.7	15
53.32	23.2	8.8	-	1.6	0.2	7.8	silty CLAY to CLAY	115	1.5	6	15	-	-	1.5	15

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Depth ft	qc PS tsf	*qcln PS -	qlncs PS -	Slv Stss tsf	pore prss (psi)	Frct Rato %	* Material Behavior Description	Unit Wght pcf	Qc to N	* SPT R-N1 60%	SPT R-N 60%	* Rel Den %	* Ftn Ang deg	Und Shr tsf	* Nk -
53.48	23.5	8.9	-	1.7	0.2	8.2	silty CLAY to CLAY	115	1.5	6	16	-	-	1.6	15
53.64	30.6	11.5	-	2.0	0.2	7.3	silty CLAY to CLAY	115	1.5	8	20	-	-	2.1	15
53.81	34.2	12.9	-	2.3	0.2	7.4	silty CLAY to CLAY	115	1.5	9	23	-	-	2.3	15
53.97	34.0	12.8	-	2.2	0.2	7.0	silty CLAY to CLAY	115	1.5	9	23	-	-	2.3	15
54.14	45.2	17.0	-	2.2	0.2	5.3	silty CLAY to CLAY	115	1.5	11	30	-	-	3.1	15
54.30	62.4	23.5	-	2.8	0.2	4.7	silty CLAY to CLAY	115	1.5	16	42	-	-	4.3	15
54.46	54.9	20.7	-	3.0	0.2	5.9	silty CLAY to CLAY	115	1.5	14	37	-	-	3.8	15
54.63	37.9	14.3	-	2.6	0.2	7.4	silty CLAY to CLAY	115	1.5	10	25	-	-	2.6	15
54.79	32.3	12.2	-	1.8	0.2	6.1	silty CLAY to CLAY	115	1.5	8	22	-	-	2.2	15
54.96	34.6	13.0	-	1.6	0.2	5.0	silty CLAY to CLAY	115	1.5	9	23	-	-	2.3	15
55.12	41.7	15.8	-	1.8	0.2	4.7	silty CLAY to CLAY	115	1.5	11	28	-	-	2.8	15
55.28	46.1	17.4	-	2.4	0.2	5.5	silty CLAY to CLAY	115	1.5	12	31	-	-	3.1	15
55.45	50.4	19.0	-	2.6	0.2	5.5	silty CLAY to CLAY	115	1.5	13	34	-	-	3.4	15
55.61	50.9	19.2	-	2.6	0.2	5.5	silty CLAY to CLAY	115	1.5	13	34	-	-	3.5	15
55.78	51.3	19.4	-	2.7	0.2	5.7	silty CLAY to CLAY	115	1.5	13	34	-	-	3.5	15
55.94	53.3	20.1	-	2.8	0.2	5.6	silty CLAY to CLAY	115	1.5	13	36	-	-	3.7	15
56.11	52.5	19.8	-	2.9	0.2	5.9	silty CLAY to CLAY	115	1.5	13	35	-	-	3.6	15
56.27	51.2	19.3	-	2.9	0.2	6.1	silty CLAY to CLAY	115	1.5	13	34	-	-	3.5	15
56.43	48.3	18.2	-	3.0	0.2	6.7	silty CLAY to CLAY	115	1.5	12	32	-	-	3.3	15
56.60	45.1	17.0	-	3.1	0.2	7.3	silty CLAY to CLAY	115	1.5	11	30	-	-	3.1	15
56.76	43.2	16.3	-	3.0	0.2	7.5	silty CLAY to CLAY	115	1.5	11	29	-	-	2.9	15
56.93	37.5	14.1	-	2.6	0.2	7.7	silty CLAY to CLAY	115	1.5	9	25	-	-	2.5	15
57.09	34.1	12.9	-	2.2	0.2	7.2	silty CLAY to CLAY	115	1.5	9	23	-	-	2.3	15
57.25	32.9	12.4	-	2.1	0.2	7.2	silty CLAY to CLAY	115	1.5	8	22	-	-	2.2	15
57.42	32.9	12.4	-	2.1	0.2	7.0	silty CLAY to CLAY	115	1.5	8	22	-	-	2.2	15
57.58	30.8	11.6	-	2.0	0.2	7.3	silty CLAY to CLAY	115	1.5	8	21	-	-	2.1	15
57.75	30.7	11.6	-	1.8	0.2	6.7	silty CLAY to CLAY	115	1.5	8	20	-	-	2.1	15
57.91	31.8	12.0	-	2.1	0.2	7.3	silty CLAY to CLAY	115	1.5	8	21	-	-	2.1	15
58.07	32.0	12.1	-	2.2	0.2	7.7	silty CLAY to CLAY	115	1.5	8	21	-	-	2.1	15
58.24	30.7	11.6	-	2.2	0.2	7.9	silty CLAY to CLAY	115	1.5	8	20	-	-	2.1	15
58.40	29.3	11.1	-	1.9	0.3	7.4	silty CLAY to CLAY	115	1.5	7	20	-	-	2.0	15
58.57	27.5	10.4	-	1.7	0.3	7.2	silty CLAY to CLAY	115	1.5	7	18	-	-	1.8	15
58.73	26.1	9.8	-	1.7	0.3	7.5	silty CLAY to CLAY	115	1.5	7	17	-	-	1.7	15
58.89	24.9	9.4	-	1.6	0.3	7.4	silty CLAY to CLAY	115	1.5	6	17	-	-	1.6	15
59.06	24.8	9.4	-	1.5	0.3	7.1	silty CLAY to CLAY	115	1.5	6	17	-	-	1.6	15
59.22	24.2	9.1	-	1.4	0.3	6.9	silty CLAY to CLAY	115	1.5	6	16	-	-	1.6	15
59.39	26.8	10.1	-	1.6	0.3	6.9	silty CLAY to CLAY	115	1.5	7	18	-	-	1.8	15
59.55	30.4	11.5	-	1.6	0.3	6.0	silty CLAY to CLAY	115	1.5	8	20	-	-	2.0	15
59.71	25.5	9.6	-	1.5	0.3	6.7	silty CLAY to CLAY	115	1.5	6	17	-	-	1.7	15
59.88	24.2	9.1	-	1.5	0.3	7.0	silty CLAY to CLAY	115	1.5	6	16	-	-	1.6	15
60.04	23.7	9.0	-	1.3	0.3	6.6	silty CLAY to CLAY	115	1.5	6	16	-	-	1.6	15
60.21	23.1	8.7	-	1.3	0.3	6.4	silty CLAY to CLAY	115	1.5	6	15	-	-	1.5	15
60.37	21.9	8.3	-	1.2	0.3	6.6	silty CLAY to CLAY	115	1.5	6	15	-	-	1.4	15
60.53	21.8	8.2	-	1.1	0.3	6.2	silty CLAY to CLAY	115	1.5	5	15	-	-	1.4	15
60.70	22.5	8.5	-	1.2	0.3	6.3	silty CLAY to CLAY	115	1.5	6	15	-	-	1.5	15
60.86	23.2	8.7	-	1.2	0.3	6.3	silty CLAY to CLAY	115	1.5	6	15	-	-	1.5	15
61.03	24.6	9.3	-	1.3	0.3	6.4	silty CLAY to CLAY	115	1.5	6	16	-	-	1.6	15
61.19	23.5	8.9	-	1.3	0.3	6.5	silty CLAY to CLAY	115	1.5	6	16	-	-	1.5	15
61.35	21.5	8.1	-	1.4	0.3	7.7	silty CLAY to CLAY	115	1.5	5	14	-	-	1.4	15
61.52	23.7	8.9	-	1.8	0.3	8.9	silty CLAY to CLAY	115	1.5	6	16	-	-	1.6	15
61.68	38.6	14.6	-	2.4	0.3	6.9	silty CLAY to CLAY	115	1.5	10	26	-	-	2.6	15
61.85	91.8	34.7	-	3.3	0.3	3.7	clayy SILT to silty CLAY	115	2.0	17	46	-	-	6.4	15
62.01	112.3	57.5	150.4	3.8	0.3	3.5	clayy SILT to silty CLAY	115	2.0	29	56	-	-	7.8	15
62.17	113.4	58.0	160.2	4.3	0.3	3.9	clayy SILT to silty CLAY	115	2.0	29	57	-	-	7.9	15
62.34	110.7	41.8	-	4.4	0.3	4.1	clayy SILT to silty CLAY	115	2.0	21	55	-	-	7.7	15
62.50	97.9	36.9	-	4.2	0.4	4.4	clayy SILT to silty CLAY	115	2.0	18	49	-	-	6.8	15
62.67	80.5	30.4	-	3.8	0.4	4.9	silty CLAY to CLAY	115	1.5	20	54	-	-	5.6	15
62.83	66.9	25.2	-	3.7	0.4	5.8	silty CLAY to CLAY	115	1.5	17	45	-	-	4.6	15
63.00	55.0	20.8	-	3.3	0.4	6.4	silty CLAY to CLAY	115	1.5	14	37	-	-	3.8	15
63.16	44.5	16.8	-	2.9	0.4	7.2	silty CLAY to CLAY	115	1.5	11	30	-	-	3.0	15
63.32	51.9	19.6	-	2.9	0.4	5.9	silty CLAY to CLAY	115	1.5	13	35	-	-	3.5	15
63.49	44.1	16.6	-	2.6	0.4	6.4	silty CLAY to CLAY	115	1.5	11	29	-	-	3.0	15
63.65	31.3	11.8	-	2.2	0.4	7.9	silty CLAY to CLAY	115	1.5	8	21	-	-	2.1	15
63.82	32.7	12.3	-	2.0	0.5	7.0	silty CLAY to CLAY	115	1.5	8	22	-	-	2.2	15
63.98	36.1	13.6	-	2.3	0.5	7.2	silty CLAY to CLAY	115	1.5	9	24	-	-	2.4	15

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Project No: 08-115
Cone/Rig: DSG1023

Depth ft	qc PS tsf	*qcln PS -	qlncs PS -	Slv Stss tsf	pore prss (psi)	Frct Rato %	* Material Behavior Description	Unit Wght pcf	Qc to N	* SPT R-N1 60%	SPT R-N 60%	* Rel Den %	* Ftn Ang deg	Und Shr tsf	Nk -
64.14	36.0	13.6	-	2.4	0.5	7.5	silty CLAY to CLAY	115	1.5	9	24	-	-	2.4	15
64.31	39.0	14.7	-	2.3	0.5	6.6	silty CLAY to CLAY	115	1.5	10	26	-	-	2.6	15
64.47	41.1	15.5	-	2.6	0.5	6.8	silty CLAY to CLAY	115	1.5	10	27	-	-	2.8	15
64.64	38.0	14.3	-	2.7	0.5	7.8	silty CLAY to CLAY	115	1.5	10	25	-	-	2.6	15
64.80	31.6	11.9	-	2.4	0.5	8.6	silty CLAY to CLAY	115	1.5	8	21	-	-	2.1	15
64.96	30.8	11.6	-	2.2	0.3	8.2	silty CLAY to CLAY	115	1.5	8	21	-	-	2.0	15
65.13	37.8	14.3	-	2.6	0.4	7.7	silty CLAY to CLAY	115	1.5	10	25	-	-	2.5	15
65.29	73.4	27.7	-	3.3	0.4	4.8	silty CLAY to CLAY	115	1.5	18	49	-	-	5.1	15
65.46	89.9	33.9	-	4.2	0.4	4.9	silty CLAY to CLAY	115	1.5	23	60	-	-	6.2	15
65.62	109.6	41.3	-	5.0	0.4	4.7	clayy SILT to silty CLAY	115	2.0	21	55	-	-	7.6	15
65.78	120.7	45.6	-	5.8	0.4	4.9	clayy SILT to silty CLAY	115	2.0	23	60	-	-	8.4	15
65.95	109.2	41.2	-	5.9	0.3	5.6	silty CLAY to CLAY	115	1.5	27	73	-	-	7.6	15
66.11	93.4	35.3	-	5.5	0.4	6.1	silty CLAY to CLAY	115	1.5	24	62	-	-	6.5	15
66.28	148.6	73.6	167.2	5.0	0.4	3.5	clayy SILT to silty CLAY	115	2.0	37	74	-	-	10.4	15
66.44	148.5	73.5	170.6	5.2	0.4	3.6	clayy SILT to silty CLAY	115	2.0	37	74	-	-	10.4	15
66.60	120.1	45.3	-	5.5	0.4	4.7	clayy SILT to silty CLAY	115	2.0	23	60	-	-	8.4	15
66.77	77.1	29.1	-	4.4	0.4	6.0	silty CLAY to CLAY	115	1.5	19	51	-	-	5.3	15
66.93	55.1	20.8	-	3.3	0.4	6.4	silty CLAY to CLAY	115	1.5	14	37	-	-	3.8	15
67.10	63.2	23.8	-	2.9	0.5	4.8	silty CLAY to CLAY	115	1.5	16	42	-	-	4.3	15
67.26	55.8	21.0	-	3.2	0.5	6.1	silty CLAY to CLAY	115	1.5	14	37	-	-	3.8	15
67.42	47.9	18.1	-	3.1	0.5	7.1	silty CLAY to CLAY	115	1.5	12	32	-	-	3.3	15
67.59	66.2	25.0	-	3.5	0.5	5.7	silty CLAY to CLAY	115	1.5	17	44	-	-	4.5	15
67.75	88.1	33.3	-	4.0	0.5	4.8	silty CLAY to CLAY	115	1.5	22	59	-	-	6.1	15
67.92	65.0	24.5	-	3.5	0.4	5.7	silty CLAY to CLAY	115	1.5	16	43	-	-	4.5	15
68.08	40.7	15.4	-	1.9	0.4	5.2	silty CLAY to CLAY	115	1.5	10	27	-	-	2.7	15
68.24	34.5	13.0	-	1.9	0.4	6.1	silty CLAY to CLAY	115	1.5	9	23	-	-	2.3	15
68.41	39.9	15.0	-	1.9	0.3	5.4	silty CLAY to CLAY	115	1.5	10	27	-	-	2.7	15
68.57	29.9	11.3	-	1.7	0.3	6.5	silty CLAY to CLAY	115	1.5	8	20	-	-	2.0	15
68.74	23.3	8.8	-	1.4	0.3	7.0	silty CLAY to CLAY	115	1.5	6	16	-	-	1.5	15
68.90	20.0	7.6	-	1.4	0.3	8.8	Organic SOILS - Peats	100	1.0	8	20	-	-	1.9	10
69.07	27.1	10.2	-	2.7	0.3	9.9	silty CLAY to CLAY	115	1.5	7	18	-	-	1.8	15
69.23	115.9	43.7	-	4.6	0.3	4.1	clayy SILT to silty CLAY	115	2.0	22	58	-	-	8.1	15
69.39	177.8	86.2	185.1	6.3	0.4	3.6	clayy SILT to silty CLAY	115	2.0	43	89	-	-	12.4	15
69.56	174.1	84.2	191.8	6.7	0.3	4.0	clayy SILT to silty CLAY	115	2.0	42	87	-	-	12.2	15
69.72	154.3	74.6	187.2	6.3	0.3	4.2	clayy SILT to silty CLAY	115	2.0	37	77	-	-	10.8	15
69.89	130.8	63.2	182.7	5.8	0.3	4.6	clayy SILT to silty CLAY	115	2.0	32	65	-	-	9.1	15
70.05	105.9	39.9	-	5.4	0.3	5.3	silty CLAY to CLAY	115	1.5	27	71	-	-	7.3	15
70.21	62.0	23.4	-	3.6	0.3	6.2	silty CLAY to CLAY	115	1.5	16	41	-	-	4.2	15
70.38	34.1	12.9	-	1.4	0.3	4.6	silty CLAY to CLAY	115	1.5	9	23	-	-	2.3	15
70.54	27.9	10.5	-	0.8	0.3	3.5	silty CLAY to CLAY	115	1.5	7	19	-	-	1.8	15
70.71	26.6	10.0	-	0.8	0.4	3.6	silty CLAY to CLAY	115	1.5	7	18	-	-	1.7	15
70.87	24.9	9.4	-	1.0	0.4	4.9	silty CLAY to CLAY	115	1.5	6	17	-	-	1.6	15
71.03	25.9	9.8	-	1.0	0.4	4.8	silty CLAY to CLAY	115	1.5	7	17	-	-	1.7	15
71.20	24.0	9.1	-	1.1	0.4	5.7	silty CLAY to CLAY	115	1.5	6	16	-	-	1.6	15
71.36	23.7	9.0	-	1.2	0.4	6.2	silty CLAY to CLAY	115	1.5	6	16	-	-	1.5	15
71.53	29.0	10.9	-	1.8	0.4	7.2	silty CLAY to CLAY	115	1.5	7	19	-	-	1.9	15
71.69	48.6	18.3	-	2.4	0.3	5.4	silty CLAY to CLAY	115	1.5	12	32	-	-	3.3	15
71.85	33.2	12.5	-	2.2	0.3	7.4	silty CLAY to CLAY	115	1.5	8	22	-	-	2.2	15
72.02	28.4	10.7	-	2.0	0.3	8.4	silty CLAY to CLAY	115	1.5	7	19	-	-	1.9	15
72.18	42.9	16.2	-	3.5	0.3	9.1	silty CLAY to CLAY	115	1.5	11	29	-	-	2.9	15
72.35	111.1	41.9	-	5.4	0.3	5.1	silty CLAY to CLAY	115	1.5	28	74	-	-	7.7	15
72.51	140.9	66.8	179.5	5.8	0.3	4.3	clayy SILT to silty CLAY	115	2.0	33	70	-	-	9.8	15
72.67	120.8	45.6	-	5.3	0.3	4.5	clayy SILT to silty CLAY	115	2.0	23	60	-	-	8.4	15
72.84	79.9	30.2	-	4.2	0.3	5.5	silty CLAY to CLAY	115	1.5	20	53	-	-	5.5	15
73.00	61.9	23.4	-	4.0	0.3	7.0	silty CLAY to CLAY	115	1.5	16	41	-	-	4.2	15
73.17	68.5	25.9	-	4.3	0.3	6.6	silty CLAY to CLAY	115	1.5	17	46	-	-	4.7	15
73.33	84.6	31.9	-	5.0	0.3	6.3	silty CLAY to CLAY	115	1.5	21	56	-	-	5.8	15
73.49	107.3	40.5	-	5.5	0.3	5.3	silty CLAY to CLAY	115	1.5	27	72	-	-	7.4	15
73.66	101.9	38.5	-	5.6	0.3	5.7	silty CLAY to CLAY	115	1.5	26	68	-	-	7.1	15
73.82	146.5	68.9	181.0	6.0	0.4	4.2	clayy SILT to silty CLAY	115	2.0	34	73	-	-	10.2	15
73.99	188.1	88.3	193.6	7.1	0.4	3.9	clayy SILT to silty CLAY	115	2.0	44	94	-	-	13.1	15
74.15	209.2	98.1	205.4	8.0	0.4	3.9	clayy SILT to silty CLAY	115	2.0	49	100	-	-	14.6	15
74.31	224.6	105.2	212.4	8.5	0.4	3.9	silty SAND to sandy SILT	120	4.0	26	56	69	41	-	16
74.48	236.9	110.8	217.4	8.9	0.5	3.8	silty SAND to sandy SILT	120	4.0	28	59	70	41	-	16
74.64	227.5	106.3	214.5	8.7	0.6	3.9	stiff SAND to clayy SAND	115	1.0	100	100	-	-	14.9	16

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Project ID: Earth Mechanics
Data File: SDF(183).cpt
CPT Date: 8/29/2008 12:45:19 PM
GW During Test: 80 ft

Sounding ID: C-08-131
Project No: 08-115
Cone/Rig: DSG1023

Depth ft	qc PS tsf	qc1n PS -	qIncs PS -	Slv Stss tsf	pore prss (psi)	Frct Ratio %	Material Behavior Description	Unit Wght pcf	Qc to N	SPT R-N1 60%	SPT R-N 60%	Rel Den %	Ftn Ang deg	Und Shr tsf	Nk -
74.81	207.9	97.0	211.0	8.4	0.6	4.1	clayy SILT to silty CLAY	115	2.0	49	100	-	-	14.5	15
74.97	164.9	76.9	203.6	7.6	0.6	4.7	clayy SILT to silty CLAY	115	2.0	38	82	-	-	11.5	15
75.13	129.8	49.0	-	6.5	0.6	5.2	clayy SILT to silty CLAY	115	2.0	24	65	-	-	9.0	15
75.30	88.4	33.3	-	4.5	0.6	5.3	silty CLAY to CLAY	115	1.5	22	59	-	-	6.1	15
75.46	54.2	20.5	-	3.3	0.6	6.6	silty CLAY to CLAY	115	1.5	14	36	-	-	3.7	15
75.63	55.3	20.9	-	3.3	0.6	6.6	silty CLAY to CLAY	115	1.5	14	37	-	-	3.8	15
75.79	70.3	26.5	-	4.2	0.6	6.3	silty CLAY to CLAY	115	1.5	18	47	-	-	4.8	15
75.96	92.7	35.0	-	5.0	0.6	5.6	silty CLAY to CLAY	115	1.5	23	62	-	-	6.4	15
76.12	112.2	42.3	-	5.9	0.6	5.5	silty CLAY to CLAY	115	1.5	28	75	-	-	7.8	15
76.28	118.2	44.6	-	6.2	0.6	5.5	silty CLAY to CLAY	115	1.5	30	79	-	-	8.2	15
76.45	93.1	35.1	-	6.9	0.6	7.8	silty CLAY to CLAY	115	1.5	23	62	-	-	6.4	15
76.61	153.7	70.9	194.6	6.9	0.6	4.7	clayy SILT to silty CLAY	115	2.0	35	77	-	-	10.7	15
76.78	175.6	80.9	195.5	7.2	0.6	4.2	clayy SILT to silty CLAY	115	2.0	40	88	-	-	12.3	15
76.94	140.4	64.6	183.5	6.2	0.6	4.5	clayy SILT to silty CLAY	115	2.0	32	70	-	-	9.8	15
77.10	88.4	33.4	-	5.1	0.6	6.1	silty CLAY to CLAY	115	1.5	22	59	-	-	6.1	15
77.27	93.8	35.4	-	5.2	0.5	5.8	silty CLAY to CLAY	115	1.5	24	63	-	-	6.5	15
77.43	79.0	29.8	-	4.9	0.5	6.5	silty CLAY to CLAY	115	1.5	20	53	-	-	5.4	15
77.60	58.0	21.9	-	4.5	0.5	8.5	silty CLAY to CLAY	115	1.5	15	39	-	-	3.9	15
77.76	99.3	37.5	-	4.4	0.6	4.7	silty CLAY to CLAY	115	1.5	25	66	-	-	6.9	15
77.92	133.8	61.2	165.4	5.1	0.6	3.9	clayy SILT to silty CLAY	115	2.0	31	67	-	-	9.3	15
78.09	138.0	63.0	169.7	5.4	0.5	4.0	clayy SILT to silty CLAY	115	2.0	32	69	-	-	9.6	15
78.25	136.3	62.2	182.0	6.1	0.4	4.6	clayy SILT to silty CLAY	115	2.0	31	68	-	-	9.5	15
78.42	105.4	39.8	-	6.0	0.4	5.9	silty CLAY to CLAY	115	1.5	27	70	-	-	7.3	15
78.58	117.8	44.5	-	6.0	0.4	5.3	silty CLAY to CLAY	115	1.5	30	79	-	-	8.2	15
78.74	115.2	43.5	-	5.5	0.4	5.0	silty CLAY to CLAY	115	1.5	29	77	-	-	8.0	15
78.91	67.1	25.3	-	4.3	0.4	7.0	silty CLAY to CLAY	115	1.5	17	45	-	-	4.6	15
79.07	67.4	25.4	-	3.3	0.4	5.3	silty CLAY to CLAY	115	1.5	17	45	-	-	4.6	15
79.24	43.3	16.4	-	2.8	0.3	7.2	silty CLAY to CLAY	115	1.5	11	29	-	-	2.9	15
79.40	51.5	19.4	-	3.3	0.3	7.0	silty CLAY to CLAY	115	1.5	13	34	-	-	3.5	15
79.56	73.0	27.5	-	4.3	0.3	6.3	silty CLAY to CLAY	115	1.5	18	49	-	-	5.0	15
79.73	68.8	26.0	-	4.9	0.3	7.6	silty CLAY to CLAY	115	1.5	17	46	-	-	4.7	15
79.89	116.1	43.8	-	5.4	0.3	4.8	clayy SILT to silty CLAY	115	2.0	22	58	-	-	8.0	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

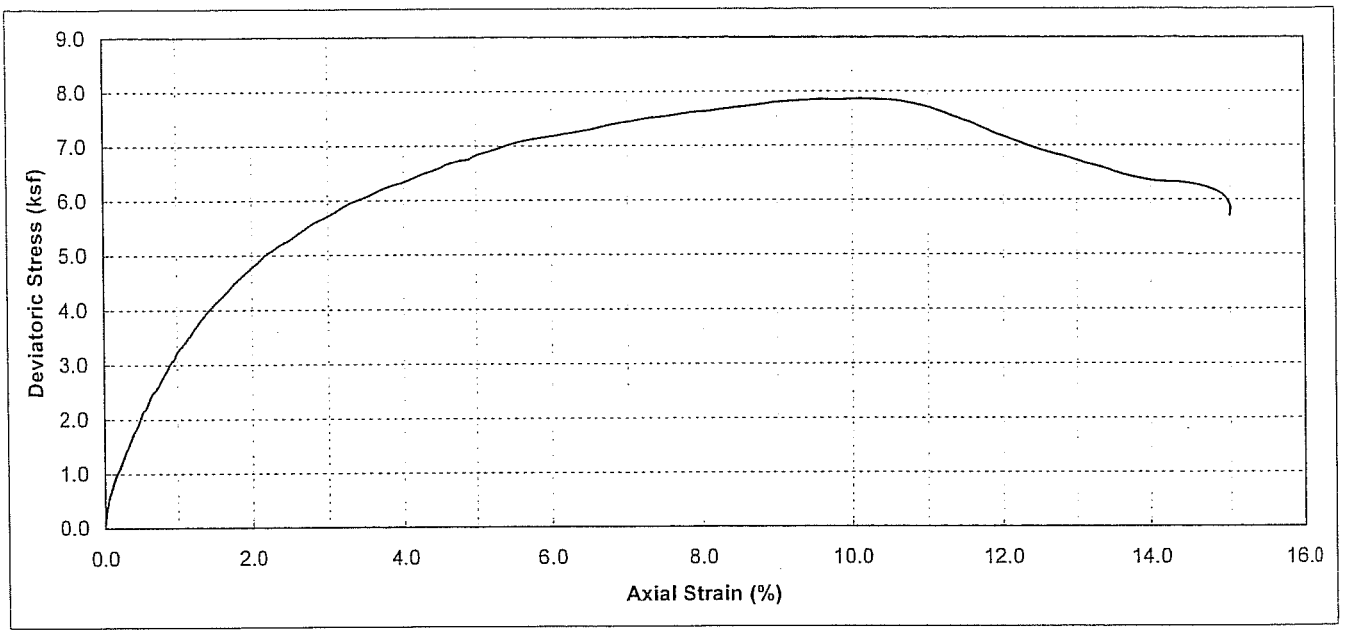
APPENDIX B

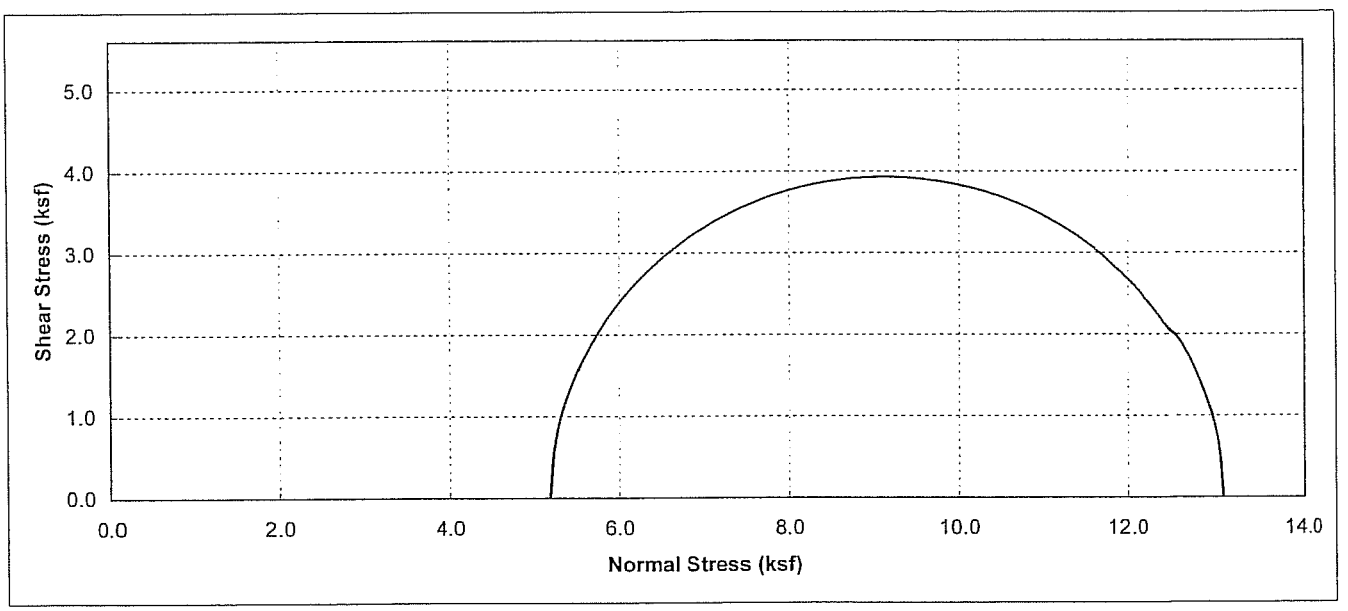
LABORATORY TEST RESULTS

TABLE 1 SUMMARY OF LABORATORY TEST RESULTS

Project No. : 08-115 Project Name : Sign Structure Foundation

Boring No.	Sample No.	Sample Depth (ft)	Soil Identification (group symbol) ASTM D2488/D2487	Moisture Content ASTM D2216 (%)	Total Unit Weight ASTM D2937 (pcf)	Pocket Penetrometer (tsf)	Grain Size Distribution GR:SA:FI (%)	Atterberg Limits ASTM D4318 (LL/PL/PI)	Soil-Minimum Resisivity CT-532 (ohm-cm)	Soil- pH CT-532	Soil-Soluble Sulfate Content CT-417 (ppm)	Soil-Moisture Free Chloride Content CT-422 (ppm)
A-08-017	Bulk	1.5 to 5	SM					Non-plastic				
A-08-017	D-2	5	SC	10.4								
A-08-017	S-3	10	CL	12.3								
A-08-017	D-4	15	CL	12.8	92.0	>4.5		30/20/10				
A-08-017	S-5	20	CL	19.9					490	7.3	250	362
A-08-017	D-6	25	SM	4.7	123.4							
A-08-017	S-7	30	CL	14.1								
A-08-017	D-8	35	SC	9.1	124.9							
A-08-017	S-9	40	CL	10.2			0:41:59					
A-08-017	D-10	45	CL	12.5	129.5	>4.5						
A-08-017	S-11	50	CL	13.8								
A-08-017	D-12	55	CL	17.4	129.9	>4.5						
A-08-017	S-13	60	SM	7.7			0:65:35					
A-08-017	D-14	65	CL	29.4	124.3	3.75						
A-08-017	S-15	70	CL	17.5								
A-08-017	D-16	75	SM	6.1	106.2							
A-08-017	S-17	80	CL	22.2								
A-08-017	S-19	90	SP-SM	1.0								
A-08-128	Bulk	0 to 5	SC-SM					24/17/7				
A-08-128	D-1	2.5	SM	5.8	135.3							
A-08-128	S-2	5	CL	14.8					1500	7.9	50	153
A-08-128	D-3	10	SP-SM	4.7	108.9							
A-08-128	S-4	15	CL	10.5								
A-08-128	D-5	20	CL	18.1	130.4	>4.5		46/19/27				
A-08-128	S-6	25	CL	27.8								
A-08-128	D-7	30	SM	5.6	109.8							
A-08-128	Bulk	0 to 5	SC-SM					24/18/6				
A-08-129	S-1	2.5	SC	11.0								
A-08-129	D-2	5	CL	13.8	136.8	>4.5						
A-08-129	S-3	10	SM	6.8								





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-017	D-14	65	Brown, LEAN CLAY With SAND (CL)	93.3	29.37	5.19	7.86	98.3

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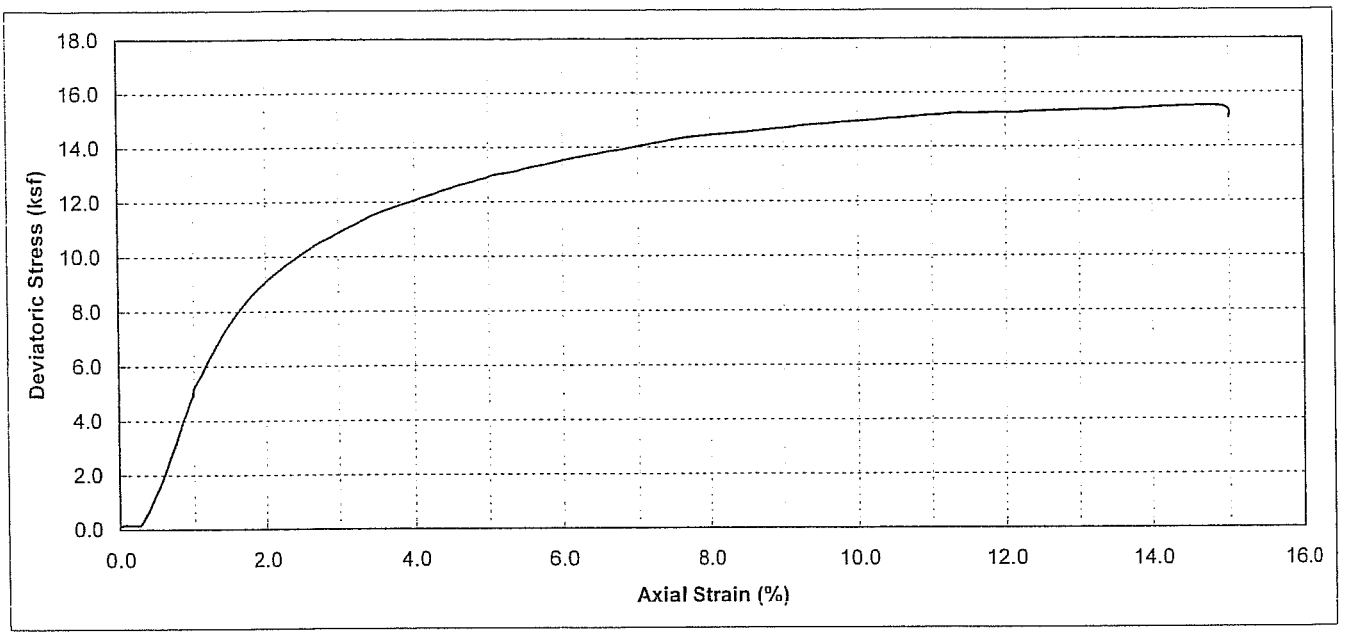
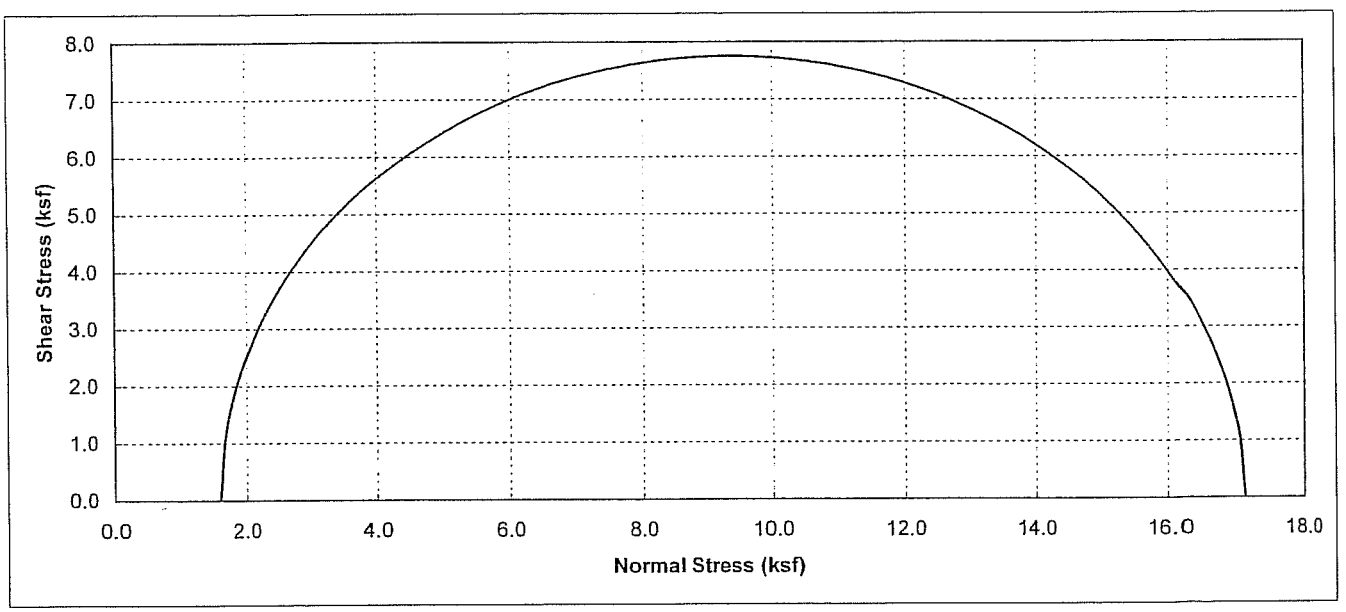
UNCONSOLIDATED UNDRAINED TEST
(ASTM D2850)

Project No. : 08-115 **Date :** 11/15/08

Figure No. :





Boring No.	Sample No.	Depth (ft)	Soil Type	Dry Density (pcf)	Moisture Content (%)	Conf. Stress (ksf)	Max. Dev. Stress (ksf)	Initial Saturation (%)
A-08-128	D-5	2	Brown, LEAN CLAY With SAND (CL)	110.9	18.14	1.58	15.51	94.3

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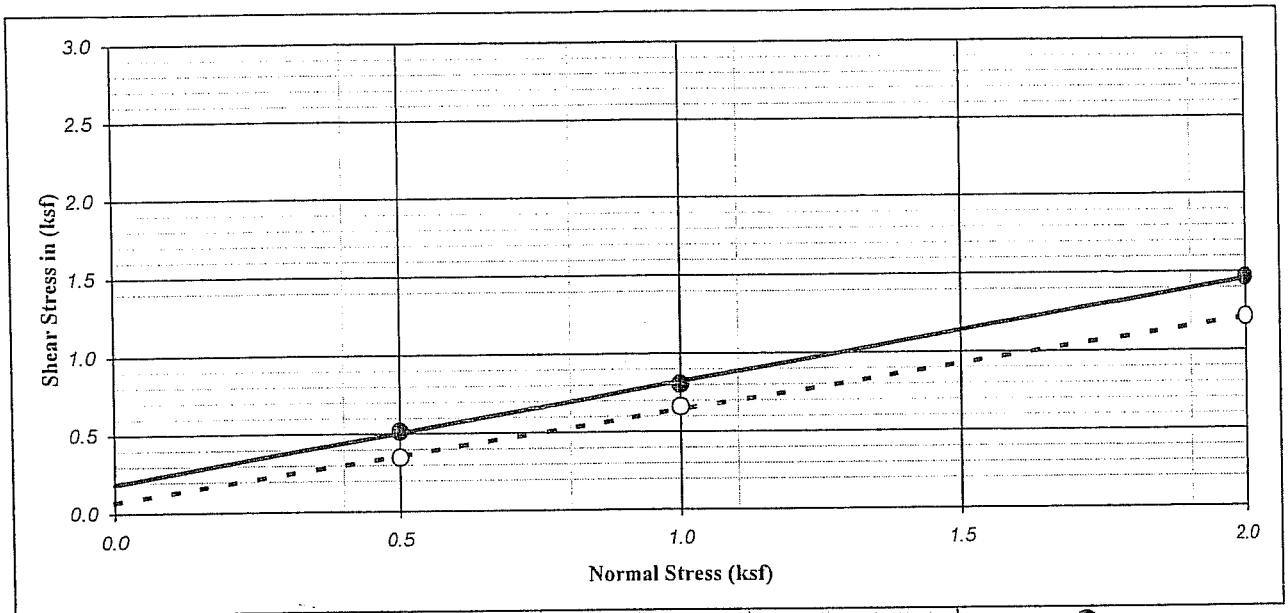
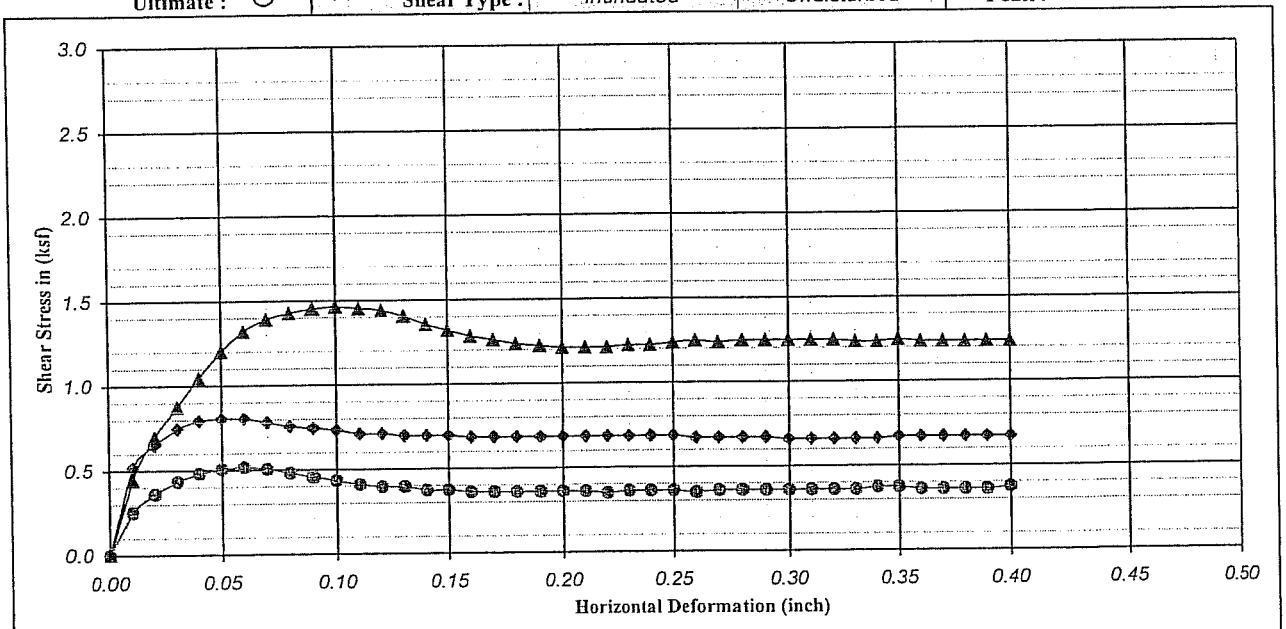
Project No. : 08-115

Date : 11/19/08

Figure No. :



Ultimate : ○ | Shear Type : Inundated | Undisturbed | Peak : ●



Boring No. : A-08-128		Strength Intercept (C) :	0.19	(ksf)	Peak	0.07	(ksf)	Ultimate
Sample No. : D-3			8.91	(kPa)		3.45	(kPa)	
Depth (ft/m) : 10.0	0.00	Friction Angle (ϕ) :	32.46	Degree		29.79	Degree	
Description : Yellowish brown, Poorly graded SAND with SILT (SP-SM)					Shear Rate (inch/minute) :		0.02	

SYMBOL	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	DRY DENSITY (kN/m^3)	VOID RATIO	NORMAL STRESS (ksf)	NORMAL STRESS (kPa)	PEAK STRESS (ksf)	PEAK STRESS (kPa)	ULTIMATE STRESS (ksf)	ULTIMATE STRESS (kPa)
●	19.70	89.91	14.15	0.87	0.50	23.94	0.52	24.71	0.35	16.66
◆	20.30	88.42	13.92	0.91	1.00	47.88	0.80	38.50	0.66	31.60
▲	21.96	84.47	13.30	1.00	2.00	95.76	1.46	70.10	1.21	58.03

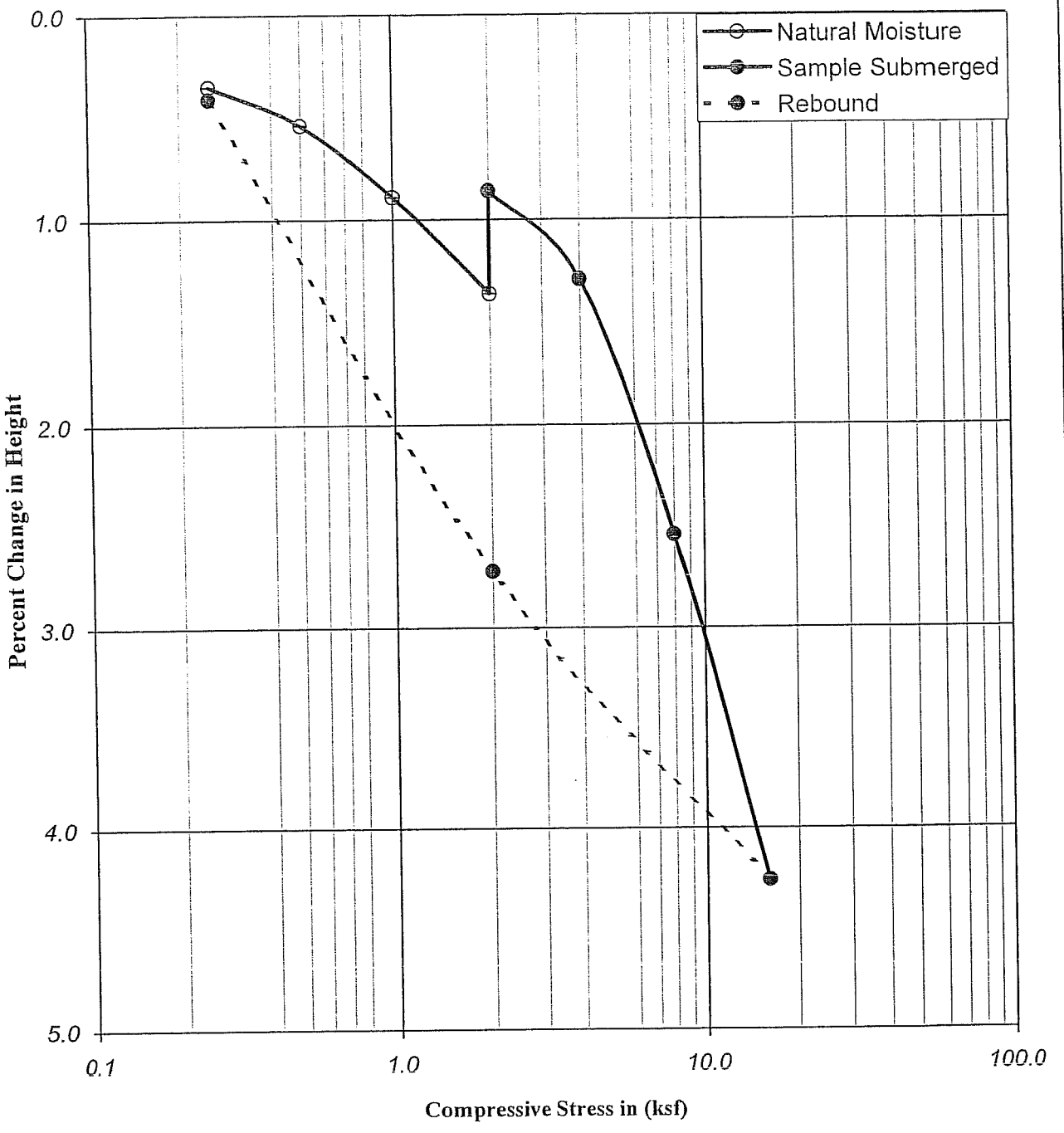
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

DIRECT SHEAR TEST (ASTM D-3080)

Project No. : 08-115 | Date : 11/23/08

Figure No. :



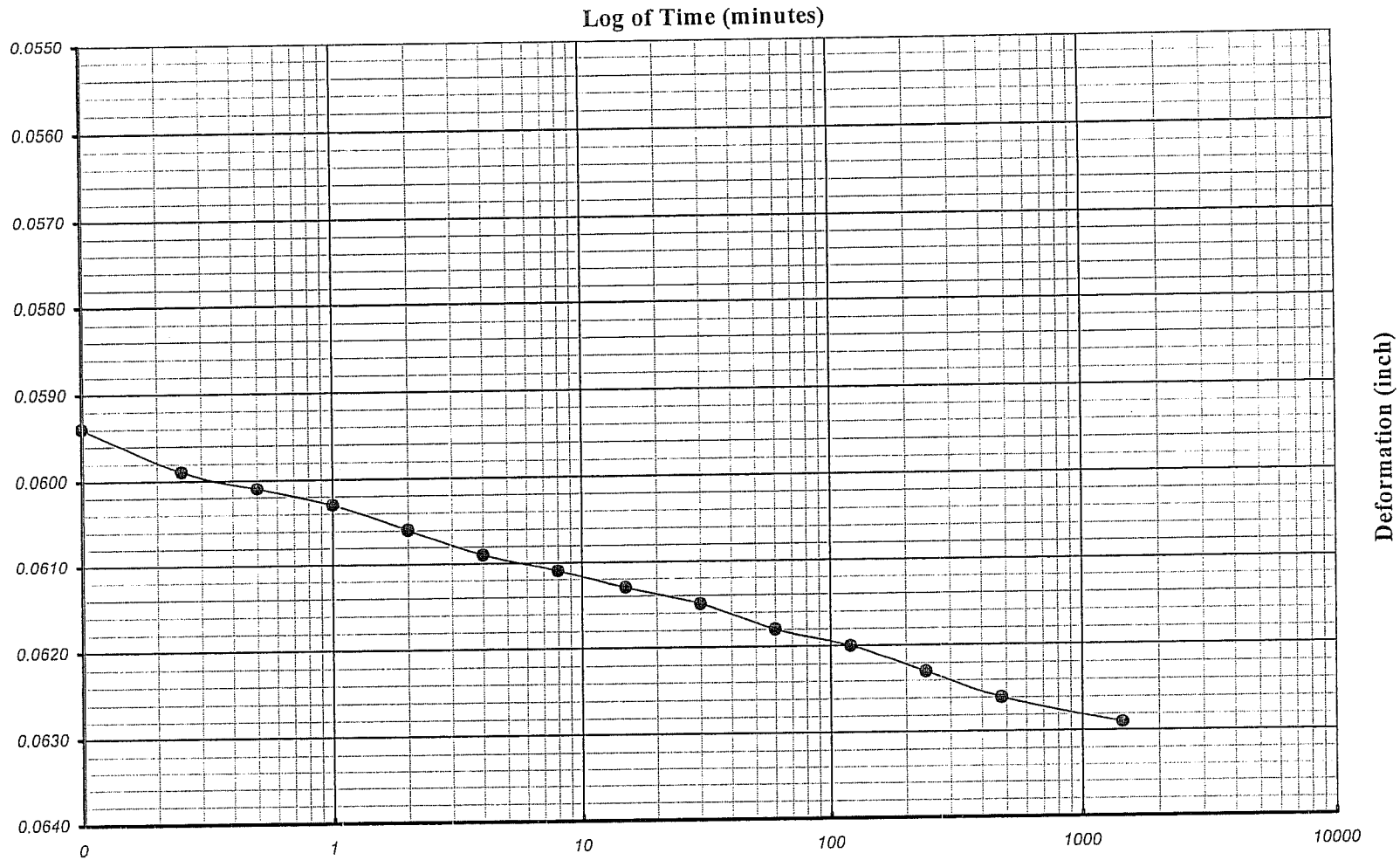
Boring No. : A-08-017			Liquid Limit :	-		Moisture Content (%)	Dry Density		Percent Saturation	Void Ratio
Sample No. : D-6			Plastic Limit :	-			(pcf)	(kN/m³)		
Depth	(ft) : 25.0	26.5	Plastic Index :	-	Initial	14.38	110.80	17.44	74.49	0.52
	(m) : 7.63	8.08	Specific Gravity :	2.70	Final	18.30	111.29	17.52	96.01	0.51
Description : Dark brown, lean CLAY with SAND (CL)										

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

RBF/SR-57 Northbound

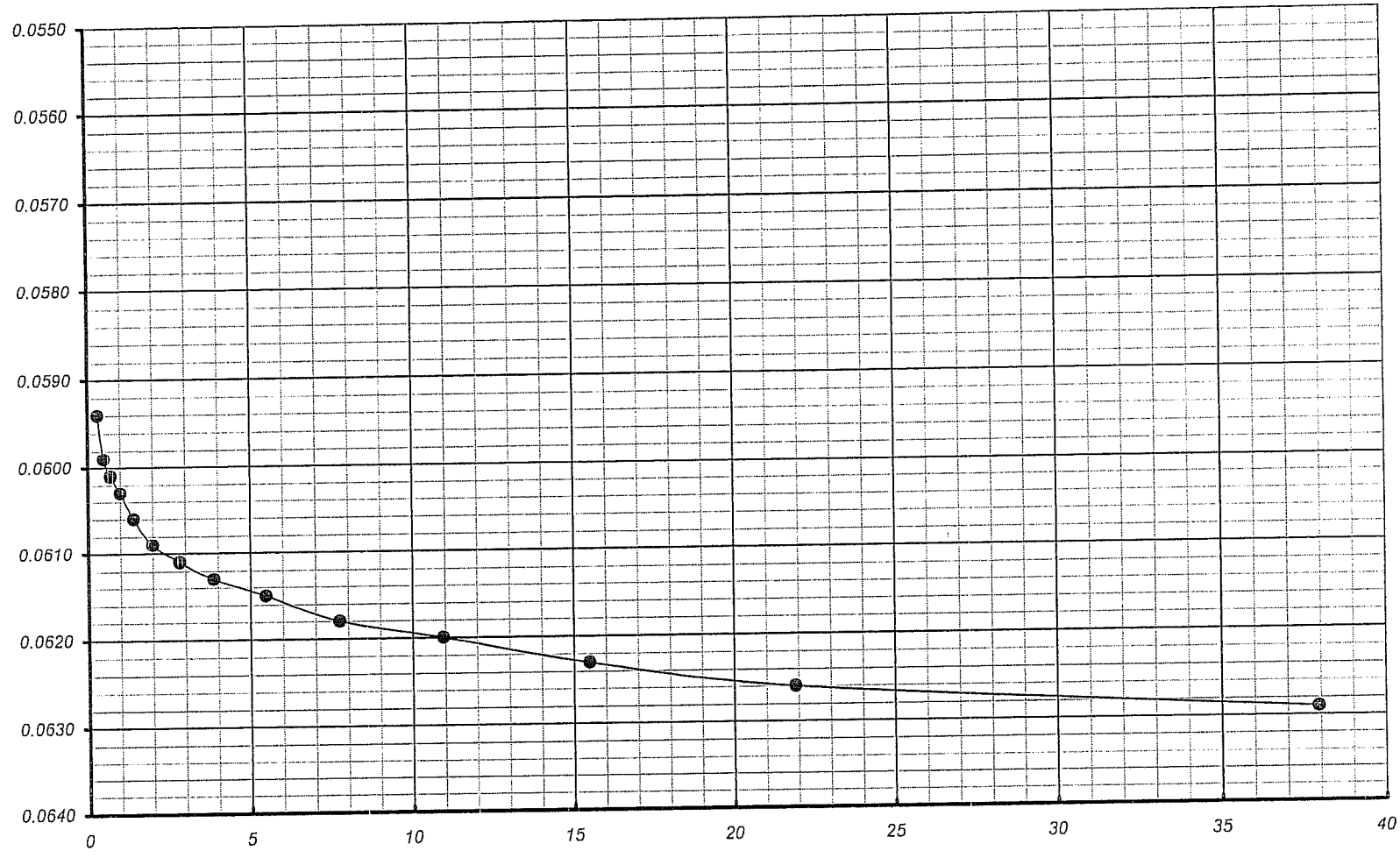
CONSOLIDATION TEST
(ASTM D-2435 / CT-219)

Project No. : 08-115 12/05/08



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	RBF/SR-57 Northbound	Boring No. : A-08-017	One-Dimensional Consolidation of Soil Time-Deformation Curve (Log of Time Method)
		Sample No. : D-6	
EMI Project No. : 08-115		Depth (ft/m) : 25.0 7.6	Veritcal Load (ksf/kpa) : 4.00 191.5

Square Root of Time (minutes)



Earth Mechanics, Inc. Geotechnical and Earthquake Engineering	*RBF/SR-57 Northbound*	Boring No. : *A-08-017*	One-Dimensional Consolidation of Soil Time-Deformation Curve (Square Root of Time Method)
		Sample No. : *D-6*	
EMI Project No. : *08-115*		Depth (ft/m) : *25.0* *7.6*	Veritcal Load (ksf/kpa) : *4.0* *191.5*

APPENDIX C

DESIGN CALCULATIONS

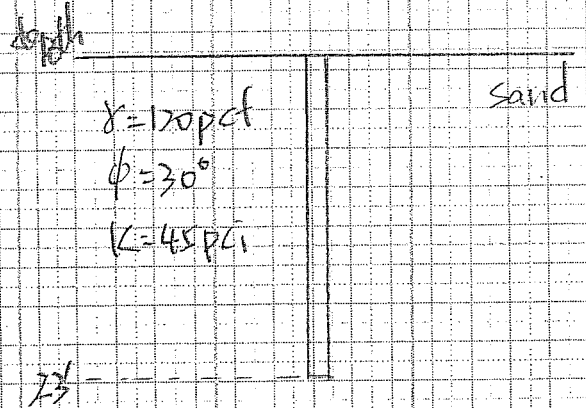
Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

17660 Newhope Street, Suite E, Fountain Valley, CA 92708
(714) 751-3826, Fax (714) 751-3928

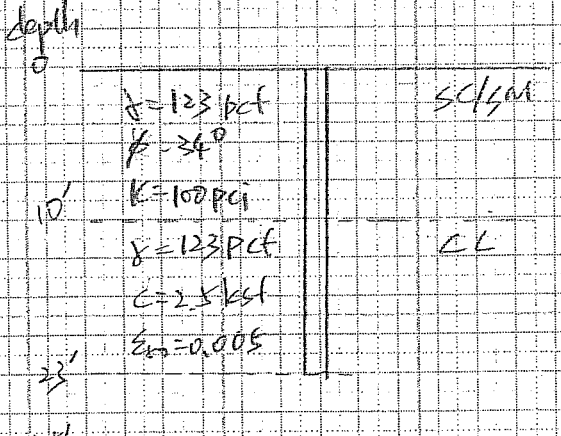
Project Sign Structures Project No. _____

By CCY Date 2/3/09 Checked By _____ Date _____ Sheet ____ of ____

(1) Standard Case



(2) Sta 535+80



Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

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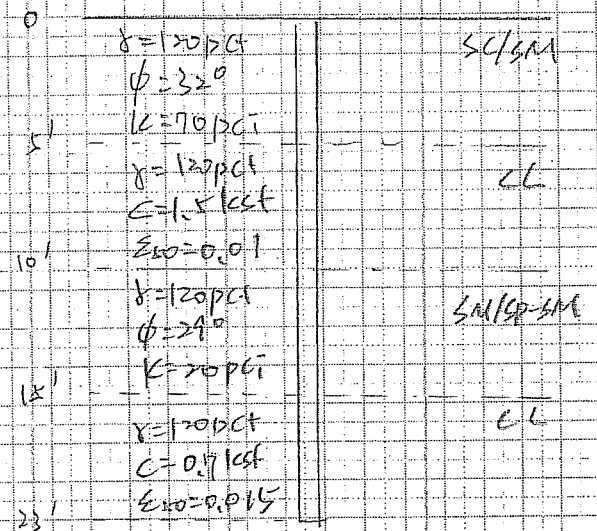
(714) 751-3826, Fax (714) 751-3928

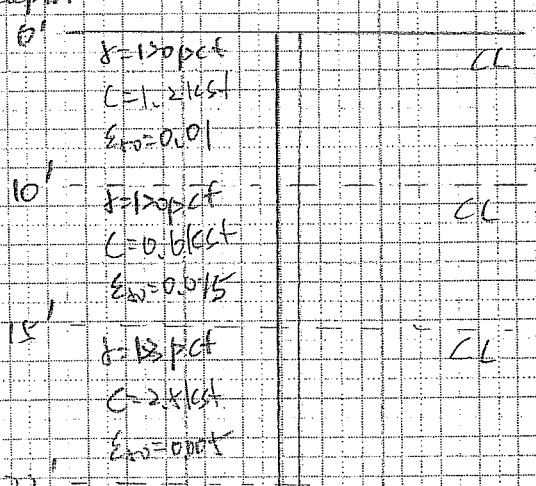
Project Sign Structures Project No. _____

