FOR CONTRACT NO.: 08-449314

INFORMATION HANDOUT

WATER QUALITY

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SANTA ANA REGION
(BOARD ORDER NO. R8-2009-0003)
(NPDES PERMIT NO. CAG998001)

PERMITS

STATE OF CALIFORNIA
DEPARTMENT OF FISH AND GAME
(NOTIFICATION NO. 1600-2008-0166-R6)

UNITED STATES ARMY CORPS OF ENGINEERS
NATIONWIDE 404 PERMIT AUTHORIZATION
(File # SPL-2009-00198-VCC)

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SANTA ANA REGION
CLEAN WATER ACT SECTION 401 WATER
QUALITY STANDARDS CERTIFICATION
(Reference # 332010-02)

ROUTE: 08-Riv-60, 215-R19.7/21.9, R61.3/62.7

MATERIALS INFORMATION

1. Asbestos Survey Report for I-215 Gap Closure at Box Springs dated April 22, 2009.
2. Aerially Deposited Lead Survey Report for Interstate 215/State Route 60 East Junction Improvements dated March 13, 2009.
3. Geotechnical Design Report for Interstate 215/State Route 60 East Junction Improvements dated January 9, 2009.
4. Revised Materials Report for Interstate 215/State Route 60 East Junction Improvements dated March 12, 2009.
5. Revised Final Structure Foundation Report for Box Springs Overhead Left Bridge Widening Bridge No. 56-0082L dated June 15, 2009.
6. Final Structure Foundation Report for Box Springs Road Overhead Replacement Bridge No. 56C0566 dated June 12, 2009.
7. Revised Structure Foundation Report Box Springs OH Right Bridge Widening Bridge No. 56-0082R dated June 12, 2009.
8. Final Structure Foundation Report for Box Springs Overhead Tieback Bridge No. 56E0036 dated June 12, 2009.
9. Revised Structure Foundation Report for Retaining Wall RW-19 & RW-20 Route 60/215 Separation Bridge No. 56-0507R dated June 15, 2009.
10. Revised Structure Foundation Report for Retaining Walls, Westbound and Eastbound State Route 60 HOV Connectors Bridge Nos 56-0841 and 56-0842 dated June 15, 2009.
11. Revised Final Structure Foundation Report for Proposed Westbound and Eastbound State Route 60 HOV Connectors Bridge Nos. 56-0841 and 56-0842 dated June 12, 2009.
12. Addendum No. 3 to Final Geotechnical Design Report - Proposed 1350-mm and 450-mm Diameter Jacked Drainage Pipes
13. Addendum No. 1 to Final Geotechnical Design Report - Proposed Rock Slope Protection Lined Trap Channel dated March 23, 2009.
14. Addendum No. 2 to Final Geotechnical Design Report - Proposed 900-mm Diameter Jacked Reinforced Concrete Pipe (RCP) dated March 24, 2009.
15. UndergroundClassification Numbers-C099-065-09T thru C103-065-09T
16. State of California, Department of Industrial Relations, Underground Classification No. C099-065-09T, dated June 22, 2009
17. California Regional Water Quality Control, Revised Clean Water Act Section 401.

ROUTE: 08-Riv-60, 215-R19.7/21.9, R61.3/62.7

18. California Dept. of Fish and Game, Notification of Lake or Streambed 1600 Permit

19. Department of the Army Notification Permit Authorization, dated March 31, 2010

20. Kinder Morgan, Guidelines for Design and Construction Near Kinder Morgan Hazardous Liquid Operated Facilities dated November 2007.

ASBESTOS SURVEY REPORT

Three Bridge Structures
I-215 Gap Closure at Box Springs
Moreno Valley, Riverside County, California

Stantec Project No.: 185801048

Submitted to:
LAN Engineering Corporation
20 Empire Drive
Lake Forest, California

Submitted by:
Stantec Consulting Corporation
25864-F Business Center Drive
Redlands, California

April 22, 2009

DRAFT

Stantec Consulting Corporation
25864-F Business Center Drive
Redlands, CA 92374
Tel: (909) 335-6116
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April 22, 2009

Mr. William Nascimento
LAN Engineering Corporation
20 Empire Drive
Lake Forest, California 92630

RE: ASBESTOS SURVEY REPORT
Three Bridge Structures
I-215 Gap Closure at Box Springs
Moreno Valley, Riverside County, California

Dear Mr. Nascimento:

Stantec Consulting Corporation (Stantec), has prepared the following Asbestos Survey Report for three bridge structures located along the Interstate 215-Freeway in the City of Moreno Valley, in Riverside County, California. This Asbestos Survey Report was performed in accordance with the scope of work and terms provided in Stantec's cost proposal dated March 11, 2009.

As part of the asbestos survey, bulk material samples were collected from representative homogeneous building materials on the bridge structures. All samples were analyzed using Polarized Light Microscopy (PLM) techniques in accordance with methodology approved by the EPA. According to the EPA, an ACM is defined as a material containing more than one percent asbestos.

SURVEY RESULTS

The following is a description of results, bridge by bridge. Identified materials that contain greater than one-percent asbestos are described by the US Environmental Protection Agency (USEPA), as Regulated Asbestos Containing Materials (RACM), Category 1, materials that may become friable if disturbed (such as demolition activities).

"A" Bridge No. 56-0082L

Of the representative materials sampled, no asbestos containing material were identified on Bridge "A". No leveling shims or guard posts, which often contain ACMs, were observed on the north railing of the bridge.

"B" Bridge No. 56-0082R

Of the representative materials sampled, no asbestos containing material were identified on Bridge "B". No leveling shims or guard posts, which often contain ACMs, were observed on the north railing of the bridge.

"C" Bridge No. 56-C0056451

Guardrail Post Shims – Stantec observed nineteen guardrail posts on the south side of this bridge. Of the nineteen guardrail posts on the south side of the bridge, four were observed, to have shims. Fibrous shims were used beneath selected guardrail posts for leveling purposes. The shims measure approximately 8-inches x 8-inches. Samples collected and tested from this bridge contain 90 percent asbestos. Three layers of the shims were observed at the base of the guardrails at approximately 1/8 inch thickness, representing an estimated total area of approximately 5 square feet of asbestos containing material. The material was observed to be in good condition, but due to its fibrous nature, is considered a friable ACM Material.

Bolt Mastic – Stantec observed a gray-colored mastic material between the shims and the guardrail post bolts. The bolt mastic contains grater than 1 percent asbestos. The gray mastic was observed to be in good condition and is therefore considered a non-friable ACM material.

ASBESTOS RECOMMENDATIONS

Any action that disturbs ACMs is subject to Federal, State, and local regulations. "Disturbance" means activities that disrupt the matrix of ACM or presumed ACM (PACM), or generate visible debris from ACM or PACM. Therefore, Stantec recommends that, prior to renovation or demolition activities, a licensed asbestos abatement firm be contracted to remove the identified RACM shim and bolt mastic materials. The identified RACMs will require removal in accordance with the USEPA NESHAP and the local South Coast Air Quality Management District (SCAQMD) Rule 1402. The asbestos abatement contractor should comply with Rule 1402 and provide at least a 10-day notification prior to asbestos removal.

Asbestos is not listed as a Resource Conservation and Recovery Act (RCRA) hazardous waste. However, asbestos is listed as a hazardous waste under the Toxic Substances Control Act. The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or "Superfund") also includes asbestos in its list. Some wastes are not considered "hazardous", but are regulated. In general, California regulations are more stringent than federal regulations regarding the handling of asbestos. Therefore, the asbestos abatement contractor should dispose of ACMs in accordance with all state and federal applicable laws.

If you have any questions or comments regarding the information enclosed herein, please contact the undersigned at your convenience.

Respectfully submitted,
Stantec Consulting Corporation

Tammy H. Lapp, REA 06825
CA Certified Asbestos Consultant ID#01-2969

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1.0 INTRODUCTION

On behalf of LAN Engineering Corporation (LAN), Stantec conducted an Asbestos Containing Materials (ACM) Survey for three bridge structures located along the (I-215) Freeway at Box Springs Road in the City of Moreno Valley, Riverside County, California. In preparation for future bridge widening and gap closure activities, LAN requested that the bridge structures be surveyed for ACMs. In conformance with Air Quality Management District (AQMD) Rule 1403, an asbestos survey is required prior to all structural renovation and demolition.

The assessment field work was performed on March 20, 2009, and consisted of a visual inspection and sampling of accessible representative external structural components to identify potential ACMs.

Bulk samples of suspect ACMs were collected using destructive techniques in selected representative locations. The visual inspection, bulk sampling, and survey documentation was performed by Ms. Tammy Lapp. Ms. Lapp is accredited by the California Division of Occupational Safety and Health (Cal-DOSH) as a Certified Asbestos Consultant, No. 91-2969. Qualifications are presented in Appendix A.

1.1 OBJECTIVES

The objectives of the assessment were to identify, estimate quantities of, and assess the condition/friability of asbestos within building components of the bridge structures. These objectives were met by completing the following tasks:

1.2 SCOPE OF WORK

This ACM Survey Report was performed in accordance with the scope of work (SOW) and terms provided in Stantec's cost proposal dated March 111, 2009. The SOW has been prepared for LAN Engineering Corporation in accordance with Caltrans, District 8 protocol for similar projects in the area. The SOW consisted of the following general elements:

- Perform a visual inspection for ACMs.
- Collect samples of suspect asbestos containing materials following criteria outlined in the Asbestos Hazard Emergency Response Act (AHERA) to identify sources of friable and non-friable ACMs.
- Submit samples to a certified laboratory for analysis.
- Report the methodology, findings and recommendations in an ACM Survey Report.

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2.0 SITE DESCRIPTION

At the time of Stantec's inspection, the bridge structures were functional and part of the I-215 Freeway system located in the City of Moreno Valley in Riverside County, California. Stantec understands that portions of the bridge structures will be demolished for proposed gap closures and bridge widening activities.

LAN provided Stantec with bridge identification numbers and locations. The three bridge structures are parallel to each other and are located along the I-215 freeway between the Day Street exit to the east and the Box Springs Road exit to the west. The following is a brief description of each bridge.

Bridge A (No. 56-0092L): Of the three structures, Bridge A is the southern most bridge (Figure 2). At the request of LAN, Stantec limited inspections to the north side of Bridge A as indicated on Figure 2. Bridge A is constructed of steel reinforced concrete with an asphalt and concrete-bridge deck. Each side of the bridge is protected with a low concrete wall. No guardrail posts were observed along the northern side of the bridge. Suspect asbestos-containing leveling shims are generally used to raise guardrail posts where necessary to create a clean, level guardrail line. However, since no tubular guard rails or posts were present, no leveling shims were observed on Bridge A.

Bridge B (No. 56-0082R): Bridge B is the middle bridge indicated on Figure 2. Bridge B was reportedly constructed in 1932. Bridge B is constructed of steel reinforced concrete with an asphalt and concrete-bridge deck. Except for the northern-most end, each side of the bridge is protected with a low concrete wall. The wall and guardrails have been removed from the northern end, and protective K-rail concrete barriers are in place. No guardrail posts or shims were observed along the bridge walls.

Bridge C (No. 56c0056): Of the three structures, Bridge C is the northern-most bridge. Bridge C is constructed of steel reinforced concrete with asphalt and concrete-bridge deck. Guardrail posts were observed along the south side of the bridge wall. Suspect asbestos-containing leveling shims are generally used to raise guardrail posts where necessary to create a clean, level guardrail line. Leveling shims were observed along the southern side of this bridge.

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3.0 ASBESTOS METHODOLOGY

3.1 VISUAL INSPECTION

Construction materials were visually inspected for asbestos using the methods presented in the Federal AHERA regulations (40 CFR, Part 763) as a guideline. The principles presented under the EPA Asbestos-Containing Materials in Schools, Final Rule and Notice is generally accepted as the industry standard for ACM inspections. Potential ACMs were also physically assessed for friability, condition, and disturbance factors.

Stantec makes no warranty as to the possible existence of ACMs in hidden materials. It is a widely accepted practice, and Stantec's recommendation, to collect additional bulk samples during actual abatement or demolition activities when hidden suspect ACMs are discovered.

3.2 BULK SAMPLING FOR ASBESTOS

Bulk samples of all homogeneous materials containing suspect ACMs were collected by Stantec personnel. A homogeneous material is defined as a surfacing material, thermal system insulation, or miscellaneous material that is uniform in use, color, and texture. Examples of homogeneous materials include piping, guardrail shims, asphalt, or concrete.

Bulk samples were collected for laboratory analysis of asbestos in representative material. The sample result identifies the percentage of each type of asbestos detected.

AHERA sample criteria guidelines are followed to determine the number of samples collected of each homogeneous area as identified in the following table.

AHERA Sample Criteria

Type of Material (homogeneous area)	AHERA Recommended Number of Samples per Homogeneous Material
Surfacing (sprayed or troweled) Less than 1000 ft^2 1000 – 5000 ft^2 Greater than 5000 ft^2	 Three Five Seven
Thermal System Insulation such as pipe insulation and wrap	Three
Miscellaneous Materials such as (but not limited to) shims, mastic, concrete	Number of samples is the discretion of the Building Inspector. Typically 2 to 3 samples collected.

A sample approximately one-half square inch in size was collected of each suspect ACM. The sample was collected by removing the material using a chisel or other sharp instrument. Stantec did not replace or repair these materials. However, the removal of small pieces of building materials does not typically compromise structural integrity. A plastic bag was used to contain the sample of suspect material and quickly sealed to prevent the escape of the material or the introduction of contamination from outside sources. A unique sample number was assigned to each sample.

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3.3 ASBESTOS LABORATORY TESTING

Environmental Management Consultant (EMC) Analytical Laboratories of Phoenix, Arizona, analyzed select samples. EMC is accredited under the National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program (NVLAP), and the State of Arizona and California Department of Health Services Environmental Laboratory Accreditation Program (ELAP) for the analysis of asbestos in bulk building material samples.

All samples were analyzed using Polarized Light Microscopy (PLM) techniques in accordance with methodology approved by the EPA. According to the EPA, ACM is defined as material containing more than one percent asbestos. The lower limit of reliable detection for asbestos using the PLM method is approximately one percent by volume; however, Cal-OSHA defines ACMs as those materials having an asbestos content greater than one-tenth of one percent (>0.1%).

When "None Detected" (ND) appears in this report, it should be interpreted as meaning no asbestos was observed in the sample material above the reliable limit of detection for the PLM method which is material dependent and is something less than one percent.

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4.0 ASBESTOS DISCUSSION

4.1 BACKGROUND

Asbestos is a common term for a group of naturally occurring mineral fibers. Due to its durability and insulating quality, it was used in a wide variety of building products including structural fireproofing, pipe and duct insulation, plasters, roofing, floor tile, and vinyl floor sheeting. Adverse health effects have been associated with the inhalation of airborne asbestos fibers by asbestos industry workers. The asbestos fibers that are tightly bound in building materials do not represent an exposure hazard unless disturbed in such a way that releases airborne fibers (i.e., cutting, drilling, or sanding). By June of 1978, the U.S. EPA had effectively banned the use of asbestos in spray application products such as structural fireproofing and acoustic ceilings, pipe-lagging, joint compounds, and spackles. Asbestos is still used in the manufacture of non-friable products such as vinyl floor tile and roofing materials.

4.2 CURRENT REGULATIONS

The following is a summary of current state and federal regulations which contain requirements related to the performance of building surveys for asbestos. These summaries are not intended to be all inclusive and do not contain every aspect of the regulations discussed. Regulations pertaining to the removal and disposal of ACMs are not included.

4.2.1 EPA NESHAP

Under the National Emission Standard for Hazardous Air Pollutants (NESHAP), 40 CFR Part 61, regulation, no visible emissions are allowed during structure demolition or renovation activities which involve regulated asbestos-containing materials (RACMs). For this reason, all buildings must be surveyed for ACMs prior to demolition or renovation. The EPA and/or the local air quality management district which implements EPA actions must be notified prior to any building demolition even if no ACMs are present. RACM is defined as any material with an asbestos content of greater than one percent and is friable, or Category I non-friable ACM that has or will become friable, or Category II friable ACM that may become or will become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation.

According to NESHAP, ACM is material containing more than one percent asbestos as determined using the methods specified in Appendix A, Subpart E, 40 CFR Part 763, Section 1, PLM. The NESHAP classifies ACM as friable or non-friable. Friable ACM is ACM that contains more than one percent asbestos and when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

Non-friable ACM also containing more than one percent asbestos is further classified as either Category I ACM or Category II ACM. The materials are distinguished by their potential to release fibers when damaged. Category II ACMs are much more likely to release fibers when damaged. Category I ACM includes asbestos-containing gaskets, packings, resilient floor coverings and mastics, and asphalt roofing products. Asphalt roofing products are those products which contain asbestos and include built-up roofing, asphalt-containing single ply membrane systems, asphalt shingles, asphalt-containing underlayment felts, asphalt-containing

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roof coatings and mastics, and asphalt-containing base flashings. Category II ACM includes all other non-friable ACM; for example: asbestos cement shingles, asbestos cement tiles, and transite boards or panels.

4.2.2 South Coast Air Quality Management District

The South Coast Air Quality Management District (SCAQMD) is a government agency that regulates sources of air pollution within San Bernardino County to protect public health. The District's regulating and enforcement authority comes from state law and, in certain cases, federal law. In response to the NESHAP requirements, SCAQMD implemented Rule 1403 that pertains to demolition/renovation activities including the removal and associated disturbance of ACMs. These requirements for demolition and renovation activities include notification, ACM removal procedures, time schedules, ACM handling and cleanup procedures, storage, disposal, and landfill requirements for asbestos-containing waste materials. Rule 1403 is applicable to owners and operators of any demolition or renovation activity and associated disturbance of ACMs. Failure to comply with Rule 1403 requirements could result in violations that carry daily penalties (penalties assessment is based upon the size of the project and severity of noncompliance).

4.2.3 Asbestos Hazard Emergency Response Act (AHERA)

AHERA requires performance of asbestos surveys and the development of Asbestos Management Plans for all of the nation's primary and secondary schools. The general procedures mandated under AHERA are considered the industry standard and are applied to all surveys performed by Stantec.

4.2.4 California Occupational Safety and Health Administration (Cal-OSHA)

Per Cal-OSHA standards 1926.1101, ACMs are defined as any materials with an asbestos content greater than one-tenth of one percent (>0.1%) and are further classified as Class I, Class II Class III or Class IV ACM. The materials are distinguished by their potential to release fibers when damaged. OSHA prescribes specific engineering controls and work practices for each Class of ACM.

Class I: This Class refers to ACMs identified as Thermal System Insulation (TSI) or surfacing (sprayed-on or troweled-on) materials. These materials are generally considered friable.

Class II: This Class refers to ACMs identified that are not Thermal System Insulation (TSI) or surfacing materials. These materials are generally considered non-friable.

Class III: This Class refers to repair and maintenance operations of all identified ACMs.

Class IV: This Class refers to incidental contact with identified ACMs such as custodial staff.

4.2.5 California Health and Safety Code

The California Health and Safety Code 25915 (former Connelly Bill) requires all building owners in the State of California to provide written notification to employees, tenants, and contractors of the presence and location of asbestos-containing construction materials (ACCMs) within their buildings. Some exclusions to the notification rule for restricted access areas are allowed. All

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documentation related to asbestos surveys (and air monitoring) must be made available to employees, tenants, or contractors for review. ACCMs are defined as any materials with an asbestos content greater than one-tenth of one percent (>0.1%).

The California Health and Safety Code also require that a seller with any knowledge of ACMs on a property disclose such information or knowledge to other parties involved in a real estate transaction.

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5.0 ASSESSMENT RESULTS

5.1 ASBESTOS SURVEY

Stantec conducted an inspection of the accessible portions of the bridge structures to determine whether suspect asbestos-containing materials (ACMs) were present. As part of the asbestos survey, representative bulk material samples were collected of suspect ACM containing materials on March 20, 2009.

Stantec submitted collected samples to EMC Analytical Laboratories. EMC is accredited under the National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program (NVLAP), and the States of Arizona and California Department of Health Services Environmental Laboratory Accreditation Program (ELAP) for the analysis of asbestos in bulk building material samples.

All samples were analyzed using Polarized Light Microscopy (PLM) techniques in accordance with methodology approved by the EPA. According to the EPA, ACM is defined as material containing more than one percent asbestos. According to Cal-OSHA, ACBM is identified as 0.1 percent asbestos. The lower limit of reliable detection for asbestos using the PLM method is approximately 1 percent by volume. However, the PLM technique can identify Cal-OSHA ACBMs. Although PLM methodology cannot quantify the exact percentage of asbestos detected less than 1 percent, if a sample had any quantity of asbestos, the laboratory, using PLM techniques, would identify these materials as containing “Trace” amounts of asbestos (< 1 percent). Only materials containing no fibers at all are identified as “None Detected”.

5.2 NON-ACMS MATERIALS

The following materials were sampled and no asbestos was detected (this is not meant as a complete listing of building materials observed within the structures):

- Concrete Bridge Components
- Concrete Embankment
- Concrete Support Pillars
- Concrete Road Base
- Asphalt Road Base
- Expansion Joint Felt
- Metal Washers
- Foam Joint Filler
- Steel Guardrails (not a suspect material)

5.3 ASBESTOS SAMPLING RESULTS

As part of the asbestos survey, bulk material samples were collected from representative homogeneous building materials on the structures. According to the EPA, ACM is defined as material containing more than one percent asbestos.

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5.4 SAMPLING RESULTS AND IDENTIFIED ACMS

As part of the asbestos survey, bulk material samples were collected from representative homogeneous building materials on the structures. All samples were analyzed using Polarized Light Microscopy (PLM) techniques in accordance with methodology approved by the EPA. According to the EPA, ACM is defined as material containing more than one percent asbestos. The sample locations and laboratory results are provided in the table section (Table 1). The sample locations are shown on the attached Figures.

The following is a description of results, bridge by bridge. Identified materials that contain greater than one-percent asbestos are described by the US Environmental Protection Agency (USEPA), as Regulated Asbestos Containing Materials (RACM), Category 1, materials that may become friable if disturbed (such as demolition activities).

"A" Bridge No. 56-0082L

Of the representative materials sampled, no asbestos containing material were identified on Bridge "A". No leveling shims or guard posts were observed on the north railing of the bridge.

"B" Bridge No. 56-0082R

Of the representative materials sampled, no asbestos containing material were identified on Bridge "B". No leveling shims or guard posts were observed on the bridge railing.

"C" Bridge No. 56-C0056451

The following ACMs were identified on Bridge C.

Guardrail Post Shims – Stantec observed nineteen guardrail posts on the south side of this bridge. Of the nineteen guardrail posts on the south side of the bridge, four were observed with shims. Fibrous shims were used beneath selected guardrail posts for leveling purposes. The shims measure approximately "8-inches x 8-inches". The shim material collected and tested from the bridge contains 90 percent asbestos. Three layers of the shims, approximately 1/8 inch thickness, were observed at the base of the guardrails representing an estimated total area of approximately 5 square feet of asbestos containing material. The material was observed to be in good condition, but due to its fibrous nature, is considered a friable ACM Material.

Bolt Mastic – Stantec observed a gray-colored mastic material between the shims and the guardrail post bolts. The bolt material contains grater than 1 percent asbestos. The gray mastic was observed to be in good condition and is therefore considered a non-friable ACM material.

5.5 ASBESTOS RECOMMENDATIONS

Stantec recommends that, prior to demolition activities, a licensed asbestos abatement firm be contracted to remove identified RACMs. The RACMs identified were generally in good condition. The identified RACMs will require removal prior to demolition activities in accordance with the USEPA NESHAP and the local South Coast Air Quality Management District (SCAQMD). This work should be completed following the SCAQMD guidelines.

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Typical engineering controls for Class I ACM work/demolition include:

- Vacuum cleaners equipped with HEPA filters to collect all debris and dust containing ACM and PACM.
- Wet methods, or wetting agents, to control worker exposures during asbestos handling, mixing, removal, cutting, application, and cleanup, except where contractors demonstrate that the use of wet methods is infeasible due to for example, the creation of electrical hazards, or equipment malfunction.
- Prompt clean up and disposal of wastes and debris contaminated with asbestos in leak-tight containers.
- Work supervised by a certified competent person.
- Use of one of the following methods to ensure that airborne asbestos does not migrate during abatement activities:

    - Critical Barriers shall be placed over all opening to regulate area; or
    - The contractor shall use another barrier or isolation method which prevents the migration of airborne asbestos from the regulated area, as verified by perimeter area monitoring or clearance monitoring.
    - Impermeable drop cloths shall be placed on surfaces beneath all removal activity.

Asbestos work shall also be performed by complying with the work practices and controls designated for each type of asbestos work to be performed as set out in the asbestos standard. Where more than one control method may be used for a type of asbestos work, the contractor may choose one or a combination of designated control methods.

The sample locations and laboratory results are provided in Table 1. The sample locations are shown on the attached Figure 2.Any action that disturbs ACMs is subject to Federal, State, and local regulations. “Disturbance” means activities that disrupt the matrix of ACM or presumed ACM (PACM), or generate visible debris from ACM or PACM. Therefore, Stantec recommends that, prior to renovation or demolition activities, a licensed asbestos abatement firm be contracted to remove the identified RACM shim and bolt mastic materials. The identified RACMs will require removal in accordance with the USEPA NESHAP and the local South Coast Air Quality Management District (SCAQMD) Rule 1402. The asbestos abatement contractor should comply with Rule 1402 and provide at least a 10-day notification prior to asbestos removal.

Asbestos is not listed as a Resource Conservation and Recovery Act (RCRA) hazardous waste. However, asbestos is listed as a hazardous waste under the Toxic Substances Control Act. The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or “Superfund”) also includes asbestos in its list. Some wastes are not considered “hazardous”, but are regulated. In general, California regulations are more stringent than federal regulations regarding the handling of asbestos. Therefore, the asbestos abatement contractor should dispose of ACMs in accordance with all state and federal applicable laws.

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6.0 CLOSURE

The conclusions and recommendations contained in this report/assessment are based upon professional opinions with regard to the subject matter. These opinions have been arrived at in accordance with currently accepted engineering standards and practices applicable to this location and are subject to the following inherent limitations:

The data and findings presented in this report are valid as of the dates when the investigations were performed. The passage of time, manifestation of latent conditions or occurrence of future events may require further exploration at the site, analysis of the data, and reevaluation of the findings, observations, and conclusions expressed in the report.

The data reported and the findings, observations, and conclusions expressed in the report are limited by the Scope of Work outlined in Stantec's Work Plan cost proposal dated March 11, 2009.

Unless otherwise stated in the report, because of the limitations stated above, the findings observations, and conclusions expressed by Stantec in this report are not, and should not be, considered an opinion concerning the compliance of any past or present owner or operator of the site with any federal, state or local law or regulation.

No warranty or guarantee, whether express or implied, is made with respect to the data or the reported findings, observations, and conclusions, all of which, however, accurately reflect site conditions in existence at the time of investigation.

Stantec Reports present professional opinions and findings of a scientific and technical nature. While attempts were made to relate the data and findings to applicable environmental laws and regulations, the report shall not be construed to offer legal opinion as to the requirements of, nor compliance with, environmental laws, rules, regulations or policies of federal, state or local governmental agencies. Any use constitutes acceptance of the limits of Stantec's liability. Stantec's liability extends only to those parties contracted to complete this project and not to any other parties who may obtain the Report. Issues raised by the report should be reviewed by appropriate legal counsel.

This report is based, in part, on unverified information supplied to Stantec by third-party sources. While efforts have been made to substantiate this third-party information, Stantec cannot guarantee its completeness or accuracy.

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FIGURES

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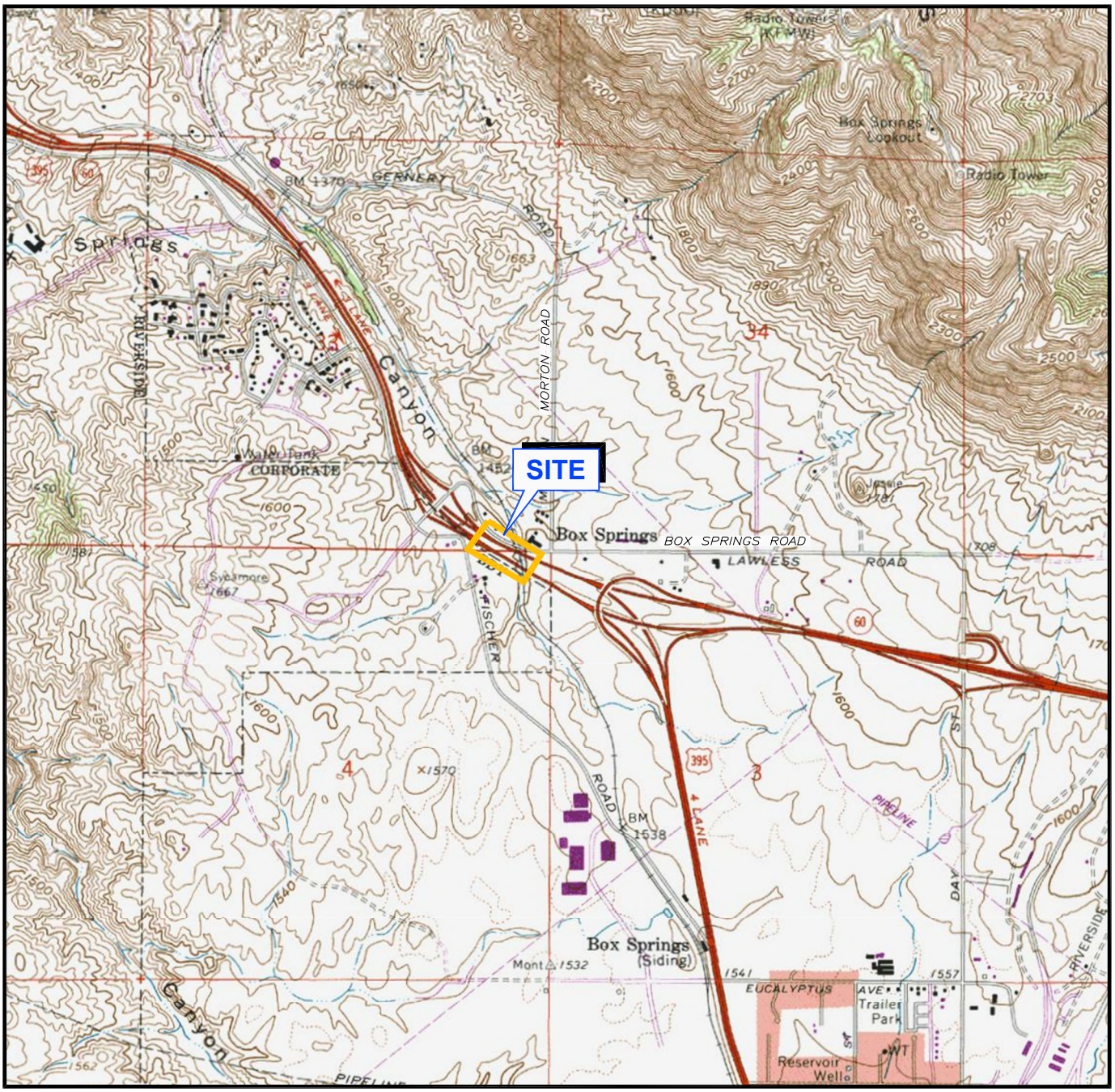


QUADRANGLE LOCATION

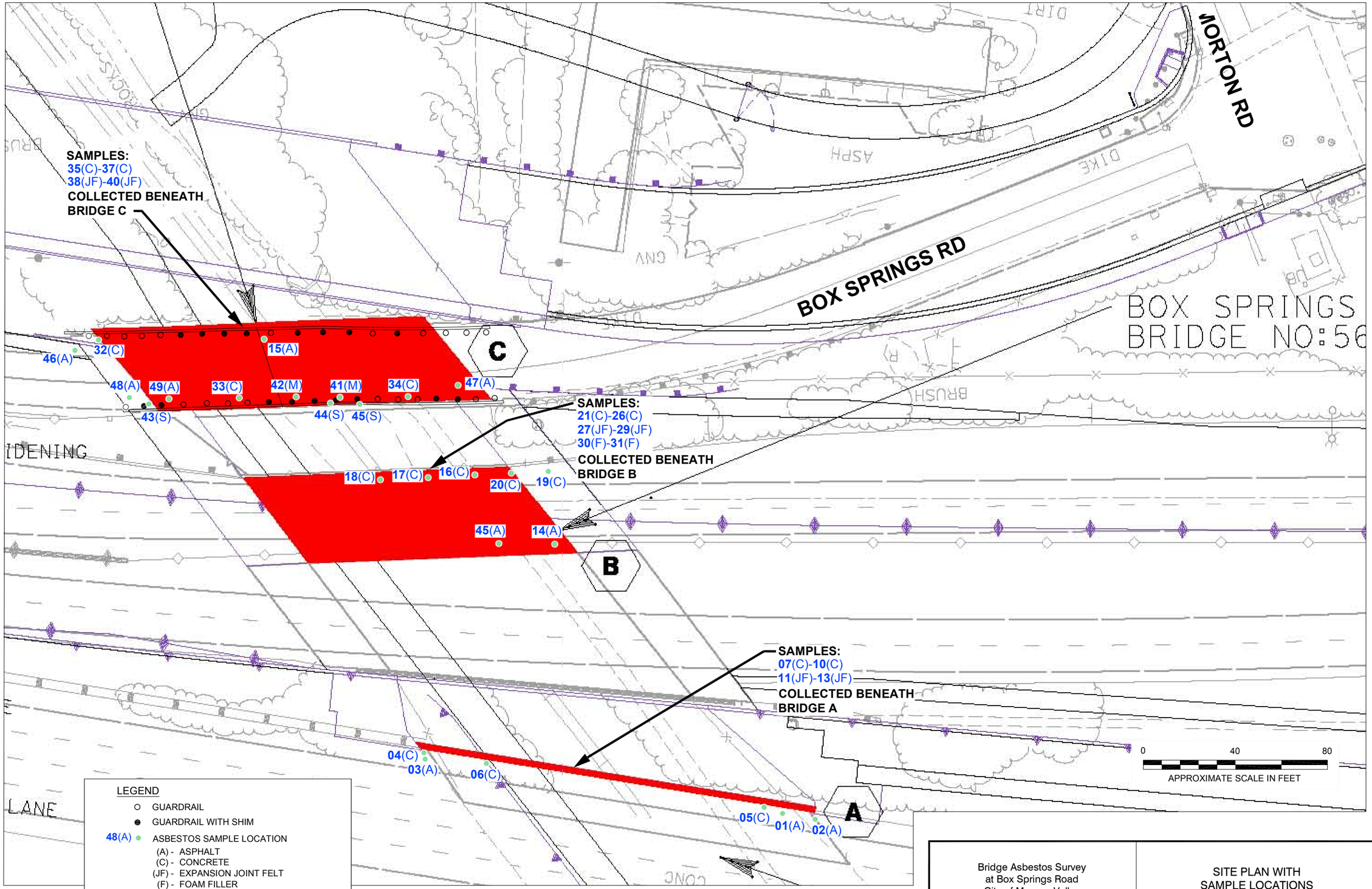
N

0 1000 2000

APPROXIMATE SCALE IN FEET

Reference: Terrain Navigator–U.S.G.S., 1967 Riverside East, California Quadrangle. 7.5–Minute Topographic Map. Photorevised 1980.

PREPARED FOR:				SHEET
Bridge Asbestos Survey at Box Springs Road City of Moreno Valley in Riverside County		SITE LOCATION MAP		1
JOB NUMBER: 185802016.200.0001	DRAWN BY: RO	CHECKED BY: AP	APPROVED BY:	DATE: 04/01/09



Bridge Asbestos Survey at Box Springs Road City of Moreno Valley in Riverside County		SITE PLAN WITH SAMPLE LOCATIONS		SHEET 2
JOB NUMBER: 185802016.200.0001	DRAWN BY: RO	CHECKED BY: AP	APPROVED BY:	DATE: 04/01/09

FILEPATH:M:\CADD-08\Projects 2009\Caltrans\LAN Eng - Box Springs Rd Bridges\Bridge Figures.dwg|rocampo|Apr 13, 2009 at 15:46|Layout: Sheet 2

APPENDIX A
PHOTOGRAPHIC LOG

DRAFT

PHOTOGRAPHIC LOG FOR:
Three Bridge Structures, Gap Closure Project, I-215 at Box Springs, Riverside County, CA

Photograph No. 1
Identification marker for bridges.

Photograph No. 2
View of all three bridges A, B and C from beneath (facing south).

PHOTOGRAPHIC LOG FOR:
Three Bridge Structures, Gap Closure Project, I-215 at Box Springs, Riverside County, CA

Photograph No. 3
View of north side of Bridge B (No. 56-0082L), facing west. Note that there are no guard rail posts.

Photograph No. 4
View of Bridge B (No. 56-0082R), facing east. Note that guardrail has been removed.

PHOTOGRAPHIC LOG FOR:
Three Bridge Structures, Gap Closure Project, I-215 at Box Springs, Riverside County, CA

Photograph No. 5
View of gap segmenting B Bridge. Photo taken from beneath the bridge.

Photograph No. 6
View of Bridge C (Box Springs Bridge), facing east. Note that guard rail posts have been removed from the north side of the bridge.

PHOTOGRAPHIC LOG FOR:
Three Bridge Structures, Gap Closure Project, I-215 at Box Springs, Riverside County, CA

Photograph No. 7
View of Bridge C guard rail post shims and bolt mastic.

Photograph No. 8
View of underside of Bridge C. Note suspect utility line attached to bridge deck.

APPENDIX B
ANALYTICAL LABORATORY REPORTS AND CHAIN-OF-CUSTODY RECORDS

DRAFT

EMC LABS, INC.