By CEY Date 2/3/09 Checked By _____ Date _____ Sheet ____ of ____

(3) Sta 5E1+00



(4) Sta 5E9+50



SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: SR-57 Sign Structures
ITEM: 5-FT DIAMETER CIDH PILE (Axial)
Station 535+80

PROJECT NO.: 08-115
DONE BY: CY DATE: 02/10/09
CHECKED BY: DATE:

D_s => 5 ft Hw => 100.0 ft Hg => 0.0 ft
p = 15.7080 ft Ho => 0.0 ft Hf => 0.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	10	123	60.6	0.00	34
(2)	10	25	123	60.6	2.50	0

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)	(kips)
0	0.0	0.0	0.0	123.0	0									
1	0.0	0.0	0.0	123.0	0	0.0				0.0			0.0	0.0
2	1.0	0.5	0.5	123.0	62	0.0	1.2000	0.0738	1.2	1.2	0.0000	0.0	0.0	1.2
3	2.0	1.5	1.5	123.0	185	0.0	1.2000	0.2214	3.5	4.6	0.0000	0.0	0.0	4.6
4	3.0	2.5	2.5	123.0	308	0.0	1.2000	0.3690	5.8	10.4	0.0000	0.0	0.0	10.4
5	4.0	3.5	3.5	123.0	431	0.0	1.2000	0.5166	8.1	18.5	0.0000	0.0	0.0	18.5
6	5.0	4.5	4.5	123.0	554	0.0	1.2000	0.6642	10.4	29.0	0.0000	0.0	0.0	29.0
7	6.0	5.5	5.5	123.0	677	0.0	1.1834	0.8006	12.6	41.6	0.0000	0.0	0.0	41.6
8	7.0	6.5	6.5	123.0	800	0.0	1.1558	0.9241	14.5	56.1	0.0000	0.0	0.0	56.1
9	8.0	7.5	7.5	123.0	923	0.0	1.1303	1.0427	16.4	72.5	0.0000	0.0	0.0	72.5
10	9.0	8.5	8.5	123.0	1046	0.0	1.1064	1.1568	18.2	90.6	0.0000	0.0	0.0	90.6
11	10.0	9.5	9.5	123.0	1169	0.0	1.0839	1.2665	19.9	110.5	0.0000	0.0	0.0	110.5
12	11.0	10.5	10.5	123.0	1292	2.5	1.0626	0.0000	0.0	110.5	1.3750	21.6	21.6	132.1
13	12.0	11.5	11.5	123.0	1415	2.5	1.0422	0.0000	0.0	110.5	1.3750	21.6	43.2	153.7
14	13.0	12.5	12.5	123.0	1538	2.5	1.0227	0.0000	0.0	110.5	1.3750	21.6	64.8	175.3
15	14.0	13.5	13.5	123.0	1661	2.5	1.0040	0.0000	0.0	110.5	1.3750	21.6	86.4	196.9
16	15.0	14.5	14.5	123.0	1784	2.5	0.9859	0.0000	0.0	110.5	1.3750	21.6	108.0	218.5
17	16.0	15.5	15.5	123.0	1907	2.5	0.9685	0.0000	0.0	110.5	1.3750	21.6	129.6	240.1
18	17.0	16.5	16.5	123.0	2030	2.5	0.9516	0.0000	0.0	110.5	1.3750	21.6	151.2	261.7
19	18.0	17.5	17.5	123.0	2153	2.5	0.9353	0.0000	0.0	110.5	1.3750	21.6	172.8	283.3
20	19.0	18.5	18.5	123.0	2276	2.5	0.9193	0.0000	0.0	110.5	1.3750	21.6	194.4	304.9
21	20.0	19.5	19.5	123.0	2399	2.5	0.9039	0.0000	0.0	110.5	1.3750	21.6	216.0	326.5
22	21.0	20.5	20.5	123.0	2522	2.5	0.8888	0.0000	0.0	110.5	1.3750	21.6	237.6	348.1
23	22.0	21.5	21.5	123.0	2645	2.5	0.8740	0.0000	0.0	110.5	1.3750	21.6	259.2	369.7
24	23.0	22.5	22.5	123.0	2768	2.5	0.8596	0.0000	0.0	110.5	1.3750	21.6	280.8	391.3

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: SR-57 Sign Structures
ITEM: 5-FT DIAMETER CIDH PILE (Axial)
Station 551+00

PROJECT NO.: 08-115
DONE BY: CY DATE: 02/10/09
CHECKED BY: DATE:

D_s =>	5 ft	Hw =>	100.0 ft	Hg =>	0.0 ft	Hw is the depth to water table.
p =	15.7080 ft	Ho =>	0.0 ft	Hf =>	0.0 ft	Hg is the depth to ground surface used in calculation.
						Ho is the depth to location starting initial overburden pressure.
						Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	5	120	57.6	0.00	32
(2)	5	10	120	57.6	1.50	0
(3)	10	15	120	57.6	0.00	29
(4)	15	25	120	57.6	0.70	0

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)	(kips)
0	0.0	0.0	0.0	120.0	0									
1	0.0	0.0	0.0	120.0	0	0.0				0.0			0.0	0.0
2	1.0	0.5	0.5	120.0	60	0.0	1.2000	0.0720	1.1	1.1	0.0000	0.0	0.0	1.1
3	2.0	1.5	1.5	120.0	180	0.0	1.2000	0.2160	3.4	4.5	0.0000	0.0	0.0	4.5
4	3.0	2.5	2.5	120.0	300	0.0	1.2000	0.3600	5.7	10.2	0.0000	0.0	0.0	10.2
5	4.0	3.5	3.5	120.0	420	0.0	1.2000	0.5040	7.9	18.1	0.0000	0.0	0.0	18.1
6	5.0	4.5	4.5	120.0	540	0.0	1.2000	0.6480	10.2	28.3	0.0000	0.0	0.0	28.3
7	6.0	5.5	5.5	120.0	660	1.5	1.1834	0.0000	0.0	28.3	0.8250	13.0	13.0	41.2
8	7.0	6.5	6.5	120.0	780	1.5	1.1558	0.0000	0.0	28.3	0.8250	13.0	25.9	54.2
9	8.0	7.5	7.5	120.0	900	1.5	1.1303	0.0000	0.0	28.3	0.8250	13.0	38.9	67.2
10	9.0	8.5	8.5	120.0	1020	1.5	1.1064	0.0000	0.0	28.3	0.8250	13.0	51.8	80.1
11	10.0	9.5	9.5	120.0	1140	1.5	1.0839	0.0000	0.0	28.3	0.8250	13.0	64.8	93.1
12	11.0	10.5	10.5	120.0	1260	0.0	1.0626	1.3388	21.0	49.3	0.0000	0.0	64.8	114.1
13	12.0	11.5	11.5	120.0	1380	0.0	1.0422	1.4382	22.6	71.9	0.0000	0.0	64.8	136.7
14	13.0	12.5	12.5	120.0	1500	0.0	1.0227	1.5341	24.1	96.0	0.0000	0.0	64.8	160.8
15	14.0	13.5	13.5	120.0	1620	0.0	1.0040	1.6264	25.5	121.5	0.0000	0.0	64.8	186.3
16	15.0	14.5	14.5	120.0	1740	0.0	0.9859	1.7155	26.9	148.5	0.0000	0.0	64.8	213.3
17	16.0	15.5	15.5	120.0	1860	0.7	0.9685	0.0000	0.0	148.5	0.3850	6.0	70.8	219.3
18	17.0	16.5	16.5	120.0	1980	0.7	0.9516	0.0000	0.0	148.5	0.3850	6.0	76.9	225.4
19	18.0	17.5	17.5	120.0	2100	0.7	0.9353	0.0000	0.0	148.5	0.3850	6.0	82.9	231.4
20	19.0	18.5	18.5	120.0	2220	0.7	0.9193	0.0000	0.0	148.5	0.3850	6.0	89.0	237.5
21	20.0	19.5	19.5	120.0	2340	0.7	0.9039	0.0000	0.0	148.5	0.3850	6.0	95.0	243.5
22	21.0	20.5	20.5	120.0	2460	0.7	0.8888	0.0000	0.0	148.5	0.3850	6.0	101.1	249.6
23	22.0	21.5	21.5	120.0	2580	0.7	0.8740	0.0000	0.0	148.5	0.3850	6.0	107.1	255.6
24	23.0	22.5	22.5	120.0	2700	0.7	0.8596	0.0000	0.0	148.5	0.3850	6.0	113.2	261.7

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: SR-57 Sign Structures
ITEM: 5-FT DIAMETER CIDH PILE (Axial)
PROJECT NO.: 08-115
Station 559+55
DONE BY: CY DATE: 02/10/09
CHECKED BY: DATE:

D_s =>	5 ft	Hw =>	100.0 ft	Hg =>	0.0 ft	Hw is the depth to water table.
p =	15.7080 ft	Ho =>	0.0 ft	Hf =>	0.0 ft	Hg is the depth to ground surface used in calculation.
						Ho is the depth to location starting initial overburden pressure.
						Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	10	120	57.6	1.20	0
(2)	10	15	120	57.6	0.60	0
(3)	15	25	123	60.6	2.50	0

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔQ_s^s	Q_s^s	f_i^c	ΔQ_s^c	Q_s^c	Q_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips)	(kips)	(ksf)	(kips)	(kips)	(kips)
0	0.0	0.0	0.0	120.0	0									
1	0.0	0.0	0.0	120.0	0	1.2				0.0			0.0	0.0
2	1.0	0.5	0.5	120.0	60	1.2	1.2000	0.0000	0.0	0.0	0.0000	0.0	0.0	0.0
3	2.0	1.5	1.5	120.0	180	1.2	1.2000	0.0000	0.0	0.0	0.0000	0.0	0.0	0.0
4	3.0	2.5	2.5	120.0	300	1.2	1.2000	0.0000	0.0	0.0	0.0000	0.0	0.0	0.0
5	4.0	3.5	3.5	120.0	420	1.2	1.2000	0.0000	0.0	0.0	0.0000	0.0	0.0	0.0
6	5.0	4.5	4.5	120.0	540	1.2	1.2000	0.0000	0.0	0.0	0.0000	0.0	0.0	0.0
7	6.0	5.5	5.5	120.0	660	1.2	1.1834	0.0000	0.0	0.0	0.6600	10.4	10.4	10.4
8	7.0	6.5	6.5	120.0	780	1.2	1.1558	0.0000	0.0	0.0	0.6600	10.4	20.7	20.7
9	8.0	7.5	7.5	120.0	900	1.2	1.1303	0.0000	0.0	0.0	0.6600	10.4	31.1	31.1
10	9.0	8.5	8.5	120.0	1020	1.2	1.1064	0.0000	0.0	0.0	0.6600	10.4	41.5	41.5
11	10.0	9.5	9.5	120.0	1140	1.2	1.0839	0.0000	0.0	0.0	0.6600	10.4	51.8	51.8
12	11.0	10.5	10.5	120.0	1260	0.6	1.0626	0.0000	0.0	0.0	0.3300	5.2	57.0	57.0
13	12.0	11.5	11.5	120.0	1380	0.6	1.0422	0.0000	0.0	0.0	0.3300	5.2	62.2	62.2
14	13.0	12.5	12.5	120.0	1500	0.6	1.0227	0.0000	0.0	0.0	0.3300	5.2	67.4	67.4
15	14.0	13.5	13.5	120.0	1620	0.6	1.0040	0.0000	0.0	0.0	0.3300	5.2	72.6	72.6
16	15.0	14.5	14.5	120.0	1740	0.6	0.9859	0.0000	0.0	0.0	0.3300	5.2	77.8	77.8
17	16.0	15.5	15.5	123.0	1863	2.5	0.9685	0.0000	0.0	0.0	1.3750	21.6	99.4	99.4
18	17.0	16.5	16.5	123.0	1986	2.5	0.9516	0.0000	0.0	0.0	1.3750	21.6	121.0	121.0
19	18.0	17.5	17.5	123.0	2109	2.5	0.9353	0.0000	0.0	0.0	1.3750	21.6	142.5	142.5
20	19.0	18.5	18.5	123.0	2232	2.5	0.9193	0.0000	0.0	0.0	1.3750	21.6	164.1	164.1
21	20.0	19.5	19.5	123.0	2355	2.5	0.9039	0.0000	0.0	0.0	1.3750	21.6	185.7	185.7
22	21.0	20.5	20.5	123.0	2478	2.5	0.8888	0.0000	0.0	0.0	1.3750	21.6	207.3	207.3
23	22.0	21.5	21.5	123.0	2601	2.5	0.8740	0.0000	0.0	0.0	1.3750	21.6	228.9	228.9
24	23.0	22.5	22.5	123.0	2724	2.5	0.8596	0.0000	0.0	0.0	1.3750	21.6	250.5	250.5

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: SR-57 Sign Structures
ITEM: 5-FT DIAMETER CIDH PILE (Torsional)
PROJECT NO.: 08-115
Station 535+80
DONE BY: CY DATE: 02/10/09
CHECKED BY: DATE:

D_s =>	5 ft	Hw =>	100.0 ft	Hg =>	0.0 ft	Hw is the depth to water table.
p =	15.7080 ft	Ho =>	0.0 ft	Hf =>	0.0 ft	Hg is the depth to ground surface used in calculation.
						Ho is the depth to location starting initial overburden pressure.
						Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	10	123	60.6	0.00	34
(2)	10	25	123	60.6	2.50	0

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔT_s^s	T_s^s	f_i^c	ΔT_s^c	T_s^c	T_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips-ft)	(kips-ft)	(ksf)	(kips-ft)	(kips-ft)	(kips-ft)
0	0.0	0.0	0.0	123.0	0									
1	0.0	0.0	0.0	123.0	0	0.0				0.0			0.0	0.0
2	1.0	0.5	0.5	123.0	62	0.0	1.2000	0.0738	2.9	2.9	0.0000	0.0	0.0	2.9
3	2.0	1.5	1.5	123.0	185	0.0	1.2000	0.2214	8.7	11.6	0.0000	0.0	0.0	11.6
4	3.0	2.5	2.5	123.0	308	0.0	1.2000	0.3690	14.5	26.1	0.0000	0.0	0.0	26.1
5	4.0	3.5	3.5	123.0	431	0.0	1.2000	0.5166	20.3	46.4	0.0000	0.0	0.0	46.4
6	5.0	4.5	4.5	123.0	554	0.0	1.2000	0.6642	26.1	72.5	0.0000	0.0	0.0	72.5
7	6.0	5.5	5.5	123.0	677	0.0	1.1834	0.8006	31.4	103.9	0.0000	0.0	0.0	103.9
8	7.0	6.5	6.5	123.0	800	0.0	1.1558	0.9241	36.3	140.2	0.0000	0.0	0.0	140.2
9	8.0	7.5	7.5	123.0	923	0.0	1.1303	1.0427	40.9	181.1	0.0000	0.0	0.0	181.1
10	9.0	8.5	8.5	123.0	1046	0.0	1.1064	1.1568	45.4	226.6	0.0000	0.0	0.0	226.6
11	10.0	9.5	9.5	123.0	1169	0.0	1.0839	1.2665	49.7	276.3	0.0000	0.0	0.0	276.3
12	11.0	10.5	10.5	123.0	1292	2.5	1.0626	0.0000	0.0	276.3	1.3750	54.0	54.0	330.3
13	12.0	11.5	11.5	123.0	1415	2.5	1.0422	0.0000	0.0	276.3	1.3750	54.0	108.0	384.3
14	13.0	12.5	12.5	123.0	1538	2.5	1.0227	0.0000	0.0	276.3	1.3750	54.0	162.0	438.3
15	14.0	13.5	13.5	123.0	1661	2.5	1.0040	0.0000	0.0	276.3	1.3750	54.0	216.0	492.3
16	15.0	14.5	14.5	123.0	1784	2.5	0.9859	0.0000	0.0	276.3	1.3750	54.0	270.0	546.3
17	16.0	15.5	15.5	123.0	1907	2.5	0.9685	0.0000	0.0	276.3	1.3750	54.0	324.0	600.3
18	17.0	16.5	16.5	123.0	2030	2.5	0.9516	0.0000	0.0	276.3	1.3750	54.0	378.0	654.3
19	18.0	17.5	17.5	123.0	2153	2.5	0.9353	0.0000	0.0	276.3	1.3750	54.0	432.0	708.3
20	19.0	18.5	18.5	123.0	2276	2.5	0.9193	0.0000	0.0	276.3	1.3750	54.0	486.0	762.3
21	20.0	19.5	19.5	123.0	2399	2.5	0.9039	0.0000	0.0	276.3	1.3750	54.0	540.0	816.2
22	21.0	20.5	20.5	123.0	2522	2.5	0.8888	0.0000	0.0	276.3	1.3750	54.0	594.0	870.2
23	22.0	21.5	21.5	123.0	2645	2.5	0.8740	0.0000	0.0	276.3	1.3750	54.0	648.0	924.2
24	23.0	22.5	22.5	123.0	2768	2.5	0.8596	0.0000	0.0	276.3	1.3750	54.0	701.9	978.2

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: SR-57 Sign Structures
ITEM: 5-FT DIAMETER CIDH PILE (Torsional)
PROJECT NO.: 08-115
Station 551+00
DONE BY: CY DATE: 02/10/09
CHECKED BY: DATE:

D_s =>	5 ft	Hw =>	100.0 ft	Hg =>	0.0 ft	Hw is the depth to water table.
p =	15.7080 ft	Ho =>	0.0 ft	Hf =>	0.0 ft	Hg is the depth to ground surface used in calculation.

Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	5	120	57.6	0.00	32
(2)	5	10	120	57.6	1.50	0
(3)	10	15	120	57.6	0.00	29
(4)	15	25	120	57.6	0.70	0

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔT_s^s	T_s^s	f_i^c	ΔT_s^c	T_s^c	T_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips-ft)	(kips-ft)	(ksf)	(kips-ft)	(kips-ft)	(kips-ft)
0	0.0	0.0	0.0	120.0	0									
1	0.0	0.0	0.0	120.0	0	0.0				0.0			0.0	0.0
2	1.0	0.5	0.5	120.0	60	0.0	1.2000	0.0720	2.8	2.8	0.0000	0.0	0.0	2.8
3	2.0	1.5	1.5	120.0	180	0.0	1.2000	0.2160	8.5	11.3	0.0000	0.0	0.0	11.3
4	3.0	2.5	2.5	120.0	300	0.0	1.2000	0.3600	14.1	25.4	0.0000	0.0	0.0	25.4
5	4.0	3.5	3.5	120.0	420	0.0	1.2000	0.5040	19.8	45.2	0.0000	0.0	0.0	45.2
6	5.0	4.5	4.5	120.0	540	0.0	1.2000	0.6480	25.4	70.7	0.0000	0.0	0.0	70.7
7	6.0	5.5	5.5	120.0	660	1.5	1.1834	0.0000	0.0	70.7	0.8250	32.4	32.4	103.1
8	7.0	6.5	6.5	120.0	780	1.5	1.1558	0.0000	0.0	70.7	0.8250	32.4	64.8	135.5
9	8.0	7.5	7.5	120.0	900	1.5	1.1303	0.0000	0.0	70.7	0.8250	32.4	97.2	167.9
10	9.0	8.5	8.5	120.0	1020	1.5	1.1064	0.0000	0.0	70.7	0.8250	32.4	129.6	200.3
11	10.0	9.5	9.5	120.0	1140	1.5	1.0839	0.0000	0.0	70.7	0.8250	32.4	162.0	232.7
12	11.0	10.5	10.5	120.0	1260	0.0	1.0626	1.3388	52.6	123.3	0.0000	0.0	162.0	285.2
13	12.0	11.5	11.5	120.0	1380	0.0	1.0422	1.4382	56.5	179.7	0.0000	0.0	162.0	341.7
14	13.0	12.5	12.5	120.0	1500	0.0	1.0227	1.5341	60.2	240.0	0.0000	0.0	162.0	402.0
15	14.0	13.5	13.5	120.0	1620	0.0	1.0040	1.6264	63.9	303.9	0.0000	0.0	162.0	465.8
16	15.0	14.5	14.5	120.0	1740	0.0	0.9859	1.7155	67.4	371.2	0.0000	0.0	162.0	533.2
17	16.0	15.5	15.5	120.0	1860	0.7	0.9685	0.0000	0.0	371.2	0.3850	15.1	177.1	548.3
18	17.0	16.5	16.5	120.0	1980	0.7	0.9516	0.0000	0.0	371.2	0.3850	15.1	192.2	563.4
19	18.0	17.5	17.5	120.0	2100	0.7	0.9353	0.0000	0.0	371.2	0.3850	15.1	207.3	578.6
20	19.0	18.5	18.5	120.0	2220	0.7	0.9193	0.0000	0.0	371.2	0.3850	15.1	222.5	593.7
21	20.0	19.5	19.5	120.0	2340	0.7	0.9039	0.0000	0.0	371.2	0.3850	15.1	237.6	608.8
22	21.0	20.5	20.5	120.0	2460	0.7	0.8888	0.0000	0.0	371.2	0.3850	15.1	252.7	623.9
23	22.0	21.5	21.5	120.0	2580	0.7	0.8740	0.0000	0.0	371.2	0.3850	15.1	267.8	639.0
24	23.0	22.5	22.5	120.0	2700	0.7	0.8596	0.0000	0.0	371.2	0.3850	15.1	282.9	654.2

SKIN FRICTION FOR DRILLED SHAFT IN BOTH COHESIONLESS AND COHESIVE SOILS USING REESE AND O'NEILL'S METHOD (1999)

PROJECT: SR-57 Sign Structures
ITEM: 5-FT DIAMETER CIDH PILE (Torsional)
PROJECT NO.: 08-115
Station 559+55
DONE BY: CY DATE: 02/10/09
CHECKED BY: DATE:

D_s => 5 ft Hw => 100.0 ft Hg => 0.0 ft
p = 15.7080 ft Ho => 0.0 ft Hf => 0.0 ft

Hw is the depth to water table.
Hg is the depth to ground surface used in calculation.
Ho is the depth to location starting initial overburden pressure.
Hf is the depth to location starting accumulation of skin friction.

Soil Layer =>	from Top	to Bottom =>	γ (pcf)=>	γ' (pcf)=	c' (ksf) =>	ϕ' =>
(1)	0	10	120	57.6	1.20	0
(2)	10	15	120	57.6	0.60	0
(3)	15	25	123	60.6	2.50	0

Sublayer No.	Depth, z	z_i	New Depth	Soil Unit	Overburden	c'	β	f_i^s	ΔT_s^s	T_s^s	f_i^c	ΔT_s^c	T_s^c	T_s
	(ft)	(ft)	(ft)	Weight (pcf)	Pressure (psf)	(ksf)		(ksf)	(kips-ft)	(kips-ft)	(ksf)	(kips-ft)	(kips-ft)	(kips-ft)
0	0.0	0.0	0.0	120.0	0									
1	0.0	0.0	0.0	120.0	0	1.2				0.0			0.0	0.0
2	1.0	0.5	0.5	120.0	60	1.2	1.2000	0.0000	0.0	0.0	0.0000	0.0	0.0	0.0
3	2.0	1.5	1.5	120.0	180	1.2	1.2000	0.0000	0.0	0.0	0.0000	0.0	0.0	0.0
4	3.0	2.5	2.5	120.0	300	1.2	1.2000	0.0000	0.0	0.0	0.0000	0.0	0.0	0.0
5	4.0	3.5	3.5	120.0	420	1.2	1.2000	0.0000	0.0	0.0	0.0000	0.0	0.0	0.0
6	5.0	4.5	4.5	120.0	540	1.2	1.2000	0.0000	0.0	0.0	0.0000	0.0	0.0	0.0
7	6.0	5.5	5.5	120.0	660	1.2	1.1834	0.0000	0.0	0.0	0.6600	25.9	25.9	25.9
8	7.0	6.5	6.5	120.0	780	1.2	1.1558	0.0000	0.0	0.0	0.6600	25.9	51.8	51.8
9	8.0	7.5	7.5	120.0	900	1.2	1.1303	0.0000	0.0	0.0	0.6600	25.9	77.8	77.8
10	9.0	8.5	8.5	120.0	1020	1.2	1.1064	0.0000	0.0	0.0	0.6600	25.9	103.7	103.7
11	10.0	9.5	9.5	120.0	1140	1.2	1.0839	0.0000	0.0	0.0	0.6600	25.9	129.6	129.6
12	11.0	10.5	10.5	120.0	1260	0.6	1.0626	0.0000	0.0	0.0	0.3300	13.0	142.5	142.5
13	12.0	11.5	11.5	120.0	1380	0.6	1.0422	0.0000	0.0	0.0	0.3300	13.0	155.5	155.5
14	13.0	12.5	12.5	120.0	1500	0.6	1.0227	0.0000	0.0	0.0	0.3300	13.0	168.5	168.5
15	14.0	13.5	13.5	120.0	1620	0.6	1.0040	0.0000	0.0	0.0	0.3300	13.0	181.4	181.4
16	15.0	14.5	14.5	120.0	1740	0.6	0.9859	0.0000	0.0	0.0	0.3300	13.0	194.4	194.4
17	16.0	15.5	15.5	123.0	1863	2.5	0.9685	0.0000	0.0	0.0	1.3750	54.0	248.4	248.4
18	17.0	16.5	16.5	123.0	1986	2.5	0.9516	0.0000	0.0	0.0	1.3750	54.0	302.4	302.4
19	18.0	17.5	17.5	123.0	2109	2.5	0.9353	0.0000	0.0	0.0	1.3750	54.0	356.4	356.4
20	19.0	18.5	18.5	123.0	2232	2.5	0.9193	0.0000	0.0	0.0	1.3750	54.0	410.4	410.4
21	20.0	19.5	19.5	123.0	2355	2.5	0.9039	0.0000	0.0	0.0	1.3750	54.0	464.4	464.4
22	21.0	20.5	20.5	123.0	2478	2.5	0.8888	0.0000	0.0	0.0	1.3750	54.0	518.4	518.4
23	22.0	21.5	21.5	123.0	2601	2.5	0.8740	0.0000	0.0	0.0	1.3750	54.0	572.4	572.4
24	23.0	22.5	22.5	123.0	2724	2.5	0.8596	0.0000	0.0	0.0	1.3750	54.0	626.4	626.4

```
================================================================================

                LPILE Plus for Windows, Version 5.0 (5.0.38)

              Analysis of Individual Piles and Drilled Shafts
            Subjected to Lateral Loading Using the p-y Method

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================================================================================

This program is licensed to:

Earth Mechanics, Inc.
Earth Mechanics, Inc.

Path to file locations:      D:\08-115 SR57NB\Calc\Sign\
Name of input data file:     S535A.lpd
Name of output file:         S535A.lpo
Name of plot output file:    S535A.lpp
Name of runtime file:        S535A.lpr

--------------------------------------------------------------------------------
                          Time and Date of Analysis
--------------------------------------------------------------------------------

               Date:  February 11, 2009     Time:  10:31:53

--------------------------------------------------------------------------------
                                 Problem Title
--------------------------------------------------------------------------------

New LPILE Plus 5.0 Data File

--------------------------------------------------------------------------------
                                 Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments            =          100
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1

--------------------------------------------------------------------------------
                    Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                                  =     276.00 in

Depth of ground surface below top of pile =        .00 in

Slope angle of ground surface                =        .00 deg.

Structural properties of pile defined using  2 points

Point     Depth         Pile      Moment of       Pile      Modulus of
            X         Diameter     Inertia        Area      Elasticity
           in            in         in**4        Sq.in      lbs/Sq.in
-----  ---------    -----------   ----------   ----------   -----------
  1       0.0000    60.00000000  317925.0000    2260.8000      3250000.
```

2	276.0000	60.00000000	317925.0000	2260.8000	3250000.

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = .000 in
Distance from top of pile to bottom of layer = 120.000 in
p-y subgrade modulus k for top of soil layer = 100.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 100.000 lbs/in**3

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 120.000 in
Distance from top of pile to bottom of layer = 300.000 in

(Depth of lowest layer extends 24.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 4 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	.00	.07118
2	120.00	.07118
3	120.00	.07118
4	300.00	.07118

Shear Strength of Soils

Shear strength parameters with depth defined using 4 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	.00000	34.00	------	------
2	120.000	.00000	34.00	------	------
3	120.000	17.36111	.00	.00500	.0
4	300.000	17.36111	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 11414.000 lbs
Bending moment at pile head = 3311364.000 in-lbs
Axial load at pile head = 15921.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 11414.000 lbs
Specified moment at pile head = 3311364.000 in-lbs
Specified axial load at pile head = 15921.000 lbs

Non-zero moment for this load case indicates the pile-head may rotate under
the applied pile-head loading, but is not a free-head (zero moment)condition.

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	.071782	3311364.	11414.0000	-.0007099	319.5087	0.0000	0.0000
2.760	.069835	3342898.	11387.6349	-.0007010	322.4843	-19.1051	755.0628
5.520	.067913	3374285.	11309.9469	-.0006920	325.4461	-37.1905	1511.4308
8.280	.066016	3405389.	11183.7333	-.0006830	328.3811	-54.2686	2268.8819
11.040	.064143	3436080.	11011.7545	-.0006738	331.2771	-70.3537	3027.2345
13.800	.062296	3466233.	10796.7295	-.0006646	334.1225	-85.4615	3786.3387
16.560	.060474	3495736.	10541.3320	-.0006553	336.9064	-99.6091	4546.0707
19.320	.058679	3524479.	10248.1872	-.0006459	339.6187	-112.8147	5306.3275
22.080	.056909	3552363.	9919.8691	-.0006365	342.2498	-125.0970	6067.0232
24.840	.055165	3579293.	9558.8983	-.0006270	344.7910	-136.4760	6828.0860
27.600	.053448	3605183.	9167.7403	-.0006174	347.2340	-146.9718	7589.4554
30.360	.051758	3629953.	8748.8036	-.0006077	349.5714	-156.6055	8351.0805
33.120	.050094	3653530.	8304.4383	-.0005980	351.7961	-165.3983	9112.9183
35.880	.048457	3675846.	7836.9351	-.0005882	353.9019	-173.3721	9874.9326
38.640	.046847	3696841.	7348.5242	-.0005783	355.8831	-180.5489	10637.0923
41.400	.045264	3716461.	6841.3742	-.0005684	357.7344	-186.9511	11399.3711
44.160	.043709	3734656.	6317.5918	-.0005585	359.4513	-192.6014	12161.7469
46.920	.042182	3751383.	5779.2207	-.0005485	361.0297	-197.5227	12924.2004
49.680	.040682	3766605.	5228.2410	-.0005384	362.4661	-201.7380	13686.7154
52.440	.039209	3780290.	4666.5693	-.0005284	363.7575	-205.2705	14449.2780
55.200	.037765	3792411.	4096.0578	-.0005182	364.9012	-208.1436	15211.8763
57.960	.036349	3802946.	3518.4942	-.0005081	365.8953	-210.3808	15974.5003
60.720	.034960	3811878.	2935.6013	-.0004979	366.7381	-212.0054	16737.1412
63.480	.033600	3819194.	2349.0372	-.0004877	367.4285	-213.0411	17499.7916
66.240	.032268	3824887.	1760.3948	-.0004775	367.9657	-213.5114	18262.4454
69.000	.030964	3828954.	1171.2020	-.0004673	368.3494	-213.4399	19025.0971
71.760	.029688	3831393.	582.9219	-.0004571	368.5797	-212.8501	19787.7422
74.520	.028441	3832211.	-3.0475	-.0004468	368.6569	-211.7655	20550.3769
77.280	.027222	3831416.	-585.3732	-.0004366	368.5818	-210.2096	21312.9980
80.040	.026031	3829019.	-1162.7864	-.0004264	368.3556	-208.2058	22075.6028
82.800	.024868	3825035.	-1734.0829	-.0004162	367.9797	-205.7772	22838.1890
85.560	.023734	3819483.	-2298.1225	-.0004059	367.4558	-202.9471	23600.7548
88.320	.022627	3812385.	-2853.8287	-.0003958	366.7860	-199.7385	24363.2988
91.080	.021549	3803765.	-3400.1885	-.0003856	365.9726	-196.1743	25125.8197
93.840	.020499	3793650.	-3936.2515	-.0003754	365.0181	-192.2772	25888.3166
96.600	.019477	3782070.	-4461.1302	-.0003653	363.9254	-188.0697	26650.7888
99.360	.018482	3769056.	-4973.9987	-.0003552	362.6974	-183.5742	27413.2358
102.120	.017516	3754644.	-5474.0927	-.0003452	361.3375	-178.8128	28175.6572
104.880	.016577	3738870.	-5960.7088	-.0003352	359.8490	-173.8075	28938.0529
107.640	.015666	3721771.	-6433.2035	-.0003252	358.2355	-168.5800	29700.4228
110.400	.014782	3703387.	-6890.9935	-.0003153	356.5007	-163.1518	30462.7670
113.160	.013925	3683760.	-7333.5538	-.0003054	354.6487	-157.5441	31225.0855
115.920	.013096	3662933.	-7760.4180	-.0002956	352.6834	-151.7778	31987.3786
118.680	.012294	3640949.	-8171.1771	-.0002859	350.6089	-145.8737	32749.6466
121.440	.011518	3617853.	-9178.3180	-.0002762	348.4296	-583.9385	139925.
124.200	.010769	3590308.	-10778.1289	-.0002665	345.8304	-575.3448	147453.
126.960	.010047	3558381.	-12353.7753	-.0002570	342.8177	-566.4280	155606.
129.720	.009351	3522138.	-13904.3499	-.0002475	339.3978	-557.1768	164460.
132.480	.008680	3481651.	-15428.9123	-.0002382	335.5773	-547.5785	174106.
135.240	.008036	3436992.	-16926.4829	-.0002289	331.3632	-537.6176	184650.
138.000	.007417	3388237.	-18396.0367	-.0002198	326.7626	-527.2764	196217.
140.760	.006822	3335465.	-19836.4943	-.0002108	321.7829	-516.5335	208961.
143.520	.006253	3278758.	-21246.7120	-.0002020	316.4319	-505.3634	223067.
146.280	.005707	3218201.	-22625.4687	-.0001933	310.7177	-493.7357	238762.
149.040	.005186	3153882.	-23971.4503	-.0001848	304.6484	-481.6133	256332.
151.800	.004687	3085894.	-25283.2288	-.0001765	298.2330	-468.9508	276136.
154.560	.004211	3014334.	-26559.2363	-.0001683	291.4804	-455.6923	298640.
157.320	.003758	2939302.	-27797.7306	-.0001604	284.4003	-441.7674	324452.
160.080	.003326	2860905.	-28996.7493	-.0001526	277.0025	-427.0868	354393.
162.840	.002915	2779254.	-30154.0474	-.0001451	269.2978	-411.5350	389600.
165.600	.002525	2694467.	-31267.0093	-.0001378	261.2972	-394.9591	431694.
168.360	.002155	2606672.	-32332.5216	-.0001307	253.0126	-377.1512	483089.
171.120	.001804	2516003.	-33346.7806	-.0001239	244.4570	-357.8191	547565.
173.880	.001471	2422609.	-34304.9854	-.0001173	235.6441	-336.5322	631441.
176.640	.001156	2326650.	-35190.2820	-.0001109	226.5893	-304.9870	728039.
179.400	.000859	2228368.	-35925.7758	-.0001049	217.3152	-227.9795	732847.
182.160	.000577	2128349.	-36453.3573	-9.9033E-05	207.8772	-154.3260	737655.
184.920	.000312	2027154.	-36782.1281	-9.3483E-05	198.3283	-83.9138	742463.
187.680	6.14E-05	1925320.	-36920.8689	-8.8204E-05	188.7190	-16.6230	747271.
190.440	-.000175	1823359.	-36878.0202	-8.3198E-05	179.0977	47.6728	752079.
193.200	-.000398	1721760.	-36661.6658	-7.8463E-05	169.5107	109.1057	756887.

195.960	-.000608	1620993.	-36279.5193	-7.3998E-05	160.0022	167.8121	761695.
198.720	-.000806	1521504.	-35738.9127	-6.9801E-05	150.6142	223.9319	766503.
201.480	-.000993	1423720.	-35046.7880	-6.5868E-05	141.3871	277.6077	771311.
204.240	-.001170	1328052.	-34209.6919	-6.2193E-05	132.3596	328.9836	776119.
207.000	-.001337	1234888.	-33269.5372	-5.8770E-05	123.5686	352.2879	727414.
209.760	-.001494	1144409.	-32275.7202	-5.5592E-05	115.0308	367.8694	679450.
212.520	-.001644	1056731.	-31240.8369	-5.2652E-05	106.7574	382.0461	641571.
215.280	-.001785	971964.	-30168.3889	-4.9943E-05	98.7585	395.0901	610908.
218.040	-.001919	890206.	-29061.2239	-4.7455E-05	91.0437	407.2034	585592.
220.800	-.002047	811550.	-27921.6952	-4.5183E-05	83.6216	418.5420	564349.
223.560	-.002169	736082.	-26751.7715	-4.3116E-05	76.5003	429.2288	546276.
226.320	-.002285	663884.	-25553.1138	-4.1246E-05	69.6876	439.3637	530717.
229.080	-.002396	595033.	-24327.1323	-3.9564E-05	63.1906	449.0287	517179.
231.840	-.002503	529602.	-23075.0287	-3.8062E-05	57.0164	458.2928	505286.
234.600	-.002606	467662.	-21797.8290	-3.6730E-05	51.1717	467.2142	494746.
237.360	-.002706	409281.	-20496.4101	-3.5559E-05	45.6627	475.8430	485327.
240.120	-.002803	354525.	-19171.5198	-3.4539E-05	40.4958	484.2224	476845.
242.880	-.002897	303457.	-17823.7948	-3.3660E-05	35.6770	492.3899	469150.
245.640	-.002989	256141.	-16453.7747	-3.2913E-05	31.2121	500.3782	462119.
248.400	-.003078	212635.	-15061.9146	-3.2287E-05	27.1069	508.2160	455651.
251.160	-.003167	173002.	-13648.5955	-3.1772E-05	23.3670	515.9283	449664.
253.920	-.003254	137298.	-12214.1338	-3.1357E-05	19.9979	523.5367	444087.
256.680	-.003340	105582.	-10758.7898	-3.1033E-05	17.0052	531.0604	438864.
259.440	-.003425	77912.2377	-9282.7752	-3.0788E-05	14.3941	538.5154	433947.
262.200	-.003510	54344.2239	-7786.2601	-3.0611E-05	12.1702	545.9158	429295.
264.960	-.003594	34934.7719	-6269.3795	-3.0492E-05	10.3387	553.2731	424877.
267.720	-.003678	19739.9287	-4732.2393	-3.0419E-05	8.9049	560.5967	420666.
270.480	-.003762	8815.4845	-3174.9218	-3.0381E-05	7.8740	567.8942	416640.
273.240	-.003846	2217.0304	-1597.4915	-3.0366E-05	7.2514	575.1712	412782.
276.000	-.003930	0.0000	0.0000	-3.0363E-05	7.0422	582.4314	204539.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.07178250 in
Computed slope at pile head	=	-.00070988
Maximum bending moment	=	3832211. lbs-in
Maximum shear force	=	-36920.86891 lbs
Depth of maximum bending moment	=	74.52000000 in
Depth of maximum shear force	=	187.68000 in
Number of iterations	=	12
Number of zero deflection points	=	1

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 11414.	M= 3.31E+06	15921.0000	.0717825	3832211.	-36920.8689

The analysis ended normally.

```
================================================================================

               LPILE Plus for Windows, Version 5.0 (5.0.38)

             Analysis of Individual Piles and Drilled Shafts
           Subjected to Lateral Loading Using the p-y Method

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================================================================================

This program is licensed to:

Earth Mechanics, Inc.
Earth Mechanics, Inc.

Path to file locations:       D:\08-115 SR57NB\Calc\Sign\
Name of input data file:      standard.lpd
Name of output file:          standard.lpo
Name of plot output file:     standard.lpp
Name of runtime file:         standard.lpr

--------------------------------------------------------------------------------
                         Time and Date of Analysis
--------------------------------------------------------------------------------

              Date:  February 11, 2009     Time:  10:29: 5

--------------------------------------------------------------------------------
                                Problem Title
--------------------------------------------------------------------------------

New LPILE Plus 5.0 Data File

--------------------------------------------------------------------------------
                                Program Options
--------------------------------------------------------------------------------

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments                =          100
- Maximum number of iterations allowed =          100
- Deflection tolerance for convergence =   1.0000E-05 in
- Maximum allowable deflection         =   1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and
  soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) =  1

--------------------------------------------------------------------------------
                    Pile Structural Properties and Geometry
--------------------------------------------------------------------------------

Pile Length                                 =     276.00 in

Depth of ground surface below top of pile =        .00 in

Slope angle of ground surface               =        .00 deg.

Structural properties of pile defined using  2 points

Point     Depth         Pile       Moment of       Pile       Modulus of
            X         Diameter      Inertia        Area       Elasticity
           in           in          in**4         Sq.in       lbs/Sq.in
-----  ---------   -----------   ----------   ----------   -----------
  1       0.0000   60.00000000   317925.0000    2260.8000      3250000.
```

2	276.0000	60.00000000	317925.0000	2260.8000	3250000.

Soil and Rock Layering Information

The soil profile is modelled using 1 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = .000 in
Distance from top of pile to bottom of layer = 600.000 in
p-y subgrade modulus k for top of soil layer = 45.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 45.000 lbs/in**3

(Depth of lowest layer extends 324.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 2 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	.00	.06944
2	600.00	.06944

Shear Strength of Soils

Shear strength parameters with depth defined using 2 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	.00000	30.00	------	------
2	600.000	.00000	30.00	------	------

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 11414.000 lbs
Bending moment at pile head = 3311364.000 in-lbs
Axial load at pile head = 15921.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Computed Values of Load Distribution and Deflection for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 11414.000 lbs

Specified moment at pile head = 3311364.000 in-lbs
Specified axial load at pile head = 15921.000 lbs

Non-zero moment for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment)condition.

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	.175950	3311364.	11414.0000	-.0012553	319.5087	0.0000	0.0000
2.760	.172498	3342922.	11384.4345	-.0012464	322.4866	-21.4242	342.7920
5.520	.169070	3374316.	11296.9132	-.0012374	325.4490	-41.9970	685.5840
8.280	.165667	3405389.	11153.7732	-.0012284	328.3811	-61.7276	1028.3760
11.040	.162290	3435992.	10957.3259	-.0012192	331.2689	-80.6255	1371.1680
13.800	.158937	3465981.	10709.8568	-.0012100	334.0987	-98.7000	1713.9600
16.560	.155610	3495217.	10413.6249	-.0012007	336.8575	-115.9608	2056.7520
19.320	.152309	3523570.	10070.8627	-.0011913	339.5328	-132.4176	2399.5440
22.080	.149034	3550913.	9683.7756	-.0011819	342.1130	-148.0803	2742.3360
24.840	.145785	3577128.	9254.5419	-.0011724	344.5867	-162.9587	3085.1280
27.600	.142563	3602101.	8785.3123	-.0011628	346.9432	-177.0627	3427.9200
30.360	.139367	3625725.	8278.2101	-.0011531	349.1724	-190.4026	3770.7120
33.120	.136197	3647898.	7735.3303	-.0011434	351.2647	-202.9885	4113.5040
35.880	.133055	3668525.	7158.7401	-.0011336	353.2111	-214.8305	4456.2960
38.640	.129940	3687514.	6550.4782	-.0011238	355.0029	-225.9390	4799.0880
41.400	.126851	3704782.	5912.5550	-.0011139	356.6324	-236.3243	5141.8800
44.160	.123791	3720249.	5246.9521	-.0011040	358.0919	-245.9967	5484.6720
46.920	.120757	3733842.	4555.6225	-.0010941	359.3746	-254.9668	5827.4640
49.680	.117751	3745492.	3840.4904	-.0010841	360.4739	-263.2449	6170.2560
52.440	.114773	3755137.	3103.4513	-.0010741	361.3840	-270.8415	6513.0480
55.200	.111822	3762718.	2346.3716	-.0010640	362.0993	-277.7670	6855.8400
57.960	.108900	3768182.	1571.0890	-.0010540	362.6150	-284.0320	7198.6320
60.720	.106005	3771483.	779.4121	-.0010439	362.9264	-289.6469	7541.4240
63.480	.103137	3772577.	-26.8789	-.0010338	363.0296	-294.6220	7884.2160
66.240	.100298	3771425.	-846.0330	-.0010237	362.9210	-298.9679	8227.0080
69.000	.097486	3767996.	-1676.3273	-.0010137	362.5974	-302.6947	8569.8000
71.760	.094702	3762261.	-2516.0677	-.0010036	362.0562	-305.8129	8912.5920
74.520	.091946	3754196.	-3363.5883	-.0009936	361.2952	-308.3325	9255.3840
77.280	.089218	3743781.	-4217.2512	-.0009836	360.3124	-310.2638	9598.1760
80.040	.086517	3731003.	-5075.4462	-.0009736	359.1067	-311.6167	9940.9680
82.800	.083844	3715851.	-5936.5910	-.0009636	357.6768	-312.4013	10283.7600
85.560	.081198	3698318.	-6799.1303	-.0009537	356.0224	-312.6272	10626.5520
88.320	.078579	3678403.	-7661.5357	-.0009439	354.1432	-312.3043	10969.3440
91.080	.075987	3656109.	-8522.3056	-.0009341	352.0395	-311.4420	11312.1360
93.840	.073423	3631442.	-9379.9644	-.0009244	349.7119	-310.0498	11654.9280
96.600	.070885	3604413.	-10233.0622	-.0009147	347.1614	-308.1370	11997.7200
99.360	.068374	3575036.	-11080.1745	-.0009051	344.3893	-305.7125	12340.5120
102.120	.065889	3543330.	-11919.9018	-.0008956	341.3975	-302.7854	12683.3040
104.880	.063430	3509317.	-12750.8685	-.0008862	338.1879	-299.3644	13026.0960
107.640	.060997	3473023.	-13571.7232	-.0008769	334.7632	-295.4579	13368.8880
110.400	.058590	3434478.	-14381.1374	-.0008676	331.1260	-291.0742	13711.6800
113.160	.056208	3393715.	-15177.8055	-.0008585	327.2796	-286.2215	14054.4720
115.920	.053851	3350772.	-15960.4438	-.0008495	323.2273	-280.9077	14397.2640
118.680	.051519	3305688.	-16727.7900	-.0008406	318.9732	-275.1403	14740.0560
121.440	.049211	3258508.	-17478.6024	-.0008318	314.5212	-268.9267	15082.8480
124.200	.046927	3209280.	-18211.6597	-.0008232	309.8758	-262.2742	15425.6400
126.960	.044667	3158052.	-18925.7595	-.0008147	305.0420	-255.1895	15768.4320
129.720	.042430	3104881.	-19619.7184	-.0008063	300.0246	-247.6793	16111.2240
132.480	.040216	3049822.	-20292.3705	-.0007981	294.8292	-239.7498	16454.0160
135.240	.038024	2992937.	-20942.5674	-.0007900	289.4614	-231.4073	16796.8080
138.000	.035855	2934289.	-21569.1767	-.0007821	283.9272	-222.6574	17139.6000
140.760	.033707	2873944.	-22171.0817	-.0007744	278.2330	-213.5056	17482.3920
143.520	.031580	2811973.	-22747.1804	-.0007668	272.3852	-203.9572	17825.1840
146.280	.029474	2748447.	-23296.3847	-.0007593	266.3908	-194.0169	18167.9760
149.040	.027389	2683443.	-23817.6196	-.0007521	260.2569	-183.6895	18510.7680
151.800	.025323	2617040.	-24309.8221	-.0007450	253.9910	-172.9791	18853.5600
154.560	.023276	2549319.	-24771.9410	-.0007381	247.6007	-161.8897	19196.3520
157.320	.021248	2480364.	-25202.9352	-.0007314	241.0940	-150.4250	19539.1440
160.080	.019239	2410263.	-25601.7736	-.0007249	234.4791	-138.5883	19881.9360
162.840	.017247	2339106.	-25967.4335	-.0007185	227.7646	-126.3827	20224.7280
165.600	.015273	2266986.	-26298.9005	-.0007124	220.9592	-113.8108	20567.5200
168.360	.013315	2193998.	-26595.1670	-.0007064	214.0720	-100.8751	20910.3120
171.120	.011373	2120242.	-26855.2318	-.0007006	207.1122	-87.5776	21253.1040
173.880	.009447	2045819.	-27078.0987	-.0006951	200.0895	-73.9202	21595.8960
176.640	.007536	1970832.	-27262.7763	-.0006897	193.0136	-59.9042	21938.6880
179.400	.005640	1895389.	-27408.2767	-.0006846	185.8947	-45.5308	22281.4800
182.160	.003758	1819599.	-27513.6146	-.0006796	178.7430	-30.8010	22624.2720
184.920	.001889	1743574.	-27577.8069	-.0006748	171.5691	-15.7152	22967.0640
187.680	3.24E-05	1667429.	-27599.8714	-.0006703	164.3839	-.2736586	23309.8560
190.440	-.001811	1591281.	-27578.8266	-.0006659	157.1985	15.5236	23652.6480
193.200	-.003644	1515252.	-27513.6901	-.0006618	150.0242	31.6768	23995.4400
195.960	-.005464	1439464.	-27403.4786	-.0006578	142.8727	48.1866	24338.2320
198.720	-.007275	1364043.	-27247.2068	-.0006541	135.7558	65.0538	24681.0240
201.480	-.009075	1289117.	-27043.8867	-.0006505	128.6857	82.2796	25023.8160
204.240	-.010866	1214818.	-26792.5270	-.0006472	121.6747	99.8652	25366.6080
207.000	-.012648	1141279.	-26492.1323	-.0006441	114.7354	117.8121	25709.4000
209.760	-.014421	1068638.	-26141.7029	-.0006411	107.8808	136.1223	26052.1920
212.520	-.016186	997033.	-25740.2335	-.0006383	101.1241	154.7976	26394.9840
215.280	-.017945	926608.	-25286.7133	-.0006358	94.4786	173.8402	26737.7760

218.040	-.019696	857506.	-24780.1252	-.0006334	87.9581	193.2526	27080.5680
220.800	-.021441	789877.	-24219.4453	-.0006312	81.5765	213.0372	27423.3600
223.560	-.023180	723870.	-23603.6428	-.0006292	75.3480	233.1966	27766.1520
226.320	-.024914	659640.	-22931.6790	-.0006273	69.2871	253.7337	28108.9440
229.080	-.026643	597343.	-22202.5076	-.0006256	63.4086	274.6514	28451.7360
231.840	-.028368	537137.	-21415.0742	-.0006241	57.7275	295.9525	28794.5280
234.600	-.030088	479186.	-20568.3161	-.0006228	52.2591	317.6403	29137.3200
237.360	-.031805	423655.	-19661.1620	-.0006216	47.0191	339.7177	29480.1120
240.120	-.033519	370711.	-18692.5321	-.0006205	42.0232	362.1879	29822.9040
242.880	-.035230	320527.	-17661.3382	-.0006196	37.2877	385.0540	30165.6960
245.640	-.036939	273275.	-16566.4833	-.0006188	32.8290	408.3191	30508.4880
248.400	-.038646	229134.	-15406.8623	-.0006181	28.6637	431.9861	30851.2800
251.160	-.040351	188284.	-14181.3616	-.0006176	24.8090	456.0579	31194.0720
253.920	-.042055	150907.	-12888.8599	-.0006171	21.2821	480.5375	31536.8640
256.680	-.043758	117191.	-11528.2282	-.0006167	18.1006	505.4275	31879.6560
259.440	-.045459	87325.5849	-10098.3305	-.0006165	15.2824	530.7303	32222.4480
262.200	-.047161	61502.7221	-8598.0243	-.0006163	12.8457	556.4482	32565.2400
264.960	-.048861	39918.6518	-7026.1608	-.0006161	10.8090	582.5833	32908.0320
267.720	-.050562	22772.4632	-5381.5865	-.0006161	9.1910	609.1373	33250.8240
270.480	-.052262	10266.4360	-3663.1430	-.0006160	8.0110	636.1116	33593.6160
273.240	-.053962	2606.0514	-1869.6689	-.0006160	7.2881	663.5073	33936.4080
276.000	-.055662	0.0000	0.0000	-.0006160	7.0422	691.3252	17139.6000

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.17595026 in
Computed slope at pile head	=	-.00125528
Maximum bending moment	=	3772577. lbs-in
Maximum shear force	=	-27599.87144 lbs
Depth of maximum bending moment	=	63.48000000 in
Depth of maximum shear force	=	187.68000 in
Number of iterations	=	5
Number of zero deflection points	=	1

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 11414.	M= 3.31E+06	15921.0000	.1759503	3772577.	-27599.8714

The analysis ended normally.

LPILE Plus for Windows, Version 5.0 (5.0.38)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Path to file locations: D:\08-115 SR57NB\Calc\Sign\
Name of input data file: S551A.lpd
Name of output file: S551A.lpo
Name of plot output file: S551A.lpp
Name of runtime file: S551A.lpr

Time and Date of Analysis

Date: February 11, 2009 Time: 11:32:54

Problem Title

New LPILE Plus 5.0 Data File

Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 276.00 in

Depth of ground surface below top of pile = .00 in

Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	60.00000000	317925.0000	2260.8000	3250000.

2	276.0000	60.00000000	317925.0000	2260.8000	3250000.

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = .000 in
Distance from top of pile to bottom of layer = 60.000 in
p-y subgrade modulus k for top of soil layer = 70.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 70.000 lbs/in**3

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 60.000 in
Distance from top of pile to bottom of layer = 120.000 in

Layer 3 is sand, p-y criteria by API RP-2A, 1987
Distance from top of pile to top of layer = 120.000 in
Distance from top of pile to bottom of layer = 180.000 in
p-y subgrade modulus k for top of soil layer = 20.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 20.000 lbs/in**3

Layer 4 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 180.000 in
Distance from top of pile to bottom of layer = 300.000 in

(Depth of lowest layer extends 24.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 8 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	.00	.06944
2	60.00	.06944
3	60.00	.06944
4	120.00	.06944
5	120.00	.06944
6	180.00	.06944
7	180.00	.06944
8	300.00	.06944

Shear Strength of Soils

Shear strength parameters with depth defined using 8 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	.00000	32.00	------	------
2	60.000	.00000	32.00	------	------
3	60.000	10.41667	.00	.01000	.0
4	120.000	10.41667	.00	.01000	.0
5	120.000	.00000	29.00	------	------
6	180.000	.00000	29.00	------	------
7	180.000	4.86111	.00	.01500	.0
8	300.000	4.86111	.00	.01500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 11414.000 lbs
Bending moment at pile head = 3311364.000 in-lbs
Axial load at pile head = .000 lbs

Non-zero moment at pile head for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment) condition.

Computed Values of Load Distribution and Deflection for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 11414.000 lbs
Specified moment at pile head = 3311364.000 in-lbs
Specified axial load at pile head = .000 lbs

Non-zero moment for this load case indicates the pile-head may rotate under the applied pile-head loading, but is not a free-head (zero moment)condition.

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	.125723	3311364.	11414.0000	-.0010365	312.4665	0.0000	0.0000
2.760	.122875	3342867.	11381.7968	-.0010276	315.4392	-23.3357	524.1623
5.520	.120051	3374192.	11286.5762	-.0010186	318.3950	-45.6648	1049.8422
8.280	.117252	3405169.	11131.1166	-.0010096	321.3181	-66.9872	1576.8112
11.040	.114478	3435635.	10918.1928	-.0010004	324.1930	-87.3054	2104.8779
13.800	.111730	3465437.	10650.5697	-.0009912	327.0051	-106.6243	2633.8819
16.560	.109007	3494426.	10330.9963	-.0009819	329.7406	-124.9506	3163.6876
19.320	.106310	3522464.	9962.2008	-.0009725	332.3863	-142.2924	3694.1805
22.080	.103638	3549418.	9546.8874	-.0009631	334.9297	-158.6593	4225.2632
24.840	.100993	3575163.	9087.7322	-.0009536	337.3591	-174.0618	4756.8528
27.600	.098375	3599582.	8587.3810	-.0009440	339.6633	-188.5115	5288.8783
30.360	.095783	3622565.	8048.4467	-.0009344	341.8321	-202.0206	5821.2790
33.120	.093217	3644009.	7473.5076	-.0009246	343.8556	-214.6020	6354.0027
35.880	.090678	3663819.	6865.1054	-.0009149	345.7248	-226.2692	6887.0044
38.640	.088167	3681905.	6225.7440	-.0009051	347.4315	-237.0362	7420.2454
41.400	.085682	3698185.	5557.8882	-.0008952	348.9677	-246.9173	7953.6919
44.160	.083225	3712584.	4863.9628	-.0008853	350.3264	-255.9272	8487.3150
46.920	.080795	3725034.	4146.3517	-.0008754	351.5012	-264.0808	9021.0894
49.680	.078393	3735472.	3407.3973	-.0008654	352.4862	-271.3934	9554.9931
52.440	.076018	3743843.	2649.3997	-.0008554	353.2761	-277.8802	10089.0071
55.200	.073671	3750097.	1874.6167	-.0008454	353.8662	-283.5568	10623.1146
57.960	.071352	3754191.	1085.2628	-.0008354	354.2525	-288.4387	11157.3011
60.720	.069060	3756088.	82.7449	-.0008254	354.4315	-438.0235	17505.7951
63.480	.066796	3754648.	-1125.8479	-.0008153	354.2956	-437.7685	18088.6560
66.240	.064559	3749873.	-2333.5259	-.0008053	353.8451	-437.3605	18697.8543
69.000	.062350	3741767.	-3539.8612	-.0007953	353.0801	-436.7956	19335.2507
71.760	.060169	3730333.	-4744.4150	-.0007853	352.0012	-436.0695	20002.8977
74.520	.058015	3715577.	-5946.7362	-.0007754	350.6089	-435.1777	20703.0659
77.280	.055889	3697507.	-7146.3604	-.0007655	348.9037	-434.1152	21438.2748
80.040	.053790	3676129.	-8342.8088	-.0007556	346.8865	-432.8764	22211.3300
82.800	.051718	3651455.	-9535.5865	-.0007459	344.5581	-431.4553	23025.3668
85.560	.049672	3623493.	-10724.1813	-.0007361	341.9196	-429.8453	23883.9016
88.320	.047654	3592257.	-11908.0620	-.0007265	338.9721	-428.0392	24790.8946
91.080	.045662	3557761.	-13086.6760	-.0007170	335.7170	-426.0289	25750.8245
93.840	.043697	3520019.	-14259.4476	-.0007075	332.1556	-423.8056	26768.7800
96.600	.041757	3479048.	-15425.7751	-.0006981	328.2895	-421.3593	27850.5710
99.360	.039843	3434868.	-16585.0280	-.0006889	324.1206	-418.6791	29002.8654
102.120	.037954	3387499.	-17736.5440	-.0006798	319.6508	-415.7527	30233.3595
104.880	.036090	3336963.	-18879.6242	-.0006708	314.8821	-412.5663	31550.9913
107.640	.034251	3283284.	-20013.5299	-.0006620	309.8168	-409.1044	32966.2087
110.400	.032436	3226488.	-21137.4760	-.0006533	304.4575	-405.3493	34491.3138
113.160	.030645	3166605.	-22250.6260	-.0006447	298.8068	-401.2811	36140.9062
115.920	.028877	3103665.	-23352.0837	-.0006364	292.8676	-396.8767	37932.4614
118.680	.027132	3037701.	-24440.8850	-.0006282	286.6432	-392.1098	39887.0986
121.440	.025410	2968751.	-25063.5447	-.0006201	280.1369	-59.0929	6418.6921
124.200	.023709	2899350.	-25222.9895	-.0006123	273.5881	-56.4469	6571.0815
126.960	.022030	2829520.	-25374.9440	-.0006047	266.9988	-53.6651	6723.4703
129.720	.020371	2759281.	-25519.0366	-.0005972	260.3709	-50.7498	6875.8582
132.480	.018733	2688655.	-25654.9018	-.0005899	253.7065	-47.7032	7028.2454
135.240	.017115	2617666.	-25782.1800	-.0005828	247.0078	-44.5273	7180.6317
138.000	.015516	2546337.	-25900.5168	-.0005759	240.2772	-41.2240	7333.0169
140.760	.013936	2474695.	-26009.5630	-.0005692	233.5168	-37.7950	7485.4010
143.520	.012374	2402764.	-26108.9741	-.0005627	226.7294	-34.2420	7637.7836

146.280	.010829	2330573.	-26198.4098	-.0005564	219.9173	-30.5665	7790.1647
149.040	.009302	2258149.	-26277.5341	-.0005503	213.0832	-26.7699	7942.5440
151.800	.007792	2185521.	-26346.0145	-.0005443	206.2299	-22.8536	8094.9211
154.560	.006298	2112719.	-26403.5221	-.0005386	199.3602	-18.8186	8247.2956
157.320	.004819	2039774.	-26449.7308	-.0005330	192.4769	-14.6660	8399.6670
160.080	.003355	1966717.	-26484.3173	-.0005277	185.5831	-10.3967	8552.0346
162.840	.001906	1893580.	-26506.9607	-.0005225	178.6818	-6.0116	8704.3978
165.600	.000471	1820398.	-26517.3421	-.0005176	171.7762	-1.5112	8856.7554
168.360	-.000951	1747205.	-26515.1443	-.0005128	164.8695	3.1038	9009.1063
171.120	-.002360	1674035.	-26500.0515	-.0005082	157.9651	7.8330	9161.4509
173.880	-.003756	1600924.	-26471.7489	-.0005039	151.0662	12.6761	9313.7893
176.640	-.005141	1527911.	-26429.9225	-.0004997	144.1765	17.6329	9466.1220
179.400	-.006515	1455031.	-26374.2587	-.0004957	137.2995	22.7032	9618.4491
182.160	-.007877	1382325.	-26125.2500	-.0004919	130.4388	157.7379	55266.2606
184.920	-.009230	1310820.	-25676.0863	-.0004883	123.6914	167.7430	50159.1587
187.680	-.010573	1240593.	-25200.2973	-.0004849	117.0647	177.0316	46212.9016
190.440	-.011907	1171714.	-24699.6385	-.0004817	110.5652	185.7647	43060.5082
193.200	-.013232	1104251.	-24175.4880	-.0004786	104.1992	194.0545	40477.2532
195.960	-.014549	1038265.	-23628.9560	-.0004758	97.9727	201.9831	38317.2316
198.720	-.015858	973819.	-23060.9550	-.0004731	91.8914	209.6119	36481.2715
201.480	-.017160	910969.	-22472.2463	-.0004706	85.9607	216.9886	34899.4326
204.240	-.018456	849772.	-21863.4737	-.0004682	80.1861	224.1509	33520.8684
207.000	-.019745	790283.	-21235.1871	-.0004660	74.5726	231.1292	32307.6616
209.760	-.021028	732554.	-20587.8605	-.0004640	69.1252	237.9481	31230.9186
212.520	-.022306	676638.	-19921.9051	-.0004621	63.8488	244.6283	30268.2078
215.280	-.023579	622585.	-19237.6801	-.0004604	58.7483	251.1870	29401.8311
218.040	-.024848	570446.	-18535.5005	-.0004588	53.8283	257.6388	28617.6249
220.800	-.026112	520269.	-17815.6441	-.0004573	49.0936	263.9963	27904.1111
223.560	-.027372	472103.	-17078.3566	-.0004560	44.5486	270.2701	27251.8837
226.320	-.028629	425996.	-16323.8557	-.0004548	40.1978	276.4697	26653.1566
229.080	-.029883	381996.	-15552.3353	-.0004537	36.0458	282.6031	26101.4270
231.840	-.031134	340148.	-14763.9678	-.0004528	32.0970	288.6777	25591.2188
234.600	-.032382	300499.	-13958.9072	-.0004519	28.3556	294.6996	25117.8867
237.360	-.033628	263094.	-13137.2910	-.0004512	24.8261	300.6745	24677.4631
240.120	-.034873	227981.	-12299.2421	-.0004505	21.5127	306.6074	24266.5384
242.880	-.036115	195203.	-11444.8703	-.0004499	18.4197	312.5026	23882.1662
245.640	-.037356	164805.	-10574.2738	-.0004495	15.5513	318.3643	23521.7865
248.400	-.038596	136833.	-9687.5406	-.0004491	12.9118	324.1960	23183.1647
251.160	-.039835	111330.	-8784.7491	-.0004487	10.5053	330.0008	22864.3417
253.920	-.041073	88340.7620	-7865.9694	-.0004485	8.3360	335.7816	22563.5926
256.680	-.042311	67909.6115	-6931.2641	-.0004483	6.4081	341.5411	22279.3930
259.440	-.043547	50080.1843	-5980.6889	-.0004481	4.7257	347.2815	22010.3911
262.200	-.044784	34896.2088	-5014.2935	-.0004480	3.2929	353.0050	21755.3842
264.960	-.046020	22401.2843	-4032.1220	-.0004479	2.1138	358.7135	21513.2989
267.720	-.047256	12638.8953	-3037.2997	-.0004479	1.1926	362.1723	21152.5659
270.480	-.048493	5635.3900	-2033.3848	-.0004478	.5317660	365.3023	20791.5492
273.240	-.049729	1414.6113	-1020.9040	-.0004478	.1334854	368.3795	20445.5636
276.000	-.050964	0.0000	0.0000	-.0004478	0.0000	371.4060	10056.8120

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.12572342 in
Computed slope at pile head	=	-.00103647
Maximum bending moment	=	3756088. lbs-in
Maximum shear force	=	-26517.34209 lbs
Depth of maximum bending moment	=	60.72000000 in
Depth of maximum shear force	=	165.60000 in
Number of iterations	=	20
Number of zero deflection points	=	1

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment,	y = pile-head displacment in
Type 2 = Shear and Slope,	M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness,	V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment,	S = Pile-head Slope, radians
Type 5 = Deflection and Slope,	R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 11414.	M= 3.31E+06	0.0000	.1257234	3756088.	-26517.3421

The analysis ended normally.

LPILE Plus for Windows, Version 5.0 (5.0.38)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Path to file locations: D:\08-115 SR57NB\Calc\Sign\
Name of input data file: S559A.lpd
Name of output file: S559A.lpo
Name of plot output file: S559A.lpp
Name of runtime file: S559A.lpr

Time and Date of Analysis

Date: February 11, 2009 Time: 10:29:38

Problem Title

New LPILE Plus 5.0 Data File

Program Options

Units Used in Computations - US Customary Units: Inches, Pounds

Basic Program Options:

Analysis Type 1:
- Computation of Lateral Pile Response Using User-specified Constant EI

Computation Options:
- Only internally-generated p-y curves used in analysis
- Analysis does not use p-y multipliers (individual pile or shaft action only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No additional p-y curves to be computed at user-specified depths

Solution Control Parameters:
- Number of pile increments = 100
- Maximum number of iterations allowed = 100
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 1.0000E+02 in

Printing Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (spacing of output points) = 1

Pile Structural Properties and Geometry

Pile Length = 276.00 in

Depth of ground surface below top of pile = .00 in

Slope angle of ground surface = .00 deg.

Structural properties of pile defined using 2 points

Point	Depth X in	Pile Diameter in	Moment of Inertia in**4	Pile Area Sq.in	Modulus of Elasticity lbs/Sq.in
1	0.0000	60.00000000	317925.0000	2260.8000	3250000.

2	276.0000	60.00000000	317925.0000	2260.8000	3250000.

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = .000 in
Distance from top of pile to bottom of layer = 120.000 in

Layer 2 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 120.000 in
Distance from top of pile to bottom of layer = 180.000 in

Layer 3 is soft clay, p-y criteria by Matlock, 1970
Distance from top of pile to top of layer = 180.000 in
Distance from top of pile to bottom of layer = 300.000 in

(Depth of lowest layer extends 24.00 in below pile tip)

Effective Unit Weight of Soil vs. Depth

Effective unit weight of soil with depth defined using 6 points

Point No.	Depth X in	Eff. Unit Weight lbs/in**3
1	.00	.06944
2	120.00	.06944
3	120.00	.06944
4	180.00	.06944
5	180.00	.07118
6	300.00	.07118

Shear Strength of Soils

Shear strength parameters with depth defined using 6 points

Point No.	Depth X in	Cohesion c lbs/in**2	Angle of Friction Deg.	E50 or k_rm	RQD %
1	.000	8.33333	.00	.01000	.0
2	120.000	8.33333	.00	.01000	.0
3	120.000	4.16667	.00	.02000	.0
4	180.000	4.16667	.00	.02000	.0
5	180.000	17.36111	.00	.00500	.0
6	300.000	17.36111	.00	.00500	.0

Notes:

(1) Cohesion = uniaxial compressive strength for rock materials.
(2) Values of E50 are reported for clay strata.
(3) Default values will be generated for E50 when input values are 0.
(4) RQD and k_rm are reported only for weak rock strata.

Loading Type

Static loading criteria was used for computation of p-y curves.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Shear force at pile head = 11414.000 lbs
Bending moment at pile head = 3311364.000 in-lbs
Axial load at pile head = 15921.000 lbs

Non-zero moment at pile head for this load case indicates the pile-head
may rotate under the applied pile-head loading, but is not a free-head
(zero moment) condition.

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Moment (BC Type 1)
Specified shear force at pile head = 11414.000 lbs
Specified moment at pile head = 3311364.000 in-lbs
Specified axial load at pile head = 15921.000 lbs

Non-zero moment for this load case indicates the pile-head may rotate under
the applied pile-head loading, but is not a free-head (zero moment)condition.

Depth X in	Deflect. y in	Moment M lbs-in	Shear V lbs	Slope S Rad.	Total Stress lbs/in**2	Soil Res. p lbs/in	Es*h F/L lbs/in
0.000	.054598	3311364.	11414.0000	-.0005881	319.5087	-248.5751	6282.8840
2.760	.052987	3341946.	10726.1323	-.0005792	322.3945	-249.8798	13015.7632
5.520	.051401	3370623.	10034.7847	-.0005703	325.1005	-251.0968	13482.8013
8.280	.049839	3397388.	9340.1998	-.0005612	327.6261	-252.2256	13967.7361
11.040	.048303	3422230.	8642.6213	-.0005521	329.9703	-253.2660	14471.4736
13.800	.046792	3445143.	7942.2939	-.0005429	332.1324	-254.2176	14994.9763
16.560	.045306	3466120.	7239.4634	-.0005337	334.1117	-255.0799	15539.2672
19.320	.043846	3485152.	6534.3765	-.0005244	335.9077	-255.8526	16105.4343
22.080	.042411	3502235.	5827.2810	-.0005151	337.5197	-256.5354	16694.6356
24.840	.041002	3517364.	5118.4255	-.0005057	338.9473	-257.1280	17308.1051
27.600	.039620	3530534.	4408.0597	-.0004963	340.1900	-257.6299	17947.1579
30.360	.038263	3541740.	3696.4342	-.0004869	341.2474	-258.0408	18613.1975
33.120	.036932	3550981.	2983.8003	-.0004774	342.1194	-258.3605	19307.7226
35.880	.035628	3558253.	2270.4105	-.0004679	342.8056	-258.5886	20032.3350
38.640	.034349	3563554.	1556.5179	-.0004584	343.3059	-258.7248	20788.7483
41.400	.033097	3566885.	842.3766	-.0004489	343.6202	-258.7688	21578.7975
44.160	.031872	3568244.	128.2415	-.0004393	343.7484	-258.7204	22404.4494
46.920	.030672	3567631.	-585.6317	-.0004298	343.6906	-258.5791	23267.8139
49.680	.029499	3565049.	-1298.9864	-.0004203	343.4469	-258.3447	24171.1573
52.440	.028352	3560498.	-2011.5653	-.0004107	343.0175	-258.0169	25116.9163
55.200	.027232	3553981.	-2723.1103	-.0004012	342.4025	-257.5954	26107.7135
57.960	.026138	3545502.	-3433.3623	-.0003918	341.6024	-257.0800	27146.3750
60.720	.025069	3535063.	-4142.0615	-.0003823	340.6174	-256.4702	28235.9501
63.480	.024027	3522671.	-4848.9474	-.0003729	339.4481	-255.7659	29379.7330
66.240	.023011	3508330.	-5553.7585	-.0003635	338.0948	-254.9667	30581.2869
69.000	.022021	3492046.	-6256.2325	-.0003541	336.5582	-254.0724	31844.4716
71.760	.021056	3473827.	-6956.1062	-.0003448	334.8390	-253.0825	33173.4741
74.520	.020117	3453679.	-7653.1154	-.0003356	332.9378	-251.9967	34572.8432
77.280	.019204	3431611.	-8346.9950	-.0003264	330.8555	-250.8147	36047.5287
80.040	.018316	3407632.	-9037.4791	-.0003173	328.5928	-249.5361	37602.9260
82.800	.017453	3381752.	-9724.3002	-.0003082	326.1507	-248.1604	39244.9262
85.560	.016614	3353981.	-10407.1901	-.0002992	323.5302	-246.6873	40979.9738
88.320	.015801	3324331.	-11085.8791	-.0002903	320.7323	-245.1163	42815.1328
91.080	.015012	3292813.	-11760.0960	-.0002814	317.7582	-243.4468	44758.1623
93.840	.014247	3259440.	-12429.5684	-.0002727	314.6090	-241.6782	46817.6035
96.600	.013507	3224225.	-13094.0219	-.0002640	311.2862	-239.8099	49002.8816
99.360	.012790	3187184.	-13753.1802	-.0002555	307.7908	-237.8411	51324.4226
102.120	.012097	3148330.	-14406.7650	-.0002470	304.1245	-235.7711	53793.7911
104.880	.011427	3107680.	-15054.4956	-.0002386	300.2887	-233.5989	56423.8513
107.640	.010779	3065250.	-15696.0883	-.0002304	296.2850	-231.3234	59228.9572
110.400	.010155	3021058.	-16331.2564	-.0002223	292.1149	-228.9434	62225.1788
113.160	.009552	2975121.	-16959.7099	-.0002143	287.7802	-226.4576	65430.5707
115.920	.008972	2927459.	-17581.1541	-.0002064	283.2828	-223.8643	68865.4963
118.680	.008413	2878092.	-18195.2901	-.0001986	278.6243	-221.1618	72553.0182
121.440	.007876	2827039.	-18644.1594	-.0001910	273.8069	-104.1058	36483.6003
124.200	.007359	2775193.	-18929.8845	-.0001835	268.9146	-102.9414	38608.8208
126.960	.006863	2722562.	-19212.3043	-.0001762	263.9482	-101.7106	40905.9844
129.720	.006386	2669156.	-19491.2334	-.0001690	258.9088	-100.4119	43395.0245
132.480	.005930	2614985.	-19766.4817	-.0001619	253.7971	-99.0434	46099.0759
135.240	.005493	2560059.	-20037.8534	-.0001550	248.6142	-97.6028	49045.1611
138.000	.005074	2504390.	-20305.1461	-.0001482	243.3611	-96.0876	52265.0668
140.760	.004674	2447988.	-20568.1501	-.0001416	238.0389	-94.4950	55796.4741
143.520	.004292	2390866.	-20826.6467	-.0001352	232.6488	-92.8214	59684.4370
146.280	.003928	2333037.	-21080.4068	-.0001289	227.1919	-91.0628	63983.3413
149.040	.003581	2274514.	-21329.1890	-.0001227	221.6696	-89.2142	68759.5415
151.800	.003251	2215310.	-21572.7372	-.0001167	216.0831	-87.2700	74094.9707
154.560	.002937	2155442.	-21810.7774	-.0001109	210.4338	-85.2229	80092.1791
157.320	.002639	2094925.	-22043.0141	-.0001052	204.7232	-83.0645	86881.5197
160.080	.002356	2033774.	-22269.1252	-9.9682E-05	198.9529	-80.7841	94631.6507
162.840	.002089	1972008.	-22488.7553	-9.4332E-05	193.1246	-78.3682	103565.
165.600	.001835	1909644.	-22701.5072	-8.9148E-05	187.2398	-75.7999	113984.
168.360	.001596	1846703.	-22906.9297	-8.4131E-05	181.3006	-73.0570	126307.
171.120	.001371	1783206.	-23104.5004	-7.9283E-05	175.3088	-70.1102	141139.
173.880	.001159	1719174.	-23291.4234	-7.4605E-05	169.2666	-65.3413	155633.
176.640	.000959	1654643.	-23456.9365	-7.0099E-05	163.1775	-54.5957	157094.

179.400	.000772	1589697.	-23593.4670	-6.5766E-05	157.0490	-44.3394	158556.
182.160	.000596	1524413.	-23873.7863	-6.1607E-05	150.8887	-158.7905	735133.
184.920	.000432	1457920.	-24252.6528	-5.7623E-05	144.6142	-115.7504	739941.
187.680	.000278	1390544.	-24515.9402	-5.3819E-05	138.2565	-75.0376	744749.
190.440	.000135	1322596.	-24669.9639	-5.0195E-05	131.8449	-36.5737	749557.
193.200	1.01E-06	1254370.	-24720.8153	-4.6754E-05	125.4069	-.2751553	754365.
195.960	-.000123	1186141.	-24674.3504	-4.3494E-05	118.9687	33.9454	759173.
198.720	-.000239	1118171.	-24536.1790	-4.0417E-05	112.5549	66.1788	763981.
201.480	-.000347	1050705.	-24311.6562	-3.7520E-05	106.1887	96.5190	768789.
204.240	-.000446	983974.	-24005.8741	-3.4802E-05	99.8919	125.0623	773597.
207.000	-.000539	918196.	-23623.6566	-3.2262E-05	93.6849	151.9069	778405.
209.760	-.000624	853575.	-23169.5545	-2.9896E-05	87.5871	177.1526	783213.
212.520	-.000704	790303.	-22647.8418	-2.7700E-05	81.6166	200.9001	788021.
215.280	-.000777	728561.	-22062.5142	-2.5671E-05	75.7906	223.2503	792829.
218.040	-.000845	668520.	-21417.2885	-2.3806E-05	70.1250	244.3045	797637.
220.800	-.000909	610340.	-20715.6029	-2.2097E-05	64.6350	264.1633	802445.
223.560	-.000967	554172.	-19960.6193	-2.0542E-05	59.3349	282.9263	807253.
226.320	-.001022	500159.	-19155.2263	-1.9134E-05	54.2381	300.6918	812061.
229.080	-.001073	448436.	-18302.0436	-1.7867E-05	49.3575	317.5565	816869.
231.840	-.001121	399133.	-17403.4277	-1.6735E-05	44.7051	333.6144	821677.
234.600	-.001165	352371.	-16461.4787	-1.5731E-05	40.2926	348.9573	826485.
237.360	-.001207	308267.	-15479.8779	-1.4849E-05	36.1309	362.3477	828262.
240.120	-.001247	266923.	-14471.4198	-1.4081E-05	32.2296	368.4191	815236.
242.880	-.001285	228386.	-13446.5211	-1.3419E-05	28.5931	374.2611	803754.
245.640	-.001321	192700.	-12405.7627	-1.2857E-05	25.2257	379.9117	793540.
248.400	-.001356	159907.	-11349.6275	-1.2386E-05	22.1314	385.4038	784369.
251.160	-.001390	130051.	-10278.5127	-1.1999E-05	19.3140	390.7663	776057.
253.920	-.001422	103171.	-9192.7413	-1.1687E-05	16.7776	396.0246	768454.
256.680	-.001454	79307.9904	-8092.5709	-1.1444E-05	14.5258	401.2004	761432.
259.440	-.001486	58501.0847	-6978.2031	-1.1259E-05	12.5625	406.3125	754891.
262.200	-.001516	40789.2987	-5849.7913	-1.1127E-05	10.8912	411.3772	748747.
264.960	-.001547	26211.2146	-4707.4484	-1.1037E-05	9.5155	416.4075	742930.
267.720	-.001577	14805.1533	-3551.2541	-1.0983E-05	8.4392	421.4145	737389.
270.480	-.001608	6609.2572	-2381.2613	-1.0954E-05	7.6659	426.4064	732080.
273.240	-.001638	1661.5533	-1197.5034	-1.0943E-05	7.1990	431.3892	726974.
276.000	-.001668	0.0000	0.0000	-1.0941E-05	7.0422	436.3669	361025.

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.05459812 in
Computed slope at pile head	=	-.00058811
Maximum bending moment	=	3568244. lbs-in
Maximum shear force	=	-24720.81527 lbs
Depth of maximum bending moment	=	44.16000000 in
Depth of maximum shear force	=	193.20000 in
Number of iterations	=	17
Number of zero deflection points	=	1

Summary of Pile Response(s)

Definition of Symbols for Pile-Head Loading Conditions:

Type 1 = Shear and Moment, y = pile-head displacment in
Type 2 = Shear and Slope, M = Pile-head Moment lbs-in
Type 3 = Shear and Rot. Stiffness, V = Pile-head Shear Force lbs
Type 4 = Deflection and Moment, S = Pile-head Slope, radians
Type 5 = Deflection and Slope, R = Rot. Stiffness of Pile-head in-lbs/rad

Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
1	V= 11414.	M= 3.31E+06	15921.0000	.0545981	3568244.	-24720.8153

The analysis ended normally.

APPENDIX D

CALTRANS REVIEW COMMENTS AND EMI RESPONSES

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

May 22, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, CA 92618

Attention: Mr. Steve Huff

Subject: Response to Caltrans Foundation Review Comments on "Sign Structures Foundation Report (dated 2/11/09), SR-57 Northbound Widening"
12-Ora-57, PM 16.2/18.6, EA 12-0F0311

Dear Mr. Huff:

Caltrans issued a Foundation Review sheet dated May 18, 2009 for overhead sign structures at Stations 535+80, 551+00 and 559+55 (SR-57 Line). A copy of this review sheet is attached. The following are our responses to those comments:

Section 2.1, Field Investigation

Response: The revised Table 2-1 is presented below:

Table 0-1. Geotechnical Exploration Information

Boring No.	Station Line	Station	Approx. Offset (ft)	Approx. Ground Surface El. (ft)	Approx. Bottom of Hole El. (ft)	Water Level El. (ft)
A-08-017	SR-57 (B-Line)	535+70	66 RT	+258.0	+166.5	None Encountered During Drilling
A-08-128		546+84	102RT	+251.0	+219.5	
A-08-129		553+15	94RT	+255.8	+244.3	
C-08-131		561+88	116RT	+263.6	+183.4	

6.2 Axial Capacity

Response: We will remove wet method of construction in the final report.

Appendix A-Log of Test Borings (LOTB) Sheets

Response: The attached LOTB sheet incorporated the following revisions per Caltrans review:

- An appropriate border is used in the attached LOTB sheet.
- SR-57 (B-Line) is now shown on the Plan View.
- Soil Legend sheets will be at the end in the final report.

17660 Newhope Street, Suite E, Fountain Valley, California 92708 Tel: (714) 751-3826 Fax: (714) 751-3928

- Name and direction have been added.
- Pocket penetrometer test results have been added.
- "Groundwater not encountered during drilling" has been added.
- Conversion factor from 2.4" California Modified Ring sampler blowcount to 1.4" Standard Penetration Test sampler blowcount is added to the "Notes"
- We added Vertical Datum is NAVD 88.
- Based on our recent discussions, separation lines are drawn when there is a change in group symbol, and not group name.

Sincerely,
EARTH MECHANICS, INC.

Lino Cheang

Lino Cheang, GE 2345
Project Manager

Attachments
- Caltrans Foundation Review sheet dated April 2, 2009
- Revised LOTB Sheets ← in foundation report

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MS. MILI LIM STAMATION
Branch Chief, Design A

Date: May 18, 2009
File: 12-ORA-57-PM 16.0/18.4
12-0F0311
Overhead Signs at Station
535+80, 551+00 & 559+55
SR-57 Northbound Widening
(Southern Segment)

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South 1 MS # 18

Subject: Review of the Draft Sign Structures Foundation Report

On May 11, 2009, the Office of Geotechnical Design-South 1 received the Sign Structures Foundation Report prepared by Earth Mechanics Inc, dated February 11, 2009 for the construction of 3 single post sign structures. We reviewed the report and our comments are as follows:

2.1 Field Investigation

- Station line (B-line) in Table 2-1 is not described clearly (e.g. SR-57 centerline)

6.2 Axial Capacity

- Wet method of construction should not be recommended for caving control, since it requires additional instrumentation and increase the chance of pile anomaly.

Appendix A-Log of Test Boring (LOTB) Sheets

- Please refer to the Caltrans Soil and Rock Logging Manual (June 2007), and use an appropriate LOTB and soil legends border. Title block should be at the bottom of the sheet, not on the left margin.
- Station line (B-line) in plan view should be described clearly (e.g. SR-57 centerline).
- Soil legend sheets should be the end sheets of the LOTB.
- Please show name and direction of the nearest cities on plan view.
- Please add pocket penetrometer test result into the description of the corresponding layer.

- When groundwater is not shown on the borings, explain in a sentence under each boring such as groundwater was not encountered or measured during field investigation.
- Correction/multiplication factor for conversion of 2.4" California Modified ring sampler blow count to 1.4" Standard Penetration Test sampler blow count for granular and cohesive soils should be noted on LOTB.
- It is required to note datum used for surveying boreholes in LOTB (NGVD 29 or NAVD88).
- Separation lines should be drawn in graphic/symbols column where group name changes (e.g. 15 feet below top of A-08-017).

If you have any questions regarding above comments, please contact Chungkeun Lee at (213) 620-2148.

Prepared by: Date: 5/18/09 Reviewed by: Date: 5/18/09

REGISTERED PROFESSIONAL ENGINEER
CHUNGKEUN LEE
C69450
Exp. 6/30/10
CIVIL
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Chungkeun Lee, P.E.
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Faramarz Gerami, P.G., C.E.G.
Engineering Geologist
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Branch C

c: OGDS1 - LA. File (2)
OGDS1 - Sac. File (1)
GS – Sac. File (1)

FINAL AERIALLY DEPOSITED LEAD REPORT

SR-57 Northbound Improvement Project
Orange County, California
12-Ora-57, PM 16.2/18.6
EA 12-0F0311

EMI Project No. 08-115
Date: June 29, 2009

EARTH MECHANICS, INC.

Geotechnical and Earthquake Engineering

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

June 29, 2009

EMI Project No. 08-115

RBF Consulting
14725 Alton Parkway
Irvine, California 92618

Attention: Mr. Steve Huff

Subject: ***Final Aerially Deposited Lead Report***
SR-57 Northbound Improvement Project (Orangethorpe Ave to Yorba Linda Blvd)
County of Orange, California
12-Ora-57, PM 16.2/18.6, EA 12-0F0311

Dear Mr. Huff:

Attached is our Final Aerially Deposited Lead (ADL) Report for the subject project. This report presents the results of our field and laboratory investigation including analyses and recommendations for handling, disposal and re-use of potentially lead-contaminated soils as part of the structure and roadway improvements for the subject project.

Earlier versions of this ADL Report, dated February 11, 2009 and June 17, 2009, were reviewed by Caltrans. A copy of the review sheets and EMI responses are attached in Appendix F of this report. This report has been revised to incorporate our responses to those review comments.

We appreciate the opportunity to provide geotechnical services for the project. If you have any questions please call us.

Sincerely,
EARTH MECHANICS, INC.

Chien-Tai Yang, CE 66374
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
CHIEN-TAI YANG
NO. C66374
EXP. 06-30-2010
CIVIL
STATE OF CALIFORNIA

Lino Cheang, GE 2345
Project Manager

REGISTERED PROFESSIONAL ENGINEER
LINO C. CHEANG
NO. GE 2345
EXP. 9/30/09
GEOTECHNICAL
STATE OF CALIFORNIA

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FINAL AERIALLY DEPOSITED LEAD REPORT
SR-57 NORTHBOUND IMPROVEMENT PROJECT
(ORANGETHORPE AVENUE TO YORBA LINDA BOULEVARD)
COUNTY OF ORANGE, CALIFORNIA
12-Ora-57, PM 16.2/18.6, EA 12-0F0311

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TABLE OF CONTENTS

Section		Page
EXECUTIVE SUMMARY		**I**
1.0	**INTRODUCTION**	**1**
1.1	Project Description and Objectives	1
1.2	Scope of Work	1
1.2.1	Pre-field Activities	1
1.2.2	Soil Sampling	2
1.2.3	Laboratory Analysis	2
1.2.4	Global Positioning System Surveying	2
1.3	Previous Site Investigations	3
2.0	**INVESTIGATIVE METHODS AND RESULTS**	**4**
2.1	Investigative Methods	4
2.2	Analytical Results	4
2.2.1	Total Lead	4
2.2.2	Soluble Lead (Wet Citric – STLC)	4
2.2.3	Soluble Lead (Wet-DI)	4
2.2.4	Toxicity Characteristic Leaching Procedure (TCLP)	4
2.2.5	pH Results	4
3.0	**STATISTICAL DATA EVALUATION**	**5**
3.1	Statistical Evaluation Methods	5
3.2	Data Distribution	5
3.3	Upper Confidence Limit (UCL)	5
3.4	Regression Analysis	6
4.0	**CONCLUSIONS AND RECOMMENDATIONS**	**7**
4.1	DTSC Variance and Aerially Deposited Lead Soil Management	7
4.1.1	DTSC Variance	7
4.1.2	Criteria for Disposal of Soil Not Intended for Reuse onsite	7
4.1.3	Caltrans Aerially Deposited Lead Soil Management	7
4.2	Conclusions	9
4.2.1	Region I - Stations 461+35 to 501	9
4.2.2	Region II - Stations 501 to 523	10
4.2.3	Region III - Stations 523 to 543	11
4.2.4	Region IV - Stations 543 to 587+15	11
4.3	Recommendations	12
5.0	**LIMITATIONS**	**14**
6.0	**REFERENCES**	**15**

TABLE OF CONTENTS (CONTINUED)

TABLE

Table 1. Summary of Analytical Soil Test Results

FIGURES

Figure 1. Site Location Map
Figure 2. Boring Location Plan (1 of 12)
Figure 3. Boring Location Plan (2 of 12)
Figure 4. Boring Location Plan (3 of 12)
Figure 5. Boring Location Plan (4 of 12)
Figure 6. Boring Location Plan (5 of 12)
Figure 7. Boring Location Plan (6 of 12)
Figure 8. Boring Location Plan (7 of 12)
Figure 9. Boring Location Plan (8 of 12)
Figure 10. Boring Location Plan (9 of 12)
Figure 11. Boring Location Plan (10 of 12)
Figure 12. Boring Location Plan (11 of 12)
Figure 13. Boring Location Plan (12 of 12)
Figure 14. Regression Analysis for Region II
Figure 15. Block Diagrams for Onsite Reuse – Region II
Figure 16. Block Diagram for Offsite Disposal – Region II
Figure 17. Regression Analysis for Region III
Figure 18. Block Diagrams for Onsite Reuse – Region III
Figure 19. Block Diagram for Offsite Disposal – Region III
Figure 20. Regression Analysis for Region IV
Figure 21. Block Diagrams for Onsite Reuse – Region IV
Figure 22. Block Diagram for Offsite Disposal – Region IV

APPENDICES

Appendix A. Lead Contamination in Yellow Thermoplastic Traffic Stripe and Pavement Marking
Appendix B. Chain-of-Custody Forms
Appendix C. Laboratory Soil Test Results
Appendix D. Statistic Calculations
Appendix E. DTSC Variance
Appendix F. Caltrans Comments and EMI Responses

EXECUTIVE SUMMARY

Earth Mechanics, Inc. (EMI) performed an aerially deposited lead study on the Mainline and ramp shoulders of the northbound State Route 57 (SR-57), approximately between Orangethorpe Avenue and Yorba Linda Boulevard. This report is prepared to evaluate the potential presence of aerially deposited lead from historic usage of leaded gasoline. Data collected during this investigation was used to identify the need for special handling or disposal of soil in the proposed project site to provide for worker and public safety during project construction.

Forty (40) shallow borings were drilled to collect near-surface samples of on-site soils specifically for ADL testing. Boring locations were selected such that borings would be evenly distributed within Caltrans right-of-way, along unpaved shoulders of existing paved roadways where excavations are planned. A total of 160 soil samples were analyzed for total lead; 27 of the samples containing total lead greater than or equal to 75 mg/kg were analyzed for soluble lead using Wet Citric method; and 21 out of 27 samples exceeding 5 mg/l of extractable lead using Wet-Citric method were analyzed for soluble lead using Wet-DI method and for leachable lead using TCLP method. A total of 24 samples were analyzed for pH.

Statistical methods were applied to the lead data using EPA ProUCL V4.00.02 software to evaluate: 1) the total lead data distribution, 2) the one-sided upper-confidence limits (UCLs) of the true means of the total lead concentrations, and 3) if an acceptable correlation between total and soluble lead concentrations exists, that would allow predication of soluble lead concentrations based on calculated UCLs. Our recommendations for soil reuse on-site and off-site disposal are based on California Department of Transportation (Caltrans) Aerially Deposited Lead Guidance (2007), Caltrans Aerially Deposited Lead Soil Management (2007), and the Lead Variance issued to Caltrans by the California Department of Toxic Substance Control (DTSC). This variance is set to expire in June 30, 2009.

Based on the analytical results, soils from the following regions including the mainline and ramps should be managed as Soil Type Y1 based on Section 4.1 of Caltrans Aerially Deposited Lead Soil Management:

- soils from the upper 0.5 feet between Station 501 and 523 (Region II),
- soils from the upper 4 feet between Station 523 and 543 (Region III), and
- soils from the upper 0.5 feet between Station 543 and 587+15 (Region IV);

the remaining soils within the project limit are considered as Soil Type X. For soils classified as Soil Type X, there is no special requirement for on-site reuse and off-site disposal.

Soils classified as Soil Type Y1 are suitable for on-site reuse with respect to the total and WET-DI soluble lead concentrations. They are allowed to be used as fill in the Caltrans right-of-way provided the soil is placed a minimum of 5 feet above the maximum level of water table and is covered with a minimum of 1 foot of clean soil. If the above soils are elected to be disposed offsite, they should be classified as Soil Type Z2 since the WET-citric soluble lead

concentrations exceed the STLC of 5.0 mg/l. Soil Type Z2 is considered as California hazardous waste. Therefore, they should be disposed at a Class I hazardous waste facility.

This report also provides detailed of an investigation for lead contamination in yellow thermoplastic traffic striping and pavement marking. Testing at three separate locations all show lead concentration in excess of 1000 mg/kg. Based on our test results and Caltrans requirements, we recommend all yellow thermoplastic traffic striping and pavement marking within the project limits (if removed) must be disposed in a Class I hazardous waste facility.

An appropriate SSP should be prepared by RBF for proper handling of contaminated soils and traffic stripes. Contractors handling contaminated soils and traffic stripes should prepare Lead Compliance Plan in accordance with the Caltrans Code of Safety Practices, California Code of Regulations and Cal-OSHA standards addressing the presence of ADL in the soils within the project area. Lead content testing results contained herein should be given to contractors handling the soils during construction.

1.0 INTRODUCTION

1.1 Project Description and Objectives

The Department of Tansportation (Caltrans) – District 12, in cooperation with the Orange County Transportation Authority (OCTA), proposed to widen northbound State Route 57 (SR-57) by adding one northbound through lane. The project limits are between 0.2 miles south of Orangethorpe Avenue and 0.2 miles north of Yorba Linda Boulevard along northbound SR-57 (Figure 1). SR-57 within the project limits generally consists of 2 HOV lanes and eight mixed-flow lanes. Within the project limits, there are interchanges located at Orangethorpe Avenue, Chapman Avenue, Nutwood Avenue and Yorba Linda Boulevard. Details of the existing configuration and proposed improvements are described in the following table.

Location	Existing Facility	Proposed Improvements
Orangethorpe Ave Exit Ramp to Orangethorpe Ave Entrance Ramp	1 HOV lane and 5 mixed-flow lanes	Add 1 mixed-flow lane
Orangethorpe Ave Entrance Ramp to Chapman Ave Exit Ramp	1 HOV lane, 4 mixed-flow lanes, and 1 auxiliary lane	Add 1 mixed-flow lane
Chapman Ave Exit Ramp to Nutwood Ave Entrance Ramp	1 HOV lane and 4 mixed-flow lanes	Add 1 mixed-flow lane
Nutwood Ave Entrance Ramp to Yorba Linda Blvd Exit Ramp	1 HOV lane, 4 mixed-flow lanes and 1 auxiliary lane	Add 1 mixed-flow lane
Yorba Linda Blvd Exit Ramp to Yorba Linda Blvd North Entrance Ramp	1 HOV lane and 4 mixed-flow lanes	Add 1 mixed-flow lane

This Aerially Deposited Lead (ADL) report has been prepared by Earth Mechanics, Inc. (EMI) to evaluate the potential presence of aerially deposited lead from historic usage of leaded gasoline. The objective of this ADL study is to identify the need of special handling or disposal of soil in the proposed project site to provide for worker and public safety during project construction.

A stand-alone memorandum is also included in Appendix A describing the investigation, testing, results and recommendations for lead contamination in yellow thermoplastic traffic striping and pavement marking.

1.2 Scope of Work

1.2.1 Pre-field Activities

EMI conducted pre-field activities including (1) preparing a site-specific health and safety plan and a boring location map, (2) securing an encroachment permit from Caltrans, (3) marking proposed borehole locations, (4) notifying Underground Service Alert for utility clearance, and (5) coordinating our work with Caltrans.

1.2.2 Soil Sampling

The field investigation, accomplished between October 6 and 10, 2008 and May 27 and 28, 2009, included excavating forty shallow borings to collect near-surface samples of on-site soils specifically for ADL testing. The approximate locations of the borings are shown on the attached boring location plans (Figures 2 through 13). Boring locations were selected such that borings would be evenly distributed within Caltrans right-of-way, along unpaved shoulders of existing paved roadways where excavations are expected to be performed. Some samples were collected on slopes and denoted by a symbol "S"; the remaining samples were collected on flat grounds and denoted by a symbol "L". Borings were excavated to a depth up to 4 feet below existing grade using a 3-inch diameter stainless steel hand auger. Soil samples were collected from depths of about 6 inches, 1.5 feet, 3 feet, and 4 feet below existing grade. A total of 160 soil samples were collected and tested for ADL content.

The soil samples were retrieved from the hand auger bailer and immediately placed in clean glass jars with teflon lids. Jars were labeled with project information including the project name and number, boring number, sample number, depth from which sample was collected, date and time of sampling. All samples were entered on the chain-of-custody forms and transported to certified laboratories for testing. Copies of the chain-of-custody forms are provided in Appendix B.

1.2.3 Laboratory Analysis

Soil samples collected from the field investigation were forwarded to TestAmerica or Associated Laboratories; both are California Certified Analytical Laboratory. The types of tests planned including total lead (TTLC), soluble lead content by the California Waste Extraction Test using CITRATE (STLC) and de-ionized water (WET-DI) as the leaching compound, soluble lead using the toxicity characteristic leaching procedure (TCLP) and pH.

Laboratory testing on the selected soil samples was based on the following criteria:

- all samples were tested for total lead using EPA Method 6010,
- samples that contain greater than or equal to 75 mg/kg of total lead will be analyzed for soluble lead using Waste Extraction Test (WET-Citric acid extraction) for extractable lead,
- samples that contain greater than or equal to 5 mg/l of extractable lead using WET-Citric, will be analyzed using WET-DI (de-ionized extraction) for de-ionized extractable lead and using the IPA Toxic Characteristic Leaching Procedure (TCLP) for leachable lead, and
- Ten percent of soil samples collected will be analyzed for pH.

A summary of test results is presented in Table 1. Copies of original laboratory test results for the soil samples are presented in Appendix C.

1.2.4 Global Positioning System Surveying

Subsequent to soil sampling, each boring location was surveyed using the Global Positioning System (GPS). GPS coordinates of each locations are presented in Table 1.

1.3 Previous Site Investigations

EMI has not performed previous investigations in the project area. In addition, Caltrans has not notified EMI of any previous investigation performed in the project area.

2.0 INVESTIGATIVE METHODS AND RESULTS

2.1 Investigative Methods

The field methods used by EMI during this sampling and site investigation were consistent with the work plan prepared by EMI dated September 9, 2008. The work plan was approved by Caltrans prior to beginning the field activities.

2.2 Analytical Results

2.2.1 Total Lead

A total of 160 soil samples were analyzed for total lead. Total lead concentrations ranged from less than 2 mg/kg (Non-Detects – ND) to 580 mg/kg. The arithmetic mean of total lead concentration for the 160 samples is approximately 48 mg/kg (the reporting limit of 2.0 mg/kg is used in the calculation for samples with ND lead).

2.2.2 Soluble Lead (Wet Citric – STLC)

A total of 27 soil samples were analyzed for soluble lead using Wet Citric Method. Only those samples that contain greater than or equal to 75 mg/kg of total lead were analyzed by this method. Concentrations ranged from 2.6 mg/l to 33 mg/l.

2.2.3 Soluble Lead (Wet-DI)

A total of 21 soil samples were analyzed for soluble lead using Wet-DI Method. Only those samples that contain greater than or equal to 5 mg/l of extractable lead using Wet-Citric method were analyzed by this method. Concentrations ranged from 0.019 mg/l to 0.33 mg/l.

2.2.4 Toxicity Characteristic Leaching Procedure (TCLP)

A total of 21 soil samples were analyzed for leachable lead using TCLP method. Only those samples that contain greater than or equal to 5 mg/l of extractable lead using Wet-Citric method were analyzed by this method. Concentrations ranged less than 0.05 mg/l (ND) to 1.65 mg/l.

2.2.5 pH Results

A total of 24 samples were analyzed for pH. The values ranged from 7.74 to 9.57.

3.0 STATISTICAL DATA EVALUATION

3.1 Statistical Evaluation Methods

The analytical results were evaluated statistically to recommend the appropriate method of onsite reuse or offsite disposal of excavated soil. Statistical methods were applied to the lead data to evaluate: (1) the total lead data distribution, (2) the one-sided upper-confidence limits (UCLs) of the true means of the total lead concentrations, and (3) if an acceptable correlation between total and soluble lead concentrations exists, that would allow prediction of soluble lead concentrations based on calculated UCLs.

For the analyses presented herein, ND samples are replaced with a value equal to the reporting limit of the analysis. This is consistent with the ProUCL V4.00.02 user guide recommendations.

3.2 Data Distribution

The primary statistical element used to classify ADL-impacted soils is the UCL on the mean. There are several different methods to calculate the 95% UCL on the mean consisting of parametric methods that are dependent on the distribution of data, and non-parametric methods that are independent of the distribution of data.

Caltrans ADL Guidance recommends specific methodology for calculation of the UCL for three different parametric distributions (normal distribution, log-normal distribution and gamma distribution) and for non-parametric distributions. The advantage of using parametric tests is their assumptions are more stringent, thereby requiring less qualification of the results in drawing conclusions about the data. Non-parametric methods enable data to be reduced that otherwise would be unsuitable for statistical analysis.

Goodness-of-fit tests are performed using the EPA's statistical program ProUCL V4.00.02 to determine the distribution of the sample data. Based on the number of samples and the distribution of data, the appropriate statistical method is selected to calculate the 95% UCL on the mean. If the data do not appear to be distributed normally, log-normally or as a gamma distribution, application of a non-parametric method is required to determine the 95% UCL on the mean.

3.3 Upper Confidence Limit (UCL)

The method of calculation of the UCL is based upon the recommendations provided in the Caltrans ADL Guidelines and determined using the statistical program ProUCL V4.00.02. For normally-distributed data, the 95% UCL on the mean is determined using the Student's-t distribution. For log-normally-distributed data, the H-statistic based UCL is used if the standard deviation is less than 2.0; otherwise, either a UCL computation based upon a gamma distribution, a non-parametric bootstrap or Chebyshev method is used to determine the UCL. For gamma-distributed data, either a gamma method, adjusted gamma method, Bootstrap-t or Hall's Bootstrap method may be used to determine the UCL. For data that are not normally-, log-normally-, or gamma-distributed, a variety of non-parametric distributions may be used including Hall's Bootstrap UCL, the Chebyshev UCL, and the modified-t statistic.

3.4 Regression Analysis

For samples tested with greater than 75 mg/kg of total lead requiring that soluble lead be tested using the WET-Citric method, a correlation between the 95% UCL on the mean for total lead and the 95% UCL on the mean for soluble lead can be obtained using a regression analysis.

The regression analysis consists of creating a least-squares-fit approximation of the soluble lead and total lead data and obtaining a correlation coefficient "r". If the regression analysis yields a correlation coefficient, "r," value of 0.8 or greater, the 95% UCL for total lead can be correlated to the 95% UCL for soluble lead. If "r" is less than 0.8, then the determination of the 95% UCL on the mean for soluble lead may not be achievable by this method. To determine the correlation coefficient, "r," a line is fit to the data using the equation:

$$y = mx + b$$

where:
- y = soluble lead by WET-Citric, mg/l
- x = total lead concentration, mg/kg
- b = y-intercept
- m = slope = $(r\ s_t)/s_s$

where:
- r = correlation coefficient
- s_t = standard deviation of the total lead concentrations
- s_s = standard deviation of the soluble lead concentrations

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 DTSC Variance and Aerially Deposited Lead Soil Management

4.1.1 DTSC Variance

The Variance issued by the California Department of Toxic Substance Control (DTSC) (See Appendix E for details) classifies soils based on total and soluble lead concentrations to provide guidance on appropriate management of these materials. In accordance with the DTSC Variance, soil that is subject to the guidelines presented below may be reused within the Caltrans right-of-way.

- Reuse - Condition 1: Soil containing less than or equal to 0.5 mg/l extractable lead by the Waste Extraction Test using de-ionized water as the extractant (WET-DI) and less than or equal to 1,411 mg/kg total lead (U.S. Environmental Protection Agency [U.S. EPA] Method 6010) may be re-used as fill in the Caltrans right-of-way provided the soil is placed a minimum of 5 feet above the maximum level of the water table and covered with at least 1 foot of non-hazardous soil.

- Reuse - Condition 2: Soil containing greater than 0.5 mg/l but less than 50 mg/l extractable lead by the WET-DI method, and more than 1,411 mg/kg total lead but less than 3,397 mg/kg total lead, may be re-used as fill in the Caltrans right-of-way provided the soil is placed a minimum of 5 feet above the maximum level of the water table and protected from infiltration by a paved structure that will be maintained by Caltrans.

- Reuse - Condition 3: Soil that has a pH value less than 5.0 may only be re-used as fill material under the paved portion of the roadway. This condition takes precedence over Conditions 1 and 2.

4.1.2 Criteria for Disposal of Soil Not Intended for Reuse onsite

If Caltrans elects not to re-use soil within the Caltrans right-of-way that has been excavated during construction activities, the soil may be classified either as hazardous waste or non-hazardous waste. This distinction is based on the total (TTLC) and soluble (STLC) lead concentrations as compared to the limits set by RCRA. According to RCRA, soils with TTLC $\geq$ 1,000 mg/kg or STLC $\geq$ 5 mg/l or pH $\leq$ 2.0 or pH $\geq$ 12.5 are classified as hazardous waste.

4.1.3 Caltrans Aerially Deposited Lead Soil Management

The following table lists the Caltrans Aerially Deposited Lead Soil Management (2007) following the DTSC Variance.

SOLUBLE LEAD (mg/l)	TOTAL LEAD (mg/kg)	SOIL TYPE	HANDLING
California Testing			
STLC < 5.0	TTLC < 1000	X	Non-hazardous. Notify and require Lead Compliance Plan for worker safety.
	1000 ≤ TTLC <1411 & DI WET < 0.5 mg/l	Y1	Hazardous Variance applies – cover with minimum 1 foot of clean soil.
	1411 ≤ TTLC < 3397 & DI WET < 50 mg/l	Y2	Hazardous Variance applies – cover with pavement structure.
	1000 ≤ TTLC < 3397 but Surplus	Z2	Surplus - Hazardous Dispose at Class 1 disposal site.
	3397 ≤ TTLC or 1000 ≤ TTLC < 3397 and DI WET > 50 mg/l	Z2	Hazardous – not reusable under Variance. Dispose at Class 1 disposal site.
STLC > 5.0	TTLC < 1411 & DI WET < 0.5 mg/l	Y1	Hazardous Variance applies – cover with minimum of 1 foot of clean soil.
	1411 ≤ TTLC < 3397 & DI WET < 50 mg/l	Y2	Hazardous Variance applies – cover with pavement structure.
	TTLC < 3397 & DI WET < 50 mg/l but Surplus	Z2	Surplus – Hazardous Dispose at Class 1 disposal site.
	3397 ≤ TTLC or DI WET > 50 mg/l	Z2	Hazardous – not reusable under Variance Dispose at Class 1 disposal site.
Federal Testing TCLP > 5.0 mg/l	N/A	Z3	RCRA Hazardous Waste Dispose at Class 1 disposal site as a RCRA waste regardless of TTLC and STLC results.

4.2 Conclusions

Based on the laboratory test results, the project was divided into four regions:

- Region I - Stations 461+35 (south project limit) to 501: contains the samples collected between Borings L-1 and S-13,
- Region II - Stations 501 to 523: contains the samples collected between Borings L-14 and L-19,
- Region III - Stations 523 to 543: contains the samples collected between Borings L-20 and L-26, and
- Region IV - Stations 543 to 587+15 (north project limit): contains the samples collected between Borings L-27 and L-40.

The above regions include the SR-57 mainline and ramps. In addition, four of the possible soil excavation depth scenarios were evaluated in each region and the corresponding UCLs for TTLC were also calculated.

Scenario		Depth Interval (ft)
A	A1	0.0-0.5
	A2	0.5-4.0
B	B1	0.0-1.5
	B2	1.5-4.0
C	C1	0.0-3.0
	C2	3.0-4.0
D		0.0-4.0

4.2.1 Region I - Stations 461+35 to 501

Results of the statistical analysis for Region I are presented below. Since there are no samples tested with greater than 75 mg/kg of TTLC, tests for soluble and leachable lead were not required. Therefore, there was no need for the regression and block diagram analyses.

Scenario		Depth Interval (ft)	TTLC			STLC		WET-DI		TCLP		UCL		
			No.	Mean (mg/kg)	SD (mg/kg)	No.	Mean (mg/l)	No.	Mean (mg/l)	No.	Mean (mg/l)	95% UCL TTLC	Distribution	Proj. STLC (mg/l)
A	A1	0.0-0.5	13	35.6	17.9	0	-	0	-	0	-	45.4	Gamma	-
	A2	0.5-4.0	39	25.2	11.9	0	-	0	-	0	-	28.3	Student's-t	-
B	B1	0.0-1.5	26	31.3	15.1	0	-	0	-	0	-	36.6	Gamma	-
	B2	1.5-4.0	26	24.3	12.6	0	-	0	-	0	-	28.5	Student's-t	-
C	C1	0.0-3.0	39	29.9	14.7	0	-	0	-	0	-	34.2	Gamma	-
	C2	3.0-4.0	13	21.4	10.9	0	-	0	-	0	-	26.8	Student's-t	-
D		0.0-4.0	52	27.8	14.2	0	-	0	-	0	-	31.5	Gamma	-

Based on the above 95% UCL of TTLC, soils in Region I are considered as Soil Type "X", which is non-hazardous. There is no special requirement for on-site reuse and off-site disposal.

4.2.2 Region II - Stations 501 to 523

Results of the statistical analysis for Region II are presented below. As shown in Figure 14, a regression analysis between TTLC and STLC was performed and a correlation coefficient of 0.98 was obtained. This indicates that the 95% UCL for TTLC can be correlated to the 95% UCL for STLC, and the projected STLC are also listed in the following table.

Scenario		Depth Interval (ft)	TTLC			STLC		WET-DI		TCLP		UCL		
			No.	Mean (mg/kg)	SD (mg/kg)	No.	Mean (mg/l)	No.	Mean (mg/l)	No.	Mean (mg/l)	95% UCL TTLC	Distribution	Proj. STLC (mg/l)
A	A1	0.0-0.5	6	97.5	146.6	2	18.5	1	0.064	1	0.36	398.0	Gamma	32.1
	A2	0.5-4.0	18	41.0	54.9	3	6.0	2	0.154	2	0.05	70.0	Gamma	0.1
B	B1	0.0-1.5	12	88.4	112.4	4	13.1	3	0.124	3	0.153	186.1	Gamma	11.4
	B2	1.5-4.0	12	21.8	26.2	1	2.6	0	-	0	-	38.0	Gamma	-3.1[1]
C	C1	0.0-3.0	18	62.8	97.9	4	13.1	3	0.124	3	0.153	114.7	Gamma	4.4
	C2	3.0-4.0	6	32.1	34.7	1	2.6	0	-	0	-	88.7	Gamma	1.9
D		0.0-4.0	24	55.1	86.8	5	11.0	3	0.124	3	0.153	89.0	Gamma	1.9

Note: (1) the value of zero is used.

Figures 15 and 16 show the Block Diagrams for the lead concentration. Based on the Block Diagrams, the most economic scenario is Scenario A. Soil from the upper 0.5 feet would be subject to the restrictions as stated in the DTSC Variance as Reuse – Condition 1 (or Soil Type Y1). If the upper 0.5 feet of excavated soil is disposed off-site, it would be classified as a hazardous waste with respect to soluble lead concentration.

Soil Management Summary for Region II (On-site Reuse)

Soil Interval (ft)	TTLC 95% UCL (mg/kg)	Within Variance?	WET-DI (mg/l)	DTSC Variance Condition
0.0-0.5	398.0	Yes	0.064	Reuse - Condition 1 (Soil Type Y1)
0.5-4.0	70.0	No	0.154	Soil Type X

Soil Management Summary for Region II (Off-site Disposal)

Soil Interval (ft)	TTLC 95% UCL (mg/kg)	STLC (mg/l)	Disposal
0.0-0.5	398.0	32.1	Class I
0.5-4.0	70.0	0.1	Non-hazardous

4.2.3 Region III - Stations 523 to 543

Results of the statistical analysis for Region III are presented below. As shown in Figure 17, a correlation coefficient of 0.92 was obtained in the regression analysis between TTLC and STLC. The projected STLC based on 95% UCL TTLC are also listed in the following table.

Scenario		Depth Interval (ft)	TTLC			STLC		WET-DI		TCLP		UCL		
			No.	Mean (mg/kg)	SD (mg/kg)	No.	Mean (mg/l)	No.	Mean (mg/l)	No.	Mean (mg/l)	95% UCL TTLC	Distribution	Proj. STLC (mg/l)
A	A1	0.0-0.5	7	155.9	195.7	4	11.75	1	0.160	1	0.095	459.0	Gamma	20.5
	A2	0.5-4.0	21	64.24	62.83	8	8.46	5	0.079	5	0.317	99.9	Gamma	7.0
B	B1	0.0-1.5	14	121.1	148	7	11.11	3	0.097	3	0.080	213.6	Gamma	11.3
	B2	1.5-4.0	14	53.22	52.53	5	7.38	3	0.087	3	0.450	97.9	Gamma	6.9
C	C1	0.0-3.0	21	98.28	127.4	9	10.29	4	0.121	4	0.304	154.9	Gamma	9.1
	C2	3.0-4.0	7	53.77	54.2	3	7.37	2	0.036	2	0.050	93.6	Student's-t	6.8
D		0.0-4.0	28	87.15	114.3	12	9.56	6	0.092	6	0.228	130.0	Gamma	8.1
Note: (1) the value of zero is used.														

Figures 18 and 19 show the Block Diagrams for the lead concentration. Based on the Block Diagrams, soil from the upper 4 feet would be subject to the restrictions as stated in the DTSC Variance as Reuse – Condition 1 (or Soil Type Y1). If the upper 4 feet of excavated soil is disposed off-site, it would be classified as a hazardous waste with respect to soluble lead concentration.

Soil Management Summary for Region III (On-site Reuse)

Soil Interval (ft)	TTLC 95% UCL (mg/kg)	WET-DI (mg/l)	Within Variance?	DTSC Variance Condition
0-4.0	130.0	0.092	Yes	Reuse - Condition 1 (Soil Type Y1)

Soil Management Summary for Region III (Off-site Disposal)

Soil Interval (ft)	TTLC 95% UCL (mg/kg)	STLC (mg/l)	Disposal
0-4.0	130.0	8.1	Class I

4.2.4 Region IV - Stations 543 to 587+15

Results of the statistical analysis for Region IV are presented below. As shown in Figure 20, a correlation coefficient of 0.96 was obtained in the regression analysis between TTLC and STLC. The projected STLC based on 95% UCL TTLC are also listed in the following table.

Scenario		Depth Interval (ft)	TTLC			STLC		WET-DI		TCLP		UCL		
			No.	Mean (mg/kg)	SD (mg/kg)	No.	Mean (mg/l)	No.	Mean (mg/l)	No.	Mean (mg/l)	95% UCL TTLC	Distribution	Proj. STLC (mg/l)
A	A1	0.0-0.5	14	81.41	101	4	11.8	4	0.118	4	0.065	156.2	Gamma	8.7
	A2	0.5-4.0	42	27.35	47.62	6	7.15	4	0.132	4	0.098	100.5	Chebyshev	4.6
B	B1	0.0-1.5	28	67.89	86.38	8	9.888	6	0.154	6	0.092	108.5	Gamma	5.2
	B2	1.5-4.0	28	13.85	22.75	2	5.5	2	0.038	2	0.050	56.63	Chebyshev	1.4
C	C1	0.0-3.0	42	52.75	75.24	10	9.01	8	0.125	8	0.081	168.3	Chebyshev	9.6
	C2	3.0-4.0	14	5.214	6.15	0	0	0	0	0	0.000	12.38	Chebyshev	-1.9[1]
D		0.0-4.0	56	40.87	68.26	10	9.01	8	0.125	8	0.081	131.6	Chebyshev	6.9
Note: (1) the value of zero is used.														

Figures 21 and 22 show the Block Diagrams for the lead concentration. Based on the Block Diagrams, the most economic scenario is Scenario B. Soil from the upper 0.5 feet would be subject to the restrictions as stated in the DTSC Variance as Reuse –Condition 1 (or Soil Type Y1). If the upper 0.5 feet of excavated soil is disposed off-site, it would be classified as a hazardous waste with respect to soluble lead concentration.

Soil Management Summary for Region IV (On-site Reuse)

Soil Interval (ft)	TTLC 95% UCL (mg/kg)	Within Variance?	WET-DI (mg/l)	DTSC Variance Condition
0.0-0.5	211.5	Yes	0.15	Reuse - Condition 1 (Soil Type Y1)
0.5-4.0	74.1	No	0.12	Soil Type X

Soil Management Summary for Region IV (Off-site Disposal)

Soil Interval (ft)	TTLC 95% UCL (mg/kg)	STLC (mg/l)	Disposal
0.0-0.5	211.5	13.6	Class I
0.5-4.0	74.1	3.0	Non-hazardous

4.3 Recommendations

Based on the analytical results, soils from the following regions including the mainline and ramps should be managed as Soil Type Y1 based on Caltrans Aerially Deposited Lead Soil Management (See Section 4.1):

- soils from the upper 0.5 feet between Station 501 and 523 (Region II),
- soils from the upper 4 feet between Station 523 and 543 (Region III), and
- soils from the upper 0.5 feet between Station 543 and 587+15 (Region IV);

the remaining soils within the project limit are considered as Soil Type X. For soils classified as Soil Type X, there is no special requirement for on-site reuse and off-site disposal.

Soils classified as Soil Type Y1 are suitable for on-site reuse with respect to the total and WET-DI soluble lead concentrations. They are allowed to be used as fill in the Caltrans right-of-way provided the soil is placed a minimum of 5 feet above the maximum level of water table and is covered with a minimum of 1 foot of clean soil. If the above soils are elected to be disposed offsite, they should be classified as Soil Type Z2 since the WET-citric soluble lead concentrations exceed the STLC of 5.0 mg/l. Soil Type Z2 is considered as California hazardous waste. Therefore, they should be disposed at a Class I hazardous waste facility.

An appropriate SSP should be prepared by RBF for proper handling of contaminated soils and traffic stripes. Contractors excavating, transporting, or stockpiling soil should prepare a Lead Compliance Plan in accordance with the Caltrans Code of Safety Practices, California Code of Regulations and Cal-OSHA standards addressing the presence of ADL in the soils within the project area. An Lead content testing results contained herein should be given to contractors handling the soils during construction.

5.0 LIMITATIONS

This report is intended for use by RBF Consulting, the Orange County Transportation Authority, and the California Department of Transportation for the proposed SR-57 Northbound Improvement Project between Orangethorpe Avenue and Yorba Linda Boulevard. This report is only relevant as of the date of the latest site visit and is only valid as of the date of the report and will require an update if additional information is obtained.

The conclusions and recommendations presented herein are based on a limited number of samples collected from in-place soil and widely spaced locations according to Caltrans protocol. The disposition and handling of the soil are governed by the California regulation. Characterization of the soil in the study area for Federal waste criteria is beyond the scope of work.

The data, opinions, and recommendations contained herein are applicable to the specific design elements and locations which are the subject of this report. Data, opinions, and recommendations herein have no applicability to any other design elements or to any other locations, and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of EMI.

Services performed by EMI were conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

6.0 REFERENCES

California Department of Transportation (Caltrans), 2007, Aerially Deposited Lead Guidance, June.

Caltrans, 2007, Aerially Deposited Lead soil Management, April.

United States Environmental Protection Agency (EPA); 2007, ProUCL Version 4.00.02 User Guide and Technical Guide, April.

EPA, 1986, Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, EPA Document SW-846; September.