9830 S. 51st Street, Suite B109, Phoenix, AZ 85044
Phone: 800-362-3373 or 480-940-5294 - Fax: (480) 893-1726

Laboratory Report
0073356

Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	STANTEC	Job# / P.O. #:	
Address:	25864-F BUSINESS CENTER DRIVE REDLANDS CA 92374	Date Received:	03/25/2009
		Date Analyzed:	03/30/2009
Collected:	03/20/2009	Date Reported:	03/30/2009
Project Name/	LAN ENGINGEERING	EPA Method:	EPA 600/M4-82-020
Address:	I-215 GAP, RIVERSIDE	Submitted By:	TAMMY LAPP
		Collected By:	Customer

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0073356-001 01A	A-BRIDGE - NE END	Asphalt, Black	No		Cellulose Fiber	<1%
					Gypsum Quartz Mica Binder/Filler	99%
0073356-002 02A	A-BRIDGE - NW END	Asphalt, Black	No		Cellulose Fiber	<1%
					Gypsum Quartz Mica Binder/Filler	99%
0073356-003 03A	A-BRIDGE - NW END	Asphalt, Black	No			
					Gypsum Quartz Mica Binder/Filler	100%
0073356-004 04C	A-BRIDGE - N. END E. SIDE	Bridge Concrete, Gray	No		Cellulose Fiber	<1%
					Gypsum Carbonates Mica Quartz Binder/Filler	99%
0073356-005 05C	A-BRIDGE - N. END E. SIDE	Bridge Concrete, Gray	No		Cellulose Fiber	<1%
					Gypsum Carbonates Mica Quartz Binder/Filler	99%

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Laboratory Report
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Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	STANTEC	Job# / P.O. #:	
Address:	25864-F BUSINESS CENTER DRIVE REDLANDS CA 92374	Date Received:	03/25/2009
		Date Analyzed:	03/30/2009
Collected:	03/20/2009	Date Reported:	03/30/2009
Project Name/	LAN ENGINGEERING	EPA Method:	EPA 600/M4-82-020
Address:	I-215 GAP, RIVERSIDE	Submitted By:	TAMMY LAPP
		Collected By:	Customer

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0073356-006 06C	A-BRIDGE - S. END W. SIDE	Bridge Concrete, Gray	No			
					Gypsum Carbonates Mica Quartz Binder/Filler	100%
0073356-007 07C	A-BRIDGE - PILLAR BENEATH E. SIDE	Bridge Concrete, Gray	No			
					Carbonates Quartz Mica Binder/Filler	100%
0073356-008 08C	A-BRIDGE - PILLAR BENEATH W. SIDE	Bridge Concrete, Gray	No			
					Gypsum Quartz Mica Binder/Filler	100%
0073356-009 09C	A-BRIDGE - PILLAR BENEATH E. SIDE S. END	Bridge Concrete, Gray	No			
					Gypsum Carbonates Mica Quartz Binder/Filler	100%

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Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	STANTEC	Job# / P.O. #:	
Address:	25864-F BUSINESS CENTER DRIVE REDLANDS CA 92374	Date Received:	03/25/2009
		Date Analyzed:	03/30/2009
Collected:	03/20/2009	Date Reported:	03/30/2009
Project Name/	LAN ENGINGEERING	EPA Method:	EPA 600/M4-82-020
Address:	I-215 GAP, RIVERSIDE	Submitted By:	TAMMY LAPP
		Collected By:	Customer

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0073356-010 10C	A-BRIDGE - EMBANKMENT-W. SIDE	Bridge Concrete, Gray	No		Synthetic Fiber	<1%
					Carbonates Gypsum Mica Quartz Binder/Filler	99%
0073356-011 11JF	A-BRIDGE - E. END	Expansion Joint Felt, Black	No		Cellulose Fiber	80%
					Gypsum Quartz Binder/Filler	20%
0073356-012 12JF	A-BRIDGE - W. END	Expansion Joint Felt, Black	No		Cellulose Fiber	80%
					Gypsum Quartz Binder/Filler	20%
0073356-013 13JF	A-BRIDGE - W. END	Expansion Joint Felt, Black	No		Cellulose Fiber	80%
					Gypsum Binder/Filler	20%
0073356-014 14A	B-BRIDGE - NE SIDE	Asphalt, Black	No		Cellulose Fiber	<1%
					Gypsum Quartz Mica Binder/Filler	99%
0073356-015 15A	B-BRIDGE - N. CENTER	Asphalt, Black	No		Cellulose Fiber	<1%
					Gypsum Quartz Mica Binder/Filler	99%

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Laboratory Report
0073356

Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	STANTEC	Job# / P.O. #:	
Address:	25864-F BUSINESS CENTER DRIVE REDLANDS CA 92374	Date Received:	03/25/2009
		Date Analyzed:	03/30/2009
Collected:	03/20/2009	Date Reported:	03/30/2009
Project Name/	LAN ENGINGEERING	EPA Method:	EPA 600/M4-82-020
Address:	I-215 GAP, RIVERSIDE	Submitted By:	TAMMY LAPP
		Collected By:	Customer

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0073356-016 16C	B-BRIDGE - N. END E. SIDE	Concrete, Gray	No		Synthetic Fiber	<1%
					Gypsum Carbonates Mica Quartz Binder/Filler	99%
0073356-017 17C	B-BRIDGE - N. END E. SIDE	Concrete, Gray	No			
					Carbonates Quartz Mica Binder/Filler	100%
0073356-018 18C	B-BRIDGE - N. END W. SIDE	Concrete, Gray	No			
					Gypsum Carbonates Mica Quartz Binder/Filler	100%
0073356-019 19C	B-BRIDGE - S. END E. SIDE	Concrete, Gray	No			
					Carbonates Quartz Mica Binder/Filler	100%
0073356-020 20C	B-BRIDGE - S. END E. SIDE	Concrete, Gray	No			
					Gypsum Carbonates Mica Quartz Binder/Filler	100%

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Laboratory Report
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Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	STANTEC	Job# / P.O. #:	
Address:	25864-F BUSINESS CENTER DRIVE REDLANDS CA 92374	Date Received:	03/25/2009
		Date Analyzed:	03/30/2009
Collected:	03/20/2009	Date Reported:	03/30/2009
Project Name/	LAN ENGINGEERING	EPA Method:	EPA 600/M4-82-020
Address:	I-215 GAP, RIVERSIDE	Submitted By:	TAMMY LAPP
		Collected By:	Customer

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0073356-021 21C	B-BRIDGE - PILLAR BENEATH E. SIDE	Concrete, Gray	No		Cellulose Fiber	<1%
					Carbonates Gypsum Mica Quartz Binder/Filler	99%
0073356-022 22C	B-BRIDGE - PILLAR BENEATH E. SIDE	Concrete, Gray	No			
					Carbonates Gypsum Mica Quartz Binder/Filler	100%
0073356-023 23C	B-BRIDGE - PILLAR BENEATH W. SIDE	Concrete, Gray	No			
					Carbonates Gypsum Mica Quartz Binder/Filler	100%
0073356-024 24C	B-BRIDGE - PILLAR BENEATH W. SIDE	Concrete, Gray	No			
					Carbonates Gypsum Mica Quartz Binder/Filler	100%

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Laboratory Report
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Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	STANTEC	Job# / P.O. #:	
Address:	25864-F BUSINESS CENTER DRIVE REDLANDS CA 92374	Date Received:	03/25/2009
		Date Analyzed:	03/30/2009
Collected:	03/20/2009	Date Reported:	03/30/2009
Project Name/	LAN ENGINGEERING	EPA Method:	EPA 600/M4-82-020
Address:	I-215 GAP, RIVERSIDE	Submitted By:	TAMMY LAPP
		Collected By:	Customer

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0073356-025 25C	B-BRIDGE - EMBANKMENT-W. SIDE	Concrete, Gray	No		Cellulose Fiber	<1%
					Carbonates Quartz Mica Binder/Filler	99%
0073356-026 26C	B-BRIDGE - EMBANKMENT-W. SIDE	Concrete, Gray	No			
					Carbonates Gypsum Mica Quartz Binder/Filler	100%
0073356-027 27JF	B-BRIDGE - E. END	Expansion Joint Felt, Black	No		Cellulose Fiber	80%
					Gypsum Quartz Binder/Filler	20%
0073356-028 28JF	B-BRIDGE - W. END	Expansion Joint Felt, Black	No		Cellulose Fiber	80%
					Gypsum Quartz Binder/Filler	20%
0073356-029 29JF	B-BRIDGE - W. END	Expansion Joint Felt, Black	No		Cellulose Fiber	80%
					Gypsum Binder/Filler	20%

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Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	STANTEC	Job# / P.O. #:	
Address:	25864-F BUSINESS CENTER DRIVE REDLANDS CA 92374	Date Received:	03/25/2009
		Date Analyzed:	03/30/2009
Collected:	03/20/2009	Date Reported:	03/30/2009
Project Name/	LAN ENGINGEERING	EPA Method:	EPA 600/M4-82-020
Address:	I-215 GAP, RIVERSIDE	Submitted By:	TAMMY LAPP
		Collected By:	Customer

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0073356-030 30F	B-BRIDGE - E. END	LAYER 1 Foam Filler, White	No		Cellulose Fiber	<1%
					Foam Quartz Binder/Filler	99%
		LAYER 2 Duct Tape, Gray	No		Synthetic Fiber	20%
					Carbonates Binder/Filler	80%
0073356-031 31F	B-BRIDGE - E. END	LAYER 1 Foam Filler, White	No		Cellulose Fiber	<1%
					Foam Quartz Binder/Filler	99%
		LAYER 2 Duct Tape, Gray	No		Synthetic Fiber	20%
					Carbonates Binder/Filler	80%
		LAYER 3 Concrete, Gray	No		Cellulose Fiber	<1%
					Gypsum Mica Quartz Binder/Filler	99%
		LAYER 4 Fiber Board, Brown	No		Cellulose Fiber	95%
					Carbonates Binder/Filler	5%
0073356-032 32C	C-BRIDGE - N. SIDE W. END	Concrete, Gray	No			
					Carbonates Quartz Mica Binder/Filler	100%
0073356-033 33C	C-BRIDGE - S. SIDE W. END	Concrete, Gray	No		Cellulose Fiber	<1%
					Carbonates Quartz Mica Binder/Filler	99%

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Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	STANTEC	Job# / P.O. #:	
Address:	25864-F BUSINESS CENTER DRIVE REDLANDS CA 92374	Date Received:	03/25/2009
		Date Analyzed:	03/30/2009
Collected:	03/20/2009	Date Reported:	03/30/2009
Project Name/	LAN ENGINGEERING	EPA Method:	EPA 600/M4-82-020
Address:	I-215 GAP, RIVERSIDE	Submitted By:	TAMMY LAPP
		Collected By:	Customer

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0073356-034 34C	C-BRIDGE - S. SIDE E. END	Concrete, Gray	No		Cellulose Fiber	<1%
					Carbonates Gypsum Mica Quartz Binder/Filler	99%
0073356-035 35C	C-BRIDGE - PILLAR BENEATH W.	Concrete, Gray	No			
					Carbonates Gypsum Mica Quartz Binder/Filler	100%
0073356-036 36C	C-BRIDGE - PILLAR BENEATH W.	Concrete, Gray	No			
					Gypsum Carbonates Mica Quartz Binder/Filler	100%
0073356-037 37C	C-BRIDGE - EMBANKMENT W.	Concrete, Gray	No		Cellulose Fiber	<1%
					Carbonates Quartz Mica Binder/Filler	99%
0073356-038 38JF	C-BRIDGE - W. END	Expansion Joint Felt, Black	No		Cellulose Fiber	80%
					Gypsum Binder/Filler	20%

EMC LABS, INC.

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Laboratory Report
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Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	STANTEC	Job# / P.O. #:	
Address:	25864-F BUSINESS CENTER DRIVE REDLANDS CA 92374	Date Received:	03/25/2009
		Date Analyzed:	03/30/2009
Collected:	03/20/2009	Date Reported:	03/30/2009
Project Name/	LAN ENGINGEERING	EPA Method:	EPA 600/M4-82-020
Address:	I-215 GAP, RIVERSIDE	Submitted By:	TAMMY LAPP
		Collected By:	Customer

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)		Non-Asbestos Constituents	
0073356-039 39JF	C-BRIDGE - W. END	Expansion Joint Felt, Black	No			Cellulose Fiber	80%
						Gypsum Binder/Filler	20%
0073356-040 40JF	C-BRIDGE - W. END	Expansion Joint Felt, Black	No			Cellulose Fiber	80%
						Gypsum Binder/Filler	20%
0073356-041 41M	C-BRIDGE - S. END CENTER	Bolt Mastic, Gray	Yes	Chrysotile	5%		
						Carbonates Quartz Binder/Filler	95%
0073356-042 42M	C-BRIDGE - S. END E. SIDE	Bolt Mastic, Gray	Yes	Chrysotile	10%		
						Carbonates Quartz Binder/Filler	90%
0073356-043 43S	C-BRIDGE - #2 S. SIDE	Shim, Black	Yes	Chrysotile	90%		
						Binder/Filler	10%
0073356-044 44S	C-BRIDGE - #8 S. SIDE	Shim, Black	Yes	Chrysotile	90%		
						Carbonates Binder/Filler	10%
0073356-045 45S	C-BRIDGE - #16 S. SIDE	Shim, Black	Yes	Chrysotile	90%		
						Binder/Filler	10%

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Laboratory Report
0073356

Bulk Asbestos Analysis by Polarized Light Microscopy

NVLAP#101926-0

Client:	STANTEC	Job# / P.O. #:	
Address:	25864-F BUSINESS CENTER DRIVE	Date Received:	03/25/2009
	REDLANDS CA 92374	Date Analyzed:	03/30/2009
Collected:	03/20/2009	Date Reported:	03/30/2009
Project Name/	LAN ENGINGEERING	EPA Method:	EPA 600/M4-82-020
Address:	I-215 GAP, RIVERSIDE	Submitted By:	TAMMY LAPP
		Collected By:	Customer

Lab ID Client ID	Sample Location	Layer Name / Sample Description	Asbestos Detected	Asbestos Type (%)	Non-Asbestos Constituents	
0073356-046 46A	C-BRIDGE - N. SIDE W. END	Asphalt, Black	No		Cellulose Fiber	<1%
					Gypsum	
					Quartz	
					Mica	
					Binder/Filler	99%
0073356-047 47A	C-BRIDGE - S. SIDE E. END	Asphalt, Black	No			
					Gypsum	
					Quartz	
					Mica	
					Binder/Filler	100%
0073356-048 48A	C-BRIDGE - S. SIDE W. END	Asphalt, Black	No		Cellulose Fiber	<1%
					Gypsum	
					Quartz	
					Mica	
					Binder/Filler	99%
0073356-049 49A	C-BRIDGE - S. SIDE W. END	Asphalt, Black	No		Cellulose Fiber	<1%
					Gypsum	
					Quartz	
					Mica	
					Binder/Filler	99%

Analyst - Paul Hofer

Signatory - Lab Director - Kurt Kettler

Distinctly stratified, easily separable layers of samples are analyzed as subsamples of the whole and are reported separately for each discernable layer. All analyses are derived from calibrated visual estimate and measured in weight percent unless otherwise noted. The report applies to the standards or procedures identified and to the sample(s) tested. The test results are not necessarily indicated or representative of the qualities of the lot from which the sample was taken or of apparently identical or similar products, nor do they represent an ongoing quality assurance program unless so noted. These reports are for the exclusive use of the addressed client and that they will not be reproduced wholly or in part for advertising or other purposes over our signature or in connection with our name without special written permission. The report shall not be reproduced except in full, without written approval by our laboratory. The samples not destroyed in testing are retained a maximum of thirty days. The laboratory measurement of uncertainty for the test method is approximately <1% by weight. Accredited by the National Institute of Standards and Technology, Voluntary Laboratory Accreditation Program for selected test method for asbestos. The accreditation or any reports generated by this laboratory in no way constitutes or implies product certification, approval, or endorsement by the National Institute of Standards and Technology. The report must not be used by any entity to claim product endorsement by NVLAP or any agency of the U.S. Government. Polarized Light Microscopy may not be consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials.

CHAIN OF CUSTODY

EMC Laboratories
9830 S. 51ST St., Ste B-109
Phoenix, AZ 85044
(800) 362-3373 Fax (480) 893-1726

LAB#: ~~73668~~ 73670
TAT: 3days
Rec'd: APR 06 P.M.
EMC USE ONLY

COMPANY NAME: STANTEC
25864-F Business Center Drive
Redland, CA 92374
CONTACT: Tammy Lapp
Phone/Fax: (909) 335-6116/ (909) 335-6120
Email: tammy.lapp@stantec.com

BILL TO: (If Different Location)

FAXED EMAILED APR 09 2009

Now Accepting: VISA – MASTERCARD

Price Quoted: $_____ / Sample $____ / Layers

COMPLETE ITEMS 1-4: (Failure to complete any items may cause a delay in processing or analyzing your samples)

1. **TURNAROUND TIME:** [4hr rush] [8hr rush] [1-Day] [2-Day] X [3-Day] [5-Day] [6-10 Day]

****Prior confirmation of turnaround time is required
****Additional charges for rush analysis (please call marketing department for pricing details)
****Laboratory analysis may be subject to delay if credit terms are not met

2. **TYPE OF ANALYSIS:** X [Bulk-PLM] [Air-PCM] [Lead] [Point Count] [Fungi: AOC, W-C, Bulk, Swab, Tape]
3. **DISPOSAL INSTRUCTIONS:** X [Dispose of samples at EMC] / [Return samples to me at my expense]
(23) *(If you do not indicate preference, EMC will dispose of samples 60 days from analysis.)*

4. **Project Name:** CALTRANS - COLORADO RIVER Bridge 54-1000
P.O. Number: _____ **Project Number:** 185802023

EMC SAMPLE #	CLIENT SAMPLE #	DATE & TIME SAMPLED	LOCATION/MATERIAL TYPE	Samples Accepted Yes / No	AIR SAMPLE INFO / COMMENTS ON	OFF	FLOW RATE
1	01	4-1-09	CONCRETE - N. END - E SIDE	(Y) N			
2	02		N. END - E. SIDE (3/4)	Y N			
3	03		CENTER - E. SIDE	Y N			
4	04		S. END - E. SIDE	Y N			
5	05		S. END - E. SIDE (3/4)	Y N			
6	06		S. END - E. SIDE	Y N			
7	07		S. END - W. SIDE	Y N			
8	08		BENEATH - N. W.	Y N			
9	09		BENEATH - N. E.	Y N			
10	10		BENEATH - N. E.	Y N			
11	11		BENEATH - base - N W	Y N			
12	12		Beneath - base - S. E.	Y N			
13	13		Beneath - base - S. W.	Y N			
14	14		Beneath - Pillar - S.	Y N			
15	15		Beneath - Pillar - S.	(Y) N			

SPECIAL INSTRUCTIONS: _____

Sample Collector: (Print) Tammy LAPP (Signature) [signature]

Relinquished by: T LAPP Date/Time: 4-3-09 Received by: Diana Federico Date/Time: 4/6/09

Relinquished by: Diana Federico Date/Time: 4/6/09 Received by: [signature] Date/Time: APR 09 2009

Relinquished by: _____ Date/Time _____ Received by: _____ Date/Time: _____

* In the event of any dispute between the above parties for these services or otherwise, parties agree that jurisdiction and venue will be in Phoenix, Arizona and prevailing party will be entitled to attorney's fees and court costs.

CHAIN OF CUSTODY

EMC Laboratories
9830 S. 51ST St., Ste B-109
Phoenix, AZ 85044
(800) 362-3373 Fax (480) 893-1726

LAB#: 73670
TAT: ~~73670~~ 8 RC
Rec'd:
EMC USE ONLY

COMPANY NAME: STANTEC
25864-F Business Center Drive
Redland, CA 92374
CONTACT: Tammy Lapp
Phone/Fax: (909) 335-6116/ (909) 335-6120
Email: tammy.lapp@stantec.com

BILL TO: (If Different Location)

Now Accepting: VISA – MASTERCARD Price Quoted: $_____ / Sample $____ / Layers

COMPLETE ITEMS 1-4: (Failure to complete any items may cause a delay in processing or analyzing your samples)

1. **TURNAROUND TIME:** [4hr rush] [8hr rush] [1-Day] [2-Day] X [3-Day] [5-Day] [6-10 Day]
***Prior confirmation of turnaround time is required
***Additional charges for rush analysis (please call marketing department for pricing details)
***Laboratory analysis may be subject to delay if credit terms are not met
2. **TYPE OF ANALYSIS:** X [Bulk-PLM] [Air-PCM] [Lead] [Point Count] [Fungi: AOC, W-C, Bulk, Swab, Tape]
3. **DISPOSAL INSTRUCTIONS:** X [Dispose of samples at EMC] / [Return samples to me at my expense]
(If you do not indicate preference, EMC will dispose of samples 60 days from analysis.)

4. Project Name: CALTRANS - COLORADO RIVER BRIDGE 54-1000
P.O. Number: _____ Project Number: 185802023

EMC SAMPLE #	CLIENT SAMPLE #	DATE & TIME SAMPLED	LOCATION/MATERIAL TYPE	Samples Accepted Yes / No	AIR SAMPLE INFO / COMMENTS ON	OFF	FLOW RATE
16	16	4-1-09	Concrete - Piller beneath S.	Y N			
17	17		Expansion Joint Filler - NE beneath	Y N			
18	18		NE beneath	Y N			
19	19		NE beneath	Y N			
20	20		Asphalt SEnd - E side	Y N			
21	21		S. END - E. side	Y N			
22	22		Center - E side	Y N			
23	23		N. END - E. side	Y N			
				Y N			
				Y N			
				Y N			
				Y N			
				Y N			
				Y N			
				Y N			

SPECIAL INSTRUCTIONS: _____

Sample Collector: (Print) Tammy Lapp (Signature) [signature]

Relinquished by: T Lapp Date/Time: 4-3-09 Received by: Diana Federico Date/Time: 4/6/09

Relinquished by: Diana Federico Date/Time: 4/6/09 Received by: [signature] Date/Time: APR 09 2009

Relinquished by: _____ Date/Time _____ Received by: _____ Date/Time: _____

In the event of any dispute between the above parties for these services or otherwise, parties agree that jurisdiction and venue will be in Phoenix, Arizona and prevailing party will be entitled to attorney's fees and court costs.

APPENDIX C
QUALIFICATIONS

DRAFT

CERTIFICATIONS
TAMMY H. LAPP

State of California
California Environmental Protection Agency
Department of Toxic Substances Control

REGISTERED ENVIRONMENTAL ASSESSOR I

Issued to: Tammy Lapp REA [illegible]

Annual Expires on: 6/30/2009

Signature:

State of California
Division of Occupational Safety and Health
Certified Asbestos Consultant

Tammy Helen Lapp
Name

Certification No. 01-2969

Expires on 07/20/09

This certification was issued by the Division of Occupational Safety and Health as authorized by Sections 7180 et seq. of the Business and Professions Code

State of California Department of Public Health

Lead-Related Construction Certificate	Certificate Type	Expiration Date
	Inspector/Assessor	10/12/2009

Tammy H. Lapp ID #: 12810

Certificate of Completion

Stantec
is pleased to present this certificate to

Tammy Lapp

Who has successfully completed a course entitled
8-Hour Refresher Course, OSHA HAZWOPER Standard, 29 CFR 1910.120
held at Stantec,
Redlands, California *on* May 07, 2008

Stantec

Philip A. Pastore, CIH
Director of Industrial Hygiene
And Health & Safety Services

American Heart Association
Learn and Live.

Heartsaver® First Aid

Tammy Lapp

This card certifies that the above individual has successfully completed the objectives and skills evaluations in accordance with the curriculum of the AHA for Heartsaver First Aid Program.
Modules Completed: Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ

November 2007	November 2009
Issue Date	Recommended Renewal Date

PARKVIEW CENTER FOR OCCUPATIONAL MEDICINE

This is to certify that
Tammy Lapp
is approved for respirator use in the course of employment
with SECOR
Employer
having passed the medical evaluation required by state law.

Robert M Lawler, MD — 11/15/07
Signature of evaluating physician — Date

9041 Magnolia Ste 107 Riverside, Ca. 92503
Address

API WorkSafe

Safety Key

Name	Tammy Lapp
Company	SECOR International, Inc.
Completed	03-Jan-08 06:26
Expires	23-Jan-09

TABLES

DRAFT

TABLE 1
Asbestos Sample Log and Analysis Results
I-215 Gap Closure Bridge "A" "B" and "C"
Moreno Valley, Riverside County, California

SAMPLE #	SAMPLING LOCATION	MATERIAL DESCRIPTION	ANALYSIS RESULTS
Bridge "A" Samples			
01A	NE End	Road Asphalt	ND
02A	NW End	Road Asphalt	ND
03A	NW End	Road Asphalt	ND
04C	N End, E Side	Bridge Concrete	ND
05C	N End, E, Side	Bridge Concrete	ND
06C	S End, W Side	Bridge Concrete	ND
07C	Beneath, E. Side	Pillar Concrete	ND
08C	Beneath, W. Side	Pillar Concrete	ND
09C	Beneath, E Side, S End	Pillar Concrete	ND
10C	Beneath, W Side	Embankment Concrete	ND
11JF	Beneath, E End	Expansion Joint Felt	ND
12JF	Beneath, W End	Expansion Joint Felt	ND
13JF	Beneath, W End	Expansion Joint Felt	ND
Bridge "B" Samples			
14A	NE End	Road Asphalt	ND
15A	N Center	Road Asphalt	ND
16C	N End, E Side	Bridge Concrete	ND
17C	N End, E Side	Bridge Concrete	ND
18C	N End, W Side	Bridge Concrete	ND
19C	S End, E Side	Bridge Concrete	ND
20C	S End, E Side	Bridge Concrete	ND
21C	Beneath, E Side	Pillar Concrete	ND
22C	Beneath, E Side	Pillar Concrete	ND
23C	Beneath, W Side	Pillar Concrete	ND
24C	Beneath, W Side	Pillar Concrete	ND
25C	Beneath, W Side	Embankment Concrete	ND
26C	Beneath, W Side	Embankment Concrete	ND
27JF	Beneath, E End	Expansion Joint Felt	ND
28JF	Beneath, W End	Expansion Joint Felt	ND
29JF	Beneath, W End	Expansion Joint Felt	ND
30F	Beneath, E Side	Foam and Filler	ND
31F	Beneath, E Side	Foam and Filler	ND
Bridge "C" Samples			
32C	N Side, W End	Bridge Concrete	ND
33C	S Side, W End	Bridge Concrete	ND
34C	S Side, E End	Bridge Concrete	ND
35C	Beneath, W End	Pillar Concrete	ND
36C	Beneath, W End	Pillar Concrete	ND

DRAFT

TABLE 1 (Continued)
Asbestos Sample Log and Analysis Results

SAMPLE #	SAMPLING LOCATION	MATERIAL DESCRIPTION	ANALYSIS RESULTS
37C	Beneath, W End	Embankment Concrete	ND
38JF	Beneath, W End	Expansion Joint Felt	ND
39JF	Beneath, W End	Expansion Joint Felt	ND
40JF	Beneath, W End	Expansion Joint Felt	ND
41M	S Side, Center	Bolt Mastic, Gray	5% Chrysotile
42M	S Side, East End	Bolt Mastic, Gray	10% Chrysotile
43S	S Side, Rail #2	Leveling Shim	90% Chrysotile
44S	S Side, Rail #8	Leveling Shim	90% Chrysotile
45S	S Side, Rail #16	Leveling Shim	90% Chrysotile
46A	N Side, W End	Road Asphalt	ND
47A	S Side, E End	Road Asphalt	ND
48A	S Side, W End	Road Asphalt	ND
49A	S Side, W End	Road Asphalt	ND

ND = No asbestos detected.
NOTE: Asbestos sample locations are depicted on attached Figures.
Bulk sample analyses completed by polarized light microscopy (PLM).

DRAFT

FINAL
AERIALLY DEPOSITED LEAD SURVEY REPORT
INTERSTATE 215/STATE ROUTE 60 EAST JUNCTION
CITY OF RIVERSIDE, CALIFORNIA
08-RIV-215/60
CALTRANS EA NO. 449311

Prepared for:

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER
43174 Business Park Drive, Suite 103
Temecula, CA 92590

Kleinfelder Project No. 98817

March 13, 2009

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March 13, 2009
Project No. 98817

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

Subject: Final Aerially Deposited Lead Survey Report
Interstate 215/State Route 60 East Junction
City of Riverside, California
08-RIV-215/60
Caltrans EA No. 449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) is pleased to present this report for the proposed aerially deposited lead (ADL) survey for the area located at the east junction of existing Interstate 215 (I-215) and State Route 60 (SR-60) in the City of Riverside, California. The purpose of this report is to document the result of the ADL sampling survey and recommendations for handling soils containing ADL.

We appreciate the opportunity to be of service on this project. If you have any questions and comments or require additional information, please do not hesitate to contact the undersigned.

Sincerely,

KLEINFELDER WEST, INC.

PROFESSIONAL GEOLOGIST
ELIZABETH ANNE SIMMONS
No. 7431
exp 8-31-09
STATE OF CALIFORNIA

Jennifer Grippa
Project Professional

Lizanne Simmons, PG No. 7431
Senior Geologist

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PLATES

Plate 1 Site Location Map
Plate 2 Sample Location Map

APPENDICES

Appendix A Laboratory Analytical Reports
Appendix B Figure 1: ADL-Impacted Soils Management Flow Chart (Caltrans Aerially Deposited Lead Guidance, 2007)
Appendix C Statistical Summary of ADL Results

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1 INTRODUCTION

1.1 PROJECT DESCRIPTION

Kleinfelder was retained by Lim & Nascimento Engineering Corporation (LAN) to perform an aerially deposited lead (ADL) survey for the Interstate 215 (I-215) and State Route 60 (SR-60) East Junction Project, State of California Department of Transportation (Caltrans) EA 449311. This report summarizes the procedures used during the performance of work and results of the ADL survey at the project site. The project limits are in the City of Riverside, Riverside County, California (Plate 1).

1.2 SCOPE OF WORK AND OBJECTIVES

This report describes the procedures, results, and recommendations from the ADL survey performed within the project limits described above. Kleinfelder's scope of work included:

- Project Planning, Regulatory Interface, and *Work Plan* Implementation (Kleinfelder, 2008) – Obtaining approval from Caltrans for field approach and sampling locations;
- Soil Sampling - Implementation through hand augering and hollow stem auger (HSA) drilling methods;
- Laboratory Analyses; and
- Report Preparation – Evaluation of data, comparison of results to variance criteria, discussion of analytical results, and presentation of the findings.

The objective of the site assessment was to evaluate the lateral and vertical extent of lead-containing soils along the freeway shoulders (Caltrans right-of-way) within the project boundaries relative to the active variance granted to Caltrans by Department of Toxic Substance Control (DTSC).

1.3 REPORT ORGANIZATION

This report documents Kleinfelder's scope of work. Section 1 describes the objectives, general scope of work, and organization of the report. Pertinent site background information is contained in Section 2. Section 3 describes site assessment and

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sampling activities. Analytical results are summarized in Section 4. Statistical analysis of the data is contained in Section 5. Section 6 provided conclusions and recommendations. Sections 7 and 8 list limitations and references cited, respectively.

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2 BACKGROUND

2.1 SITE IMPROVEMENTS

Our understanding of the project is based on discussions with LAN, a site plan showing locations requiring ADL data, review of Apex Environmental Recovery's report *Aerial Lead Investigation State Route 215/60 in Riverside from Linden Street to Day Street* (2001) and Geocon Environmental Consultants, Inc.'s report *Lead Investigation of Routes 215 and 60 from Martin Luther King, Jr. Boulevard to Fredrick Street Overcrossing* (1998), and our familiarity with similar projects. The sampling approach was based on discussions between LAN and Caltrans, and was prepared consistent with the guidelines and specifications set forth in Caltrans' memorandum concerning Interim Aerially Deposited Lead Testing Procedures (2007) (referred to as the guidance document). Specifically the following scoped areas were evaluated for the presence of ADL in unpaved soil areas:

- Adding two new high occupancy vehicle (HOV) lane structures at the East Junction of I-215/SR-60 between the Box Springs over crossing (OC) and the Day Street under crossing (UC);
- Extending the existing HOV lanes to connect to the new two new HOV lane structures;
- Lowering and widening of the existing northbound (NB) I-215 ramp;
- Adding new pavement sections;
- Widening of Box Springs Overhead Right Bridge;
- Widening and associated tieback wall of Box Springs Overhead Left Bridge;
- Improving North Frontage Road, including replacing Frontage Road Overhead bridge and adding another bridge to the north; and
- Adding a Box Culvert Crossing adjacent to the existing Box Springs Overhead Bridge.

These improvements will result in soil being excavated and, depending on analytical results, re-used on-site.

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2.2 LEAD ANALYSIS, DISPOSAL, AND REUSE CRITERIA

Due to the historic use of lead in gasoline formulations, lead contamination is common in surface soils found along roadways. According to Title 22, California Code of Regulations (CCR), solid wastes with total lead concentrations equal to or exceeding 1,000 milligrams per kilogram (mg/kg), the Total Threshold Limit Concentration (TTLC), are classified as California hazardous waste. Assembly Bill 2784 (AB 2784), effective January 1, 1999, amended California Health and Safety Code (HSC) Section 25157.8 (a) and Title 22 CCR by reducing the practical disposal limit for non-hazardous solid waste to 350 mg/kg total lead until the California Regional Water Quality Control Board (RWQCB) amends a disposal facility's waste discharge requirements.

Solid wastes with soluble lead concentrations (assessed using California Waste Extraction Test [WET] procedures) equal to or exceeding 5.0 milligrams per liter (mg/L), the Soluble Threshold Limit Concentration (STLC), are classified as California hazardous under California law. California hazardous materials must be disposed under hazardous waste manifest at an approved Class I disposal facility. Wastes with lead concentrations less than both the TTLC and the STLC, therefore not a California hazardous waste, may be disposed of at a Class II or III facility, provided that site-specific disposal facility requirements are satisfied. Furthermore, according to federal law, as stipulated in the Resource Conservation and Recovery Act (RCRA), wastes that exceed 5.0 mg/L soluble lead, extracted using the federal Toxicity Characteristic Leaching Procedure (TCLP), are classified as RCRA hazardous waste. This material must be disposed of as RCRA hazardous waste if transported off-site.

In September 2000, the DTSC issued a 5-year variance (District 8 [00-H-VAR-04] to Caltrans specifying that ADL-impacted soil within a highway right-of-way could be used as fill material within the right-of-way during earth moving and road construction activities provided that the waste met specific criteria (DTSC, 2000). The DTSC Variance for Caltrans District 8 was modified in September 2003 (DTSC, 2003). In the interim, the current variance was extended until June 30, 2009 (DTSC, 2008). The following are the current DTSC variance conditions:

- For Variance Condition 9.a.1, "lead-contaminated" soil with total lead concentrations 1,411 mg/kg or less and 0.5 mg/L or less soluble lead (using a modified WET with deionized [DI] water as the extractant rather than an acidic, buffered sodium citrate solution) may be reused in a Caltrans right-of-way

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provided it is placed a minimum of 5 feet (1.5 meters) above the maximum water table and is covered by 1 foot (0.3 meter) of clean soil. The hydrogen ion index (pH) of the reused soil also must be above 5.0 standard units (SU), otherwise the soil must be placed as specified in Variance Condition 2.

- For Variance Condition 9.a.2, "lead-contaminated" soil that contains 3,397 mg/kg total lead or less, and more than 0.5 mg/L and less than 50 mg/L soluble lead (DI-WET) may be reused provided that it is placed a minimum of 5 feet (1.5 meters) above maximum water table and is covered by a pavement structure.

Other reuse conditions, soil handling procedures, and notifications are specified in the Variance. Soil that exceeds 3,397 mg/kg total lead or 50 mg/L soluble lead (DI-WET) cannot be reused within a Caltrans right-of-way and must be properly disposed off-site. Under California law hazardous wastes must be disposed of under a hazardous waste manifest to an approved Class I disposal facility. Solid wastes with lead concentrations less than both the TTLC and the STLC may be disposed of at a Class II or III facility provided that site-specific disposal facility requirements are satisfied. Similarly, solid waste that exceeds 5.0 mg/L soluble lead by TCLP is considered to be a federal or RCRA-hazardous waste and cannot be reused within a Caltrans right-of-way.

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3 SAMPLING ACTIVITIES

3.1 PRE-FIELD ACTIVITIES

The scope of work was performed under a Caltrans right-of-way encroachment permit issued to LAN under number 08-06-N-SV-1185, which was extended to expire March 2009 under rider number 08-08-N-RT-0873. A pre-job meeting was performed over the phone with Caltrans department representative Mr. Payman Hatam, who discussed field activities and safety precautions.

Prior to ground-disturbance activities, Kleinfelder visited each sample point to mark excavation locations in white paint. Underground Service Alert (USA) was notified 48-hours in advance of subsurface sampling activities. The health and safety plan was reviewed daily with field personnel for potential hazards, emergency contact information, and hospital routes (Kleinfelder, 2008).

3.2 SAMPLING LOCATIONS

ADL sample locations were selected on the basis of the recommendations presented in Caltrans' February 1995 memo, "Caltrans Variance for Reuse of Lead Contaminated Soils," and discussions with Caltrans personnel. The following sampling frequency was used:

Horizontal Sampling Locations. For Caltrans projects, the ratio of sample spacing to total lineal length of the project is estimated such that a sufficient number of samples are collected and analyzed to give a statistically valid correlation between total lead and soluble lead within the sample population. Sampling locations were spaced approximately 300 feet from each other. This spacing was approved in the submitted *Work Plan* (Kleinfelder, 2008).

Lateral Sampling Locations. The guidance document provides a sampling template for locating samples away from the paved roadway shoulders. Consistent with the Caltrans guidance document, where unpaved shoulder widths or excavation areas are 12 feet or less, samples were typically collected approximately 6 feet from the edge of the pavement. Sample locations were sometimes adjusted on the basis of utility clearance and access.

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Vertical Sampling Locations. Three soil samples were collected from each boring location at depths of approximately 0 to 0.5 feet below ground surface (bgs), 0.5 to 1 feet bgs, and 1.5 to 2 feet bgs, or until refusal. Additional soil samples were collected up to a depth of 20 feet bgs at four locations near the Box Springs Bridge. Site conditions (i.e., refusal) dictated sample retrieval; therefore, the depth of one sample collected was modified in one boring (BS-02) when refusal was encountered at 12 feet bgs.

3.3 SAMPLING METHODS

Kleinfelder obtained the services of American Barricade to provide traffic control for closure of freeway shoulders. Workers were also followed by an attenuator truck for safety concerns working near the freeway. Work was performed in the unpaved shoulder areas from 9:00 AM to 3:00 PM Monday through Thursday and 9:00 AM to 1:00 PM Friday, opposite the direction of heaviest traffic volume whenever possible.

Soil borings were advanced in unpaved areas at locations shown in Plate 2, using hand augering or HSA drilling methods. HSA drilling methods were advanced in unpaved median areas near the Box Springs Bridge up to a depth of 20 feet bgs; however, two of the four locations were hand augered due to drill rig access issues. Soil samples were collected up to a depth of 2 feet bgs at most locations and up to a depth of 20 feet at the bridge locations; however, refusal was encountered at boring BS-02, which prevented reaching the full depth desired. Therefore, a sample was taken at the point of refusal, 12 feet bgs.

Soil samples were collected by scooping soil from the boring or split spoon sampler and placing the soil into laboratory-supplied, 8-ounce jars with Teflon lids. The sample jars were labeled with sample identification information and placed in a secured, chilled ice chest. Standard chain-of-custody procedures were used during sampling and transportation to the laboratory. Coordinates of the sample locations were recorded using a 2008 GeoXH model GPS unit from the Explorer series with sub-foot accuracy and are provided in Table 1.

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3.4 DECONTAMINATION AND BORING ABANDONMENT

Sampling equipment (i.e., hand auger cutter head, soil sampler, etc.) were washed with a solution of Alconox® detergent and double rinsed with distilled water in buckets prior to each use. Generation of wash water was minimized. Wash water was contained in 5-gallon pails for disposal. At the end of each day, wash water was disposed at the surface in Caltrans right-of-way, away from storm drains or slopes that would lead to storm drains. Soil cuttings originating from each boring were used as backfill.

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4 SAMPLE RESULTS

A summary of the soil sample and duplicate analytical results is presented in Table 2. Certified laboratory reports are included as Appendix A. The results for the different types of analyses (total lead, soluble lead, pH) and quality assurance/quality control samples are discussed below.

4.1 ANALYTICAL PROGRAM

One or more of the following methods were used for analyses of samples:

- EPA Method 6010B for total and soluble lead;
- Title 22, Section 66261.24 (a) (2), Appendix II for Standard WET procedures using sodium citrate buffer solution;
- Modified Title 22, Section 66261.24 (a) (2), Appendix II for WET procedures using deionized water (DI-WET);
- EPA Method 6010B for TCLP lead; or
- EPA Method 9045C for hydrogen index (pH).

Soil samples were collected from 25 shallow borings advanced within proposed improvement areas. At each hand auger location, samples were collected from several depths; generally, 0.5 foot, 1 foot and 2 feet (where refusal was not encountered). At the Box Springs Bridge locations, 3 borings were completed to 20 feet and one to 12 feet bgs. A total of 96 primary and duplicate soil samples were collected from these methods. Each soil sample was analyzed for total lead. Due to the anomalous total lead concentrations from the three samples at I215-03 location, samples were re-processed and re-analyzed. A subset of 36 samples (38 percent of total) were also analyzed by citrate WET method. A DI-WET analysis was also performed on 10 soil samples (10 percent of total). The pH of 11 (11 percent of total) samples was measured, and soluble lead was analyzed by TCLP for 14 (15 percent of total) samples.

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4.2 ADL SOIL SAMPLE RESULTS

4.2.1 Total Lead

Total lead was detected in each of the 96 soil samples, and results ranged in concentration from 0.922 to 948 mg/kg. Seventy-two (72) of the samples were reported to contain less than 50 mg/kg total lead. Because of the small sample population, additional samples with concentrations greater than 25 mg/kg total lead were submitted for further testing for soluble lead. As expected, near surface samples generally contained higher concentrations of total lead compared to the deeper samples at a single sample location.

4.2.2 pH

The pH values of the 11 soil samples (approximately 11 percent of the total samples) analyzed were slightly basic, ranging from 6.52 to 8.14 with a mean value of 7.27. According to the DTSC, soils with a pH of less than 5.0 would be of concern for potentially leaching lead (DTSC, 2000). However, none of the soil samples analyzed had a pH less than 5.0.

4.2.3 WET Soluble Lead

WET soluble lead (citrate extraction) was detected at concentrations greater than 5.0 mg/L (the STLC) in 6 of the 36 samples tested. The maximum WET soluble lead concentration was 376 mg/L, detected in sample I215-03-1.0. This sample also had the highest concentration of total lead at 948 mg/kg.

4.2.4 DI-WET Soluble Lead

Concentrations of DI-WET soluble lead were detected in 7 of the 10 samples tested. None of the samples analyzed for DI-WET soluble lead had concentrations greater than 50 mg/L, the maximum threshold concentration for Variance Condition 2. The maximum DI-WET soluble lead was 5.11 mg/L, which corresponds to a total lead concentration of 948 mg/kg and a standard-WET soluble lead concentration of 376 mg/L (sample I215-03-1.0).

4.2.5 TCLP Soluble Lead

TCLP soluble lead was analyzed on approximately 15 percent of the total lead samples. TCLP soluble lead concentrations ranged from below laboratory reporting limits to 58.5

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mg/L. Soil sample I215-03-1.0 had TCLP soluble lead concentrations in excess of the respective RCRA hazardous waste concentration of 5.0 mg/L. The samples above and below this sample contained concentrations of TCLP soluble lead below 5.0 mg/L.

4.3 DATA USABILITY EVALUATION

The following section summarizes the QA/QC program and data quality assessment. The data quality assessment process consists of a review, verification, and evaluation of the analytical data generated during the East Junction ADL survey and was performed using the U.S. Environmental Protection Agency (USEPA) Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA, 2004a).

A total of 98 samples including primary and duplicate soil samples and rinsate samples, were collected and submitted to Calscience Environmental Laboratories in Garden Grove, California for one or more of the following analyses:

- Total lead by EPA Method 6010B,
- Hydrogen ion concentration (pH) by EPA Method 9045D,
- Soluble lead by EPA Method 1311,
- Soluble lead by California WET Method, and
- Soluble lead by California WET-deionized water (DI) Method.

One hundred percent of the data generated for this project underwent a data quality review. A total of three sample delivery groups (SDGs) were evaluated during the data quality assessment, which consisted of evaluating the following parameters:

- Technical holding times and temperature,
- Chains-of-custody (COCs) – samples and analyses,
- Sample results,
- Laboratory method blanks,
- Laboratory control sample (LCS) spike results,
- Matrix spike (MS) and matrix spike duplicate (MSD) results, and
- Laboratory duplicate results.

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Field and laboratory personnel implemented QA/QC procedures consistent with the quality assurance criteria specified in the *Aerially Deposited Lead Survey Work Plan* (Kleinfelder, 2008) during the soil sampling events. Field QC consisted of collecting equipment rinsate samples (rinsate samples) and duplicate samples, which were collected at frequencies required by the *Work Plan*. Two rinsate samples were collected. Total lead concentrations of these samples were detected at 0.0264 mg/L and not detected above the laboratory detection limit, respectively. No qualifications were applied to data based on the rinsate sample results. Field duplicates were collected for at least 5 percent of the total number of samples (5 duplicates total) and results were compared to parent samples; however, no qualifications were applied to data based on the field duplicate recoveries. Laboratory QC samples (i.e., method blank and matrix spikes) were also analyzed consistent with the *Work Plan* and the analytical method requirements.

During the data quality assessment, the following discrepancies were observed:

- Four method blank samples for lead and soluble lead analyses reported detections above the method detection limit. "B" qualifiers were applied to associated sample results in laboratory report 09-01-1176.
- Two MS/MSD samples for soluble lead analyses reported spike recoveries outside the laboratory control limits; however, the associated LCS recoveries were within the laboratory control limits. Therefore, no qualifications were applied to the associated data due to MS/MSD recovery issues.
- Spike recoveries were unable to be reported for one MS/MSD total lead analysis due to lead concentrations greater than 4 times the spike concentration; however, the associated LCS recovery was within the laboratory control limits. Therefore, no qualifications were applied to the associated data due to MS/MSD recovery issues.

Of the soil data evaluated during the data quality assessment, the data are considered acceptable for project use based on the quality control criteria defined in the *Work Plan* (Kleinfelder, 2008).

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5 STATISTICAL EVALUATION

The data were analyzed to identify the appropriate handling of soil affected by ADL under the terms of the Variance granted by DTSC to Caltrans District 8 for highway construction projects. During the course of construction, this soil is likely to be excavated, stockpiled, and relocated using methods that tend to homogenize soil constituent concentrations.

According to Caltrans, to evaluate whether reanalysis of samples and/or laboratory procedure adjustments are necessary for the dataset, a correlation coefficient (r) between total lead values and soluble (STLC by WET method) lead analytical results is calculated. The correlation coefficient is calculated using the following formula:

$$Correl\,(X,Y) = \frac{\sum\left(x-\overline{x}\right)\left(y-\overline{y}\right)}{\sqrt{\sum\left(x-\overline{x}\right)^2\sum\left(y-\overline{y}\right)^2}}$$

where x and y are the sample means AVERAGE(array1) and AVERAGE(array2).

For this project, samples which exceeded 25 mg/kg for total lead (36 samples) were submitted for WET analysis. The calculated correlation coefficient of 0.89 is above the referenced threshold of 0.8 and reanalysis was not necessary.

Caltrans has prepared an ADL guidance document to support the implementation of the DTSC Variance (Caltrans, 2007). The guidance document provides a flow chart/decision diagram to address DTSC Variance applicability based on the various analyses (see Appendix B). The criteria against which the lead analytical results for this ADL study were found applicable in this evaluation and the decision points were as follows: If the 95 percent upper confidence limit (UCL) on mean total lead is less than 1,000 mg/kg, and if the 95 percent UCL on mean for soluble lead (DI-WET) is less than 0.5 mg/L, then the soil is considered non-hazardous and can be released to the contractor for reuse on-site. If the 95 percent UCL on mean for soluble lead (DI-WET) is NOT less than 0.5 mg/L and if the 95 percent UCL on mean for soluble lead (DI-WET) less than 50 mg/L, then the soil qualifies for use under at least one foot of clean fill.