TABLE

Table 1. Summary of Analytical Soil Test Results (1/4)

Sample ID	*Latitude (Deg)*	*Longitude (Deg)*	*Depth (ft)*	*Total Lead (mg/kg)*	*Wet-Citric (mg/l)*	*DI-WET (mg/l)*	*TCLP (mg/l)*	*pH*
L-1-1	33.860362	-117.876311	0.5	21				8.61
L-1-2			1.5	28				
L-1-3			3.0	30				
L-1-4			4.0	33				
L-2-1	33.861131	-117.876818	0.5	44				
L-2-2			1.5	19				
L-2-3			3.0	12				
L-2-4			4.0	27				
L-3-1	33.861769	-117.877033	0.5	17				
L-3-2			1.5	21				8.37
L-3-3			3.0	55				
L-3-4			4.0	19				
L-4-1	33.862246	-117.876919	0.5	48				
L-4-2			1.5	16				
L-4-3			3.0	21				8.59
L-4-4			4.0	23				
L-5-1	33.862206	-117.877193	0.5	27				
L-5-2			1.5	22				
L-5-3			3.0	22				
L-5-4			4.0	20				
L-6-1	33.863081	-117.877286	0.5	33				
L-6-2			1.5	47				
L-6-3			3.0	27				
L-6-4			4.0	25				8.65
L-7-1	33.863563	-117.877527	0.5	26				7.74
L-7-2			1.5	28				
L-7-3			3.0	25				
L-7-4			4.0	23				
L-8-1	33.864871	-117.877983	0.5	22				
L-8-2			1.5	22				
L-8-3			3.0	10				
L-8-4			4.0	10				
L-9-1	33.865311	-117.878126	0.5	66				
L-9-2			1.5	28				8.12
L-9-3			3.0	37				
L-9-4			4.0	37				
L-10-1	33.866616	-117.878535	0.5	23				
L-10-2			1.5	37				
L-10-3			3.0	33				8.11
L-10-4			4.0	38				

Table 1 (cont.). Summary of Analytical Soil Test Results (2/4)

Sample ID	*Latitude (Deg)*	*Longitude (Deg)*	*Depth (ft)*	*Total Lead (mg/kg)*	*Wet-Citric (mg/l)*	*DI-WET (mg/l)*	*TCLP (mg/l)*	*pH*
L-11-1	33.867184	-117.878703	0.5	28				
L-11-2			1.5	28				
L-11-3			3.0	27				
L-11-4			4.0	13				
S-12-1	33.867872	-117.878902	0.5	33				
S-12-2			1.5	44				
S-12-3			3.0	47				
S-12-4			4.0	4.3				7.92
S-13-1	33.868910	-117.879126	0.5	75				8.39
S-13-2			1.5	9.4				
S-13-3			3.0	7.2				
S-13-4			4.0	6.4				
S-14-1	33.870065	-117.879563	0.5	73				
S-14-2			1.5	210	10	0.05	ND	
S-14-3			3.0	11				
S-14-4			4.0	27				
L-15-1	33.871599	-117.879950	0.5	79	4.0			
L-15-2			1.5	61				9.57
L-15-3			3.0	13				
L-15-4			4.0	26				
L-16-1	33.872370	-117.880131	0.5	390	33	0.064	0.36	
L-16-2			1.5	130	5.3	0.258	ND	
L-16-3			3.0	14				8.18
L-16-4			4.0	100	2.6			
L-17-1	33.872875	-117.880150	0.5	13				
L-17-2			1.5	16				
L-17-3			3.0	23				
L-17-4			4.0	26				
L-18-1	33.873211	-117.879874	0.5	4.8				
L-18-2			1.5	-				
L-18-3			3.0	4.3				
L-18-4			4.0	9.5				8.36
L-19-1	33.874524	-117.880132	0.5	25				
L-19-2			1.5	57				
L-19-3			3.0	3.4				
L-19-4			4.0	4.0				
L-20-1	33.875256	-117.880033	0.5	190	11	0.164	0.17	8.19
L-20-2			1.5	29				
L-20-3			3.0	13				
L-20-4			4.0	130	9.3	0.019	ND	

Table 1 (cont.). Summary of Analytical Soil Test Results (3/4)

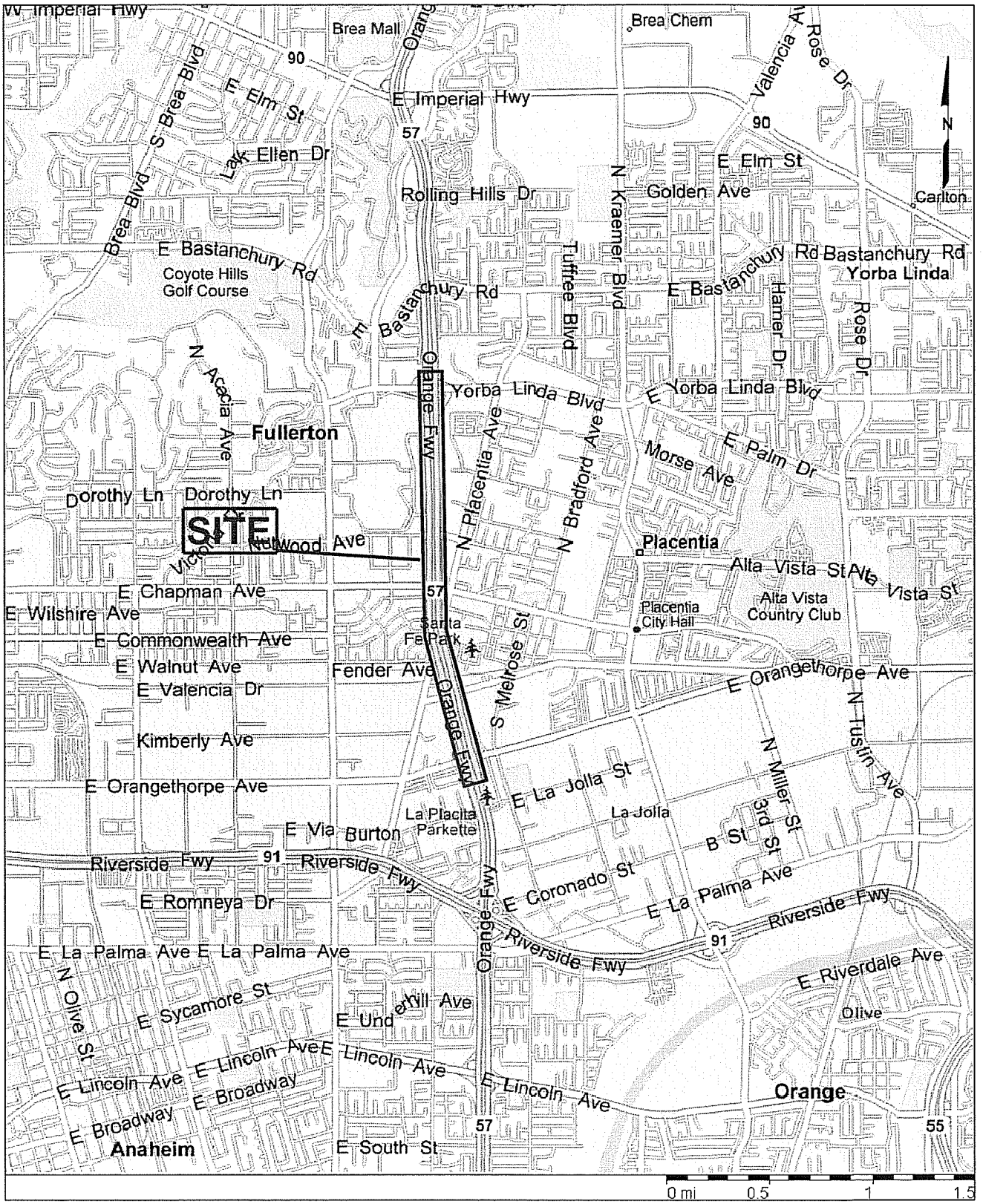
Sample ID	*Latitude (Deg)*	*Longitude (Deg)*	*Depth (ft)*	*Total Lead (mg/kg)*	*Wet-Citric (mg/l)*	*DI-WET (mg/l)*	*TCLP (mg/l)*	*pH*
L-21-1	33.875930	-117.879952	0.5	110	6.5	0.102	0.099	
L-21-2			1.5	78	4.8			
L-21-3			3.0	3.7				
L-21-4			4.0	3.6				
L-22-1	33.876718	-117.880093	0.5	63				
L-22-2			1.5	13				8.41
L-22-3			3.0	16				
L-22-4			4.0	35				
L-23-1	33.877393	-117.880066	0.5	94	5.5	0.074	0.06	
L-23-2			1.5	53				
L-23-3			3.0	160	11	0.19	1.65	
L-23-4			4.0	5.6				
L-24-1	33.878613	-117.880128	0.5	580	24	0.16	ND	
L-24-2			1.5	230	11	0.062	ND	
L-24-3			3.0	85	3.8			7.84
L-24-4			4.0	87	5.6	0.019	ND	
S-25-1	33.879743	-117.880093	0.5	4.1				
S-25-2			1.5	160	15	0.070	ND	
S-25-3			3.0	57				
S-25-4			4.0	5.2				
L-26-1	33.880412	-117.880028	0.5	50				
L-26-2			1.5	41				
L-26-3			3.0	34				
L-26-4			4.0	110	7.2	0.053	ND	7.81
L-27-1	33.881068	-117.880105	0.5	34				
L-27-2			1.5	230	14	0.33	0.24	
L-27-3			3.0	16				
L-27-4			4.0	4.0				
L-28-1	33.882121	-117.880130	0.5	33				8.28
L-28-2			1.5	4.6				
L-28-3			3.0	28				
L-28-4			4.0	4.0				
L-29-1	33.883249	-117.880154	0.5	14				
L-29-2			1.5	11				
L-29-3			3.0	93	5.5	0.049	ND	
L-29-4			4.0	2.9				
L-30-1	33.884591	-117.880200	0.5	190	8.0	0.029	ND	
L-30-2			1.5	130	4.1			8.82
L-30-3			3.0	82	5.5	0.027	ND	
L-30-4			4.0	26				

Table 1 (cont.). Summary of Analytical Soil Test Results (4/4)

Sample ID	*Latitude (Deg)*	*Longitude (Deg)*	*Depth (ft)*	*Total Lead (mg/kg)*	*Wet-Citric (mg/l)*	*DI-WET (mg/l)*	*TCLP (mg/l)*	*pH*
L-31-1	33.885919	-117.880228	0.5	58				
L-31-2			1.5	23				
L-31-3			3.0	5.6				8.00
L-31-4			4.0	-				
L-32-1	33.886586	-117.879943	0.5	3.4				
L-32-2			1.5	6.1				
L-32-3			3.0	3.0				
L-32-4			4.0	5.5				
L-33-1	33.887150	-117.880256	0.5	130	6.4	0.082	ND	
L-33-2			1.5	29				
L-33-3			3.0	34				
L-33-4			4.0	2.6				8.49
L-34-1	33.887919	-117.880289	0.5	68				
L-34-2			1.5	9.4				
L-34-3			3.0	3.6				
L-34-4			4.0	3.3				
L-35-1	33.888510	-117.879207	0.5	9.1				8.19
L-35-2			1.5	9.4				
L-35-3			3.0	7.1				
L-35-4			4.0	-				
L-36-1	33.889352	-117.880294	0.5	370	26	0.21	0.11	
L-36-2			1.5	150	9.8	0.12	ND	
L-36-3			3.0	7.0				
L-36-4			4.0	5.8				
L-37-1	33.889410	-117.879309	0.5	15				
L-37-2			1.5	2.7				8.08
L-37-3			3.0	2.4				
L-37-4			4.0	4.2				
L-38-1	33.890196	-117.880155	0.5	3.3				
L-38-2			1.5	7.9				
L-38-3			3.0	2.8				
L-38-4			4.0	2.5				
L-39-1	33.890871	-117.880257	0.5	140	6.8	0.15	ND	
L-39-2			1.5	75	4.0			
L-39-3			3.0	3.3				8.35
L-39-4			4.0	6.2				
L-40-1	33.892219	-117.880346	0.5	72				
L-40-2			1.5	73				
L-40-3			3.0	27				
L-40-4			4.0	2.0				8.62
Average Value:				46.9	9.6	0.11	0.16	8.32
Regulatory Limits:				1411	5	0.5	5	5

Note: L: samples were collected on a flat ground; S: samples were collected on a slope

FIGURES



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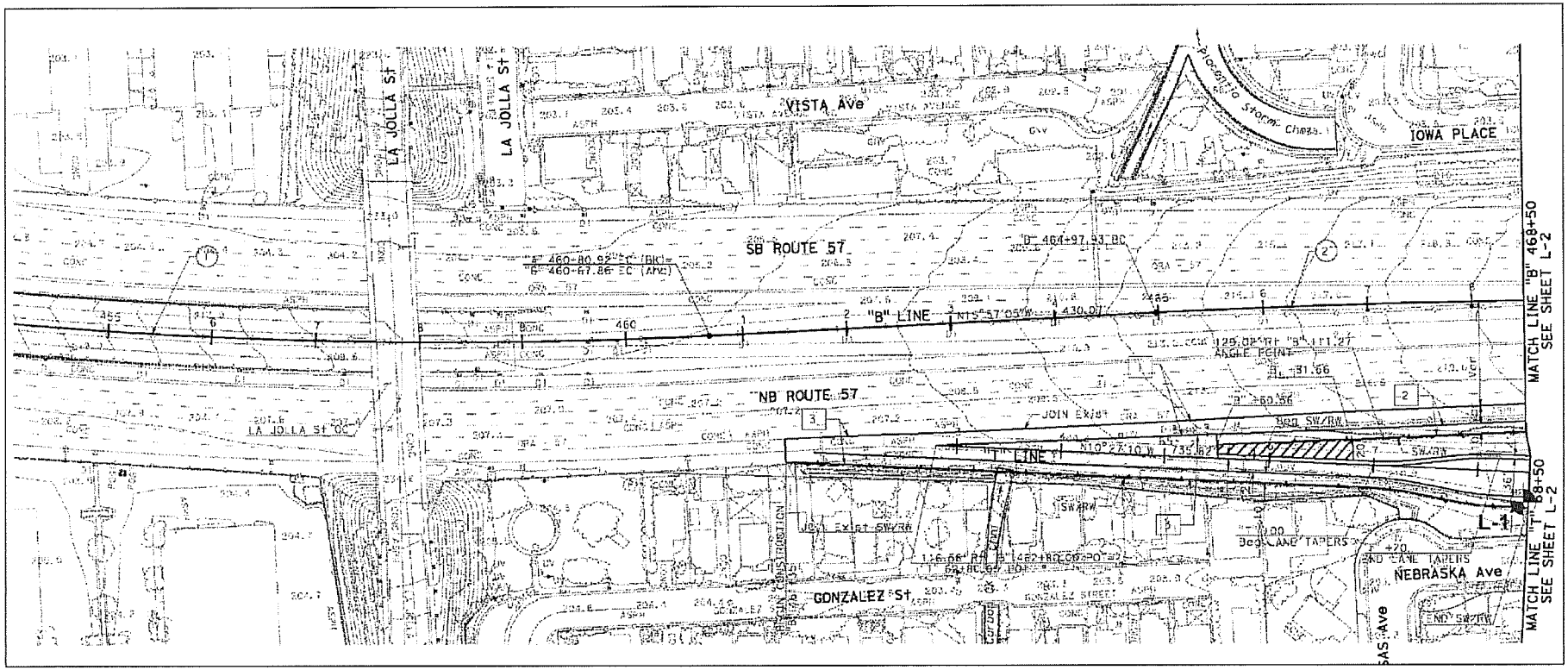
SITE LOCATION MAP

Figure 1

SR-57 Northbound Improvement Project

Project No. 08-115

Date: 12-24-08



ADL Boring

Sample ID	Latitude (Deg)	Longitude (Deg)	Depth (ft)	Total Lead (mg/kg)	Wet-Citric (mg/l)	DI-WET (mg/l)	TCLP (mg/l)	pH
L-1-1	33.860362	-117.876311	0.5	21				8.61
L-1-2			1.5	28				
L-1-3			3.0	30				
L-1-4			4.0	33				

Scale: 1" = 50'

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SR-57 Northbound Improvement Project

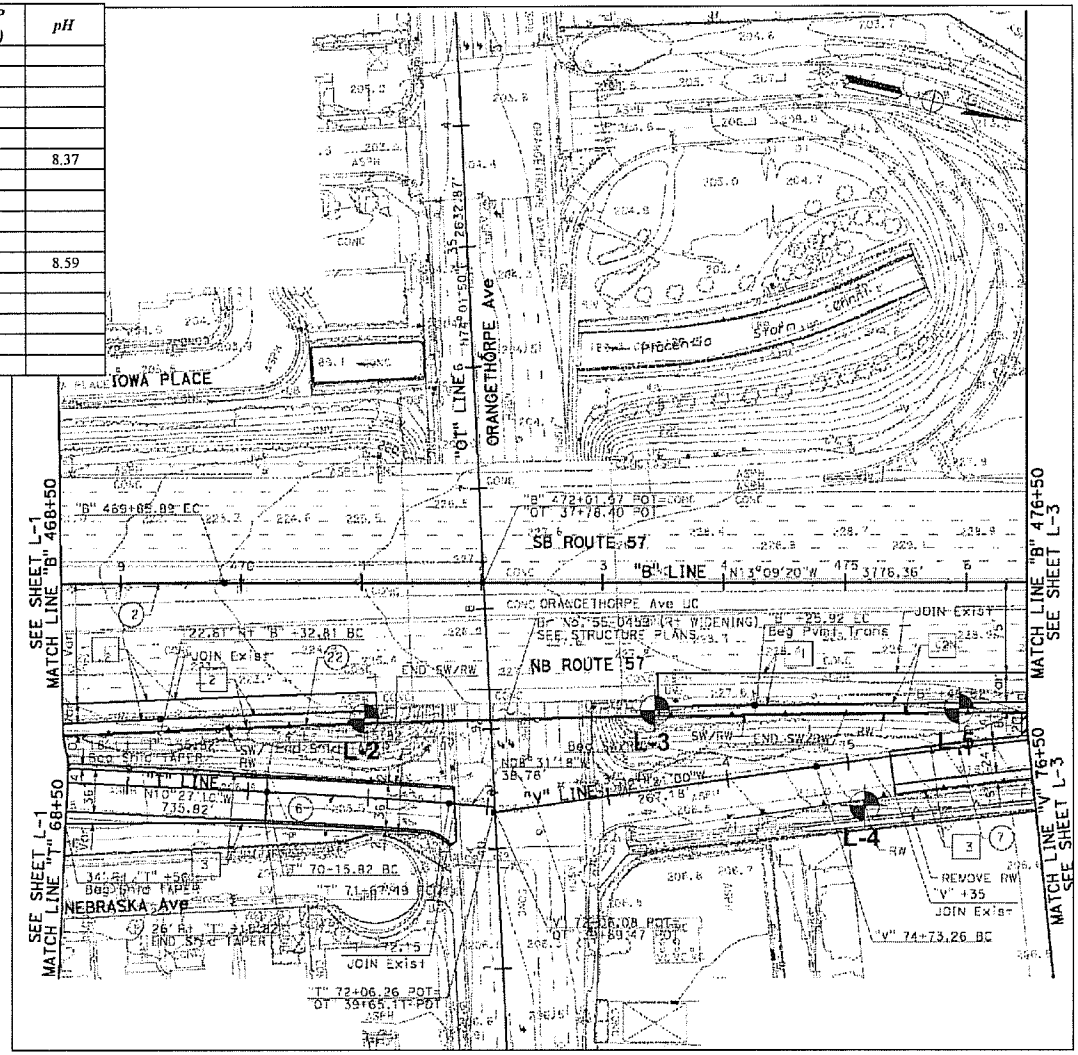
EMI Project No.: 08-115 Date: 12-15-08

Boring Location Plan

Sheet 1 of 12

Figure 2

Sample ID	Latitude (Deg)	Longitude (Deg)	Depth (ft)	Total Lead (mg/kg)	Wet-Citric (mg/l)	DI-WET (mg/l)	TCLP (mg/l)	pH
L-2-1	33.861131	-117.876818	0.5	44				
L-2-2			1.5	19				
L-2-3			3.0	12				
L-2-4			4.0	27				
L-3-1	33.861769	-117.877033	0.5	17				
L-3-2			1.5	21				8.37
L-3-3			3.0	55				
L-3-4			4.0	19				
L-4-1	33.862246	-117.876919	0.5	48				
L-4-2			1.5	16				
L-4-3			3.0	21				8.59
L-4-4			4.0	23				
L-5-1	33.862206	-117.877193	0.5	27				
L-5-2			1.5	22				
L-5-3			3.0	22				
L-5-4			4.0	20				



ADL Boring

Scale: 1" = 50'

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SR-57 Northbound Improvement Project

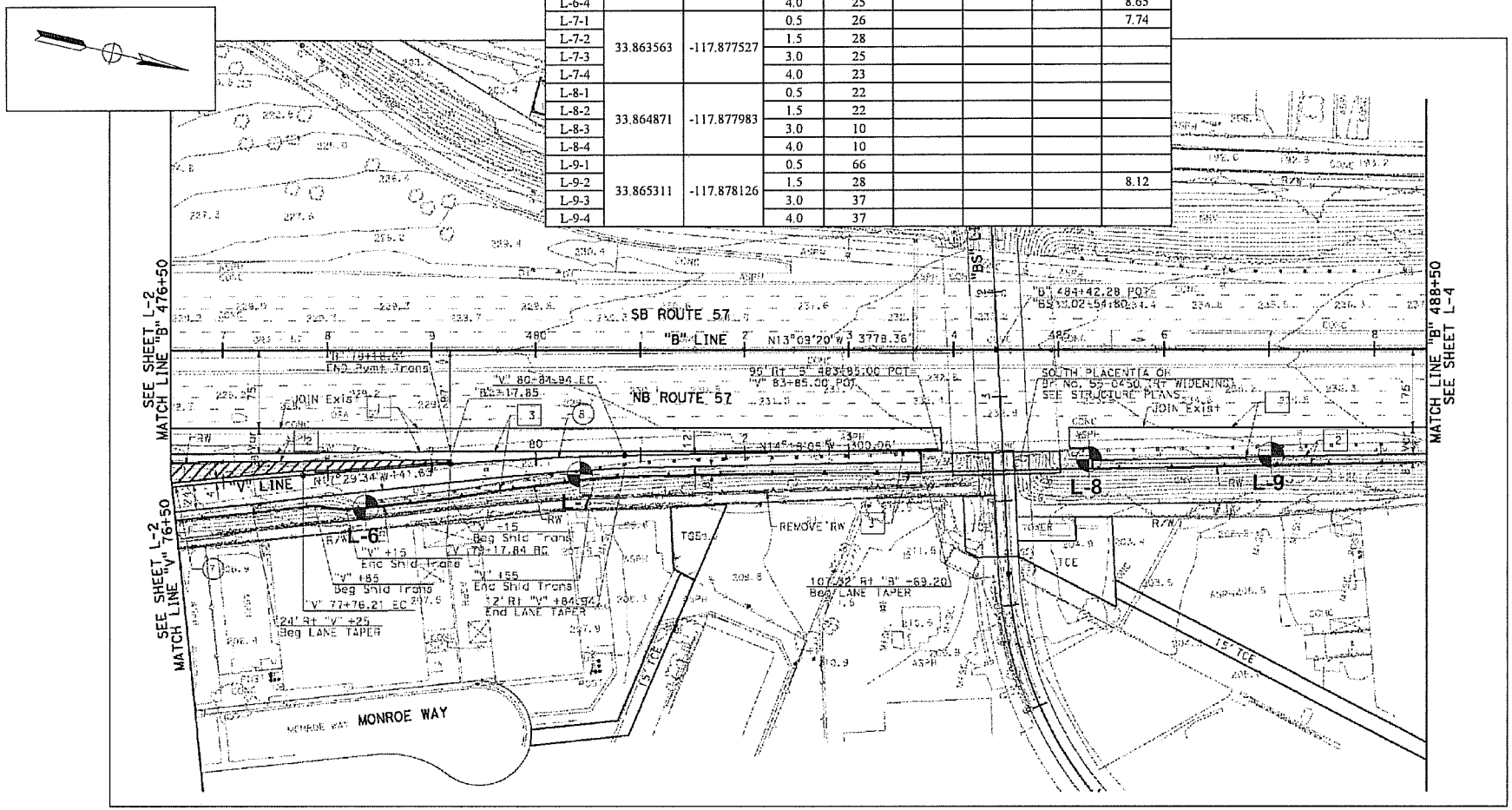
EMI Project No.: 08-115 Date: 12-15-08

Boring Location Plan

Sheet 2 of 12

Figure 3

Sample ID	Latitude (Deg)	Longitude (Deg)	Depth (ft)	Total Lead (mg/kg)	Wet-Citric (mg/l)	DI-WET (mg/l)	TCLP (mg/l)	pH
L-6-1	33.863081	-117.877286	0.5	33				
L-6-2			1.5	47				
L-6-3			3.0	27				
L-6-4			4.0	25				8.65
L-7-1	33.863563	-117.877527	0.5	26				7.74
L-7-2			1.5	28				
L-7-3			3.0	25				
L-7-4			4.0	23				
L-8-1	33.864871	-117.877983	0.5	22				
L-8-2			1.5	22				
L-8-3			3.0	10				
L-8-4			4.0	10				
L-9-1	33.865311	-117.878126	0.5	66				
L-9-2			1.5	28				8.12
L-9-3			3.0	37				
L-9-4			4.0	37				



ADL Boring

Scale: 1" = 50'

Earth Mechanics, Inc.
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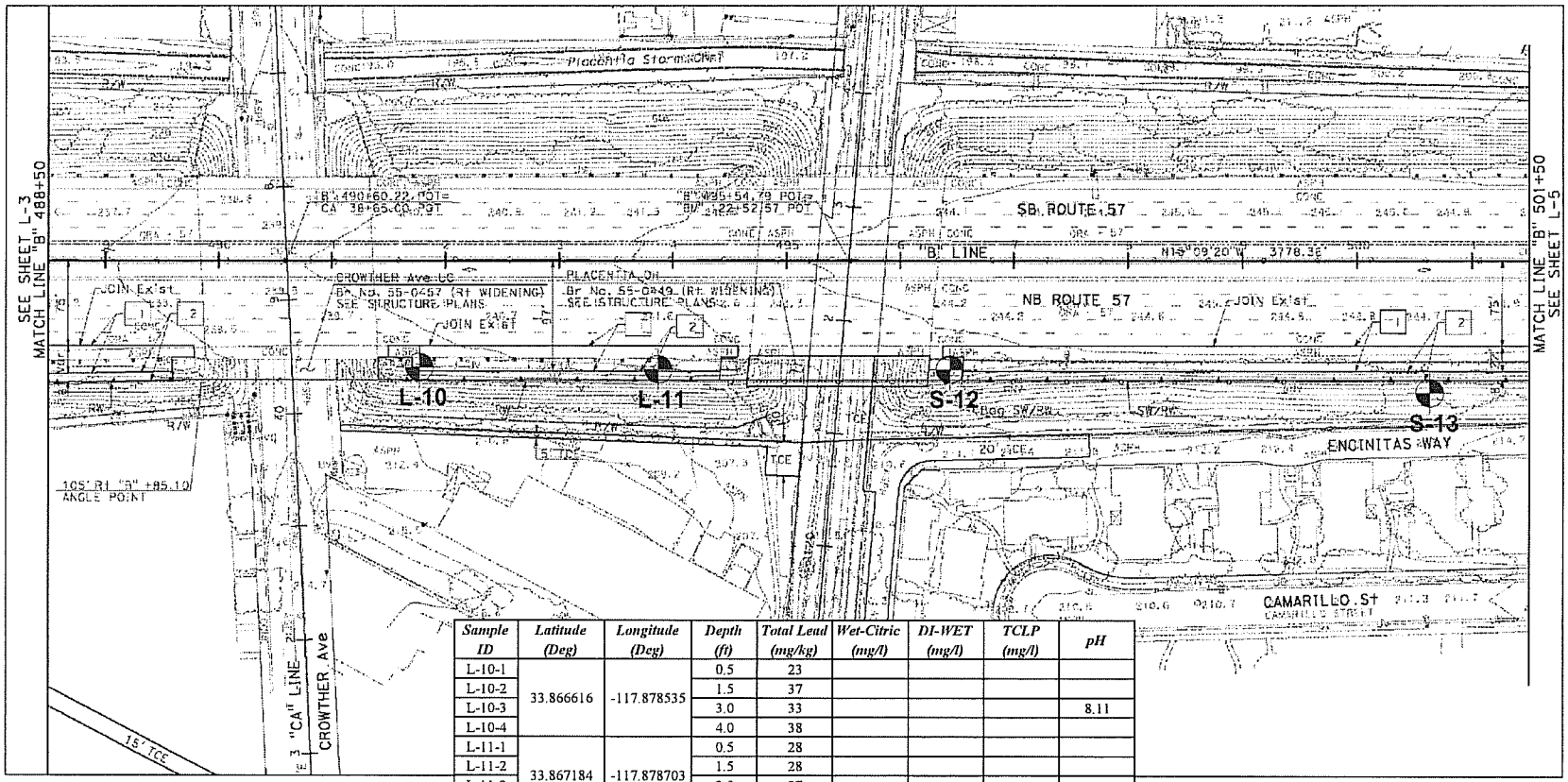
SR-57 Northbound Improvement Project

EMI Project No.: 08-115 Date: 12-15-08

Boring Location Plan

Sheet 3 of 12

Figure 4



Sample ID	Latitude (Deg)	Longitude (Deg)	Depth (ft)	Total Lead (mg/kg)	Wet-Citric (mg/l)	DI-WET (mg/l)	TCLP (mg/l)	pH
L-10-1	33.866616	-117.878535	0.5	23				
L-10-2			1.5	37				
L-10-3			3.0	33				8.11
L-10-4			4.0	38				
L-11-1	33.867184	-117.878703	0.5	28				
L-11-2			1.5	28				
L-11-3			3.0	27				
L-11-4			4.0	13				
S-12-1	33.867872	-117.878902	0.5	33				
S-12-2			1.5	44				
S-12-3			3.0	47				
S-12-4			4.0	4.3				7.92
S-13-1	33.868910	-117.879126	0.5	75				8.39
S-13-2			1.5	9.4				
S-13-3			3.0	7.2				
S-13-4			4.0	6.4				

Note: L: samples were taken on a flat ground
S: samples were taken on a Slope

ADL Boring

Scale: 1" = 50'

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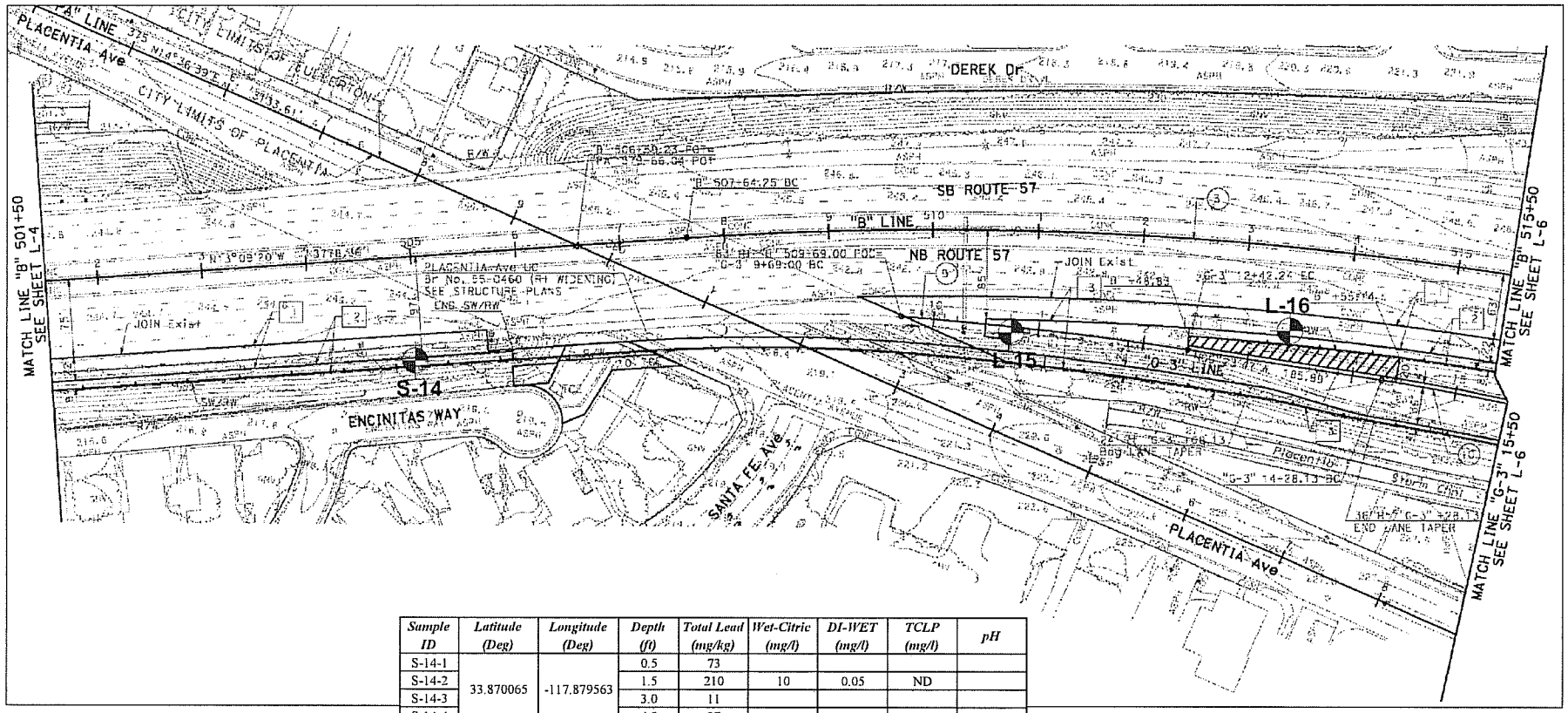
SR-57 Northbound Improvement Project

EMI Project No.: 08-115 Date: 12-15-08

Boring Location Plan

Sheet 4 of 12

Figure 5



Sample ID	Latitude (Deg)	Longitude (Deg)	Depth (ft)	Total Lead (mg/kg)	Wet-Citric (mg/l)	DI-WET (mg/l)	TCLP (mg/l)	pH
S-14-1	33.870065	-117.879563	0.5	73				
S-14-2			1.5	210	10	0.05	ND	
S-14-3			3.0	11				
S-14-4			4.0	27				
L-15-1	33.871599	-117.879950	0.5	79	4.0			
L-15-2			1.5	61				9.57
L-15-3			3.0	13				
L-15-4			4.0	26				
L-16-1	33.872370	-117.880131	0.5	390	33	0.064	0.36	
L-16-2			1.5	130	5.3	0.258	ND	
L-16-3			3.0	14				8.18
L-16-4			4.0	100	2.6			

Note: L: samples were taken on a flat ground
S: samples were taken on a Slope

ADL Boring

Scale: 1" = 50'

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

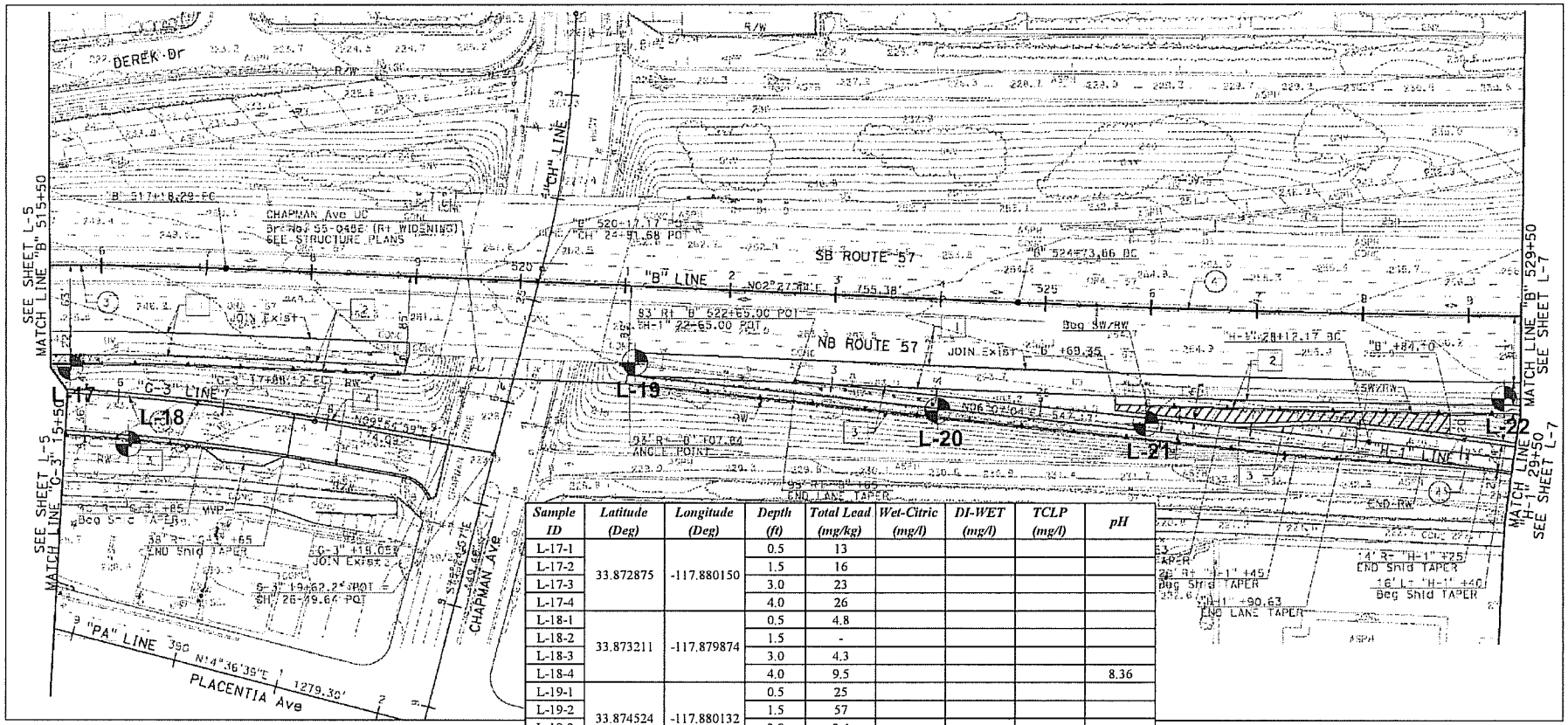
SR-57 Northbound Improvement Project

EMI Project No.: 08-115 Date: 12-15-08

Boring Location Plan

Sheet 5 of 12

Figure 6



Sample ID	Latitude (Deg)	Longitude (Deg)	Depth (ft)	Total Lead (mg/kg)	Wet-Citric (mg/l)	DI-WET (mg/l)	TCLP (mg/l)	pH
L-17-1	33.872875	-117.880150	0.5	13				
L-17-2			1.5	16				
L-17-3			3.0	23				
L-17-4			4.0	26				
L-18-1	33.873211	-117.879874	0.5	4.8				
L-18-2			1.5	-				
L-18-3			3.0	4.3				
L-18-4			4.0	9.5				8.36
L-19-1	33.874524	-117.880132	0.5	25				
L-19-2			1.5	57				
L-19-3			3.0	3.4				
L-19-4			4.0	4.0				
L-20-1	33.875256	-117.880033	0.5	190	11	0.164	0.17	8.19
L-20-2			1.5	29				
L-20-3			3.0	13				
L-20-4			4.0	130	9.3	0.019	ND	
L-21-1	33.875930	-117.879952	0.5	110	6.5	0.102	0.099	
L-21-2			1.5	78	4.8			
L-21-3			3.0	3.7				
L-21-4			4.0	3.6				
L-22-1	33.876718	-117.880093	0.5	63				
L-22-2			1.5	13				8.41
L-22-3			3.0	16				
L-22-4			4.0	35				

ADL Boring

Scale: 1" = 50'

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SR-57 Northbound Improvement Project

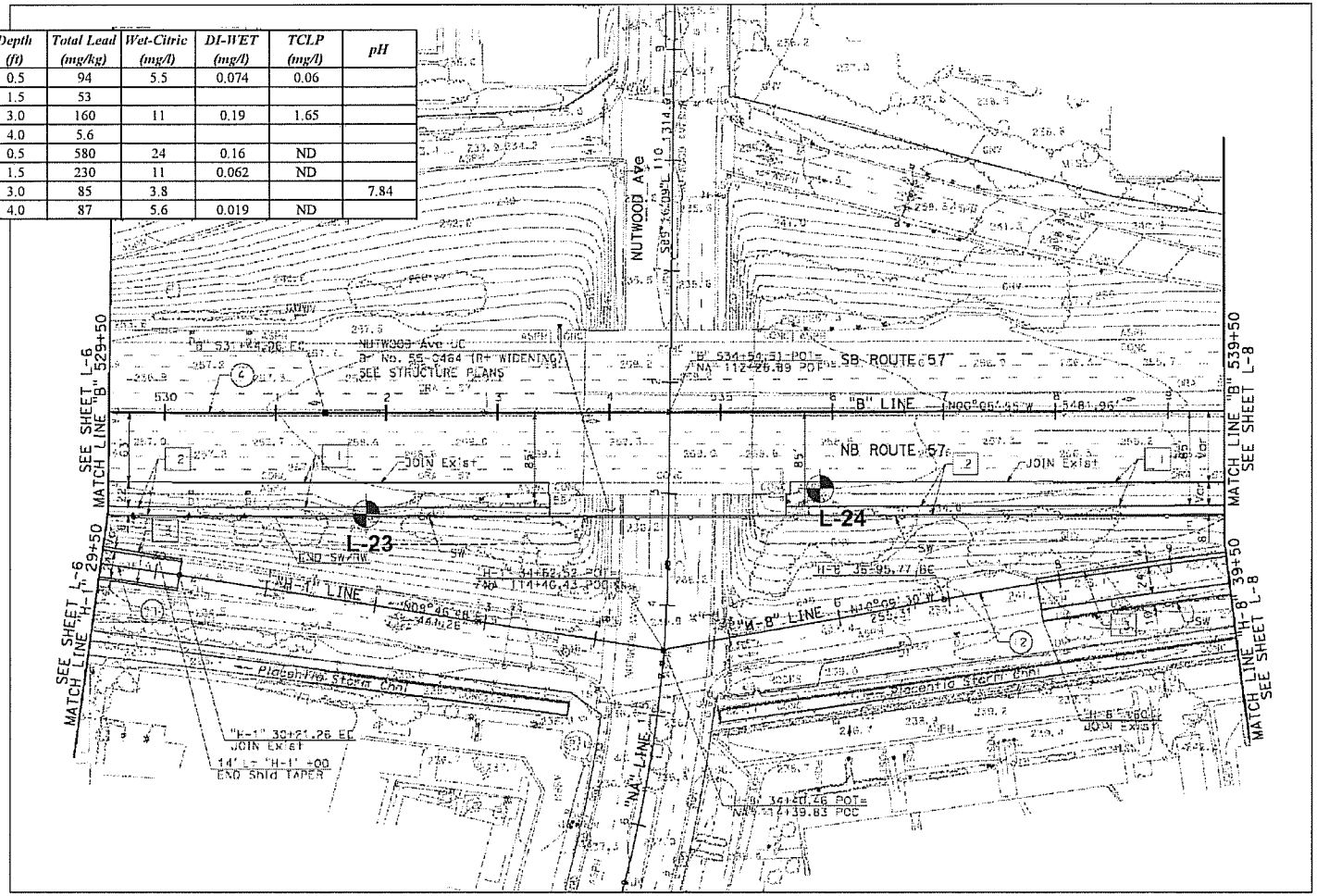
EMI Project No.: 08-115 | Date: 12-15-08

Boring Location Plan

Sheet 6 of 12

Figure 7

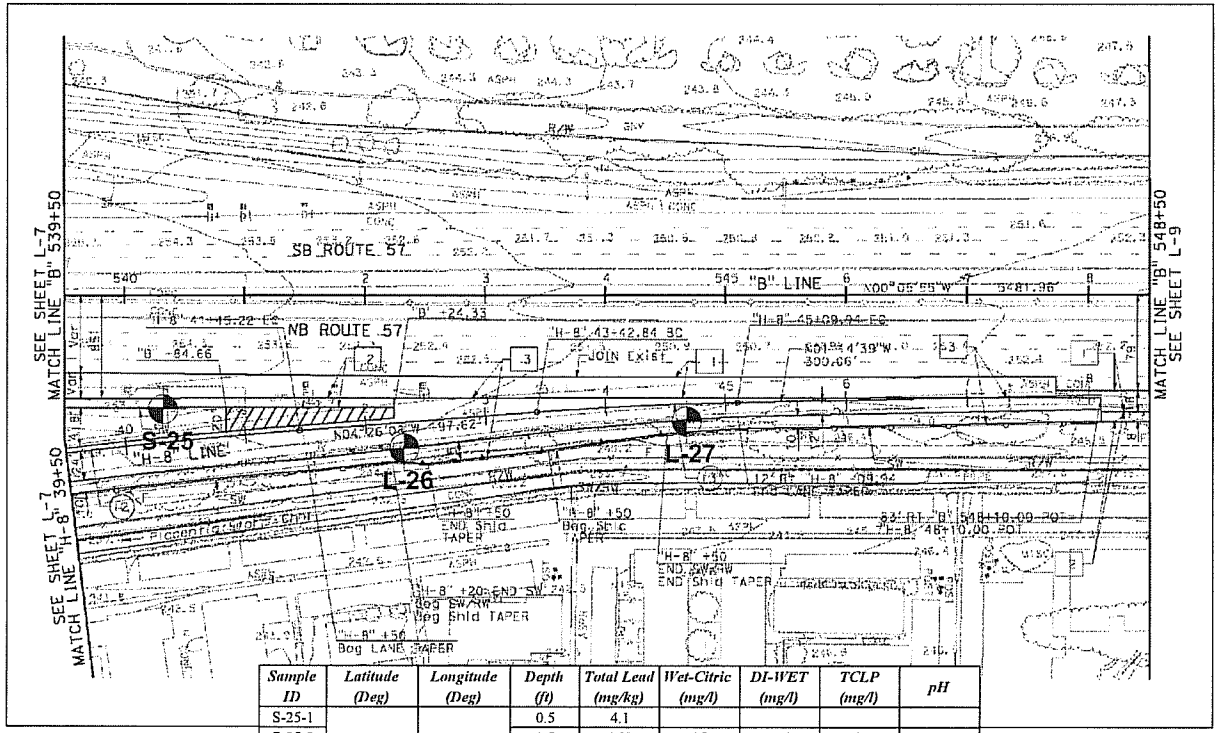
Sample ID	Latitude (Deg)	Longitude (Deg)	Depth (ft)	Total Lead (mg/kg)	Wet-Citric (mg/l)	DI-WET (mg/l)	TCLP (mg/l)	pH
L-23-1	33.877393	-117.880066	0.5	94	5.5	0.074	0.06	
L-23-2			1.5	53				
L-23-3			3.0	160	11	0.19	1.65	
L-23-4			4.0	5.6				
L-24-1	33.878613	-117.880128	0.5	580	24	0.16	ND	
L-24-2			1.5	230	11	0.062	ND	
L-24-3			3.0	85	3.8			7.84
L-24-4			4.0	87	5.6	0.019	ND	



ADL Boring

Scale: 1" = 50'

Earth Mechanics, Inc. Geotechnical & Earthquake Engineering	SR-57 Northbound Improvement Project	Boring Location Plan	
	EMI Project No.: 08-115 Date: 12-15-08	Sheet 7 of 12	Figure 8



Sample ID	Latitude (Deg)	Longitude (Deg)	Depth (ft)	Total Lead (mg/kg)	Wet-Citric (mg/l)	DI-WET (mg/l)	TCLP (mg/l)	pH
S-25-1	33.879743	-117.880093	0.5	4.1				
S-25-2			1.5	160	15	0.070	ND	
S-25-3			3.0	57				
S-25-4			4.0	5.2				
L-26-1	33.880412	-117.880028	0.5	50				
L-26-2			1.5	41				
L-26-3			3.0	34				
L-26-4			4.0	110	7.2	0.053	ND	7.81
L-27-1	33.881068	-117.880105	0.5	34				
L-27-2			1.5	230	14	0.33	0.24	
L-27-3			3.0	16				
L-27-4			4.0	4.0				

Note: L: samples were taken on a flat ground
S: samples were taken on a Slope

ADL Boring

Scale: 1" = 50'

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

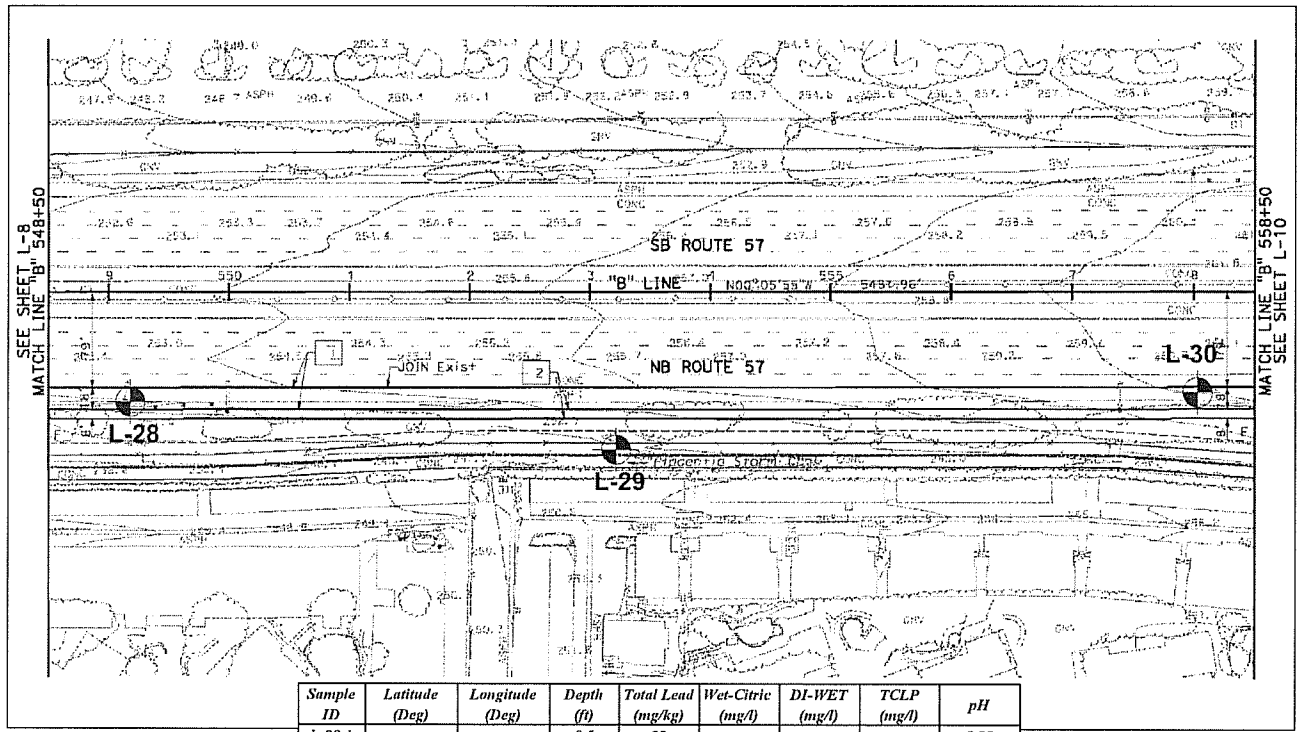
SR-57 Northbound Improvement Project

EMI Project No.: 08-115 Date: 12-15-08

Boring Location Plan

Sheet 8 of 12

Figure 9



Sample ID	Latitude (Deg)	Longitude (Deg)	Depth (ft)	Total Lead (mg/kg)	Wet-Citric (mg/l)	DI-WET (mg/l)	TCLP (mg/l)	pH
L-28-1	33.882121	-117.880130	0.5	33				8.28
L-28-2			1.5	4.6				
L-28-3			3.0	28				
L-28-4			4.0	4.0				
L-29-1	33.883249	-117.880154	0.5	14				
L-29-2			1.5	11				
L-29-3			3.0	93	5.5	0.049	ND	
L-29-4			4.0	2.9				
L-30-1	33.884591	-117.880200	0.5	190	8.0	0.029	ND	
L-30-2			1.5	130	4.1			8.82
L-30-3			3.0	82	5.5	0.027	ND	
L-30-4			4.0	26				

ADL Boring

Scale: 1" = 50'

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

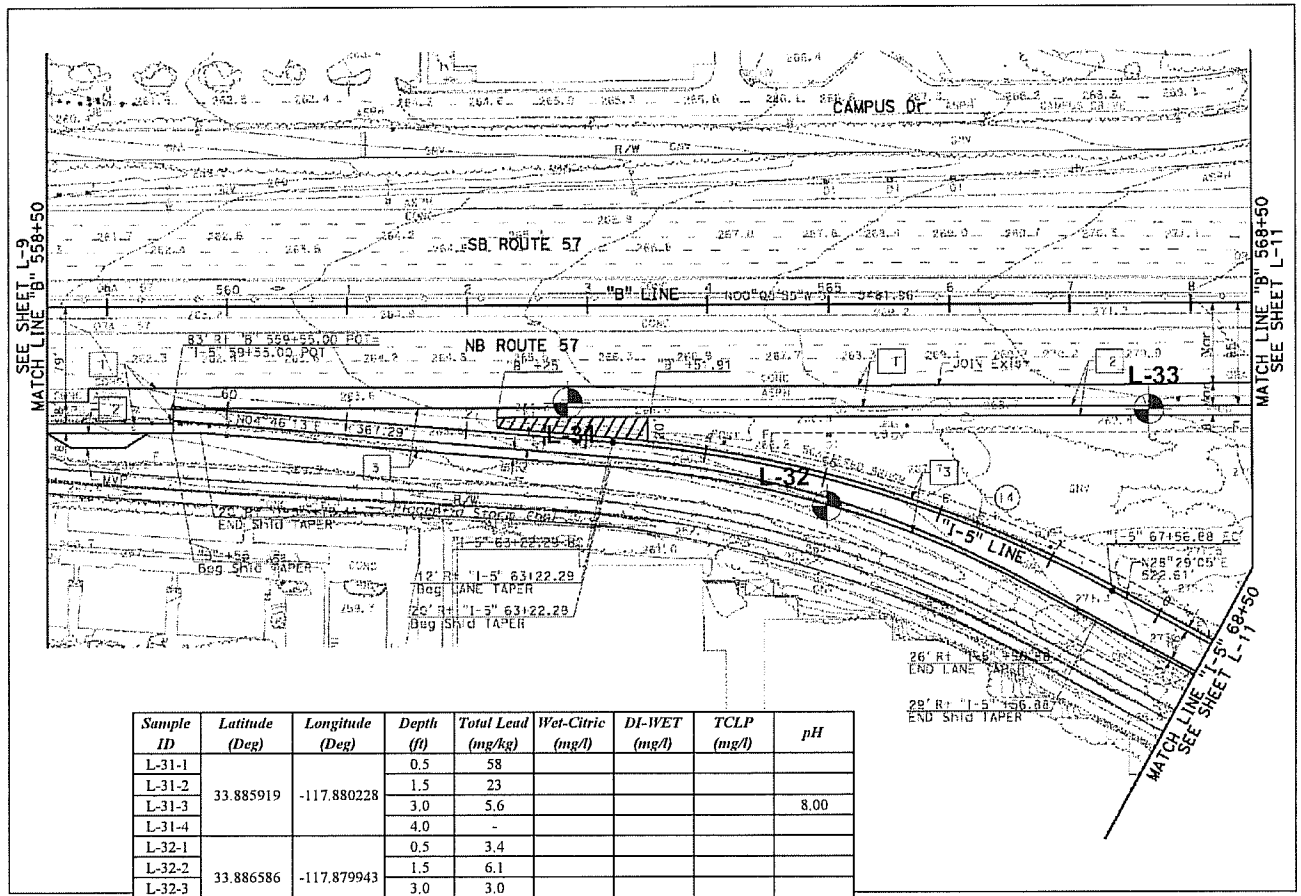
SR-57 Northbound Improvement Project

EMI Project No.: 08-115 Date: 12-15-08

Boring Location Plan

Sheet 9 of 12

Figure 10



Sample ID	Latitude (Deg)	Longitude (Deg)	Depth (ft)	Total Lead (mg/kg)	Wet-Citric (mg/l)	DI-WET (mg/l)	TCLP (mg/l)	pH
L-31-1	33.885919	-117.880228	0.5	58				
L-31-2			1.5	23				
L-31-3			3.0	5.6				8.00
L-31-4			4.0	-				
L-32-1	33.886586	-117.879943	0.5	3.4				
L-32-2			1.5	6.1				
L-32-3			3.0	3.0				
L-32-4			4.0	5.5				
L-33-1	33.887150	-117.880256	0.5	130	6.4	0.082	ND	
L-33-2			1.5	29				
L-33-3			3.0	34				
L-33-4			4.0	2.6				8.49

ADL Boring

Scale: 1" = 50'

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SR-57 Northbound Improvement Project

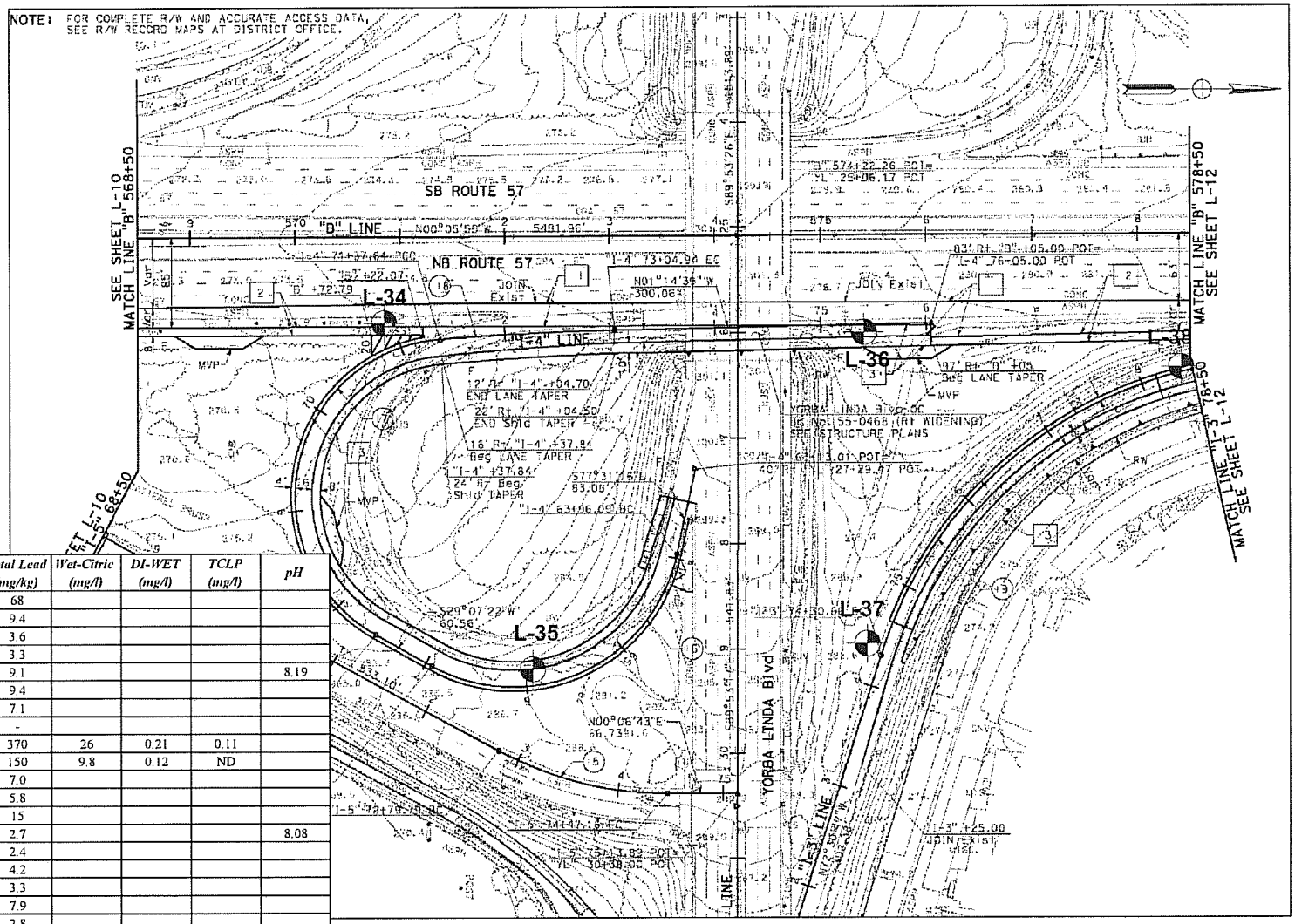
EMI Project No.: 08-115 | Date: 12-15-08

Boring Location Plan

Sheet 10 of 12

Figure 11

ADL Boring



Sample ID	Latitude (Deg)	Longitude (Deg)	Depth (ft)	Total Lead (mg/kg)	Wet-Citric (mg/l)	DI-WET (mg/l)	TCLP (mg/l)	pH
L-34-1	33.887919	-117.880289	0.5	68				
L-34-2			1.5	9.4				
L-34-3			3.0	3.6				
L-34-4			4.0	3.3				
L-35-1	33.888510	-117.879207	0.5	9.1				8.19
L-35-2			1.5	9.4				
L-35-3			3.0	7.1				
L-35-4			4.0	-				
L-36-1	33.889352	-117.880294	0.5	370	26	0.21	0.11	
L-36-2			1.5	150	9.8	0.12	ND	
L-36-3			3.0	7.0				
L-36-4			4.0	5.8				
L-37-1	33.889410	-117.879309	0.5	15				
L-37-2			1.5	2.7				8.08
L-37-3			3.0	2.4				
L-37-4			4.0	4.2				
L-38-1	33.890196	-117.880155	0.5	3.3				
L-38-2			1.5	7.9				
L-38-3			3.0	2.8				
L-38-4			4.0	2.5				

Scale: 1" = 50'