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Reported lead concentrations were aggregated vertically and horizontally in the statistical analysis to reflect homogenization that occurs during the construction process. For samples with duplicates, the lower result value of the primary and the duplicate sample was omitted from the data set. Additionally, results below laboratory detection limits for total lead and DI-WET soluble lead were handled in the statistical analysis by taking half the value of the laboratory detection limit.

The USEPA statistical analysis package, ProUCL (version 4.0, April 2007) was used to complete the statistical evaluation (USEPA, 2004b). ProUCL allows the computation of a reliable, stable, and conservative 95 percent UCL of the mean concentration in an environmental data set and offers 15 different methods of computing a 95 percent UCL depending on the distribution of a given data set. Outputs from the three data sets analyzed are provided in Appendix C.

Table 3 (below) provides a summary of the total lead concentrations observed in soil samples from the subject site. Due to the anomalous nature of the total lead results from location I215-03, these three samples were reanalyzed for total lead and the re-analzyed data incorporated into the statistical evaluation. Based on a comparison of the 95 percent UCL value generated by ProUCL, the data set for total lead passes the first criterion established in the Caltrans ADL guidance: "Is the 95 percent UCL for total lead less than 1,000 mg/kg?"

Table 3
Statistical Evaluation of Total Lead (mg/kg)

Statistic	Value
Number of Samples	91
Detects	91
Non-detects (ND) at 0.5 mg/kg	0
Minimum Detected Concentration of Lead	0.92
Maximum Detected Concentration of Lead	948
95% Upper Confidence Limit on Mean (95UCL)	119.1[a]
Is 95UCL less than 1,000 mg/kg?	**YES**

[a] Based on 97.5% Chebyshev UCL generated and recommended by ProUCL.

A statistical analysis of soluble lead using data from the DI-WET analysis was also performed to address the second criterion from the Caltrans ADL flow chart/decision diagram (Table 4).

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Table 4
Statistical Evaluation of Soluble Lead by DI-WET (mg/L)

Statistic	Value
Number of Samples	10
Detects	7
Minimum Detected Concentration of Lead	0.117
Maximum Detected Concentration of Lead	5.11
95% Upper Confidence Limit on Mean (95UCL)	3.854[a]
Is 95% UCL less than 0.5 mg/L?	**NO**

[a] Based on 95% Chebyshev UCL generated and recommended by ProUCL.

Based on the DI-WET results reported in Table 4, the 95 percent UCL exceeds 0.5 mg/L. Therefore, the soil cannot be classified as non-hazardous and acceptable for re-use without restriction. However, the 95 percent UCL is less than 50 mg/L and can, therefore, be re-used under at least one foot of clean cover based on the Caltrans ADL guidance flowchart.

The 95 percent UCL in excess of the 0.5 mg/L DI-WET criterion (Table 4) is likely a result of high lead concentrations reported at just one of the 25 locations sampled, I215-03, from which the following soil samples were collected and analyzed for lead, I215-03-0.5, I215-03-1.0, and I215-03-2.0. These samples contained DI-WET soluble lead concentrations of 1.95 mg/kg, 5.11 mg/kg, and 2.86 mg/kg, respectively. Removing this location (and associated three samples) from the DI-WET data set yields a 95 percent UCL of 0.251, which is less than the 0.5 mg/L DI-WET criterion (Table 5).

Table 5
Statistical Evaluation of Soluble Lead by DI-WET (mg/L)
Without I215-03 Samples

Statistic	Value
Number of Samples	7
Detects	5
Minimum Detected Concentration of Lead	0.117
Maximum Detected Concentration of Lead	0.386
95% Upper Confidence Limit on Mean (95UCL)	0.251[a]
Is 95% UCL less than 0.5 mg/L?	**YES**

[a] Based on 95% Chebyshev UCL generated and recommended by ProUCL.

Therefore, removal of soil from this location, followed by confirmation soil samples and recalculation of the 95 percent UCL would be expected to demonstrate that the DI-WET

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0.5 mg/L criterion is met and soil from the study area would be classified as non-hazardous and available for re-use without restrictions.

In conclusion, based on CalTrans ADL guidance flow chart, soil from the study area could be handled under two different options. Treating the soil as one unit, the soil can be re-used on-site under at least 1 foot of clean cover. Alternatively, soil surrounding sample location I215-03 could be reused on-site under 1 foot of clean soil, and then the remaining soil would meet the DTSC variance 0.5 mg/L criterion for DI-WET, resulting in the classification of the remaining Site soil as non-hazardous and available for re-use without restriction.

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6 CONCLUSIONS AND RECOMMENDATIONS

Current plans for construction call for re-use of soil on Site.

6.1 VARIANCE CONCLUSIONS

Although certain individual lead samples fall above maximum soluble lead concentrations allowed by DTSC variances, based on statistical analysis of the analytical results of this ADL Survey, soil tested within the Caltrans right-of-way excluding location I215-03 contains DI-WET soluble lead concentrations below DTSC Variance conditions (Appendix B) and may be released to the contractor.

Soil from location I215-03 within the Site limits to a depth of 2 feet bgs contained soluble concentrations that would apply to the DTSC Variance condition under classification as Y-1 soils. Thus, soils from I215-03 may be reused on-site under one foot of clean fill. Should off-site disposal be required, the soil from I215-03 sample location should be managed as a RCRA hazardous waste based on the criteria described in Section 6.2.

6.2 WASTE CHARACTERIZATION CONCLUSIONS

The analytical results of this ADL Survey suggest that the soil tested at the 25 sample locations on the Site does not contain total lead in excess of the respective California TTLC of 1,000 mg/kg. The standard-WET soluble lead test results indicate that soils are in excess of the respective California STLC of 5.0 mg/L in two samples from location I215-03. Statistical analyses performed on samples yielded results that indicated, based on California STLC, soil at I215-03 should be treated as a California hazardous waste should off-site disposal be required.

One sample analyzed for TCLP soluble lead concentration was greater than 5.0 mg/L. Therefore, soil excavated from location I215-03 would be classified as RCRA hazardous waste pursuant to California and federal limits and should off-site disposal be required.

6.3 RECOMMENDATIONS

Based on the findings and conclusions of this report, Kleinfelder only recommends additional ADL soil sampling be completed for the Site should off-site excavation of the area surrounding I215-03 occur. Otherwise, the data reported herein is sufficient to

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characterize Site soils. However, if excavations are planned for deeper than 2 feet bgs on freeway shoulders, then Kleinfelder recommends that additional sampling and laboratory analytical testing be completed to characterize the area of excavation.

Should imported soil be brought on-site, testing of the soil is required to comply with Caltrans Standard Specifications.

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7 LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.

The work performed was based on project information provided by Client. If the Client does not retain Kleinfelder to review any plans and specifications, including any revisions or modifications to the plans and specifications, Kleinfelder assumes no responsibility for the suitability of our recommendations. In addition, if there are any changes in the field to the plans and specifications, the Client must obtain written approval from Kleinfelder's engineer that such changes do not affect our recommendations. Failure to do so will vitiate Kleinfelder's recommendations.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. It should be recognized that definition and evaluation of geologic and environmental conditions are a difficult and inexact science. Judgments leading to conclusions and recommendations are generally made with incomplete knowledge of the subsurface conditions present due to the limitations of data from field studies. Although risk can never be eliminated, more-detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service that provide adequate information for their purposes at acceptable levels of risk. More extensive studies, including subsurface studies or field tests, should be performed to reduce uncertainties. Acceptance of this report will

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indicate that the Client has reviewed the document and determined that it does not need or want a greater level of service than provided.

During the course of the performance of Kleinfelder's services, hazardous materials may have been discovered. Kleinfelder assumes no responsibility or liability whatsoever for any claim, loss of property value, damage, or injury that results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials. Nothing contained in this report should be construed or interpreted as requiring Kleinfelder to assume the status of an owner, operator, or generator, or person who arranges for disposal, transport, storage or treatment of hazardous materials within the meaning of any governmental statute, regulation or order. The Client is solely responsible for directing notification of all governmental agencies, and the public at large, of the existence, release, treatment or disposal of any hazardous materials observed at the project site, either before or during performance of Kleinfelder's services. The Client is responsible for directing all arrangements to lawfully store, treat, recycle, dispose, or otherwise handle hazardous materials, including cuttings and samples resulting from Kleinfelder's services.

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8 REFERENCES

Caltrans, 2007. *Caltrans Aerially Deposited Lead Guidance*, June.

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DTSC, 2008. Letter to Department of Transportation District 8, Subject: Lead Contaminated Soil Variance Modification, Variance Number 00-H-VAR-04, Caltrans District 8; Extension, June 17.

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USEPA, 2004a, Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, dated October.

USEPA, 2004b, ProUCL version 3.0, April.

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TABLES

Table 1
Summary of Sample Location Coordinates
I-215/SR-60 East Junction Improvements
Riverside, California

Sample Location	X (meters)	Y (meters)
60WB-01	1904170.99637000000	697586.13334199900
60WB-02	1904115.46245000000	697598.79897100000
60WB-03	1904050.18574999000	697615.36171700000
60WB-04	1903981.98621000000	697630.95018399900
BS-01	1903176.14635999000	697876.89774199900
BS-02	1903146.82415000000	697902.83096499900
BS-03	1903104.49564999000	697903.57850199900
BS-04	1903089.92023999000	697925.22076800000
I215-01	1903681.21268000000	697423.34977099900
I215-02	1903696.44368000000	697432.39318100000
I215-03	1903662.61271000000	697496.35893999900
I215-04	1903673.02453000000	697505.65520699900
I215-05	1903626.54319000000	697566.63872299900
I215-06	1903638.81425999000	697576.67869299900
I215-07	1903607.95065000000	697620.18522600000
I215-08	1903579.68999999000	697629.48149300000
I215-09	1903569.65002999000	697662.20435599900
I215-10	1903537.67087000000	697671.12877299900
I215-11	1903523.91239000000	697700.87682899900
I215-12	1903461.44147000000	697724.30342400000
I215-13	1903467.76294000000	697736.94634799900
I215-14	1903374.80025999000	697761.86034500000
I215-15	1903323.86990000000	697776.33802000000
I215-16	1903246.02354000000	697805.96458699900
I215-17	1903170.86531000000	697836.13637900000

Notes:
Coordinates provided in NAD 83 CA State Plane Zone VI (meters).
BS - Box Springs
WB - Westbound

Table 2
Summary of Analytical Results
I-215/SR-60 East Junction Improvements
Riverside, California

					TOTAL LEAD	TCLP	pH	WET	DI WET
				Preparation	3050B	1311	NA	T22.11.5 All	T22.11.5 All DI
				EPA Method	6010B	6010B	9045D	6010B	6010B
Sample ID	Lab Report ID	Date Sampled	Sample Location	Sample Depth	mg/kg	mg/L	pH units	mg/L	mg/L
60WB-01-0.5	09-01-1382	1/15/2009	60WB-01	0.5	38.0	ND		2.06	
60WB-01-1.0	09-01-1382	1/15/2009	60WB-01	1.0	23.6				
DUP-1	09-01-1382	1/15/2009	DUP	NA	55.5			2.59	
60WB-01-2.0	09-01-1382	1/15/2009	60WB-01	2.0	55.1			4.25	
60WB-02-0.5	09-01-1382	1/15/2009	60WB-02	0.5	18.1				
60WB-02-1.0	09-01-1382	1/15/2009	60WB-02	1.0	86.1			3.59	
DUP-2	09-01-1382	1/15/2009	DUP	NA	47.8			2.82	
60WB-02-2.0	09-01-1382	1/15/2009	60WB-02	2.0	3.82				
60WB-03-0.5	09-01-1382	1/15/2009	60WB-03	0.5	41.7			2.55	
60WB-03-1.0	09-01-1382	1/15/2009	60WB-03	1.0	78.1			4.67	
DUP-4	09-01-1382	1/15/2009	DUP	NA	85.8			0.222	
60WB-03-2.0	09-01-1382	1/15/2009	60WB-03	2.0	6.36		6.60		
60WB-04-0.5	09-01-1382	1/15/2009	60WB-04	0.5	55.7			2.59	
60WB-04-1.0	09-01-1382	1/15/2009	60WB-04	1.0	59.5			2.51	
DUP-3	09-01-1382	1/15/2009	DUP	NA	70.5			0.679	
60WB-04-2.0	09-01-1382	1/15/2009	60WB-04	2.0	132	0.957		1.61	0.117
BS-01-0.5	09-01-1382	1/15/2009	BS-01	0.5	79.4			4.03	
BS-01-1.0	09-01-1382	1/15/2009	BS-01	1.0	7.08				
BS-01-2.0	09-01-1382	1/15/2009	BS-01	2.0	16.8		6.52		
BS-01-3.0	09-01-1382	1/15/2009	BS-01	3.0	10.2				
BS-01-5.0	09-01-1382	1/15/2009	BS-01	5.0	3.69	ND			
BS-01-10.0	09-01-1382	1/15/2009	BS-01	10.0	4.19				
BS-01-20.0	09-01-1382	1/15/2009	BS-01	20.0	1.24				
BS-02-0.5	09-01-1379	1/16/2009	BS-02	0.5	27.9			1.40	
BS-02-1.0	09-01-1379	1/16/2009	BS-02	1.0	15.0	ND			
DUP-5	09-01-1379	1/16/2009	DUP	NA	22.6				
BS-02-2.0	09-01-1379	1/16/2009	BS-02	2.0	6.86				
BS-02-3.0	09-01-1379	1/16/2009	BS-02	3.0	5.99				
BS-02-5.0	09-01-1379	1/16/2009	BS-02	5.0	7.09		7.34		

Table 2
Summary of Analytical Results
I-215/SR-60 East Junction Improvements
Riverside, California

					TOTAL LEAD	TCLP	pH	WET	DI WET
				Preparation	3050B	1311	NA	T22.11.5 All	T22.11.5 All DI
				EPA Method	6010B	6010B	9045D	6010B	6010B
Sample ID	Lab Report ID	Date Sampled	Sample Location	Sample Depth	mg/kg	mg/L	pH units	mg/L	mg/L
BS-02-10.0	09-01-1379	1/16/2009	BS-02	10.0	8.00	ND			
BS-02-12.0	09-01-1379	1/16/2009	BS-02	12.0	7.38				
BS-03-0.5	09-01-1379	1/16/2009	BS-03	0.5	136			6.14	0.386
BS-03-5.0	09-01-1379	1/16/2009	BS-03	0.5	18.1	ND			
BS-03-1.0	09-01-1379	1/16/2009	BS-03	1.0	115		6.78	4.94	ND
BS-03-2.0	09-01-1379	1/16/2009	BS-03	2.0	232			11.8	ND
BS-03-3.0	09-01-1379	1/16/2009	BS-03	3.0	170			4.20	ND
BS-03-10.0	09-01-1379	1/16/2009	BS-03	10.0	50.3			4.59	
BS-03-20.0	09-01-1379	1/16/2009	BS-03	20.0	46.4		7.13	3.30	
BS-04-0.5	09-01-1382	1/15/2009	BS-04	0.5	7.80				
BS-04-1.0	09-01-1382	1/15/2009	BS-04	1.0	1.66				
BS-04-2.0	09-01-1382	1/15/2009	BS-04	2.0	14.7				
BS-04-3.0	09-01-1382	1/15/2009	BS-04	3.0	9.95				
BS-04-5.0	09-01-1382	1/15/2009	BS-04	5.0	1.08				
BS-04-10.0	09-01-1382	1/15/2009	BS-04	10.0	1.70		6.76		
BS-04-20.0	09-01-1382	1/15/2009	BS-04	20.0	0.922				
I215-01-0.5	09-01-1176	1/14/2009	I215-01	0.5	38.9			0.835	
I215-01-1.0	09-01-1176	1/14/2009	I215-01	1.0	6.15				
I215-01-2.0	09-01-1176	1/14/2009	I215-01	2.0	2.74	ND			
I215-02-0.5	09-01-1176	1/14/2009	I215-02	0.5	28.9			1.07	
I215-02-1.0	09-01-1176	1/14/2009	I215-02	1.0	11.5				
I215-02-2.0	09-01-1176	1/14/2009	I215-02	2.0	9.39	ND			
I215-03-0.5	09-01-1176	1/14/2009	I215-03	0.5	111*	2.36		44.4	1.95
I215-03-1.0	09-01-1176	1/14/2009	I215-03	1.0	948*	58.5	7.64	376	5.11
I215-03-2.0	09-01-1176	1/14/2009	I215-03	2.0	50.8*	1.64		72.6	2.86
I215-04-0.5	09-01-1176	1/14/2009	I215-04	0.5	77.2			2.19	
I215-04-1.0	09-01-1176	1/14/2009	I215-04	1.0	9.38				
I215-04-2.0	09-01-1176	1/14/2009	I215-04	2.0	8.35		8.14		
I215-05-0.5	09-01-1176	1/14/2009	I215-05	0.5	13.0				

Table 2
Summary of Analytical Results
I-215/SR-60 East Junction Improvements
Riverside, California

					TOTAL LEAD	TCLP	pH	WET	DI WET
				Preparation	3050B	1311	NA	T22.11.5 All	T22.11.5 All DI
				EPA Method	6010B	6010B	9045D	6010B	6010B
Sample ID	Lab Report ID	Date Sampled	Sample Location	Sample Depth	mg/kg	mg/L	pH units	mg/L	mg/L
I215-05-1.0	09-01-1176	1/14/2009	I215-05	1.0	6.63				
I215-05-2.0	09-01-1176	1/14/2009	I215-05	2.0	3.34				
I215-06-0.5	09-01-1176	1/14/2009	I215-06	0.5	137			2.52	0.287
I215-06-1.0	09-01-1176	1/14/2009	I215-06	1.0	48.7			0.752	
I215-06-2.0	09-01-1176	1/14/2009	I215-06	2.0	3.57				
I215-07-0.5	09-01-1176	1/14/2009	I215-07	0.5	28.3			0.442	
I215-07-1.0	09-01-1176	1/14/2009	I215-07	1.0	4.04	ND			
I215-07-2.0	09-01-1176	1/14/2009	I215-07	2.0	8.68				
I215-08-0.5	09-01-1176	1/14/2009	I215-08	0.5	16.5				
I215-08-1.0	09-01-1176	1/14/2009	I215-08	1.0	18.6				
I215-08-2.0	09-01-1176	1/14/2009	I215-08	2.0	17.0				
I215-09-0.5	09-01-1176	1/14/2009	I215-09	0.5	10.8		7.60		
I215-09-1.0	09-01-1176	1/14/2009	I215-09	1.0	8.80				
I215-09-2.0	09-01-1176	1/14/2009	I215-09	2.0	87.0			1.55	
I215-10-0.5	09-01-1176	1/14/2009	I215-10	0.5	54.3	ND		1.94	
I215-10-1.0	09-01-1176	1/14/2009	I215-10	1.0	1.87				
I215-10-2.0	09-01-1176	1/14/2009	I215-10	2.0	2.40				
I215-11-0.5	09-01-1176	1/14/2009	I215-11	0.5	10.9				
I215-11-1.0	09-01-1176	1/14/2009	I215-11	1.0	6.91				
I215-11-2.0	09-01-1176	1/14/2009	I215-11	2.0	4.28				
I215-12-0.5	09-01-1176	1/14/2009	I215-12	0.5	42.8		7.57	1.71	
I215-12-1.0	09-01-1176	1/14/2009	I215-12	1.0	5.93				
I215-12-2.0	09-01-1176	1/14/2009	I215-12	2.0	8.70				
I215-13-0.5	09-01-1176	1/14/2009	I215-13	0.5	420			16.3	0.137
I215-13-1.0	09-01-1176	1/14/2009	I215-13	1.0	23.8				
I215-13-2.0	09-01-1176	1/14/2009	I215-13	2.0	6.62				
I215-14-0.5	09-01-1176	1/14/2009	I215-14	0.5	7.77				
I215-14-1.0	09-01-1176	1/14/2009	I215-14	1.0	37.5			1.67	
I215-14-2.0	09-01-1176	1/14/2009	I215-14	2.0	11.2				

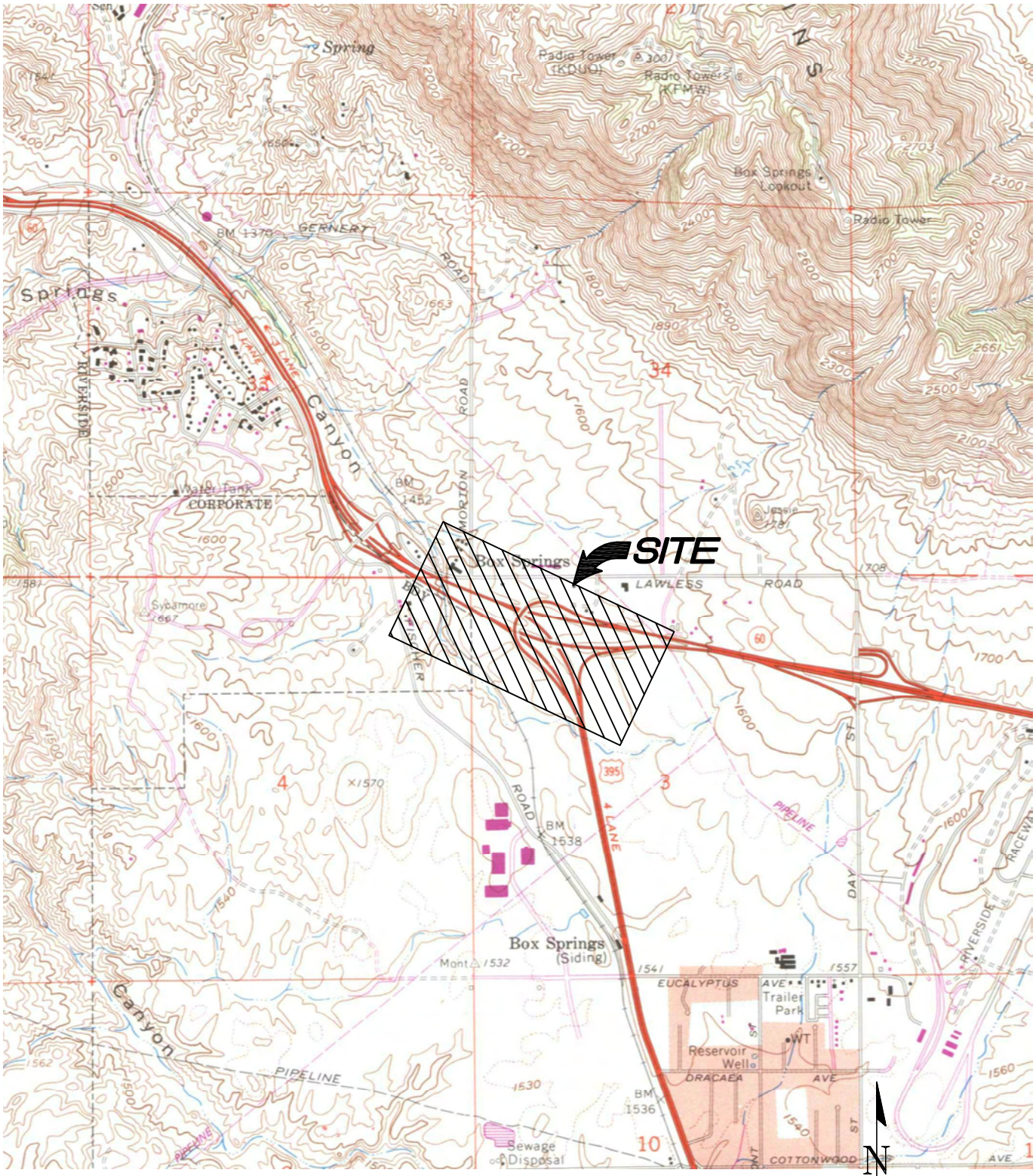
Table 2
Summary of Analytical Results
I-215/SR-60 East Junction Improvements
Riverside, California

					TOTAL LEAD	TCLP	pH	WET	DI WET
				Preparation	3050B	1311	NA	T22.11.5 All	T22.11.5 All DI
				EPA Method	6010B	6010B	9045D	6010B	6010B
Sample ID	**Lab Report ID**	**Date Sampled**	**Sample Location**	**Sample Depth**	mg/kg	mg/L	pH units	mg/L	mg/L
I215-15-0.5	09-01-1176	1/14/2009	I215-15	0.5	51.3		7.86	1.53	
I215-15-1.0	09-01-1176	1/14/2009	I215-15	1.0	7.82				
I215-15-2.0	09-01-1176	1/14/2009	I215-15	2.0	5.87				
I215-16-0.5	09-01-1176	1/14/2009	I215-16	0.5	37.0	0.0412 J		1.44	
I215-16-1.0	09-01-1176	1/14/2009	I215-16	1.0	6.54				
I215-16-2.0	09-01-1176	1/14/2009	I215-16	2.0	2.62				
I215-17-0.5	09-01-1176	1/14/2009	I215-17	0.5	16.20				
I215-17-1.0	09-01-1176	1/14/2009	I215-17	1.0	7.55				
I215-17-2.0	09-01-1176	1/14/2009	I215-17	2.0	5.64				
Totals	**96**				**96**	**14**	**11**	**36**	**10**

Notes:
TCLP - Toxicity Characteristc Leaching Procedure
WET - Waste Extraction Test
BS - Box Springs
mg/kg - milligram per kilogram
mg/L - milligram per liter
*Samples re-processed and re-analyzed for total lead on 3/10/09.

DI - deionized water
DUP - duplicate (preceeding ID is primary sample)
WB - Westbound direction
ND - Not detected above laboratory method detection limit
NA - Not applicable

PLATES



SOURCE: U.S.G.S. 7.5' topographic series, Riverside East, California quadrangle dated 1967, photorevised 1980.

2,000 1,000 0 2,000

APPROXIMATE SCALE (feet)

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PROJECT NO.	98817
DRAWN:	11/14/08
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME: 988179p1.dwg	

SITE LOCATION MAP

I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE, CALIFORNIA

PLATE 1

PLOTTED: 14 Nov 2008, 10:20am, dfahrney
CAD FILE: L:\2008\CADD\98817\ LAYOUT: 1
Images: 76979p1.jpg
ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA

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Legend

- ADL Sample Locations

Notes: * Indicates samples reprocessed and re-analyzed on 3/10/09.
Total lead reported in mg/kg.
WET, DIWET, and TCLP reported in mg/L.
"J" flag indicates analyte is estimated, and was detected below the laboratory reporting limit.

0 150 300 600 900 Feet

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PROJECT NO.	98817
DRAWN:	02/10/09
DRAWN BY:	V. REYNOLDS
CHECKED BY:	L. SIMMONS
FILE NAME:	EAST JUNCTION ADL.MXD

SAMPLE LOCATION MAP

I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE, CALIFORNIA

PLATE
2

APPENDIX A

Laboratory Analytical Reports

Calscience Environmental Laboratories, Inc.

Supplemental Report 2

March 13, 2009

Additional requested analyses are reported as a stand-alone report.

Liz Simmons
Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Subject: **Calscience Work Order No.: 09-01-1176**
Client Reference: East Junction HOV 98817

Dear Client:

Enclosed is an analytical report for the above-referenced project. The samples included in this report were received 1/15/2009 and analyzed in accordance with the attached chain-of-custody.

Unless otherwise noted, all analytical testing was accomplished in accordance with the guidelines established in our Quality Systems Manual, applicable standard operating procedures, and other related documentation. The original report of subcontracted analysis, if any, is provided herein, and follows the standard Calscience data package. The results in this analytical report are limited to the samples tested and any reproduction thereof must be made in its entirety.

If you have any questions regarding this report, please do not hesitate to contact the undersigned.

Sincerely,

Ranjit K. K. Clarke

Calscience Environmental
Laboratories, Inc.
Ranjit Clarke
Project Manager

Calscience Environmental Laboratories, Inc.

Work Order Case Narrative

Project Name: **East Junction HOV 98817**
Calscience Work Order Number: **09-01-1176**

1. Total Lead – EPA 6010B:

   A request was received from Kleinfelder, Inc. on 03/09/09 to homogenize and re-analyze samples “I215-03-0.5”, “I215-03-1.0”, and “I215-03-2.0” for Total Lead and TCLP Lead. Due the fact that there was limited sample remaining, the TCLP Lead analysis was cancelled. The Total Lead analysis, however, was performed. Both the original results and the rerun results for Total Lead are reported herein.

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/15/09
1220 Research Drive, Suite B		Work Order No:	09-01-1176
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction HOV 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
I215-03-0.5	**09-01-1176-4-A**	**01/14/09 09:30**	**Solid**	**ICP 5300**	**01/16/09**	**01/17/09 17:42**	**090116L04**

Comment(s): -Results were evaluated to the MDL, concentrations >= to the MDL but < RL, if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Lead	321	0.500	0.0527	1	B	mg/kg

I215-03-0.5	**09-01-1176-4-A**	**01/14/09 09:30**	**Solid**	**ICP 5300**	**03/09/09**	**03/10/09 10:34**	**090309L02**

Comment(s): -Results were evaluated to the MDL, concentrations >= to the MDL but < RL, if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Lead	111	0.500	0.0527	1	B	mg/kg

I215-03-1.0	**09-01-1176-5-A**	**01/14/09 09:35**	**Solid**	**ICP 5300**	**01/16/09**	**01/20/09 11:22**	**090116L04**

Comment(s): -Results were evaluated to the MDL, concentrations >= to the MDL but < RL, if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Lead	6510	5.00	0.527	10	B	mg/kg

I215-03-1.0	**09-01-1176-5-A**	**01/14/09 09:35**	**Solid**	**ICP 5300**	**03/09/09**	**03/10/09 10:35**	**090309L02**

Comment(s): -Results were evaluated to the MDL, concentrations >= to the MDL but < RL, if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Lead	948	0.500	0.0527	1	B	mg/kg

I215-03-2.0	**09-01-1176-6-A**	**01/14/09 09:40**	**Solid**	**ICP 5300**	**01/16/09**	**01/20/09 11:25**	**090116L04**

Comment(s): -Results were evaluated to the MDL, concentrations >= to the MDL but < RL, if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Lead	7650	5.00	0.527	10	B	mg/kg

I215-03-2.0	**09-01-1176-6-A**	**01/14/09 09:40**	**Solid**	**ICP 5300**	**03/09/09**	**03/10/09 10:37**	**090309L02**

Comment(s): -Results were evaluated to the MDL, concentrations >= to the MDL but < RL, if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Lead	50.8	0.500	0.0527	1	B	mg/kg

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/15/09
1220 Research Drive, Suite B		Work Order No:	09-01-1176
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction HOV 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**097-01-002-11,949**	**N/A**	**Solid**	**ICP 5300**	**01/16/09**	**01/17/09 17:15**	**090116L04**

Comment(s): -Results were evaluated to the MDL, concentrations >= to the MDL but < RL, if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Lead	0.180	0.500	0.0527	1	J	mg/kg

Method Blank	**097-01-002-12,104**	**N/A**	**Solid**	**ICP 5300**	**03/09/09**	**03/09/09 16:32**	**090309L02**

Comment(s): -Results were evaluated to the MDL, concentrations >= to the MDL but < RL, if found, are qualified with a "J" flag.

Parameter	Result	RL	MDL	DF	Qual	Units
Lead	0.204	0.500	0.0527	1	J	mg/kg

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received:	01/15/09
Work Order No:	09-01-1176
Preparation:	EPA 3050B
Method:	EPA 6010B

Project East Junction HOV 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
I215-01-0.5	**Solid**	**ICP 5300**	**01/16/09**	**01/17/09**	**090116S04**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	90	90	75-125	0	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received:	01/15/09
Work Order No:	09-01-1176
Preparation:	EPA 3050B
Method:	EPA 6010B

Project East Junction HOV 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
09-03-0666-1	**Solid**	**ICP 5300**	**03/09/09**	**03/09/09**	**090309S02**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	103	101	75-125	1	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - PDS / PDSD

Kleinfelder Inc.		Date Received	01/15/09
1220 Research Drive, Suite B		Work Order No:	09-01-1176
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction HOV 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	PDS/PDSD Batch Number
09-03-0666-1	**Solid**	**ICP 5300**	**03/09/09**	**03/09/09**	**090309S02**

Parameter	PDS %REC	PDSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	99	97	75-125	2	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Laboratory Control Sample

Kleinfelder Inc.		Date Received:	N/A
1220 Research Drive, Suite B		Work Order No:	09-01-1176
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction HOV 98817

Quality Control Sample ID	Matrix	Instrument	Date Analyzed	Lab File ID	LCS Batch Number
097-01-002-11,949	**Solid**	**ICP 5300**	**01/17/09**	**090116-I-04**	**090116L04**

Parameter	Conc Added	Conc Recovered	LCS %Rec	%Rec CL	Qualifiers
Lead	25.0	26.5	106	80-120	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Kleinfelder Inc.		Date Received:	N/A
1220 Research Drive, Suite B		Work Order No:	09-01-1176
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction HOV 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
097-01-002-12,104	**Solid**	**ICP 5300**	**03/09/09**	**03/09/09**	**090309L02**

Parameter	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	107	103	80-120	4	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Glossary of Terms and Qualifiers

Work Order Number: 09-01-1176

Qualifier	Definition
*	See applicable analysis comment.
1	Surrogate compound recovery was out of control due to a required sample dilution, therefore, the sample data was reported without further clarification.
2	Surrogate compound recovery was out of control due to matrix interference. The associated method blank surrogate spike compound was in control and, therefore, the sample data was reported without further clarification.
3	Recovery of the Matrix Spike (MS) or Matrix Spike Duplicate (MSD) compound was out of control due to matrix interference. The associated LCS and/or LCSD was in control and, therefore, the sample data was reported without further clarification.
4	The MS/MSD RPD was out of control due to matrix interference. The LCS/LCSD RPD was in control and, therefore, the sample data was reported without further clarification.
5	The PDS/PDSD associated with this batch of samples was out of control due to a matrix interference effect. The associated batch LCS/LCSD was in control and, hence, the associated sample data was reported with no further corrective action required.
A	Result is the average of all dilutions, as defined by the method.
B	Analyte was present in the associated method blank.
C	Analyte presence was not confirmed on primary column.
E	Concentration exceeds the calibration range.
H	Sample received and/or analyzed past the recommended holding time.
J	Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.
ME	LCS Recovery Percentage is within LCS ME Control Limit range.
N	Nontarget Analyte.
ND	Parameter not detected at the indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the parameter concentration in the sample exceeding the spike concentration by a factor of four or greater.
U	Undetected at the laboratory method detection limit.
X	% Recovery and/or RPD out-of-range.
Z	Analyte presence was not confirmed by second column or GC/MS analysis.

Calscience Environmental Laboratories, Inc.

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(714) 895-5494

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5063 Commercial Circle, Suite H
Concord, CA 94520-8577
(925) 689-9022

CHAIN OF CUSTODY RECORD

Date 1-14-09

Page 1 of 6

LABORATORY CLIENT: Kleinfelder

ADDRESS: 1220 Research Dr. suite B

CITY: Redlands STATE: CA ZIP:

TEL: (951) 506-1488 E-MAIL:

CLIENT PROJECT NAME / NUMBER: East Junction HOV 98817

P.O. NO.:

PROJECT CONTACT: Liz Simmons

LAB USE ONLY: 01-1176

SAMPLER(S): (PRINT) Jason Williams

COELT LOG CODE ☐☐☐☐

COOLER RECEIPT TEMP= °C

TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☐ 5 DAYS ☒ 10 DAYS

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY)
☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐

SPECIAL INSTRUCTIONS:

REQUESTED ANALYSES

LAB USE ONLY	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.	Total Lead	TCLP	pH
1	I215-01-0.5		1-14-09	0915	Soil	1	X		
2	I215-01-1.0			0920					
3	I215-01-2.0			0925				X	
4	I215-03-0.5			0930					
5	I215-03-1.0			0935					X
6	I215-03-2.0			0940					
7	I215-05-0.5			0945					
8	I215-05-1.0			0950					
9	I215-05-2.0			0955					
10	I215-08-0.5			1000					

Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
[signature]	FMG CEL	1/15/9	1050
FMG	[signature]	1/15/09	1315

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ADDRESS: 1220 Research Dr. Suite B

CITY: Red lands STATE: ZIP:

TEL: (951) 506-1488 E-MAIL:

CLIENT PROJECT NAME / NUMBER: East Junction Hov 98817

PROJECT CONTACT: Liz Simmons

P.O. NO.:

LAB USE ONLY: 0 1 - 1 1 7 6

SAMPLER(S): (PRINT) Jason Williams

COELT LOG CODE

COOLER RECEIPT TEMP= °C

TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☐ STANDARD

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY): ☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐

SPECIAL INSTRUCTIONS:

REQUESTED ANALYSES

LAB USE ONLY	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.	TPH (g)	TPH (d) or (C6-C36) or (C6-C44)	TPH ( )	BTEX / MTBE (8260B) or ( )	VOCs (8260B)	Oxygenates (8260B)	Encore Prep (5035)	SVOCs (8270C)	Pesticides (8081A)	PCBs (8082)	PNAs (8310) or (8270C)	T22 Metals (6010B/747X)	Cr(VI) [7196A or 7199 or 218.6]	VOCs (TO-14A) or (TO-15)	TPH (g) [TO-3]+	Total Lead	TCLP	PH
11	I215-8-1.0		1-14-09	1005	Soil	1																X		
12	I215-8-2.0			1010																				
13	I215-10-0.5			1015																			X	
14	I215-10-1.0			1020																				
15	I215-10-2.0			1025																				
16	I215-12-0.5			1030																				X
17	I215-12-1.0			1035																				
18	I215-12-2.0			1040																				
19	I215-14-0.5			1045																				
20	I215-14-1.0			1050																				

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[signature]	Eng CEL	1/15/9	1050
Eng	[signature]	1/15/09	1315

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LABORATORY CLIENT: Kleinfelder

ADDRESS: 1220 Research Dr. Suite B

CITY: Redlands STATE: CA ZIP:

TEL (951) 506-1488 E-MAIL:

CLIENT PROJECT NAME / NUMBER: East Junction HOV 98817

P.O. NO.:

PROJECT CONTACT: Liz Simmons

0 0 1 1 7 6

SAMPLER(S): (PRINT) Jason Williams

COELT LOG CODE

COOLER RECEIPT TEMP= °C

TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☐ 5 DAYS ☒ 10 DAYS

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY)
☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐

SPECIAL INSTRUCTIONS:

REQUESTED ANALYSES

LAB USE ONLY	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.	TPH (g)	TPH (d) or (C7-C36) or (C7-C44)	TPH ( )	BTEX / MTBE (8260B) or ( )	VOCs (8260B)	Oxygenates (8260B)	Encore Prep (5035)	SVOCs (8270C)	Pesticides (8081A)	PCBs (8082)	PNAs (8310) or (8270C)	T22 Metals (6010B/747X)	Cr(VI) [7196A or 7199 or 218.6]	VOCs (TO-14A) or (TO-15)	TPH (g) [TO-3]+	Total Lead	TCLP	PH
21	I215-14-2.0		1-14-09	1055	Soil	1																X		
22	I215-15-0.5			1115																				X
23	I215-15-1.0			1120																				
24	I215-15-2.0			1125																				
25	I215-16-0.5			1130																			X	
26	I215-16-1.0			1135																				
27	I215-16-2.0			1140																				
28	I215-17-0.5			1145																				
29	I215-17-1.0			1150																				
30	I215-17-2.0			1155																				

Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
[signature]	FMS CEL	1/15/9	1050
FMS	[signature]	1/15/09	1315

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CHAIN OF CUSTODY RECORD

Date 1-14-09

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LABORATORY CLIENT: Kleinfelder

ADDRESS: 1220 Research Dr. Suite B

CITY: Redlands STATE: CA ZIP:

TEL: (951) 506-1488 E-MAIL:

CLIENT PROJECT NAME / NUMBER: East Junction HOV 98817

P.O. NO.:

PROJECT CONTACT: Liz Simmons

0 1 1 1 7 6

SAMPLER(S): (PRINT) Jason Williams

COELT LOG CODE

COOLER RECEIPT TEMP= °C

TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☐ 5 DAYS ☒ 10 DAYS

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY)
☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐

SPECIAL INSTRUCTIONS:

REQUESTED ANALYSES

LAB USE ONLY	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.	TPH (g)	TPH (d) or (C7-C36) or (C7-C44)	TPH ( )	BTEX / MTBE (8260B) or ( )	VOCs (8260B)	Oxygenates (8260B)	Encore Prep (5035)	SVOCs (8270C)	Pesticides (8081A)	PCBs (8082)	PNAs (8310) or (8270C)	T22 Metals (6010B/747X)	Cr(VI) [7196A or 7199 or 218.6]	VOCs (TO-14A) or (TO-15)	TPH (g) [TO-3]+	Total Lead	TCLP	PH
31	I215-02-0.5		1-14-09	1210	Soil	1																X		
32	I215-02-1.0			1215																				
33	I215-02-2.0			1220																			X	
34	I215-04-0.5			1225																				
35	I215-04-1.0			1230																				
36	I215-04-2.0			1235																				X
37	I215-06-0.5			1240																				
38	I215-06-1.0			1245																				
39	I215-06-2.0			1250																				
40	I215-07-0.5			1300																				

Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
[signature]	FMY CEL	1/15/9	1050
FMY	[signature]	1/15/09	1315

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CHAIN OF CUSTODY RECORD

Date 1-14-09

Page 5 of 6

LABORATORY CLIENT: Kleinfelder

ADDRESS: 1220 Research Dr. suite B

CITY: Redlands STATE: CA ZIP:

TEL: (951) 506-1488 E-MAIL:

CLIENT PROJECT NAME / NUMBER: East Junction HOV

P.O. NO.:

PROJECT CONTACT: Liz Simmons

CO 1 1 1 7 6

SAMPLER(S): (PRINT) Jason Williams

COELT LOG CODE

COOLER RECEIPT TEMP= °C

TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☐ 5 DAYS ☒ 10 DAYS

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY): ☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐

SPECIAL INSTRUCTIONS:

REQUESTED ANALYSES

LAE USE ONL	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.	TPH (g)	TPH (d) or (C7-C36) or (C7-C44)	TPH ( )	BTEX / MTBE (8260B) or ( )	VOCs (8260B)	Oxygenates (8260B)	Encore Prep (5035)	SVOCs (8270C)	Pesticides (8081A)	PCBs (8082)	PNAs (8310) or (8270C)	T22 Metals (6010B/747X)	Cr(VI) [7196A or 7199 or 218.6]	VOCs (TO-14A) or (TO-15)	TPH (g) [TO-3]+	Total Lead	TCLP	pH
41	I215-07-1.0		1-14-09	1305	Soil	1																X	X	
42	I215-07-2.0			1310																				
43	I215-09-0.5			1320																				X
44	I215-09-1.0			1325																				
45	I215-09-2.0			1330																				
46	I215-11-0.5			1340																				
47	I215-11-1.0			1345																				
48	I215-11-2.0			1350																				
49	I215-13-0.5			1355																				
50	I215-13-1.0			1400																				

Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
[signature]	FMF CEL	1/15/9	1050
Relinquished by: (Signature) FMF	Received by: (Signature/Affiliation) [signature]	Date: 1/15/09	Time: 1315
Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:

DISTRIBUTION: White with final report, Green and Yellow to Client.
Please note that pages 1 and 2 of 2 of our T/Cs are printed on the reverse side of the Green and Yellow copies respectively.