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

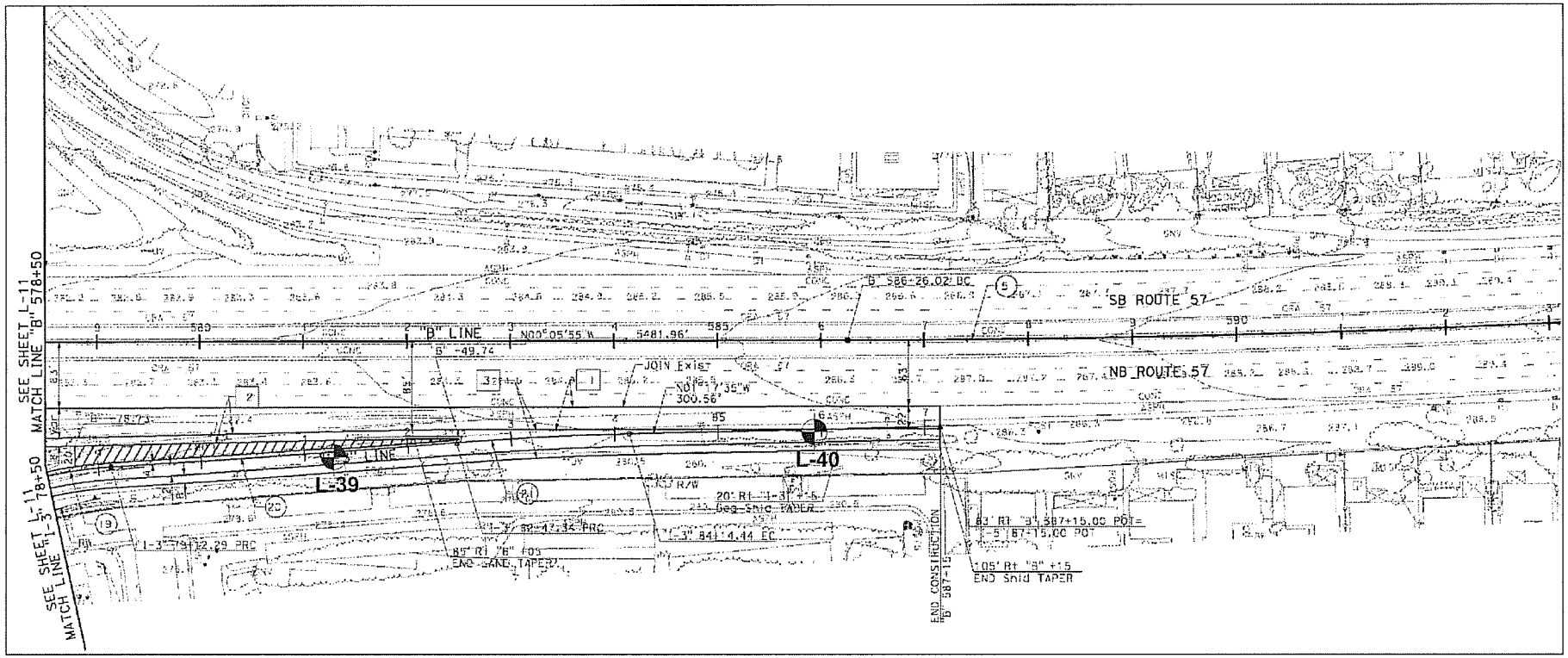
SR-57 Northbound Improvement Project

EMI Project No.: 08-115 | Date: 12-15-08

Boring Location Plan

Sheet 11 of 12

Figure 12



Sample ID	Latitude (Deg)	Longitude (Deg)	Depth (ft)	Total Lead (mg/kg)	Wet-Citric (mg/l)	DI-WET (mg/l)	TCLP (mg/l)	pH
L-39-1	33.890871	-117.880257	0.5	140	6.8	0.15	ND	
L-39-2			1.5	75	4.0			
L-39-3			3.0	3.3				8.35
L-39-4			4.0	6.2				
L-40-1	33.892219	-117.880346	0.5	72				
L-40-2			1.5	73				
L-40-3			3.0	27				
L-40-4			4.0	2.0				8.62

ADL Boring

Scale: 1" = 50'

Earth Mechanics, Inc.
Geotechnical & Earthquake Engineering

SR-57 Northbound Improvement Project

EMI Project No.: 08-115 Date: 12-15-08

Boring Location Plan

Sheet 12 of 12

Figure 13

Figure 14. Regression Analysis for Region II

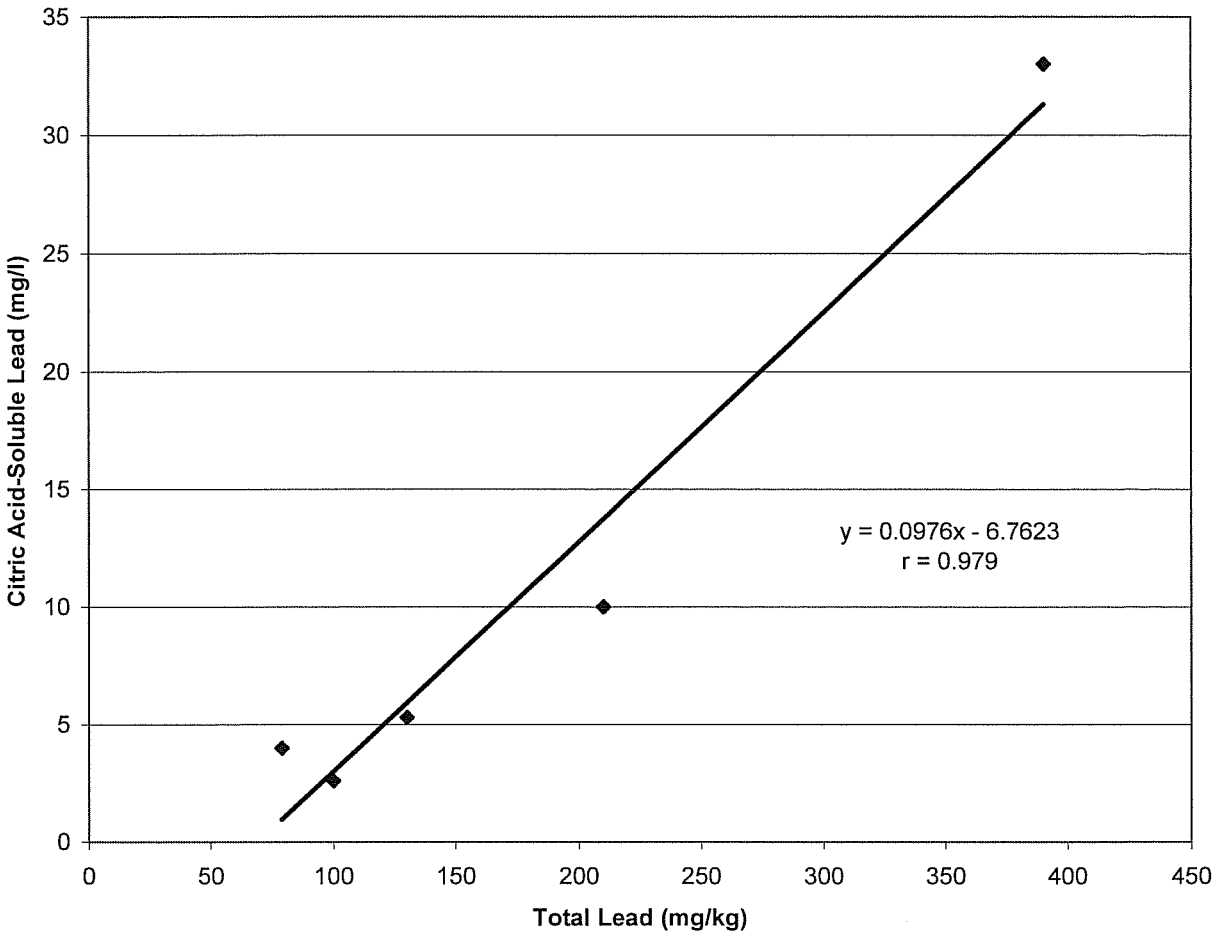
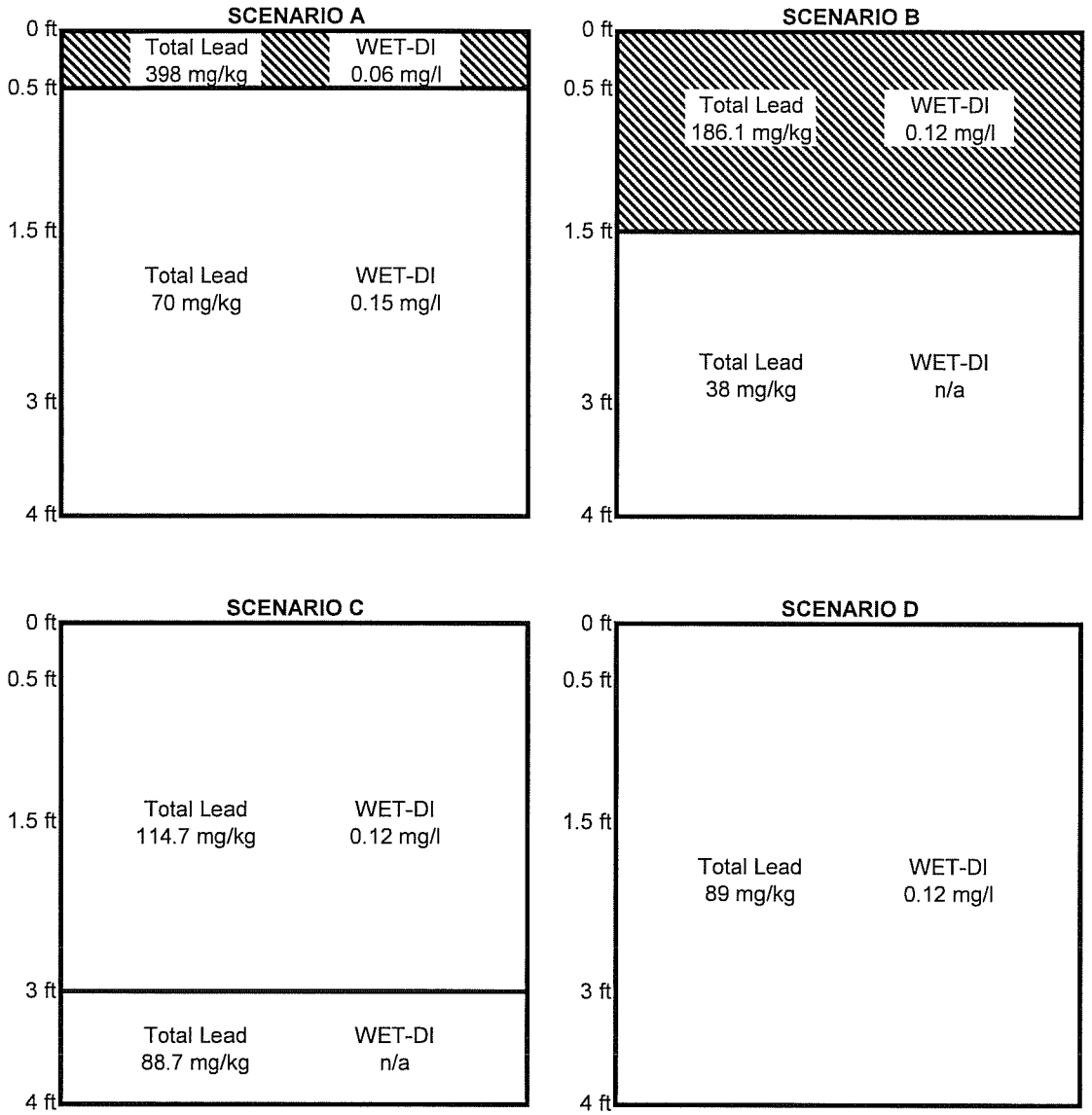


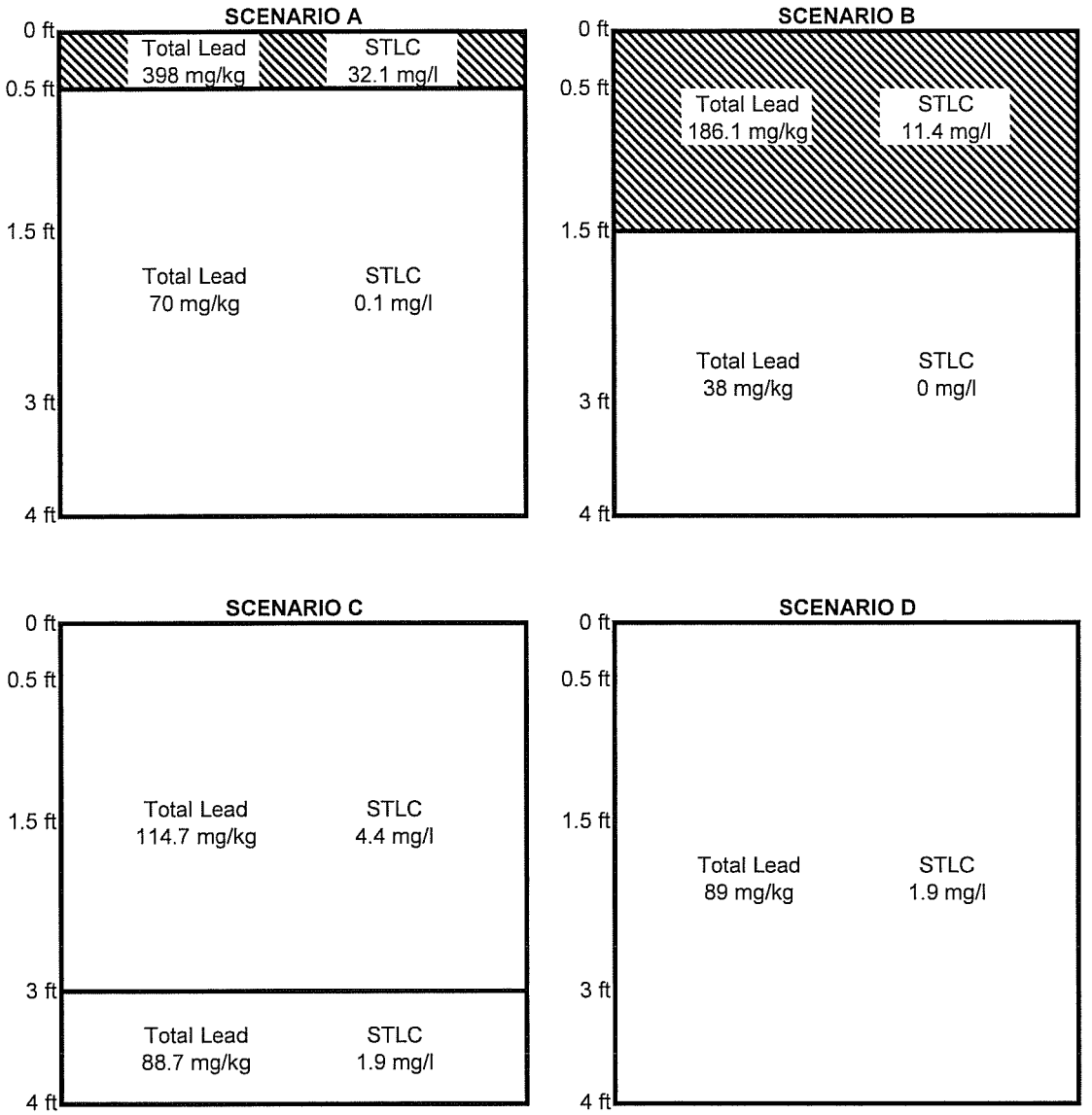
Figure 15. Block Diagrams for Reuse Onsite - Region II



Scenario		Depth Interval (ft)
A	A1	0.0-0.5
	A2	0.5-4.0
B	B1	0.0-1.5
	B2	1.5-4.0
C	C1	0.0-3.0
	C2	3.0-4.0
D		0.0-4.0

Shaded area indicated soil interval would fall under the DTSC Variance based on total lead or soluble lead concentration, or should be disposed as hazardous waste based on the STLC limit of 5 mg/l

Figure 16. Block Diagrams for Offsite Disposal - Region II



Scenario		Depth Interval (ft)
A	A1	0.0-0.5
	A2	0.5-4.0
B	B1	0.0-1.5
	B2	1.5-4.0
C	C1	0.0-3.0
	C2	3.0-4.0
D		0.0-4.0

Shaded area indicated soil interval would fall under the DTSC Variance based on total lead or soluble lead concentration, or should be disposed as hazardous waste based on the STLC limit of 5 mg/l

Figure 17. Regression Analysis for Region III

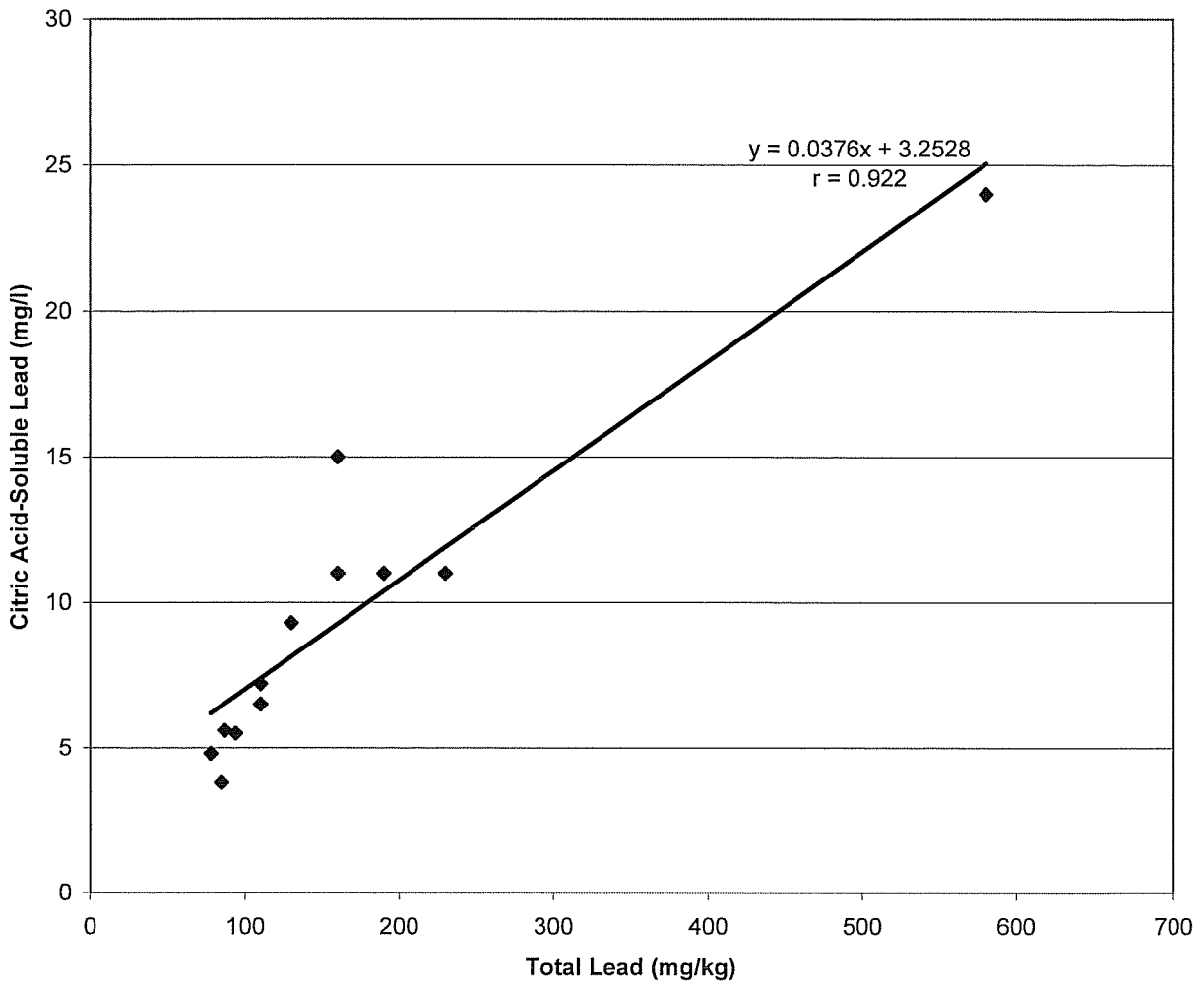
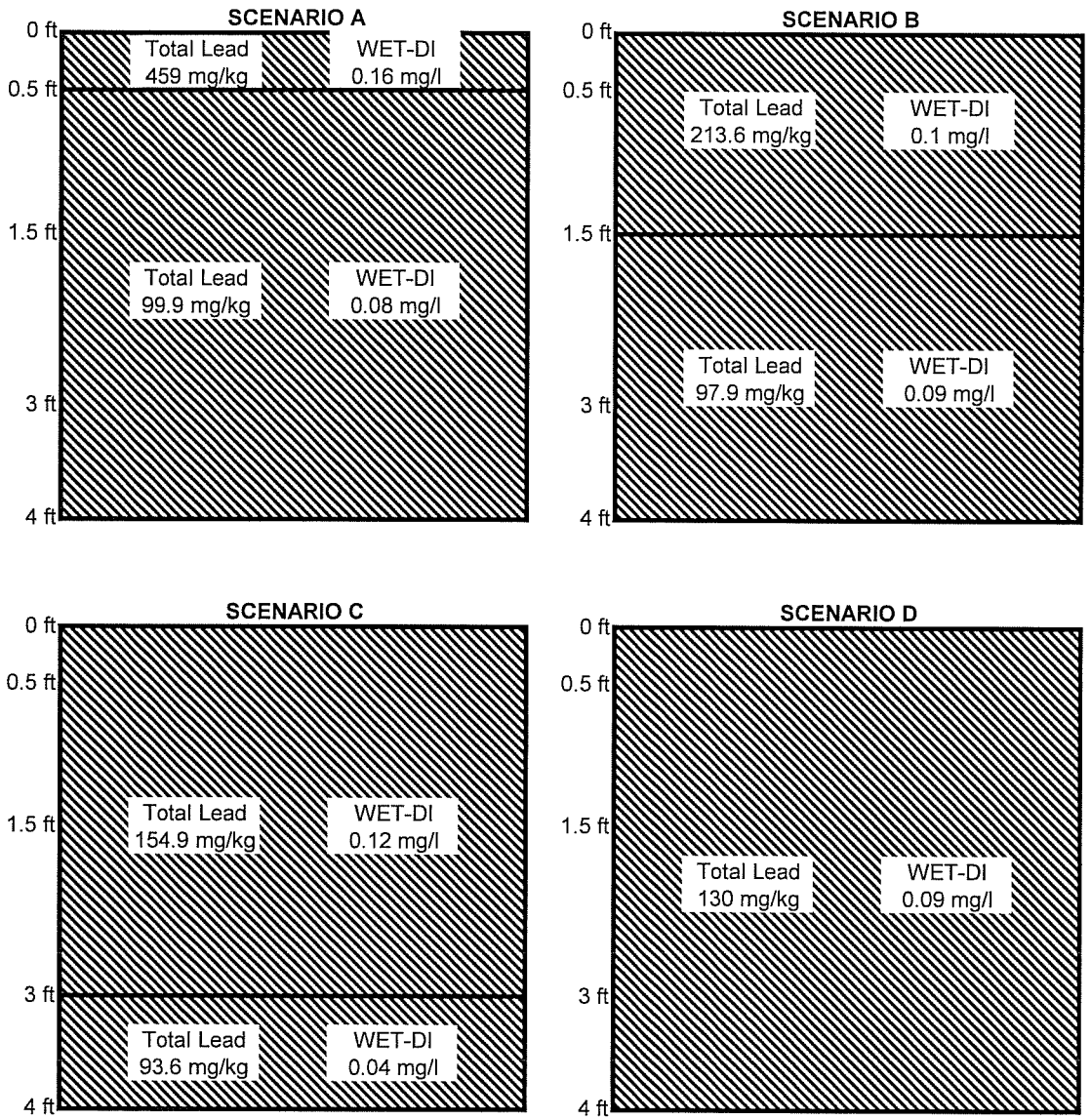


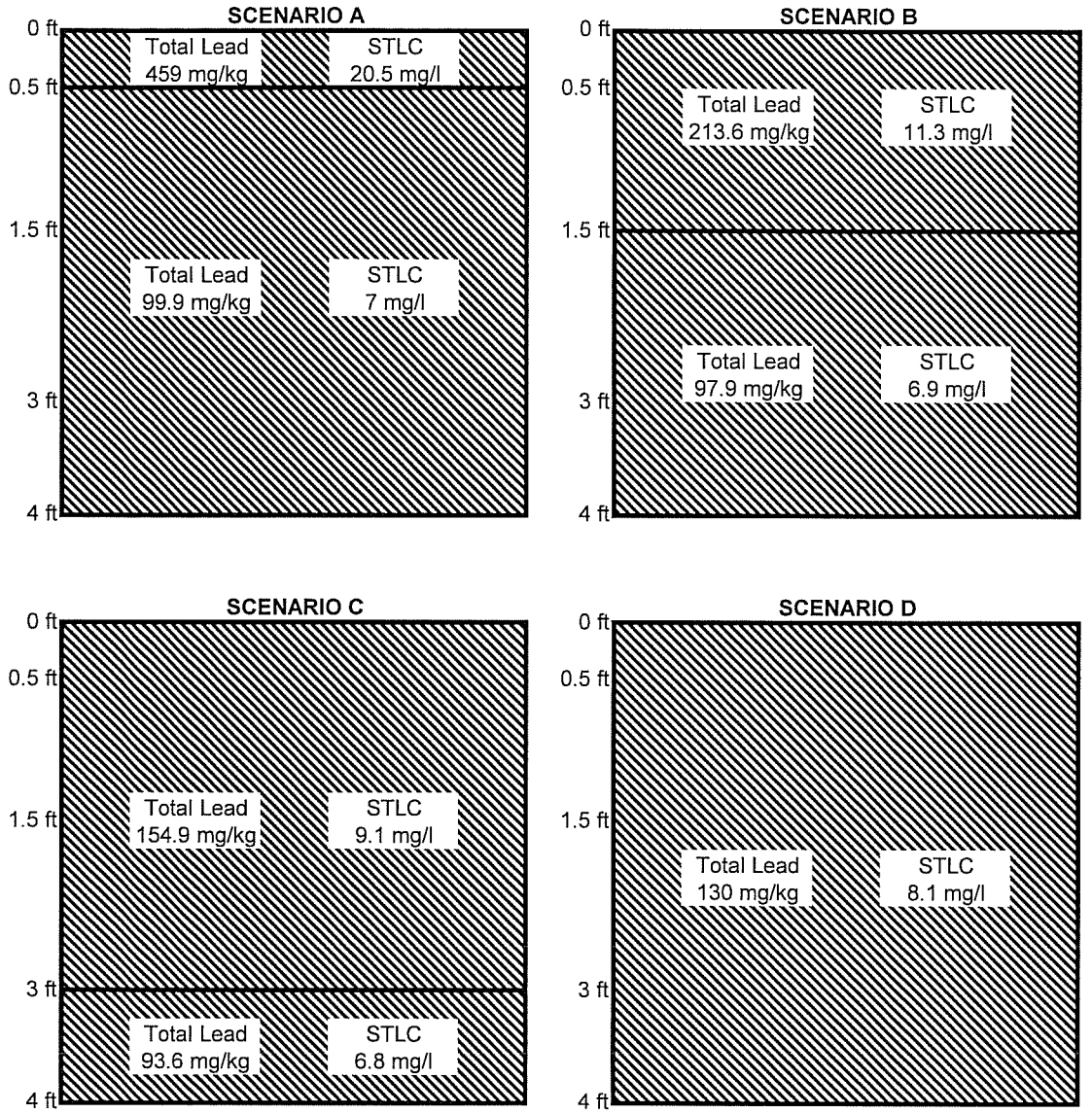
Figure 18. Block Diagrams for Reuse Onsite - Region III



Scenario		Depth Interval (ft)
A	A1	0.0-0.5
	A2	0.5-4.0
B	B1	0.0-1.5
	B2	1.5-4.0
C	C1	0.0-3.0
	C2	3.0-4.0
D		0.0-4.0

Shaded area indicated soil interval would fall under the DTSC Variance based on total lead or soluble lead concentration, or should be disposed as hazardous waste based on the STLC limit of 5 mg/l

Figure 19. Block Diagrams for Offsite Disposal - Region III



Scenario		Depth Interval (ft)
A	A1	0.0-0.5
	A2	0.5-4.0
B	B1	0.0-1.5
	B2	1.5-4.0
C	C1	0.0-3.0
	C2	3.0-4.0
D		0.0-4.0

Shaded area indicated soil interval would fall under the DTSC Variance based on total lead or soluble lead concentration, or should be disposed as hazardous waste based on the STLC limit of 5 mg/l

Figure 20. Regression Analysis for Region IV

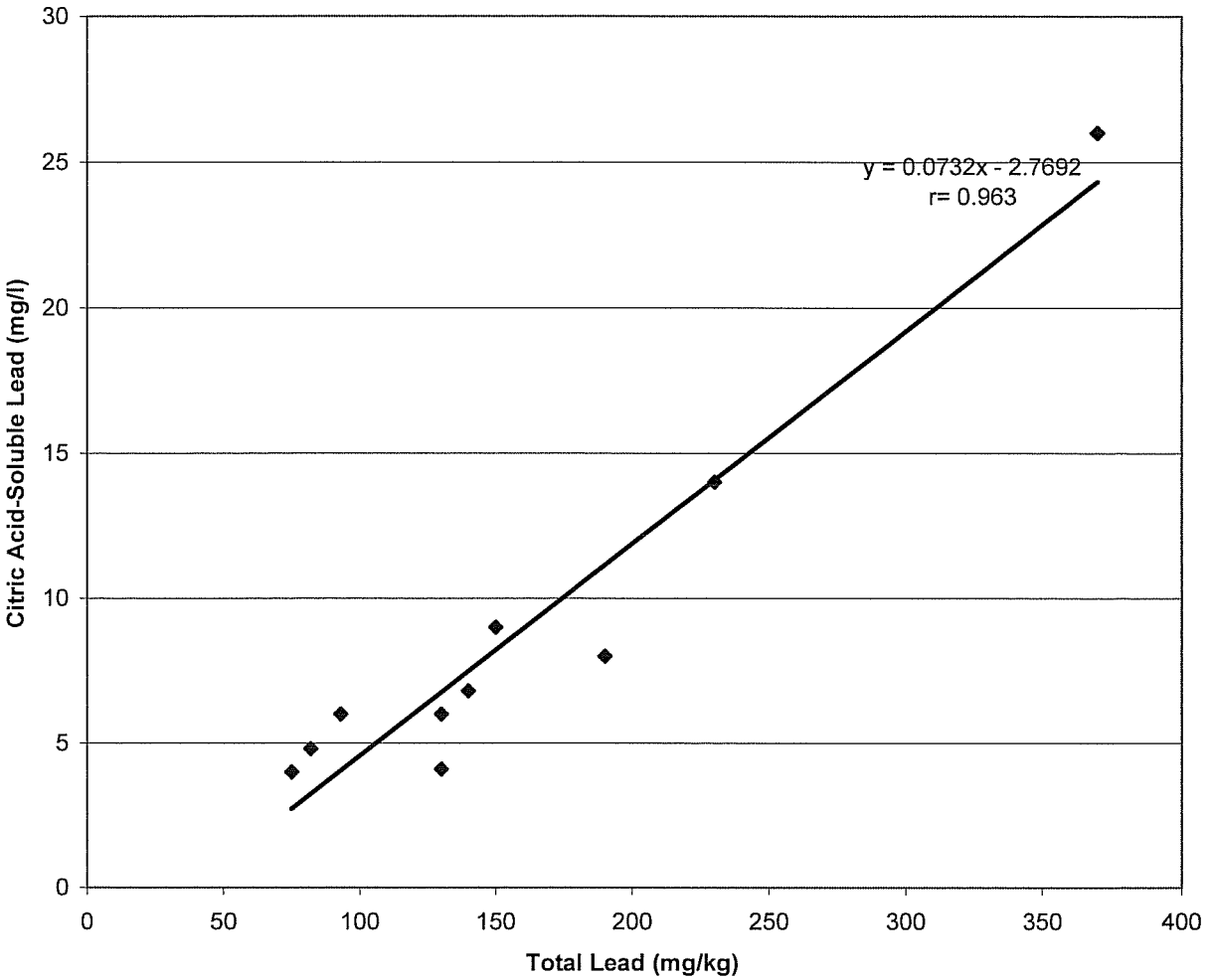
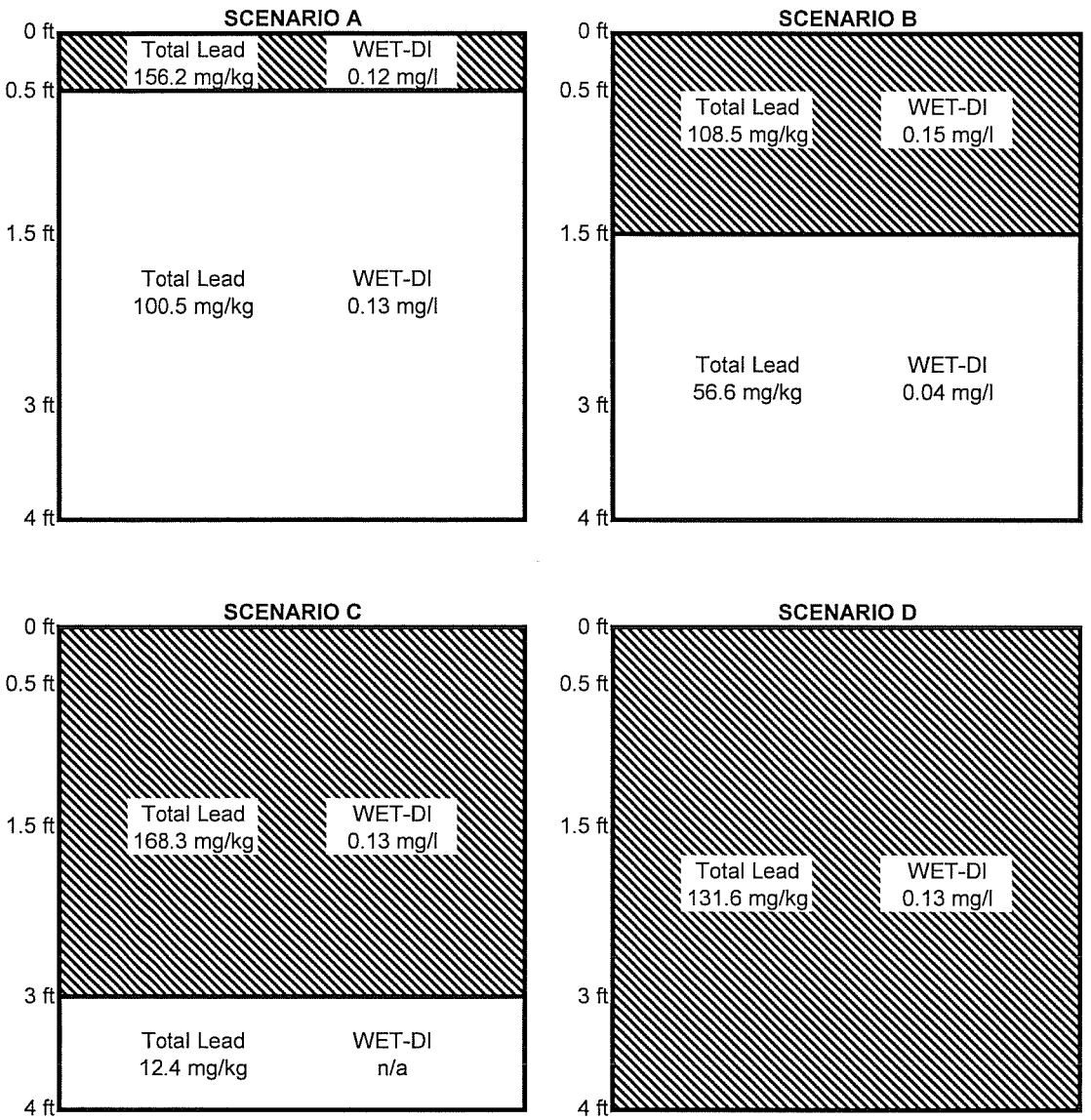


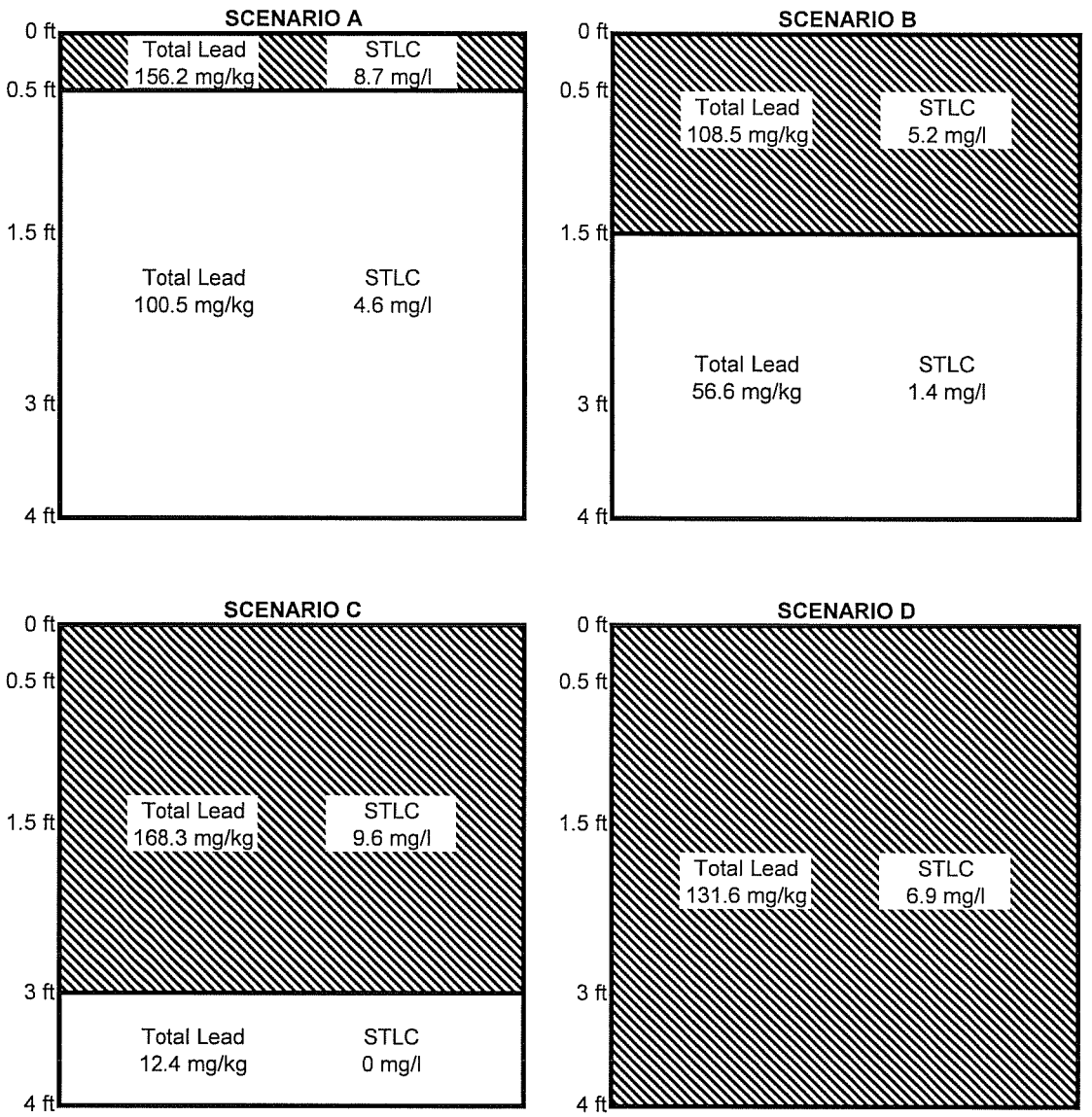
Figure 21. Block Diagrams for Reuse Onsite - Region IV



Scenario		Depth Interval (ft)
A	A1	0.0-0.5
	A2	0.5-4.0
B	B1	0.0-1.5
	B2	1.5-4.0
C	C1	0.0-3.0
	C2	3.0-4.0
D		0.0-4.0

Shaded area indicated soil interval would fall under the DTSC Variance based on total lead or soluble lead concentration, or should be disposed as hazardous waste based on the STLC limit of 5 mg/l

Figure 22. Block Diagrams for Offsite Disposal - Region IV



Scenario		Depth Interval (ft)
A	A1	0.0-0.5
	A2	0.5-4.0
B	B1	0.0-1.5
	B2	1.5-4.0
C	C1	0.0-3.0
	C2	3.0-4.0
D		0.0-4.0

Shaded area indicated soil interval would fall under the DTSC Variance based on total lead or soluble lead concentration, or should be disposed as hazardous waste based on the STLC limit of 5 mg/l

APPENDIX A

LEAD CONTAMINATION IN YELLOW THERMOPLASTIC TRAFFIC STRIPING AND PAVEMENT MARKING

Earth Mechanics, Inc. (EMI) conducted paints testing of lead concentrations in yellow thermoplastic traffic striping from three off-ramps of SR-57. The purpose of this testing was to evaluate the lead concentrations in the paints. The samples were collected November 6, 2008, from the off-ramps of Chapman Avenue, Nutwood Avenue, and Orangethorpe Avenue, in City of Yorba Linda, California.

A1.0 GUIDELINES AND TERMINOLOGY FOR LEAD

A1.1 Lead-Based Paint and Lead-Containing Paint Definitions

In 1978, the Consumer Product Safety Commission (CPSC) established a maximum lead content in paint of less than 0.06 percent by weight in a dry film of newly applied paint (U.S. Department of Housing and Urban Development [HUD], 1995). HUD specifies that lead-based paint (LBP) exists when paint contains lead equal to or greater than 1.0 milligram per square centimeter (mg/cm2) by area or 0.5 percent by weight (HUD, 1995). California Department of Public Health (DPH) adopted HUD's LBP definitions in the Title 17, California Code of Regulations (CCR), Section 35033.

Typically, the area concentrations are based on field x-ray fluorescence (XRF) analysis, while the weight concentrations are based on one of several laboratory analytical methods such as atomic absorption spectrometry (AAS) and inductively coupled plasma-atomic emission spectrometry (ICP-AES).

The definitions used in this report are as follows:

- LBP (greater than or equal to 0.5 percent by weight) – The HUD and DPH definitions are the generally accepted industry standards for determining the presence or absence of LBP. Therefore, HUD and DPH definitions are used as the evaluation criteria for LBP in this report.

- Lead-Containing Paint (LCP) – This definition is used for coatings containing detectable lead concentrations below 0.5 percent by weight but greater than or equal to 0.06 percent.

- Non-LBP – This definition is used for coatings containing lead concentrations below CPSC's maximum lead content of 0.06 percent by weight.

A1.2 Lead-Containing Hazardous Waste

Regulation 22 CCR 66261.24 states that when representative samples of a waste exhibit certain toxic characteristics then the waste is considered hazardous. Lead-containing waste (LCW) is regulated as a hazardous waste if it exhibits one of the three threshold concentrations: total threshold limit concentration (TTLC), soluble threshold limit concentration (STLC), and/or Toxic Characteristic Leaching Procedures (TCLP). Interpretations of the waste concentrations are presented below.

- TTLC equal to or greater than 1,000 milligrams per kilogram (mg/kg) (or 0.1 percent)

The TTLC for lead is 1,000 mg/kg. If the sample concentration is at or above 1,000 mg/kg, then the represented material/waste when demolished will be considered as a California hazardous waste.

Additional TCLP analysis is required to determine whether the California-regulated waste is a Resource Conservation and Recovery Act (RCRA) hazardous waste. If the TCLP result is at or above 5 milligrams per liter (mg/l) of solution, then the waste is a California-regulated and RCRA hazardous waste. If the TCLP is below 5 mg/l, then the waste is considered to be a California-regulated waste but a non-RCRA hazardous waste.

- TTLC between 50 and 1,000 mg/kg (or 0.005 to 0.1 percent)

  If the sample concentration is between 50 and 1,000 mg/kg, then additional testing using the California-mandated waste extraction test (WET) can be conducted to further characterize the STLC of the waste. The STLC for lead is 5 mg/l. At or above 5 mg/l of lead, the material would need to be disposed of as a California hazardous waste. Below 5 mg/l of lead, the waste is considered as construction debris or nonhazardous waste.

  If the sample concentration is between 100 to 1,000 mg/kg, then additional testing using the TCLP can be conducted to further characterize the TCLP of the waste. The TCLP for lead is 5 mg/l. At or above 5 mg/l of lead, the material is classified as RCRA hazardous waste. Below 5 mg/l of lead, the waste is considered as non-RCRA hazardous waste; however, the STLC analysis is still required to determine if the waste is a California-regulated waste.

- TTLC less than 50 mg/kg (or 0.005 percent)

  If the sample concentrations are less than 50 mg/kg, then the waste is considered as construction debris or nonhazardous waste.

A2.0 SAMPLING RESULTS AND INTERPRETATIONS

A total of three bulk samples of thermoplastic traffic striping were collected by EMI and submitted to Forensic Analytical Specialties, Inc. (Forensic) for analysis using AAS. Three samples were judged to be from homogeneous/similar material. The chain-of-custody form and the test results reported by Forensic are attached. The following table presents the sample number, description, location and lead concentration.

SAMPLE NO.	DESCRIPTION	LOCATION	LEAD CONC.	
			% by weight	(mg/kg)
RZ081106-LB-1	yellow thermoplastic traffic striping on asphalt	SR-57, Chapman Avenue off-ramp	1.20	12000
RZ081106-LB-2	yellow thermoplastic traffic striping on asphalt	SR-57, Nutwood Avenue off-ramp	0.43	4300
RZ081106-LB-3	yellow thermoplastic traffic striping on asphalt	SR-57, Orangethorpe Avenue off-ramp	0.12	1200

A3.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information obtained during this sampling, laboratory analytical results, current regulatory guidelines and laws, state-of-the-industry practices, and the professional judgment of EMI, the following conclusions have been made:

- Presence of LCP (Detectable Lead Concentrations <0.5% and ≥0.06% by Weight)

  Two samples (RZ081106-LB-2 and RZ081106-LB-3) have lead concentrations that would normally characterize the individual sample as LCP. However, because these samples were judged to be homogeneous/similar to RZ081106-LB-1, they were judged to be LBP. See following section for further explanation.

- Presence of LBP (Detectable Lead Concentrations >0.5% by Weight)

  One sample (RZ081106-LB-1) has a lead concentration above LBP definition. Since all three samples were collected from homogeneous material (yellow thermoplastic traffic striping), the material was judged to be LBP because:

  - The average lead concentration is 0.58 percent; and
  - With any confidence level (i.e., 80-percent or higher) the material would be above 0.5 percent.

- **Lead-Containing Hazardous Waste** – Whether a waste is a hazardous waste or not is determined based on representative TTLC, STLC, and TCLP concentrations in waste stream's samples. The representative waste streams should be characterized by the contractor for proper waste disposal. Without additional waste characterization, there is a very high likelihood that the paint removed without the asphalt substrate would be characterized as a **hazardous waste under Paragraph 3 of "Caltrans SSP 15-010,"** updated English Version March 2008.

RBF should include the above SSP for proper handling of contaminated traffic stripes into the PS&E package.

4.0 REFERENCE

California Division of Occupational Safety and Health (DOSH), 1997. Title 8, California Code of Regulations, Section 1532.1. Revised 1997.

Forensic Analytical

Final Report

Metals Analysis of Bulks

Hsin H. Chou

,

Client ID:	5572
Report Number:	M098893
Date Received:	11/07/08
Date Analyzed:	11/07/08
Date Printed:	11/14/08
First Reported:	11/14/08

Job ID / Site: C08-664, Freeway 57, PB Sampling

FASI Job ID: 5572-1000

Sample Number	Lab Number	Analyte	Result	Result Units	Reporting Limit*	Method Reference
RZ081106-LB-1	30334400	Pb	12000	mg/kg	600	EPA 3050B/7420
RZ081106-LB-2	30334401	Pb	4300	mg/kg	300	EPA 3050B/7420
RZ081106-LB-3	30334402	Pb	1200	mg/kg	60	EPA 3050B/7420

* The Reporting Limit represents the lowest amount of analyte that the laboratory can confidently detect in the sample, and is not a regulatory level. The Units for the Reporting Limit are the same as the Units for the Final Results.

Dave Sandusky, Laboratory Supervisor, Hayward Laboratory

Analytical results and reports are generated by Forensic Analytical at the request of and for the exclusive use of the person or entity (client) named on such report. Results, reports or copies of same will not be released by Forensic Analytical to any third party without prior written request from client. This report applies only to the sample(s) tested. Supporting laboratory documentation is available upon request. This report must not be reproduced except in full, unless approved by Forensic Analytical. The client is solely responsible for the use and interpretation of test results and reports requested from Forensic Analytical. Forensic Analytical is not able to assess the degree of hazard resulting from materials analyzed. Forensic Analytical reserves the right to dispose of all samples after a period of thirty (30) days, according to all state and federal guidelines, unless otherwise specified. Any modifications that have been made to referenced test methods are documented in Forensic Analytical's Standard Operating Procedures Manual. Sample results have not been blank corrected. Quality control and sample receipt condition were acceptable unless otherwise noted.

3777 Depot Road, Suite 409, Hayward, CA 94545 / Telephone: (510) 887-8828 (800) 827-FASI / Fax: (510) 887-4218

Forensic Analytical — Analysis Request Form

Client Name & Address: Hsin H. Chou, Earth Mechanics, Inc.

P.O. #: C08-664 **Date:** 11/6/08

Turn Around Time: ☐ ____ hr / ☐ 12hr / ☐ 24hr / ☐ 48hr / ☐ Ext: Regular

Due Date: — **Due Time:** —

☐ PLM: ☐ Standard / ☐ Point Count 400 ☐ Point Count 1000 ☐ PCM: NIOSH 7400

Contact: Hsin Chou / Lino Cheang

Phone #: on file

Fax #:

Site:

Job:

☐ TEM Air: ☐ AHERA / ☐ Yamate2 / ☐ NIOSH 7402
☐ TEM Bulk: ☐ Quantitative / ☐ Qualitative / ☐ Chatfield
☐ TEM Water: ☐ Potable / ☐ Non-Potable / ☐ Wt %
☐ TEM Microvac

☐ Special Project:

☒ Metals Analysis: Method Lead by AAS

Matrix:

Analytes:

Comments / Email Reports To: —

Sample ID	Date/ Time	Sample Location/Description	FOR AIR SAMPLES ONLY Type	Time On/Off	Avg. LPM	Total Time	Sample Area or Air Volume
RZ081106-LB-1	11/6/08	—	☐A ☐P ☐C				
RZ081106-LB-2	↓	—	☐A ☑P ☐C				
RZ081106-LB-3	↓	—	☐A ☐P ☑C				
			☐A ☐P ☐C				
			☐A ☐P ☐C				
			☐A ☐P ☐C				
			☐A ☑P ☐C				
			☐A ☐P ☐C				
			☐A ☐P ☐C				

Sampled by: Ricardo Zambrano **Date:** 11/6/08 **Time:** 12:00

Shipped via: ☒ Fed Ex ☐ Airborne ☐ UPS ☐ US Mail ☐ Courier ☐ Drop Off ☐ Other:

Relinquished by:	Relinquished by:	Relinquished by:
Date / Time: 11/6/08	Date / Time: 11/6/08 12:30	Date / Time:
Received by:	**Received by:**	**Received by:**
Date / Time: 11/6/08 12:00	Date / Time: 10am. COC 11/14/08 SMP 11/7/08	Date / Time:
Condition Acceptable? ☑ Yes ☐ No	Condition Acceptable? ☑ Yes ☐ No	Condition Acceptable? ☐ Yes ☐ No

San Francisco Office: 3777 Depot Road, Suite 409, Hayward, California 94545 / Telephone: (510) 887-8828 (800) 827-FASI / Fax: (510) 887-4218
Los Angeles Office: 2959 Pacific Commerce Drive, Rancho Dominguez, California 90221 / Telephone: (310) 763-2374 / Fax: (310) 763-8684
Las Vegas Office: 6765 S. Eastern Avenue, Suite 3, Las Vegas, Nevada 89119 / Telephone: (702) 387-0040 / Fax: (702) 784-0030

APPENDIX B

CHAIN-OF-CUSTODY FORMS

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

CHAIN OF CUSTODY FORM

17461 Derian Ave., #100, Irvine, CA 92614 (949) 261-1022 FAX (949) 260-3297
1014 E. Cooley Dr., Suite A, Colton, CA 92324 (909) 370-4667 FAX (909) 370-1046
9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851
2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

TAL-0013(1007)

Client Name/Address:
Earth Mechanics, Inc.
17660 Newhope st., Suite E
Fountain Valley, CA 92708

Project/PO Number:
N/B SR-57 Widening
EMI #08-115

Project Manager:
LINO CHEONG

Phone Number:
714-751-3826

Sampler:
Reynold Jie

Fax Number:
714-751-3928

Analysis Required

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Total Lead (6010)	STLC (WET-DI)	** TCLP	pH	* STLC (citrate)				All Samples Special Instructions
L-1-1	Soil	9 oz. jar	1	10-2-08	0730	None	✓			✓					* Test for STLC (citrate) when total lead is ≥ 75 mg/kg and < 1000 mg/kg. ** Test for TCLP when total lead is ≥ 1000 mg/kg.
L-1-2					0735		✓								
L-1-3					0740		✓								
L-1-4				↓	0750		✓								
L-2-1				10-6-08	0815		✓								
L-2-2					0820		✓								
L-2-3					0830		✓								
L-2-4					0840		✓								
L-3-1					0935		✓								
L-3-2					0940		✓			✓					
L-3-3					0950		✓								
L-3-4	↓	↓	↓	↓	1000	↓	✓								

0.0 10/6/08 9:15

Note: Additional STLC (WET-DI) may be assigned if failure. Please keep samples refrigerated

Relinquished By:	Date/Time:	Received By:	Date/Time:
Reynold Jie/Reynold Jie	10/15/08 1460	Jason Romanjuk	10/15/08 1400
Relinquished By: Jason Romanjuk	Date/Time: 10/15/08 1510	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received in Lab By:	Date/Time: 10/15/08 1510

Turnaround Time: (Check)

same day		72 hours	
24 hours		5 days	
48 hours		normal	X

Sample Integrity: (Check)
intact X on ice X 3.5 | 3.4

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

#A

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

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2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

TAL-0013(1007)

Client Name/Address:
Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project/PO Number:
N/B SR-57 Widening
EMI #08-115

Project Manager:
Lino Cheang

Phone Number:
714-751-3826

Sampler:
Reynold Jr

Fax Number:
714-751-3928

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Analysis Required: Total Lead (6010)	STLC (WET-DI)	** TCLP	PH	* STLC (citrate)					All Samples * Special Instructions
L-4-1	Soil	9oz jar	1	10-6-08	1225	None	✓									* Test for STLC (citrate) when total lead is ≥ 75 mg./kg. and < 1000 mg./kg. ** Test for TCLP when total lead is ≥ 1000 mg./kg.
L-4-2					1230		✓									
L-4-3					1240		✓			✓						
L-4-4					1250		✓									
L-5-1					1045		✓									
L-5-2					1050		✓									
L-5-3					1100		✓									
L-5-4					1110		✓									
L-6-1				10-7-08	0815		✓									
L-6-2					0820		✓									
L-6-3					0825		✓									
L-6-4					0835		✓			✓						

Note: Additional STLC (WET-DI) may be assigned in future. please keep samples refrigerated

Relinquished By:	Date/Time:	Received By:	Date/Time:
Reynold Jr	10-15-08 1400	Jason Ramanujk	10/15/08 1400
Jason Ramanujk	10/15/08 1510		
		Received in Lab By:	10/15/08 1510

Turnaround Time: (Check)

same day		72 hours	
24 hours		5 days	
48 hours		normal	X

Sample Integrity: (Check)
intact X on ice X 3.5 | 3.4

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

TestAmerica

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2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

TAL-0013(1007)

Client Name/Address: Earth Mechanics, Inc. 17660 Newhope St., Suite E Fountain Valley, CA 92708

Project/PO Number: N/B SR-57 Widening EMI #08-115

Project Manager: Lino Cheang

Phone Number: 714-751-3826

Sampler: Reynold Jr

Fax Number: 714-751-3928

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Analysis Required: Total Lead (6010)	STLC (WET-DI)	** TCLP	pH	* STLC (citrate)					All samples Special Instructions
L-7-1	Soil	9oz. jar	1	10-6-08	1515	none	✓			✓						* Test for STLC (citrate) when Total lead is ≥ 75 mg/kg. and < 1000 mg/kg.
L-7-2					1520		✓									** Test for TCLP when Total lead is ≥ 1000 mg/kg.
L-7-3					1530		✓									
L-7-4					1540		✓									
L-8-1					1420		✓									
L-8-2					1425		✓									
L-8-3					1435		✓									
L-8-4					1445		✓									
L-9-1					1340		✓									
L-9-2					1345		✓			✓						
L-9-3					1355		✓									
L-9-4	↓	↓	↓	↓	1405	↓	✓									
X																

Note: Additional STLC (WET-DI) may be assigned in future, please keep samples refrigerated

Relinquished By: Reynold Jr / Reynold Jr	Date/Time: 10-15-08 1400	Received By: Jason Romanyk	Date/Time: 10/15/08 1400
Relinquished By: Jason Romanyk	Date/Time: 10/15/08 1510	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received in Lab By:	Date/Time: 10/15/08 1510

Turnaround Time: (Check)
same day ____ 72 hours ____
24 hours ____ 5 days ____
48 hours ____ normal X

Sample Integrity: (Check)
intact X on ice X 3-5 | 3-4

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

TestAmerica

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2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

TAL-0013(1007)

Client Name/Address: Earth Mechanics, Inc. 17660 Newhope St., Suite E Fountain Valley, CA 92708

Project/PO Number: N/B SR-57 Widening EMI #08-115

Project Manager: Gino Cheang

Phone Number: 714-751-3826

Sampler: Reynold Jue

Fax Number: 714-751-3928

Analysis Required

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Total Lead (6010)	STLC (WET-DI) ** TCLP	PH * STLC (citrate)	All Samples Special Instructions
L-10-1	Soil	9oz. jar	1	10/7/08	0750	none	✓			* Test for STLC (citrate) when Total lead is ≥ 75 mg/kg. and < 1000 mg/kg. ** Test for TCLP when total lead is ≥ 1000 mg/kg
L-10-2					0755		✓			
L-10-3					0800		✓		✓	
L-10-4					0805		✓			
L-11-1					0850		✓			
L-11-2					0855		✓			
L-11-3					0900		✓			
L-11-4					0905		✓			
SK-12-1					1030		✓			
SK-12-2					1035		✓			
SK-12-3					1040		✓			
SK-12-4	↓	↓	↓	↓	1045	↓	✓		✓	

Note, Additional STLC (WET-DI) may be assigned in future, please Keep Samples Refrigerated

Relinquished By:	Date/Time:	Received By:	Date/Time:
Reynold Jue/Reynold Jue	10/15/08 1400	Jason Romanyk	10/15/08 1400
Jason Romanyk	10/15/08 1510		
		Received in Lab By:	10/15/08 1510

Turnaround Time: (Check)

same day		72 hours	
24 hours		5 days	
48 hours		normal	X

Sample Integrity: (Check) 3.5°C

intact X on ice X

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

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2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

TAL-0013(1007)

Client Name/Address: Earth Mechanics, Inc. 17660 Newhope st., Suite E Fountain Valley, CA 92708

Project/PO Number: N/B SR-57 Widening EMI # 08-115

Project Manager: Lino Cheang

Phone Number: 714-751-3826

Sampler: Reynold Jil

Fax Number: 714-751-3928

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Total Lead (6010)	STLC (WET-DI)	** TCLP	PH	* STLC (citrate)					All samples Special Instructions
S-13-1	Soil	9 oz jar	1	10-708	1300	none	✓			✓						* Test for STLC (citrate) when Total lead is ≥ 75 mg/kg. and < 1000 mg/kg ** Test for TCLP when Total lead is ≥ 1000 mg/kg
S-13-2	↓	↓	↓	↓	1305	↓	✓									
S-13-3					1315		✓									
S-13-4					1325		✓									
S-14-1					1405		✓									
S-14-2					1410		✓									
S-14-3					1420		✓									
S-14-4					1430		✓									
L-15-1					1540		✓									
L-15-2					1545		✓			✓						
L-15-3					1555		✓									
L-15-4	↓	↓	↓	↓	1605	↓	✓									

NOTE: Additional STLC (WET-DI) may be assigned as feature, please keep samples refrigerated

Relinquished By:	Date/Time:	Received By:	Date/Time:
REYNOLD JIL/Reynold Jil	10-15-08 1400	Jason Romanjuk	10/15/08 1400
Relinquished By: Jason Romanjuk	Date/Time: 10/15/08 1510	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received in Lab By:	Date/Time: 10/15/08 1520

Turnaround Time: (Check)

same day		72 hours	
24 hours		5 days	
48 hours		normal	X

Sample Integrity: (Check) X 3.5

intact ~~X~~ on ice 3.4

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

TestAmerica

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2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

TAL-0013(1007)

Client Name/Address: Earth Mechanics, Inc. 17660 Newhope St., Suite E Fountain Valley, CA 92708

Project/PO Number: N/B SR-57 Widening EMI # 08-115

Project Manager: Lino Cheang

Phone Number: 714-751-3826

Sampler: Reynold Jie

Fax Number: 714-751-3928

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Total Lead (6010)	STLC (WET-DI)	*TCLP	pH	*STLC (citrate)	All Samples Special Instructions
L-16-1	Soil	9oz jar	1	10/8/08	0750	None	✓					*Test for STLC (citrate) when total lead is ≥ 75 mg/kg. And < 1000 mg/kg. **Test for TCLP when Total lead is ≥ 1000 mg/kg.
L-16-2					0755		✓					
L-16-3					0805		✓			✓		
L-16-4					0815		✓					
L-17-1					0950		✓					
L-17-2					0955		✓					
L-17-3					1005		✓					
L-17-4					1015		✓					
L-18-1					0850		✓					
L-18-2					0855		✓					
L-18-3					0905		✓					
L-18-4	↓	↓	↓	↓	0915	↓	✓			✓		

Note: Additional STLC (WET-DI) may be assigned in future. Please Keep Samples refrigerated

Relinquished By:	Date/Time:	Received By:	Date/Time:	Turnaround Time: (Check)	
Reynold Jie/Reynold Jie	10/15/08 1400	Jason Romanyk	10/15/08 1400	same day ____	72 hours ____
Relinquished By: Jason Romanyk	Date/Time: 10/15/08 1510	Received By:	Date/Time:	24 hours ____	5 days ____
				48 hours ____	normal X
Relinquished By:	Date/Time:	Received in Lab By:	Date/Time: 10/15/08 1510	Sample Integrity: (Check) intact X	on ice X 3.5/3.4

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

TestAmerica

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2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

TAL-0013(1007)

Client Name/Address:
Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project/PO Number:
N/B SR-57 Widening
EMI # 08-115

Project Manager:
Lino Cheung

Phone Number:
714-751-3826

Sampler:
Reynold Jie

Fax Number:
714-751-3928

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Analysis Required: Total Lead (6010)	STLC(WET-DI)	** TCLP	pH	* STLC (citrate)					Special Instructions
L-19-1	Soil	9oz. jar	1	10-8-08	1150	none	✓									All samples * Test for STLC (citrate) when total lead is ≥ 75 mg/kg. and < 1000 mg/kg ** Test for TCLP when total lead is ≥ 1000 mg/kg
L-19-2					1155		✓									
L-19-3					1205		✓									
L-19-4					1215		✓									
L-20-1					1320		✓			✓						
L-20-2					1325		✓									
L-20-3					1335		✓									
L-20-4					1345		✓									
L-21-1					1410		✓									
L-21-2					1415		✓									
L-21-3					1425		✓									
L-21-4					1435		✓									
X																

Note: Additional STLC(WET-DI) may be assigned in future. please Keep samples refrigerated

Relinquished By:	Date/Time:	Received By:	Date/Time:
Reynold Jie/Reynold Jie	10.15.08 1400	Jason Romanyk	10/15/08 1400
Relinquished By:	Date/Time:	Received By:	Date/Time:
Jason Romanyk	10/15/08 1510		
Relinquished By:	Date/Time:	Received in Lab By:	Date/Time:
			10/15/08 1510

Turnaround Time: (Check)
same day ____ 72 hours ____
24 hours ____ 5 days ____
48 hours ____ normal X

Sample Integrity: (Check)
intact X on ice X 3.5/3.4

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

TestAmerica

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TAL-0013(1007)

Client Name/Address: Earth Mechanics, Inc. 17660 Newhope st., Suite E Fountain Valley, CA 92708

Project/PO Number: N/B SR-57 Widening EMI #08-115

Project Manager: Lino Cheung

Phone Number: 714-751-3826

Samples: Reynold Jie

Fax Number: 714-751-3928

Analysis Required

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Total Lead (6010)	STLC (WET-DI)	** TCLP	PH	* STLC (citrate)					Special Instructions
L-22-1	Soil	9oz jar	1	10-8-08	1515	none	✓									All samples * Test for STLC (citrate) when Total lead is ≥ 75 mg/kg and < 1000 mg/kg. ** Test for TCLP when total lead is ≥ 1000 mg/kg.
L-22-2					1520		✓			✓						
L-22-3					1530		✓									
L-22-4					1540		✓									
L-23-1				10-9-08	0750		✓									
L-23-2					0755		✓									
L-23-3					0805		✓									
L-23-4					0815		✓									
L-24-1					0855		✓									
L-24-2					0900		✓									
L-24-3					0910		✓			✓						
L-24-4					0920		✓									

Note: Additional STLC (WET-DI) may be assigned in future. Please Keep samples refrigerated.