10/01/07 Revision

Calscience Environmental Laboratories, Inc.

☐ SoCal Laboratory
7440 Lincoln Way
Garden Grove, CA 92841-1427
(714) 895-5494

☐ NorCal Service Center
5063 Commercial Circle, Suite H
Concord, CA 94520-8577
(925) 689-9022

CHAIN OF CUSTODY RECORD

Date 1-14-09

Page 6 of 6

LABORATORY CLIENT: Klein Felder

ADDRESS: 1220 Research Dr. Suite B

CITY: Redlands STATE: ZIP:

TEL: (951) 506-1488 E-MAIL:

CLIENT PROJECT NAME / NUMBER: East Junction HOV 98817

P.O. NO.:

PROJECT CONTACT: Liz Simmons

0 1 1 1 7 6

SAMPLER(S): (PRINT) Jason Williams

COELT LOG CODE ☐☐☐☐

COOLER RECEIPT TEMP= °C

TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☐ 5 DAYS ☒ 10 DAYS

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY)
☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐

SPECIAL INSTRUCTIONS:

REQUESTED ANALYSES

LAE USE ONL.	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.	TPH (g)	TPH (d) or (C7-C36) or (C7-C44)	TPH ( )	BTEX / MTBE (8260B) or ( )	VOCs (8260B)	Oxygenates (8260B)	Encore Prep (5035)	SVOCs (8270C)	Pesticides (8081A)	PCBs (8082)	PNAs (8310) or (8270C)	T22 Metals (6010B/747X)	Cr(VI) [7196A or 7199 or 218.6]	VOCs (TO-14A) or (TO-15)	TPH (g) [TO-3]+	Total Lead		
51	I215-13-2.0		1-14-09	1405	Soil	1																X		
52	Rinsate		1-14-09	0900	water	1																X		

Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
[signature]	[signature] CEL	1/15/9	1050
[signature]	[signature]	1/15/09	1315

DISTRIBUTION: White with final report, Green and Yellow to Client.
Please note that pages 1 and 2 of 2 of our T/Cs are printed on the reverse side of the Green and Yellow copies respectively.

10/01/07 Revision

Q&Q Graphic 714-898-9702

Calscience Environmental Laboratories, Inc.

WORK ORDER #: 09-01-1176

SAMPLE RECEIPT FORM

Cooler 1 of 1

CLIENT: Kleinfelder

DATE: 1/15/9

TEMPERATURE: (Criteria: 0.0 °C – 6.0 °C, not frozen)

Temperature 1.9 °C - 0.2 °C (CF) = 1.7 °C ☑ Blank ☐ Sample

☐ Sample(s) outside temperature criteria (PM/APM contacted by:_____).

☐ Sample(s) outside temperature criteria but received on ice/chilled on same day of sampling.

☐ **Received at ambient temperature, placed on ice for transport by Courier.**

Ambient Temperature: ☐ Air ☐ Filter ☐ Metals Only ☐ PCBs Only Initial: FMG

CUSTODY SEALS INTACT:

☐ Cooler ☐_____ ☐ No (Not Intact) ☑ Not Present ☐ N/A Initial: FMG

☐ Sample ☐_____ ☐ No (Not Intact) ☑ Not Present Initial: WSC

SAMPLE CONDITION:	Yes	No	N/A
Chain-Of-Custody (COC) document(s) received with samples	☑	☐	☐
COC document(s) received complete	☑	☐	☐
Sampler's name indicated on COC	☑	☐	☐
Sample container label(s) consistent with COC	☑	☐	☐
Sample container(s) intact and good condition	☑	☐	☐
Correct containers and volume for analyses requested	☑	☐	☐
Analyses received within holding time	☑	☐	☐
Proper preservation noted on COC or sample container	☑	☐	☐
Volatile analysis container(s) free of headspace	☐	☐	☑
Tedlar bag(s) free of condensation	☐	☐	☑

CONTAINER TYPE:

Solid: ☐4ozCGJ ☑8ozCGJ ☐16ozCGJ ☐Sleeve ☐EnCores® ☐TerraCores® ☐_____

Water: ☐VOA ☐VOAh ☐VOAna$_2$ ☐125AGB ☐125AGBh ☐125AGBpo$_4$ ☐1AGB ☐1AGBna$_2$ ☐1AGBs ☐500AGB ☐500AGBs ☐250CGB ☐250CGBs ☐1PB ☐500PB ☐500PBna ☐250PB ☑250PBn (-32) ☐125PB ☐125PBznna ☐100PBsterile ☐100PBna$_2$ ☐_____ ☐_____ ☐_____

Air: ☐Tedlar® ☐Summa® ☐_____

Checked/Labeled by: WSC

Reviewed by: BF

Scanned by: WSC

Container: C:Clear A:Amber P:Poly/Plastic G:Glass J:Jar B:Bottle

Preservative: h:HCL n:HNO_3 na$_2$:$Na_2S_2O_3$ na:NaOH po$_4$:H_3PO_4 s:H_2SO_4 znna:ZnAc$_2$+NaOH

Ranjit Clarke

From: Jen Grippa [JSGrippa@kleinfelder.com]
Sent: Monday, March 09, 2009 4:21 PM
To: Johnny Dao
Cc: Ranjit Clarke; Liz Simmons
Subject: RE: Sample processing question

Ranjit,
As Johnny has confirmed these three samples are still on-hand, please homogenize the three samples and re-analyzed for total lead and TCLP with the fastest turn around that the methods/extractions will allow (Johnny wasn't sure if it was 3 days or less).

I'd also like to talk to you regarding the homogenization in general, can you please call me in the office tomorrow?

Thanks,

Jen Grippa
Project Professional - Environmental Services
43174 Business Park Drive, Suite 103
Temecula, CA 92590
o| 951.506.1488
c| 951.634.1941
(http://www.kleinfelder.com)

>>> "Johnny Dao" <JDao@calscience.com> 3/6/2009 3:58 PM >>>
Hi Jen,

For samples 09-01-1176-4,5,6 (I215-03-0.5, -1.0, -2.0), the samples were not homogenized prior to testing unless the client specially requested it.

Johnny

-----Original Message-----
From: Jen Grippa [mailto:JSGrippa@kleinfelder.com]
Sent: Friday, March 06, 2009 3:14 PM
To: Johnny Dao
Subject: Sample processing question

Hi Johnny,
Our client would like to know the following information for the samples from 09-01-1176 (I215-03-0.5, -1.5, -3.0):

How were the samples processed. Specifically if the samples were homogenized prior to testing.

Thank you for your assistance,

Jen Grippa
Project Professional - Environmental Services
43174 Business Park Drive, Suite 103
Temecula, CA 92590
o| 951.506.1488
c| 951.634.1941
(http://www.kleinfelder.com)

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Calscience Environmental Laboratories, Inc.

Supplemental Report 1

January 30, 2009

Additional requested analyses have been added to the original report.

Liz Simmons
Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Subject: **Calscience Work Order No.: 09-01-1379**
Client Reference: East Junction 98817

Dear Client:

Enclosed is an analytical report for the above-referenced project. The samples included in this report were received 1/16/2009 and analyzed in accordance with the attached chain-of-custody.

Unless otherwise noted, all analytical testing was accomplished in accordance with the guidelines established in our Quality Systems Manual, applicable standard operating procedures, and other related documentation. The original report of subcontracted analysis, if any, is provided herein, and follows the standard Calscience data package. The results in this analytical report are limited to the samples tested and any reproduction thereof must be made in its entirety.

If you have any questions regarding this report, please do not hesitate to contact the undersigned.

Sincerely,

Ranjit K. K. Clarke

Calscience Environmental
Laboratories, Inc.
Ranjit Clarke
Project Manager

Calscience Environmental Laboratories, Inc.

Work Order Case Narrative

Project Name: **East Junction 98817**
Calscience Work Order Number: **09-01-1379**

1. EPA 6010B – STLC & STLC-DI

   An e-mail request was received from Kleinfelder on 01/23/09 to perform additional analyses on selected samples via EPA 6010B (STLC and STLC-DI) for Lead.

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1379
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BS-03-0.5	**09-01-1379-1-A**	**01/16/09 09:15**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 15:43**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	136	0.500	1		mg/kg

BS-03-1.0	**09-01-1379-2-A**	**01/16/09 09:17**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 16:43**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	115	0.500	1		mg/kg

BS-03-2.0	**09-01-1379-3-A**	**01/16/09 09:20**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 15:44**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	232	0.500	1		mg/kg

BS-03-3.0	**09-01-1379-4-A**	**01/16/09 09:25**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 15:46**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	170	0.500	1		mg/kg

BS-03-5.0	**09-01-1379-5-A**	**01/16/09 09:30**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 15:48**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	18.1	0.500	1		mg/kg

BS-03-10.0	**09-01-1379-6-A**	**01/16/09 09:55**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 15:49**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	50.3	0.500	1		mg/kg

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1379
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BS-03-20.0	**09-01-1379-7-A**	**01/16/09 11:05**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 15:51**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	46.4	0.500	1		mg/kg

BS-02-0.5	**09-01-1379-8-A**	**01/16/09 11:25**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 15:52**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	27.9	0.500	1		mg/kg

BS-02-1.0	**09-01-1379-9-A**	**01/16/09 11:28**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 15:54**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	15.0	0.500	1		mg/kg

BS-02-2.0	**09-01-1379-10-A**	**01/16/09 11:35**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 15:56**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	6.86	0.500	1		mg/kg

BS-02-3.0	**09-01-1379-11-A**	**01/16/09 11:40**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 15:57**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	5.99	0.500	1		mg/kg

BS-02-5.0	**09-01-1379-12-A**	**01/16/09 11:50**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 16:02**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	7.09	0.500	1		mg/kg

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1379
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BS-02-10.0	**09-01-1379-13-A**	**01/16/09 12:00**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 16:04**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	8.00	0.500	1		mg/kg

BS-02-12.0	**09-01-1379-14-A**	**01/16/09 12:40**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 16:05**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	7.38	0.500	1		mg/kg

DUP-5	**09-01-1379-15-A**	**01/16/09 11:28**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 16:07**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	22.6	0.500	1		mg/kg

Method Blank	**097-01-002-11,968**	**N/A**	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09 16:35**	**090119L02**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.500	1		mg/kg

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1379
Redlands, CA 92374-4552		Preparation:	EPA 1311
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BS-03-5.0	**09-01-1379-5-A**	**01/16/09 09:30**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 13:23**	**090119LA1A**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

BS-02-1.0	**09-01-1379-9-A**	**01/16/09 11:28**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 13:24**	**090119LA1A**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

BS-02-10.0	**09-01-1379-13-A**	**01/16/09 12:00**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 13:26**	**090119LA1A**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

Method Blank	**097-05-001-3,843**	**N/A**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 11:22**	**090119LA1A**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1379
Redlands, CA 92374-4552		Preparation:	T22.11.5. All
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BS-03-0.5	**09-01-1379-1-A**	**01/16/09 09:15**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 19:05**	**090127LA1**

Parameter	Result	RL	DF	Qual	Units
Lead	6.14	0.100	1		mg/L

BS-03-1.0	**09-01-1379-2-A**	**01/16/09 09:17**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 19:06**	**090127LA1**

Parameter	Result	RL	DF	Qual	Units
Lead	4.94	0.100	1		mg/L

BS-03-2.0	**09-01-1379-3-A**	**01/16/09 09:20**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 19:08**	**090127LA1**

Parameter	Result	RL	DF	Qual	Units
Lead	11.8	0.100	1		mg/L

BS-03-3.0	**09-01-1379-4-A**	**01/16/09 09:25**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 19:10**	**090127LA1**

Parameter	Result	RL	DF	Qual	Units
Lead	4.20	0.100	1		mg/L

BS-03-10.0	**09-01-1379-6-A**	**01/16/09 09:55**	**Solid**	**ICP 5300**	**01/23/09**	**01/29/09 19:15**	**090127LA1**

Parameter	Result	RL	DF	Qual	Units
Lead	4.59	0.100	1		mg/L

BS-03-20.0	**09-01-1379-7-A**	**01/16/09 11:05**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 19:15**	**090127LA1**

Parameter	Result	RL	DF	Qual	Units
Lead	3.30	0.100	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1379
Redlands, CA 92374-4552		Preparation:	T22.11.5. All
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BS-02-0.5	**09-01-1379-8-A**	**01/16/09 11:25**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 19:17**	**090127LA1**

Parameter	Result	RL	DF	Qual	Units
Lead	1.40	0.100	1		mg/L

Method Blank	**097-05-006-4,435**	**N/A**	**Solid**	**ICP 5300**	**01/23/09**	**01/27/09 11:23**	**090127LA1**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1379
Redlands, CA 92374-4552		Preparation:	T22.11.5.AII DI
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BS-03-0.5	**09-01-1379-1-A**	**01/16/09 09:15**	**Solid**	**ICP 5300**	**01/23/09**	**01/27/09 21:00**	**090126LA4**

Parameter	Result	RL	DF	Qual	Units
Lead	0.386	0.100	1		mg/L

BS-03-1.0	**09-01-1379-2-A**	**01/16/09 09:17**	**Solid**	**ICP 5300**	**01/23/09**	**01/27/09 21:08**	**090126LA4**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

BS-03-2.0	**09-01-1379-3-A**	**01/16/09 09:20**	**Solid**	**ICP 5300**	**01/23/09**	**01/27/09 21:11**	**090126LA4**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

BS-03-3.0	**09-01-1379-4-A**	**01/16/09 09:25**	**Solid**	**ICP 5300**	**01/23/09**	**01/27/09 21:14**	**090126LA4**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

Method Blank	**097-05-006-4,438**	**N/A**	**Solid**	**ICP 5300**	**01/23/09**	**01/27/09 20:55**	**090126LA4**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received: 01/16/09
Work Order No: 09-01-1379

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date Collected	Matrix
BS-03-1.0	**09-01-1379-2**	**01/16/09**	**Solid**

Parameter	Result	RL	DF	Qual	Units	Date Prepared	Date Analyzed	Method
pH	6.78	0.01	1		pH units	01/16/09	01/16/09	EPA 9045D

BS-03-20.0	**09-01-1379-7**	**01/16/09**	**Solid**

Parameter	Result	RL	DF	Qual	Units	Date Prepared	Date Analyzed	Method
pH	7.13	0.01	1		pH units	01/16/09	01/16/09	EPA 9045D

BS-02-5.0	**09-01-1379-12**	**01/16/09**	**Solid**

Parameter	Result	RL	DF	Qual	Units	Date Prepared	Date Analyzed	Method
pH	7.34	0.01	1		pH units	01/16/09	01/16/09	EPA 9045D

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1379
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
BS-03-1.0	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09**	**090119S02**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	4X	4X	75-125	4X	0-20	Q

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received:	01/16/09
Work Order No:	09-01-1379
Preparation:	EPA 1311
Method:	EPA 6010B

Project East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
09-01-1176-3	**Solid**	**ICP 5300**	**01/16/09**	**01/21/09**	**090119SA1**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	99	100	75-125	1	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received:	01/16/09
Work Order No:	09-01-1379
Preparation:	T22.11.5.AII DI
Method:	EPA 6010B

Project East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
BS-03-0.5	**Solid**	**ICP 5300**	**01/23/09**	**01/27/09**	**090126SA4**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	96	94	75-125	2	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received:	01/16/09
Work Order No:	09-01-1379
Preparation:	T22.11.5. All
Method:	EPA 6010B

Project East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
09-01-1500-2	**Solid**	**ICP 5300**	**01/23/09**	**01/27/09**	**090127SA1**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	82	61	75-125	10	0-20	3

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Duplicate

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received: N/A
Work Order No: 09-01-1379

Project: East Junction 98817

Matrix: Solid

Parameter	Method	QC Sample ID	Date Analyzed	Sample Conc	DUP Conc	RPD	RPD CL	Qualifiers
pH	EPA 9045D	09-01-0363-25	01/16/09	8.20	8.23	0	0-25	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Kleinfelder Inc.		Date Received:	N/A
1220 Research Drive, Suite B		Work Order No:	09-01-1379
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
097-01-002-11,968	**Solid**	**ICP 5300**	**01/19/09**	**01/21/09**	**090119L02**

Parameter	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	107	106	80-120	1	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Laboratory Control Sample

Kleinfelder Inc.		Date Received:	N/A
1220 Research Drive, Suite B		Work Order No:	09-01-1379
Redlands, CA 92374-4552		Preparation:	EPA 1311
		Method:	EPA 6010B

Project: East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Analyzed	Lab File ID	LCS Batch Number
097-05-001-3,843	**Solid**	**ICP 5300**	**01/21/09**	**090119-la-02**	**090119LA1A**

Parameter	Conc Added	Conc Recovered	LCS %Rec	%Rec CL	Qualifiers
Lead	5.00	5.05	101	80-120	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Laboratory Control Sample

Kleinfelder Inc.		Date Received:	N/A
1220 Research Drive, Suite B		Work Order No:	09-01-1379
Redlands, CA 92374-4552		Preparation:	T22.11.5.AII DI
		Method:	EPA 6010B

Project: East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Analyzed	Lab File ID	LCS Batch Number
097-05-006-4,438	**Solid**	**ICP 5300**	**01/27/09**	**090126-la-4**	**090126LA4**

Parameter	Conc Added	Conc Recovered	LCS %Rec	%Rec CL	Qualifiers
Lead	5.00	5.46	109	80-120	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Laboratory Control Sample

Kleinfelder Inc.		Date Received:	N/A
1220 Research Drive, Suite B		Work Order No:	09-01-1379
Redlands, CA 92374-4552		Preparation:	T22.11.5. All
		Method:	EPA 6010B

Project: East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Analyzed	Lab File ID	LCS Batch Number
097-05-006-4,435	**Solid**	**ICP 5300**	**01/27/09**	**090127-la-1**	**090127LA1**

Parameter	Conc Added	Conc Recovered	LCS %Rec	%Rec CL	Qualifiers
Lead	5.00	5.47	109	80-120	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Glossary of Terms and Qualifiers

Work Order Number: 09-01-1379

Qualifier	Definition
*	See applicable analysis comment.
1	Surrogate compound recovery was out of control due to a required sample dilution, therefore, the sample data was reported without further clarification.
2	Surrogate compound recovery was out of control due to matrix interference. The associated method blank surrogate spike compound was in control and, therefore, the sample data was reported without further clarification.
3	Recovery of the Matrix Spike (MS) or Matrix Spike Duplicate (MSD) compound was out of control due to matrix interference. The associated LCS and/or LCSD was in control and, therefore, the sample data was reported without further clarification.
4	The MS/MSD RPD was out of control due to matrix interference. The LCS/LCSD RPD was in control and, therefore, the sample data was reported without further clarification.
5	The PDS/PDSD associated with this batch of samples was out of control due to a matrix interference effect. The associated batch LCS/LCSD was in control and, hence, the associated sample data was reported with no further corrective action required.
A	Result is the average of all dilutions, as defined by the method.
B	Analyte was present in the associated method blank.
C	Analyte presence was not confirmed on primary column.
E	Concentration exceeds the calibration range.
H	Sample received and/or analyzed past the recommended holding time.
J	Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.
ME	LCS Recovery Percentage is within LCS ME Control Limit range.
N	Nontarget Analyte.
ND	Parameter not detected at the indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the parameter concentration in the sample exceeding the spike concentration by a factor of four or greater.
U	Undetected at the laboratory method detection limit.
X	% Recovery and/or RPD out-of-range.
Z	Analyte presence was not confirmed by second column or GC/MS analysis.

Calscience Environmental Laboratories, Inc.

☐ SoCal Laboratory
7440 Lincoln Way
Garden Grove, CA 92841-1427
(714) 895-5494

☐ NorCal Service Center
5063 Commercial Circle, Suite H
Concord, CA 94520-8577
(925) 689-9022

CHAIN OF CUSTODY RECORD

Date 1-16-09

Page 1 of 2

LABORATORY CLIENT: Kleinfelder

ADDRESS: 1220 Research Dr. Suite B

CITY: Redlands STATE: CA ZIP:

TEL: (951) 506-1488 E-MAIL:

TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☒ STANDARD

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY): ☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐

SPECIAL INSTRUCTIONS:

CLIENT PROJECT NAME / NUMBER: East Junction 98817

P.O. NO.:

PROJECT CONTACT: Liz Simmons

LAB USE ONLY: 0 1 - 1 3 7 9

SAMPLER(S): (PRINT) Jason Williams

COELT LOG CODE

COOLER RECEIPT TEMP= °C

REQUESTED ANALYSES

LAB USE ONLY	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.	TPH (g)	TPH (d) or (C6-C36) or (C6-C44)	TPH (___)	BTEX / MTBE (8260B) or (___)	VOCs (8260B)	Oxygenates (8260B)	Encore Prep (5035)	SVOCs (8270C)	Pesticides (8081A)	PCBs (8082)	PNAs (8310) or (8270C)	T22 Metals (6010B/747X)	Cr(VI) [7196A or 7199 or 218.6]	VOCs (TO-14A) or (TO-15)	TPH (g) [TO-3]+ ___	Total Lead	pH	TCLP
1	BS-03-0.5		1-16-09	0915	Soil	1																X		
2	BS-03-1.0			0917																			X	
3	BS-03-2.0			0920																				
4	BS-03-3.0			0925																				
5	BS-03-5.0			0930																				X
6	BS-03-10.0			0955																				
7	BS-03-20.0			1105																			X	
8	BS-02-.5			1125																				
9	BS-02-1.0			1128																				X
10	BS-02-2.0			1135																				

Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
FMS	FMS CEL	1/16/9	245
FMS	Wbatu CEL	1/16/09	1650

DISTRIBUTION: White with final report, Green and Yellow to Client.
Please note that pages 1 and 2 of 2 of our T/Cs are printed on the reverse side of the Green and Yellow copies respectively.

05/01/07 Revision

Q&Q Graphic 714-898-9702

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(714) 895-5494

☐ NorCal Service Center
5063 Commercial Circle, Suite H
Concord, CA 94520-8577
(925) 689-9022

CHAIN OF CUSTODY RECORD

Date 1-16-09

Page 2 of 2

LABORATORY CLIENT: Kleinfelder

ADDRESS: 1220 Research Dr. Suite B

CITY: Redlands STATE: CA ZIP:

TEL: (951) 506-1488 E-MAIL:

CLIENT PROJECT NAME / NUMBER: East Junction 98817

P.O. NO.:

PROJECT CONTACT: Liz Simmons

0 1 1 3 7 9

SAMPLER(S): (PRINT) Jason Williams

COELT LOG CODE

COOLER RECEIPT TEMP= °C

TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☐ 5 DAYS ☒ 10 DAYS

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY)
☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐

SPECIAL INSTRUCTIONS:

REQUESTED ANALYSES

LAB USE ONLY	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.	TPH (g)	TPH (d) or (C7-C36) or (C7-C44)	TPH ( )	BTEX / MTBE (8260B) or ( )	VOCs (8260B)	Oxygenates (8260B)	Encore Prep (5035)	SVOCs (8270C)	Pesticides (8081A)	PCBs (8082)	PNAs (8310) or (8270C)	T22 Metals (6010B/747X)	Cr(VI) [7196A or 7199 or 218.6]	VOCs (TO-14A) or (TO-15)	TPH (g) [TO-3]+	Total Lead	pH	TCLP
11	BS-02-3.0		1/16/09	1140	Soil	1																X		
12	BS-02-5.0			1150																			X	
13	BS-02-10.0			1200																				X
14	BS-02-12.0			1240																				
15	DUP-5			1128																				

Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
	FMG CEL	1/16/9	1445
FMG	WCBatu CEL	1/16/09	1650

DISTRIBUTION: White with final report, Green and Yellow to Client.
Please note that pages 1 and 2 of 2 of our T/Cs are printed on the reverse side of the Green and Yellow copies respectively.

10/01/07 Revision

Calscience Environmental Laboratories, Inc.

WORK ORDER #: 09-01-1379

SAMPLE RECEIPT FORM

Cooler 1 of 1

CLIENT: Kleinfelder

DATE: 1/16/9

TEMPERATURE: (Criteria: 0.0 °C – 6.0 °C, not frozen)

Temperature 1.4 °C - 0.2 °C (CF) = 1.2 °C ☑ Blank ☐ Sample

☐ Sample(s) outside temperature criteria (PM/APM contacted by: _____).

☐ Sample(s) outside temperature criteria but received on ice/chilled on same day of sampling.

☐ **Received at ambient temperature, placed on ice for transport by Courier.**

Ambient Temperature: ☐ Air ☐ Filter ☐ Metals Only ☐ PCBs Only Initial: FMG

CUSTODY SEALS INTACT:

☐ Cooler ☐ _____ ☐ No (Not Intact) ☑ Not Present ☐ N/A Initial: FMG

☐ Sample ☐ _____ ☐ No (Not Intact) ☑ Not Present Initial: BP

SAMPLE CONDITION:	Yes	No	N/A
Chain-Of-Custody (COC) document(s) received with samples	☑	☐	☐
COC document(s) received complete	☑	☐	☐
Sampler's name indicated on COC	☑	☐	☐
Sample container label(s) consistent with COC	☑	☐	☐
Sample container(s) intact and good condition	☑	☐	☐
Correct containers and volume for analyses requested	☑	☐	☐
Analyses received within holding time	☑	☐	☐
Proper preservation noted on COC or sample container	☐	☐	☑
Volatile analysis container(s) free of headspace	☐	☐	☑
Tedlar bag(s) free of condensation	☐	☐	☑

CONTAINER TYPE:

Solid: ☐4ozCGJ ☑8ozCGJ ☐16ozCGJ ☐Sleeve ☐EnCores® ☐TerraCores® ☐_____

Water: ☐VOA ☐VOAh ☐VOAna$_2$ ☐125AGB ☐125AGBh ☐125AGBpo$_4$ ☐1AGB ☐1AGBna$_2$ ☐1AGBs ☐500AGB ☐500AGBs ☐250CGB ☐250CGBs ☐1PB ☐500PB ☐500PBna ☐250PB ☐250PBn ☐125PB ☐125PBznna ☐100PBsterile ☐100PBna$_2$ ☐_____ ☐_____ ☐_____

Air: ☐Tedlar® ☐Summa® ☐_____

Checked/Labeled by: BP

Reviewed by: YL

Scanned by: BP

Container: C:Clear A:Amber P:Poly/Plastic G:Glass J:Jar B:Bottle

Preservative: h:HCL n:HNO$_3$ na$_2$:Na$_2$S$_2$O$_3$ na:NaOH po$_4$:H$_3$PO$_4$ s:H$_2$SO$_4$ znna:ZnAc$_2$+NaOH

Ranjit Clarke

From: Liz Simmons [LSimmons@kleinfelder.com]
Sent: Friday, January 23, 2009 4:56 PM
To: Ranjit Clarke; Jen Grippa
Subject: Re: East Junction 98817 / CEL 09-01-1382 (01/15/09)

Thanks Ranjit! Attached is a spreadsheet showing additional analyses that need to be run on project samples (ie, WET [STLC], DI-WET [STLC], and TCLP). Let me know if you have any questions. Thanks again.

Liz

>>> "Ranjit Clarke" <RClarke@calscience.com> 1/23/2009 10:24 AM >>>
<<09-01-1382.pdf>>
Here is the final PDF report for the samples collected on 01/15/09.

> Ranjit K. K. Clarke
> Project Manager
> Calscience Environmental
> Laboratories, Inc.
> 7440 Lincoln Way
> Garden Grove, CA 92841-1427
> Tel.: 714-895-5494 Ext. 222
> Fax : 714-894-7501
> rclarke@calscience.com
>
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Warning: Information provided via electronic media is not guaranteed against defects including translation and

Lead Sample Tests Table

East Junction ADL

Sample ID	TOTAL LEAD mg/kg	WET mg/L	DI WET mg/L	TCLP mg/L
Order#: Date Sampled, 09-01-1379: 1/16/09				
BS-02-0.5	27.9	X		
BS-03-0.5	136	X	X	
BS-03-1.0	115	X	X	
BS-03-2.0	232	X	X	
BS-03-3.0	170	X	X	
BS-03-10.0	50.3	X		
BS-03-20.0	46.4	X		
Order#: Date Sampled, 09-01-1176: 1/14/09				
I215-01-0.5	38.9	X		
I215-02-0.5	28.9	X		
I215-03-0.5	321	X	X	X
I215-03-1.0	6,510	X	X	X
I215-03-2.0	7,650	X	X	X
I215-06-1.0	48.7	X		
I215-07-0.5	28.3	X		
I215-10-0.5	54.3	X		
I215-15-0.5	51.3	X		
I215-04-0.5	77.2	X		
I215-06-0.5	137	X	X	
I215-09-2.0	87.0	X		
I215-12-0.5	42.8	X		
I215-13-0.5	420	X	X	
I215-14-1.0	37.5	X		
I215-16-0.5	37.0	X		
Order#: Date Sampled, 09-01-1382: 1/15/09				
BS-01-0.5	79.4	X		
60WB-01-0.5	38.0	X		
60WB-01-2.0	55.1	X		
60WB-02-1.0	86.1	X		
60WB-03-0.5	41.7	X		
60WB-03-1.0	78.1	X		
60WB-04-0.5	55.7	X		
60WB-04-1.0	59.5	X		
60WB-04-2.0	132	X	X	
DUP-1	55.5	X		
DUP-2	47.8	X		
DUP-3	70.5	X		
DUP-4	85.8	X		
Total: 108 Samples as of 1/23/09		36 WET	10 DI WET	3 TCLP

Calscience Environmental Laboratories, Inc.

Supplemental Report 1

February 02, 2009

Additional requested analyses have been added to the original report.

Liz Simmons
Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Subject: **Calscience Work Order No.: 09-01-1382**
Client Reference: East Junction 98817

Dear Client:

Enclosed is an analytical report for the above-referenced project. The samples included in this report were received 1/16/2009 and analyzed in accordance with the attached chain-of-custody.

Unless otherwise noted, all analytical testing was accomplished in accordance with the guidelines established in our Quality Systems Manual, applicable standard operating procedures, and other related documentation. The original report of subcontracted analysis, if any, is provided herein, and follows the standard Calscience data package. The results in this analytical report are limited to the samples tested and any reproduction thereof must be made in its entirety.

If you have any questions regarding this report, please do not hesitate to contact the undersigned.

Sincerely,

Ranjit K. K. Clarke

Calscience Environmental
Laboratories, Inc.
Ranjit Clarke
Project Manager

Calscience Environmental Laboratories, Inc.

Work Order Case Narrative

Project Name: **East Junction 98817**
Calscience Work Order Number: **09-01-1382**

1. EPA 6010B – STLC & STLC-DI

   An e-mail request was received from Kleinfelder on 01/23/09 to perform additional analyses on selected samples via EPA 6010B (STLC and STLC-DI) for Lead.

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BS-01-0.5	**09-01-1382-1-A**	**01/15/09 09:40**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 14:45**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	79.4	0.500	1		mg/kg

BS-01-1.0	**09-01-1382-2-A**	**01/15/09 09:45**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 14:47**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	7.08	0.500	1		mg/kg

BS-01-2.0	**09-01-1382-3-A**	**01/15/09 09:50**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 14:48**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	16.8	0.500	1		mg/kg

BS-01-3.0	**09-01-1382-4-A**	**01/15/09 09:55**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 14:50**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	10.2	0.500	1		mg/kg

BS-01-5.0	**09-01-1382-5-A**	**01/15/09 10:15**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 14:52**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	3.69	0.500	1		mg/kg

BS-01-10.0	**09-01-1382-6-A**	**01/15/09 10:45**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 14:53**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	4.19	0.500	1		mg/kg

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BS-01-20.0	**09-01-1382-7-A**	**01/15/09 11:15**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 14:55**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	1.24	0.500	1		mg/kg

BS-04-0.5	**09-01-1382-8-A**	**01/15/09 11:35**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 14:56**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	7.80	0.500	1		mg/kg

BS-04-1.0	**09-01-1382-9-A**	**01/15/09 11:38**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 14:58**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	1.66	0.500	1		mg/kg

BS-04-2.0	**09-01-1382-10-A**	**01/15/09 11:41**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:00**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	14.7	0.500	1		mg/kg

BS-4-3.0	**09-01-1382-11-A**	**01/15/09 11:45**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:04**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	9.95	0.500	1		mg/kg

BS-4-5.0	**09-01-1382-12-A**	**01/15/09 11:50**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:06**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	1.08	0.500	1		mg/kg

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BS-4-10.0	**09-01-1382-13-A**	**01/15/09 12:15**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:08**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	1.70	0.500	1		mg/kg

BS-4-20.0	**09-01-1382-14-A**	**01/15/09 13:15**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:09**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	0.922	0.500	1		mg/kg

60WB-01-0.5	**09-01-1382-15-A**	**01/15/09 13:50**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:11**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	38.0	0.500	1		mg/kg

60WB-01-1.0	**09-01-1382-16-A**	**01/15/09 13:55**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:12**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	23.6	0.500	1		mg/kg

60WB-01-2.0	**09-01-1382-17-A**	**01/15/09 14:00**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:14**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	55.1	0.500	1		mg/kg

60WB-02-0.5	**09-01-1382-18-A**	**01/15/09 14:05**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:15**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	18.1	0.500	1		mg/kg

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
60WB-02-1.0	**09-01-1382-19-A**	**01/15/09 14:10**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:17**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	86.1	0.500	1		mg/kg

60WB-02-2.0	**09-01-1382-20-A**	**01/15/09 14:15**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:19**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	3.82	0.500	1		mg/kg

60WB-03-0.5	**09-01-1382-21-A**	**01/15/09 14:35**	**Solid**	**ICP 5300**	**01/17/09**	**01/19/09 11:27**	**090117L04**

Parameter	Result	RL	DF	Qual	Units
Lead	41.7	0.500	1		mg/kg

60WB-03-1.0	**09-01-1382-22-A**	**01/15/09 14:40**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:23**	**090117L04**

Parameter	Result	RL	DF	Qual	Units
Lead	78.1	0.500	1		mg/kg

60WB-03-2.0	**09-01-1382-23-A**	**01/15/09 14:45**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:25**	**090117L04**

Parameter	Result	RL	DF	Qual	Units
Lead	6.36	0.500	1		mg/kg

60WB-04-0.5	**09-01-1382-24-A**	**01/15/09 14:20**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:27**	**090117L04**

Parameter	Result	RL	DF	Qual	Units
Lead	55.7	0.500	1		mg/kg

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
60WB-04-1.0	**09-01-1382-25-A**	**01/15/09 14:25**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:28**	**090117L04**

Parameter	Result	RL	DF	Qual	Units
Lead	59.5	0.500	1		mg/kg

60WB-04-2.0	**09-01-1382-26-A**	**01/15/09 14:30**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:30**	**090117L04**

Parameter	Result	RL	DF	Qual	Units
Lead	132	0.500	1		mg/kg

DUP-1	**09-01-1382-27-A**	**01/15/09 13:55**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:31**	**090117L04**

Parameter	Result	RL	DF	Qual	Units
Lead	55.5	0.500	1		mg/kg

DUP-2	**09-01-1382-28-A**	**01/15/09 14:10**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:33**	**090117L04**

Parameter	Result	RL	DF	Qual	Units
Lead	47.8	0.500	1		mg/kg

DUP-3	**09-01-1382-29-A**	**01/15/09 14:25**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:35**	**090117L04**

Parameter	Result	RL	DF	Qual	Units
Lead	70.5	0.500	1		mg/kg

DUP-4	**09-01-1382-30-A**	**01/15/09 14:40**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 15:36**	**090117L04**

Parameter	Result	RL	DF	Qual	Units
Lead	85.8	0.500	1		mg/kg

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**097-01-002-11,951**	**N/A**	**Solid**	**ICP 5300**	**01/17/09**	**01/19/09 11:19**	**090117L04**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.500	1		mg/kg

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**097-01-002-11,963**	**N/A**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 17:50**	**090117L03**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.500	1		mg/kg

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	EPA 3010A Total
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Rinsate	**09-01-1382-31-A**	**01/15/09 09:00**	**Aqueous**	**ICP 5300**	**01/21/09**	**01/22/09 13:56**	**090121LA1**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.0100	1		mg/L

Method Blank	**097-01-003-9,058**	**N/A**	**Aqueous**	**ICP 5300**	**01/21/09**	**01/22/09 11:00**	**090121LA1**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.0100	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	EPA 1311
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BS-01-5.0	**09-01-1382-5-A**	**01/15/09 10:15**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 13:16**	**090119LA1A**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

60WB-01-0.5	**09-01-1382-15-A**	**01/15/09 13:50**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 13:17**	**090119LA1A**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

60WB-04-2.0	**09-01-1382-26-A**	**01/15/09 14:30**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 13:19**	**090119LA1A**

Parameter	Result	RL	DF	Qual	Units
Lead	0.957	0.100	1		mg/L

Method Blank	**097-05-001-3,843**	**N/A**	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09 11:22**	**090119LA1A**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	T22.11.5. All
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
BS-01-0.5	**09-01-1382-1-A**	**01/15/09 09:40**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 00:31**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	4.03	0.100	1		mg/L

60WB-01-0.5	**09-01-1382-15-A**	**01/15/09 13:50**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 00:33**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	2.06	0.100	1		mg/L

60WB-01-2.0	**09-01-1382-17-A**	**01/15/09 14:00**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 00:34**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	4.25	0.100	1		mg/L

60WB-02-1.0	**09-01-1382-19-A**	**01/15/09 14:10**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 00:36**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	3.59	0.100	1		mg/L

60WB-03-0.5	**09-01-1382-21-A**	**01/15/09 14:35**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 00:37**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	2.55	0.100	1		mg/L

60WB-03-1.0	**09-01-1382-22-A**	**01/15/09 14:40**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 00:39**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	4.67	0.100	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	T22.11.5. All
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
60WB-04-0.5	**09-01-1382-24-A**	**01/15/09 14:20**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 00:41**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	2.59	0.100	1		mg/L

60WB-04-1.0	**09-01-1382-25-A**	**01/15/09 14:25**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 00:42**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	2.51	0.100	1		mg/L

60WB-04-2.0	**09-01-1382-26-A**	**01/15/09 14:30**	**Solid**	**ICP 5300**	**01/23/09**	**01/26/09 18:10**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	1.61	0.100	1		mg/L

DUP-1	**09-01-1382-27-A**	**01/15/09 13:55**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 00:44**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	2.59	0.100	1		mg/L

DUP-2	**09-01-1382-28-A**	**01/15/09 14:10**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 00:46**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	2.82	0.100	1		mg/L

DUP-3	**09-01-1382-29-A**	**01/15/09 14:25**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 00:51**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	0.679	0.100	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	T22.11.5. All
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
DUP-4	**09-01-1382-30-A**	**01/15/09 14:40**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 00:52**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	0.222	0.100	1		mg/L

Method Blank	**097-05-006-4,433**	**N/A**	**Solid**	**ICP 5300**	**01/23/09**	**01/26/09 18:02**	**090126LA2**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	T22.11.5.AII DI
		Method:	EPA 6010B

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
60WB-04-2.0	**09-01-1382-26-A**	**01/15/09 14:30**	**Solid**	**ICP 5300**	**01/23/09**	**01/28/09 00:54**	**090126LA4**

Parameter	Result	RL	DF	Qual	Units
Lead	0.117	0.100	1		mg/L

Method Blank	**097-05-006-4,438**	**N/A**	**Solid**	**ICP 5300**	**01/23/09**	**01/27/09 20:55**	**090126LA4**

Parameter	Result	RL	DF	Qual	Units
Lead	ND	0.100	1		mg/L

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received: 01/16/09
Work Order No: 09-01-1382

Project: East Junction 98817

Client Sample Number	Lab Sample Number	Date Collected	Matrix
BS-01-2.0	**09-01-1382-3**	**01/15/09**	**Solid**

Parameter	Result	RL	DF	Qual	Units	Date Prepared	Date Analyzed	Method
pH	6.52	0.01	1		pH units	01/16/09	01/16/09	EPA 9045D

BS-4-10.0	**09-01-1382-13**	**01/15/09**	**Solid**

Parameter	Result	RL	DF	Qual	Units	Date Prepared	Date Analyzed	Method
pH	6.76	0.01	1		pH units	01/16/09	01/16/09	EPA 9045D

60WB-03-2.0	**09-01-1382-23**	**01/15/09**	**Solid**

Parameter	Result	RL	DF	Qual	Units	Date Prepared	Date Analyzed	Method
pH	6.60	0.01	1		pH units	01/16/09	01/16/09	EPA 9045D

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received:	01/16/09
Work Order No:	09-01-1382
Preparation:	EPA 3050B
Method:	EPA 6010B

Project East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
BS-01-10.0	**Solid**	**ICP 5300**	**01/17/09**	**01/21/09**	**090117S03**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	94	96	75-125	2	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received:	01/16/09
Work Order No:	09-01-1382
Preparation:	EPA 3050B
Method:	EPA 6010B

Project East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
60WB-03-0.5	**Solid**	**ICP 5300**	**01/17/09**	**01/19/09**	**090117S04**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	147	144	75-125	1	0-20	3

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Kleinfelder Inc.		Date Received:	01/16/09
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	EPA 1311
		Method:	EPA 6010B

Project East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
09-01-1176-3	**Solid**	**ICP 5300**	**01/16/09**	**01/21/09**	**090119SA1**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	99	100	75-125	1	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received:	01/16/09
Work Order No:	09-01-1382
Preparation:	EPA 3010A Total
Method:	EPA 6010B

Project East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
09-01-1634-1	**Aqueous**	**ICP 5300**	**01/21/09**	**01/22/09**	**090121SA1**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	110	111	84-120	1	0-7	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received:	01/16/09
Work Order No:	09-01-1382
Preparation:	T22.11.5. All
Method:	EPA 6010B

Project East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
60WB-04-2.0	**Solid**	**ICP 5300**	**01/23/09**	**01/26/09**	**090126SA2**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	77	93	75-125	14	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received:	01/16/09
Work Order No:	09-01-1382
Preparation:	T22.11.5.AII DI
Method:	EPA 6010B

Project East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
09-01-1379-1	**Solid**	**ICP 5300**	**01/23/09**	**01/27/09**	**090126SA4**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	96	94	75-125	2	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Duplicate

Kleinfelder Inc.
1220 Research Drive, Suite B
Redlands, CA 92374-4552

Date Received: N/A
Work Order No: 09-01-1382

Project: East Junction 98817

Matrix: Solid

Parameter	Method	QC Sample ID	Date Analyzed	Sample Conc	DUP Conc	RPD	RPD CL	Qualifiers
pH	EPA 9045D	09-01-0363-25	01/16/09	8.20	8.23	0	0-25	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Laboratory Control Sample

Kleinfelder Inc.		Date Received:	N/A
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Analyzed	Lab File ID	LCS Batch Number
097-01-002-11,963	**Solid**	**ICP 5300**	**01/21/09**	**090119-I-03**	**090117L03**

Parameter	Conc Added	Conc Recovered	LCS %Rec	%Rec CL	Qualifiers
Lead	25.0	25.4	102	80-120	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Kleinfelder Inc.		Date Received:	N/A
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	EPA 3050B
		Method:	EPA 6010B

Project: East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
097-01-002-11,951	**Solid**	**ICP 5300**	**01/17/09**	**01/19/09**	**090117L04**

Parameter	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	104	103	80-120	1	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Laboratory Control Sample

Kleinfelder Inc.		Date Received:	N/A
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	EPA 1311
		Method:	EPA 6010B

Project: East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Analyzed	Lab File ID	LCS Batch Number
097-05-001-3,843	**Solid**	**ICP 5300**	**01/21/09**	**090119-la-02**	**090119LA1A**

Parameter	Conc Added	Conc Recovered	LCS %Rec	%Rec CL	Qualifiers
Lead	5.00	5.05	101	80-120	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Kleinfelder Inc.		Date Received:	N/A
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	EPA 3010A Total
		Method:	EPA 6010B

Project: East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
097-01-003-9,058	**Aqueous**	**ICP 5300**	**01/21/09**	**01/22/09**	**090121LA1**

Parameter	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	105	104	80-120	1	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

Kleinfelder Inc.		Date Received:	N/A
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	T22.11.5. All
		Method:	EPA 6010B

Project: East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
097-05-006-4,433	**Solid**	**ICP 5300**	**01/23/09**	**01/26/09**	**090126LA2**

Parameter	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Lead	92	90	80-120	2	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Laboratory Control Sample

Kleinfelder Inc.		Date Received:	N/A
1220 Research Drive, Suite B		Work Order No:	09-01-1382
Redlands, CA 92374-4552		Preparation:	T22.11.5.AII DI
		Method:	EPA 6010B

Project: East Junction 98817

Quality Control Sample ID	Matrix	Instrument	Date Analyzed	Lab File ID	LCS Batch Number
097-05-006-4,438	**Solid**	**ICP 5300**	**01/27/09**	**090126-la-4**	**090126LA4**

Parameter	Conc Added	Conc Recovered	LCS %Rec	%Rec CL	Qualifiers
Lead	5.00	5.46	109	80-120	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Glossary of Terms and Qualifiers

Work Order Number: 09-01-1382

Qualifier	Definition
*	See applicable analysis comment.
1	Surrogate compound recovery was out of control due to a required sample dilution, therefore, the sample data was reported without further clarification.
2	Surrogate compound recovery was out of control due to matrix interference. The associated method blank surrogate spike compound was in control and, therefore, the sample data was reported without further clarification.
3	Recovery of the Matrix Spike (MS) or Matrix Spike Duplicate (MSD) compound was out of control due to matrix interference. The associated LCS and/or LCSD was in control and, therefore, the sample data was reported without further clarification.
4	The MS/MSD RPD was out of control due to matrix interference. The LCS/LCSD RPD was in control and, therefore, the sample data was reported without further clarification.
5	The PDS/PDSD associated with this batch of samples was out of control due to a matrix interference effect. The associated batch LCS/LCSD was in control and, hence, the associated sample data was reported with no further corrective action required.
A	Result is the average of all dilutions, as defined by the method.
B	Analyte was present in the associated method blank.
C	Analyte presence was not confirmed on primary column.
E	Concentration exceeds the calibration range.
H	Sample received and/or analyzed past the recommended holding time.
J	Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.
ME	LCS Recovery Percentage is within LCS ME Control Limit range.
N	Nontarget Analyte.
ND	Parameter not detected at the indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the parameter concentration in the sample exceeding the spike concentration by a factor of four or greater.
U	Undetected at the laboratory method detection limit.
X	% Recovery and/or RPD out-of-range.
Z	Analyte presence was not confirmed by second column or GC/MS analysis.

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(925) 689-9022

CHAIN OF CUSTODY RECORD

Date 1-15-09

Page 1 of 3

LABORATORY CLIENT: Kleinfelder

ADDRESS: 1220 Research Dr. suite B

CITY: Redlands STATE: CA ZIP:

TEL: (951) 506-1488 E-MAIL:

CLIENT PROJECT NAME / NUMBER: East Junction 98817

P.O. NO.:

PROJECT CONTACT: Liz Simmons

LAB USE ONLY: 0 1 - 1 3 8 2

SAMPLER(S): (PRINT) Jason Williams

COELT LOG CODE

COOLER RECEIPT TEMP= °C

TURNAROUND TIME:
☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☒ STANDARD

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY)
☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐

SPECIAL INSTRUCTIONS:

REQUESTED ANALYSES

LAB USE ONLY	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.	TPH (g)	TPH (d) or (C6-C36) or (C6-C44)	TPH ( )	BTEX / MTBE (8260B) or ( )	VOCs (8260B)	Oxygenates (8260B)	Encore Prep (5035)	SVOCs (8270C)	Pesticides (8081A)	PCBs (8082)	PNAs (8310) or (8270C)	T22 Metals (6010B/747X)	Cr(VI) [7196A or 7199 or 218.6]	VOCs (TO-14A) or (TO-15)	TPH (g) [TO-3]+	Total Lead	pH	TCLP
1	BS-01-0.5		1-15-09	0940	Soil	1																X		
2	BS-01-1.0			0945																				
3	BS-01-2.0			0950																			X	
4	BS-01-3.0			0955																				
5	BS-01-5.0			1015																				X
6	BS-01-10.0			1045																				
7	BS-01-20.0			1115																				
8	BS-04-0.5			1135																				
9	BS-04-1.0			1138																				
10	BS-04-2.0			1141																				

Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
[signature]	FMS CEL	1/16/9	1445
FMS	WCBath CE	1/16/09	1650

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05/01/07 Revision

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CHAIN OF CUSTODY RECORD

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Page 2 of 4

LABORATORY CLIENT: Kleinfelder

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CITY: Redlands STATE: CA ZIP:

TEL: (951) 506-1488 E-MAIL:

CLIENT PROJECT NAME / NUMBER: East Junction 98817

P.O. NO.:

PROJECT CONTACT: Liz Simmons

LAB USE ONLY: 0 1 - 1 3 8 2

SAMPLER(S): (PRINT) Jason Williams

COELT LOG CODE

COOLER RECEIPT TEMP= °C

TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☒ STANDARD

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY): ☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐

SPECIAL INSTRUCTIONS:

REQUESTED ANALYSES

LAB USE ONLY	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.	TPH (g)	TPH (d) or (C6-C36) or (C6-C44)	TPH (___)	BTEX / MTBE (8260B) or (___)	VOCs (8260B)	Oxygenates (8260B)	Encore Prep (5035)	SVOCs (8270C)	Pesticides (8081A)	PCBs (8082)	PNAs (8310) or (8270C)	T22 Metals (6010B/747X)	Cr(VI) [7196A or 7199 or 218.6]	VOCs (TO-14A) or (TO-15)	TPH (g) [TO-3]+___	Total Lead	pH	TCLP
11	BS-4-3.0		1-15-09	1145	Soil	1																X		
12	BS-4-5.0			1150																				
13	BS-4-10.0			1215																			X	
14	BS-4-20.0			1315																				
15	60WB-01-0.5			1350																				X
16	60WB-01-1.0			1355																				
17	60WB-01-2.0			1400																				
18	60WB-02-0.5			1405																				
19	60WB-02-1.0			1410																				
20	60WB-02-2.0			1415																				

Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
[signature]	FMY CEL	1/16/9	1745
FMY	Wbatu CE	1/16/09	1650

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CHAIN OF CUSTODY RECORD

Date 1-15-09

Page 3 of 4

LABORATORY CLIENT: Kleinfelder

ADDRESS: 1220 Research Dr. Suite B

CITY: Redlands STATE: CA ZIP:

TEL: (951) 506-1488 E-MAIL:

TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☐ 5 DAYS ☒ 10 DAYS

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY): ☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐

SPECIAL INSTRUCTIONS:

CLIENT PROJECT NAME / NUMBER: East Junction 98817

P.O. NO.:

PROJECT CONTACT: Liz Simmons

LAB USE ONLY: 0 1 - 1 3 8 2

SAMPLER(S): (PRINT) Jason Williams

COELT LOG CODE

COOLER RECEIPT TEMP= °C

REQUESTED ANALYSES

LAB USE ONLY	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.	TPH (g)	TPH (d) or (C7-C36) or (C7-C44)	TPH ( )	BTEX / MTBE (8260B)	VOCs (8260B)	VOCs+Oxys (8260B)	Encore Prep (5035)	SVOCs (8270C)	Pesticides (8181A)	PCBs (8082)	PNAs (8310) or (8270C)	T22 Metals (6010B/747X)	Cr(VI)[7196A or 7199 or 218.6]	VOCs (TO-14A) or (TO-15)	TPH (g)[TO-3]+	Total Lead	PH	TCLP
21	60WB-03-0.5		1-15-09	1435	Soil	1																X		
22	60WB-03-1.0			1440																				
23	60WB-03-2.0			1445																			X	
24	60WB-04-0.5			1420																				
25	60WB-04-1.0			1425																				
26	60WB-04-2.0			1430																				X
27	DUP-1			1355																				
28	DUP-2			1410																				
29	DUP-3			1425																				
30	DUP-4			1440																				

Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
[signature]	[signature] CEL	1/16/9	1445
[signature]	[signature] CEL	1/16/09	1650

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CHAIN OF CUSTODY RECORD

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Page 4 of 4

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TEL: (951) 506-1488 E-MAIL:

CLIENT PROJECT NAME / NUMBER: East Junction 98817

P.O. NO.:

PROJECT CONTACT: Liz Simmons

LAB USE ONLY: 0 1 - 1 3 8 2

SAMPLER(S): (PRINT) Jason Williams

COELT LOG CODE

COOLER RECEIPT TEMP= °C

TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☒ STANDARD

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY): ☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐

SPECIAL INSTRUCTIONS:

REQUESTED ANALYSES

LAB USE ONLY	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.	TPH (g)	TPH (d) or (C6-C36) or (C6-C44)	TPH ( )	BTEX / MTBE (8260B) or ( )	VOCs (8260B)	Oxygenates (8260B)	Encore Prep (5035)	SVOCs (8270C)	Pesticides (8081A)	PCBs (8082)	PNAs (8310) or (8270C)	T22 Metals (6010B/747X)	Cr(VI) [7196A or 7199 or 218.6]	VOCs (TO-14A) or (TO-15)	TPH (g) [TO-3]+	Total Lead	pH	TCLP
31	Rinsate		1-15-09	0900	water	1																X		

Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
[signature]	FTG CEL	1/16/9	1445
[signature]	Wbatu CEL	1/16/09	1650

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Calscience Environmental Laboratories, Inc.

WORK ORDER #: 09-01-1382

SAMPLE RECEIPT FORM

Cooler 1 of 1

CLIENT: Kleinfelder

DATE: 1/16/9

TEMPERATURE: (Criteria: 0.0 °C – 6.0 °C, not frozen)

Temperature 1.4 °C - 0.2 °C (CF) = 1.2 °C ☑ Blank ☐ Sample

☐ Sample(s) outside temperature criteria (PM/APM contacted by _____).

☐ Sample(s) outside temperature criteria but received on ice/chilled on same day of sampling.

☐ Received at ambient temperature, placed on ice for transport by Courier.

Ambient Temperature: ☐ Air ☐ Filter ☐ Metals Only ☐ PCBs Only Initial: KMB

CUSTODY SEALS INTACT:

☐ Cooler ☐ _____ ☐ No (Not Intact) ☑ Not Present ☐ N/A Initial: KMB

☐ Sample ☐ _____ ☐ No (Not Intact) ☑ Not Present Initial: AM

SAMPLE CONDITION:	Yes	No	N/A
Chain-Of-Custody (COC) document(s) received with samples	☑	☐	☐
COC document(s) received complete	☑	☐	☐
Sampler's name indicated on COC	☑	☐	☐
Sample container label(s) consistent with COC	☑	☐	☐
Sample container(s) intact and good condition	☑	☐	☐
Correct containers and volume for analyses requested	☑	☐	☐
Analyses received within holding time	☑	☐	☐
Proper preservation noted on COC or sample container	☐	☐	☑
Volatile analysis container(s) free of headspace	☐	☐	☑
Tedlar bag(s) free of condensation	☐	☐	☑

CONTAINER TYPE:

Solid: ☐4ozCGJ ☑8ozCGJ ☐16ozCGJ ☑Sleeve 5/6/7/13/14 ☐EnCores® ☐TerraCores® ☐ _____

Water: ☐VOA ☐VOAh ☐VOAna$_2$ ☐125AGB ☐125AGBh ☐125AGBpo$_4$ ☐1AGB ☐1AGBna$_2$ ☐1AGBs ☐500AGB ☐500AGBs ☐250CGB ☐250CGBs ☐1PB ☐500PB ☐500PBna ☑250PB ☐250PBn ☐125PB ☐125PBznna ☐100PBsterile ☐100PBna$_2$ ☐ _____ ☐ _____ ☐ _____

Air: ☐Tedlar® ☐Summa® ☐ _____

Container: C:Clear A:Amber P:Poly/Plastic G:Glass J:Jar B:Bottle

Preservative: h:HCL n:HNO$_3$ na$_2$:Na$_2$S$_2$O$_3$ na:NaOH po$_4$:H$_3$PO$_4$ s:H$_2$SO$_4$ znna:ZnAc$_2$+NaOH

Checked/Labeled by: AM

Reviewed by: WSC

Scanned by: AM

Ranjit Clarke

From: Liz Simmons [LSimmons@kleinfelder.com]
Sent: Friday, January 23, 2009 4:56 PM
To: Ranjit Clarke; Jen Grippa
Subject: Re: East Junction 98817 / CEL 09-01-1382 (01/15/09)

Thanks Ranjit! Attached is a spreadsheet showing additional analyses that need to be run on project samples (ie, WET [STLC], DI-WET [STLC], and TCLP). Let me know if you have any questions. Thanks again.

Liz

>>> "Ranjit Clarke" <RClarke@calscience.com> 1/23/2009 10:24 AM >>>
<<09-01-1382.pdf>>
Here is the final PDF report for the samples collected on 01/15/09.

> Ranjit K. K. Clarke
> Project Manager
> Calscience Environmental
> Laboratories, Inc.
> 7440 Lincoln Way
> Garden Grove, CA 92841-1427
> Tel.: 714-895-5494 Ext. 222
> Fax : 714-894-7501
> rclarke@calscience.com
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Lead Sample Tests Table

East Junction ADL

Sample ID	TOTAL LEAD mg/kg	WET mg/L	DI WET mg/L	TCLP mg/L
Order#: Date Sampled, 09-01-1379: 1/16/09				
BS-02-0.5	27.9	X		
BS-03-0.5	136	X	X	
BS-03-1.0	115	X	X	
BS-03-2.0	232	X	X	
BS-03-3.0	170	X	X	
BS-03-10.0	50.3	X		
BS-03-20.0	46.4	X		
Order#: Date Sampled, 09-01-1176: 1/14/09				
I215-01-0.5	38.9	X		
I215-02-0.5	28.9	X		
I215-03-0.5	321	X	X	X
I215-03-1.0	6,510	X	X	X
I215-03-2.0	7,650	X	X	X
I215-06-1.0	48.7	X		
I215-07-0.5	28.3	X		
I215-10-0.5	54.3	X		
I215-15-0.5	51.3	X		
I215-04-0.5	77.2	X		
I215-06-0.5	137	X	X	
I215-09-2.0	87.0	X		
I215-12-0.5	42.8	X		
I215-13-0.5	420	X	X	
I215-14-1.0	37.5	X		
I215-16-0.5	37.0	X		
Order#: Date Sampled, 09-01-1382: 1/15/09				
BS-01-0.5	79.4	X		
60WB-01-0.5	38.0	X		
60WB-01-2.0	55.1	X		
60WB-02-1.0	86.1	X		
60WB-03-0.5	41.7	X		
60WB-03-1.0	78.1	X		
60WB-04-0.5	55.7	X		
60WB-04-1.0	59.5	X		
60WB-04-2.0	132	X	X	
DUP-1	55.5	X		
DUP-2	47.8	X		
DUP-3	70.5	X		
DUP-4	85.8	X		
Total: 108 Samples as of 1/23/09		36 WET	10 DI WET	3 TCLP

APPENDIX B

Figure 1 ADL-Impacted Soils Management Flow Chart (Caltrans Aerially Deposited Lead Guidance, 2007)

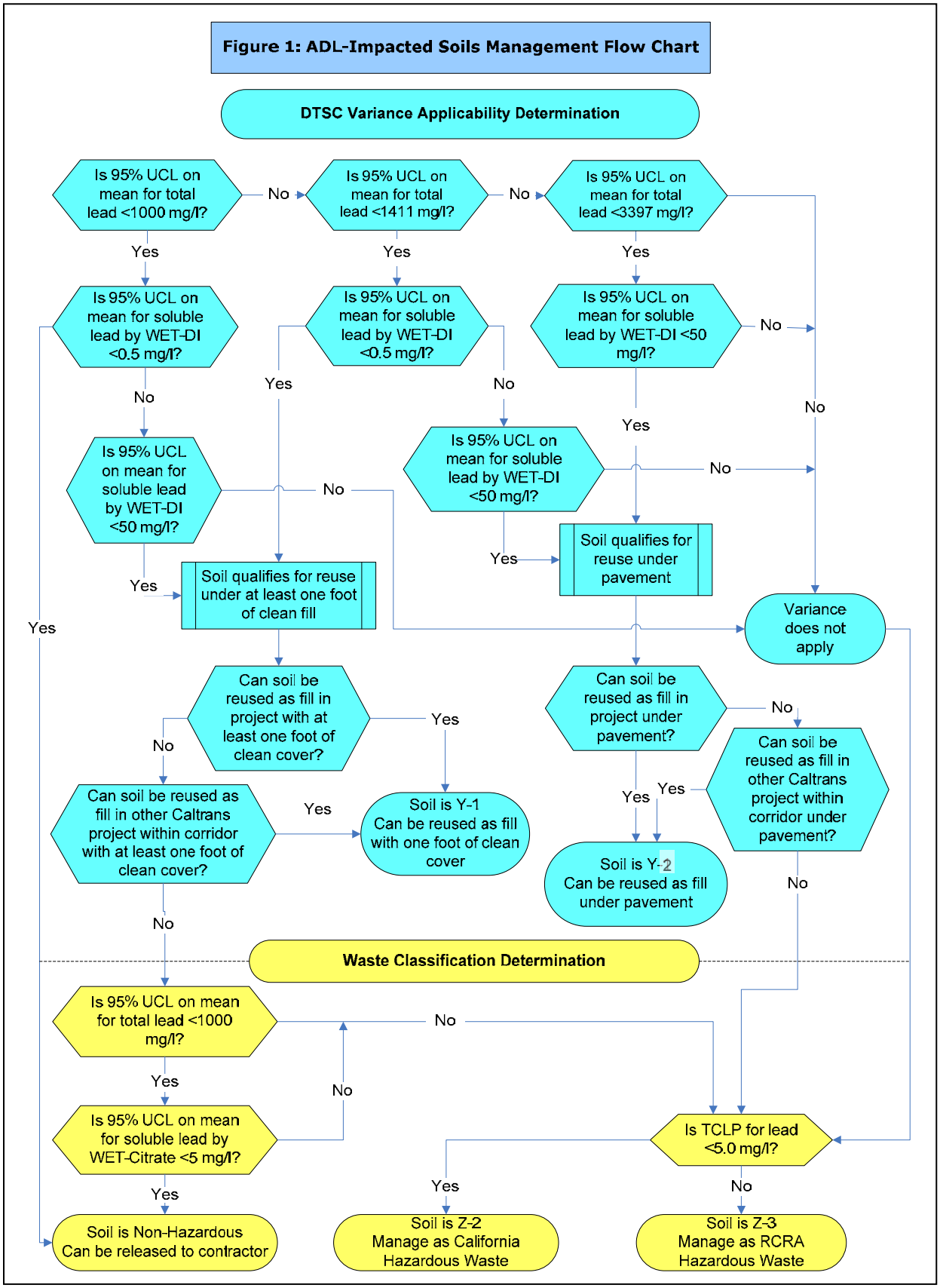
Figure 1: ADL-Impacted Soils Management Flow Chart
DTSC Variance Applicability Determination
Is 95% UCL on mean for total lead <1000 mg/l?
Is 95% UCL on mean for total lead <1411 mg/l?
Is 95% UCL on mean for total lead <3397 mg/l?
Is 95% UCL on mean for soluble lead by WET-DI <0.5 mg/l?
Is 95% UCL on mean for soluble lead by WET-DI <0.5 mg/l?
Is 95% UCL on mean for soluble lead by WET-DI <50 mg/l?
Is 95% UCL on mean for soluble lead by WET-DI <50 mg/l?
Is 95% UCL on mean for soluble lead by WET-DI <50 mg/l?
Soil qualifies for reuse under at least one foot of clean fill
Soil qualifies for reuse under pavement
Variance does not apply
Can soil be reused as fill in project with at least one foot of clean cover?
Can soil be reused as fill in project under pavement?
Can soil be reused as fill in other Caltrans project within corridor with at least one foot of clean cover?
Soil is Y-1 Can be reused as fill with one foot of clean cover
Can soil be reused as fill in other Caltrans project within corridor under pavement?
Soil is Y-2 Can be reused as fill under pavement
Waste Classification Determination
Is 95% UCL on mean for total lead <1000 mg/l?
Is 95% UCL on mean for soluble lead by WET-Citrate <5 mg/l?
Is TCLP for lead <5.0 mg/l?
Soil is Non-Hazardous Can be released to contractor
Soil is Z-2 Manage as California Hazardous Waste
Soil is Z-3 Manage as RCRA Hazardous Waste
Yes
No

APPENDIX C

Statistical Summary of ADL Results

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

Total Pb Sample set

General Statistics

Number of Valid Samples	91	**Number of Unique Samples**	90
Raw Statistics		**Log-transformed Statistics**	
Minimum	0.922	**Minimum of Log Data**	-0.0812
Maximum	948	**Maximum of Log Data**	6.854
Mean	45.74	**Mean of log Data**	2.758
Median	11.2	**SD of log Data**	1.391
SD	112		
Coefficient of Variation	2.449		
Skewness	6.428		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Lilliefors Test Statistic	0.345	**Lilliefors Test Statistic**	0.106
Lilliefors Critical Value	0.0929	**Lilliefors Critical Value**	0.0929
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	65.26	**95% H-UCL**	60.85
95% UCLs (Adjusted for Skewness)		**95% Chebyshev (MVUE) UCL**	75.22
95% Adjusted-CLT UCL	73.51	**97.5% Chebyshev (MVUE) UCL**	90.18
95% Modified-t UCL	66.57	**99% Chebyshev (MVUE) UCL**	119.6
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.571	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	80.12		
nu star	103.9		
Approximate Chi Square Value (.05)	81.39	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0474	**95% CLT UCL**	65.06
Adjusted Chi Square Value	81.07	**95% Jackknife UCL**	65.26
		95% Standard Bootstrap UCL	64.89
Anderson-Darling Test Statistic	3.762	**95% Bootstrap-t UCL**	89.78
Anderson-Darling 5% Critical Value	0.81	**95% Hall's Bootstrap UCL**	147.2
Kolmogorov-Smirnov Test Statistic	0.17	**95% Percentile Bootstrap UCL**	65.81
Kolmogorov-Smirnov 5% Critical Value	0.0986	**95% BCA Bootstrap UCL**	76.8
Data not Gamma Distributed at 5% Significance Level		**95% Chebyshev(Mean, Sd) UCL**	96.92
		97.5% Chebyshev(Mean, Sd) UCL	119.1
Assuming Gamma Distribution		**99% Chebyshev(Mean, Sd) UCL**	162.6
95% Approximate Gamma UCL	58.4		
95% Adjusted Gamma UCL	58.63		

Potential UCL to Use: Use 97.5% Chebyshev (Mean, Sd) UCL = 119.1

	A	B	C	D	E	F	G	H	I	J	K	L
1				General UCL Statistics for Full Data Sets								
2		User Selected Options										
3			From File	WorkSheet.wst								
4			Full Precision	OFF								
5			Confidence Coefficient	95%								
6			Number of Bootstrap Operations	2000								
7												
8												
9	**DI-WET Sample set**											
10												
11	General Statistics											
12			Number of Valid Samples	10			Number of Unique Samples	8				
13												
14	Raw Statistics						Log-transformed Statistics					
15			Minimum	0.05			Minimum of Log Data	-2.996				
16			Maximum	5.11			Maximum of Log Data	1.631				
17			Mean	1.1			Mean of log Data	-1.197				
18			Median	0.212			SD of log Data	1.758				
19			SD	1.709								
20			Coefficient of Variation	1.554								
21			Skewness	1.792								
22												
23	Relevant UCL Statistics											
24	Normal Distribution Test						Lognormal Distribution Test					
25			Shapiro Wilk Test Statistic	0.695			Shapiro Wilk Test Statistic	0.88				
26			Shapiro Wilk Critical Value	0.842			Shapiro Wilk Critical Value	0.842				
27	Data not Normal at 5% Significance Level						Data appear Lognormal at 5% Significance Level					
28												
29	Assuming Normal Distribution						Assuming Lognormal Distribution					
30			95% Student's-t UCL	2.09			95% H-UCL	23.82				
31	95% UCLs (Adjusted for Skewness)						95% Chebyshev (MVUE) UCL	3.735				
32			95% Adjusted-CLT UCL	2.316			97.5% Chebyshev (MVUE) UCL	4.894				
33			95% Modified-t UCL	2.141			99% Chebyshev (MVUE) UCL	7.171				
34												
35	Gamma Distribution Test						Data Distribution					
36			k star (bias corrected)	0.412			Data appear Gamma Distributed at 5% Significance Level					
37			Theta Star	2.672								
38			nu star	8.231								
39			Approximate Chi Square Value (.05)	2.87			Nonparametric Statistics					
40			Adjusted Level of Significance	0.0267			95% CLT UCL	1.988				
41			Adjusted Chi Square Value	2.349			95% Jackknife UCL	2.09				
42							95% Standard Bootstrap UCL	1.943				
43			Anderson-Darling Test Statistic	0.743			95% Bootstrap-t UCL	3.332				
44			Anderson-Darling 5% Critical Value	0.778			95% Hall's Bootstrap UCL	2.488				
45			Kolmogorov-Smirnov Test Statistic	0.25			95% Percentile Bootstrap UCL	2.061				
46			Kolmogorov-Smirnov 5% Critical Value	0.281			95% BCA Bootstrap UCL	2.169				
47	Data appear Gamma Distributed at 5% Significance Level						95% Chebyshev(Mean, Sd) UCL	3.455				
48							97.5% Chebyshev(Mean, Sd) UCL	4.474				
49	Assuming Gamma Distribution						99% Chebyshev(Mean, Sd) UCL	6.476				
50			95% Approximate Gamma UCL	3.154								
51			95% Adjusted Gamma UCL	3.854								
52												
53	Potential UCL to Use						Use 95% Adjusted Gamma UCL	3.854				

	A	B	C	D	E	F	G	H	I	J	K	L
1				General UCL Statistics for Full Data Sets								
2		User Selected Options										
3			From File	WorkSheet.wst								
4			Full Precision	OFF								
5			Confidence Coefficient	95%								
6			Number of Bootstrap Operations	2000								
7												
8												
9	WET-DI Sample set without samples from location I215-03											
10												
11	General Statistics											
12			Number of Valid Samples	7			Number of Unique Samples	5				
13												
14	Raw Statistics						Log-transformed Statistics					
15			Minimum	0.05			Minimum of Log Data	-2.996				
16			Maximum	0.386			Maximum of Log Data	-0.952				
17			Mean	0.154			Mean of log Data	-2.189				
18			Median	0.117			SD of log Data	0.857				
19			SD	0.133								
20			Coefficient of Variation	0.862								
21			Skewness	1.144								
22												
23	Relevant UCL Statistics											
24	Normal Distribution Test						Lognormal Distribution Test					
25			Shapiro Wilk Test Statistic	0.815			Shapiro Wilk Test Statistic	0.858				
26			Shapiro Wilk Critical Value	0.803			Shapiro Wilk Critical Value	0.803				
27	Data appear Normal at 5% Significance Level						Data appear Lognormal at 5% Significance Level					
28												
29	Assuming Normal Distribution						Assuming Lognormal Distribution					
30			95% Student's-t UCL	0.251			95% H-UCL	0.515				
31	95% UCLs (Adjusted for Skewness)						95% Chebyshev (MVUE) UCL	0.368				
32			95% Adjusted-CLT UCL	0.26			97.5% Chebyshev (MVUE) UCL	0.461				
33			95% Modified-t UCL	0.255			99% Chebyshev (MVUE) UCL	0.644				
34												
35	Gamma Distribution Test						Data Distribution					
36			k star (bias corrected)	1.081			Data appear Normal at 5% Significance Level					
37			Theta Star	0.142								
38			nu star	15.14								
39			Approximate Chi Square Value (.05)	7.357			Nonparametric Statistics					
40			Adjusted Level of Significance	0.0158			95% CLT UCL	0.236				
41			Adjusted Chi Square Value	5.799			95% Jackknife UCL	0.251				
42							95% Standard Bootstrap UCL	0.23				
43			Anderson-Darling Test Statistic	0.528			95% Bootstrap-t UCL	0.394				
44			Anderson-Darling 5% Critical Value	0.718			95% Hall's Bootstrap UCL	0.785				
45			Kolmogorov-Smirnov Test Statistic	0.263			95% Percentile Bootstrap UCL	0.236				
46			Kolmogorov-Smirnov 5% Critical Value	0.316			95% BCA Bootstrap UCL	0.242				
47	Data appear Gamma Distributed at 5% Significance Level						95% Chebyshev(Mean, Sd) UCL	0.372				
48							97.5% Chebyshev(Mean, Sd) UCL	0.467				
49	Assuming Gamma Distribution						99% Chebyshev(Mean, Sd) UCL	0.653				
50			95% Approximate Gamma UCL	0.317								
51			95% Adjusted Gamma UCL	0.402								
52												
53	Potential UCL to Use						Use 95% Student's-t UCL	0.251				

GEOTECHNICAL DESIGN REPORT
INTERSTATE 215/STATE ROUTE 60
EAST JUNCTION IMPROVEMENTS
RIVERSIDE AND MORENO VALLEY, CALIFORNIA
08-RIV-215/60, KP 60.7/70.6, 22.0/18.5
CALTRANS EA NO. 449311

Prepared for:

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Project No. 76979

January 9, 2009

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January 9, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

Subject: **Geotechnical Design Report**
Interstate 215/State Route 60 East Junction Improvements
Riverside and Moreno Valley, California
08-RIV-215/60, KP 60.7/70.6, 22.0/18.5
Caltrans EA No. 449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) is pleased to present this Geotechnical Design Report for the proposed improvements at the east junction of Interstate 215 (I-215) and State Route 60 (SR-60) in the Cities of Riverside and Moreno Valley, California. The purpose of this report is to provide geotechnical design and construction recommendations, and subsurface soil and groundwater conditions.. Geotechnical recommendations for other elements of the project are presented in separate *Material Report and Structural Foundation Report (SFR).*

We appreciate the opportunity to provide geotechnical services to Lim & Nascimento Engineering Corporation and trust the information in this report meets the current project needs. If you have any questions, please contact the undersigned at your convenience.

Respectfully submitted,

KLEINFELDER WEST, INC.

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Appendix A Field Exploration
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1.0 INTRODUCTION

1.1 GENERAL

This Geotechnical Design Report presents the results of our geotechnical study for the proposed improvements at the east junction of Interstate 215 (I-215) and State Route 60 (SR-60), located in the Cities of Riverside and Moreno Valley, California. The study area is shown on the attached Plate 1, *Site Vicinity Map*.

The project is planned to meet the area's needs based on recent and projected growth trends throughout both cities and the County. The purpose of this study is to provide geotechnical information related to pavement structural sections, subsurface conditions, and materials information for use by the project designers for further planning, design and economic evaluations of the proposed interchange improvements. Our understanding of the project is based on our discussions with Lim & Nascimento Engineering Corporation (LAN Engineering) and our review of the documents listed in Section 1.3 of this report.

1.2 PURPOSE AND SCOPE OF SERVICES

The purpose of this report is to document subsurface conditions, provide analyses of anticipated conditions along the proposed alignment as they pertain to the project and to recommend geotechnical design and construction criteria for the proposed pavements. This report establishes a geotechnical baseline to be used by the project roadway design team in developing the project plans and specifications. The scope of our services included the following tasks:

- Review of existing geotechnical and geologic data pertaining to the proposed project.
- Drilling and sampling of twenty seven soil borings in the project area.
- Laboratory testing of selected samples to characterize the subsurface conditions.
- Engineering analyses to develop geotechnical recommendations for pavement design.
- Preparation of this report.

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1.3 PERTINENT REPORTS AND INVESTIGATIONS

The following documents were reviewed for this study:

- *Structure Foundation Report, Proposed Box Springs Overhead Right Bridge Widening, Bridge Number 56-0082R*, I-215/SR60 East Junction, Riverside, California, 08-RIV-215/60, KP 60.7/70.6, 22.0/18.5, Caltrans EA No. 449311**,** Kleinfelder Project No. 76979, dated October 10, 2008.

- *Structure Foundation Report, Proposed Frontage Road Overhead Replacement, Bridge Number 56C-0056*, I-215/SR60 East Junction, Riverside, California, 08-RIV-215/60, KP 60.7/70.6, 22.0/18.5, Caltrans EA No. 449311**,** Kleinfelder Project No. 76979, dated October 13, 2008.

- *Structure Foundation Report,* Proposed Eastbound and Westbound SR60 HOV Connectors*,* I-215/SR60 East Junction, Riverside, California, 08-RIV-215/60, Caltrans EA No. 449311**,** Kleinfelder Project No. 76979, dated July 18, 2008.

- *Structure Foundation Report, Proposed Box Springs Overhead Left Bridge Widening, Bridge Number 56-0082L*, I-215/SR60 East Junction, Riverside, California, 08-RIV-215/60, KP R38.6, Caltrans EA No. 449311**,** Kleinfelder Project No. 76979, dated March 14, 2008.

- *Memorandum, Supplemental Materials Report, Revised Two Layer Sections*, File Number Riv-215-R37.7/43.9, Riv-60-R12.1/13.7 and Riv-91-20.3/21.6, 08-334841, dated May 18, 200, Bruce W. Kean, District 8 Materials Engineer, department of Transportation.

Geologic data compiled and reviewed for this study were obtained from the Geologic Map of the Riverside East 7.5' Quadrangle, scale 1:24,000 (Morton, D.M. and Cox, D.F., 2001), and the Geologic Map of the Riverside East/South ½ of the San Bernardino South Quadrangles, map scale 1:24,000 (Dibblee, 2003). Other maps and publications we reviewed addressing regional geology include the *Geologic Map of the San Bernardino and Santa Ana 30' x 60' Quadrangles*, California, map scale 1 :100,000 (Morton, D.M., and Millen, F.K., 2006), *Geologic Map of California, San Bernardino Sheet,* compiled by T.H. Rogers (1967), map scale 1:250,000, and the *Geologic Map of*

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the San Bernardino Quadrangle, California, compiled by E.J. Bortugno and T.E. Spittler (1986), map scale 1:250,000.

Maps, reports, and other studies reviewed addressing faulting and seismicity included "*Fault Rupture Hazard Zones in California*," (Bryant, W.A., and Hart, E.W., 2007); "*Fault Activity Map of California and Adjacent Areas, California*," Jennings, C.W. (1994); and *Map showing Quaternary faults and 1978-84 seismicity of the Los Angeles Region, California*, Ziony, J.I., and Jones, L. (1989).

Groundwater information from wells within the study area was researched based on records available through the Cooperative Well Measuring Program covering the Upper Santa Ana River, San Jacinto, and Upper Santa Margarita Watersheds (Western Municipal Water District (WMWD)).

Additional references used are listed in Section 9.0 of this report.

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2.0 EXISTING FACILITIES AND PROPOSED IMPROVEMENTS

2.1 EXISTING FACILITIES

The study area includes the existing I-215 and SR-60 freeways, Metrolink railroad, Box Springs Overhead (Bridge Nos. 56-0082R/L), Lawless Road Overhead (Bridge No. 56C-0056), Box Springs Truck Overhead (Bridge No. 56-0805G), Box Springs Overcrossing (Bridge No. 56-0804) and the Box Springs Road. The site is shown on the attached Plate 1, *Site Vicinity Map*.

I-215 and SR-60 are four-lane roadways in the subject area. The existing bridges crossing the Metrolink railroad are three- and five-span structures supported on two abutments and two to four bents, all founded on spread footings. The embankments for the bridges consists of fill slopes having a gradient of 1:1.5 (Vertical: Horizontal, V:H). We understand that the existing Right Bridge was recently constructed to replace an older bridge but was only partially completed and will be widened in the future.

Metrolink railroad in the project area consists of a single track and runs in a north-south direction. Box Springs Road is a two-lane roadway located to the north of I-215/SR-60 interchange, running parallel to I-215/SR-60 in east-west direction in the subject area.

2.2 PROPOSED IMPROVEMENTS

The project consists of the improvements at the east junction of I-215 and SR-60 in the City of Riverside and City of Moreno Valley. This includes construction of new eastbound and westbound SR-60 HOV structures, widening of the existing Box Springs Overhead, replacement of the existing Lawless Road Overhead, and construction of jacked drainage pipe across the freeway. Separate Structure Foundation Reports (SFR) and Materials Report (MR) were prepared for this project by Kleinfelder.

2.2.1 Eastbound and Westbound SR-60 HOV Bridge Structures

Eastbound and westbound SR-60 HOV structures will be built between the existing Box Springs Overcrossing and the Day Street Undercrossing, extending the existing HOV lanes. This project will also include lowering and widening of the existing northbound I-215 mainline to the West. Tie-back Retaining walls will be constructed under the

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proposed lowering portion of the bridge. A separate structure foundation report will be prepared for the tieback walls. The three-span SR-60 HOV structures will be constructed with cast-in-place, prestressed concrete box girders with total lengths of 109.2 and 130.7 meters (for the eastbound and westbound structures, respectively) and width of 9.105 meters for both structures.

2.2.2 Box Springs Overhead Bridge Widening

The proposed Box Springs Overhead Right Bridge widening consists of a 39.55-meter long, three-span bridge to be constructed with cast-in-place, prestressed slab. The bridge abutments and bents will be supported on spread footings.

The proposed Box Springs Overhead Left Bridge widening consists of a 44.81-meter long, three-span bridge to be constructed with either precast, prestressed rectangular girders or cast-in-place T-girder. The bridge abutments and bents will be supported on spread footings.

To provide for proposed railroad maintenance road under the bridge, a tieback wall will be constructed at Abutment 1 slope. The widened bridges are proposed to be founded on shallow foundations similar to the existing bridges.

2.2.3 Lawless Road Overhead Bridge Replacement

The widening of the Box Spring Overhead Right Bridge requires that the existing Lawless Road Overhead be relocated. The existing bridge will be demolished and replaced with a new three-span, cast-in-place, prestressed concrete box girder bridge on the north side of the existing bridge. The bridge will be approximately 70 meters long and 22 meters wide. The bridge abutments and bents will be supported on spread footings. The proposed bridge will be called Frontage Road Overhead. In addition to the construction of the bridge, a railroad maintenance road with an approximate width of 10 meters is proposed to be constructed near the toe of west embankment.

2.2.4 Jacked Drainage Pipe

According to the plan provided by LAN Engineering, a jacked drainage pipe consists of either a single 2.6-meter diameter or a double 2.4-meter diameter Reinforced Concrete Pipe (RCP) will be constructed approximately 25.8 meters to the east of and parallel to

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the Metrolink Railroad tracks. The drainage pipe will be 149-meter long and will have invert elevations of 451.5 meters (MSL) at its southern terminus and 450.0 meters (MSL) at its northern terminus. The southern terminus of the drainage pipe is located approximately 60.7 meters south of Sta. 15+23.10 of “3CC” Line, and its northern terminus is located approximately 12.3 meters north of Sta. 14+10.63 of “H” Line.

It is our understanding that the jacked pipe will be constructed in three sections. The first section of the pipe is 43 meters long and the second and third sections of the pipe are 54 and 52 meters long, respectively. Ground cover over the pipe is anticipated to be on the order of 7 to 11 meters.

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3.0 GEOTECHNICAL INVESTIGATION PROGRAM

3.1 FIELD EXPLORATION

Prior to conducting the field exploration, our proposed exploration locations were cleared of known existing utility lines through Underground Service Alert (USA). Our subsurface exploration program for the proposed interchange improvement consisted of drilling and logging 27 exploratory soil borings (KA-1 through KA-3, BS-1 and BS-2, HV-1 through HV-18, and BD-1 through BD-4) between March 5, 2007 and October 21, 2008. These borings were advanced to depths ranging from approximately 5.0 to 25.3 meters below the existing ground surface (bgs). Locations of our borings are shown on Plates 2a through 2d, *Exploration Location Map*. The borings were advanced using a Mobile B-61, truck-mounted drill rig and a CME/Mobile L10-T hybrid track drill rig equipped with 200-mm diameter hollow-stem augers and an automatic hammer delivery system for sample collection.

The borings were logged and sampled by a staff engineer/geologist from our office using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Each soil sample was observed and described in general accordance with the Unified Soil Classification System (USCS). Following drilling, sampling and logging, the borings were backfilled with native cuttings. The boring logs are presented in Appendix A, *Field Exploration*.

3.2 LABORATORY TESTING

Laboratory testing was performed on soil samples collected during our field exploration to substantiate field classifications and to evaluate the physical characteristics of the subsurface soils. Testing consisted of in-situ moisture content and unit weight, grain size distribution, laboratory maximum dry unit weight and optimum moisture content, shear strength, R-value, sand equivalent and corrosion analyses. The laboratory tests performed for this geotechnical study are described and the test results are presented in Appendix B, *Laboratory Testing*.

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4.0 PHYSICAL SETTING

4.1 CLIMATE

The climate in the region of the site is generally characterized by dry, moderate to warm summers and moist, cool winters. On average, the warmest month is July, with temperature ranging from 16° to 34° C. The coolest month is December, with temperature ranging from 5° to 20° C. The highest recorded temperature was 45° C in 1960 and the lowest recorded temperature was -6° C in 1990. The maximum average precipitation is 63 mm which typically occurs in January, and the minimum average precipitation is less than 2.5 mm which typically occurs in July. On average, the precipitation in Riverside is less than 25.4 mm, between the months of April and October. Water usually freezes and thaws when the air temperature is at approximately 4° C. Therefore, the subject project site is not within a freeze-thaw area.

4.2 TOPOGRAPHY AND DRAINAGE

Topographically, the project site is an area of locally steep graded slopes adjacent to each side of the active Metrolink railroad tracks. The slopes are approximately 7.6 meters (25 feet) high, descending to the rail bed which gently slopes to north. The areas at the top of each slope are relatively level with a gentle gradient to the north. Surface drainage for the study area is via sheet flow runoff toward the north. Drainage in the area is along the railroad tracks and flows north to Box Springs Canyon.

4.3 MAN-MADE AND NATURAL FEATURES OF ENGINEERING AND CONSTRUCTION SIGNIFICANCE

The project alignment is situated in the City of Riverside and City of Moreno Valley, Riverside County. Existing man-made features in the area include the I-215, SR-60, several overhead bridges crossing over Metrolink railroad, Box Springs Road, and several commercial facilities and residential properties in the vicinity of the alignment. Two drainage pipe culverts approximately 910 mm in diameter were observed on the south side of the eastern embankment of existing Box Springs Truck Overhead (Bridge No. 56-0805G). A drainage pipe approximately 300 mm in diameter running in north-south direction and buried approximately halfway beneath the eastern embankment of Box Springs Truck Overhead was also observed during our site reconnaissance.