Relinquished By: Reynold Jie	Date/Time: 10-15-08 1400	Received By: Jason Romanyk	Date/Time: 10/15/08 1400
Relinquished By: Jason Romanyk	Date/Time: 10/15/08 1510	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received in Lab By:	Date/Time: 10/15/08 1510

Turnaround Time: (Check)

same day ____ 72 hours ____

24 hours ____ 5 days ____

48 hours ____ normal X

Sample Integrity: (Check)

intact X on ice X 3.5 / 3.4

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

CHAIN OF CUSTODY FORM

17461 Derian Ave., #100, Irvine, CA 92614 (949) 261-1022 FAX (949) 260-3297
1014 E. Cooley Dr., Suite A, Colton, CA 92324 (909) 370-4667 FAX (909) 370-1046
9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851
2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

TAL-0013(1007)

Client Name/Address: Earth Mechanics, Inc. 17660 Newhope St., Suite E Fountain Valley, CA 92708

Project/PO Number: N/B SR-57 Widening EMI # 08-115

Project Manager: Lino Cheung

Phone Number: 714-751-3826

Sampler: Reynold Jie

Fax Number: 714-75-3928

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Analysis Required: Total Lead (6010)	STLC (WET-DI) * TCLP	pH *	STLC (citrate)	All Samples Special Instructions
SE-25-1	Soil	9oz. jar	1	10-9-08	0950	None	✓				* Test for STLC (citrate) when Total lead is 175 mg/kg. And <1000 mg/kg. ** Test for TCLP when Total lead is ≥1000 mg/kg.
SE-25-2	↓	↓	↓	↓	0955	↓	✓				
SE-25-3					1005		✓				
SE-25-4					1015		✓				
L-26-1					1050		✓				
L-26-2					1055		✓				
L-26-3					1105		✓				
L-26-4					1115		✓		V		
L-27-1					1255		✓				
L-27-2					1300		✓				
L-27-3					1310		✓				
L-27-4	↓	↓	↓	↓	1320	↓	✓				

Note: Additional STLC (WET-DI) may be assigned in future. Please keep samples refrigerated.

Relinquished By:	Date/Time:	Received By:	Date/Time:
Reynold Jie/Reynold Jie	10.15.08 1400	Jason Romanyk	10/15/08 1400
Jason Romanyk	10/15/08 1510		
		Received in Lab By:	10/15/08 1510

Turnaround Time: (Check)

same day		72 hours	
24 hours		5 days	
48 hours		normal	X

Sample Integrity: (Check) 3.5 / 3.4

intact X on ice X

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

17461 Derian Ave., #100, Irvine, CA 92614 (949) 261-1022 FAX (949) 260-3297
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2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

CHAIN OF CUSTODY FORM

TAL-0013(1007)

Client Name/Address: Earth Mechanics, Inc. 17600 Newhope st., Suite E Fountain Valley, CA 92708

Project/PO Number: N/B SR-57 Widening EMI #08-115

Project Manager: Lino Cheang

Phone Number: 714-751-3826

Sampler: Reynold Jie

Fax Number: 714-751-3928

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Analysis Required: Total Lead (6010)	STLC (WET-DI)	** TCLP	pH *	STLC (citrate)					Special Instructions
L-28-1	Soil	9oz jar	1	10-9-08	1355	none	✓			✓						All samples. * Test for STLC (citrate) when Total lead is ≥ 375 mg/kg. and < 1000 mg/kg ** Test for TCLP when Total lead is ≥ 1,000 mg/kg
L-28-2					1400		✓									
L-28-3					1410		✓									
L-28-4					1420		✓									
L-29-1				10-30-08	0855		✓									
L-29-2					0900		✓									
L-29-3					0905		✓									
L-29-4					0915		✓									
L-30-1					0945		✓									
L-30-2					0950		✓			✓						
L-30-3					1000		✓									
L-30-4					1010		✓									

Note: Additional STLC (WET-DI) may be assigned in future. please Keep samples refrigerated

Relinquished By:	Date/Time:	Received By:	Date/Time:
Reynold Jie	10.15.08 1400	Jason Romanyk	10/15/08 1400
Jason Romanyk	10/15/08 1510		
		Received in Lab By:	10/15/08 1510

Turnaround Time: (Check)
same day ____ 72 hours ____
24 hours ____ 5 days ____
48 hours ____ normal X

Sample Integrity: (Check)
intact X on ice X 3.5 / 3.4

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

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2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

TAL-0013(1007)

Client Name/Address:
Earth Mechanics, Inc.
17660 Newhope St., Suite
Fountain Valley, CA 92708

Project/PO Number:
N/B SR-57 widening
EMI #08-115

Project Manager:
Lino Cheang

Phone Number:
714-751-3826

Fax Number:
714-751-3928

Samples:
Reynold Jie

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Analysis Required: Total Lead (6010)	STLC (WET-DI)	**TCLP	PH	*STLC (citrate)					Special Instructions
L-31-1	Soil	9oz jar	1	10/3/08	1045	none	√									* Test for STLC
L-31-2					1050		√									(citrate) when
L-31-3					1100		√			√						Total lead is
L-31-4					1110		√									≥ 75 mg/kg.
L-32-1					1140		√									And < 1000 mg/kg.
L-32-2					1145		√									** Test for TCLP
L-32-3					1155		√									when total lead
L-32-4					1205		√									is ≥ 1000 mg/kg
L-33-1					1305		√									
L-33-2					1310		√									
L-33-3					1320		√									
L-33-4	↓	↓	↓	↓	1330	↓	√			√						Note: Additional STLC (WET-DI) may be assigned in future, please Keep samples refrigerated.
X																

Relinquished By:	Date/Time:	Received By:	Date/Time:
Reynold Jie / Reynold Jie	10-15-08 1400	Jason Romanyk	10/15/08 1400
Jason Romanyk	10/15/08 1510		
		Received in Lab By:	10/15/08 1510

Turnaround Time: (Check)
same day ____ 72 hours ____
24 hours ____ 5 days ____
48 hours ____ normal X

Sample Integrity: (Check) 3.5/3.4
intact X on ice X

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

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2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

TAL-0013(1007)

Client Name/Address: Earth Mechanics, Inc. 17660 Newhope st., Suite E Fountain Valley, CA 92708

Project/PO Number: N/B SR-57 Widening EMI #08-115

Project Manager: Lino Cheung

Phone Number: 714-751-3826

Sampler: Reynold Jie

Fax Number: 714-751-3928

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Analysis Required: Total Lead (6010)	STLC (WET-DI)	**TCLP	pH	*STLC (citrate)					All samples Special Instructions
L-34-1	Soil	9 oz. jar	1	10-9-08	1455	none	✓									*Test for STLC (citrate) when Total lead is ≥ 75 mg/kg. and < 1000 mg/kg **Test for TCLP when Total lead is ≥ 1000 mg/kg
L-34-2					1500		✓									
L-34-3					1510		✓									
L-34-4					1520		✓									
L-35-1				10-7-08	1405		✓			✓						
L-35-2					1410		✓									
L-35-3					1420		✓									
L-35-4					1430		✓									
L-36-1				10-8-08	0750		✓									
L-36-2					0755		✓									
L-36-3					0805		✓									
L-36-4					0815		✓									
X																

Note: Additional STLC (WET-DI) may be assigned if future. Please keep samples refrigerated.

Relinquished By:	Date/Time:	Received By:	Date/Time:
Reynold Jie/Reynold Jie	10-15-08 1400	Jason Romanyk	10/15/08 1400
Relinquished By: Jason Romanyk	10/15/08 1510	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received in Lab By:	Date/Time: 10/15/08 1510

Turnaround Time: (Check)
same day ____ 72 hours ____
24 hours ____ 5 days ____
48 hours ____ normal X

Sample Integrity: (Check)
intact X on ice X 3-5 | 3-4

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

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2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

TAL-0013(1007)

Client Name/Address: Earth Mechanics, Inc. 17660 Newhope st., Suite E Fountain Valley, CA 92708

Project/PO Number: N/B SR-57 widening EMI # 08-115

Project Manager: Lino Cheang

Phone Number: 714-751-3826

Sampler: Reynold Jin

Fax Number: 714-751-3928

Analysis Required

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Total Lead (6010)	STLC (WET-DI)	** TCLP	pH	*STLC (citrate)	Special Instructions
L-37-1	Soil	8oz jar	1	10-10-08	1035	none	✓					All samples * Test for STLC (citrate) when total lead is ≥ 75 mg/kg. and < 1000 mg/kg. ** Test for TCLP when total lead is ≥ 1000 mg/kg.
L-37-2					1130		✓			✓		
L-37-3					1140		✓					
L-37-4					1150		✓					
L-38-1					1505		✓					
L-38-2					1510		✓					
L-38-3					1520		✓					
L-38-4					1530		✓					
L-39-1					1600		✓					
L-39-2					1605		✓					
L-39-3					1615		✓			✓		
L-39-4					1625		✓					

Note: Additional STLC (WET-DI) may be assigned in future, please keep samples refrigerated.

Relinquished By:	Date/Time:	Received By:	Date/Time:
Reynold Jin/Reynold Jin	10-15-08 1400	Jason Romanyk	10/15/08 1400
Jason Romanyk	10/15/08 1510		
		Received in Lab By:	10/15/08 1510

Turnaround Time: (Check)

same day		72 hours	
24 hours		5 days	
48 hours		normal	X

Sample Integrity: (Check)

intact X on ice X 3.5/3.4

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

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9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851
2520 E. Sunset Rd. #3, Las Vegas, NV 89120 (702) 798-3620 FAX (702) 798-3621

TAL-0013(1007)

Client Name/Address: Earth Mechanics, Inc. 17660 Newhope St., Suite E Fountain Valley, CA 92708

Project/PO Number: N/B SR-57 Widening EMI # 08-115

Project Manager: Lino Cheang

Phone Number: 714-751-3826

Sampler: Reynold Joe

Fax Number: 714-751-3928

Analysis Required

Sample Description	Sample Matrix	Container Type	# of Cont.	Sampling Date	Sampling Time	Preservatives	Total Lead (6010)	STLC (WET-DI) ** TCLP	pH * STLC (citrate)					All Samples Special Instructions
L-40-1	Soil	9oz jar	1	10-10-08	1425	None	✓							* Test for STLC (citrate) when total lead is 75 mg/kg and < 1000 mg/kg. ** Test for TCLP when total lead is 1000 mg/kg
L-40-2	↓	↓	↓	↓	1430	↓	✓							
L-40-3					1440		✓							
L-40-4	↓	↓	↓	↓	1450	↓	✓		✓					
L-41-1	Water	500ml plastic		10-13-08	0805	HNO_3	✓							
L-41-2	4	↓	↓	4	0810	↓	✓		✓					

Note: Additional STLC (WET-DI) may be assigned in future, please keep samples refrigerated

Relinquished By: Reynold Joe / Reynold Joe	Date/Time: 10-15-08 1400	Received By: Jason Romanyk	Date/Time: 10/15/08 1400
Relinquished By: Jason Romanyk	Date/Time: 10/15/08 1510	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received in Lab By:	Date/Time: 10/15/08 1510

Turnaround Time: (Check)
same day ____ 72 hours ____
24 hours ____ 5 days ____
48 hours ____ normal X

Sample Integrity: (Check)
intact X on ice X 3.5/3.4

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

ASSOCIATED LABORATORIES
806 North Batavia • Orange, California 92868
Phone: (714) 771-6900 • Fax: (714) 538-1209

Date May 29, 2009 Page 1 of 3

CHAIN OF CUSTODY RECORD

Assigned LR# 285045

CLIENT: EARTH MECHANICS, INC.
ADDRESS 19660 NEWHOPE ST, SUITE E
FOUNTAIN VALLEY, CA 92708
Is this the address the final report is to be sent to? Yes V No ____
If "No" list mailing address in "Special Instructions" section at the bottom of this Chain of Custody.

PROJECT IDENTIFICATION/LOCATION:
N/B SR-57 Widening
PURCHASE ORDER #: 08-115
SAMPLER: (Print AND Sign) REYNOLD JIE
Reynold Jie

SAMPLE TURNAROUND TIME:
Requested Turnaround Time (*CIRCLE ONE*)*
Priority Charges Apply to Rush Turn Around Times
RUSH: Same Day 24 Hr 48 Hr 72 Hr
STANDARD: Standard TAT **(5 to 10 Working Days)
Other See Danielle
* Availability of Same Day/24/48/72 Hr TAT Varies Based Upon Test Method Requirements.
**Standard TAT Varies According to Analyses.

CONTACT PERSON: LINO CHEANG
SAMPLED BY (*Circle One*): (Client) Assoc. Lab Personnel
PHONE #: (714) 751-3826
FAX #: (714) 751-3928

SAMPLE CONDITION INFO - ***FOR LAB USE ONLY:***
Samples Intact: Yes ____ No ____
Sample Seals Intact: Yes ____ No ____ N/A ____
Cooler Seals Intact: Yes ____ No ____ N/A ____

Sample ID	Sample or Location Description	Date	Time	Matrix (See Codes Below)	# of Containers	Preservatives	Test Required WET-DI	Test Required TCLP
S-14-2	Soil	5-27-09	0820	S	1	none	✓	✓
L-16-1			0905				✓	✓
L-16-2			0915				✓	✓
L-20-1			1000				✓	✓
L-20-4			1050				✓	✓
L-21-1			1125				✓	✓
L-23-1			1235				✓	✓
L-23-3			1255					✓
L-24-1			1340					✓
L-24-2			1355					✓

MATRIX: GW=Ground Water DW=Drinking Water WW=Waste Water SW=Storm Water S=Solid/Soil A=Air L=Liquid F=Food (*Use the codes shown here to identify the matrix above*)

Relinquished by: (Print AND Sign)***	Received By: (Print AND Sign)	Date/Time:
REYNOLD JIE / Reynold Jie		5-29-09 / 0955
Relinquished by: (Print AND Sign)**	Received By: (Print AND Sign)	Date/Time:
	M. Ecbert	5-29-09
Relinquished by: (Print AND Sign)*** 5/29/09	Received by Lab for Analysis: (Print AND Sign)	Date/Time:

Special Instructions:
please check w/ us before discarding 1040 samples

***By signing this Chain of Custody you are authorizing the analyses shown above.
REYNOLD JIE / Reynold Jie
(Print AND Sign)

COC DISTRIBUTION:
White with report. Yellow to AL. Pink to Client's Courier.

ASSOCIATED LABORATORIES
806 North Batavia • Orange, California 92868
Phone: (714) 771-6900 • Fax: (714) 538-1209

Date 5-29-09 Page 2 of 3

CHAIN OF CUSTODY RECORD

Assigned LR# _____

CLIENT: EARTH MECHANICS, INC.

ADDRESS 17660 Newhope St., Suite E
Fountain Valley, CA 92708

Is this the address the final report is to be sent to? Yes ____ No ____
If "No" list mailing address in "Special Instructions" section at the bottom of this Chain of Custody.

PROJECT IDENTIFICATION/LOCATION:
N/B SR-57 widening

PURCHASE ORDER #: 08-115

SAMPLER (*Print AND Sign*) REYNOLD JIE
Reynold Jie

SAMPLE TURNAROUND TIME:

Requested Turnaround Time (*CIRCLE ONE*)*
Priority Charges Apply to Rush Turn Around Times
RUSH: Same Day 24 Hr 48 Hr 72 Hr
STANDARD: Standard TAT **(5 to 10 Working Days)
Other See Daniella
* Availability of Same Day/24/48/72 Hr TAT Varies Based Upon Test Method Requirements.
**Standard TAT Varies According to Analyses.

CONTACT PERSON: LINO CHEANG

SAMPLED BY (*Circle One*): (Client) **Assoc. Lab Personnel**

PHONE #: (714) 751-3826

FAX #: (714) 751-3928

SAMPLE CONDITION INFO - ***FOR LAB USE ONLY:***
Samples Intact: Yes ____ No ____
Sample Seals Intact: Yes ____ No ____ N/A ____
Cooler Seals Intact: Yes ____ No ____ N/A ____

Sample ID	Sample or Location Description	Date	Time	Matrix (See Codes Below)	# of Containers	Preservatives	WET-DI Test Required TCLP
L-24-4	Soil	5-27-09	1425	S	1	none	✓
L-25-2		"	1500				✓
L-26-4		5-28-09	0750				✓
L-27-2			0845				✓
L-29-3			0930				✓
L-30-1			1030				✓
L-30-3			1050				✓
L-33-1			1200				✓
L-36-1			1330				✓
L-36-2			1350				✓

MATRIX: **GW**=Ground Water **DW**=Drinking Water **WW**=Waste Water **SW**=Storm Water **S**=Solid/Soil **A**=Air **L**=Liquid **F**=Food (*Use the codes shown here to identify the matrix above*)

Relinquished by: (Print AND Sign)*** REYNOLD JIE / Reynold Jie	Received By: (Print AND Sign)	Date/Time: 5-29-09 / 0955
Relinquished by: (Print AND Sign)***	Received By: (Print AND Sign)	Date/Time: 5-29-09
Relinquished by: (Print AND Sign)*** 5/29/09 1033	Received by Lab for Analysis: (Print AND Sign)	Date/Time:

Special Instructions:
please check w/ us before discarding
1050 samples

***By signing this Chain of Custody you are authorizing the analyses shown above.

REYNOLD JIE / Reynold Jie
(Print AND Sign)

COC DISTRIBUTION:
White with report. **Yellow** to AL. **Pink** to Client's Courier.

ASSOCIATED LABORATORIES
806 North Batavia • Orange, California 92868
Phone: (714) 771-6900 • Fax: (714) 538-1209

Date 5-29-09 Page 3 of 3

CHAIN OF CUSTODY RECORD

Assigned LR# _____

CLIENT: EARTH MECHANICS, INC.

ADDRESS 17660 Newhope St., Suite E
Fountain Valley, CA 92708

Is this the address the final report is to be sent to? Yes ✓ No ____
If "No" list mailing address in "Special Instructions" section at the bottom of this Chain of Custody.

PROJECT IDENTIFICATION/LOCATION:
N/B SR-57 widening

PURCHASE ORDER #: 08-115

SAMPLER: (*Print AND Sign*) REYNOLD JIE
Reynold Jie

SAMPLE TURNAROUND TIME:

Requested Turnaround Time (*CIRCLE ONE*)*
Priority Charges Apply to Rush Turn Around Times
RUSH: Same Day 24 Hr 48 Hr 72 Hr
STANDARD: Standard TAT **(5 to 10 Working Days)
Other Sue Danielle
* Availability of Same Day/24/48/72 Hr TAT Varies Based Upon Test Method Requirements.
**Standard TAT Varies According to Analyses.

CONTACT PERSON: LINO CHEUNG

SAMPLED BY (*Circle One*): (Client) Assoc. Lab Personnel

PHONE #: (714) 751-3826

FAX #: (714) 751-3928

SAMPLE CONDITION INFO - ***FOR LAB USE ONLY:***
Samples Intact: Yes ____ No ____
Sample Seals Intact: Yes ____ No ____ N/A ____
Cooler Seals Intact: Yes ____ No ____ N/A ____

	Sample ID	Sample or Location Description	Date	Time	Matrix (See Codes Below)	# of Containers	Preservatives	WET-DI Test Required TCLP
	L-39-1	Soil	5-28-09	1420	S	1	none	✓

MATRIX: **GW**=Ground Water **DW**=Drinking Water **WW**=Waste Water **SW**=Storm Water **S**=Solid/Soil **A**=Air **L**=Liquid **F**=Food (*Use the codes shown here to identify the matrix above*)

Relinquished by: (Print AND Sign)***	Received By: (Print AND Sign)	Date/Time:
REYNOLD JIE Reynold Jie		5-29-09 0955
Relinquished by: (Print AND Sign)***	Received By: (Print AND Sign)	Date/Time
		5-29-09
Relinquished by: (Print AND Sign)*** 5/29/09 1600	Received by Lab for Analysis: (Print AND Sign)	Date/Time:

Special Instructions:
please check w/ us before 10% discarding samples

***By signing this Chain of Custody you are authorizing the analyses shown above. REYNOLD JIE Reynold Jie (Print AND Sign)

COC DISTRIBUTION:
White with report. **Yellow** to AL. **Pink** to Client's Courier.

APPENDIX C

LABORATORY SOIL TEST RESULTS

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

17461 Derian Avenue. Suite 100, Irvine, CA 92614 (949) 261-1022 Fax:(949) 260-3297

LABORATORY REPORT

Prepared For: Earth Mechanics
17660 Newhope Street, Suite E
Fountain Valley, CA 92708
Attention: Lino Cheang

Project: N/B SR-57 Widening Project
08-115
EMI #08-115
Sampled: 10/03/08-10/13/08
Received: 10/15/08
Issued: 11/19/08 17:11

NELAP #01108CA California ELAP#2706 CSDLAC #10256 AZ #AZ0671 NV #CA01531

The results listed within this Laboratory Report pertain only to the samples tested in the laboratory. The analyses contained in this report were performed in accordance with the applicable certifications as noted. All soil samples are reported on a wet weight basis unless otherwise noted in the report. This Laboratory Report is confidential and is intended for the sole use of TestAmerica and its client. This report shall not be reproduced, except in full, without written permission from TestAmerica. The Chain(s) of Custody, 15 pages, are included and are an integral part of this report.
This entire report was reviewed and approved for release.

SAMPLE CROSS REFERENCE

ADDITIONAL INFORMATION: This is a complete final report.

LABORATORY ID	CLIENT ID	MATRIX
IRJ1583-01	L-1-1	Soil
IRJ1583-02	L-1-2	Soil
IRJ1583-03	L-1-3	Soil
IRJ1583-04	L-1-4	Soil
IRJ1583-05	L-2-1	Soil
IRJ1583-06	L-2-2	Soil
IRJ1583-07	L-2-3	Soil
IRJ1583-08	L-2-4	Soil
IRJ1583-09	L-3-1	Soil
IRJ1583-10	L-3-2	Soil
IRJ1583-11	L-3-3	Soil
IRJ1583-12	L-3-4	Soil
IRJ1583-13	L-4-1	Soil
IRJ1583-14	L-4-2	Soil
IRJ1583-15	L-4-3	Soil
IRJ1583-16	L-4-4	Soil
IRJ1583-17	L-5-1	Soil
IRJ1583-18	L-5-2	Soil
IRJ1583-19	L-5-3	Soil
IRJ1583-20	L-5-4	Soil
IRJ1583-21	L-6-1	Soil
IRJ1583-22	L-6-2	Soil
IRJ1583-23	L-6-3	Soil

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Earth Mechanics
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Attention: Lino Cheang

Project ID: N/B SR-57 Widening Project 08-115
EMI #08-115
Report Number: IRJ1583

Sampled: 10/03/08-10/13/08
Received: 10/15/08

LABORATORY ID	CLIENT ID	MATRIX
IRJ1583-24	L-6-4	Soil
IRJ1583-25	L-7-1	Soil
IRJ1583-26	L-7-2	Soil
IRJ1583-27	L-7-3	Soil
IRJ1583-28	L-7-4	Soil
IRJ1583-29	L-8-1	Soil
IRJ1583-30	L-8-2	Soil
IRJ1583-31	L-8-3	Soil
IRJ1583-32	L-8-4	Soil
IRJ1583-33	L-9-1	Soil
IRJ1583-34	L-9-2	Soil
IRJ1583-35	L-9-3	Soil
IRJ1583-36	L-9-4	Soil
IRJ1583-37	L-10-1	Soil
IRJ1583-38	L-10-2	Soil
IRJ1583-39	L-10-3	Soil
IRJ1583-40	L-10-4	Soil
IRJ1583-41	L-11-1	Soil
IRJ1583-42	L-11-2	Soil
IRJ1583-43	L-11-3	Soil
IRJ1583-44	L-11-4	Soil
IRJ1583-45	S-12-1	Soil
IRJ1583-46	S-12-2	Soil
IRJ1583-47	S-12-3	Soil
IRJ1583-48	S-12-4	Soil
IRJ1583-49	S-13-1	Soil
IRJ1583-50	S-13-2	Soil
IRJ1583-51	S-13-3	Soil
IRJ1583-52	S-13-4	Soil
IRJ1583-53	S-14-1	Soil
IRJ1583-54	S-14-2	Soil
IRJ1583-55	S-14-3	Soil
IRJ1583-56	S-14-4	Soil
IRJ1583-57	L-15-1	Soil
IRJ1583-58	L-15-2	Soil
IRJ1583-59	L-15-3	Soil
IRJ1583-60	L-15-4	Soil
IRJ1583-61	L-16-1	Soil
IRJ1583-62	L-16-2	Soil
IRJ1583-63	L-16-3	Soil
IRJ1583-64	L-16-4	Soil
IRJ1583-65	L-17-1	Soil
IRJ1583-66	L-17-2	Soil

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EMI #08-115
Report Number: IRJ1583

Sampled: 10/03/08-10/13/08
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LABORATORY ID	CLIENT ID	MATRIX
IRJ1583-67	L-17-3	Soil
IRJ1583-68	L-17-4	Soil
IRJ1583-69	L-18-1	Soil
IRJ1583-70	L-18-2	Soil
IRJ1583-71	L-18-3	Soil
IRJ1583-72	L-18-4	Soil
IRJ1583-73	L-19-1	Soil
IRJ1583-74	L-19-2	Soil
IRJ1583-75	L-19-3	Soil
IRJ1583-76	L-19-4	Soil
IRJ1583-77	L-20-1	Soil
IRJ1583-78	L-20-2	Soil
IRJ1583-79	L-20-3	Soil
IRJ1583-80	L-20-4	Soil
IRJ1583-81	L-21-1	Soil
IRJ1583-82	L-21-2	Soil
IRJ1583-83	L-21-3	Soil
IRJ1583-84	L-21-4	Soil
IRJ1583-85	L-22-1	Soil
IRJ1583-86	L-22-2	Soil
IRJ1583-87	L-22-3	Soil
IRJ1583-88	L-22-4	Soil
IRJ1583-89	L-23-1	Soil
IRJ1583-90	L-23-2	Soil
IRJ1583-91	L-23-3	Soil
IRJ1583-92	L-23-4	Soil
IRJ1583-93	L-24-1	Soil
IRJ1583-94	L-24-2	Soil
IRJ1583-95	L-24-3	Soil
IRJ1583-96	L-24-4	Soil
IRJ1583-97	S-25-1	Soil
IRJ1583-98	S-25-2	Soil
IRJ1583-99	S-25-3	Soil
IRJ1583-AA	S-25-4	Soil
IRJ1583-AB	L-26-1	Soil
IRJ1583-AC	L-26-2	Soil
IRJ1583-AD	L-26-3	Soil
IRJ1583-AE	L-26-4	Soil
IRJ1583-AF	L-27-1	Soil
IRJ1583-AG	L-27-2	Soil
IRJ1583-AH	L-27-3	Soil
IRJ1583-AI	L-27-4	Soil
IRJ1583-AJ	L-28-1	Soil

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Project ID: N/B SR-57 Widening Project 08-115
EMI #08-115
Report Number: IRJ1583

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LABORATORY ID	CLIENT ID	MATRIX
IRJ1583-AK	L-28-2	Soil
IRJ1583-AL	L-28-3	Soil
IRJ1583-AM	L-28-4	Soil
IRJ1583-AN	L-29-1	Soil
IRJ1583-AO	L-29-2	Soil
IRJ1583-AP	L-29-3	Soil
IRJ1583-AQ	L-29-4	Soil
IRJ1583-AR	L-30-1	Soil
IRJ1583-AS	L-30-2	Soil
IRJ1583-AT	L-30-3	Soil
IRJ1583-AU	L-30-4	Soil
IRJ1583-AV	L-31-1	Soil
IRJ1583-AW	L-31-2	Soil
IRJ1583-AX	L-31-3	Soil
IRJ1583-AY	L-31-4	Soil
IRJ1583-AZ	L-32-1	Soil
IRJ1583-BA	L-32-2	Soil
IRJ1583-BB	L-32-3	Soil
IRJ1583-BC	L-32-4	Soil
IRJ1583-BD	L-33-1	Soil
IRJ1583-BE	L-33-2	Soil
IRJ1583-BF	L-33-3	Soil
IRJ1583-BG	L-33-4	Soil
IRJ1583-BH	L-34-1	Soil
IRJ1583-BI	L-34-2	Soil
IRJ1583-BJ	L-34-3	Soil
IRJ1583-BK	L-34-4	Soil
IRJ1583-BL	L-35-1	Soil
IRJ1583-BM	L-35-2	Soil
IRJ1583-BN	L-35-3	Soil
IRJ1583-BO	L-35-4	Soil
IRJ1583-BP	L-36-1	Soil
IRJ1583-BQ	L-36-2	Soil
IRJ1583-BR	L-36-3	Soil
IRJ1583-BS	L-36-4	Soil
IRJ1583-BT	L-37-1	Soil
IRJ1583-BU	L-37-2	Soil
IRJ1583-BV	L-37-3	Soil
IRJ1583-BW	L-37-4	Soil
IRJ1583-BX	L-38-1	Soil
IRJ1583-BY	L-38-2	Soil
IRJ1583-BZ	L-38-3	Soil
IRJ1583-CA	L-38-4	Soil

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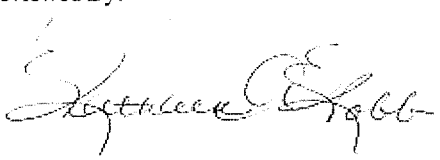
Project ID: N/B SR-57 Widening Project 08-115
EMI #08-115
Report Number: IRJ1583

Sampled: 10/03/08-10/13/08
Received: 10/15/08

LABORATORY ID	CLIENT ID	MATRIX
IRJ1583-CB	L-39-1	Soil
IRJ1583-CC	L-39-2	Soil
IRJ1583-CD	L-39-3	Soil
IRJ1583-CE	L-39-4	Soil
IRJ1583-CF	L-40-1	Soil
IRJ1583-CG	L-40-2	Soil
IRJ1583-CH	L-40-3	Soil
IRJ1583-CI	L-40-4	Soil
IRJ1583-CJ	L-41-1	Water
IRJ1583-CK	L-41-2	Water

Reviewed By:



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Report Number: IRJ1583

Sampled: 10/03/08-10/13/08
Received: 10/15/08

METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-01 (L-1-1 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24079	2.0	**21**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-02 (L-1-2 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J22079	2.0	**28**	1.01	10/22/2008	10/22/2008	
Sample ID: IRJ1583-03 (L-1-3 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J22079	2.0	**30**	0.995	10/22/2008	10/22/2008	
Sample ID: IRJ1583-04 (L-1-4 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J22079	2.0	**33**	1.01	10/22/2008	10/22/2008	
Sample ID: IRJ1583-05 (L-2-1 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J22079	2.0	**44**	1.01	10/22/2008	10/22/2008	
Sample ID: IRJ1583-06 (L-2-2 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J22079	2.0	**19**	1.01	10/22/2008	10/22/2008	
Sample ID: IRJ1583-07 (L-2-3 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J22079	2.0	**12**	0.995	10/22/2008	10/22/2008	
Sample ID: IRJ1583-08 (L-2-4 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J22079	2.0	**27**	0.995	10/22/2008	10/22/2008	
Sample ID: IRJ1583-09 (L-3-1 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J22079	2.0	**17**	0.995	10/22/2008	10/22/2008	
Sample ID: IRJ1583-10 (L-3-2 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24079	2.0	**21**	1	10/24/2008	10/24/2008	

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Project Manager

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Project ID: N/B SR-57 Widening Project 08-115
EMI #08-115
Report Number: IRJ1583

Sampled: 10/03/08-10/13/08
Received: 10/15/08

METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-11 (L-3-3 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J22079	2.0	**55**	0.995	10/22/2008	10/22/2008	
Sample ID: IRJ1583-12 (L-3-4 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24079	2.0	**19**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-13 (L-4-1 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J22079	2.0	**48**	1.01	10/22/2008	10/22/2008	
Sample ID: IRJ1583-14 (L-4-2 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**16**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-15 (L-4-3 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**21**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-16 (L-4-4 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**23**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-17 (L-5-1 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J22079	2.0	**27**	1	10/22/2008	10/22/2008	
Sample ID: IRJ1583-18 (L-5-2 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**22**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-19 (L-5-3 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**22**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-20 (L-5-4 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**20**	1	10/23/2008	10/23/2008	

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Project ID: N/B SR-57 Widening Project 08-115
EMI #08-115
Report Number: IRJ1583

Sampled: 10/03/08-10/13/08
Received: 10/15/08

METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-21 (L-6-1 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**33**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-22 (L-6-2 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**47**	0.995	10/23/2008	10/23/2008	
Sample ID: IRJ1583-23 (L-6-3 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**27**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-24 (L-6-4 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	4.0	**25**	1.98	10/23/2008	10/24/2008	
Sample ID: IRJ1583-25 (L-7-1 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	4.0	**26**	2	10/23/2008	10/24/2008	
Sample ID: IRJ1583-26 (L-7-2 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**28**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-27 (L-7-3 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**25**	0.995	10/23/2008	10/23/2008	
Sample ID: IRJ1583-28 (L-7-4 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**23**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-29 (L-8-1 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**22**	0.995	10/23/2008	10/23/2008	
Sample ID: IRJ1583-30 (L-8-2 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**22**	1	10/23/2008	10/23/2008	

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Attention: Lino Cheang

Project ID: N/B SR-57 Widening Project 08-115
EMI #08-115
Report Number: IRJ1583

Sampled: 10/03/08-10/13/08
Received: 10/15/08

METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-31 (L-8-3 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**10**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-32 (L-8-4 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**10**	0.995	10/23/2008	10/23/2008	
Sample ID: IRJ1583-33 (L-9-1 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23088	2.0	**66**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-34 (L-9-2 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**28**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-35 (L-9-3 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**37**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-36 (L-9-4 - Soil)					**Sampled: 10/06/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**37**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-37 (L-10-1 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**23**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-38 (L-10-2 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**37**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-39 (L-10-3 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**33**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-40 (L-10-4 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**38**	1	10/23/2008	10/23/2008	

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Project ID: N/B SR-57 Widening Project 08-115
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METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-41 (L-11-1 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**28**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-42 (L-11-2 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**28**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-43 (L-11-3 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**27**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-44 (L-11-4 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**13**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-45 (S-12-1 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**33**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-46 (S-12-2 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**44**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-47 (S-12-3 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**47**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-48 (S-12-4 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**4.3**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-49 (S-13-1 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**75**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-50 (S-13-2 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**9.4**	1	10/23/2008	10/23/2008	

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METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-51 (S-13-3 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**7.2**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-52 (S-13-4 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**6.4**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-53 (S-14-1 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23089	2.0	**73**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-54 (S-14-2 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**210**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-55 (S-14-3 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**11**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-56 (S-14-4 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**27**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-57 (L-15-1 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**79**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-58 (L-15-2 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**61**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-59 (L-15-3 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**13**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-60 (L-15-4 - Soil)					**Sampled: 10/07/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**26**	1	10/24/2008	10/24/2008	

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METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-61 (L-16-1 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**390**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-62 (L-16-2 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**130**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-63 (L-16-3 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**14**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-64 (L-16-4 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**100**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-65 (L-17-1 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**13**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-66 (L-17-2 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**16**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-67 (L-17-3 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**23**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-68 (L-17-4 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**26**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-69 (L-18-1 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**4.8**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-70 (L-18-2 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	ND	1	10/24/2008	10/24/2008	

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METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-71 (L-18-3 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**4.3**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-72 (L-18-4 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**9.5**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-73 (L-19-1 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24002	2.0	**25**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-74 (L-19-2 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**57**	1	10/23/2008	10/23/2008	M1
Sample ID: IRJ1583-75 (L-19-3 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**3.4**	0.995	10/23/2008	10/23/2008	
Sample ID: IRJ1583-76 (L-19-4 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**4.0**	0.995	10/23/2008	10/23/2008	
Sample ID: IRJ1583-77 (L-20-1 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**190**	1.01	10/23/2008	10/23/2008	
Sample ID: IRJ1583-78 (L-20-2 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**29**	0.995	10/23/2008	10/23/2008	
Sample ID: IRJ1583-79 (L-20-3 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**13**	1	10/23/2008	10/23/2008	
Sample ID: IRJ1583-80 (L-20-4 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**130**	1.01	10/23/2008	10/23/2008	

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METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-81 (L-21-1 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**110**	1.01	10/23/2008	10/23/2008	
Sample ID: IRJ1583-82 (L-21-2 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**78**	0.995	10/23/2008	10/23/2008	
Sample ID: IRJ1583-83 (L-21-3 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**3.7**	0.995	10/23/2008	10/23/2008	
Sample ID: IRJ1583-84 (L-21-4 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**3.6**	0.995	10/23/2008	10/23/2008	
Sample ID: IRJ1583-85 (L-22-1 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**63**	1.01	10/23/2008	10/24/2008	
Sample ID: IRJ1583-86 (L-22-2 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**13**	1.01	10/23/2008	10/24/2008	
Sample ID: IRJ1583-87 (L-22-3 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**16**	1	10/23/2008	10/24/2008	
Sample ID: IRJ1583-88 (L-22-4 - Soil)					**Sampled: 10/08/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**35**	1.01	10/23/2008	10/24/2008	
Sample ID: IRJ1583-89 (L-23-1 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**94**	1.01	10/23/2008	10/24/2008	
Sample ID: IRJ1583-90 (L-23-2 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**53**	1	10/23/2008	10/24/2008	

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METALS

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Sample ID: IRJ1583-91 (L-23-3 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23132	2.0	**160**	0.995	10/23/2008	10/24/2008	
Sample ID: IRJ1583-92 (L-23-4 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24001	2.0	**5.6**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-93 (L-24-1 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24001	2.0	**580**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-94 (L-24-2 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24001	2.0	**230**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-95 (L-24-3 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24001	2.0	**85**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-96 (L-24-4 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24001	2.0	**87**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-97 (S-25-1 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24001	2.0	**4.1**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-98 (S-25-2 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24001	2.0	**160**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-99 (S-25-3 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24001	2.0	**57**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-AA (S-25-4 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**5.2**	1	10/24/2008	10/24/2008	M2

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METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-AB (L-26-1 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**50**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AC (L-26-2 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**41**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AD (L-26-3 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**34**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AE (L-26-4 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**110**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AF (L-27-1 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**34**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AG (L-27-2 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**230**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AH (L-27-3 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**16**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AI (L-27-4 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**4.0**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AJ (L-28-1 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**33**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AK (L-28-2 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**4.6**	1	10/24/2008	10/24/2008	

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METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-AL (L-28-3 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**28**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AM (L-28-4 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**4.0**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AN (L-29-1 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**14**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AO (L-29-2 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**11**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AP (L-29-3 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**93**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AQ (L-29-4 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**2.9**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AR (L-30-1 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**190**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AS (L-30-2 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**130**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AT (L-30-3 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24003	2.0	**82**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-AU (L-30-4 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**26**	1	10/24/2008	10/25/2008	

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Project ID: N/B SR-57 Widening Project 08-115
EMI #08-115
Report Number: IRJ1583

Sampled: 10/03/08-10/13/08
Received: 10/15/08

METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-AV (L-31-1 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23167	2.0	**58**	1	10/23/2008	10/24/2008	
Sample ID: IRJ1583-AW (L-31-2 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**23**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-AX (L-31-3 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**5.6**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-AY (L-31-4 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	ND	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-AZ (L-32-1 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**3.4**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BA (L-32-2 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**6.1**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BB (L-32-3 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**3.0**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BC (L-32-4 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**5.5**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BD (L-33-1 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**130**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BE (L-33-2 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**29**	1	10/24/2008	10/25/2008	

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METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-BF (L-33-3 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**34**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BG (L-33-4 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**2.6**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BH (L-34-1 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**68**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BI (L-34-2 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**9.4**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BJ (L-34-3 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**3.6**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BK (L-34-4 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**3.3**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BL (L-35-1 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**9.1**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BM (L-35-2 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**9.4**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BN (L-35-3 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**7.1**	1	10/24/2008	10/25/2008	
Sample ID: IRJ1583-BO (L-35-4 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	ND	0.995	10/23/2008	10/24/2008	

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METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-BP (L-36-1 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**370**	0.985	10/23/2008	10/24/2008	
Sample ID: IRJ1583-BQ (L-36-2 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**150**	1	10/23/2008	10/24/2008	
Sample ID: IRJ1583-BR (L-36-3 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**7.0**	1	10/23/2008	10/27/2008	
Sample ID: IRJ1583-BS (L-36-4 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**5.8**	0.995	10/23/2008	10/27/2008	
Sample ID: IRJ1583-BT (L-37-1 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**15**	0.99	10/23/2008	10/27/2008	
Sample ID: IRJ1583-BU (L-37-2 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**2.7**	0.995	10/23/2008	10/24/2008	
Sample ID: IRJ1583-BV (L-37-3 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**2.4**	1	10/23/2008	10/24/2008	
Sample ID: IRJ1583-BW (L-37-4 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J24004	2.0	**4.2**	1	10/24/2008	10/24/2008	
Sample ID: IRJ1583-BX (L-38-1 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**3.3**	1.01	10/23/2008	10/24/2008	
Sample ID: IRJ1583-BY (L-38-2 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**7.9**	0.985	10/23/2008	10/24/2008	

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METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-BZ (L-38-3 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**2.8**	1	10/23/2008	10/24/2008	
Sample ID: IRJ1583-CA (L-38-4 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**2.5**	0.985	10/23/2008	10/24/2008	
Sample ID: IRJ1583-CB (L-39-1 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**140**	0.985	10/23/2008	10/24/2008	
Sample ID: IRJ1583-CC (L-39-2 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**75**	0.995	10/23/2008	10/24/2008	
Sample ID: IRJ1583-CD (L-39-3 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**3.3**	1	10/23/2008	10/24/2008	
Sample ID: IRJ1583-CE (L-39-4 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**6.2**	0.99	10/23/2008	10/24/2008	
Sample ID: IRJ1583-CF (L-40-1 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**72**	1	10/23/2008	10/24/2008	
Sample ID: IRJ1583-CG (L-40-2 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**73**	1.01	10/23/2008	10/24/2008	
Sample ID: IRJ1583-CH (L-40-3 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**27**	1	10/23/2008	10/24/2008	
Sample ID: IRJ1583-CI (L-40-4 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/kg								
Lead	EPA 6010B	8J23139	2.0	**2.0**	0.995	10/23/2008	10/24/2008	

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METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-CJ (L-41-1 - Water)					**Sampled: 10/13/08**			
Reporting Units: mg/l								
Lead	EPA 6010B	8J20066	0.0050	**0.11**	1	10/20/2008	10/21/2008	
Sample ID: IRJ1583-CK (L-41-2 - Water)					**Sampled: 10/13/08**			
Reporting Units: mg/l								
Lead	EPA 6010B	8J20066	0.0050	ND	1	10/20/2008	10/21/2008	

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STLC METALS (DI WET)

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-91 (L-23-3 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.19**	1	11/17/2008	11/18/2008	
Sample ID: IRJ1583-93 (L-24-1 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.16**	1	11/17/2008	11/18/2008	
Sample ID: IRJ1583-94 (L-24-2 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.062**	1	11/17/2008	11/18/2008	
Sample ID: IRJ1583-96 (L-24-4 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.019**	1	11/17/2008	11/18/2008	
Sample ID: IRJ1583-98 (S-25-2 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.070**	1	11/17/2008	11/18/2008	
Sample ID: IRJ1583-AE (L-26-4 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.053**	1	11/17/2008	11/18/2008	
Sample ID: IRJ1583-AG (L-27-2 - Soil)					**Sampled: 10/09/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.33**	1	11/17/2008	11/18/2008	
Sample ID: IRJ1583-AP (L-29-3 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.049**	1	11/17/2008	11/18/2008	
Sample ID: IRJ1583-AR (L-30-1 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.029**	1	11/17/2008	11/18/2008	
Sample ID: IRJ1583-AT (L-30-3 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.027**	1	11/17/2008	11/18/2008	

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STLC METALS (DI WET)

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-BD (L-33-1 - Soil)					**Sampled: 10/03/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.082**	1	11/17/2008	11/18/2008	
Sample ID: IRJ1583-BP (L-36-1 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.21**	1	11/17/2008	11/18/2008	
Sample ID: IRJ1583-BQ (L-36-2 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.12**	1	11/17/2008	11/18/2008	
Sample ID: IRJ1583-CB (L-39-1 - Soil)					**Sampled: 10/10/08**			
Reporting Units: mg/l								
Lead	6010B-DI WET	8K17105	0.0050	**0.15**	1	11/17/2008	11/18/2008	

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Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-01 (L-1-1 - Soil)					**Sampled: 10/03/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**8.61**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-10 (L-3-2 - Soil)					**Sampled: 10/06/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**8.37**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-15 (L-4-3 - Soil)					**Sampled: 10/06/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**8.59**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-24 (L-6-4 - Soil)					**Sampled: 10/03/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**8.65**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-25 (L-7-1 - Soil)					**Sampled: 10/06/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**7.74**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-34 (L-9-2 - Soil)					**Sampled: 10/06/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**8.12**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-39 (L-10-3 - Soil)					**Sampled: 10/07/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**8.11**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-48 (S-12-4 - Soil)					**Sampled: 10/07/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**7.92**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-49 (S-13-1 - Soil)					**Sampled: 10/07/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**8.39**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-58 (L-15-2 - Soil)					**Sampled: 10/07/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**9.57**	1	10/16/2008	10/16/2008	H3

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Project ID: N/B SR-57 Widening Project 08-115
EMI #08-115
Report Number: IRJ1583

Sampled: 10/03/08-10/13/08
Received: 10/15/08

INORGANICS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-63 (L-16-3 - Soil)					**Sampled: 10/08/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**8.18**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-72 (L-18-4 - Soil)					**Sampled: 10/08/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**8.36**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-77 (L-20-1 - Soil)					**Sampled: 10/08/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**8.19**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-86 (L-22-2 - Soil)					**Sampled: 10/08/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**8.41**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-95 (L-24-3 - Soil)					**Sampled: 10/09/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**7.84**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-AE (L-26-4 - Soil)					**Sampled: 10/09/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16081	0.100	**7.81**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-AJ (L-28-1 - Soil)					**Sampled: 10/09/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16081	0.100	**8.28**	1	10/16/2008	10/16/2008	
Sample ID: IRJ1583-AS (L-30-2 - Soil)					**Sampled: 10/03/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16080	0.100	**8.82**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-AX (L-31-3 - Soil)					**Sampled: 10/03/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16081	0.100	**8.00**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-BG (L-33-4 - Soil)					**Sampled: 10/03/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16081	0.100	**8.49**	1	10/16/2008	10/16/2008	H3

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INORGANICS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-BL (L-35-1 - Soil)					**Sampled: 10/03/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16081	0.100	**8.19**	1	10/16/2008	10/16/2008	H3
Sample ID: IRJ1583-BU (L-37-2 - Soil)					**Sampled: 10/10/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16081	0.100	**8.08**	1	10/16/2008	10/16/2008	
Sample ID: IRJ1583-CD (L-39-3 - Soil)					**Sampled: 10/10/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16081	0.100	**8.35**	1	10/16/2008	10/16/2008	
Sample ID: IRJ1583-CI (L-40-4 - Soil)					**Sampled: 10/10/08**			
Reporting Units: pH Units								
pH	EPA 9045C	8J16081	0.100	**8.62**	1	10/16/2008	10/16/2008	

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STLC METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	STLC Limit	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-54 (S-14-2 - Soil)					**Sampled: 10/07/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**10**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-57 (L-15-1 - Soil)					**Sampled: 10/07/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**4.0**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-61 (L-16-1 - Soil)					**Sampled: 10/08/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**33**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-62 (L-16-2 - Soil)					**Sampled: 10/08/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**5.3**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-64 (L-16-4 - Soil)					**Sampled: 10/08/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**2.6**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-77 (L-20-1 - Soil)					**Sampled: 10/08/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**11**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-80 (L-20-4 - Soil)					**Sampled: 10/08/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**9.3**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-81 (L-21-1 - Soil)					**Sampled: 10/08/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**6.5**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-82 (L-21-2 - Soil)					**Sampled: 10/08/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**4.8**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-89 (L-23-1 - Soil)					**Sampled: 10/09/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**5.5**	1	5.0	11/7/2008	11/7/2008	

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STLC METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	STLC Limit	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-91 (L-23-3 - Soil)					**Sampled: 10/09/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**11**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-93 (L-24-1 - Soil)					**Sampled: 10/09/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**24**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-94 (L-24-2 - Soil)					**Sampled: 10/09/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**11**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-95 (L-24-3 - Soil)					**Sampled: 10/09/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**3.8**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-96 (L-24-4 - Soil)					**Sampled: 10/09/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**5.6**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-98 (S-25-2 - Soil)					**Sampled: 10/09/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**15**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-AE (L-26-4 - Soil)					**Sampled: 10/09/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**7.2**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-AG (L-27-2 - Soil)					**Sampled: 10/09/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**14**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-AP (L-29-3 - Soil)					**Sampled: 10/03/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**5.5**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-AR (L-30-1 - Soil)					**Sampled: 10/03/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07129	0.10	**8.0**	1	5.0	11/7/2008	11/7/2008	

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STLC METALS

Analyte	Method	Batch	Reporting Limit	Sample Result	Dilution Factor	STLC Limit	Date Extracted	Date Analyzed	Data Qualifiers
Sample ID: IRJ1583-AS (L-30-2 - Soil)					**Sampled: 10/03/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07130	0.10	**4.1**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-AT (L-30-3 - Soil)					**Sampled: 10/03/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07130	0.10	**5.5**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-BD (L-33-1 - Soil)					**Sampled: 10/03/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07130	0.10	**6.4**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-BP (L-36-1 - Soil)					**Sampled: 10/10/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07130	0.10	**26**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-BQ (L-36-2 - Soil)					**Sampled: 10/10/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07130	0.10	**9.8**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-CB (L-39-1 - Soil)					**Sampled: 10/10/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07130	0.10	**6.8**	1	5.0	11/7/2008	11/7/2008	
Sample ID: IRJ1583-CC (L-39-2 - Soil)					**Sampled: 10/10/08**				
Reporting Units: mg/l									
Lead	6010B-STLC	8K07130	0.10	**4.0**	1	5.0	11/7/2008	11/7/2008	

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WASTE EXTRACTION TEST (STLC) - Metals/Inorganics

Analyte	Method	Batch	Extraction Start Date	Extraction End Date	Data Qualifiers
Sample ID: IRJ1583-54 (S-14-2 - Soil)			**Sampled: 10/07/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-57 (L-15-1 - Soil)			**Sampled: 10/07/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-61 (L-16-1 - Soil)			**Sampled: 10/08/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-62 (L-16-2 - Soil)			**Sampled: 10/08/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-64 (L-16-4 - Soil)			**Sampled: 10/08/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-77 (L-20-1 - Soil)			**Sampled: 10/08/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-80 (L-20-4 - Soil)			**Sampled: 10/08/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-81 (L-21-1 - Soil)			**Sampled: 10/08/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	

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WASTE EXTRACTION TEST (STLC) - Metals/Inorganics

Analyte	Method	Batch	Extraction Start Date	Extraction End Date	Data Qualifiers
Sample ID: IRJ1583-82 (L-21-2 - Soil)			**Sampled: 10/08/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-89 (L-23-1 - Soil)			**Sampled: 10/09/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-91 (L-23-3 - Soil)			**Sampled: 10/09/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-93 (L-24-1 - Soil)			**Sampled: 10/09/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-94 (L-24-2 - Soil)			**Sampled: 10/09/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-95 (L-24-3 - Soil)			**Sampled: 10/09/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-96 (L-24-4 - Soil)			**Sampled: 10/09/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-98 (S-25-2 - Soil)			**Sampled: 10/09/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	

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WASTE EXTRACTION TEST (STLC) - Metals/Inorganics

Analyte	Method	Batch	Extraction Start Date	Extraction End Date	Data Qualifiers
Sample ID: IRJ1583-AE (L-26-4 - Soil)			**Sampled: 10/09/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-AG (L-27-2 - Soil)			**Sampled: 10/09/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-AP (L-29-3 - Soil)			**Sampled: 10/03/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-AR (L-30-1 - Soil)			**Sampled: 10/03/08**		
Extraction	STLC-Met	8K05139	11/5/2008	11/7/2008	
Sample ID: IRJ1583-AS (L-30-2 - Soil)			**Sampled: 10/03/08**		
Extraction	STLC-Met	8K05140	11/5/2008	11/7/2008	
Sample ID: IRJ1583-AT (L-30-3 - Soil)			**Sampled: 10/03/08**		
Extraction	STLC-Met	8K05140	11/5/2008	11/7/2008	
Sample ID: IRJ1583-BD (L-33-1 - Soil)			**Sampled: 10/03/08**		
Extraction	STLC-Met	8K05140	11/5/2008	11/7/2008	
Sample ID: IRJ1583-BP (L-36-1 - Soil)			**Sampled: 10/10/08**		
Extraction	STLC-Met	8K05140	11/5/2008	11/7/2008	

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WASTE EXTRACTION TEST (STLC) - Metals/Inorganics

Analyte	Method	Batch	Extraction Start Date	Extraction End Date	Data Qualifiers
Sample ID: IRJ1583-BQ (L-36-2 - Soil)			**Sampled: 10/10/08**		
Extraction	STLC-Met	8K05140	11/5/2008	11/7/2008	
Sample ID: IRJ1583-CB (L-39-1 - Soil)			**Sampled: 10/10/08**		
Extraction	STLC-Met	8K05140	11/5/2008	11/7/2008	
Sample ID: IRJ1583-CC (L-39-2 - Soil)			**Sampled: 10/10/08**		
Extraction	STLC-Met	8K05140	11/5/2008	11/7/2008	

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Received: 10/15/08

WASTE EXTRACTION TEST (DI Water) - METALS

Analyte	Method	Batch	Extraction Start Date	Extraction End Date	Data Qualifiers
Sample ID: IRJ1583-91 (L-23-3 - Soil)			**Sampled: 10/09/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	
Sample ID: IRJ1583-93 (L-24-1 - Soil)			**Sampled: 10/09/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	
Sample ID: IRJ1583-94 (L-24-2 - Soil)			**Sampled: 10/09/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	
Sample ID: IRJ1583-96 (L-24-4 - Soil)			**Sampled: 10/09/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	
Sample ID: IRJ1583-98 (S-25-2 - Soil)			**Sampled: 10/09/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	
Sample ID: IRJ1583-AE (L-26-4 - Soil)			**Sampled: 10/09/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	
Sample ID: IRJ1583-AG (L-27-2 - Soil)			**Sampled: 10/09/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	
Sample ID: IRJ1583-AP (L-29-3 - Soil)			**Sampled: 10/03/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	

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Attention: Lino Cheang

Project ID: N/B SR-57 Widening Project 08-115
EMI #08-115
Report Number: IRJ1583

Sampled: 10/03/08-10/13/08
Received: 10/15/08

WASTE EXTRACTION TEST (DI Water) - METALS

Analyte	Method	Batch	Extraction Start Date	Extraction End Date	Data Qualifiers
Sample ID: IRJ1583-AR (L-30-1 - Soil)			**Sampled: 10/03/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	
Sample ID: IRJ1583-AT (L-30-3 - Soil)			**Sampled: 10/03/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	
Sample ID: IRJ1583-BD (L-33-1 - Soil)			**Sampled: 10/03/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	
Sample ID: IRJ1583-BP (L-36-1 - Soil)			**Sampled: 10/10/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	
Sample ID: IRJ1583-BQ (L-36-2 - Soil)			**Sampled: 10/10/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	
Sample ID: IRJ1583-CB (L-39-1 - Soil)			**Sampled: 10/10/08**		
Extraction	DI WET-Met	8K15042	11/15/2008	11/17/2008	

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METHOD BLANK/QC DATA

METALS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Data Qualifiers
Batch: 8J20066 Extracted: 10/20/08										
Blank Analyzed: 10/21/2008 (8J20066-BLK1)										
Lead	ND	0.0050	mg/l							
LCS Analyzed: 10/21/2008 (8J20066-BS1)										
Lead	1.01	0.0050	mg/l	1.00		101	80-120			
Matrix Spike Analyzed: 10/21/2008 (8J20066-MS1)					**Source: IRJ1917-01**					
Lead	1.01	0.0050	mg/l	1.00	ND	101	75-125			
Matrix Spike Dup Analyzed: 10/21/2008 (8J20066-MSD1)					**Source: IRJ1917-01**					
Lead	1.01	0.0050	mg/l	1.00	ND	101	75-125	0	20	
Batch: 8J22079 Extracted: 10/22/08										
Blank Analyzed: 10/22/2008 (8J22079-BLK1)										
Lead	ND	2.0	mg/kg							
LCS Analyzed: 10/22/2008 (8J22079-BS1)										
Lead	48.1	2.0	mg/kg	50.0		96	80-120			
Matrix Spike Analyzed: 10/22/2008 (8J22079-MS1)					**Source: IRJ1516-01**					
Lead	55.5	2.0	mg/kg	50.0	4.66	102	75-125			
Matrix Spike Dup Analyzed: 10/22/2008 (8J22079-MSD1)					**Source: IRJ1516-01**					
Lead	52.1	2.0	mg/kg	50.0	4.66	95	75-125	6	20	
Batch: 8J23088 Extracted: 10/23/08										
Blank Analyzed: 10/23/2008 (8J23088-BLK1)										
Lead	ND	2.0	mg/kg							

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METHOD BLANK/QC DATA

METALS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Data Qualifiers
Batch: 8J23088 Extracted: 10/23/08										
LCS Analyzed: 10/23/2008 (8J23088-BS1)										
Lead	42.5	2.0	mg/kg	50.0		85	80-120			
Matrix Spike Analyzed: 10/23/2008 (8J23088-MS1)					**Source: IRJ1583-14**					
Lead	57.9	2.0	mg/kg	50.0	15.9	84	75-125			
Matrix Spike Dup Analyzed: 10/23/2008 (8J23088-MSD1)					**Source: IRJ1583-14**					
Lead	59.3	2.0	mg/kg	50.0	15.9	87	75-125	2	20	
Batch: 8J23089 Extracted: 10/23/08										
Blank Analyzed: 10/23/2008 (8J23089-BLK1)										
Lead	ND	2.0	mg/kg							
LCS Analyzed: 10/23/2008 (8J23089-BS1)										
Lead	45.4	2.0	mg/kg	50.0		91	80-120			
Matrix Spike Analyzed: 10/23/2008 (8J23089-MS1)					**Source: IRJ1583-34**					
Lead	72.9	2.0	mg/kg	50.0	27.9	90	75-125			
Matrix Spike Dup Analyzed: 10/23/2008 (8J23089-MSD1)					**Source: IRJ1583-34**					
Lead	71.5	2.0	mg/kg	50.0	27.9	87	75-125	2	20	
Batch: 8J23132 Extracted: 10/23/08										
Blank Analyzed: 10/23/2008 (8J23132-BLK1)										
Lead	ND	2.0	mg/kg							

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METHOD BLANK/QC DATA

METALS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Data Qualifiers
Batch: 8J23132 Extracted: 10/23/08										
LCS Analyzed: 10/23/2008 (8J23132-BS1)										
Lead	44.6	2.0	mg/kg	50.0		89	80-120			
Matrix Spike Analyzed: 10/23/2008 (8J23132-MS1)					**Source: IRJ1583-74**					
Lead	131	2.0	mg/kg	50.0	57.5	147	75-125			*M1*
Matrix Spike Dup Analyzed: 10/23/2008 (8J23132-MSD1)					**Source: IRJ1583-74**					
Lead	99.9	2.0	mg/kg	50.0	57.5	85	75-125	27	20	*R-3*
Batch: 8J23139 Extracted: 10/23/08										
Blank Analyzed: 10/24/2008 (8J23139-BLK1)										
Lead	ND	2.0	mg/kg							
LCS Analyzed: 10/24/2008 (8J23139-BS1)										
Lead	43.9	2.0	mg/kg	50.0		88	80-120			
Matrix Spike Analyzed: 10/24/2008 (8J23139-MS1)					**Source: IRJ1583-CI**					
Lead	43.6	2.0	mg/kg	50.0	1.98	83	75-125			
Matrix Spike Dup Analyzed: 10/24/2008 (8J23139-MSD1)					**Source: IRJ1583-CI**					
Lead	43.1	2.0	mg/kg	49.8	1.98	83	75-125	1	20	
Batch: 8J23167 Extracted: 10/23/08										
Blank Analyzed: 10/24/2008 (8J23167-BLK1)										
Lead	ND	2.0	mg/kg							

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METHOD BLANK/QC DATA

METALS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Data Qualifiers
Batch: 8J23167 Extracted: 10/23/08										
LCS Analyzed: 10/24/2008 (8J23167-BS1)										
Lead	46.4	2.0	mg/kg	50.0		93	80-120			
Matrix Spike Analyzed: 10/24/2008 (8J23167-MS1)					**Source: IRJ1613-18**					
Lead	48.8	2.0	mg/kg	50.0	4.32	89	75-125			
Matrix Spike Analyzed: 10/24/2008 (8J23167-MS2)					**Source: IRJ1613-16**					
Lead	61.6	2.0	mg/kg	50.0	29.5	64	75-125			*M2*
Matrix Spike Dup Analyzed: 10/24/2008 (8J23167-MSD1)					**Source: IRJ1613-18**					
Lead	47.5	2.0	mg/kg	50.0	4.32	86	75-125	3	20	
Matrix Spike Dup Analyzed: 10/24/2008 (8J23167-MSD2)					**Source: IRJ1613-16**					
Lead	60.1	2.0	mg/kg	50.0	29.5	61	75-125	2	20	*M2*
Batch: 8J24001 Extracted: 10/24/08										
Blank Analyzed: 10/24/2008 (8J24001-BLK1)										
Lead	ND	2.0	mg/kg							
LCS Analyzed: 10/24/2008 (8J24001-BS1)										
Lead	46.3	2.0	mg/kg	50.0		93	80-120			
Matrix Spike Analyzed: 10/24/2008 (8J24001-MS1)					**Source: IRJ1872-01**					
Lead	73.8	2.0	mg/kg	50.0	26.9	94	75-125			
Matrix Spike Dup Analyzed: 10/24/2008 (8J24001-MSD1)					**Source: IRJ1872-01**					
Lead	74.9	2.0	mg/kg	50.0	26.9	96	75-125	1	20	

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METHOD BLANK/QC DATA

METALS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Data Qualifiers
Batch: 8J24002 Extracted: 10/24/08										
Blank Analyzed: 10/24/2008 (8J24002-BLK1)										
Lead	ND	2.0	mg/kg							
LCS Analyzed: 10/24/2008 (8J24002-BS1)										
Lead	43.7	2.0	mg/kg	50.0		87	80-120			
Matrix Spike Analyzed: 10/24/2008 (8J24002-MS1)					**Source: IRJ1583-54**					
Lead	239	2.0	mg/kg	50.0	209	60	75-125			*M2*
Matrix Spike Dup Analyzed: 10/24/2008 (8J24002-MSD1)					**Source: IRJ1583-54**					
Lead	249	2.0	mg/kg	50.0	209	79	75-125	4	20	*M2*
Batch: 8J24003 Extracted: 10/24/08										
Blank Analyzed: 10/24/2008 (8J24003-BLK1)										
Lead	ND	2.0	mg/kg							
LCS Analyzed: 10/24/2008 (8J24003-BS1)										
Lead	42.9	2.0	mg/kg	50.0		86	80-120			
Matrix Spike Analyzed: 10/24/2008 (8J24003-MS1)					**Source: IRJ1583-AA**					
Lead	48.1	2.0	mg/kg	50.0	5.22	86	75-125			
Matrix Spike Dup Analyzed: 10/24/2008 (8J24003-MSD1)					**Source: IRJ1583-AA**					
Lead	39.4	2.0	mg/kg	50.0	5.22	68	75-125	20	20	*M2*
Batch: 8J24004 Extracted: 10/24/08										
Blank Analyzed: 10/24/2008 (8J24004-BLK1)										
Lead	ND	2.0	mg/kg							

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METHOD BLANK/QC DATA

METALS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Data Qualifiers
Batch: 8J24004 Extracted: 10/24/08										
LCS Analyzed: 10/24/2008 (8J24004-BS1)										
Lead	46.2	2.0	mg/kg	50.0		92	80-120			
Matrix Spike Analyzed: 10/24/2008 (8J24004-MS1)					**Source: IRJ1583-BW**					
Lead	50.2	2.0	mg/kg	50.0	4.24	92	75-125			
Matrix Spike Dup Analyzed: 10/24/2008 (8J24004-MSD1)					**Source: IRJ1583-BW**					
Lead	50.3	2.0	mg/kg	50.0	4.24	92	75-125	0	20	
Batch: 8J24079 Extracted: 10/24/08										
Blank Analyzed: 10/24/2008 (8J24079-BLK1)										
Lead	ND	2.0	mg/kg							
LCS Analyzed: 10/24/2008 (8J24079-BS1)										
Lead	46.5	2.0	mg/kg	50.0		93	80-120			
Matrix Spike Analyzed: 10/25/2008 (8J24079-MS1)					**Source: IRJ1670-41**					
Lead	67.1	20	mg/kg	50.0	24.6	85	75-125			
Matrix Spike Dup Analyzed: 10/25/2008 (8J24079-MSD1)					**Source: IRJ1670-41**					
Lead	73.0	20	mg/kg	50.0	24.6	97	75-125	8	20	

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METHOD BLANK/QC DATA

STLC METALS (DI WET)

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Data Qualifiers
Batch: 8K17105 Extracted: 11/17/08										
Blank Analyzed: 11/18/2008 (8K17105-BLK1)										
Lead	ND	0.0050	mg/l							
LCS Analyzed: 11/18/2008 (8K17105-BS1)										
Lead	0.980	0.0050	mg/l	1.00		98	80-120			
Matrix Spike Analyzed: 11/18/2008 (8K17105-MS1)					**Source: IRJ1583-91**					
Lead	1.19	0.0050	mg/l	1.00	0.194	99	75-125			
Matrix Spike Dup Analyzed: 11/18/2008 (8K17105-MSD1)					**Source: IRJ1583-91**					
Lead	1.18	0.0050	mg/l	1.00	0.194	98	75-125	1	20	

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METHOD BLANK/QC DATA

STLC METALS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Data Qualifiers
Batch: 8K07129 Extracted: 11/07/08										
Blank Analyzed: 11/07/2008 (8K07129-BLK1)										
Lead	ND	0.10	mg/l							
LCS Analyzed: 11/07/2008 (8K07129-BS1)										
Lead	18.4	0.10	mg/l	20.0		92	80-120			
Matrix Spike Analyzed: 11/07/2008 (8K07129-MS1)					**Source: IRJ1583-54**					
Lead	29.4	0.10	mg/l	20.0	10.4	95	75-125			
Matrix Spike Dup Analyzed: 11/07/2008 (8K07129-MSD1)					**Source: IRJ1583-54**					
Lead	29.8	0.10	mg/l	20.0	10.4	97	75-125	1	20	
Batch: 8K07130 Extracted: 11/07/08										
Blank Analyzed: 11/07/2008 (8K07130-BLK1)										
Lead	ND	0.10	mg/l							
LCS Analyzed: 11/07/2008 (8K07130-BS1)										
Lead	18.8	0.10	mg/l	20.0		94	80-120			
Matrix Spike Analyzed: 11/07/2008 (8K07130-MS1)					**Source: IRJ2830-01**					
Lead	18.6	0.10	mg/l	20.0	ND	93	75-125			
Matrix Spike Dup Analyzed: 11/07/2008 (8K07130-MSD1)					**Source: IRJ2830-01**					
Lead	18.8	0.10	mg/l	20.0	ND	94	75-125	1	20	

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METHOD BLANK/QC DATA

INORGANICS

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Data Qualifiers
Batch: 8J16080 Extracted: 10/16/08										
Duplicate Analyzed: 10/16/2008 (8J16080-DUP1)					**Source: IRJ1408-02**					
pH	7.62	0.100	pH Units		7.57			1	5	
Duplicate Analyzed: 10/16/2008 (8J16080-DUP2)					**Source: IRJ1583-AS**					
pH	8.82	0.100	pH Units		8.82			0	5	
Batch: 8J16081 Extracted: 10/16/08										
Duplicate Analyzed: 10/16/2008 (8J16081-DUP1)					**Source: IRJ1583-CI**					
pH	8.59	0.100	pH Units		8.62			0	5	

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DATA QUALIFIERS AND DEFINITIONS

H3	Sample was received and analyzed past holding time.
M1	The MS and/or MSD were above the acceptance limits due to sample matrix interference. See Blank Spike (LCS).
M2	The MS and/or MSD were below the acceptance limits due to sample matrix interference. See Blank Spike (LCS).
R-3	The RPD exceeded the acceptance limit due to sample matrix effects.
ND	Analyte NOT DETECTED at or above the reporting limit or MDL, if MDL is specified.
RPD	Relative Percent Difference

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Certification Summary

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Method	Matrix	Nelac	California
6010B-DI WET	Soil	X	X
6010B-STLC	Soil	X	X
DI WET-Met	Soil	X	X
EPA 6010B	Soil	X	X
EPA 6010B	Water	X	X
EPA 9045C	Soil	X	X
STLC-Met	Soil	X	X

Nevada and NELAP provide analyte specific accreditations. Analyte specific information for TestAmerica may be obtained by contacting the laboratory or visiting our website at www.testamericainc.com

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LAB REQUEST 235045
REPORTED 06/05/2009
RECEIVED 05/29/2009

PROJECT #08-115
N-B SR-57 Widening

SUBMITTER Client

COMMENTS

This laboratory request covers the following listed samples which were analyzed for the parameters indicated on the attached Analytical Result Report. All analyses were conducted using the appropriate methods as indicated on the report. This cover letter is an integral part of the final report.

Order No.	Client Sample Identification
997150	S-14-2
997151	L-16-1
997152	L-16-2
997153	L-20-1
997154	L-20-4
997155	L-21-1
997156	L-23-1
997157	L-23-3
997158	L-24-1
997159	L-24-2
997160	L-24-4
997161	L-25-2

Thank you for the opportunity to be of service to your company. Please feel free to call if there are any questions regarding this report or if we can be of further service.

ASSOCIATED LABORATORIES by,

for Edward S. Behare, Ph.D.
Vice President

NOTE: Unless notified in writing , all samples will be discarded by appropriate disposal protocol 30 days from date reported.

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Environmental

ASSOCIATED LABORATORIES
806 North Batavia - Orange, California 92868 - 714/771-6900 *FAX 714/538-1209*

CLIENT Earth Mechanics, Inc. (12926)
ATTN: Lino Cheang
17660 Newhope Street Suite E
Fountain Valley, CA 92708

LAB REQUEST 235045
REPORTED 06/05/2009
RECEIVED 05/29/2009

PROJECT #08-115
N-B SR-57 Widening

SUBMITTER Client

COMMENTS

This laboratory request covers the following listed samples which were analyzed for the parameters indicated on the attached Analytical Result Report. All analyses were conducted using the appropriate methods as indicated on the report. This cover letter is an integral part of the final report.

Order No.	Client Sample Identification
997162	L-26-4
997163	L-27-2
997164	L-29-3
997165	L-30-1
997166	L-30-3
997167	L-33-1
997168	L-36-1
997169	L-36-2
997170	L-39-1
997171	Laboratory Method Blank

Thank you for the opportunity to be of service to your company. Please feel free to call if there are any questions regarding this report or if we can be of further service.

ASSOCIATED LABORATORIES by,

Edward S. Behare, Ph.D.
Vice President

NOTE: Unless notified in writing , all samples will be discarded by appropriate disposal protocol 30 days from date reported.

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Order #: 997150 **Client Sample ID:** S-14-2
Matrix: SOLID
Date Sampled: 05/27/2009
Time Sampled: 08:20

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN
6010 Deionized Water WET Extraction				
Lead	0.05	0.005	mg/L	06/01/09 KN

Order #: 997151 **Client Sample ID:** L-16-1
Matrix: SOLID
Date Sampled: 05/27/2009
Time Sampled: 09:05

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	0.36	0.05	mg/L	06/02/09 KN
6010 Deionized Water WET Extraction				
Lead	0.064	0.005	mg/L	06/08/09 KN

Order #: 997152 **Client Sample ID:** L-16-2
Matrix: SOLID
Date Sampled: 05/27/2009
Time Sampled: 09:15

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN
6010 Deionized Water WET Extraction				
Lead	0.258	0.005	mg/L	06/01/09 KN

DLR = Detection limit for reporting purposes, ND = Not Detected below indicated detection limit

Order #: 997153 **Client Sample ID:** L-20-1
Matrix: SOLID
Date Sampled: 05/27/2009
Time Sampled: 10:00

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	0.17	0.05	mg/L	06/02/09 KN
6010 Deionized Water WET Extraction				
Lead	0.164	0.005	mg/L	06/01/09 KN

Order #: 997154 **Client Sample ID:** L-20-4
Matrix: SOLID
Date Sampled: 05/27/2009
Time Sampled: 10:50

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN
6010 Deionized Water WET Extraction				
Lead	0.019	0.005	mg/L	06/01/09 KN

Order #: 997155 **Client Sample ID:** L-21-1
Matrix: SOLID
Date Sampled: 05/27/2009
Time Sampled: 11:25

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	0.099	0.05	mg/L	06/02/09 KN
6010 Deionized Water WET Extraction				
Lead	0.102	0.005	mg/L	06/01/09 KN

DLR = Detection limit for reporting purposes, ND = Not Detected below indicated detection limit

Order #: 997156 **Client Sample ID:** L-23-1
Matrix: SOLID
Date Sampled: 05/27/2009
Time Sampled: 12:35

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	0.06	0.05	mg/L	06/02/09 KN
6010 Deionized Water WET Extraction				
Lead	0.074	0.005	mg/L	06/01/09 KN

Order #: 997157 **Client Sample ID:** L-23-3
Matrix: SOLID
Date Sampled: 05/27/2009
Time Sampled: 12:55

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	1.65	0.05	mg/L	06/02/09 KN

Order #: 997158 **Client Sample ID:** L-24-1
Matrix: SOLID
Date Sampled: 05/27/2009
Time Sampled: 13:40

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN

Order #: 997159 **Client Sample ID:** L-24-2
Matrix: SOLID
Date Sampled: 05/27/2009
Time Sampled: 13:55

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN

DLR = Detection limit for reporting purposes, ND = Not Detected below indicated detection limit

Order #: 997160 **Client Sample ID:** L-24-4
Matrix: SOLID
Date Sampled: 05/27/2009
Time Sampled: 14:25

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN

Order #: 997161 **Client Sample ID:** L-25-2
Matrix: SOLID
Date Sampled: 05/27/2009
Time Sampled: 15:00

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN

Order #: 997162 **Client Sample ID:** L-26-4
Matrix: SOLID
Date Sampled: 05/28/2009
Time Sampled: 07:50

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN

Order #: 997163 **Client Sample ID:** L-27-2
Matrix: SOLID
Date Sampled: 05/28/2009
Time Sampled: 08:45

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	0.24	0.05	mg/L	06/02/09 KN

DLR = Detection limit for reporting purposes, ND = Not Detected below indicated detection limit

Order #: 997164 **Client Sample ID:** L-29-3
Matrix: SOLID
Date Sampled: 05/28/2009
Time Sampled: 09:30

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN

Order #: 997165 **Client Sample ID:** L-30-1
Matrix: SOLID
Date Sampled: 05/28/2009
Time Sampled: 10:30

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN

Order #: 997166 **Client Sample ID:** L-30-3
Matrix: SOLID
Date Sampled: 05/28/2009
Time Sampled: 10:50

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN

Order #: 997167 **Client Sample ID:** L-33-1
Matrix: SOLID
Date Sampled: 05/28/2009
Time Sampled: 12:00

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN

DLR = Detection limit for reporting purposes, ND = Not Detected below indicated detection limit

Order #: 997168 **Client Sample ID:** L-36-1
Matrix: SOLID
Date Sampled: 05/28/2009
Time Sampled: 13:30

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	0.11	0.05	mg/L	06/02/09 KN

Order #: 997169 **Client Sample ID:** L-36-2
Matrix: SOLID
Date Sampled: 05/28/2009
Time Sampled: 13:50

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN

Order #: 997170 **Client Sample ID:** L-39-1
Matrix:
Date Sampled: 05/28/2009
Time Sampled: 14:20

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN

Order #: 997171 **Client Sample ID:** Laboratory Method Blank
Matrix: SOLID

Analyte	Result	DLR	Units	Date/Analyst
1311/6010B TCLP (ICP Metals)				
Lead TCLP	ND	0.05	mg/L	06/02/09 KN
6010 Deionized Water WET Extraction				
Lead	ND	0.005	mg/L	06/01/09 KN

DLR = Detection limit for reporting purposes, ND = Not Detected below indicated detection limit

APPENDIX D

STATISTIC CALCULATIONS

From File: WorkSheet.wst **Regional I**

Summary Statistics for Raw Full Data Sets

Variable	NumObs	Minimum	Maximum	Mean	Median	Variance	SD	MAD/0.675	Skewness	Kurtosis	CV
TTLC A1-Region I	13	17	75	35.62	28	320.1	17.89	8.895	1.299	0.823	0.502
TTLC A2-Region I	39	4.3	55	25.16	25	141.4	11.89	8.895	0.401	0.0106	0.473
TTLC B1-Region I	26	9.4	75	31.25	28	228.4	15.11	9.637	1.437	2.173	0.484
TTLC B2-Region I	26	4.3	55	24.3	24	157.7	12.56	13.34	0.452	0.135	0.517
TTLC C1-Region I	39	7.2	75	29.89	27	214.6	14.65	8.895	1.169	1.714	0.49
TTLC C2-Region I	13	4.3	38	21.44	23	119	10.91	14.83	-0.0355	-0.887	0.509
TTLC D-Region I	52	4.3	75	27.78	26.5	201.6	14.2	9.637	1.095	1.945	0.511
ph D-Region I	9	7.74	8.65	8.278	8.37	0.105	0.324	0.371	-0.423	-1.09	0.0391

From File: WorkSheet.wst **Regional II**

Summary Statistics for Raw Full Data Sets

Variable	NumObs	Minimum	Maximum	Mean	Median	Variance	SD	MAD/0.675	Skewness	Kurtosis	CV
TTLC A1-Region II	6	4.8	390	97.47	49	21498	146.6	48.93	2.211	5.073	1.504
TTLC A2-Region II	18	2	210	40.96	19.5	3016	54.92	18.68	2.163	4.713	1.341
TTLC B1-Region II	12	2	390	88.4	59	12631	112.4	65.97	2.071	4.537	1.271
TTLC B2-Region II	12	3.4	100	21.77	13.5	686.1	26.19	14.08	2.779	8.625	1.203
TTLC C1-Region II	18	2	390	62.75	19.5	9582	97.89	23.2	2.611	7.383	1.56
TTLC C2-Region II	6	4	100	32.08	26	1202	34.67	12.97	2.008	4.483	1.081
TTLC D-Region II	24	2	390	55.08	24	7527	86.76	28.84	2.945	9.771	1.575
STLC A1-Region II	2	4	33	18.5	18.5	420.5	20.51	21.5	N/A	N/A	1.108
STLC A2-Region II	3	2.6	10	5.967	5.3	14.02	3.745	4.003	0.776	N/A	0.628
STLC B1-Region II	4	4	33	13.08	7.65	183.1	13.53	4.448	1.793	3.22	1.035
STLC B2-Region II	1	2.6	2.6	2.6	2.6	N/A	N/A	0	N/A	N/A	N/A
STLC C1-Region II	4	4	33	13.08	7.65	183.1	13.53	4.448	1.793	3.22	1.035
STLC C2-Region II	1	2.6	2.6	2.6	2.6	N/A	N/A	0	N/A	N/A	N/A
STLC D-Region II	5	2.6	33	10.98	5.3	159.3	12.62	4.003	1.983	3.998	1.149
ph D-Region II	3	8.18	9.57	8.703	8.36	0.571	0.756	0.267	1.622	N/A	0.0869

From File: WorkSheet.wst **Regional III**

Summary Statistics for Raw Full Data Sets

Variable	NumObs	Minimum	Maximum	Mean	Median	Variance	SD	MAD/0.675	Skewness	Kurtosis	CV
TTLC A1-Region III	13	4.1	580	113	63	23281	152.6	50.41	2.73	8.289	1.35
TTLC A2-Region III	31	2.9	230	60.44	34	4418	66.46	44.48	1.28	0.874	1.1
TTLC B1-Region III	22	4.1	580	106.4	58	16630	129	68.2	2.558	8.314	1.212
TTLC B2-Region III	22	2.9	160	45.5	27	2244	47.37	34.32	1.018	-0.0067	1.041
TTLC C1-Region III	33	3.7	580	88.77	53	12267	110.8	59.3	2.975	11.65	1.248
TTLC C2-Region III	11	2.9	130	37.57	5.6	2305	48.01	4.003	1.177	-0.236	1.278
TTLC D-Region III	44	2.9	580	75.97	38	10168	100.8	50.33	3.194	13.98	1.327
STLC A1-Region III	5	5.5	24	11	8	57.13	7.558	3.706	1.846	3.479	0.687
STLC A2-Region III	12	3.8	15	8.067	6.4	15.15	3.892	3.632	0.685	-0.931	0.482
STLC B1-Region III	10	4.1	24	10.39	9.5	37.31	6.109	6.301	1.251	1.666	0.588
STLC B2-Region III	7	3.8	11	6.843	5.6	6.31	2.512	2.372	0.762	-0.362	0.367
STLC C1-Region III	14	3.8	24	9.264	7.25	31.52	5.614	4.893	1.49	2.495	0.606
STLC C2-Region III	3	5.6	9.3	7.367	7.2	3.443	1.856	2.372	0.401	N/A	0.252
STLC D-Region III	17	3.8	24	8.929	7.2	26.59	5.157	3.558	1.708	3.524	0.578
DI-WET A1-Region III	2	0.029	0.16	0.0945	0.0945	0.00858	0.0926	0.0971	N/A	N/A	0.98
DI-WET A2-Region III	8	0.019	0.33	0.1	0.0575	0.0114	0.107	0.0319	1.816	2.835	1.069
DI-WET B1-Region III	5	0.029	0.33	0.13	0.07	0.0148	0.122	0.0608	1.483	1.854	0.935
DI-WET B2-Region III	5	0.019	0.19	0.0676	0.049	0.00489	0.0699	0.0326	2.003	4.187	1.034
DI-WET C1-Region III	8	0.027	0.33	0.115	0.066	0.0112	0.106	0.0563	1.402	1.503	0.922
DI-WET C2-Region III	2	0.019	0.053	0.036	0.036	5.78E-04	0.024	0.0252	N/A	N/A	0.668
DI-WET D-Region III	10	0.019	0.33	0.0989	0.0575	0.00985	0.0993	0.0437	1.677	2.495	1.004
ph D-Region III	6	7.81	8.82	8.225	8.235	0.143	0.378	0.423	0.493	-0.117	0.0459

From File: WorkSheet.wst **Regional IV**

Summary Statistics for Raw Full Data Sets

Variable	NumObs	Minimum	Maximum	Mean	Median	Variance	SD	MAD/0.675	Skewness	Kurtosis	CV
TTLC A1-Region IV	10	3.3	370	86.88	63	12380	111.3	84.14	2.106	5.056	1.281
TTLC A2-Region IV	30	2	150	17.25	5.7	979.4	31.3	4.522	3.209	11.35	1.815
TTLC B1-Region IV	20	2.7	370	62.72	26	7545	86.86	34.1	2.57	8.036	1.385
TTLC B2-Region IV	20	2	34	6.595	3.45	70.96	8.424	2.15	2.775	7.082	1.277
TTLC C1-Region IV	30	2.4	370	45	9.4	5631	75.04	9.859	3.146	11.98	1.668
TTLC C2-Region IV	10	2	6.2	3.61	2.95	2.839	1.685	1.408	0.577	-1.533	0.467
TTLC D-Region IV	40	2	370	34.66	6.6	4518	67.21	5.856	3.625	15.89	1.94
STLC A1-Region IV	3	6.4	26	13.07	6.8	125.5	11.2	0.593	1.73	N/A	0.857
STLC A2-Region IV	2	4	9.8	6.9	6.9	16.82	4.101	4.299	N/A	N/A	0.594
STLC B1-Region IV	5	4	26	10.6	6.8	78.36	8.852	4.151	1.943	3.942	0.835
STLC B2-Region IV	0										
STLC C1-Region IV	5	4	26	10.6	6.8	78.36	8.852	4.151	1.943	3.942	0.835
STLC C2-Region IV	0										
STLC D-Region IV	5	4	26	10.6	6.8	78.36	8.852	4.151	1.943	3.942	0.835
DI-WET A1-Region IV	3	0.082	0.21	0.147	0.15	0.0041	0.064	0.089	-0.187	N/A	0.435
DI-WET A2-Region IV	1	0.12	0.12	0.12	0.12	N/A	N/A	0	N/A	N/A	N/A
DI-WET B1-Region IV	4	0.082	0.21	0.141	0.135	0.00292	0.054	0.0504	0.539	0.263	0.385
DI-WET B2-Region IV	0										
DI-WET C1-Region IV	4	0.082	0.21	0.141	0.135	0.00292	0.054	0.0504	0.539	0.263	0.385
DI-WET C2-Region IV	0										
DI-WET D-Region IV	4	0.082	0.21	0.141	0.135	0.00292	0.054	0.0504	0.539	0.263	0.385
ph D-Region IV	6	8	8.62	8.288	8.27	0.0581	0.241	0.304	0.234	-1.557	0.0291

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

TTLC A1-Region I

General Statistics

Number of Valid Observations	13	Number of Distinct Observations	12
Raw Statistics		Log-transformed Statistics	
Minimum	17	Minimum of Log Data	2.833
Maximum	75	Maximum of Log Data	4.317
Mean	35.62	Mean of log Data	3.473
Median	28	SD of log Data	0.45
SD	17.89		
Coefficient of Variation	0.502		
Skewness	1.299		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.846	Shapiro Wilk Test Statistic	0.94
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	44.46	95% H-UCL	46.59
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	55.03
95% Adjusted-CLT UCL	45.69	97.5% Chebyshev (MVUE) UCL	63.54
95% Modified-t UCL	44.76	99% Chebyshev (MVUE) UCL	80.26
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	4.021	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	8.858		
nu star	104.5		
Approximate Chi Square Value (.05)	81.95	Nonparametric Statistics	
Adjusted Level of Significance	0.0301	95% CLT UCL	43.78
Adjusted Chi Square Value	79.1	95% Jackknife UCL	44.46
		95% Standard Bootstrap UCL	43.71
Anderson-Darling Test Statistic	0.518	95% Bootstrap-t UCL	49.82
Anderson-Darling 5% Critical Value	0.736	95% Hall's Bootstrap UCL	49.4
Kolmogorov-Smirnov Test Statistic	0.201	95% Percentile Bootstrap UCL	44
Kolmogorov-Smirnov 5% Critical Value	0.237	95% BCA Bootstrap UCL	44.69
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	57.24
		97.5% Chebyshev(Mean, Sd) UCL	66.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	84.99
95% Approximate Gamma UCL	45.44		
95% Adjusted Gamma UCL	47.07		
Potential UCL to Use		Use 95% Approximate Gamma UCL	45.44

TTLC A2-Region I

General Statistics

Number of Valid Observations	39	Number of Distinct Observations	23
Raw Statistics		Log-transformed Statistics	
Minimum	4.3	Minimum of Log Data	1.459
Maximum	55	Maximum of Log Data	4.007
Mean	25.16	Mean of log Data	3.089
Median	25	SD of log Data	0.576
SD	11.89		
Coefficient of Variation	0.473		

Skewness	0.401		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.968	Shapiro Wilk Test Statistic	0.925
Shapiro Wilk Critical Value	0.939	Shapiro Wilk Critical Value	0.939
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	28.37	95% H-UCL	31.13
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	36.82
95% Adjusted-CLT UCL	28.42	97.5% Chebyshev (MVUE) UCL	41.58
95% Modified-t UCL	28.39	99% Chebyshev (MVUE) UCL	50.95
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	3.559	Data appear Normal at 5% Significance Level	
Theta Star	7.07		
nu star	277.6		
Approximate Chi Square Value (.05)	240	Nonparametric Statistics	
Adjusted Level of Significance	0.0437	95% CLT UCL	28.29
Adjusted Chi Square Value	238.6	95% Jackknife UCL	28.37
		95% Standard Bootstrap UCL	28.17
Anderson-Darling Test Statistic	0.578	95% Bootstrap-t UCL	28.5
Anderson-Darling 5% Critical Value	0.753	95% Hall's Bootstrap UCL	28.36
Kolmogorov-Smirnov Test Statistic	0.132	95% Percentile Bootstrap UCL	28.31
Kolmogorov-Smirnov 5% Critical Value	0.142	95% BCA Bootstrap UCL	28.22
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	33.46
		97.5% Chebyshev(Mean, Sd) UCL	37.05
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	44.11
95% Approximate Gamma UCL	29.1		
95% Adjusted Gamma UCL	29.27		
Potential UCL to Use		Use 95% Student's-t UCL	28.37

TTLC B1-Region I

General Statistics			
Number of Valid Observations	26	Number of Distinct Observations	17
Raw Statistics		Log-transformed Statistics	
Minimum	9.4	Minimum of Log Data	2.241
Maximum	75	Maximum of Log Data	4.317
Mean	31.25	Mean of log Data	3.342
Median	28	SD of log Data	0.451
SD	15.11		
Coefficient of Variation	0.484		
Skewness	1.437		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.868	Shapiro Wilk Test Statistic	0.969
Shapiro Wilk Critical Value	0.92	Shapiro Wilk Critical Value	0.92
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	36.31	95% H-UCL	37.23
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	43.63
95% Adjusted-CLT UCL	37.01	97.5% Chebyshev (MVUE) UCL	49.02
95% Modified-t UCL	36.45	99% Chebyshev (MVUE) UCL	59.6
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	4.617	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	6.768		
nu star	240.1		
Approximate Chi Square Value (.05)	205.2	Nonparametric Statistics	
Adjusted Level of Significance	0.0398	95% CLT UCL	36.12

Adjusted Chi Square Value	203.1	95% Jackknife UCL	36.31
		95% Standard Bootstrap UCL	36.07
Anderson-Darling Test Statistic	0.584	95% Bootstrap-t UCL	37.24
Anderson-Darling 5% Critical Value	0.746	95% Hall's Bootstrap UCL	38.43
Kolmogorov-Smirnov Test Statistic	0.193	95% Percentile Bootstrap UCL	36.19
Kolmogorov-Smirnov 5% Critical Value	0.172	95% BCA Bootstrap UCL	37
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	44.17
		97.5% Chebyshev(Mean, Sd) UCL	49.76
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	60.74
95% Approximate Gamma UCL	36.56		
95% Adjusted Gamma UCL	36.94		
Potential UCL to Use		Use 95% Approximate Gamma UCL	36.56

TTLC B2-Region I

General Statistics			
Number of Valid Observations	26	Number of Distinct Observations	19
Raw Statistics		Log-transformed Statistics	
Minimum	4.3	Minimum of Log Data	1.459
Maximum	55	Maximum of Log Data	4.007
Mean	24.3	Mean of log Data	3.028
Median	24	SD of log Data	0.635
SD	12.56		
Coefficient of Variation	0.517		
Skewness	0.452		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.966	Shapiro Wilk Test Statistic	0.927
Shapiro Wilk Critical Value	0.92	Shapiro Wilk Critical Value	0.92
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	28.51	95% H-UCL	32.9
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	39.54
95% Adjusted-CLT UCL	28.59	97.5% Chebyshev (MVUE) UCL	45.8
95% Modified-t UCL	28.55	99% Chebyshev (MVUE) UCL	58.12
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	2.884	Data appear Normal at 5% Significance Level	
Theta Star	8.428		
nu star	150		
Approximate Chi Square Value (.05)	122.6	Nonparametric Statistics	
Adjusted Level of Significance	0.0398	95% CLT UCL	28.35
Adjusted Chi Square Value	121	95% Jackknife UCL	28.51
		95% Standard Bootstrap UCL	28.43
Anderson-Darling Test Statistic	0.463	95% Bootstrap-t UCL	28.67
Anderson-Darling 5% Critical Value	0.75	95% Hall's Bootstrap UCL	28.7
Kolmogorov-Smirnov Test Statistic	0.138	95% Percentile Bootstrap UCL	28.32
Kolmogorov-Smirnov 5% Critical Value	0.172	95% BCA Bootstrap UCL	28.77
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	35.04
		97.5% Chebyshev(Mean, Sd) UCL	39.68
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	48.81
95% Approximate Gamma UCL	29.71		
95% Adjusted Gamma UCL	30.11		
Potential UCL to Use		Use 95% Student's-t UCL	28.51

TTLC C1-Region I

General Statistics			
Number of Valid Observations	39	Number of Distinct Observations	23

Raw Statistics		Log-transformed Statistics	
Minimum	7.2	Minimum of Log Data	1.974
Maximum	75	Maximum of Log Data	4.317
Mean	29.89	Mean of log Data	3.281
Median	27	SD of log Data	0.503
SD	14.65		
Coefficient of Variation	0.49		
Skewness	1.169		

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.912	Shapiro Wilk Test Statistic	0.965
Shapiro Wilk Critical Value	0.939	Shapiro Wilk Critical Value	0.939
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	33.84	95% H-UCL	35.27
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	41.16
95% Adjusted-CLT UCL	34.21	97.5% Chebyshev (MVUE) UCL	45.95
95% Modified-t UCL	33.92	99% Chebyshev (MVUE) UCL	55.36
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	4.146	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	7.209		
nu star	323.4		
Approximate Chi Square Value (.05)	282.7	Nonparametric Statistics	
Adjusted Level of Significance	0.0437	95% CLT UCL	33.75
Adjusted Chi Square Value	281.2	95% Jackknife UCL	33.84
		95% Standard Bootstrap UCL	33.8
Anderson-Darling Test Statistic	0.494	95% Bootstrap-t UCL	34.7
Anderson-Darling 5% Critical Value	0.752	95% Hall's Bootstrap UCL	34.54
Kolmogorov-Smirnov Test Statistic	0.132	95% Percentile Bootstrap UCL	33.82
Kolmogorov-Smirnov 5% Critical Value	0.142	95% BCA Bootstrap UCL	34.49
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	40.11
		97.5% Chebyshev(Mean, Sd) UCL	44.54
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	53.23
95% Approximate Gamma UCL	34.19		
95% Adjusted Gamma UCL	34.37		
Potential UCL to Use		Use 95% Approximate Gamma UCL	34.19

TTLC C2-Region I

General Statistics			
Number of Valid Observations	13	Number of Distinct Observations	12

Raw Statistics		Log-transformed Statistics	
Minimum	4.3	Minimum of Log Data	1.459
Maximum	38	Maximum of Log Data	3.638
Mean	21.44	Mean of log Data	2.896
Median	23	SD of log Data	0.672
SD	10.91		
Coefficient of Variation	0.509		
Skewness	-0.0355		

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.958	Shapiro Wilk Test Statistic	0.894
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	26.83	95% H-UCL	35.69
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	41.1
95% Adjusted-CLT UCL	26.38	97.5% Chebyshev (MVUE) UCL	49.26
95% Modified-t UCL	26.83	99% Chebyshev (MVUE) UCL	65.29

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	2.451	Data appear Normal at 5% Significance Level	
Theta Star	8.748		
nu star	63.72		
Approximate Chi Square Value (.05)	46.35	Nonparametric Statistics	
Adjusted Level of Significance	0.0301	95% CLT UCL	26.42
Adjusted Chi Square Value	44.25	95% Jackknife UCL	26.83
		95% Standard Bootstrap UCL	26.22
Anderson-Darling Test Statistic	0.396	95% Bootstrap-t UCL	26.94
Anderson-Darling 5% Critical Value	0.739	95% Hall's Bootstrap UCL	26.41
Kolmogorov-Smirnov Test Statistic	0.185	95% Percentile Bootstrap UCL	26.15
Kolmogorov-Smirnov 5% Critical Value	0.238	95% BCA Bootstrap UCL	26.02
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	34.63
		97.5% Chebyshev(Mean, Sd) UCL	40.34
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	51.55
95% Approximate Gamma UCL	29.47		
95% Adjusted Gamma UCL	30.87		
Potential UCL to Use		Use 95% Student's-t UCL	26.83

TTLC D-Region I

General Statistics			
Number of Valid Observations	52	Number of Distinct Observations	28
Raw Statistics		Log-transformed Statistics	
Minimum	4.3	Minimum of Log Data	1.459
Maximum	75	Maximum of Log Data	4.317
Mean	27.78	Mean of log Data	3.185
Median	26.5	SD of log Data	0.568
SD	14.2		
Coefficient of Variation	0.511		
Skewness	1.095		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Lilliefors Test Statistic	0.167	Lilliefors Test Statistic	0.152
Lilliefors Critical Value	0.123	Lilliefors Critical Value	0.123
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	31.07	95% H-UCL	33.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	38.66
95% Adjusted-CLT UCL	31.33	97.5% Chebyshev (MVUE) UCL	43.14
95% Modified-t UCL	31.12	99% Chebyshev (MVUE) UCL	51.94
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	3.554	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	7.815		
nu star	369.6		
Approximate Chi Square Value (.05)	326	Nonparametric Statistics	
Adjusted Level of Significance	0.0454	95% CLT UCL	31.01
Adjusted Chi Square Value	324.9	95% Jackknife UCL	31.07
		95% Standard Bootstrap UCL	30.98
Anderson-Darling Test Statistic	0.595	95% Bootstrap-t UCL	31.41
Anderson-Darling 5% Critical Value	0.754	95% Hall's Bootstrap UCL	31.79
Kolmogorov-Smirnov Test Statistic	0.116	95% Percentile Bootstrap UCL	31.04
Kolmogorov-Smirnov 5% Critical Value	0.124	95% BCA Bootstrap UCL	31.38
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	36.36
		97.5% Chebyshev(Mean, Sd) UCL	40.07
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	47.36
95% Approximate Gamma UCL	31.49		
95% Adjusted Gamma UCL	31.6		
Potential UCL to Use		Use 95% Approximate Gamma UCL	31.49

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

TTLC A1-Region II

General Statistics			
Number of Valid Observations	6	Number of Distinct Observations	6
Raw Statistics		**Log-transformed Statistics**	
Minimum	4.8	Minimum of Log Data	1.569
Maximum	390	Maximum of Log Data	5.966
Mean	97.47	Mean of log Data	3.663
Median	49	SD of log Data	1.548
SD	146.6		
Coefficient of Variation	1.504		
Skewness	2.211		

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.68	Shapiro Wilk Test Statistic	0.98
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	218.1	95% H-UCL	8550
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	338.9
95% Adjusted-CLT UCL	253.7	97.5% Chebyshev (MVUE) UCL	444.5
95% Modified-t UCL	227.1	99% Chebyshev (MVUE) UCL	652.1
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.443	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	219.9		
nu star	5.319		
Approximate Chi Square Value (.05)	1.303	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0122	95% CLT UCL	195.9
Adjusted Chi Square Value	0.719	95% Jackknife UCL	218.1
		95% Standard Bootstrap UCL	184
Anderson-Darling Test Statistic	0.325	95% Bootstrap-t UCL	497.7
Anderson-Darling 5% Critical Value	0.726	95% Hall's Bootstrap UCL	602.6
Kolmogorov-Smirnov Test Statistic	0.233	95% Percentile Bootstrap UCL	211.1
Kolmogorov-Smirnov 5% Critical Value	0.345	95% BCA Bootstrap UCL	232.5
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	358.4
		97.5% Chebyshev(Mean, Sd) UCL	471.3
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	693
95% Approximate Gamma UCL	398		
95% Adjusted Gamma UCL	721.4		
Potential UCL to Use		Use 95% Approximate Gamma UCL	398
Recommended UCL exceeds the maximum observation			

TTLC A2-Region II

General Statistics			
Number of Valid Observations	18	Number of Distinct Observations	17
Raw Statistics		Log-transformed Statistics	
Minimum	2	Minimum of Log Data	0.693
Maximum	210	Maximum of Log Data	5.347
Mean	40.96	Mean of log Data	2.962
Median	19.5	SD of log Data	1.303
SD	54.92		
Coefficient of Variation	1.341		
Skewness	2.163		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.705	Shapiro Wilk Test Statistic	0.975
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	63.47	95% H-UCL	120.5
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	106.3
95% Adjusted-CLT UCL	69.3	97.5% Chebyshev (MVUE) UCL	134.2
95% Modified-t UCL	64.57	99% Chebyshev (MVUE) UCL	189.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.697	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	58.79		
nu star	25.08		
Approximate Chi Square Value (.05)	14.67	Nonparametric Statistics	
Adjusted Level of Significance	0.0357	95% CLT UCL	62.25
Adjusted Chi Square Value	13.91	95% Jackknife UCL	63.47
		95% Standard Bootstrap UCL	61.78
Anderson-Darling Test Statistic	0.502	95% Bootstrap-t UCL	87.06
Anderson-Darling 5% Critical Value	0.776	95% Hall's Bootstrap UCL	86.58
Kolmogorov-Smirnov Test Statistic	0.205	95% Percentile Bootstrap UCL	63.6
Kolmogorov-Smirnov 5% Critical Value	0.211	95% BCA Bootstrap UCL	70.27
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	97.38
		97.5% Chebyshev(Mean, Sd) UCL	121.8
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	169.7
95% Approximate Gamma UCL	70.01		
95% Adjusted Gamma UCL	73.84		
Potential UCL to Use		Use 95% Approximate Gamma UCL	70.01

TTLC B1-Region II

General Statistics			
Number of Valid Observations	12	Number of Distinct Observations	12
Raw Statistics		Log-transformed Statistics	
Minimum	2	Minimum of Log Data	0.693
Maximum	390	Maximum of Log Data	5.966
Mean	88.4	Mean of log Data	3.651
Median	59	SD of log Data	1.544
SD	112.4		
Coefficient of Variation	1.271		
Skewness	2.071		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.749	Shapiro Wilk Test Statistic	0.968
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859

Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	146.7	95% H-UCL	812.4
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	332.7
95% Adjusted-CLT UCL	162.5	97.5% Chebyshev (MVUE) UCL	430.7
95% Modified-t UCL	149.9	99% Chebyshev (MVUE) UCL	623.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.599	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	147.7		
nu star	14.37		
Approximate Chi Square Value (.05)	6.823	Nonparametric Statistics	
Adjusted Level of Significance	0.029	95% CLT UCL	141.8
Adjusted Chi Square Value	6.046	95% Jackknife UCL	146.7
		95% Standard Bootstrap UCL	140.1
Anderson-Darling Test Statistic	0.178	95% Bootstrap-t UCL	211
Anderson-Darling 5% Critical Value	0.768	95% Hall's Bootstrap UCL	400
Kolmogorov-Smirnov Test Statistic	0.13	95% Percentile Bootstrap UCL	144.6
Kolmogorov-Smirnov 5% Critical Value	0.255	95% BCA Bootstrap UCL	167.2
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	229.8
		97.5% Chebyshev(Mean, Sd) UCL	291
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	411.2
95% Approximate Gamma UCL	186.1		
95% Adjusted Gamma UCL	210		
Potential UCL to Use		Use 95% Approximate Gamma UCL	186.1

TTLC B2-Region II

General Statistics			
Number of Valid Observations	12	Number of Distinct Observations	11
Raw Statistics		Log-transformed Statistics	
Minimum	3.4	Minimum of Log Data	1.224
Maximum	100	Maximum of Log Data	4.605
Mean	21.77	Mean of log Data	2.623
Median	13.5	SD of log Data	0.976
SD	26.19		
Coefficient of Variation	1.203		
Skewness	2.779		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.638	Shapiro Wilk Test Statistic	0.939
Shapiro Wilk Critical Value	0.859	Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	35.35	95% H-UCL	51.68
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	48.62
95% Adjusted-CLT UCL	40.68	97.5% Chebyshev (MVUE) UCL	60.56
95% Modified-t UCL	36.36	99% Chebyshev (MVUE) UCL	84
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.98	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	22.21		
nu star	23.53		
Approximate Chi Square Value (.05)	13.49	Nonparametric Statistics	
Adjusted Level of Significance	0.029	95% CLT UCL	34.2
Adjusted Chi Square Value	12.34	95% Jackknife UCL	35.35
		95% Standard Bootstrap UCL	33.73
Anderson-Darling Test Statistic	0.512	95% Bootstrap-t UCL	52.64
Anderson-Darling 5% Critical Value	0.752	95% Hall's Bootstrap UCL	81.57
Kolmogorov-Smirnov Test Statistic	0.209	95% Percentile Bootstrap UCL	35.98
Kolmogorov-Smirnov 5% Critical Value	0.251	95% BCA Bootstrap UCL	43.08

Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	54.73
		97.5% Chebyshev(Mean, Sd) UCL	68.99
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	97
95% Approximate Gamma UCL	37.96		
95% Adjusted Gamma UCL	41.49		
Potential UCL to Use		Use 95% Approximate Gamma UCL	37.96

TTLC C1-Region II

General Statistics			
Number of Valid Observations	18	Number of Distinct Observations	17
Raw Statistics		Log-transformed Statistics	
Minimum	2	Minimum of Log Data	0.693
Maximum	390	Maximum of Log Data	5.966
Mean	62.75	Mean of log Data	3.18
Median	19.5	SD of log Data	1.475
SD	97.89		
Coefficient of Variation	1.56		
Skewness	2.611		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.644	Shapiro Wilk Test Statistic	0.974
Shapiro Wilk Critical Value	0.897	Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	102.9	95% H-UCL	239.7
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	177.5
95% Adjusted-CLT UCL	115.9	97.5% Chebyshev (MVUE) UCL	226.7
95% Modified-t UCL	105.3	99% Chebyshev (MVUE) UCL	323.2
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.569	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	110.3		
nu star	20.48		
Approximate Chi Square Value (.05)	11.2	Nonparametric Statistics	
Adjusted Level of Significance	0.0357	95% CLT UCL	100.7
Adjusted Chi Square Value	10.55	95% Jackknife UCL	102.9
		95% Standard Bootstrap UCL	99.6
Anderson-Darling Test Statistic	0.576	95% Bootstrap-t UCL	155.8
Anderson-Darling 5% Critical Value	0.788	95% Hall's Bootstrap UCL	258.4
Kolmogorov-Smirnov Test Statistic	0.189	95% Percentile Bootstrap UCL	104.5
Kolmogorov-Smirnov 5% Critical Value	0.213	95% BCA Bootstrap UCL	120.8
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	163.3
		97.5% Chebyshev(Mean, Sd) UCL	206.8
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	292.3
95% Approximate Gamma UCL	114.7		
95% Adjusted Gamma UCL	121.8		
Potential UCL to Use		Use 95% Approximate Gamma UCL	114.7

TTLC C2-Region II

General Statistics			
Number of Valid Observations	6	Number of Distinct Observations	5
Raw Statistics		Log-transformed Statistics	
Minimum	4	Minimum of Log Data	1.386
Maximum	100	Maximum of Log Data	4.605
Mean	32.08	Mean of log Data	3.009
Median	26	SD of log Data	1.092
SD	34.67		

Coefficient of Variation	1.081
Skewness	2.008

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.739	Shapiro Wilk Test Statistic	0.937
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	60.61	95% H-UCL	323.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	93.66
95% Adjusted-CLT UCL	67.77	97.5% Chebyshev (MVUE) UCL	120.2
95% Modified-t UCL	62.54	99% Chebyshev (MVUE) UCL	172.4
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.725	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	44.22		
nu star	8.706		
Approximate Chi Square Value (.05)	3.15	Nonparametric Statistics	
Adjusted Level of Significance	0.0122	95% CLT UCL	55.37
Adjusted Chi Square Value	2.073	95% Jackknife UCL	60.61
		95% Standard Bootstrap UCL	53.02
Anderson-Darling Test Statistic	0.413	95% Bootstrap-t UCL	95.63
Anderson-Darling 5% Critical Value	0.712	95% Hall's Bootstrap UCL	165.6
Kolmogorov-Smirnov Test Statistic	0.285	95% Percentile Bootstrap UCL	56.58
Kolmogorov-Smirnov 5% Critical Value	0.339	95% BCA Bootstrap UCL	63.17
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	93.79
		97.5% Chebyshev(Mean, Sd) UCL	120.5
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	172.9
95% Approximate Gamma UCL	88.66		
95% Adjusted Gamma UCL	134.8		
Potential UCL to Use		Use 95% Approximate Gamma UCL	88.66

TTLC D-Region II

General Statistics			
Number of Valid Observations	24	Number of Distinct Observations	22
Raw Statistics		Log-transformed Statistics	
Minimum	2	Minimum of Log Data	0.693
Maximum	390	Maximum of Log Data	5.966
Mean	55.08	Mean of log Data	3.137
Median	24	SD of log Data	1.368
SD	86.76		
Coefficient of Variation	1.575		
Skewness	2.945		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.617	Shapiro Wilk Test Statistic	0.979
Shapiro Wilk Critical Value	0.916	Shapiro Wilk Critical Value	0.916

Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	85.44	95% H-UCL	139.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	135.3
95% Adjusted-CLT UCL	95.59	97.5% Chebyshev (MVUE) UCL	170.1
95% Modified-t UCL	87.21	99% Chebyshev (MVUE) UCL	238.4
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.635	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	86.74		
nu star	30.48		
Approximate Chi Square Value (.05)	18.87	Nonparametric Statistics	
Adjusted Level of Significance	0.0392	95% CLT UCL	84.21
Adjusted Chi Square Value	18.23	95% Jackknife UCL	85.44
		95% Standard Bootstrap UCL	83.59
Anderson-Darling Test Statistic	0.708	95% Bootstrap-t UCL	124.6
Anderson-Darling 5% Critical Value	0.788	95% Hall's Bootstrap UCL	207.1
Kolmogorov-Smirnov Test Statistic	0.211	95% Percentile Bootstrap UCL	85.98
Kolmogorov-Smirnov 5% Critical Value	0.186	95% BCA Bootstrap UCL	98.15
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	132.3
		97.5% Chebyshev(Mean, Sd) UCL	165.7
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	231.3
95% Approximate Gamma UCL	88.97		
95% Adjusted Gamma UCL	92.11		
Potential UCL to Use		Use 95% Approximate Gamma UCL	88.97

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

TTLC A1-Region III

General Statistics

Number of Valid Observations	13	Number of Distinct Observations	12
Raw Statistics		Log-transformed Statistics	
Minimum	4.1	Minimum of Log Data	1.411
Maximum	580	Maximum of Log Data	6.363
Mean	113	Mean of log Data	4.073
Median	63	SD of log Data	1.258
SD	152.6		
Coefficient of Variation	1.35		
Skewness	2.73		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.653	Shapiro Wilk Test Statistic	0.98
Shapiro Wilk Critical Value	0.866	Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	188.4	95% H-UCL	432.3
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	315.2
95% Adjusted-CLT UCL	216.9	97.5% Chebyshev (MVUE) UCL	400.5
95% Modified-t UCL	193.8	99% Chebyshev (MVUE) UCL	568.2
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.739	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	152.9		
nu star	19.22		
Approximate Chi Square Value (.05)	10.28	Nonparametric Statistics	
Adjusted Level of Significance	0.0301	95% CLT UCL	182.6
Adjusted Chi Square Value	9.359	95% Jackknife UCL	188.4
		95% Standard Bootstrap UCL	179.9
Anderson-Darling Test Statistic	0.315	95% Bootstrap-t UCL	280.8
Anderson-Darling 5% Critical Value	0.763	95% Hall's Bootstrap UCL	434.3
Kolmogorov-Smirnov Test Statistic	0.139	95% Percentile Bootstrap UCL	188.6
Kolmogorov-Smirnov 5% Critical Value	0.244	95% BCA Bootstrap UCL	218.5
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	297.5
		97.5% Chebyshev(Mean, Sd) UCL	377.3
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	534.1
95% Approximate Gamma UCL	211.3		
95% Adjusted Gamma UCL	232.1		
Potential UCL to Use		Use 95% Approximate Gamma UCL	211.3

TTLC A2-Region III

General Statistics

Number of Valid Observations	31	Number of Distinct Observations	25
Raw Statistics		Log-transformed Statistics	
Minimum	2.9	Minimum of Log Data	1.065
Maximum	230	Maximum of Log Data	5.438
Mean	60.44	Mean of log Data	3.326
Median	34	SD of log Data	1.416
SD	66.46		
Coefficient of Variation	1.1		
Skewness	1.28		

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.814	Shapiro Wilk Test Statistic	0.92
Shapiro Wilk Critical Value	0.929	Shapiro Wilk Critical Value	0.929
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	80.7	95% H-UCL	163.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	170.4
95% Adjusted-CLT UCL	83.01	97.5% Chebyshev (MVUE) UCL	213.2
95% Modified-t UCL	81.16	99% Chebyshev (MVUE) UCL	297.3
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.716	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	84.38		
nu star	44.41		
Approximate Chi Square Value (.05)	30.12	Nonparametric Statistics	
Adjusted Level of Significance	0.0413	95% CLT UCL	80.07
Adjusted Chi Square Value	29.47	95% Jackknife UCL	80.7
		95% Standard Bootstrap UCL	79.71
Anderson-Darling Test Statistic	0.63	95% Bootstrap-t UCL	84.49
Anderson-Darling 5% Critical Value	0.787	95% Hall's Bootstrap UCL	83.14
Kolmogorov-Smirnov Test Statistic	0.127	95% Percentile Bootstrap UCL	79.81
Kolmogorov-Smirnov 5% Critical Value	0.164	95% BCA Bootstrap UCL	83.88
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	112.5
		97.5% Chebyshev(Mean, Sd) UCL	135
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	179.2
95% Approximate Gamma UCL	89.1		
95% Adjusted Gamma UCL	91.08		
Potential UCL to Use		Use 95% Approximate Gamma UCL	89.1

TTLC B1-Region III

General Statistics			
Number of Valid Observations	22	Number of Distinct Observations	20
Raw Statistics		Log-transformed Statistics	
Minimum	4.1	Minimum of Log Data	1.411
Maximum	580	Maximum of Log Data	6.363
Mean	106.4	Mean of log Data	3.997
Median	58	SD of log Data	1.308
SD	129		
Coefficient of Variation	1.212		
Skewness	2.558		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.721	Shapiro Wilk Test Statistic	0.968
Shapiro Wilk Critical Value	0.911	Shapiro Wilk Critical Value	0.911
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	153.8	95% H-UCL	300.4
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	292.6
95% Adjusted-CLT UCL	167.7	97.5% Chebyshev (MVUE) UCL	367.2
95% Modified-t UCL	156.3	99% Chebyshev (MVUE) UCL	513.9
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.786	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	135.4		
nu star	34.6		
Approximate Chi Square Value (.05)	22.14	Nonparametric Statistics	
Adjusted Level of Significance	0.0386	95% CLT UCL	151.7
Adjusted Chi Square Value	21.4	95% Jackknife UCL	153.8
		95% Standard Bootstrap UCL	149.8

Anderson-Darling Test Statistic	0.212	95% Bootstrap-t UCL	186.8
Anderson-Darling 5% Critical Value	0.777	95% Hall's Bootstrap UCL	344
Kolmogorov-Smirnov Test Statistic	0.083	95% Percentile Bootstrap UCL	154.1
Kolmogorov-Smirnov 5% Critical Value	0.192	95% BCA Bootstrap UCL	167.8
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	226.3
		97.5% Chebyshev(Mean, Sd) UCL	278.1
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	380
95% Approximate Gamma UCL	166.3		
95% Adjusted Gamma UCL	172.1		
Potential UCL to Use		Use 95% Approximate Gamma UCL	166.3

TTLC B2-Region III

General Statistics			
Number of Valid Observations	22	Number of Distinct Observations	20
Raw Statistics		Log-transformed Statistics	
Minimum	2.9	Minimum of Log Data	1.065
Maximum	160	Maximum of Log Data	5.075
Mean	45.5	Mean of log Data	3.096
Median	27	SD of log Data	1.37
SD	47.37		
Coefficient of Variation	1.041		
Skewness	1.018		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.84	Shapiro Wilk Test Statistic	0.907
Shapiro Wilk Critical Value	0.911	Shapiro Wilk Critical Value	0.911
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	62.88	95% H-UCL	141.8
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	132.1
95% Adjusted-CLT UCL	64.45	97.5% Chebyshev (MVUE) UCL	166.6
95% Modified-t UCL	63.24	99% Chebyshev (MVUE) UCL	234.3
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.738	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	61.63		
nu star	32.49		
Approximate Chi Square Value (.05)	20.46	Nonparametric Statistics	
Adjusted Level of Significance	0.0386	95% CLT UCL	62.11
Adjusted Chi Square Value	19.75	95% Jackknife UCL	62.88
		95% Standard Bootstrap UCL	61.43
Anderson-Darling Test Statistic	0.674	95% Bootstrap-t UCL	67.28
Anderson-Darling 5% Critical Value	0.78	95% Hall's Bootstrap UCL	64.59
Kolmogorov-Smirnov Test Statistic	0.163	95% Percentile Bootstrap UCL	62.36
Kolmogorov-Smirnov 5% Critical Value	0.192	95% BCA Bootstrap UCL	64.13
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	89.52
		97.5% Chebyshev(Mean, Sd) UCL	108.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	146
95% Approximate Gamma UCL	72.25		
95% Adjusted Gamma UCL	74.86		
Potential UCL to Use		Use 95% Approximate Gamma UCL	72.25

TTLC C1-Region III

General Statistics			
Number of Valid Observations	33	Number of Distinct Observations	27
Raw Statistics		Log-transformed Statistics	
Minimum	3.7	Minimum of Log Data	1.308
Maximum	580	Maximum of Log Data	6.363