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4.4 REGIONAL AND LOCAL GEOLOGY

The project site is situated within the northern Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are a northwest-southeast oriented complex of blocks separated by similarly trending faults which extend 200 km from the Transverse Ranges south to the Mexican border and beyond another 1250 km to the tip of Baja California. The province varies in width from 50 to 160 km and is bounded on the east by the Colorado Desert and the Gulf of California and on the west by the Pacific Ocean.

The Peninsular Ranges contain Jurassic-age and Cretaceous-age igneous and metamorphic rocks, as well as a thick sequence of marine and non-marine sedimentary rock. The Peninsular Ranges Province is further described by sub-units, which include the Perris Block, the Santa Ana Mountains, and the San Jacinto Mountains. The Perris Block is characterized as a broad area of intermixed valleys and low mountain ranges situated between the Elsinore and San Jacinto fault zones.

The project site is located in the northern portion of the Perris Block and Perris Valley. Typical lithographic units within this area consist of Quaternary alluvial deposits overlying granitic and metamorphic bedrock. Sporadic outcrops of bedrock dot the valley floor and represent remnants of eroded hills and mountains. Bedrock consists of mostly Cretaceous-age igneous rock (tonalite) forming the bedrock hills north of the site.

4.5 FAULTING AND SEISMICITY

The project site is located in the highly seismic southern California region within the influence of several fault systems that are considered to be active or potentially active. An active fault is defined by the State of California as “a sufficiently active and well defined fault, which has exhibited surface displacement within the Holocene time (the last 11,000 years).” The definition of “potentially active” varies. A generally accepted definition of “potentially active” is a fault showing evidence of displacement that is older than 11,000 years (Holocene age) and younger than 1.7 million years (Pleistocene age). However, “potentially active” is no longer used as criteria for zoning by the California Geologic Survey (CGS). The terms “sufficiently active” and “well-defined” are now used by the CGS as criteria for zoning faults under the Alquist-Priolo Earthquake Fault Act. A “sufficiently active fault” is a fault that shows evidence of

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Holocene surface displacement along one of more of its segments and branches, while a “well-defined fault” is a fault whose trace is clearly detectable by a trained geologist as a physical feature at or just below the ground surface. The definition “inactive” generally implies that a fault has not been active since the beginning of the Pleistocene Epoch (older than 1.7 million years old). These sufficiently active and well defined faults are capable of producing seismic shaking at the site that could potentially be damaging to structures. It is anticipated that the study area will periodically experience ground acceleration as a result of moderate to large magnitude earthquakes.

The San Jacinto fault zone is the nearest major active fault to the site. Numerous other faults may also represent significant hazards. However, this fault is considered to have the greatest impact to the site due to anticipated high peak ground accelerations resulting from a maximum credible earthquake.

The most significant geologic hazard to this project is the potential for moderate to severe seismic shaking that is likely to occur during the design life of the proposed structures.

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5.0 SUBSURFACE CONDITIONS

5.1 EARTH MATERIALS

Based on the results of our geotechnical investigation, the subsurface conditions anticipated at the project site consists of undocumented fill soil, alluvial sandy soil deposits, and granitic bedrock. Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the Boring Logs provided in Appendix A.

5.1.1 Undocumented Artificial Fill (Qaf)

Undocumented fill soils were encountered in borings KB-1, KB-2, BS-1, BS-2, HV-3, HV-4, HV-10, HV-11, HV-12, HV-16, BD-1, BD-2, BD-3, and BD-4 to depths ranging from approximately 1 to 7.5 meters below ground surface. The fill soils were likely placed as part of the development of the existing interchange and the railroad crossing. In general, the undocumented fill soils consist of silty sand (SM). Additional areas of undocumented fill soils may be encountered during earthwork operations that were not identified during this investigation.

5.1.2 Alluvium (Qal)

Alluvial soils were encountered below the fill soils in borings KB-1, KB-3, BS-1, BS-2, HV-3, HV-4, HV-10, HV-11, HV-12, HV-16, BD-1, BD-2, BD-3, and BD-4 and in the remaining borings excavated for the proposed project, except KB-2 where no alluvial soil was encountered. The alluvial soils extend to depths ranging from approximately 1 to 19.5 meters below existing grades. In general, the alluvial soil deposits encountered during our investigation consisted of silty sand (SM), poorly graded and well graded sand with silt (SP-SM and SW-SM), and clayey sand (SC). The alluvial soils encountered are generally medium dense to very dense.

5.1.3 Granitic Bedrock (Kt)

Tonalite granitic bedrock was encountered in 14 of our 27 borings excavated for the proposed Interchange Improvement. The bedrock was encountered at depths ranging from approximately 1.1 to 9.1 meters below existing grades and extended to the

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maximum depth explored of 25.3 meters below the existing grade. In general, the tonalite rock is moderately to highly weathered and decomposed near the contact with the alluvial soils and becomes less weathered with depth.

Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the Boring Logs provided in Appendix A.

5.2 WATER

5.2.1 Surface Water

Surface drainage flows primarily by surficial sheet flow over the existing contour of the land. Proposed roadway improvements should be designed to provide positive surface drainage to prevent ponding and/or saturation of the soils in the vicinity of foundations or pavements. The site is not located within a Federal Emergency Management Agency (FEMA) flood hazard zone based on the latest Flood Insurance Rate Maps (FIRM) for the region.

5.2.2 Groundwater

Groundwater was encountered in twelve of our twenty seven borings excavated for the proposed Interchange Improvement at depths ranging from approximately 3 to 20 meters below existing grades. These depths to groundwater correspond to groundwater elevations of approximately 447.31 to 439.52 meters, above Mean Sea Level (MSL).

Fluctuations of the groundwater level, localized zones of perched water, and soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas on or immediately adjacent to the site can also cause a fluctuation of local groundwater levels.

5.3 EXPANSIVE SOILS

Expansive soils generally contain clay particles that swell considerably when wetted and shrink when dried. Foundations constructed on these soils are subjected to uplifting forces caused by the swelling.

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Based on our observation of soil samples obtained from the excavations, soil materials at the project site appear to have a “very low” expansion potential. Testing of the final subgrade soils after completion of backfilling should be conducted to evaluate their expansion potential and confirm or modify the recommendations presented herein.

5.4 COLLAPSIBLE SOILS

A collapsible soil is generally defined as a soil that will undergo a sudden decrease in volume after wetting when its internal support structure is lost. The internal support is considered to be a temporary strength and is derived from any number of sources, including capillary tension, cementing agents (e.g. iron oxide and calcium carbonate), clay-welding of grains, silt bonds, clay bonds and clay bridges. Collapse can occur even when there is no increase in vertical stress. Soils found to be most susceptible to collapse include loess deposits (fine-grained wind-deposited soils), valley alluvium deposited within a semi-arid to arid climate, and residual soil deposits.

Based on the results of our field exploration and laboratory testing, the general collapse potential of encountered on-site soils deposits is considered to be “low”.

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6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 DYNAMIC ANALYSIS

6.1.1 Ground Surface Rupture and Deformation Potential

The site is not located within a currently delineated State of California Alquist-Priolo Earthquake Fault Zone (Bryant and Hart, 2007). No known active faults have been identified on the site, thus, the potential for future surface fault rupture at the site is considered to be "low." While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

6.1.2 Seismic Shaking

The 1996 California Seismic Hazard Map prepared by Caltrans (Mualchin, 1996a) indicates that the controlling fault for this project is the San Jacinto Fault (SJO), a strike slip fault with a maximum credible earthquake (MCE) moment magnitude of 7.5. The closest fault distance to the project site is approximately 8.8 km.

The horizontal peak bedrock acceleration (PBA) at the site based on the 1996 Caltrans Seismic Hazard Map is 0.5g, as shown on Plate 3, *Fault and PBA Map*. Caltrans Guidelines for Structures Foundation Reports (CGSFR), Version 2.0, dated March 2006, requires that the PBA determined above be verified with well-established attenuation relationships such as Sadigh et al. (1997) for controlling faults. The PBA value for the site, estimated using Sadigh et al. (1997) attenuation relationship, is 0.46g. Therefore, a PBA of 0.5g is recommended in accordance with Caltrans design practice.

Based on the results of our field exploration, our past experience, and in accordance with Table B.1 of Caltrans Seismic Design Criteria (SDC) (Version 1.4, dated June 2006), the site can be classified as Soil Profile Type C. The recommended seismic design parameters are summarized in the following Table 1.

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Table 1
Seismic Design Parameters

Seismic Parameters	Design Recommendation and Reference
Controlling Fault	San Jacinto (SJO), (Mualchin, 1996a)
Type of Fault	Strike-Slip (Mualchin, 1996b)
Closest Distance to the Fault	8.8 km (Mualchin, 1996a)
Earthquake Magnitude (MCE)	7.5 (Mualchin, 1996a,b)
Horizontal Peak Bedrock Acceleration (PBA)	0.5g
Soil Profile Type	C (Table B.1, 2006 Caltrans Seismic Design Criteria)

6.1.3 Liquefaction Potential

Seismically induced soil liquefaction generally occurs in loose, saturated, cohesionless soil when pore pressures within the soil increase during ground shaking. The increase in pore pressure transforms the soil from a solid to a semi-liquid state. The primary factors affecting the liquefaction potential of a soil deposit are: 1) intensity and duration of earthquake shaking, 2) soil type and relative density, 3) overburden pressures, and 4) depth to groundwater. Soils most susceptible to liquefaction are clean, loose, uniformly graded, fine-grained sands, and non-plastic silts that are saturated. Silty sands have also been shown to be susceptible to liquefaction. These soils typically lose a portion or all of their shear strength and regain strength sometime after shaking stops. Soil movements (both vertical and lateral) have been observed under these conditions due to consolidation of the liquefied soils and the reduced shear resistance of slopes.

According to a Liquefaction Hazard Map prepared by the County of Riverside (Generalized Liquefaction Figure S-3, 2002), the site is located in an area designated as having a “low” liquefaction susceptibility.

In order to evaluate the liquefaction potential at the site, we used the simplified liquefaction analysis procedure recommended by NCEER (Youd and Idriss, 2001). It is our professional opinion that, based on an assumed groundwater elevation of 449.0 meters and the anticipated depth to weathered bedrock, the site has a “low” liquefaction potential.

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6.1.4 Seismically Induced Settlements

Unconsolidated, loose to medium dense sandy soil deposits tend to densify or become more tightly packed during strong ground shaking, thereby causing ground settlement. Using an empirical procedure developed by Tokimatsu and Seed (1987), seismically induced settlements due to seismic compaction of dry or unsaturated soils below the foundations were estimated to be on the order of 13 mm or less.

6.2 CUTS AND EXCAVATION

Project grading plans were not available at the time this report was prepared. However, we anticipate that temporary excavations will be required during construction of drainage improvements and underground utilities. Bedrock may be anticipated within the required depths of excavation. Conventional earth-moving equipment is expected to be capable of performing the excavations required. Groundwater may be anticipated within the excavations at the site for bridge widening, bridge replacement, drainage improvements, underground utilities, or pavement subgrade. We anticipate that the on-site soils encountered during construction of the project, excluding cobbles and boulders, organics, debris, and/or other deleterious materials, may be suitable for reuse as engineered fill.

6.3 EMBANKMENTS AND FILL

Approach embankments constructed of compacted fill soils will be required for the proposed bridge widening and new ramps. In accordance with the latest edition (2006) of Caltrans Highway Design Manual, fill slopes should be 1:4 (V:H) or flatter. Slopes steeper than 1:4 (V:H) must be approved by the District Landscape Architect.

Engineered fill to be used in general embankment areas should be free of organic and other deleterious debris, well-graded with maximum dimension of 76.2 mm, essentially non-plastic (liquid limit less than 30, plasticity index less than 12), with less than 50 percent passing the No. 200 sieve, and an Expansion Index (EI) of less than 50. In general, well-graded mixtures of gravel, sand, and non-plastic silt and clay meeting the above requirements are acceptable for use as engineered fill in general embankment areas. It should be noted that as the percentage of fines (% passing No. 200 sieve) increases, the magnitude of in-fill settlement and the settlement duration (waiting

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period) will increase. Engineered fill placed as subgrade below pavements (within 1.2 meters of finished grade) should have an R-value of 25 or greater.

In general, structure backfill soils should conform to Section 19 of the Caltrans Standard Specifications.

6.4 PAVEMENT DESIGN

Pavement design and recommended structural sections are presented in a separate Materials Report prepared by Kleinfelder for this project.

6.5 CORROSION ASSESSMENT

According to Section 5.5 of Caltrans *Corrosion Guidelines Version 1.1* (2003), a site is considered corrosive to foundation elements if one or more of the following conditions exist for the soil and/or water samples taken at the site:

- Chloride concentration is greater than or equal to 500 ppm,
- Sulfate concentration is greater than or equal to 2,000 ppm, and/or
- pH is 5.5 or less.

Five representative soil samples were tested to determine the corrosion potential of encountered near-surface soils. The tests included minimum electrical resistivity, pH, soluble sulfate content, and soluble chloride content using procedures described in California Test Methods 643, 532, 417, and 422, respectively.

Test results, presented in Table B-2 in Appendix B, indicate a minimum resistivity ranging from 1200 to 3200 Ohm-cm, pH value ranging from 7.1 to 8.1, sulfate content ranging from 5 and 20 ppm, and chloride content ranging from 126 to 323 ppm. Based on these results and Caltrans Corrosion Guidelines, the on-site soils are not considered corrosive to concrete and ferrous metals. As a minimum, the Caltrans standard Type II modified cement with a maximum water-cement ratio of 0.45 should be used for the proposed project in accordance with Section 90-1.01 of Caltrans Standard Specifications.

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6.6 Earth Retaining Systems

6.6.1 Standard Retaining Walls

A total of three new standard retaining walls are planned in various locations within the project area. Table 2 summarizes the proposed retaining walls for this project.

Table 2
Summary of Proposed Standard Retaining Walls

Wall No.	Wall Type	Station and Side	Wall Design Height (mm)		Wall Foundation Type
			Minimum	Maximum	
10	Type 1 and Type 5	”J” 10+30.0 to “J” 10+99.71	1800	3000	Spread Footing
12	Type 1	”J” 11+47.83 to ”J” 14+30.00	2400	4200	Spread Footing
14	Type 1	”X” 14+03.585 to ”X” 15+31.516	1200	2400	Spread Footing

We recommend an allowable bearing pressure of 195 kPa for the design of footing-supported retaining walls. All backfill placed adjacent to retaining walls should consist of granular structural fill. The backfill should be compacted to at least 95 percent relative compaction, in accordance with Caltrans Standard Specifications. The use of heavy compaction equipment to compact the backfill adjacent to the walls may cause significantly higher lateral pressures to develop on the walls. Therefore, all fill placed within 1.52 meters of the wall should be compacted using hand-operated equipment.

6.6.2 Box Springs Overhead Tieback Wall

To provide for the construction of access road along the west side of existing Metrolink railroad, we understand that a tieback wall with two to four levels of tieback anchors will be constructed at Abutment 1 slope of proposed Box Springs Overhead Left Bridge widening. The height of the tieback wall will range from 4.7 to 6.8 meters and backfill slopes of 1:1.5 and 1:2 (V:H). Geotechnical design recommendations for the proposed tieback wall are presented in a separate Structure Foundation Report prepared by Kleinfelder.

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6.7 CULVERT FOUNDATION

6.7.1 General

All culverts located in the project area will be inspected by Caltrans Maintenance Staff. Extensions and/or replacements of these culverts will be part of the project. The following general guidelines can be used for the design of proposed culverts:

- Field and laboratory data indicate that the foundation soils, in general, will have adequate bearing capacity to support the culverts. Removal and recompaction of loose/soft alluvial soils, if encountered, will be required to minimize post-construction settlements.

- The culverts should be designed to support the weight of the overburden and traffic surcharge. The overburden pressure on the culvert can be calculated by multiplying the unit weight of the soil cover by the thickness of this cover. For design purposes, a soil unit weight of 22 kN/m^3 for compacted fill should be used in accordance with Section 6.2.1 of Caltrans Bridge Design Specifications.

6.7.2 Pipe Bedding and Trench Backfill

At a minimum, bedding materials, and all backfill should meet the requirements of the Caltrans and/or the pipe manufacturer's specifications, if available, and be placed according to the pipe manufacturer's and/or the Caltrans specifications. Recommendations provided above for backfill are minimum requirements only. More stringent material specifications may be required to fulfil local building requirements and/or bedding requirements for specific types of pipes. We recommend the project Civil Engineer develop these material specifications based on planned pipe types, bedding conditions, and other factors beyond the scope of this study.

The soils exposed at the bottom of the trench excavation should be in a firm, and unyielding condition. Voids within the trench subgrade or sidewalls should be filled with material compacted in accordance with the recommendations presented within. A representative from our firm should be present during excavation and fill placement operations to observe the materials uncovered during grading, substantiate the proper use of materials, and verify or modify the recommendations presented herein.

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Pipe Bedding

Some soils anticipated to be exposed at the pipe invert elevation along the alignment are fine-grained materials that are considered to be unsuitable for pipe bedding. In areas such as these, suitable bedding material will have to be imported from offsite or from other areas of the alignment where suitable excess native material has been excavated. Bedding materials should consist of sand, gravel, crushed aggregate, or native free-draining granular material with a maximum particle size of 19 mm and a minimum sand equivalent of 30. Bedding materials should also conform to the pipe manufacturer's specifications, if available.

Where import of bedding materials is necessary, the trench should be excavated to a depth of at least six inches below the bottom of the pipe and the overexcavation replaced with suitable bedding material.

Our representative should observe the soil conditions exposed at the invert elevation to verify that the exposed materials are suitable for bedding of the pipe or to identify materials requiring overexcavation and recompaction.

Pipe Zone

The pipe zone includes the full width of the trench from the bottom of the pipe to a horizontal level 300 mm above the top of the pipe. Soils generated from trench excavations along the alignment should generally be suitable for use as pipe zone backfill provided the backfill has a maximum particle size of 19 mm and is free of vegetation, debris, organics and other deleterious material. Sufficient material suitable for use as pipe zone backfill should exist along the alignment; however, stockpiling and transportation of selected pipe zone backfill during trench excavation may be necessary.

Trench Zone

The trench zone is the full width of the trench above the pipe zone to the bottom of the street zone in paved areas or to the existing surface in unpaved areas. Soils generated from trench excavations along the alignment are considered suitable for use as backfilling the trench zone, provided the materials are less than six inches in maximum dimension, and is free of vegetation, debris, organics and other deleterious materials.

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Street Zone

The street zone is the top 300 mm of the trench immediately below any paved areas. Soils generated from trench excavations along the alignment should generally be suitable for use as street zone backfill provided the backfill has a maximum particle size of 19 mm and is free of vegetation, debris, organics, and other deleterious material.

Import Material

If import material is used for pipe bedding, pipe zone, or trench zone backfill, we recommend it consists of fine-grained sand with a sand equivalent of at least 30. All import materials should be evaluated by the Geotechnical Engineer prior to use.

6.7.3 Compaction Methods

The native materials along the alignment are suitable for placement and compaction using conventional mechanical methods. Jetting of pipe bedding or trench backfill materials is not recommended. Regardless of the method of compaction used, materials should be brought up at substantially the same rate on both sides of the pipe. Care should be taken so that the pipe is not floated or displaced before backfilling is completed.

Mechanical Compaction

Pipe zone and trench zone backfill should be moisture conditioned to near optimum moisture content, placed in horizontal lifts less than 200 mm in loose thickness and compacted to at least 90 percent of the maximum dry density based on ASTM Test Method D1557. The upper 300 mm of backfill below street pavement sections (street zone) should be compacted to at least 95 percent relative compaction.

Slurry Backfill

Backfill of the pipe zone material around the pipe using a cement slurry is a suitable alternative to mechanical compaction. If slurry is used for backfilling around the pipe, it should extend a minimum of 150 mm above the pipe to reduce the potential for corrosion cells. The cement slurry should contain at least one sack of cement per cubic yard. Additional backfill should not be placed over the slurry until the slurry has reached the initial set.

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6.8 DESIGN AND CONSTRUCTION OF THE JACKED PIPE/ TUNNEL SECTION

The following section provides our recommendations for design and construction of the proposed jacked drainage pipe. The selection of the method of construction for the drainage pipe should be provided by the contractor. We recommend that the contractor's actual method of construction be reviewed by the geotechnical engineer prior to construction to evaluate if the installation method is consistent with the design assumptions. The method of excavation and support is ultimately left to the contractor with guidance and specifications provided by the designer and owner. The tunneling operations should be performed only by contractors highly experienced in this type of construction under the anticipated conditions, and under strict construction monitoring and quality control. The contractor should demonstrate at least 8 years of experience with tunneling in the types of soil and bedrock present at the site.

6.8.1 Anticipated Ground Conditions

Borings BD-1 through BD-4 encountered artificial fill in the upper portions of the borings and alluvial soils underlying the fill. Granitic rock was also encountered in the lower portion of boring BD-4. In general, medium dense to very dense granular alluvial soils are anticipated at the tunnel depth in the areas of borings BD-1, BD-2 and BD-3 in the southern and central portions of the alignment, and in the upper portion of the tunnel zone in the area of boring BD-4. Weathered granitic bedrock is anticipated in the invert of the pipe excavation in the area of BD-4. The high blow counts, difficult drilling conditions, and refusal encountered in the lower portion of boring BD-3 also suggest hard, difficult ground conditions or even possibly weathered bedrock conditions in or near the invert of the pipe excavation beginning near boring BD-3 and continuing to the area of BD-4. Groundwater was also encountered at an approximate depth of 14.6 meters (elevation 446 meters above MSL) in boring BD-2 and at an approximate depth of 11.9 meters (elevation 448 meters above MSL) in boring BD-4. The encountered groundwater may be representative of a perched groundwater condition.

Based on the anticipated alluvial soils within the tunnel zone, "soft ground" conditions are anticipated for the majority of the pipe excavation. The ground conditions are characterized as "mixed-face" conditions, where granular, coarse-grained alluvial soils are anticipated in the tunnel crown and granitic bedrock is anticipated in the invert. The mixed-face conditions are anticipated in the northern portion of the pipe excavation between borings BD-3 and BD-4.

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6.8.2 Anticipated Ground Construction and Behaviour

This section presents the anticipated ground behavior for the various soil, rock and mixed-face conditions anticipated along the tunnel alignment. We anticipate the pipeline will be constructed by tunneling or jack-and-bore operations. Soft-ground and mixed-face tunneling by means of a tunneling shield, tunnel boring machine, microtunneling, hand mining, jacking-and-boring, or other similar means has been assumed for describing ground behavior during construction.

6.3.1 Soft-Ground Conditions

Soft-ground behavior is described in terms of the "Tunnelman's Ground Classification System", first described by Terzaghi (1950) and later modified by Heuer (1974). The Tunnelman's ground classification for soft ground is presented in the table below.

Table 2
Tunnelman's Ground Classification System for Soft Ground

CLASSIFICATION	BEHAVIOR	TYPICAL SOIL TYPES
Firm	Heading can be advanced without initial support, final lining can be constructed before ground starts to move.	Loess above the water table, hard clay, marl, cemented sand and gravel when not highly overstressed.
Raveling - Slow Raveling - Fast Raveling	Chunks or flakes of materials begin to drop out of the arch or walls sometime after the ground has been exposed, due to loosening, over-stress and "brittle" fracture. In fast raveling ground, the process starts within a few minutes, otherwise the ground is slow raveling.	Residual soils or sand with small amounts of binder may be fast raveling below the water table, slow raveling above. Stiff fissured clay may be slow or fast raveling depending upon degree of overstress.
Squeezing	Ground squeezes or extrudes plastically into tunnel, without visible fracturing or loss of continuity, and without perceptible increases in water content. Ductile, plastic yield and flow due to overstress.	Ground with low frictional strength. Rate of squeeze depends on degree of overstress. Occurs at shallow to medium depth in clay of very soft to medium consistency. Stiff to hard clay under high cover may move in combination with raveling at execution surface and squeezing at depth behind face.
Running	Granular materials without cohesion are unstable at a slope greater than their angle of repose (approx. 30 - 35 degrees). When exposed at steep slopes they run like granulated sugar or dune sand	Clean, dry granular materials. Apparent cohesion in moist sand, or weak cementation in any granular soil, may allow the material to stand for a brief period of raveling before it breaks down and runs. Such behavior is

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CLASSIFICATION	BEHAVIOR	TYPICAL SOIL TYPES
	until the slope flattens to the angle of repose.	cohesive running.
Flowing	A mixture of soil and water flows into the tunnel like a viscous fluid. The material can enter the tunnel from the invert as well as from the face, crown, and wall, and can flow for great distances, completely filling the tunnel in some cases.	Below the water table in silt, sand, or gravel without enough clay content to give significant cohesion and plasticity. May also occur in highly sensitive clay when such material is disturbed.
Swelling	Ground absorbs water, increases in volume, and expands slowly into the tunnel.	Highly preconsolidated clay with plasticity index in excess of about 30, generally containing significant percentages of montmorillonite.

Along most portions of the tunnel, we anticipate slow to fast raveling ground conditions for the granular soils in the tunnel crown, with slow raveling anticipated where medium dense to very dense soils are encountered, and fast raveling, locally, where loose sands and gravels are encountered. Local running ground conditions could occur where isolated lenses or pockets of clean, dry, cohesionless sands and gravels are encountered. Firm ground conditions are anticipated locally where stiff to very stiff fine-grained soils are encountered.

Groundwater at or near the bedrock-alluvium interface may also result in localized inflows of sand and gravel. Fast raveling or running ground conditions associated with groundwater inflow may require full-face breasting, control of water, or other precautionary ground improvement techniques.

The most difficult ground conditions along the alignment are associated with the mixed-face soil and rock conditions. The bedrock is significantly stronger than the soft-ground conditions in the crown and will require greater excavation effort than that required for the alluvium. Cobbles and boulders, although not documented in the borings, may exist at or near the base of the alluvial deposits requiring additional excavation and handling effort.

6.8.3 Initial Ground Support Systems for Tunneling

The anticipated systems for tunnel support include steel casing, which is jacked or advanced directly into place, liner plates, and horseshoe or circular steel ribs with lagging or shotcrete, if applicable. The support systems for tunneling should be

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designed to withstand jacking forces and the applicable ground and surcharge loads at depth.

Along most portions of the tunnel we anticipate slow to fast raveling ground conditions for the granular soils in the tunnel crown with slow raveling anticipated where medium dense to very dense soils are encountered, and fast raveling locally where loose sands and gravels are encountered. Local running ground conditions could occur where isolated lenses or pockets of clean, dry, cohesionless sands and gravels are encountered. Firm ground conditions are anticipated locally where stiff to very stiff fine-grained soils are encountered.

Groundwater at or near the bedrock-terrace deposits interface may also result in localized inflows of sand and gravel. Fast raveling or running ground conditions associated with groundwater inflow may require full face breasting, control of water, or other precautionary ground improvement techniques.

The most difficult ground conditions along the alignment are associated with the mixed-face soil and rock conditions. The shale bedrock (Unit 3) is significantly stronger than the soft-ground conditions in the crown and will require greater excavation effort than that required for the terrace deposits (Units 2A and 2B). Cobbles and boulders may also be anticipated locally at or near the base of the terrace deposits requiring additional excavation and handling effort.

6.8.4 Anticipated Tunnel Excavation Method and Initial Ground Support Methods

Based on the soil/bedrock conditions encountered during our field explorations, it is our opinion that an open face digger shield or conventional mining will be the more favorable tunnel excavation methods for the proposed trenchless alignment. Other tunnel excavation methods, such as tunnel boring machines (TBM), may also be feasible; however, they should be designed for the mixed face condition. Although, it is our opinion that that an open face digger shield or conventional mining will be the more favorable tunnel excavation methods for the proposed trenchless alignment, other methods should be evaluated and may be proposed by the contractor.

6.8.4.1 Open Face Digger Shield with Breasting Capabilities

The open face digger shield generally consists of a steel shell with a projecting hood that provides support of the ground prior to the installation of the initial support system.

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The excavation of the tunnel face is typically performed with various methods including, but are not limited to, a hydraulic excavator arm, roadheader, Load/Haul/Dump (LHD) excavator, and hand mining. The shield has steering jacks to maintain line and grade and breasting capabilities to support the face if the ground becomes unstable. Full breasting is required during shutdown periods, such as weekends, off shifts, and mechanical breakdowns. The open face configuration allows access for removal of over-sized materials if encountered. Advancement of the shield is accomplished by erecting steel ribs and lagging support or liner plates within the tail shield and pushing off the last set installed, or by jacking a casing from a jacking pit or shaft.

6.8.4.2 Conventional Mining with Horseshoe Steel and Lagging

A horseshoe shaped steel rib and lagging tunnel is a conventional technique that is applied to ground conditions with good stand-up time. This method consists of mining forward, erecting the steel rib and lagging, and blocking the ground prior to large ground movements. The newly excavated portion of the tunnel is supported by ground arching, which spans the gap between the last steel set installed and the face of the tunnel. The length of time before raveling starts varies directly with the cohesion of the soil and inversely with the span of the ground arch. If the ground conditions become unstable, pre-support spiling may be required to stabilize the ground ahead of the excavation. The excavation of the tunnel face is typically performed with methods including, but are not limited to, roadheader, Load/Haul/Dump (LHD) excavator, and hand mining.

6.8.4.3 Mechanized Tunnel Boring Machines

Mechanized tunnel boring machines (TBMs) may also be used for tunnel excavation. TBM tunnels are generally circular shaped and come in a variety of sizes and designs. Numerous TBMs are generally available for soft ground or hard rock conditions employing full face rotating cutter heads with picks or disc cutters for soil or rock conditions, respectively. For this project a fully shielded TBM will be required due to the soft-ground soils in the tunnel crown.

6.8.5 Pipe Jacking and Pipe Jacking Forces

Frictional resistance should be considered for jacked, pit-launched methods of trenchless installations. The actual jacking friction will depend on several factors including, but not limited to soil properties, overcut, lubrication, misalignment, steering correction. The contractor should consider these factors when assessing jacking

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forces. Jacking forces can be resisted by passive earth pressures from the shaft wall as determined by the contractor's engineer.

6.8.6 Muck Disposal

Muck (excavated soil and bedrock) disposal from tunnel and launching pit excavations should be removed from the site and properly disposed of at an acceptable location. Muck, either processed or unprocessed, may also be used as backfill provided it meets the specification requirements. Bentonite slurry, if used, should be disposed of in accordance with local and state regulations. Muck and slurry disposal are the responsibility of the contractor.

6.8.7 Pressure Grouting of Annular Space

After installation of the pipe, the annular space around the pipe should be pressure grouted under the observation of the geotechnical engineer. The volume of the required grout should be checked during placement. In addition, the portion of the launching pit below the invert level of the pipeline should be backfilled with structural concrete prior to installation of the remainder of the pipe.

6.8.8 Launching Pit Construction

Geometry

The launching pits should accommodate all ancillary tunneling equipment such as the jacking frame, the jacking unit, at least one length of steel casing, and/or carrier pipe, and the trust block. With some construction techniques, the launching pits need only accommodate the tunneling equipment and/or ancillary tunnel support equipment. Launching pit excavations are generally on the order of 4.6 meters by 10.7 meters in plan dimension, although smaller pits could be specified, if required.

Design of Lateral Support Systems for the Launching and Receiving Pits

Design of the temporary support system for the launching and receiving pits is the responsibility of the contractor. The design should be performed by a California Registered Civil Engineer who is retained by the contractor. Furthermore, the contractor, through his or her engineer is responsible for defining the final design parameters used for temporary shoring. The excavation should be designed and

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constructed in accordance with OSHA and other applicable federal, state, and local requirements.

Anticipated Shoring Types

The following construction methods may be suitable for the launching and receiving pits:

Soldier Piles and Steel Plate Lagging. A soldier-pile-and-steel-plate system is considered suitable for the anticipated ground conditions. Pre-drilled auger holes for the placement of the soldier piles are expected to typically have good stand-up time in the bedrock. Pre-drilled auger holes within the alluvial soils may have to be cased to prevent caving during drilling. Furthermore, shallow groundwater may be encountered in auger holes. Voids created behind the walls during construction should be backfilled with granular material to prevent surface settlement and damage to utilities and structures in the immediate vicinity.

Liner Plate. Liner plate shoring systems might be used for the launching pit construction. The excavation should proceed only in a "top-down" construction sequence. Excavation of the shaft should only slightly exceed the width of the liner plate, followed closely by the liner plate installation. The space between the liner plate and the ground should be grouted or backfilled with lean concrete at the end of the day, or more frequently, if necessary, for shaft stability.

6.8.9 Shaft Breakout

Alluvial soils will be encountered at the tunnel elevation and ground reinforcement may be necessary at the tunnel breakout. Depending of the type of shaft lining chosen by the contractor, pre-support prior to breakout may be required immediately outside of the shaft for stabilization. Ground reinforcement may include, but are not limited to, grouting, drilled spiling, or other suitable methods designed by the contractor. Additional structural members will likely be required in the shoring system at the breakout area.

6.8.10 Ground Settlement Monitoring

Ground losses (settlement) may occur as the result of soil movement in front of the excavation by means of raveling, caving, loose running, or flowing ground, or may also

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occur as a result of soil movement around the tunneling equipment. Ground losses may also occur as the result of soil movement downward toward the support system (casing). We recommend that the ground surface and other vital structures (utilities, roadways, etc.) be monitored for settlement and signs of distress prior to, during and following tunnel operations.

The contractor should have an onsite means of immediately controlling potential caving or other ground loss conditions that may occur in order to prevent any damage to utilities or roadway above the tunneling operations. Additionally, the contractor should provide for construction techniques to control raveling, and loose running conditions through proper equipment and installation selection and ground improvement techniques, such as pressure grouting, if required.

6.8.11 Cal-OSHA Gas Classification

Prior to initiating construction of a tunnel in the State of California, the Division of Occupational Safety and Health (OSH), Mining and Tunneling Unit of the Department of Industrial Relations is required to make a review and classification of the proposed tunnel ground conditions with respect to the presence of flammable gas or vapors. This classification should be included in the contract documents.

6.8.12 Construction Monitoring/Resident Engineering

Variation in the subsurface conditions may likely be encountered during construction. To proactively manage the construction risk associated with the difference that may exist between the geotechnical data contained in this report and the actual conditions encountered during tunnel excavation, and to provide periodic observation for the purpose of conformance with the plans and specifications, it is recommended that a tunneling consultant be retained to provide technical monitoring of the construction operations.

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7.0 CONSTRUCTION CONSIDERATIONS

7.1 SITE PREPARATION

All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations, and other local, state, or federal specifications. All references to maximum unit weight should be established in accordance with the current ASTM Standard Test Method D1557 and may supersede references cited herein.

7.1.1 Stripping and Grubbing

Prior to general site grading, existing pavement, vegetation, organic topsoil, existing fill soils, and debris shall be stripped and disposed of outside the construction limits. Deeper stripping or grubbing may be required where concentrations of fill debris, organic soils, existing trees, or thick root mats are encountered during site grading. Stripped topsoil (less any debris) may be stockpiled and reused for landscape purposes elsewhere on the project; however, this material should not be incorporated into any engineered fill.

In areas where existing trees will be removed, care should be taken to remove the root-ball, roots exceeding 25.4 mm in diameter, and remaining organics, and to backfill the excavations with compacted engineered fill. We strongly recommend having a representative of Kleinfelder present during tree removal in areas to receive fill or beneath foundations to observe removal of large roots and subsequent scarification and recompaction. Engineered fill should be placed and compacted in accordance with recommendations provided below.

7.1.2 Earthwork and Backfill

After clearing and stripping, the exposed surface should be excavated to a minimum depth of 600 mm before placement of new fill. In addition, any compressible soils encountered shall be removed and replaced with compacted engineered fill in accordance with Caltrans Standard Specifications Section 19-3.06. The exposed

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surface should be proof-rolled with loaded heavy equipment. Any areas of loose or yielding soils should be overexcavated and recompacted. Any soils that cannot be compacted, or are otherwise unsuitable for the planned use, should be excavated and disposed of from the project site. The exposed surface should then be scarified and compacted to the specified density before placement of new fill. New fill placed on or adjacent to the existing slopes should be properly benched into the existing fill in accordance with Caltrans Standard Specifications.

All earthwork should be performed in accordance with Caltrans Standard Specification Section 19. All materials to be placed as fill should be free of vegetation, organics, debris, and other deleterious materials. All fill placed around foundations and behind walls should be structural backfill placed in thin loose lifts, moisture-conditioned, and compacted in accordance with Caltrans Standard Specification Section 19.3.06.

Abutment wall backfill shall be structural backfill according to Caltrans Standard Specifications. In addition, we recommend that abutment backfill be well-graded soil with maximum dimension of 100 mm, essentially non-plastic (liquid limit less than 30, plasticity index less than 12, and with less than 50 percent passing the No. 200 sieve) and non-expansive. Expansive soils, defined as soils with Expansion Index (EI) greater than 50 and/or soils with Sand Equivalent (SE) less than 20, should be excluded from the bridge abutment backfill. Expansion Index should be determined in accordance with ASTM D4829. Sand Equivalent should be determined in accordance with California Test Method (CTM) 217.

The limits of bridge approach zone are considered to extend longitudinally 46 meters measured horizontally from the bridge abutment and either parallel or concentric with the roadway centerline, and transversely the full width of embankment except the outer 1.5 meters measured horizontally from the embankment side slopes. Fills placed within 46 meters of abutments should be compacted to 95 percent relative compaction per ASTM D1557.

7.1.3 Temporary Excavations and Shoring

All excavations must comply with the current CAL-OSHA Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We

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are providing the information below solely as a service to our client. Under no circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

A shoring design and safety plan should be required from the contractor and submitted to the Engineer for review and approval. Likewise, measures to control impact of both groundwater (if encountered) and surface water on the stability of temporary excavations and shoring should be employed and should remain the sole responsibility of the contractor.

7.2 SETTLEMENT MONITORING

A settlement monitoring program is recommended to evaluate the rate and magnitude of actual settlement in the field for the proposed embankment areas. Surface monuments, constructed in accordance with Caltrans Standard Plan A74 or equivalent, should be installed in a timely manner upon completion of fill placement. Surface monuments should be placed at all abutment locations. The actual location of surface monuments will be determined during grading under the direction of the Geotechnical Engineer. Settlement platforms or liquid-filled settlement gauges should also be placed at the bottom of new fill placement after the site development and grading at the abutments. Settlement platform details and installation method should conform to Caltrans Test Method (CTM) 112.

Settlements should be monitored at the time of installation, on a weekly basis for at least one month following installation, and then once every two weeks thereafter until the settlement criterion is satisfied. Pile installation may begin when an extrapolation of the settlement plot shows that the residual (remaining) total settlement of the foundation soil is less than or equal to 13 mm. All settlement monitoring devices should be protected from damage throughout the construction and monitoring periods.

7.3 SURFACE WATER CONTROL

Ponding of water adjacent to the structure should be avoided. During and after construction, positive drainage should be provided to direct surface water away from structures and all excavations toward suitable, non-erosive drainage devices.

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8.0 ADDITIONAL SERVICES AND LIMITATIONS

8.1 ADDITIONAL SERVICES

The review of plans and specifications, and the observation and testing by Kleinfelder of earthwork and foundation related construction activities, are an integral part of the conclusions and recommendations made in this report. If Kleinfelder is not retained for these services, the client will be assuming our responsibility for any potential claims that may arise during or after construction. The recommended tests, observations, and consultation by Kleinfelder during construction include, but are not limited to:

- A review of preliminary plans and specifications;
- Observation of site clearing, undocumented fill removal, and subgrade preparation;
- Engineered fill placement and compaction;
- Construction observation and density testing of fill material placement, trench backfill, and subgrade preparation;
- Monitoring device installation;
- Observation of pile installation; and
- When any unusual conditions are encountered during construction.

These services may be performed in accordance with our current fee schedule.

8.2 LIMITATIONS

The conclusions and recommendations presented in this report are intended to provide preliminary geotechnical design data and recommendations for the proposed improvements at the east junction of I-215 and SR-60, located in the Cities of Riverside and Moreno Valley, Riverside County, California. The findings, conclusions and recommendations were prepared in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made. This report was based on the proposed project information provided to Kleinfelder. If any change (i.e.,

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structure type, location, etc.) is implemented which materially alters the project, additional geotechnical services may be required, which could include revisions to the geotechnical recommendations presented herein. Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard. They are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

This report may be used only by the project designers and Caltrans and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on-site and off-site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party, and client agrees to defend, indemnify, and hold harmless Kleinfelder from any claim or liability associated with such unauthorized use or non-compliance.

Environmental site assessment for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater or atmosphere, or the presence of wetlands was not included in the scope of our services for this report.

This report may be used only by the project designers and Caltrans and only for the purposes stated, within a reasonable time from its issuance, but in no event later than one year from the date of the report. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party, and client agrees to defend, indemnify, and hold harmless Kleinfelder from any claim or liability associated with such unauthorized use or non-compliance.

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Environmental site assessment for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater or atmosphere, or the presence of wetlands was not included in the scope of our services for this report.

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9.0 REFERENCES

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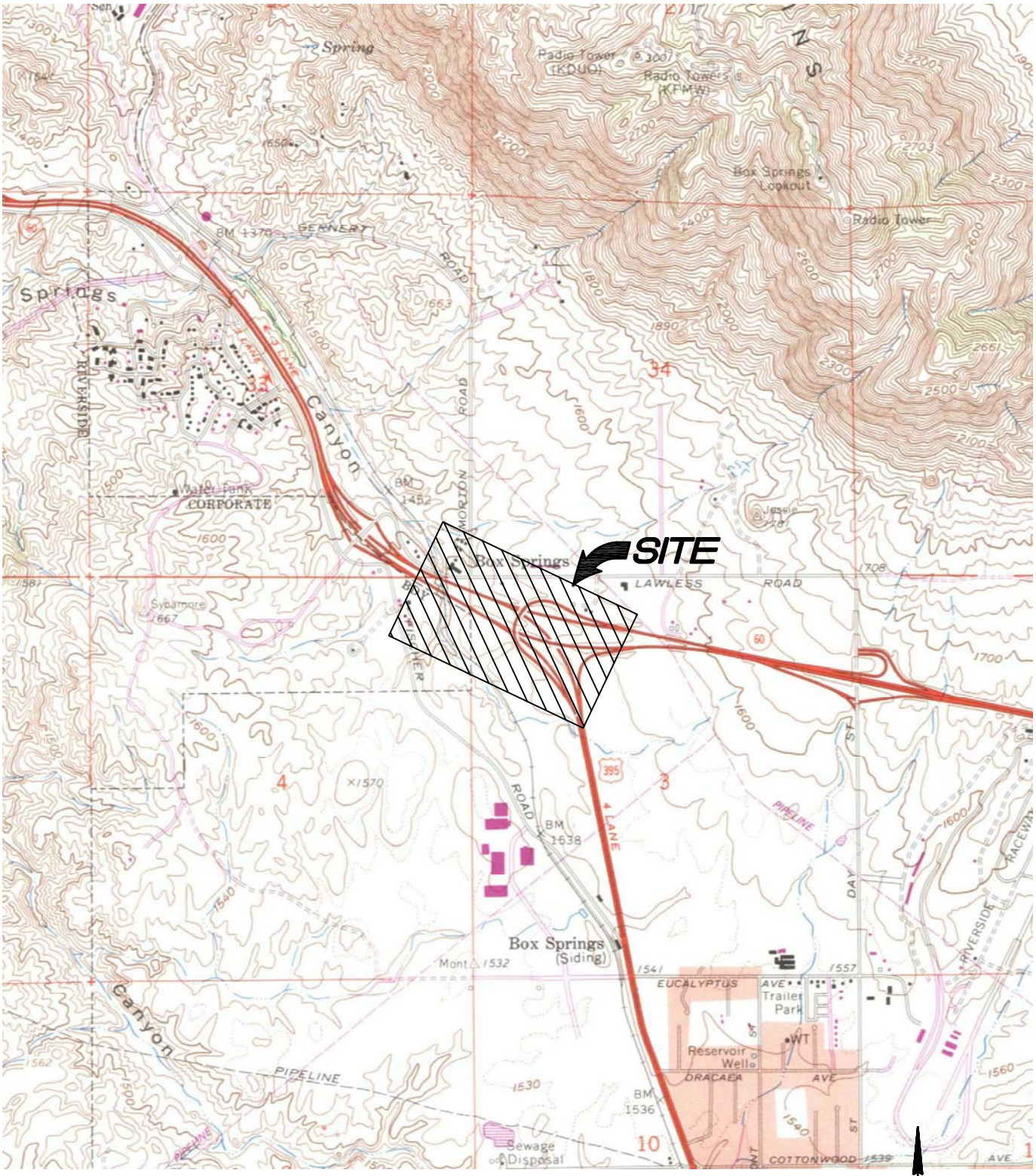
PLATES



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CHECKED BY:	MC
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SITE LOCATION MAP

I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE, CALIFORNIA

PLATE 1

PLOTTED: 24 Oct 2008, 4:25pm, MGriffin
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ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

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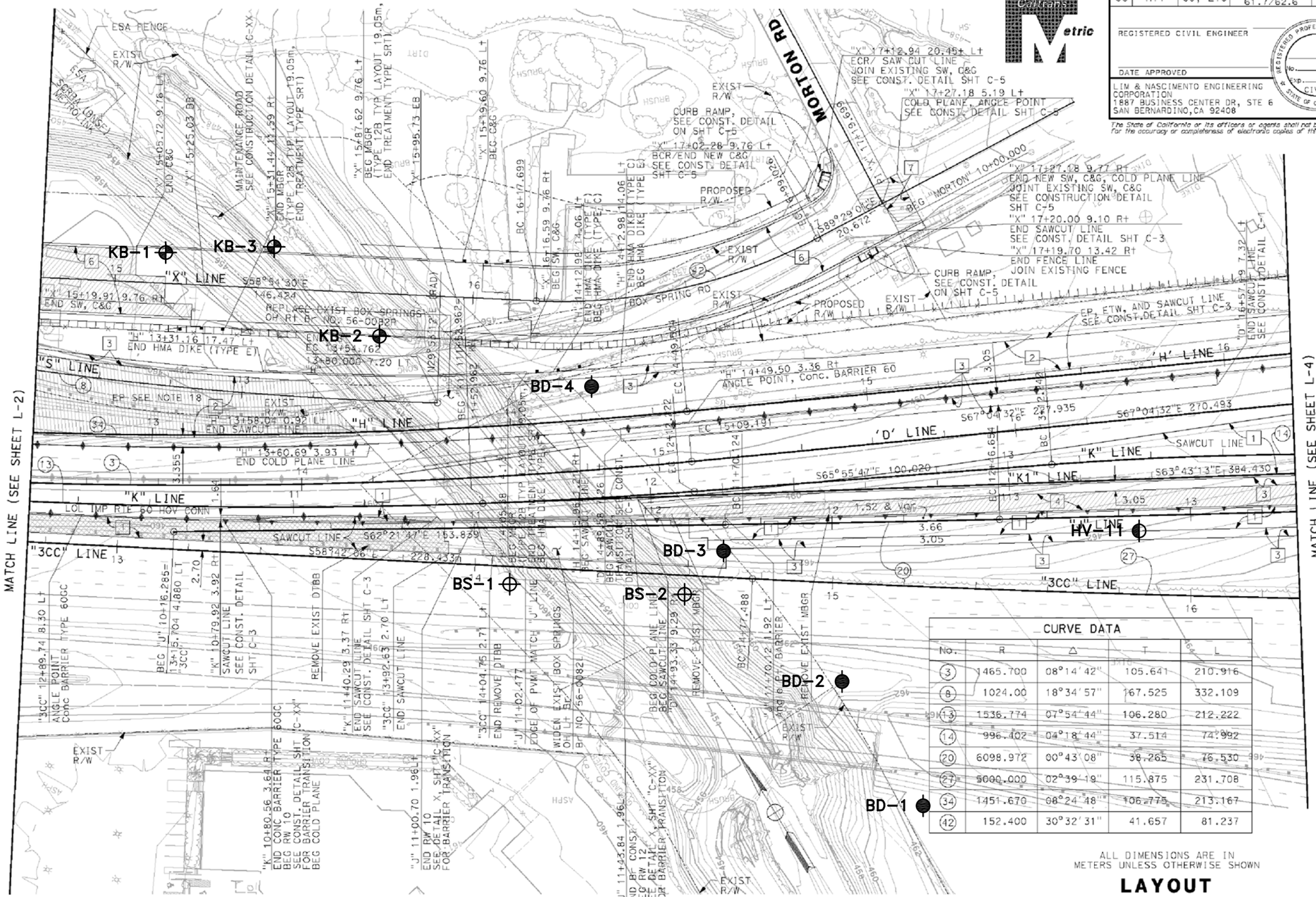

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ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

LAYOUT

SCALE: 1:500

L-3

EXPLANATION

KB-3	APPROXIMATE KLEINFELDER BORING LOCATION, SEPTEMBER 2008.
HV-11	APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.
BS-2	APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.
BD-4	APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

REFERENCE:

BASE MAP PROVIDED BY LAN ENIGINEERING, DATED 8/20/2008.

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EXPLORATION LOCATION MAP

I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE, CALIFORNIA

PLATE **2a**

PLOTTED: 11 Nov 2008, 9:03am, MGriffin
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DIAMOND BAR, CA

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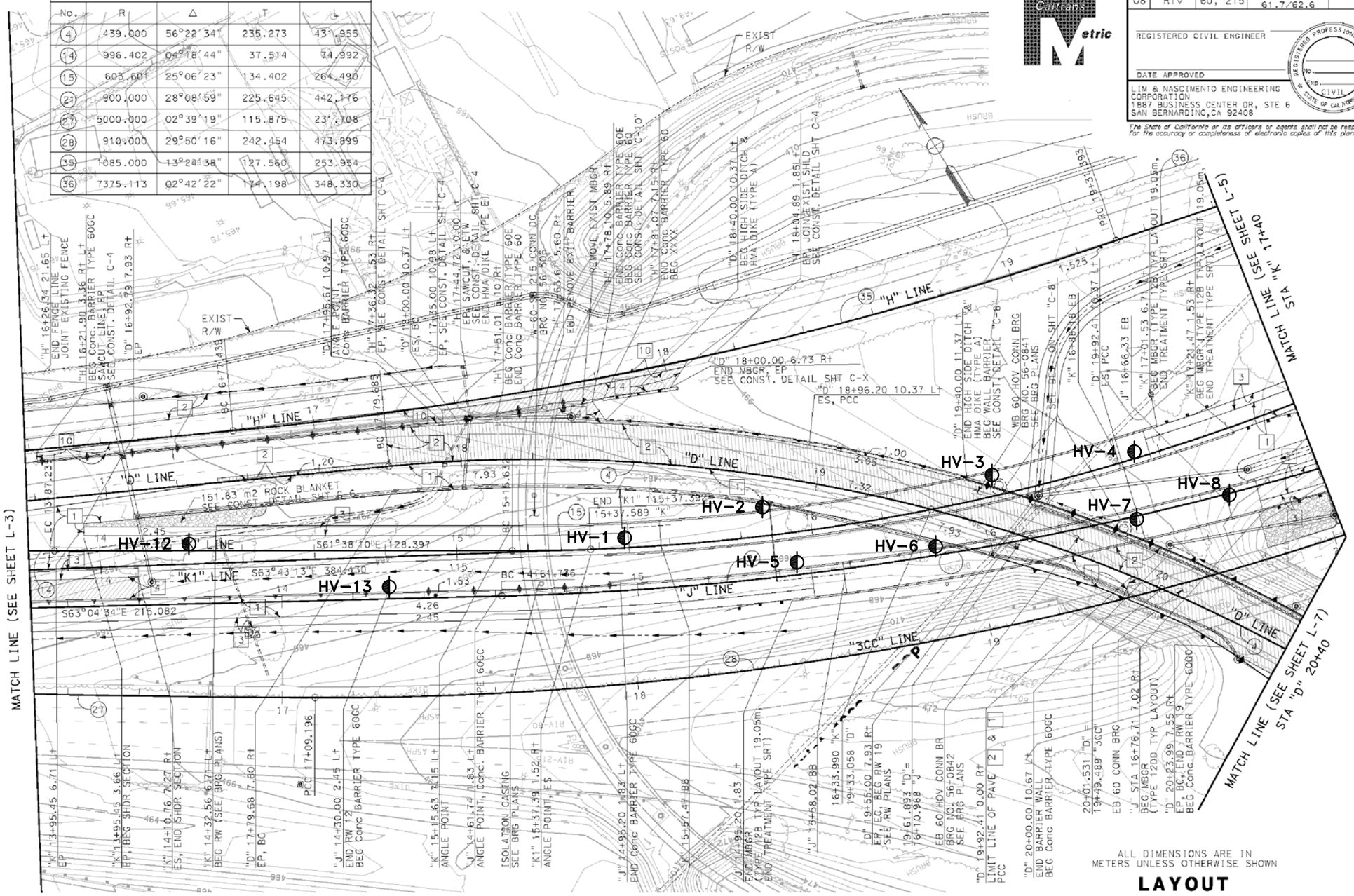

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
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EXPLANATION

HV-13 APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

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EXPLORATION LOCATION MAP

I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE, CALIFORNIA

PLATE **2b**

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
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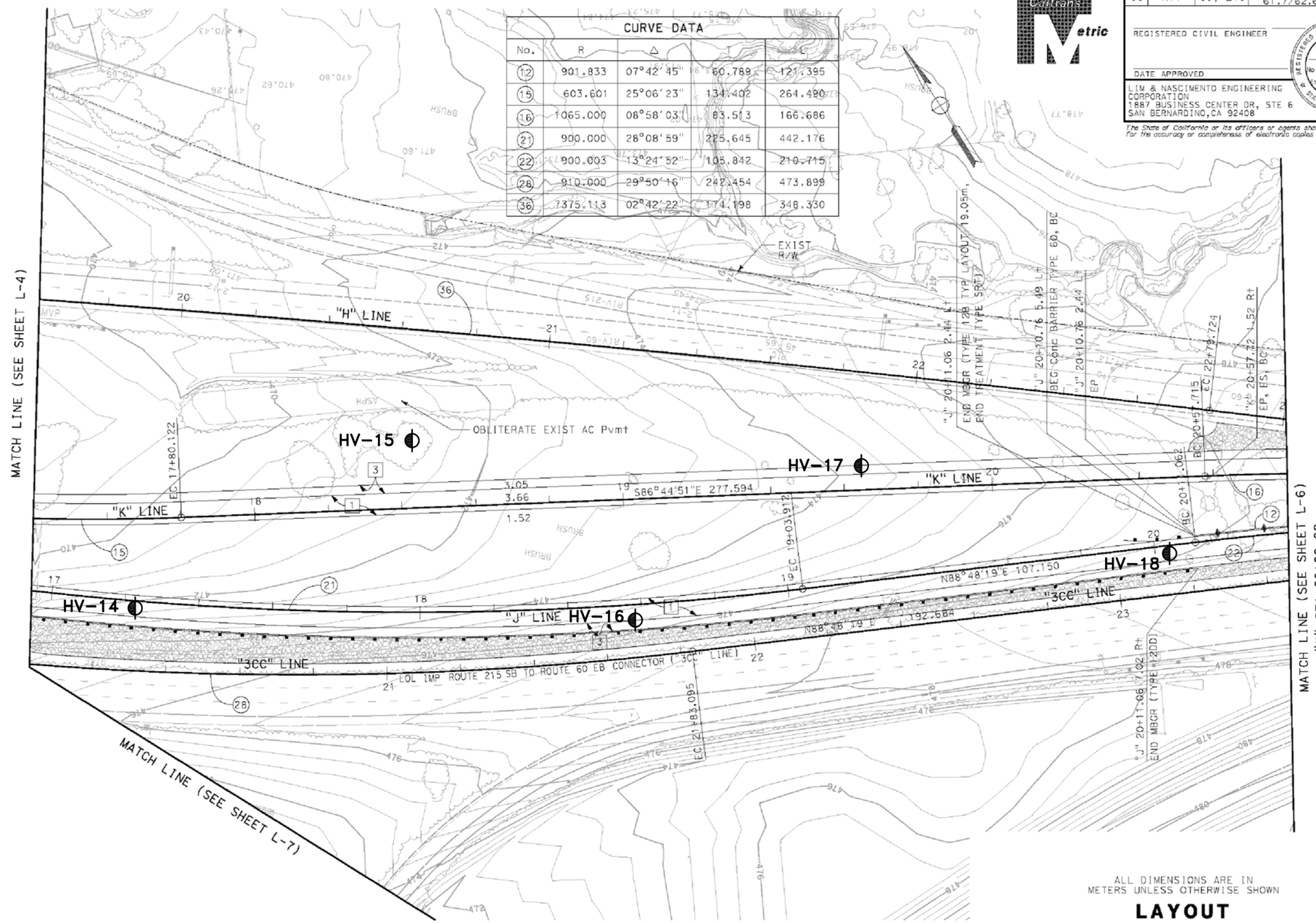
28	910.000	29°50'16"	242.454	473.899
36	7375.113	02°42'22"	174.198	348.330



ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

LAYOUT

SCALE: 1:500

L-5

EXPLANATION

HV-18 APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

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REFERENCE: BASE MAP PROVIDED BY LAN ENGINEERING, DATED 8/20/2008.

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PROJECT NO.	76979
DRAWN:	10/23/08
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME: 76979p2c.dwg	

EXPLORATION LOCATION MAP

I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE, CALIFORNIA

PLATE **2c**

ATTACHED IMAGES: Images: For Plate 2c.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: U:\MGriffin\CADD\2008\76979\I-215_SR60\081022_I-215_SR60\ LAYOUT: 2c PLOTTED: 23 Oct 2008, 2:11pm, MGriffin

ATTACHED IMAGES: Images: For Plate 2d.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: U:\MGriffin\CADD\2008\76979\I-215_SR60\081022_I-215_SR60\ LAYOUT: 2d PLOTTED: 23 Oct 2008, 2:13pm, MGriffin

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

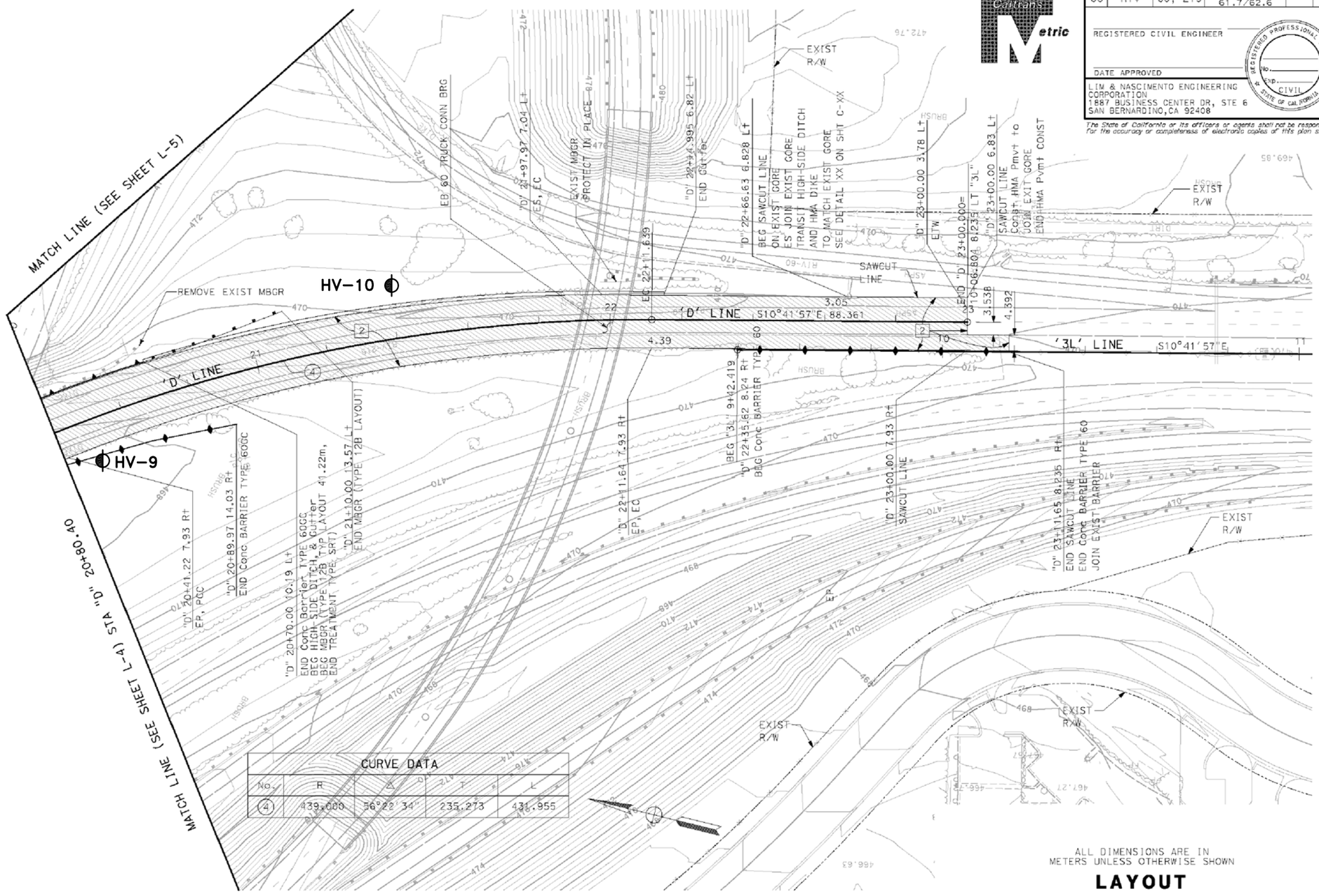
REGISTERED CIVIL ENGINEER

DATE APPROVED

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 BUSINESS CENTER DR, STE 6
SAN BERNARDINO, CA 92408

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — 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.



CURVE DATA				
No.	R	Δ	T	L
4	439.000	56°22'34"	235.273	431.955

LAYOUT

SCALE: 1:500

L-7

EXPLANATION

HV-10 APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

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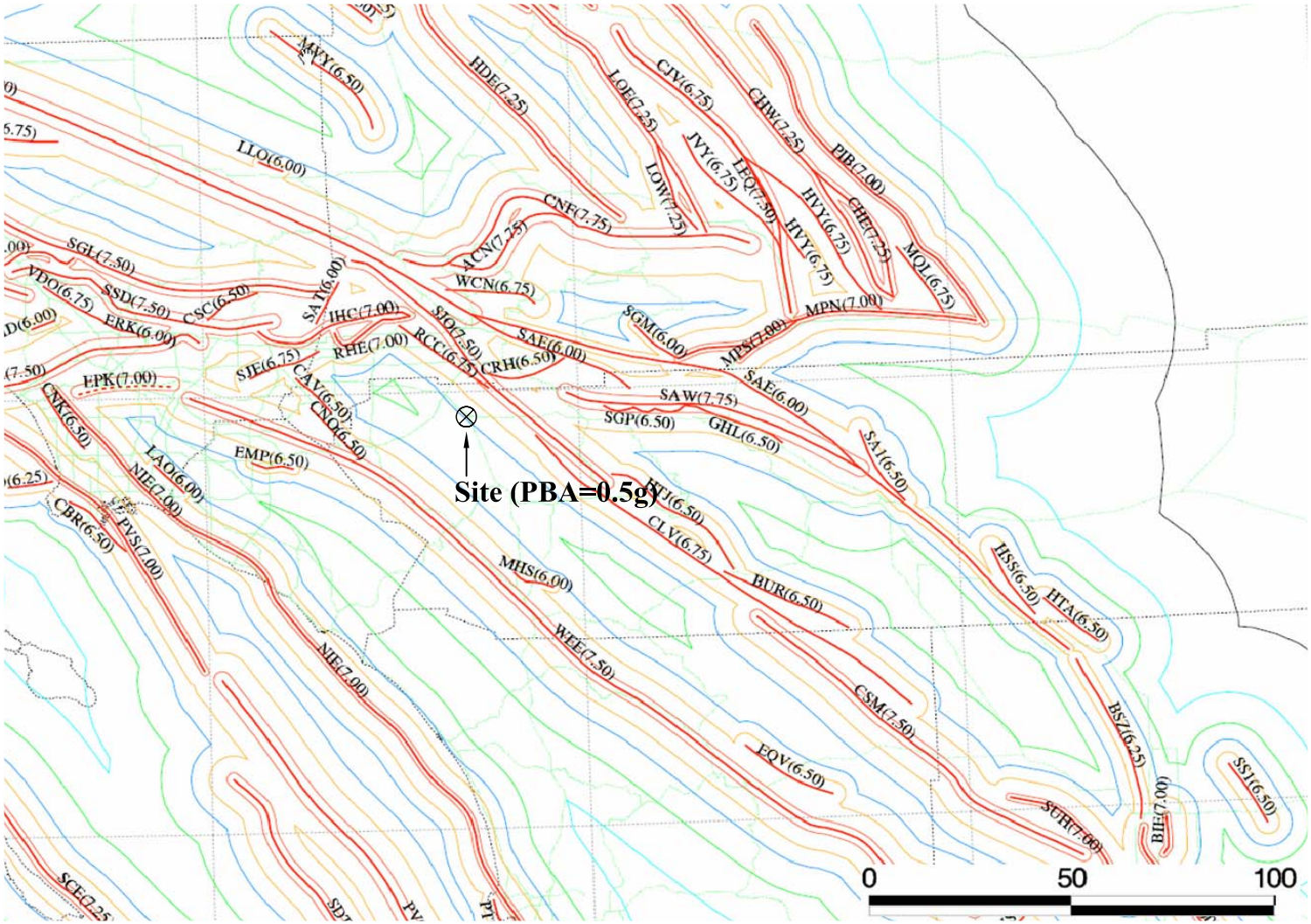
PROJECT NO.	76979
DRAWN:	10/23/08
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p2d.dwg

EXPLORATION LOCATION MAP

I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE, CALIFORNIA

PLATE **2d**

ATTACHED IMAGES: Images: Fault.tif Images: Fault-legend.tif
ATTACHED XREFS:
DIAMOND BAR, CA CAD FILE: U:\MGriffin\CADD\2008\76979\I-215_SR60\081003_Frontage-Rd_OH\ LAYOUT: 3 PLOTTED: 13 Nov 2008, 4:16pm, MGriffin



LEGEND:

- 0.7g Peak Acceleration Contour
- 0.6g Peak Acceleration Contour
- 0.5g Peak Acceleration Contour
- 0.4g Peak Acceleration Contour
- 0.3g Peak Acceleration Contour
- 0.2g Peak Acceleration Contour
- 0.1g Peak Acceleration Contour
- Special Seismic Source (SSS)
- Faults with Fault Codes (MCE)
- State Highways
- County Boundary
- Latitude & Longitude

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DRAWN BY:	MRG
CHECKED BY:	SL
FILE NAME:	76979p3.dwg

FAULT AND PBA MAP

I-215/SR-60 EAST JUNCTION
CITY OF RIVERSIDE
RIVERSIDE, CALIFORNIA

PLATE
3

APPENDIX A

FIELD EXPLORATION

APPENDIX A
FIELD EXPLORATION

The subsurface exploration program for the proposed improvements at the east junction of I-215 and SR-60 consisted of drilling and logging a total of 27 exploratory borings in the project area. The borings were drilled for the proposed Frontage Road Overhead bridge replacement (borings KA-1 through KA-3), Box Springs Overhead bridge widening (borings BS-1 and BS-2), Eastbound and Westbound SR-60 HOV Connectors (borings HV-1 through HV-18), and Jacked Drainage Pipe (borings BD-1 through BD-4) between March 5, 2007 and October 21, 2008. These borings were advanced to depths ranging from approximately 15.7 to 25.3 meters below the existing ground surface (bgs). The borings were advanced using a Mobile B-61, truck-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer delivery system for borings drilled for proposed Frontage Road Overhead replacement bridge, Box Springs Overhead bridge widening, and Eastbound and Westbound SR60 HOV Connectors. A CME/Mobile L-10T hybrid track drill rig was used for the drilling of borings proposed for Jacked Drainage Pipe. The borings were logged and sampled using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Following drilling, sampling and logging, the borings were backfilled with native cuttings.

The *Field Exploration Summary* is presented in Table A-1 below, and the boring logs are presented on Plates A-2a through A-27b at the end of this appendix. The logs describe the earth materials encountered during drilling, and indicate the locations of the samples obtained. The excavations were logged by a staff professional from Kleinfelder using methods outlined in the Unified Soil Classification System (USCS) and general procedures established in ASTM D2488. The boundaries between soil and rock type(s) shown on the logs are approximate because the transition between different soil and rock layer(s) may be gradual.

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Table A-1
Summary of Field Exploration

Boring Number	Boring Depth (m)	Groundwater Depth (m)	Approximate Station No. and Offset (m)	Ground Surface Elevation (m)	Associated Structure
KB-1	21.0	20	Sta. 15+22.71 (1.25 LT from "X" Line)	459.52	Frontage Road Overhead
KB-2	15.7	3	Sta. 15+44.25 (11.25 LT from "X" Line)	450.31	Frontage Road Overhead
KB-3	14.6	4	Sta. 15+77.25 (11.5 RT from "X" Line)	450.52	Frontage Road Overhead
BS-1	15.1	Not Encountered	Sta. 14+61.83 (7.92 LT from "3CC" Line)	461.48	Box Springs Left Overhead
BS-2	11.3	Not Encountered	Sta. 14+11.81 (7.92 LT from "3CC" Line)	452.75	Box Springs Left Overhead
HV-1	15.7	8.8	Sta. 15+92.02 (3.84 LT from "K" Line)	464.70	WB SR-60 HOV Connector
HV-2	25.0	10	Sta. 15+50.15 (8.09 LT from "K" Line)	464.82	WB SR-60 HOV Connector
HV-3	17.1	11	Sta. 16+56.35 (6.84 LT from "K" Line)	466.87	WB SR-60 HOV Connector
HV-4	15.7	11.6	Sta. 16+94.75 (3.66 LT from "K" Line)	468.15	WB SR-60 HOV Connector
HV-5	15.7	10.7	Sta. 115+53.84 (3.85 LT from "J" Line)	466.17	EB SR-60 HOV Connector
HV-6	25.3	10.4	Sta. 115+85.37 (3.99 LT from "J" Line)	465.91	EB SR-60 HOV Connector
HV-7	21.3	10.7	Sta. 116+41.09 (0.68 LT from "J" Line)	467.86	EB SR-60 HOV Connector
HV-8	15.7	12.5	Sta. 116+71.89 (0.33 LT from "J" Line)	469.78	EB SR-60 HOV Connector
HV-9	5.0	Not Encountered	Sta. 20+49.62 (11.60 RT from "D" Line)	466.83	WB SR-60 HOV Connector
HV-10	5.0	Not Encountered	Sta. 21+34.41 (17.60 LT from "D" Line)	470.00	WB SR-60 HOV Connector
HV-11	6.6	Not Encountered	Sta. 112+78.84 (4.23 LT from "J" Line)	462.96	EB SR-60 HOV Connector
HV-12	6.6	Not Encountered	Sta. 14+25.00 (2.12 LT from "K" Line)	463.89	WB SR-60 HOV Connector
HV-13	6.6	Not Encountered	Sta. 114+28.45 (3.84 LT from "J" Line)	465.54	EB SR-60 HOV Connector

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Table A-1 (Continued)
Summary of Field Exploration

Boring Number	Boring Depth (m)	Groundwater Depth (m)	Approximate Station No. and Offset (m)	Ground Surface Elevation (m)	Associated Structure
HV-14	7.8	Not Encountered	Sta. 117+23.08 (3.08 LT from "J" Line)	472.41	EB SR-60 HOV Connector
HV-15	6.6	Not Encountered	Sta. 18+42.31 (21.15 LT from "K" Line)	470.82	WB SR-60 HOV Connector
HV-16	9.6	Not Encountered	Sta. 118+57.69 (3.85 LT from "J" Line)	477.74	EB SR-60 HOV Connector
HV-17	5.0	Not Encountered	Sta. 19+65.38 (3.85 LT from "K" Line)	--	WB SR-60 HOV Connector
HV-18	5.0	Not Encountered	Sta. 120+3.85 (2.31 LT from "J" Line)	476.98	EB SR-60 HOV Connector
BD-1	15.7	Not Encountered	Sta. 15+28.5 (61.9 RT from "3CC" Line)	462.6	Jacked Drainage Pipe
BD-2	15.7	Not Encountered	Sta 15+2.1 (25.8 RT from "3CC" Line)	461.5	Jacked Drainage Pipe
BD-3	14.6	Not Encountered	Sta 14+66.5 (8.2 LT from "3CC" Line)	461.3	Jacked Drainage Pipe
BD-4	15.7	11.9	Sta 16+24.7 (25.8 RT from "X" Line)	459.7	Jacked Drainage Pipe

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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	ID	DESCRIPTION	MAJOR DIVISION		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Well-graded gravels, gravel-sand mixtures	FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands
		GP		Poorly-graded gravels, gravel-sand mixtures			CL		Inorganic clays of low to medium plasticity; gravelly clays silty clays,sandy clays, lean clays
		GM		Silty gravels, gravel-sand-silt mixtures			OL		Organic silts and organic silt-clays of low plasticity
		GC		Clayey gravels, gravel-sand-clay mixtures					
	SAND AND SANDY SOILS	SW		Well-graded sands, gravelly sands		SILTS AND CLAYS LL > 50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		SP		Poorly-graded sands and gravelly sands			CH		Inorganic clays of medium to high plasticity
		SM		Silty sands, sand-silt mixture			OH		Organic clays of medium to high plasticity
		SC		Clayey sands, sand-clay mixture		HIGHLY ORGANIC SOILS	Pt		Peat, muck and other highly organic soils

▼ Approximate water level observed in boring following drilling

SOIL SAMPLE

- Bulk Sample
- Drive Sample - California Sample
- Shelby Tube Sample
- Standard Penetration Test (SPT) Sample

ADDITIONAL TESTS

CN	- Consolidation
COR	- Corrosion
CP	- Collapse Potential
DS	- Direct Shear
EI	- Expansion Potential
MAX	- Maximum Dry Density
OC	- Organic Content
PI	- Plasticity Index
RV	- R-Value
SE	- Sand Equivalent
GS	- Grain Size Distribution

NOTES:

Blow counts represent the number of blows of a 64-kilogram hammer falling 760 mm required to drive a sampler through the last 300 mm of a 460 mm penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

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PH. (909) 793-2691 • FAX (909) 792-1704

LEGEND TO LOGS

PLATE A-1

Date Drilled	9/15/08	Water Depth:	20 meters
Drilled By:	Cal Pac Drilling	Date Measured:	9/15/08
Drilling Method:	200mm Hollow-stem auger	Elevation:	1507.6 feet (approx.)
Logged By:	L. Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Brown, moist, fine to coarse grained sand, with trace fine gravel to 6.4 mm, with some clay			GS, DS, COR, MAX
459		2	32				--olive, medium dense, fine to coarse grained sand with trace fine gravel to 12.7 mm, with trace calcium carbonate, with clay	19.6	7.0	
	1									
458		3	7				--dark brown, loose, fine to medium grained sand, with trace clay, with trace fine gravel to 6.4 mm			
	2									
457										
	3	4	30				--brown, medium dense, medium grained sand, weakly cemented, with trace calcium carbonate, with trace fine gravel to 12.7 mm			CP
456										
	4					SM	**Alluvium (Qal): Silty Sand:** Gray-brown, moist, very dense, fine to coarse grained sand, with trace fine gravel to 12.7 mm			
455		5	26 50/130				--very dense, with trace fine gravel to 12.7 mm, fractured coarse gravel to 19.1 mm in sampler			GS
	5									
454										
	6	6	52/170				--medium grained sand --interbedded a thin layer of Poorly-graded Sand, medium to coarse grained sand			
453										
	7						--red-brown			
452		7	22 50/130				--fine to medium grained sand, weakly cemented, with trace calcium carbonate			
	8									
451										
	9	8	10 50/130				**Bedrock (Kt):** Tonalite, mottled black, white, and olive-brown, moist, hard, moderately weathered,	18.2	6.2	
450										

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-1

PLATE
A-2a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						recovered as fine to coarse grained sand, with trace mica			
449	9	26 50/100							
11									
448									
12	10	50/80				--less weathered	18.3	2.8	
447									
13									
446	11	50/100				--increase in moisture content			
14									
445									
15	12	50/130					19.0	5.1	
444									
16									
443	13	50/100							
17									
442									
18	14	50/80				--moist to wet			
441									
19									
440	15	50/100			▼	--wet, moderately weathered			
20									
439									
21		50/130							

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-1

PLATE A-2b

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
438	16					Boring terminated at 21.5 meters. Groundwater was encountered at 20.0 meters. Hole backfilled using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-1

PLATE

A-2c

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Date Drilled	9/15/08	Water Depth:	3 meters
Drilled By:	Cal Pac Drilling	Date Measured:	9/15/08
Drilling Method:	200mm Hollow-stem auger	Elevation:	1478.1 feet (approx.)
Logged By:	L. Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Dark brown, moist, fine to medium grained sand			
450		2	9				--loose, fine grained sand			
	1									
449		3	1				--very dark gray-brown, moist to wet, very loose, fine to medium grained sand			
	2									
448										
	3	4	4			▼	--wet, fine to medium grained sand, with trace mica	16.8	20.0	COR
447										
	4									
446		5	58				**Bedrock (Kt):** Tonalite, mottled olive, white, and brown, wet, hard, slightly weathered, recovered as fine to coarse grained sand, with trace mica			GS
	5									
445										
	6	6	25 50/80				--moderately weathered	17.6	15.8	
444										
	7									
443		7	16 50/80				--moderately weathered, with trace calcium carbonate, with some fine sand, with trace silt			
	8									
442										
	9	8	50/100				--increase in silt content, with trace calcium carbonate			
441										

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-2

PLATE
A-3a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
440	9	50/130							
11									
439									
12	10	50/130				--mottled white, black, and gray, moderately weathered, with some silt			
438									
13									
437	11	50/130							
14									
436									
15	12	50/100							

Boring terminated at 15.1 meters.
Groundwater was encountered at 3.0 meters.
Hole backfilled using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-2

PLATE
A-3b

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Date Drilled	9/15/08	Water Depth:	4 meters
Drilled By:	Cal Pac Drilling	Date Measured:	9/15/08
Drilling Method:	200mm Hollow-stem auger	Elevation:	1477.4 feet (approx.)
Logged By:	L. Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1					A layer of 101.6 mm riprap consists of rocks to 38.1 mm			
450		2	36				**Alluvium (Qal): Silty Sand:** Olive, moist, fine grained sand, with trace mica			
	1						--medium dense, with trace clay			
449		3	33 50/130				**Bedrock (Kt):** Tonalite, mottled black, white, and olive-brown, moist, hard, moderately weathered, recovered as fine to coarse grained sand, with trace mica, with trace clay	21.0	4.5	DS, CP
	2						--very dense			
448										
	3	4	12 50/130				--increase in quartz content, with trace calcium carbonate, with trace mica			
447										
	4					▼				
446		5	50/150				--wet, with trace mica	17.4	21.7	
	5									
445										
	6	6	50/130				--with trace silt			
444										
	7									
443		7	50/100				--moderately weathered			
	8									
442										
	9	8	50/100							
441										

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-3

PLATE A-4a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
440									
	9	50/80							
11									
439									
12						--increase in silt content			
438	10	50/100				--mottled white, black, and, dark gray, with trace mica			
13									
437									
	11	50/100							
14									
436									
15									
435	12	50/100							
						Boring terminated at 15.4 meters. Groundwater was encountered at 4.0 meters. Hole backfilled using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-3

PLATE

A-4b

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1514.052 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
461		1 2	40			SM	**Undocumented Fill** **Silty Sand:** brown, dry, medium dense, fine to medium grained sand			
460	1	3	35				--olive-brown, iron staining	18.7	9.0	
459	2	4	31				--slightly moist, medium dense, fine to coarse grained sand	20.4	7.2	DS
458	3	5	15				--brown, some clay			GS
457	4	6	22					18.5	7.9	CN
456	5									
455	6	7	22							
454	7						--drilling effort increases			
453	8	8	98			SM	**Alluvium** **Silty Sand:** light brown, dry, very dense, fine to medium grained	19.6	6.3	
452	9	9	30, 50/15							

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING BS-1

PLATE A-5a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
451									
11	10	50/150				--orange-brown			
450						--auger bit chatter			
12									
449	11	50							
13									
448									
14	12	6, 50/15				--brown to dark gray			
447									
15		50/25				**Bedrock:** Sampler refusal and practical drill refusal on bedrock			

Boring terminated at 15.1 meters due to practical refusal.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING BS-1

PLATE

A-5b

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1485.413 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
							Undocumented Fill			
452	1	1	6			SM	**Silty Sand:** brown, slightly moist, loose, fine to medium grained sand			
							--dark brown			
451	2	2	5				--moist	15.4	9.6	
		3								GS, COR
		4	16				--medium dense, trace clay	18.8	9.9	CN
450	3	5	53			SM	**Alluvium** **Silty Sand:** olive, moist, dense, fine to medium grained sand	18.8	13.5	
449	4						--some clay			
448	5	6	78				--orange-brown, very dense, fine to coarse grained sand, coarse gravel in upper 0.3 meters of sample			
							--trace to some clay			
447	6	7	22, 50/10							
446	7									
							--auger bit chatter			
445	8	8	50/100				**Bedrock**: Tonalite, brown, moderately weathered, recovered as fine to coarse grained sand	16.9	7.5	
444	9	9	50/130				--brown, moderately to highly weathered, recovered as fine to medium grained sand			
443										

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING BS-2

PLATE

A-6a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
442 11	10	26, 50/5				--light brown, less weathered			
						Practical drill refusal on bedrock at approximately 11.3 meters			
						Boring terminated at 11.3 meters due to practical refusal. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING BS-2

PLATE

A-6b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/5/07	Water Depth:	9 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/5/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1524.610 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
464		1	36, 50/130			SM	**Alluvium** **Silty Sand:** light brown, dry, fine grained sand			
	1	2								
463		3	32, 50/130				--fine to medium grained sand	19.6	5.6	
	2									
		4	42				--olive-brown, dense			GS
462										
	3	5	68				--very dense	20.8	6.1	DS
461										
	4									
460		6	37				--dense, trace iron staining			
	5									
459										
	6	7	62				--very dense	18.5	3.7	
458										
	7									
457		8	40				--dense, fine to medium grained sand			
	8									
456							--groundwater encountered at 8.3 meters after drilling			
	9	9	62				--very dense, trace clay			
455										

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 1

PLATE

A-7a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
454 11	10	59							
453 12	11	48				--dense			
452 13									
451 14	12	48							
450 15	13	72				--very dense			

Boring terminated at 15.7 meters.
Groundwater encountered at 8.8 meters after drilling.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 1

PLATE

A-7b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/5/07	Water Depth:	10 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/5/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1524.987 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
464	1	1 34, 50/150				SM	**Alluvium** **Silty Sand:** light brown, dry, very dense, fine to medium grained sand			
		2								COR
463	2	3 33, 50/100					--fine to coarse grained sand, caliche			
		4	50/130				--fine grained sand		10.2	
462	3	5	28				--medium dense			
461	4									
460	5	6	74				--red-brown, very dense	20.0	7.7	
459	6	7	51			SP-SM	**Sand with Silt:** brown, dry, very dense, fine to coarse grained sand			
458	7									
457	8	8	66			SM	**Silty Sand:** light brown, dry, fine to medium grained sand, trace clay			
456	9	9	67				--slightly moist			
455										

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 2

PLATE A-8a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--groundwater encountered at 10 meters after drilling			
454 11	10	70				--trace clay	18.8	13.0	
453 12	11	28, 50/13							
452 13						--some clay			
451 14	12	34				--moist, dense			
450 15	13	72			SC	**Clayey Sand:** red-brown, slightly moist, very dense, fine to medium grained sand	19.5	12.8	
449 16									
448 17	14	43				--dense			
447 18	15	46, 50/7				--very dense			
446 19									
445 20	16	46, 50/7				**Bedrock:** Tonalite, moderately weathered			
444 21									

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 2

PLATE

A-8b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
		17	50							
443	22									
442	23	18	50/75							
441	24									
		19	50/50							
440							Practical drill refusal at 25 meters			

Boring terminated at 25 meters due to practical refusal, lead auger sheared in half at 25 meters due to tight drilling in bedrock.
Groundwater encountered at 10 meters after drilling.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 2

PLATE
A-8c

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	11 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1531.719 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1					**Fill**			
466	1	2	39			SM	**Silty Sand:** dark brown, dense, fine to coarse grained sand, with fine gravel and asphalt grindings			
465	2	3	29				--medium dense, asphalt grindings	15.3	6.6	
		4	13				--fine grained sand, trace medium sand, iron staining, gravel content decreasing			
464	3	5	4			SM	**Alluvium** **Silty Sand:** brown, slightly moist, loose			GS
463	4									
462	5	6	77			SM	**Silty Sand:** red-brown, slightly moist, very dense, fine to medium grained sand, trace clay	20.7	7.0	
461	6	7	33				--dense, fine grained sand			
460	7									
459	8	8	64			SC	**Clayey Sand:** brown, moist, very dense, fine grained sand			
458	9	9	33, 50/13				--very dense			
457										

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 3

PLATE

A-9a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
456 / 11	10	3, 50/13				--groundwater encountered at 11 meters			
455 / 12	11	50/75				**Bedrock:** Tonalite, gray-brown, wet, moderately weathered --drilling effort increases			
454 / 13									
453 / 14	12	50/75				--gray			
452 / 15						--very difficult drilling			
	13	50/75				--less weathered, moist, gray-brown, fine to medium grained	20.0	3.0	DS
451 / 16									
450 / 17	14	50/50				--wet Practical drill refusal at 17.1 meters			