Mean	88.77	Mean of log Data	3.84
Median	53	SD of log Data	1.249
SD	110.8		
Coefficient of Variation	1.248		
Skewness	2.975		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.694	Shapiro Wilk Test Statistic	0.97
Shapiro Wilk Critical Value	0.931	Shapiro Wilk Critical Value	0.931
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	121.4	95% H-UCL	184.6
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	209.9
95% Adjusted-CLT UCL	131.2	97.5% Chebyshev (MVUE) UCL	258.5
95% Modified-t UCL	123.1	99% Chebyshev (MVUE) UCL	354.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.842	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	105.4		
nu star	55.6		
Approximate Chi Square Value (.05)	39.46	Nonparametric Statistics	
Adjusted Level of Significance	0.0419	95% CLT UCL	120.5
Adjusted Chi Square Value	38.76	95% Jackknife UCL	121.4
		95% Standard Bootstrap UCL	120
Anderson-Darling Test Statistic	0.281	95% Bootstrap-t UCL	141.2
Anderson-Darling 5% Critical Value	0.78	95% Hall's Bootstrap UCL	259.1
Kolmogorov-Smirnov Test Statistic	0.0862	95% Percentile Bootstrap UCL	122.9
Kolmogorov-Smirnov 5% Critical Value	0.158	95% BCA Bootstrap UCL	133
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	172.8
		97.5% Chebyshev(Mean, Sd) UCL	209.2
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	280.6
95% Approximate Gamma UCL	125.1		
95% Adjusted Gamma UCL	127.3		
Potential UCL to Use		Use 95% Approximate Gamma UCL	125.1

TTLC C2-Region III

General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	10
Raw Statistics		Log-transformed Statistics	
Minimum	2.9	Minimum of Log Data	1.065
Maximum	130	Maximum of Log Data	4.868
Mean	37.57	Mean of log Data	2.667
Median	5.6	SD of log Data	1.518
SD	48.01		
Coefficient of Variation	1.278		
Skewness	1.177		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.745	Shapiro Wilk Test Statistic	0.833
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	63.81	95% H-UCL	322.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	119.7
95% Adjusted-CLT UCL	66.87	97.5% Chebyshev (MVUE) UCL	155
95% Modified-t UCL	64.67	99% Chebyshev (MVUE) UCL	224.4
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.525	Data do not follow a Discernable Distribution (0.05)	
Theta Star	71.59		

nu star	11.55		
Approximate Chi Square Value (.05)	4.93	Nonparametric Statistics	
Adjusted Level of Significance	0.0278	95% CLT UCL	61.38
Adjusted Chi Square Value	4.247	95% Jackknife UCL	63.81
		95% Standard Bootstrap UCL	60.1
Anderson-Darling Test Statistic	0.928	95% Bootstrap-t UCL	75.87
Anderson-Darling 5% Critical Value	0.771	95% Hall's Bootstrap UCL	60.52
Kolmogorov-Smirnov Test Statistic	0.306	95% Percentile Bootstrap UCL	61.6
Kolmogorov-Smirnov 5% Critical Value	0.267	95% BCA Bootstrap UCL	65.44
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	100.7
		97.5% Chebyshev(Mean, Sd) UCL	128
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	181.6
95% Approximate Gamma UCL	88		
95% Adjusted Gamma UCL	102.2		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	181.6
Recommended UCL exceeds the maximum observation			

TTLC D-Region III

General Statistics			
Number of Valid Observations	44	Number of Distinct Observations	35
Raw Statistics		Log-transformed Statistics	
Minimum	2.9	Minimum of Log Data	1.065
Maximum	580	Maximum of Log Data	6.363
Mean	75.97	Mean of log Data	3.547
Median	38	SD of log Data	1.4
SD	100.8		
Coefficient of Variation	1.327		
Skewness	3.194		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.685	Shapiro Wilk Test Statistic	0.942
Shapiro Wilk Critical Value	0.944	Shapiro Wilk Critical Value	0.944
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	101.5	95% H-UCL	168.3
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	193.6
95% Adjusted-CLT UCL	108.8	97.5% Chebyshev (MVUE) UCL	238.9
95% Modified-t UCL	102.7	99% Chebyshev (MVUE) UCL	328.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.725	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	104.7		
nu star	63.84		
Approximate Chi Square Value (.05)	46.46	Nonparametric Statistics	
Adjusted Level of Significance	0.0445	95% CLT UCL	101
Adjusted Chi Square Value	45.96	95% Jackknife UCL	101.5
		95% Standard Bootstrap UCL	100.3
Anderson-Darling Test Statistic	0.466	95% Bootstrap-t UCL	114.5
Anderson-Darling 5% Critical Value	0.789	95% Hall's Bootstrap UCL	204.8
Kolmogorov-Smirnov Test Statistic	0.0897	95% Percentile Bootstrap UCL	102.9
Kolmogorov-Smirnov 5% Critical Value	0.139	95% BCA Bootstrap UCL	108.3
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	142.2
		97.5% Chebyshev(Mean, Sd) UCL	170.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	227.2
95% Approximate Gamma UCL	104.4		
95% Adjusted Gamma UCL	105.5		
Potential UCL to Use		Use 95% Approximate Gamma UCL	104.4

General UCL Statistics for Full Data Sets

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

TTLC A1-Region IV

General Statistics			
Number of Valid Observations	10	Number of Distinct Observations	10
Raw Statistics		Log-transformed Statistics	
Minimum	3.3	Minimum of Log Data	1.194
Maximum	370	Maximum of Log Data	5.914
Mean	86.88	Mean of log Data	3.561
Median	63	SD of log Data	1.632
SD	111.3		
Coefficient of Variation	1.281		
Skewness	2.106		

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.748	Shapiro Wilk Test Statistic	0.922
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	151.4	95% H-UCL	1554
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	353.4
95% Adjusted-CLT UCL	169.8	97.5% Chebyshev (MVUE) UCL	460.8
95% Modified-t UCL	155.3	99% Chebyshev (MVUE) UCL	672
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.538	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	161.6		
nu star	10.75		
Approximate Chi Square Value (.05)	4.418	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	144.8
Adjusted Chi Square Value	3.738	95% Jackknife UCL	151.4
		95% Standard Bootstrap UCL	142.9
Anderson-Darling Test Statistic	0.303	95% Bootstrap-t UCL	204.5
Anderson-Darling 5% Critical Value	0.763	95% Hall's Bootstrap UCL	374.9
Kolmogorov-Smirnov Test Statistic	0.152	95% Percentile Bootstrap UCL	147.1
Kolmogorov-Smirnov 5% Critical Value	0.277	95% BCA Bootstrap UCL	166.6
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	240.2
		97.5% Chebyshev(Mean, Sd) UCL	306.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	437
95% Approximate Gamma UCL	211.5		
95% Adjusted Gamma UCL	249.9		
Potential UCL to Use		Use 95% Approximate Gamma UCL	211.5

TTLC A2-Region IV

General Statistics			
Number of Valid Observations	30	Number of Distinct Observations	26
Raw Statistics		Log-transformed Statistics	
Minimum	2	Minimum of Log Data	0.693
Maximum	150	Maximum of Log Data	5.011
Mean	17.25	Mean of log Data	1.976
Median	5.7	SD of log Data	1.186
SD	31.3		
Coefficient of Variation	1.815		
Skewness	3.209		

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.534	Shapiro Wilk Test Statistic	0.87
Shapiro Wilk Critical Value	0.927	Shapiro Wilk Critical Value	0.927
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	26.95	95% H-UCL	26.22
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	29.83
95% Adjusted-CLT UCL	30.22	97.5% Chebyshev (MVUE) UCL	36.67
95% Modified-t UCL	27.51	99% Chebyshev (MVUE) UCL	50.1
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.647	Data do not follow a Discernable Distribution (0.05)	
Theta Star	26.67		
nu star	38.8		
Approximate Chi Square Value (.05)	25.54	Nonparametric Statistics	
Adjusted Level of Significance	0.041	95% CLT UCL	26.64
Adjusted Chi Square Value	24.91	95% Jackknife UCL	26.95
		95% Standard Bootstrap UCL	26.21
Anderson-Darling Test Statistic	2.708	95% Bootstrap-t UCL	36.18
Anderson-Darling 5% Critical Value	0.793	95% Hall's Bootstrap UCL	32.93
Kolmogorov-Smirnov Test Statistic	0.283	95% Percentile Bootstrap UCL	27.62
Kolmogorov-Smirnov 5% Critical Value	0.167	95% BCA Bootstrap UCL	31.6
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	42.15
		97.5% Chebyshev(Mean, Sd) UCL	52.93
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	74.1
95% Approximate Gamma UCL	26.21		
95% Adjusted Gamma UCL	26.86		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	74.1

TTLC B1-Region IV

General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	19
Raw Statistics		Log-transformed Statistics	
Minimum	2.7	Minimum of Log Data	0.993
Maximum	370	Maximum of Log Data	5.914
Mean	62.72	Mean of log Data	3.254
Median	26	SD of log Data	1.467
SD	86.86		
Coefficient of Variation	1.385		
Skewness	2.57		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.688	Shapiro Wilk Test Statistic	0.943
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	96.3	95% H-UCL	230.3
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	186.1
95% Adjusted-CLT UCL	106.6	97.5% Chebyshev (MVUE) UCL	236.9
95% Modified-t UCL	98.16	99% Chebyshev (MVUE) UCL	336.6
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.616	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	101.8		
nu star	24.64		
Approximate Chi Square Value (.05)	14.33	Nonparametric Statistics	
Adjusted Level of Significance	0.038	95% CLT UCL	94.66
Adjusted Chi Square Value	13.71	95% Jackknife UCL	96.3
		95% Standard Bootstrap UCL	94.15

Anderson-Darling Test Statistic	0.57	95% Bootstrap-t UCL	120.8
Anderson-Darling 5% Critical Value	0.785	95% Hall's Bootstrap UCL	224.2
Kolmogorov-Smirnov Test Statistic	0.177	95% Percentile Bootstrap UCL	97.32
Kolmogorov-Smirnov 5% Critical Value	0.202	95% BCA Bootstrap UCL	109.3
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	147.4
		97.5% Chebyshev(Mean, Sd) UCL	184
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	256
95% Approximate Gamma UCL	107.8		
95% Adjusted Gamma UCL	112.7		
Potential UCL to Use		Use 95% Approximate Gamma UCL	107.8

TTLC B2-Region IV

General Statistics			
Number of Valid Observations	20	Number of Distinct Observations	17
Raw Statistics		Log-transformed Statistics	
Minimum	2	Minimum of Log Data	0.693
Maximum	34	Maximum of Log Data	3.526
Mean	6.595	Mean of log Data	1.49
Median	3.45	SD of log Data	0.782
SD	8.424		
Coefficient of Variation	1.277		
Skewness	2.775		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.541	Shapiro Wilk Test Statistic	0.833
Shapiro Wilk Critical Value	0.905	Shapiro Wilk Critical Value	0.905
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	9.852	95% H-UCL	9.097
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	10.77
95% Adjusted-CLT UCL	10.94	97.5% Chebyshev (MVUE) UCL	12.87
95% Modified-t UCL	10.05	99% Chebyshev (MVUE) UCL	17.01
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.227	Data do not follow a Discernable Distribution (0.05)	
Theta Star	5.374		
nu star	49.09		
Approximate Chi Square Value (.05)	34	Nonparametric Statistics	
Adjusted Level of Significance	0.038	95% CLT UCL	9.693
Adjusted Chi Square Value	33.01	95% Jackknife UCL	9.852
		95% Standard Bootstrap UCL	9.581
Anderson-Darling Test Statistic	1.973	95% Bootstrap-t UCL	20.45
Anderson-Darling 5% Critical Value	0.76	95% Hall's Bootstrap UCL	27.39
Kolmogorov-Smirnov Test Statistic	0.255	95% Percentile Bootstrap UCL	9.885
Kolmogorov-Smirnov 5% Critical Value	0.198	95% BCA Bootstrap UCL	11.08
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	14.81
		97.5% Chebyshev(Mean, Sd) UCL	18.36
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	25.34
95% Approximate Gamma UCL	9.521		
95% Adjusted Gamma UCL	9.807		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	14.81

TTLC C1-Region IV

General Statistics			
Number of Valid Observations	30	Number of Distinct Observations	28
Raw Statistics		Log-transformed Statistics	
Minimum	2.4	Minimum of Log Data	0.875
Maximum	370	Maximum of Log Data	5.914

Mean	45	Mean of log Data	2.767
Median	9.4	SD of log Data	1.474
SD	75.04		
Coefficient of Variation	1.668		
Skewness	3.146		

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.606	Shapiro Wilk Test Statistic	0.917
Shapiro Wilk Critical Value	0.927	Shapiro Wilk Critical Value	0.927
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	68.28	95% H-UCL	108.8
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	108.8
95% Adjusted-CLT UCL	75.95	97.5% Chebyshev (MVUE) UCL	136.9
95% Modified-t UCL	69.59	99% Chebyshev (MVUE) UCL	191.9
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.558	Data do not follow a Discernable Distribution (0.05)	
Theta Star	80.68		
nu star	33.47		
Approximate Chi Square Value (.05)	21.24	Nonparametric Statistics	
Adjusted Level of Significance	0.041	95% CLT UCL	67.54
Adjusted Chi Square Value	20.68	95% Jackknife UCL	68.28
		95% Standard Bootstrap UCL	67.47
Anderson-Darling Test Statistic	1.39	95% Bootstrap-t UCL	86.6
Anderson-Darling 5% Critical Value	0.801	95% Hall's Bootstrap UCL	153.1
Kolmogorov-Smirnov Test Statistic	0.224	95% Percentile Bootstrap UCL	69.7
Kolmogorov-Smirnov 5% Critical Value	0.168	95% BCA Bootstrap UCL	77.4
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	104.7
		97.5% Chebyshev(Mean, Sd) UCL	130.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	181.3
95% Approximate Gamma UCL	70.91		
95% Adjusted Gamma UCL	72.84		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	181.3

TTLC C2-Region IV

General Statistics			
Number of Valid Observations	10	Number of Distinct Observations	8
Raw Statistics		Log-transformed Statistics	
Minimum	2	Minimum of Log Data	0.693
Maximum	6.2	Maximum of Log Data	1.825
Mean	3.61	Mean of log Data	1.187
Median	2.95	SD of log Data	0.462
SD	1.685		
Coefficient of Variation	0.467		
Skewness	0.577		

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.845	Shapiro Wilk Test Statistic	0.866
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	4.587	95% H-UCL	5.09
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	5.934
95% Adjusted-CLT UCL	4.59	97.5% Chebyshev (MVUE) UCL	6.942
95% Modified-t UCL	4.603	99% Chebyshev (MVUE) UCL	8.923
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	3.789	Data appear Normal at 5% Significance Level	

Theta Star	0.953		
nu star	75.78		
Approximate Chi Square Value (.05)	56.73	Nonparametric Statistics	
Adjusted Level of Significance	0.0267	95% CLT UCL	4.486
Adjusted Chi Square Value	53.87	95% Jackknife UCL	4.587
		95% Standard Bootstrap UCL	4.436
Anderson-Darling Test Statistic	0.613	95% Bootstrap-t UCL	4.801
Anderson-Darling 5% Critical Value	0.729	95% Hall's Bootstrap UCL	4.371
Kolmogorov-Smirnov Test Statistic	0.215	95% Percentile Bootstrap UCL	4.47
Kolmogorov-Smirnov 5% Critical Value	0.267	95% BCA Bootstrap UCL	4.46
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	5.932
		97.5% Chebyshev(Mean, Sd) UCL	6.937
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	8.911
95% Approximate Gamma UCL	4.822		
95% Adjusted Gamma UCL	5.078		
Potential UCL to Use		Use 95% Student's-t UCL	4.587

TTLC D-Region IV

General Statistics			
Number of Valid Observations	40	Number of Distinct Observations	35
Raw Statistics		Log-transformed Statistics	
Minimum	2	Minimum of Log Data	0.693
Maximum	370	Maximum of Log Data	5.914
Mean	34.66	Mean of log Data	2.372
Median	6.6	SD of log Data	1.464
SD	67.21		
Coefficient of Variation	1.94		
Skewness	3.625		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.54	Shapiro Wilk Test Statistic	0.883
Shapiro Wilk Critical Value	0.94	Shapiro Wilk Critical Value	0.94
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	52.56	95% H-UCL	62.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	68.51
95% Adjusted-CLT UCL	58.64	97.5% Chebyshev (MVUE) UCL	85.28
95% Modified-t UCL	53.58	99% Chebyshev (MVUE) UCL	118.2
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.512	Data do not follow a Discernable Distribution (0.05)	
Theta Star	67.67		
nu star	40.97		
Approximate Chi Square Value (.05)	27.3	Nonparametric Statistics	
Adjusted Level of Significance	0.044	95% CLT UCL	52.14
Adjusted Chi Square Value	26.88	95% Jackknife UCL	52.56
		95% Standard Bootstrap UCL	51.91
Anderson-Darling Test Statistic	2.969	95% Bootstrap-t UCL	67.97
Anderson-Darling 5% Critical Value	0.81	95% Hall's Bootstrap UCL	118.3
Kolmogorov-Smirnov Test Statistic	0.269	95% Percentile Bootstrap UCL	52.34
Kolmogorov-Smirnov 5% Critical Value	0.147	95% BCA Bootstrap UCL	61.17
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	80.98
		97.5% Chebyshev(Mean, Sd) UCL	101
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	140.4
95% Approximate Gamma UCL	52.01		
95% Adjusted Gamma UCL	52.82		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	140.4

APPENDIX E

DTSC VARIANCE

California Environmental Protection Agency
Department of Toxic Substances Control

VARIANCE

Applicant Names:

Mr. Ken Nelson, Acting District Director
State of California
Department of Transportation, District 12
(Caltrans)
3347 Michelson Drive
Irvine, California 92612

Variance No. 00-H-VAR-07

Effective Date: September 22, 2000

Expiration Date: September 22, 2005

Modification History:

Pursuant to Section 25143 of the California Health and Safety Code, the Department of Toxic Substances Control hereby issues the attached Variance consisting of 8 pages to Department of Transportation District 12.

Frederick S. Moss
Chief, Permitting Division
Department of Toxic Substances
Control

Date: 9/22/00

VARIANCE

1. INTRODUCTION.

1.1 Pursuant to Section 25143, Chapter 6.5, Division 20 of the Health and Safety Code (HSC), the California Department of Toxic Substances Control (DTSC) grants a variance to the applicant below for waste considered hazardous solely because of its contaminant concentrations and as further specified herein.

1.2 DTSC hereby grants a variance only from the requirements specified herein and only in accordance with all terms and conditions specified herein.

2. IDENTIFYING INFORMATION.

APPLICANT/OWNER/OPERATOR

Mr. Ken Nelson, Acting District Director
State of California
Department of Transportation, District 12 (Caltrans)
3347 Michelson Drive
Irvine, California 92612

3. TYPE OF VARIANCE.

Generation, Manifest, Transportation, Storage and Disposal

4. ISSUANCE AND EXPIRATION DATES.

DATE ISSUED: September 22, 2000 EXPIRATION DATE: September 22, 2005.

5. APPLICABLE STATUTES AND REGULATIONS. The hazardous waste that is the subject of this variance is fully regulated under HSC, Section 25100, et seq. and Title 22 of the California Code of Regulations (CCR) Division 4.5 except as specifically identified in Section 8 of this variance.

6. DEFINITION. For the purposes of this variance, waste that meets the criteria in paragraphs a) and b) of section 9 below, shall be referred to as "lead-contaminated soil(s)".

7. FINDINGS/DETERMINATIONS. DTSC has determined that the variance applicant meets the requirements set forth in HSC Section 25143 for a variance from specific regulatory requirements as outlined in Section 8 of this variance. The specific determinations and findings made by DTSC are as follows:

a) Caltrans intends to excavate, stockpile, transport, bury and cover large volumes

of soil associated with highway construction projects throughout the State. In the more urbanized highway corridors this soil is contaminated with lead, primarily due to historic emissions from automobile exhausts. In situ testing has shown the uppermost two feet of soil have been found to contain concentrations of lead in excess of regulatory thresholds. However, DTSC has prepared a risk assessment that shows that soil contaminated with low concentrations of lead can be managed in a way that presents no significant risk to human health and the environment.

b) The lead-contaminated soil will be placed only in Caltrans rights of way. Based on concentration levels, the wastes will be covered with a minimum thickness of one (1) foot of non-hazardous soil or asphalt cover and will always be five (5) feet above the highest groundwater elevation. Caltrans will assure that proper health and safety procedures will be followed for workers. This includes any persons engaged in maintenance work in areas where the waste has been buried and covered.

c) DTSC finds and requires that the lead contaminated soil excavated, stockpiled, transported, buried and covered is a non-RCRA hazardous waste, and that the hazardous waste management activity is insignificant as a potential hazard to human health and safety and the environment, when managed in accordance with the conditions, limitations and other requirements specified in this variance.

8. PROVISIONS SUBJECT TO VARIANCE.

DTSC, subject to all terms and conditions herein, waives the hazardous waste management requirements of Title 22, CCR, sections 66264.250 through 66264.259, 22 CCR 66268.1 through 66268.9, 22 CCR 66262.10, 22 CCR 66262.12, 22 CCR 66262.20, 22 CCR 66262.30 through 66262.34, 22 CCR 66262.40 through 66262.42, 22 CCR 66263.10 through 66263.18 and 22 CCR 66263.20 through 66263.23 for the generation, transportation, manifesting, storage and land disposal of hazardous waste. These management requirements are waived only provided all other requirements of this variance are complied with at Caltrans construction projects in the Caltrans District specified in section 2 above.

9. SPECIFICATIONS OF THE CONDITIONS, LIMITATIONS, OR OTHER REQUIREMENTS. The owner/operator shall be subject to the following conditions:

a) Caltrans shall manage all soil contaminated with lead at concentrations such that it is considered a hazardous waste pursuant to HSC 25117 and 22 CCR, Div 4.5, Chapter 11, unless the contaminant concentrations and management practices meet the following conditions:

1. Soil containing 500 ug/l extractible lead or less (based on a modified waste extraction test using deionized water as the extractant) and 350 ppm or less total lead may be used as fill provided that the lead-contaminated soil is placed a minimum of five (5) feet above the maximum water table elevation and covered with at least one (1) foot of nonhazardous soil. The limit on total lead within shall be the

following: Total parts per million (ppm) lead shall be at or below the statutory limits in effect when the soil is used as fill or the risk based limit of 1496 mg/kg, whichever is less. On the effective date of this variance, HSC section 25157.8 limits total lead concentrations to 350 ppm. That section may be amended and/or expire in the future. Additionally, other parts of relevant statutes may be added or amended in the future to include lead limits applicable to this variance.

2. Soil containing more than 500 ug/l and less than 50 mg/l extractible lead (based on a modified waste extraction test using deionized water as the extractant) and 350 or less ppm total lead may be used as fill provided that the lead-contaminated soils are placed a minimum of five (5) feet above the maximum water table elevation and protected from infiltration by a pavement structure which will be maintained by Caltrans. Caltrans shall comply with the lead limits discussed in paragraph a) 1 above.

3. Contaminated soil with a pH < 5.0 shall only be used as fill material only under the paved portion of the roadway.

b) Caltrans will implement appropriate health and safety procedures to protect its employees and the public, and to prevent or minimize exposure to potentially hazardous substances. A project-specific health and safety plan must be prepared and implemented. The monitoring and exposure standards shall be based on Construction Standards in Title 22, CCR section 1532.1.

c) All lead-contaminated soil that cannot be buried and covered within the same Caltrans corridor from where it originated shall be managed as a hazardous waste.

d) Lead-contaminated soil will not be moved outside the designated corridor boundaries (see paragraph q) below).

e) Lead-contaminated soil shall not be buried in areas where it will be in contact with groundwater or surface water.

f) Lead-contaminated soil shall be buried and covered only in locations that are protected from erosion resulting from storm water run-on and run-off.

g) The lead-contaminated soil shall be buried and covered in a manner that will prevent accidental or deliberate breach of the asphalt, concrete, and/or cover soil.

h) The presence of lead-contaminated soil will be incorporated into the projects' as-built drawings. The as-built drawings shall be annotated with the location, representative analytical data, and volume of lead-contaminated soil. The as-built drawings shall also state the depth of the cover. These as-built drawings shall be retained by Caltrans until its rights-of-way or property ownership are relinquished.

I) Caltrans shall ensure that no other hazardous wastes, other than the lead-contaminated

soil, are placed in the burial areas.

j) Lead-contaminated soil shall not be buried within ten (10) feet of culverts or locations subject to frequent worker exposure.

k) Excavated lead-contaminated soil not placed into the designated area (fill area, roadbed area) by the end of the working day shall be stockpiled and covered with sheets of polyethylene or at least one foot of non-hazardous soil. The lead contaminated soil, while stockpiled or under transport, shall be protected from contacting surface water and being dislodged or transported by wind or storm water. The stockpile covers shall be inspected at least once a week and within 24 hours after rainstorms.

l) Caltrans shall ensure that all stockpiling of lead contaminated soil remains within the specified corridor. Stockpiling of lead-contaminated soil outside the area of contamination is in direct violation of land disposal restrictions and is prohibited.

m) Caltrans shall conduct confirmatory sampling, if appropriate, of any stockpile area after removal of the lead- contaminated soil to ensure that contamination has not been left behind or has not migrated from the stockpiled material to the surrounding soils. Caltrans shall ensure that test results are kept with Caltrans project records located at the District office or a subsequent permanent location and are available to DTSC upon request.

n) Caltrans shall stockpile lead-contaminated soil only on high ground (i.e. no sump areas or low points) which will not be affected by surface water run-on or run-off.

o) Caltrans shall not stockpile soil in an environmentally sensitive area.

p) Caltrans shall ensure that run-off which has come into contact with stockpiled lead-contaminated soil will not flow to storm drains, inlets, or waters of the state.

q) Caltrans may move lead-contaminated soil from one Caltrans project to another Caltrans project so long as the lead-contaminated soil remains within the same designated Caltrans corridor. Caltrans shall record this movement of lead- contaminated soil by using a bill of lading. The bill of lading must contain: 1) US DOT description including shipping name, hazard class and ID number; 2) handling codes; 3) quantity of material; 4) volume of material; and 5) any specific handling instructions. The bill of lading shall be referenced in and kept on file with the project's as-built drawings. Lead-contaminated soil must be kept covered during transportation.

r) For each specific corridor where this variance is to be implemented, all of the following information will be submitted in writing to DTSC at least five (5) days before construction of any project begins:

1. a plan drawing designating the boundaries of the corridor where lead-contaminated soils will be excavated, stockpiled, buried and covered;

2. a list of the Caltrans projects that the corridor encompasses;

3. a list of Caltrans contractors that will be conducting any phase of work on any project affected by this variance;

4. duration of corridor construction;

5. location where sampling and analytical data used to make lead concentration level determinations are kept (e.g. a particular Caltrans project file);

6. name and phone number (please include area code) of project resident engineer and project manager;

7. location where Caltrans and contractor health and safety records are kept;

8. location of project special provisions (including page or section number) for soil excavation, transportation, stockpile, burial and placement of cover material;

9. location of project drawings (including drawing page number) for soil excavation, burial and placement of cover in plan and cross section (For example, "The project plans are located at the resident engineer's office located at 5th and Main Streets, City of Fresno,. See pages xxxxx of contract xxxx");

10. If a Caltrans project within the corridor is added, changed or deleted, Caltrans must update the information provided to DTSC five (5) days before construction begins; and

11. The type of environmental document for each project, date of adoption, document title, Clearing House number and where the document is available for review. A copy of the Notice of Exemption for any project shall be submitted to the DTSC Headquarters Project Manager within five (5) days of signing.

s) Changes in location of lead-contaminated soil placement, quantities or protection measures (field changes) will be noted in the resident engineer's project log within five (5) days of the field change.

t) Caltrans shall ensure that field changes are in compliance with the requirements of this variance.

u) If areas subject to the terms of this variance are sold, relinquished or abandoned (including roadways), all future property owners shall be notified in writing in advance by Caltrans of the requirements of this variance, and Caltrans shall provide the owner with a copy of the variance. A copy of such a notice shall be sent to and contain the corridor location and project. Caltrans shall also disclose to the new owner the location of areas where lead contaminated soil has been buried. Future property owners will be subject to the same requirements as Caltrans retains the right to modify or revoke this variance

pursuant to HSC 25143 upon a change of ownership or at any other time.

v) For the purposes of informing the public about instances where the variance is implemented, Caltrans shall:

1. Maintain current fact sheets at all Caltrans resident engineer offices and the Caltrans District office. Caltrans shall make the fact sheets available to anyone expressing an interest in variance-related work.

2. Maintain a binder(s) containing copies of all reports submitted to DTSC at the District office. Caltrans shall ensure that the binders are readily accessible to the public.

3. Carry out the following actions when it identifies additional projects:

(A) Notify the public via a display advertisement in a newspaper of general circulation in that area.

(B) Update and distribute the fact sheet to the mailing list and repository locations.

w) Caltrans implementation of this variance shall comply with all applicable state policies for water quality control, water quality control plans, waste discharge requirements (including storm water permits), and others issued by the State Water Resources Control Board or a California Regional Water Quality Control Board.

x) This variance is applicable only to soil considered hazardous because of aerially-deposited lead contamination. The variance is not applicable to any other hazardous waste.

y) Lead-contaminated soil may be buried only in areas where access is limited or where lead-contaminated soil is covered and contained by a pavement structure.

1) Dust containing lead-contaminated soil must be controlled. Water or dust palliative may be applied to control dust. If visible dust migration occurs, all excavation, stockpiling and truck loading and burying must be stopped. The granting of this variance confers no relief on Caltrans from compliance with the laws, regulations and requirements enforced by any local air district or the California Air Resources Board.

2) Sampling and analysis is required to show the lead contaminated soil meets the variance criteria specified in a). All sampling and analysis must be done according to U.S. EPA subsection SW-846.

z) All correspondence shall be directed to the following office:

Frederick S. Moss, Chief
Permitting Division
Department of Toxic Substances Control
400 P Street, 4th Floor
P.O. Box 806
Sacramento, CA 95812-0806

Attn: Caltrans Lead Variance Notification Unit

10. DISCLAIMER.

10.1 The issuance of this variance does not relieve Caltrans of the responsibility for compliance with Division 20, Chapter 6.5, HSC, or the regulations adopted thereunder, and any other laws and regulations other than those specifically identified in Section 8 of this variance. Caltrans is subject to all terms and conditions herein. The granting of this variance confers no relief from compliance with any federal, state or local requirements other than those specifically provided herein.

10.2 The issuance of this variance does not release Caltrans from any liability associated with the handling of hazardous waste, except as specifically provided herein and subject to all terms and conditions of this variance.

11. VARIANCE MODIFICATION OR REVOCATION. This variance is subject to review at the discretion of DTSC and may be modified or revoked at any time pursuant to Health and Safety Code section 25143.

12. CEQA DETERMINATION. DTSC adopted a Negative Declaration on September 22, 2000.

Approved:

9/22/00
Date

Frederick S. Moss, Chief
Permitting Division
Hazardous Waste Management Program
Department of Toxic Substances Control

KEA / Marc Boswell

Department of Toxic Substances Control

Edwin F. Lowry, Director
1001 "I" Street, 25th Floor
P.O. Box 806
Sacramento, California 95812-0806

Winston H. Hickox
Agency Secretary
California Environmental
Protection Agency

Gray Davis
Governor

December 13, 2002

Mr. Mike Leonardo
District Director
California Department of Transportation, District 6
1352 West Olive Avenue
Fresno, California 93728

CALTRANS LEAD CONTAMINATED SOIL VARIANCE MODIFICATION, DISTRICT 6.

Dear Mr. Leonardo:

This letter concerns the lead contaminated soil variance the Department of Toxic Substances Control (DTSC) issued to Caltrans, District 6 (the District) on September 22, 2000. The variance governs the District's management of soil that contains aerially deposited lead. DTSC has conducted a new risk assessment in the course of processing another variance application from Caltrans. The new risk assessment shows the total lead levels specified in the District's current variance are somewhat higher than the new recommended levels. Therefore, conditions 9.a.1 and 2 in the District's variance have been modified to incorporate the new recommended lead levels and provide more clarity. Specifically, the following paragraphs shall replace the existing sections in the variances:

9.a.1. Lead contaminated soil containing 500 ug/l extractible lead or less (based on a modified waste extraction test using deionized water as the extractant) and 1411 mg/kg or less total lead may be used as fill provided that this soil is placed a minimum of five (5) feet above the maximum water table elevation and covered with at least one (1) foot of nonhazardous soil.

9.a.2. Lead contaminated soil containing ~~more than 500 ug/l and~~ less than 50 mg/l extractible lead (based on a modified waste extraction test using deionized water as the extractant) and ~~more than 1411 mg/kg total lead but~~ less than 3397 mg/kg total lead may be used as fill provided that this soil is placed a minimum of five (5) feet above the maximum water table elevation and protected from infiltration by a pavement structure which will be maintained by Caltrans.

KEA/Marc Boswell

c: JML

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Effective upon receipt of this modification language, all new projects conducted pursuant to the District's variance shall be required to use the modified lead levels specified above. This letter will formally modify the variance issued to the District and shall be attached as addendum to the existing variance.

If you have any questions or comments, please contact Mr. Michael Choe of my staff at (916) 322-5308.

Sincerely,

Frederick S. Moss

Frederick S. Moss, Chief
Permitting Division
Hazardous Waste Management Program

cc: Ms. Marge Rouch, Chief
Office of Noise, Vibration,
and Hazardous Waste Management
Department of Transportation
1120 N Street, MS 27
Sacramento, California 95814

Ms. Marilee Hanson
Office of Legal Counsel and Investigations
Department of Toxic Substances Control
P.O. Box 806
Sacramento, California 95812-0806

Mr. Jan Radimsky, P.E., Chief
Permit Streamlining Branch
Department of Toxic Substances Control
P.O. Box 806
Sacramento, California 95812-0806

Mr. David Wright, P.E., Chief
Permit Program Development Section
Department of Toxic Substances Control
P.O. Box 806
Sacramento, California 95812-0806

Margy Kouri

Department of Toxic Substances Control

Edwin F. Lowry, Director
1001 "I" Street, 25th Floor
P.O. Box 806
Sacramento, California 95812-0806

Winston H. Hickox
Agency Secretary
California Environmental
Protection Agency

Gray Davis
Governor

September 12, 2003

CERTIFIED MAIL – 7001-0320-0000-9689-1178

Ms. Cindy Quon, District Director
California Department of Transportation, District 12
3347 Michelson Drive, Suite 100
Irvine, California 92612

LEAD CONTAMINATED SOIL VARIANCE, CALTRANS DISTRICT 12; SECOND MODIFICATION

Dear Ms. Quon:

This modification letter concerns the lead contaminated soil variance the Department of Toxic Substances Control (DTSC) issued to Caltrans, District 12 (the District) on September 22, 2000, which was first modified on December 13, 2002 (the First Modification). This modification (the Second Modification) replaces and supercedes the previous modification. The purpose of this Second Modification is to provide more clarity concerning new recommended lead levels.

The following paragraphs shall replace the corresponding sections in the variance issued on September 22, 2000 and the First Modification:

9.a.1. Lead contaminated soil containing 500 ug/l extractible lead or less (based on a modified waste extraction test using deionized water as the extractant) and 1411 mg/kg or less total lead may be used as fill provided that this soil is placed a minimum of five (5) feet above the maximum water table elevation and covered with at least one (1) foot of nonhazardous soil.

Soil that exceeds the allowed lead concentrations in this Condition 9.a.1. may still be used as fill if it meets the concentration levels described in Condition 9.a.2. below and the other requirements of Condition 9.a.2. are met.

9.a.2. Lead contaminated soil containing less than 50 mg/l extractible lead (based on a modified waste extraction test using deionized water as the extractant) and 3397 mg/kg or less total lead may be used as fill provided that this soil is placed a minimum of five (5) feet above the maximum water table elevation and protected from infiltration by a pavement structure which will be maintained by Caltrans.

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our Web-site at www.dtsc.ca.gov.

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Effective upon receipt of this Second Modification, all new projects conducted pursuant to the District's variance shall be required to use the modified lead levels and meet the other requirements specified above. This letter will formally modify the variance issued to the District and shall be attached as addendum to the existing variance. This letter also replaces and supersedes the First Modification.

If you have any questions or comments, please contact Michael Choe of my staff at (916) 322-5308.

Sincerely,

Peggy Harris, P.E., Chief
Regulatory and Program Development Division
Hazardous Waste Management Program

cc: ✓Ms. Marge Rouch, Chief
Office of Noise, Vibration, and Hazardous Waste Management
Department of Transportation
1120 N Street, MS 27
Sacramento, California 95814

Ms. Marilee Hanson
Office of Legal Counsel and Investigations
Department of Toxic Substances Control
1001 "I" Street, P.O. Box 806
Sacramento, California 95812-0806

Mr. Jan Radimsky, P.E., Chief
Permitting Program Development Branch
Department of Toxic Substances Control
1001 "I" Street, P.O. Box 806
Sacramento, California 95812-0806

Mr. David Wright, P.E., Chief
Permit Program Development Section
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Department of Toxic Substances Control

Linda S. Adams
Secretary for
Environmental Protection

Maureen F. Gorsen, Director
1001 "I" Street
P.O. Box 806
Sacramento, California 95812-0806

Arnold Schwarzenegger
Governor

June 17, 2008

Ms. Cindy Quon
District Director
State of California
Department of Transportation, District 12
3337 Michelson Drive, Suite CN 380
Irvine, California 92612-8894

LEAD CONTAMINATED SOIL VARIANCE MODIFICATION
VARIANCE NUMBER 00-H-VAR-07, CALTRANS DISTRICT 12

Dear Ms. Quon:

The Department of Toxic Substances Control (DTSC) received the letter dated February 19, 2008,[1] from the California Department of Transportation (Caltrans) requesting that DTSC extend the variance issued to Caltrans District 12 on September 22, 2000. The variance authorizes Caltrans to manage and dispose onsite contaminated soil during highway construction projects. The contaminated soil is hazardous primarily due to aerially-deposited lead associated with exhaust emissions from the operation of motor vehicles.

The variance, originally scheduled to expire on September 22, 2005, was granted extensions by DTSC that allows Caltrans to continue using the variance until June 30, 2008. Once the variance expires, Caltrans will no longer be able to dispose of lead contaminated soil onsite.

Over the past year, DTSC has been working with Caltrans headquarters staff to renew this variance. Although we have made progress on the variance renewal, the variance will not be completed by June 30, 2008. Furthermore, Caltrans has requested that DTSC allow time for Caltrans to provide appropriate notification of the variance status to all parties involved in large highway construction projects. Currently, DTSC and Caltrans are still trying to resolve the maximum allowable level of extractible lead

[1] Although the date on your letter is dated February 19, 2008, the postal mark on the envelope indicates the letter was mailed on March 25, 2008. DTSC received the letter on March 26, 2008.

appropriate for onsite disposal of lead contaminated soil. DTSC understands that while work toward the new variance continues, Caltrans has construction projects that will require the use of current variance. Therefore, DTSC will extend the expiration date of variance No. 00-H-VAR-07 to June 30, 2009. Please note, this variance expiration extension is granted with the expectation that a good faith effort is shown by Caltrans to proceed with the variance renewal.

This letter formally modifies the variance No. 00-H-VAR-07 issued to Caltrans District 12 and shall be attached as addendum to the existing variance. However, DTSC has the authority to modify or revoke the variance at any time.

If you have any questions or comments regarding this letter, please contact Ms. Evelia Rodriguez of my staff at (916) 322-3810.

Environmentally,

Leonard E. Robinson
Chief Deputy Director

cc: Mr. Richard Bailey
Caltrans – Division of Environmental Analysis
Environmental Engineering Processes – Hazardous Waste
1120 N Street, MS 27
Sacramento, California 95814

Mr. Edward Nieto
Office of Legislative and Regulatory Policy
Department of Toxic Substances Control

APPENDIX F

CALTRANS COMMENTS AND EMI RESPONSES

Memorandum

Flex your power!
Be energy efficient!

To: **Mrs. Milli Lim, Chief**
Design "A"

Date: June 25, 2009
File No: 12-ORA-57
PM: 16.0/18.4
EA: 0F0311

From: ENVIRONMENTAL ENGINEERING
D 12 – Project Delivery

Subject: Review of Final Aerially Deposited Lead Report (ADL), for SR-57 Northbound Improvement Project from Orangethorpe Ave to Yorba Linda Blvd.

References:

1. Aerially Deposited Lead Report, for SR-57 Northbound Improvement Project, (Orangethorpe Ave to Yorba Linda Blvd), County of Orange, California, prepared by Earth Mechanics, Inc., dated February 11, 2009.

2. Final Aerially Deposited Lead Report, for SR-57 Northbound Improvement Project, (Orangethorpe Ave to Yorba Linda Blvd), County of Orange, California, prepared by Earth Mechanics, Inc., dated June 17, 2009.

Dear Mili:

We have reviewed the above referenced No. 2 document and the following are our comments.

1. The above report is approved provided the following recommendations are followed.

2. Project plans must show the approximate location of the proposed ADL contaminated soil burial site(s). These plans shall be submitted to Environmental Engineering Branch for approval.

See Appendix E

3. A COPY OF THE DISTRICT VARIANCE IS ATTACHED. THE DESIGN TEAM MUST INCLUDE A COPY OF THE VARIANCE WITH THE PS&E PACKAGE, WITH INSTRUCTIONS TO THE RESIDENT ENGINEER (RE) TO IMPLEMENT ALL THE PROVISIONS OF THE VARIANCE.

4. The (RE) will be responsible to ensure that the burial site(s) is surveyed and be shown on the as built plans.

5. As of July 1st, 2009 and per Department Headquarter (HQ) requirements, the above information such as burial site(s) location/coordinates, etc. must be submitted to HQ to be compiled onto their data base.

6. Please prepare an appropriate SSP for proper handling of contaminated soil and traffic stripes during PS&E phase of the project and submit for our review. The contractor should pay attention to several new SSP's replacing the old version of SSP 15-300

If you have any questions please feel free to call Mr. David Yaghoubi at (949) 756-7828 or myself at (949) 724 2738.

Sincerely

R. Aurasteh

Reza Aurasteh, Ph.D., P.E., Chief
Branch Chief, Environmental Engineering

C: Joel Robinson, Project Engineer
Lino Cheang, Earth Mechanics, Inc. Project Engineer
David Yaghoubi, Environmental Engineering

Responses to Caltrans Comments on ADL Report:

- According to Table 1, The Wet Citric Acid Extraction test results for samples S-14-2, L-16-1, L-16-2, l-20-1, L-20-4, L-21-1, L-23-1 are above 5 (mg/L), however Wet Di Test results for the above samples are missing from Table 1. Please provide the test results.

  Response: The DI-WET results for samples S-14-2, L-16-1, L-16-2, L-20-1, L20-4, L-21-1 and L23-1 were added to Table 1. Those values were also analyzed and presented in Section 4.2.

- An appropriate SSP must be prepared for proper handling of contaminated soils and traffic stripes during PS&E phase of the project.
  Response: The above recommendation was added to the Abstract (page ii), Section 4.3 (page 13) and Appendix A3.0.

- DTSC variance modification, dated June 17, 2008 or latest version along with the original variance dated September 22, 2000 shall be a part of the report. See attachments.

  Response: DTSC Variance is discussed in Section 4.1 (page 7). DTSC variance modification along with the original variance is attached in the report as Appendix E.

- Please add the DTSC Variance for re-use condition 1, 2 & 3 along with criteria for disposal of soil not intended for reuse on site. See the sample provided.

  Response: DTSC Variance for re-use conditions and criteria for soil disposal were added to Section 4.1 (page 7).

- Table 1 shows two different symbols for borings. Please provide a foot note stating what the difference between L and S. is.

  Response: Explanation of the two symbols was added to Section 1.2.2 (page 2) and a footing note was also added to the end of Table 1.

- According to section A2.0 of your report, "paint sampling results", only three samples were tested for Yellow Paint. Was there a Thermoplastic Traffic Striping or Pavement Markers within the project limits? If so where are the test results?

  Response: There is no yellow paint within the project limit. However, white markings, white markers and yellow thermoplastic traffic striping are located throughout the project site. It is our understanding that white color markers and markings would not contain lead and only the yellow thermoplastic traffic striping could contain lead. Based on our field reconnaissance, there are five locations containing yellow thermoplastic traffic striping: Orangethorpe Avenue on-ramp and off-ramp, Chapman Avenue off-ramp, and Nutwood Avenue on-ramp and off-ramp. It is likely that the yellow thermoplastic traffic striping used on the Orangethorpe Avenue on-ramp and off-ramp is from the same batch. Therefore, we only collected a representative sample from one of the ramps for testing. The same decision was

made for the Nutwood Avenue on-ramp and off-ramp. As a result, samples were collected and tested from three out of five locations. Our recommendations given in the Abstract and Appendix A apply to all yellow thermoplastic traffic striping encountered within the project limits.

Memorandum

Flex your power!
Be energy efficient!

To: **Mrs. Milli Lim, Chief**
Design "A"

Date: February 26, 2009
File No: 12-ORA-57
PM: 16.0/18.4
EA: 0F0311

From: ENVIRONMENTAL ENGINEERING
D 12 – Project Delivery

Subject: Review of Aerially Deposited Lead Report, for SR-57 Northbound Improvement Project from Orangethorpe Ave to Yorba Linda Blvd.

Reference:

Aerially Deposited Lead Report, for SR-57 Northbound Improvement Project, (Orangethorpe Ave to Yorba Linda Blvd), County of Orange, California, prepared by Earth Mechanics, Inc., dated February 11, 2009.

Dear Mili:

We have reviewed the above documents and the following are our comments for the consultant:

- According to Table 1, The Wet Citric Acid Extraction test results for samples S-14-2, L-16-1, L-16-2, l-20-1, L-20-4, L-21-1, L-23-1 are above 5 (mg/L), however Wet Di Test results for the above samples are missing from Table 1. Please provide the test results.

- An appropriate SSP must be prepared for proper handling of contaminated soils and traffic stripes during PS&E phase of the project.

- DTSC variance modification, dated June 17, 2008 or latest version along with the original variance dated September 22, 2000 shall be a part of the report. See attachments.

- Please add the DTSC Variance for re-use condition 1, 2 & 3 along with criteria for disposal of soil not intended for reuse on site. See the sample provided.

- Table 1 shows two different symbols for borings. Please provide a foot note stating what the difference between L and S. is.

- According to section A2.0 of your report, "paint sampling results", only three samples were tested for Yellow Paint. Was there a Thermoplastic Traffic Striping or Pavement Markers within the project limits? If so where are the test results?

Important reminder

The new regulations require the Wet Citric Acid test to be conducted on all samples that a Total Lead exceeds 50 mg/kg.

If you have any questions please feel free to call Mr. David Yaghoubi at (949) 756-7828 or myself at (949) 724 2738.

Sincerely

R. Aurasteh

Reza Aurasteh, Ph.D., P.E., Chief
Branch Chief, Environmental Engineering

C: Joel Robinson, Project Engineer
Lino Cheang, Earth Mechanics, Inc. Project Engineer
David Yaghoubi, Environmental Engineering

Attachments:
DTSC variance and modifications
Reuse conditions 1, 2, 3 & Criteria for disposal of soil .....

California Regional Water Quality Control Board
Santa Ana Region

Linda S. Adams
Secretary for
Environmental Protection

3737 Main Street, Suite 500, Riverside, California 92501-3348
Phone (951) 782-4130 • FAX (951) 781-6288 • TDD (951) 782-3221
www.waterboards.ca.gov/santaana

Arnold Schwarzenegger
Governor

June 25, 2009

Mili Lim Stamation
Department of Transportation ("Caltrans")
District 12
3337 Michelson Drive, Suite 380
Irvine, CA 92612

CLEAN WATER ACT SECTION 401 WATER QUALITY STANDARDS CERTIFICATION FOR THE STATE ROUTE 57 NORTHBOUND WIDENING PROJECT, CITIES OF PLACENTIA, FULLERTON AND BREA, ORANGE COUNTY (CORPS FILE NO. NOT AVAILABLE)

Dear Ms. Stamation:

On May 18, 2009, we received an application for Clean Water Act Section 401 Water Quality Standards Certification ("Certification"), submitted on your behalf by RBF Consulting, for the proposed State Route 57 ("SR-57") northbound widening project, in the Cities of Placentia, Fullerton, and Brea, Orange County. This letter responds to your request for certification that the proposed project, described in the application and summarized below, will comply with State water quality standards outlined in the Water Quality Control Plan for the Santa Ana River Basin (1995) and subsequent Basin Plan amendments ("Basin Plan"):

Project Description: Widening of a 4.9-mile section of SR-57 between Mira Loma Avenue in the City of Placentia and Deodara Street in the City of Brea. The project will include the addition of a northbound lane through the section and related interchange improvements. The project will involve the extension of five box culverts, and the placement of fill, in Loftus Channel as the result of the construction of a northbound off-ramp at that location, and the extension of a box culvert crossing Carbon Creek by 7.5 feet. The project is located within Sections 13, 24, 25, and 36 of Township 3 South and Range 10 West and Section 1 of Township 4 South, Range 10 West of the U.S. Geological Survey *La Habra, California*, 7.5-rninute

	topographic quadrangle map (33 deg. 54 min. 31 sec. N/- 117 deg. 52 min. 55 sec. W).
Receiving Waters:	Loftus Channel.
Fill Area:	0.002 acre of permanent impact to an ephemeral concrete-lined channel.
Dredge Volume:	Not applicable.
Federal Permits:	US Army Corps of Engineers Nationwide Permit No. 14.

This certification addresses impacts to water quality standards associated with the dredging or filling of waters of the United States. Construction and post-construction impacts resulting from the project and use of the roadways are addressed by waste discharge requirements issued to the Department of Transportation by the State Water Resources Control Board in Order No. 99-06 DWQ. These requirements include the development and implementation of appropriate Best Management Practices for the purpose of removing construction-related and transportation-related pollutants from discharges from Caltrans' rights-of-way and easements.

The proposed project is subject to a nationwide permit from the U.S. Army Corps of Engineers in compliance with Section 404 of the Clean Water Act. You have applied for a Streambed Alteration Agreement under Fish and Game Code Section 1600 *et seq.* Pursuant to the California Environmental Quality Act ("CEQA"), Caltrans adopted a Mitigated Negative Declaration for the SR-57 Northbound Widening Project on November 30, 2007 (State Clearinghouse No. 2007081001). Pursuant to California Code of Regulations, Title 14, Section 15096, subdivision (f), the Regional Board must consider the environmental effects of the project as shown in the associated environmental documents prior to reaching a decision on the project. The Regional Board has considered Caltrans' environmental documents in the issuance of this Certification and finds that changes or alterations have been required, or incorporated into the proposed project, which avoid impacts to water quality or mitigates them to a less than significant level.

This 401 Certification is contingent upon the execution of the following conditions:

1) A copy of this Certification and any subsequent amendments must be maintained on site as a denoted element of the project Storm Water Pollution Prevention Plan(s) ("SWPPP").

2) The discharger must comply with the conditions and provisions of the U.S. Army Corps of Engineer's permit(s).

Under California Water Code, Section 1058, and Pursuant to 23 CCR §3860, the following shall be included as conditions of all water quality certification actions:

(a) Every certification action is subject to modification or revocation upon administrative or judicial review, including review and amendment pursuant to Section §13330 of the Water Code and Article 6 (commencing with Section 3867) of this Chapter.

(b) Certification is not intended and shall not be construed to apply to any activity involving a hydroelectric facility and requiring a FERC license or an amendment to a FERC license unless the pertinent certification application was filed pursuant to Subsection §3855(b) of this Chapter and that application specifically identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought.

(c) Certification is conditioned upon total payment of any fee required under this Chapter and owed by the applicant.

If the above stated conditions are changed, any of the criteria or conditions as previously described are not met, or new information becomes available that indicates a water quality problem, the Regional Board may require the applicant to submit a report of waste discharge and obtain Waste Discharge Requirements.

In the event of any violation or threatened violation of the conditions of this certification, the holder of any permit or license subject to this certification shall be subject to any remedies, penalties, process or sanctions as provided for under state law. For purposes of section 401(d) of the Clean Water Act, the applicability of any state law authorizing remedies, penalties, process or sanctions for the violation or threatened violation constitutes a limitation necessary to assure compliance with the water quality standards and other pertinent requirements incorporated into this certification. Violations of the conditions of this certification may subject the applicant to civil liability pursuant to Water Code section 13350 and/or 13385.

This letter constitutes a Water Quality Standards Certification issued pursuant to Clean Water Act Section 401. I hereby issue an order certifying that any discharge from the referenced project will comply with the applicable provisions of Sections 301 (Effluent Limitations), 302 (Water Quality Related Effluent Limitations), 303 (Water Quality Standards and Implementation Plans), 306 (National Standards of Performance), and 307 (Toxic and Pretreatment Effluent Standards) of the Clean Water Act, and with other

applicable requirements of State law. This discharge is also regulated under State Water Resources Control Board Order No. 2003-0017-DWQ (Order No. 2003-0017-DWQ), "General Waste Discharge Requirements for Dredge and Fill Discharges That Have Received Water Quality Certification" which requires compliance with all conditions of this Water Quality Standards Certification. Order No. 200-0017-DWQ is available at:
www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2003/wqo/wqo2003-0017.pdf

Should there be any questions, please contact Adam Fischer at (951) 320-6363, or Mark Adelson at (951) 782-3234.

Sincerely,

for GERARD J. THIBEAULT
Executive Officer

cc (via electronic message):
U. S. Army Corps of Engineers, Los Angeles Office – Mark Durham
State Water Resources Control Board, OCC – David Rice
State Water Resources Control Board, DWQ – Water Quality Certification Unit
California Department of Fish and Game – Marilyn Fluharty
U.S. EPA – Supervisor of the Wetlands Regulatory Office WTR- 8

APF: 401/certifications/SR 57 NB widening 302009-18

Nationwide Permit Summary

U S Army Corps of Engineers

33 CFR Part 330; Issuance of Nationwide Permits – March 19, 2007 includes corrections of May 8, 2007

14. Linear Transportation Projects. Activities required for the construction, expansion, modification, or improvement of linear transportation projects (e.g., roads, highways, railways, trails, airport runways, and taxiways) in waters of the United States. For linear transportation projects in non-tidal waters, the discharge cannot cause the loss of greater than 1/2-acre of waters of the United States. For linear transportation projects in tidal waters, the discharge cannot cause the loss of greater than 1/3-acre of waters of the United States. Any stream channel modification, including bank stabilization, is limited to the minimum necessary to construct or protect the linear transportation project; such modifications must be in the immediate vicinity of the project.

This NWP also authorizes temporary structures, fills, and work necessary to construct the linear transportation project. Appropriate measures must be taken to maintain normal downstream flows and minimize flooding to the maximum extent practicable, when temporary structures, work, and discharges, including cofferdams, are necessary for construction activities, access fills, or dewatering of construction sites. Temporary fills must consist of materials, and be placed in a manner, that will not be eroded by expected high flows. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The areas affected by temporary fills must be revegetated, as appropriate.

This NWP cannot be used to authorize non-linear features commonly associated with transportation projects, such as vehicle maintenance or storage buildings, parking lots, train stations, or aircraft hangars.

Notification: The permittee must submit a pre-construction notification to the district engineer prior to commencing the activity if: (1) the loss of waters of the United States exceeds 1/10 acre; or (2) there is a discharge in a special aquatic site, including wetlands. (See general condition 27.) (Sections 10 and 404)

Note: Some discharges for the construction of farm roads or forest roads, or temporary roads for moving mining equipment, may qualify for an exemption under Section 404(f) of the Clean Water Act (see 33 CFR 323.4)

A. Nationwide Permit General Conditions

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as appropriate, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP.

☒ **1. Navigation.**

☒ (a) No activity may cause more than a minimal adverse effect on navigation.

☒ (b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.

☒ (c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

☒ **2. Aquatic Life Movements**. No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. Culverts placed in streams must be installed to maintain low flow conditions.

☒ **3 Spawning Areas.** Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

☒ **4. Migratory Bird Breeding Areas.** Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

☒ **5. Shellfish Beds**. No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48.

☒ **6. Suitable Material**. No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

☒ **7. Water Supply Intakes**. No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

☒ **8. Adverse Effects From Impoundments**. If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or

restricting its flow must be minimized to the maximum extent practicable.

☒ **9. Management of Water Flows**. To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

☒ **10. Fills Within 100-Year Floodplains**. The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

☒ **11. Equipment**. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

☒ **12. Soil Erosion and Sediment Controls**. Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

☒ **13. Removal of Temporary Fills**. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

☒ **14. Proper Maintenance**. Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety.

☒ **15. Wild and Scenic Rivers**. No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency in the area (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

☒ **16. Tribal Rights**. No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

☒ **17. Endangered Species**.

☒ (a) No activity is authorized under any NWP which is likely to jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.

☒ (b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements.

☒ (c) Non-federal permittees shall notify the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that may be affected by the proposed work or that utilize the designated critical habitat that may be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed.

☒ (d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs.

☒ (e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the U.S. FWS or the NMFS, both lethal and non-lethal "takes" of protected species are in violation of the ESA. Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their world wide Web pages at http://www.fws.gov/ and http://www.noaa.gov/fisheries.html respectively.

☒ **18. Historic Properties**.

☒ (a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

☒ (b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements.

☒ (c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties which the activity may have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

☒ (d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR §800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-Federal applicant that he or she cannot begin work until Section 106 consultation is completed.

☒ (e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, explaining the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

☒ **19. Designated Critical Resource Waters.** Critical resource waters include, NOAA-designated marine sanctuaries, National Estuarine Research Reserves, state natural heritage sites, and outstanding national resource waters or other waters officially designated by a state as having particular environmental or ecological significance and identified by the district engineer after notice and opportunity for public comment. The district engineer may also designate additional critical resource waters after notice and opportunity for comment.

☒ (a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, and 50 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

☒ (b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 27, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

☒ **20 Mitigation.** The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal:

☒ (a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

☒ (b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

☒ (c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10 acre and require pre-construction notification, unless the district engineer determines in writing that some other form of mitigation would be more environmentally appropriate and provides a project-specific waiver of this requirement. For wetland losses of 1/10 acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the

aquatic environment. Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

☒ (d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream restoration, to ensure that the activity results in minimal adverse effects on the aquatic environment.

☒ (e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2 acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2 acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

☒ (f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

☒ (g) Permittees may propose the use of mitigation banks, in-lieu fee arrangements or separate activity-specific compensatory mitigation. In all cases, the mitigation provisions will specify the party responsible for accomplishing and/or complying with the mitigation plan.

☒ (h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

☒ **21. Water Quality.** Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

☒ **22. Coastal Zone Management**. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

☒ **23. Regional and Case-By-Case Conditions**. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

☒ **24. Use of Multiple Nationwide Permits**. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

☒ **25. Transfer of Nationwide Permit Verifications**. If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

> "When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."
>
> ---
>
> (Transferee)
>
> ---
>
> (Date)

☒ **26. Compliance Certification**. Each permittee who received an NWP verification from the Corps must submit a signed certification regarding the completed work and any required mitigation. The certification form must be forwarded by the Corps with the NWP verification letter and will include:

☒ (a) A statement that the authorized work was done in accordance with the NWP authorization, including any general or specific conditions;

☒ (b) A statement that any required mitigation was completed in accordance with the permit conditions; and

☒ (c) The signature of the permittee certifying the completion of the work and mitigation.

☒ **27. Pre-Construction Notification.**

☐ (a) **Timing**.. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, as a general rule, will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:

☒ (1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or

☒ (2) Forty-five calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 17 that listed species or critical habitat might affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 18 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) is completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee cannot begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

☒ (b) Contents of Pre-Construction Notification: The PCN must be in writing and include the following information:

☒ (1) Name, address and telephone numbers of the prospective permittee;

☒ (2) Location of the proposed project;

☒ (3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided result in a quicker decision.);

☒ (4) The PCN must include a delineation of special aquatic sites and other waters of the United States on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters of the United States, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the United States. Furthermore, the 45 day period will not start until the delineation has been submitted to or completed by the Corps, where appropriate;

☒ (5) If the proposed activity will result in the loss of greater than 1/10 acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

☒ (6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and

☒ (7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic

property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.

(c) Form of Pre-Construction Notification: The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used.

(d) Agency Coordination:

(1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.

(2) For all NWP 48 activities requiring pre-construction notification and for other NWP activities requiring pre-construction notification to the district engineer that result in the loss of greater than 1/2-acre of waters of the United States, the district engineer will immediately provide (e.g., via facsimile transmission, overnight mail, or other expeditious manner) a copy of the PCN to the appropriate Federal or state offices (U.S. FWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will then have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame, but will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(4) Applicants are encouraged to provide the Corps multiple copies of pre-construction notifications to expedite agency coordination.

(5) For NWP 48 activities that require reporting, the district engineer will provide a copy of each report within 10 calendar days of receipt to the appropriate regional office of the NMFS.

(e) In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. If the proposed activity requires a PCN and will result in a loss of greater than 1/10 acre of wetlands, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for projects with smaller impacts. The district engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed work are minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the district engineer will notify the permittee and include any conditions the district engineer deems necessary. The district engineer must approve any compensatory mitigation proposal before the permittee commences work. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are determined by the district engineer to be minimal, the district engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP.

If the district engineer determines that the adverse effects of the proposed work are more than minimal, then the district engineer will notify the applicant either: (1) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit; (2) that the project is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level; or (3) that the project is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period. The authorization will include the necessary conceptual or specific mitigation or a requirement that the applicant

submit a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level. When mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan.

☒ **(a) 28. Single and Complete Project.** The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.