Boring terminated at 17.1 meters due to practical refusal.
Groundwater encountered at 11 meters.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 3

PLATE
A-9b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	12 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1535.925 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
468		1					**Fill**			
		2	14			SM	**Silty Sand:** red-brown, dry, medium dense, fine to medium grained sand, trace coarse sand			
467	1									
		3	32			SM	**Alluvium** **Silty Sand:** brown, slightly moist, medium dense, fine to coarse grained sand	20.3	5.8	
466	2									
		4	14				--roots			
465	3	5	58				--brown, slightly moist, very dense, fine grained sand			
464	4									
		6	48				--orange-brown, dry, dense			
463	5									
462	6	7	36, 50/13							
461	7									
		8	37				--dense			
460	8									
459	9	9	30, 50/13			SC	**Clayey Sand:** red-brown, moist, very dense	20.3	10.2	

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 4

PLATE
A-10a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
458									
11 / 457	10	34, 50/5				**Bedrock:** Tonalite, tan-brown, dry, moderately weathered, recovered as fine to medium grained sand			
					▼	--groundwater encountered at approximately 11.6 meters			
12 / 456	11	50/150							
13 / 455									
14 / 454	12	50/130							
15 / 453	13	50/130							
						Boring terminated at 15.7 meters. Groundwater encountered at 11.6 meters. Hole backfilled and tamped using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 4

PLATE

A-10b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/5/07	Water Depth:	11 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/5/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1529.439 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
466		1					**Alluvium**			
		2	88			SM	**Silty Sand:** light brown, dry, very dense, fine grained sand			
465	1									
		3	23, 50/120				--fine to medium grained sand	19.2	2.5	
464	2									
		4	48				--dense, trace clay			
463	3	5	83				--very dense			
462	4									
		6	54				--dense			
461	5									
460	6	7	49, 50/75				--very dense	20.7	6.4	
459	7									
		8	40				--dense			
458	8									
457	9	9	41, 50/100				--very dense	20.0	9.4	DS

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 5

PLATE A-11a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
456						--drilling effort increases			
	10	43				--slightly moist, dense, trace clay, groundwater encountered at 10.7 meters			
11 455									
12 454	11	56				--very dense			
13 453									
	12	47				--dense			
14 452									
15 451									
	13	47, 50/10				--very dense			
						Boring terminated at 15.7 meters. Groundwater encountered at 10.7 meters. Some caving observed in borehole after removal of augers. Hole backfilled and tamped using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 5

PLATE

A-11b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/6/07	Water Depth:	10 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/6/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1528.576 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1	27			SM	**Alluvium** **Silty Sand:** brown, dry, medium dense, fine grained sand			
465	1	2								
		3	22							
464	2									
		4	23			SW-SM	**Sand with Silt:** light brown, dry, medium dense, fine to coarse grained sand	17.2	1.2	DS
463	3	5	6				--loose			
462	4									
		6	43			SM	**Silty Sand:** brown, dry, dense, fine grained sand			
461	5									
460	6	7	29				--medium dense, trace clay			
459	7									
458	8	8	33, 50/13				--very dense, fine to medium grained, sand			
457	9	9	27, 50/13				--slightly moist			
456										

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 6

PLATE

A-12a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
							--groundwater encountered at 10.4 meters			
455	11	10	35, 50/13				--moist			
454	12	11	28, 50/10				--wet			
453	13									
452	14	12	41				--dense			
451	15	13	20, 50/13				--very dense, trace clay			
450	16									
449	17	14	44, 50/13				**Bedrock:** Tonalite, moderately weathered			
448	18	15	50/100				--less weathered			
447	19									
446	20	16	50/130							
445	21									

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 6

PLATE

A-12b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
	17	50/130					18.4	20.8	
444 22									
443 23	18	50/100							
442 24									
	19	50/50							
441 25									
						Practical drill refusal on on bedrock at approximately 25.3 meters			

Boring terminated at 25.3 meters due to practical refusal.
Groundwater encountered at 10.4 meters.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 6

PLATE

A-12c

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/6/07	Water Depth:	11 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/6/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1534.980 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium** **Silty Sand:** light brown, dry, dense, fine to medium grained sand			
467	1	1 2	45							COR
466	2	3 2	4, 50/130				--very dense, light brown to olive-brown, mottled, trace clay	19.7	7.8	
		4 4	0, 50/130				--iron staining			
465	3	5	64							
464	4									
463	5	6	84				--brown, dry, fine to medium grained sand, trace clay	20.1	7.4	
462	6	7	37				--dense			
461	7									
460	8	8 3	5, 50/130				--very dense			
459	9	9	70							
458	10									

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 7

PLATE

A-13a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
457	11	10	50/130				--groundwater at 10.7 meters			
456	12	11	64							
455	13									
454	14	12	50/130				**Bedrock:** Tonalite, moderately weathered, fine to medium grained			
453	15	13	50/130				--less weathered, fine to coarse grained	17.4	6.1	
452	16									
451	17	14	50/100							
450	18									
		15	50/100							
449	19									
448	20	16	50/100							
447	21	17	50/25				--difficult drilling Practical drill refusal at approximately 21.3 meters			

Boring terminated at 21.3 meters due to practical refusal.
Groundwater encountered at 10.7 meters.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 7

PLATE
A-13b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	12 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1541.266 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
469	1	2	12			SM	**Alluvium** **Silty Sand:** red-brown, dry, medium dense, fine grained sand			
		1								
468	2	3	40, 50/130				--very dense, mottled, iron staining	19.6	9.3	
		4	69				--iron staining, caliche veins, trace clay			
467	3	5	88				--orange-brown, dry, fine to medium grained sand	19.4	6.9	
466	4									
465	5	6	31				--dense			
464	6	7	46					20.3	8.1	DS
463	7									
462	8	8	17, 50/10				--very dense			
461	9	9	50/100				**Bedrock:** Tonalite, gray-brown, slightly moist, moderately weathered, recovered as fine to medium grained sand			
460										

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 8

PLATE A-14a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--drilling effort increases			
459 11	10	50/100				--gray-brown, slightly moist, recovered as fine to medium grained sand			
						--drilling effort increases			
458 12									
	11	50/100			▼	--groundwater encountered at 12.5 meters			
457 13									
456 14	12	5, 50/10				--less weathered			
455 15									
	13	50/100				--gray-brown, slightly moist, fine to medium grained			
						Boring terminated at 15.7 meters. Groundwater encountered at 12.5 meters. Hole backfilled and tamped using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 8

PLATE

A-14b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1534.583 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1								
467	1	2	50/130			SM	**Alluvium** **Silty Sand:** light brown, slightly moist, very dense, fine to medium grained	19.9	6.6	
466	2	3	76				--slightly moist	19.6	9.4	
465	3	4	42				--dry, dense			GS
		5	40, 50/13				--light brown, very dense, fine to medium grained sand			
464	4									
463	5	6	48				--dense, trace clay			

Boring terminated at 5.0 meters.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 9

PLATE
A-15

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1542.008 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1								
469	1	2	28			SM	**Fill** **Silty Sand:** brown, slightly moist, medium dense, fine to medium grained sand, trace clay	19.1	5.7	
468	2	3	35			SM	**Alluvium** **Silty Sand:** red-brown, slightly moist, medium dense	19.1	7.2	
		4	8, 50/15			CL	**Sandy Clay:** mottled brown, moist, hard, fine grained sand			
467	3	5	28			SM	**Silty Sand:** brown, dry to slightly moist, medium dense, fine to medium grained sand			
466	4	6	24, 50/10			SC	**Clayey Sand:** mottled-brown, slightly moist, very dense, fine grained sand			
465	5						Boring terminated at 5.0 meters. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-10

PLATE
A-16

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1518.901 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1 2	73			SM	**Fill** **Silty Sand:** light brown, dry, very dense, fine to medium grained sand	20.3	6.5	
462	1									
		3	58			SM	**Alluvium** **Silty Sand:** light brown, dry, very dense, iron staining, trace clay and caliche			
461	2									
460	3	4	38			CL-ML	**Sandy Silty Clay:** mottled olive-brown, dry, very stiff, fine grained sand, iron staining	17.6	16.8	
459	4									
		5	18			SM	**Silty Sand:** gray, dry, medium dense, fine graine sand, trace clay and iron staining			
458	5									
457	6									
		6	33				--olive, slightly moist, increased percentage of fines			
							Boring terminated at 6.6 meters. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-11

PLATE
A-17

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1521.936 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1	43			SM	**Fill** **Silty Sand:** brown, dry, dense, fine to medium grained sand, trace caliche			
463	1	2								
		3	64				--brown to dark brown, very dense	19.4	1.9	
462	2					GP	Interbedded layer of Sandy Gravel			
							Alluvium			
461	3	4	51			SM	**Silty Sand:** brown, dry, very dense, fine to medium grained sand, trace clay and caliche			
460	4									
		5	54			SP	**Sand:** light brown, slightly moist, dense, fine to medium grained, trace silt	18.0	3.2	
459	5	7				SM	**Silty Sand:** dark brown, slightly moist, fine to medium grained sand			
458	6	648, 50/15					--light brown, dry, very dense			

Boring terminated at 6.6 meters.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-12

PLATE A-18

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1527.346 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
465		1 2	27			SM	**Alluvium** **Silty Sand:** brown, dry, medium dense, fine to medium grained	18.8	5.5	
464	1	3	33				--dense			GS
463	2									
462	3	4	77			SC-SM	**Silty Clayey Sand:** brown, slightly moist, very dense, fine to medium grained sand	20.3	5.7	
461	4									
460	5	5	36			SM	**Silty Sand:** brown, dry, dense, fine to medium grained sand, trace caliche and iron staining			
459	6	6	79				--red-brown, very dense, less silt			

Boring terminated at 6.6 meters.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-13

PLATE A-19

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1549.915 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
472		1 2	26			SM	**Alluvium** **Silty Sand:** olive-brown, dry, medium dense, fine grained sand	18.8	8.9	
471	1	3	11				--dark brown, slightly moist, fine to medium grained sand			
470	2									
469	3	4	38				--dense, fine to coarse grained sand, with gravel	20.5	8.0	
468	4						--auger bit chatter through gravel			
467	5	5	5			CL	**Sandy Clay:** brown, moist, medium stiff, fine grained sand, trace coarse sand			GS
466	6	6	50/150				**Bedrock:** Tonalite, orange brown, dry, slightly weathered, very dense, recovered as fine to medium grained sand			
465	7	7	50/100				Boring terminated at 7.8 meters. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-14

PLATE A-20

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1544.669 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
470	1	1 2	29			SC	**Alluvium** **Clayey Sand:** red-brown, dry, medium dense, fine grained sand			GS
469	2	3	50/130			SM	**Silty Sand:** brown, dry, very dense, fine grained sand	19.7	9.8	
468 467	3 4	4	46, 50/7			SM	**Silty Sand:** gray-brown, dry, very dense, fine to medium grained sand			
466 465	5 6	5 6	50/100 38, 50/13				**Bedrock:** Tonalite, slightly to moderately weathered, very dense, recovered as fine to coarse grained sand			
							Boring terminated at 21.5 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-15

PLATE
A-21

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1567.398 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
477	1						**Stockpiled Fill:** Soil stockpiled during on-going construction activity at site			
476	2									
475	3	1	15							
474	4									
473	5	2	26							
472	6	3	15			SM	**Alluvium** **Silty Sand:** red-brown, slightly moist, medium dense, trace clay	18.7	4.2	
471	7									
470	8	4	52				--very dense, cemented			
469	9	5	43, 50/10				--mottled red-brown to brown			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-16

PLATE A-22a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						Boring terminated at 9.6 meters. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-16

PLATE

A-22b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	N.A. feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
	1								
1	2	41, 50/100			SM	**Alluvium** **Silty Sand:** brown, dry, very dense, fine to medium grained sand	18.2	6.2	
2	3	82				--red-brown, trace clay			GS
3	4	36, 50/100				--orange-brown, dry, fine to medium grained sand			
4	5	46				--light brown, dense			
5						Boring terminated at 5.0 meters. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-17

PLATE
A-23

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1564.898 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1								
476	1	2	27			SM	**Alluvium** **Silty Sand:** red-brown, dry, medium dense, fine to medium grained sand, trace clay			
475	2	3	10, 50/15"				--very dense, iron staining, trace caliche	17.4	3.9	
474	3	4	70				--cemented, trace clay			
473	4									
472	5	5	25, 50/13"					19.1	6.0	

Boring terminated at 5.0 meters.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
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LOG OF BORING HV-18

PLATE
A-24

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	10/21/08	Water Depth:	Not Encountered(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	10/21/08
Drilling Method:	Mobile L-10T, 200mm HSA	Elevation:	463 meters (approx.)
Logged By:	L.Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Brown to dark brown, slightly moist, medium dense to dense, fine grained sand, with trace fine gravel to 19 mm			COR
463		2	32				--dark brown, moist, dense, with trace fine gravel to 6 mm			
	1									
462		3	40 50/100				--brown-gray, very dense, weakly to moderately cemented, with trace fine gravel to 6 mm, with trace calcium carbonate			
	2									
461										
	3	4	30				--medium dense, with trace fine gravel to 6 mm, with trace medium to coarse grained sand			
460										
	4									
459		5	47				--dark gray-brown, dense, with trace coarse grained sand, with trace calcium carbonate	20.1	7.8	DS
	5									
458							--with trace clay			
	6	6	12				--medium dense, with trace calcium carbonate			GS
457										
	7									
456		7	21 50/50			SM	**Alluvium (Qal): Silty Sand:** Light olive-brown, moist, very dense, moderately cemented, fine grained sand, with trace medium grained sand, with trace fine gravel to 6 mm, with trace calcium carbonate	18.5	5.6	DS
	8	13								COR
455										
	9									
454		8	28			ML	**Sandy Silt:** Brown-gray to olive-brown, moist, very stiff, with fine grained sand			

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I-215/SR60 East Junction
Riverside, California

PLATE
A-25a

PROJECT NO. 76979

LOG OF BORING BD-1

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--with trace fine gravel to 6 mm, more coarse sand appeared			
453					SP				
11	9	70				**Sand:** Brown, moist, very dense, moderately cemented, fine to medium grained sand, with trace fine gravel to 6 mm	17.7	2.6	
452									
12					SM	**Silty Sand:** Redd-brown, moist, very dense, fine grained sand, with trace fine gravel to 6 mm			
451	10	52							
13									
450									
14	11	80				-- fine to medium grained sand, with trace fine gravel to 6 mm			
449									
15									
448	12	39				--dense, fine grained sand, with trace fine gravel to 6 mm			
						Borehole terminated at approximately 15.7 meters without refusal No groundwater encountered Borehole backfilled with soil cuttings			

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING BD-1

PLATE

A-25b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Date Drilled	10/21/08	Water Depth:	Not Encountered(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	10/21/08
Drilling Method:	Mobile L-10T, 200mm HSA	Elevation:	460 meters (approx.)
Logged By:	L.Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
460		1				SM	**Fill (Qaf): Silty Sand:** Light brown, dry to slightly moist, loose to medium dense, with trace fine gravel to 12.5 mm			DS, SE, MAX
	1	2	6				--dark brown, moist, loose, fine grained sand, with trace coarse grained sand			
459							--increase in silt content			
		3	17			ML	**Sandy Silt:** Dark oilve-brown, moist, stiff, with very fine to fine grained sand	15.7	6.6	
	2						--100 mm debries appeared, decrease in silt content			
458										
	3	4	33			SM	**Alluvium (Qal): Silty Sand:** Olive-gray, moist, dense, weakly to moderately cemented, fine grained sand, with trace calcium carbonate			
457										
	4	13								
456										
		5	23 50/125				--very dense, weakly to moderately cemented, with trace fine gravel to 6 mm			
	5									
455							--with trace fine grvel to 6 mm			
	6	6	29				--medium dense, weakly cemented, with trace fine gravel to 6 mm, with trace calcium carbonate, decrease in silt content			
454										
	7									
453						SP	**Sand:** Brown, moist, very dense, fine grained sand, with trace coarse grained sand, with trace silt			
		7	26 50/150							
	8									
452										
	9									
		8	51			SM	**Silty Sand:** Olive-brown, moist, very dense, weakly cemented, fine grained sand, with trace coarse grained sand, with trace calcium carbonate			GS
451										

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I-215/SR60 East Junction
Riverside, California

PLATE
A-26a

PROJECT NO. 76979

LOG OF BORING BD-2

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
450						--water was added while drilling due to difficult drilling			
						--with trace fine gravel to 19 mm			
	9	32 50/75				--fine to medium grained sand, weakly to moderately cemented at about 11 meters, light brown at about 11 meters, with trace calcium carbonate, with trace fine gravel to 6 mm	17.3	3.9	DS
11									
449									
					SP	**Sand:** Mottled white, brown, and black, moist, dense, weakly to moderately cemented, fine to medium grained sand			
12									
	10	48							
448					SM	**Silty Sand:** Dark Brown, moist, dense, with trace gravel to 6 mm, with trace calcium carbonate			
13									
447									
	11	22 50/150			SM-SP	**Sand with Silt:** Dark red-brown, moist, very dense, weakly cemented, fine to medium grained sand, with trace clay, with trace calcium carbonate, with trace fine gravel to 12.5 mm			
14									
446									
						--with trace fine gravel to 6 mm			
15						--perched water appeared			
	12	70				--moist to wet, fine grained sand, with trace coarse grained sand			
						Borehole terminated at approximately 15.7 meters without refusal			
						Perched water encountered at approximately 14.6 meters			
						Borehole backfilled with soil cuttings			

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I-215/SR60 East Junction
Riverside, California

PLATE
A-26b

PROJECT NO. 76979

LOG OF BORING BD-2

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Date Drilled	10/21/08	Water Depth:	Not Encountered(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	10/21/08
Drilling Method:	Mobile L-10T, 200mm HSA	Elevation:	461 meters (approx.)
Logged By:	L.Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Olive-brown, dry to slightly moist, very fine to fine grained sand, with trace fine gravel to 12.5 mm			
460	1	2	77				--slightly moist, very dense, weakly cemented, with trace fractured rock to 6 mm			
		3	27				--olive-brown to gray-brown, medium dense, weakly cemented, with trace gravel to 6 mm			
459	2						--increase in silt content			
458	3	4	42 50/75			SM	**Alluvium (Qal): Silty Sand:** Light brown to white-gray, dry to slightly moist, very dense, with trace coarse grained sand, with trace fine gravel to 6 mm	17.6	4.1	
457	4						--more coarse grained sand appeared			
		5	28			SM-SP	**Sand with Silt:** Brown, slightly moist, medium dense, fine to medium grained sand, with trace gravel to 6 mm			
456	5									
455	6	6	88			SM / ML	**Silty Sand to Sandy Silt:** Olive-brown, moist, very dense, moderately cemented, very fine to fine grained sand, with trace fine gravel to 6 mm			
454	7	13					--with trace fine gravel to 19 mm			
							--decrease in silt content			
		7	41			SM	**Silty Sand** Dark brown with mottled white and black, moist, dense, weakly to moderately cemented, with trace fractured rock to 12.5 mm, with trace fine gravel to 12.5 mm, with trace calcium carbonate			GS
453	8						--with trace coarse gravel to 25 mm, decrease in silt content			
452	9	8	46 50/75				--difficult drilling, rig chatter	19.2	11.6	DS
451							--olive-brown, very dense, fine to medium grained sand, with trace fine gravel to 6 mm, with trace clay, with			

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I-215/SR60 East Junction
Riverside, California

PLATE
A-27a

PROJECT NO. 76979

LOG OF BORING BD-3

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						weathered rock to 30 mm --difficult drilling, rig chatter --with trace gravel to 25 mm			
450 11	9	17 50/130			SP	**Sand:** Mottled brown, gray, and white, moist, very dense, fine to medium grained sand, moderately cemented, with trace fine gravel to 19 mm, with trace calcium carbonate, with trace crushed rock to 10 mm at 35 m			
449 12	10	27 50/100				--water was added due to difficult drilling, rig chatter -- red-brown with mottled black and white, fine to medium grained sand, strongly cemented, with trace calcium carbonate, with trace clay			
448 13									
447 14	11	55			SM	**Silty Sand:** Dark olive-brown, moist, very dense, fine grained sand, weakly to moderately cemented --very difficult drilling, rig chatter excessively			
						Borehole terminated at approximately 14.6 meters Refusal was encountered at approximately 14.6 meters No groundwater encountered Borehole backfilled with soil cuttings			

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING BD-3

PLATE

A-27b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Date Drilled	10/21/08	Water Depth:	12 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	10/21/08
Drilling Method:	Mobile L-10T, 200mm HSA	Elevation:	460 meters (approx.)
Logged By:	L.Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Brown, dry to slightly moist, medium dense to dense, very fine to fine grained sand, with trace fine gravel to 12.5 mm			COR
459	1	2	39				--dense, very fine to fine grained sand, with fractured rock to 6 mm, with trace calcium carbonate --with trace coarse gravel to 27 mm			
458	2	3	56				--mottled black, white, and brown, slightly moist to moist, with trace calcium carbonate, with fractured rock to 60 mm in sampler with trace fine gravel to 12.5 mm	20.5	4.4	
457	3	4	13				--brown, moist, medium dense, fine grained sand, with trace fine gravel to 6 mm, with a thin layer of moderately cemented sand at approximately 3.3 meters			
456	4						--with trace fine gravel to 12.5 mm			
455	5	5	36 50/100			SM	**Alluvium (Qal): Silty Sand:** Light brwon-olive, slightly moist, very dense, moderately to strongly cemented, fine grained sand, with trace fine gravel to 6 mm, increase in silt content			
454	6	6	48				--dense, weakly cemented, very fine to fine grained sand, with trace coarse grained sand			
453	7						--decrease in silt content, increase in coarse grained sand content			
452	8	7	30 50/150			SP	**Sand:** Mottled white, dark brown, and dark gray, moist, very dense, with fractured rock on the top portion of the sampler to 25 mm, with 45 mm rock in the tip of the sampler, with trace of silt	19.2	8.0	
451	9						--encountered difficult drilling			
450		8	40 50/50				**Bedrock (Kt):** Tonalite, mottled white, orange brown, and gray, moist, moderately weathered, recovered as very fine to fine grained silty sand, with trace clay			

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I-215/SR60 East Junction
Riverside, California

PLATE
A-28a

PROJECT NO. 76979

LOG OF BORING BD-4

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
449 11	9	50/75				--orange-brown, moist, slightly weathered, recovered as fine grained silty sand			
448 12	10	42 50/100				--encountered groundwater at 11.9 meters --mottled white, black and brown, slightly to moderately weathered, recovered as fine to medium grained sand			
447 13									
446 14	11	50/100							
445 15	12	50/100							
						Borehole terminated at approximately 15.7 meters with refusal Groundwater was encountered at approximately 11.9 meters Borehole backfilled with soil cuttings			

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I-215/SR60 East Junction
Riverside, California

PLATE
A-28b

PROJECT NO. 76979

LOG OF BORING BD-4

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

APPENDIX B

LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

Geotechnical laboratory tests were performed on selected drive and bulk soil samples to estimate engineering characteristics of various earth materials encountered at the site. Testing was performed in general accordance with procedures outlined by the American Society for Testing and Materials (ASTM) and the California Department of Transportation test methods (CTM).

IN-SITU MOISTURE CONTENT AND DRY UNIT WEIGHT

In-situ moisture content and dry unit weight tests were performed on samples that could be recovered in a relatively undisturbed condition. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937. The test results are presented on the Logs of Borings in Appendix A, *Field Exploration*.

GRAIN SIZE DISTRIBUTION

Sieve analyses were performed on selected samples of the materials encountered at the site to evaluate the grain size distribution characteristics of the soils and to aid in their classification. The tests were performed in general accordance with ASTM Standard Test Method D 422. The results of these tests are presented on Plates B-1 through B-16, *Grain Size Distribution*.

COMPACTION TEST

A laboratory compaction test (ASTM D1557) was performed on two representative bulk samples to determine the maximum dry unit weight and optimum moisture content of the material tested. Test results are summarized in Table B-1.

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Table B-1
Summary of Compaction Test Results

Location	Depth (m)	USCS Soil Type	Maximum Unit Weight (kN/m^3)	Optimum Moisture Content (%)
KB-1	0 – 1.5	SM	21.0	7.5
BD-2	0 – 1.5	SM	21.5	7.0

DIRECT SHEAR TEST

Thirteen direct shear tests were performed on samples to evaluate the drained shear strength of the soils. The samples were soaked and tested in a near-saturated condition in general accordance with ASTM Test Method D 3080 (consolidated, drained). The results of these tests are presented on Plates B-21 through B-33, *Direct Shear Test*, and summarized in Table B-2, below.

Table B-2
Direct Shear Test Results

Boring No.	Depth (m)	USCS Soil Type	Dry Unit Weight (kN/m^3)	Friction Angle (degrees)	Cohesion (kPa)
KB-1*	0 - 1.5	SM	18.5	38	0
KB-3	1.5 - 2.0	Tonalite	19.8	31	41.2
BS-1	2.3	SM	20.4	33	44
HV-1	3.0	SM	20.8	40	12.3
HV-3	15.2	Tonalite	20.0	43	0
HV-5	9.1	SM	20.0	36	0
HV-6	2.3	SW-SM	17.2	42	0
HV-8	6.1	SM	20.3	28	16.2
BD-1	4.6	SM	20.1	35	19.6
BD-1	7.6	SM	18.5	40	0
BD-2*	0 – 1.5	SM	19.3	37	0
BD-2	10.7	SM	17.3	40	1.0
BD-3	9.1	SM	19.2	29	23.7

* Remolded to 90% of Maximum Density

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CONSOLIDATION / COLLAPSE POTENTIAL TEST

Consolidation/ collapse potential tests were performed on four representative drive soil samples to evaluate the settlement characteristics of the in-situ soils when subjected to typical foundation loads and wetting. The tests were performed in accordance with ASTM D5333. Test results are presented on Plates B-17 and B-20, Consolidation/*Collapse Potential Test*.

CORROSIVITY TESTS

Corrosivity tests were performed on eight bulk samples to estimate pH, resistivity, soluble sulfate, and chloride contents of encountered earth materials, in general accordance with the following Caltrans Standard Test Methods: CTM 643 for electrical resistivity, CTM 532 for pH, CTM 417 for sulfate content, and CTM 422 for chloride content. Test results are summarized in Table B-2, below.

Table B-2
Corrosion Test Results

Boring No.	Depth (m)	Minimum Resistivity (Ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
KB-1	0 -1.5	1900	8.1	11	131
KB-2	3.0 - 3.5	2300	7.7	17	148
BS-2	2 - 3	3000	7.7	8	131
HV-2	0.9 - 2.4	1200	7.4	7	254
HV-7	0.9 - 2.4	3200	7.9	5	126
BD-1	0 – 1.5	1500	7.2	20	318
BD-1	8.2 – 8.8	1600	7.2	16	323
BD-4	0 - 1.5	2000	7.1	14	186

R-VALUE TESTS

Three resistance value (R-value) tests were performed on bulk soil samples to evaluate pavement support characteristics of the near-surface onsite soils. R-value testing was

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performed in general accordance with Caltrans Standard Test Method 301. Test results are presented in Table B-3, below.

Table B-3
Summary of R-Value Test Results

Location	Depth (m)	USCS Soil Type	R-Value
HV-9	0 – 1.5	SM	52
HV-12	0.6 – 2.1	SM	36
HV-18	0 – 1.5	SM	16

SAND EQUIVALENT TEST

One sand equivalent test was performed on near-surface soil to determine the suitability of the onsite materials for use as engineered fill during construction. The test was performed in accordance with ASTM D2419. The test results are presented in Table B-4, below.

Table B-4
Sand Equivalent Test Results

Location	Depth (m)	USCS Soil Type	Sand Equivalent (SE)
BD-2	0 – 1.5	SM	21

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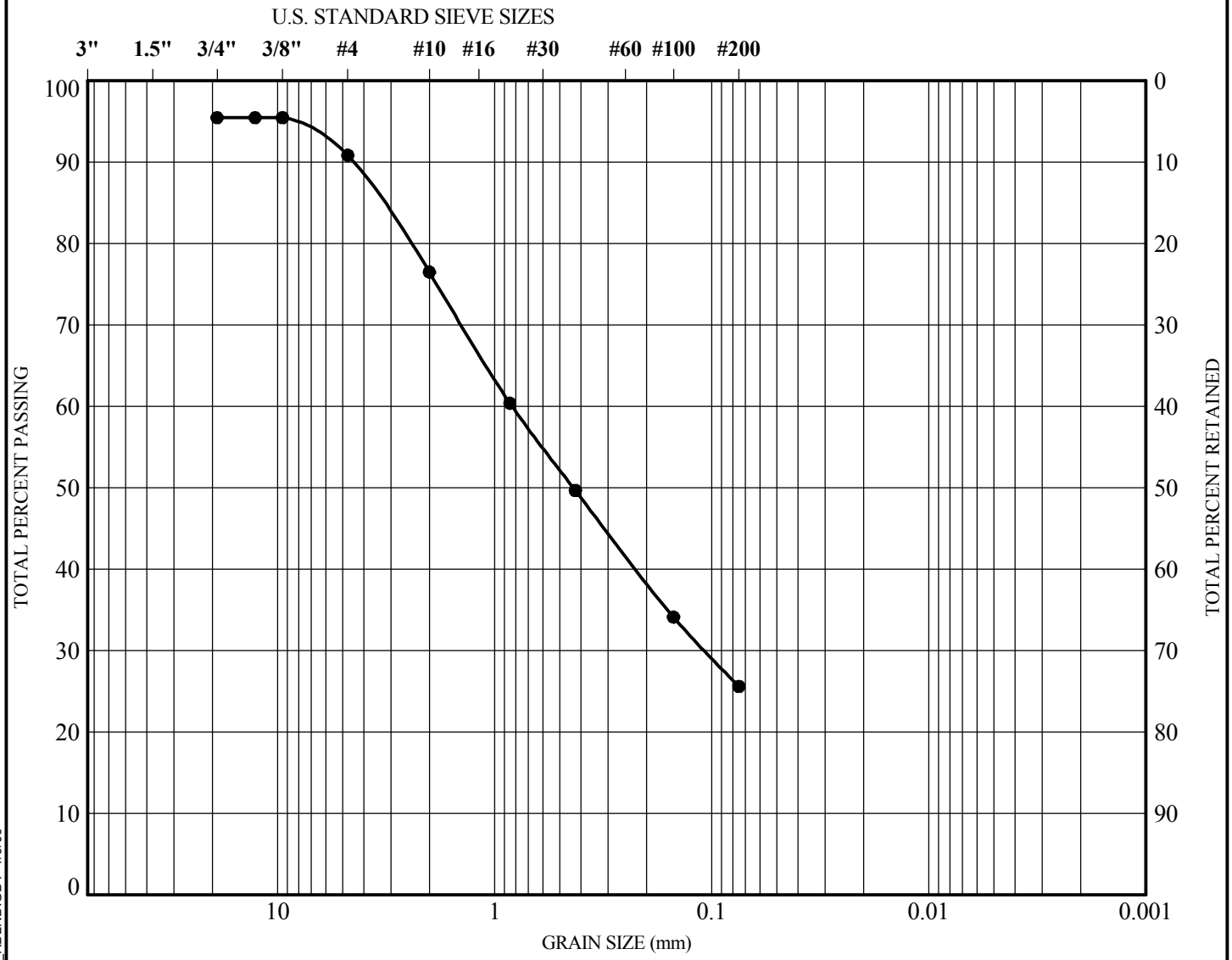
SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	KB-1	0 - 1.5	Silty Sand	SM

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I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

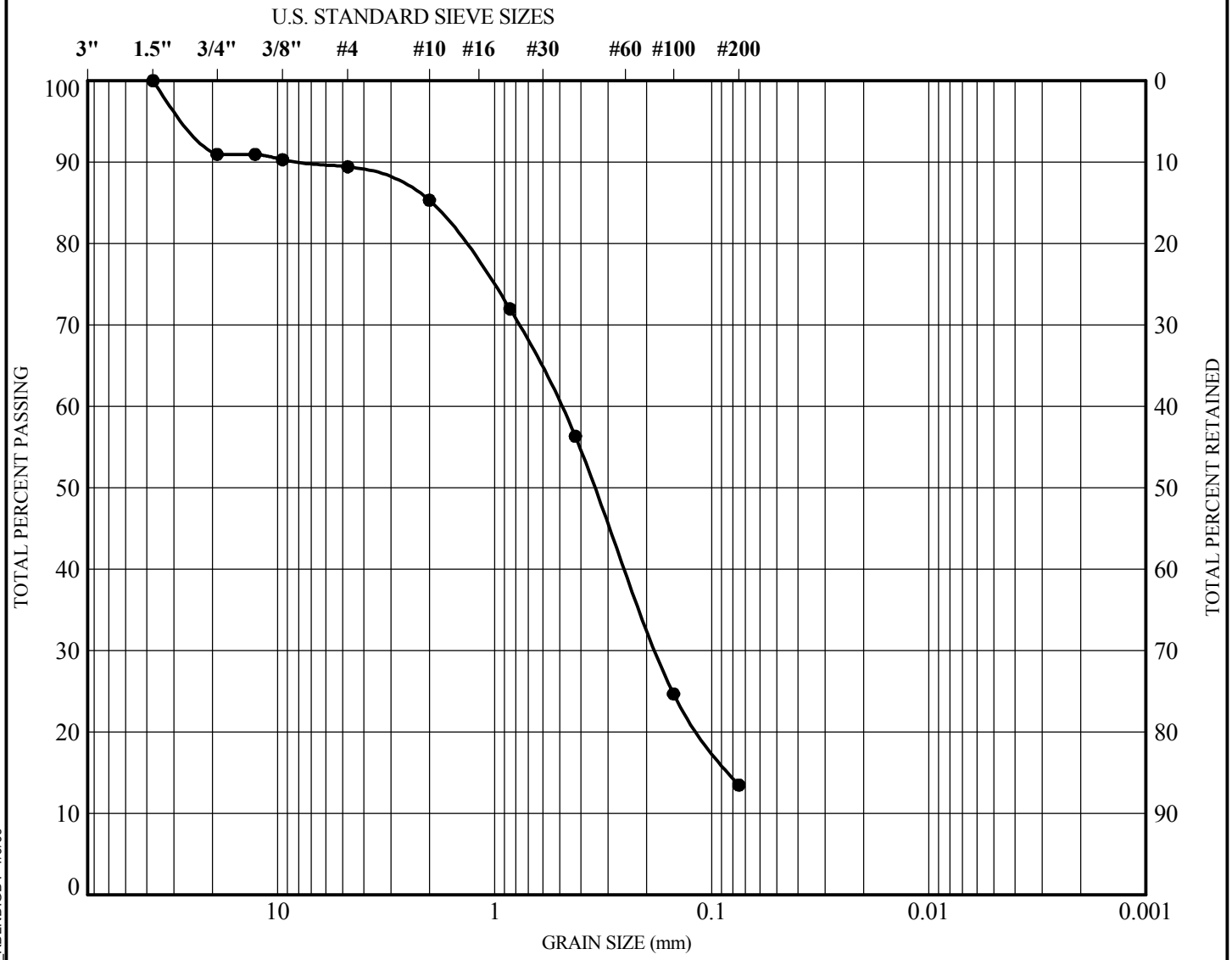
GRAIN SIZE DISTRIBUTION

PLATE

B-1

GRAIN SIZE 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	KB-1	5	Silty Sand	SM

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I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

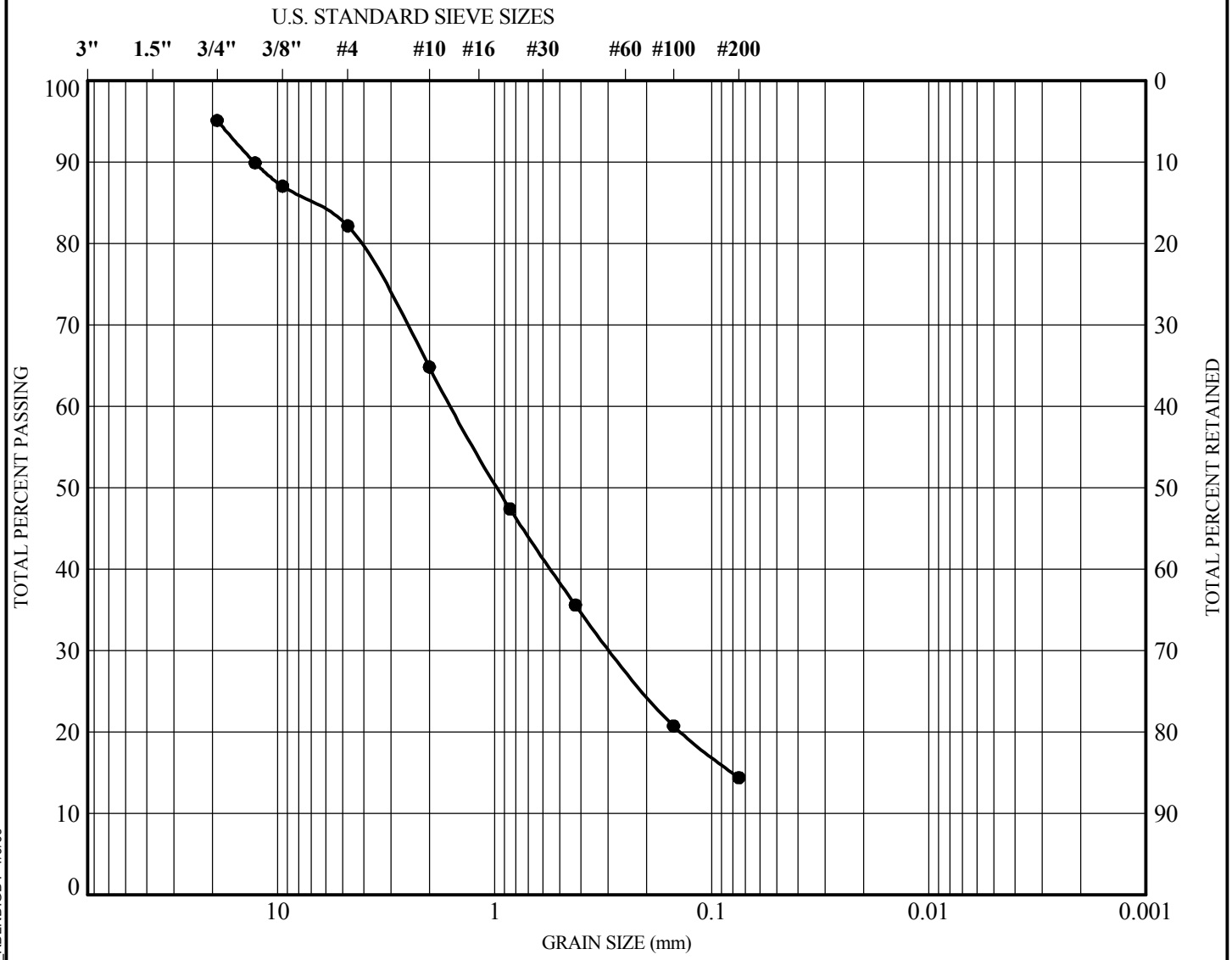
GRAIN SIZE DISTRIBUTION

PLATE

B-2

GRAIN SIZE 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	KB-2	5	Silty Sand with Gravel	SM

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Frontage Road OH Replacement
Riverside, California

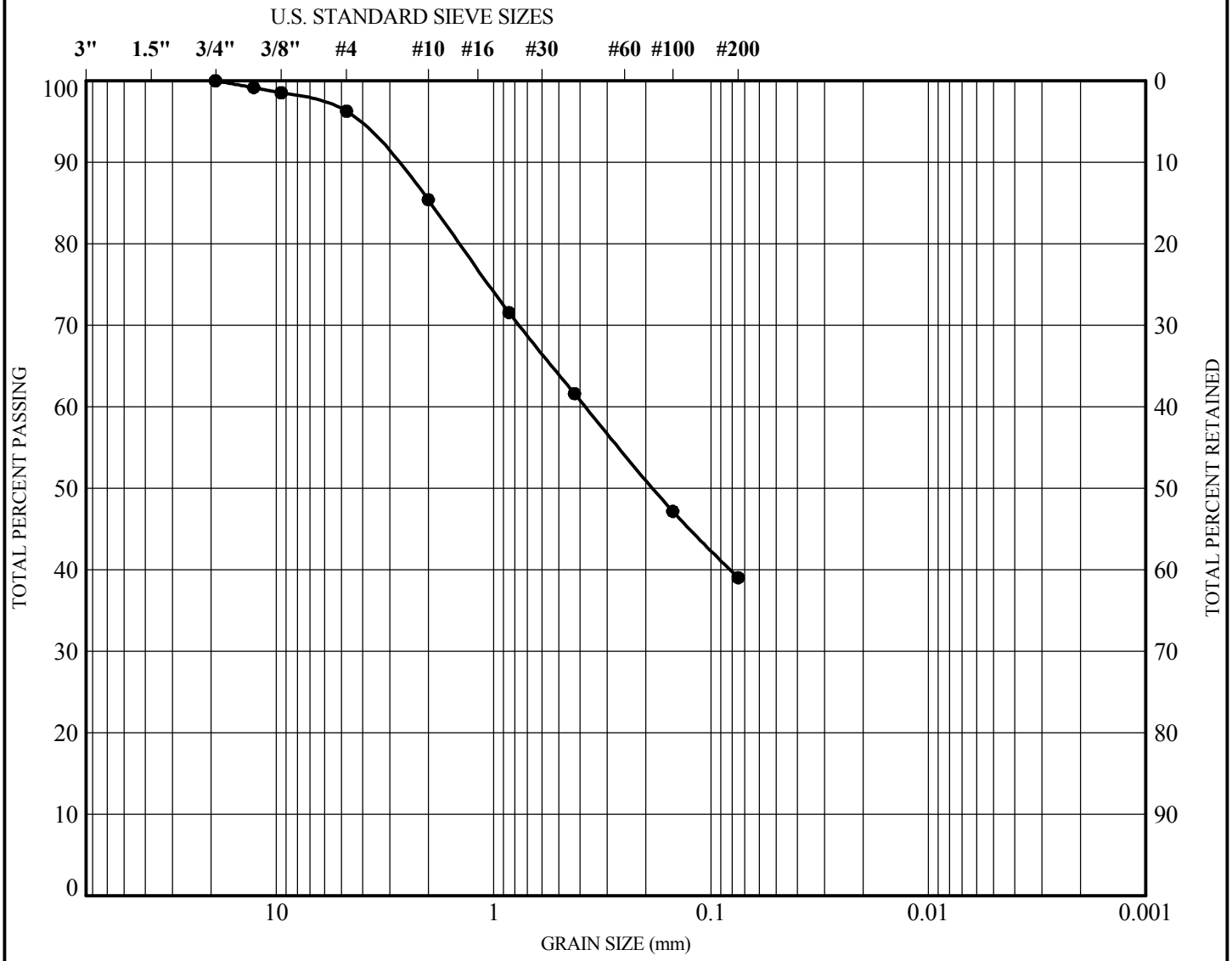
GRAIN SIZE DISTRIBUTION

PLATE

B-3

GRAIN SIZE 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	BS-1	3	Silty Sand	SM

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PROJECT NO. 76979

I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

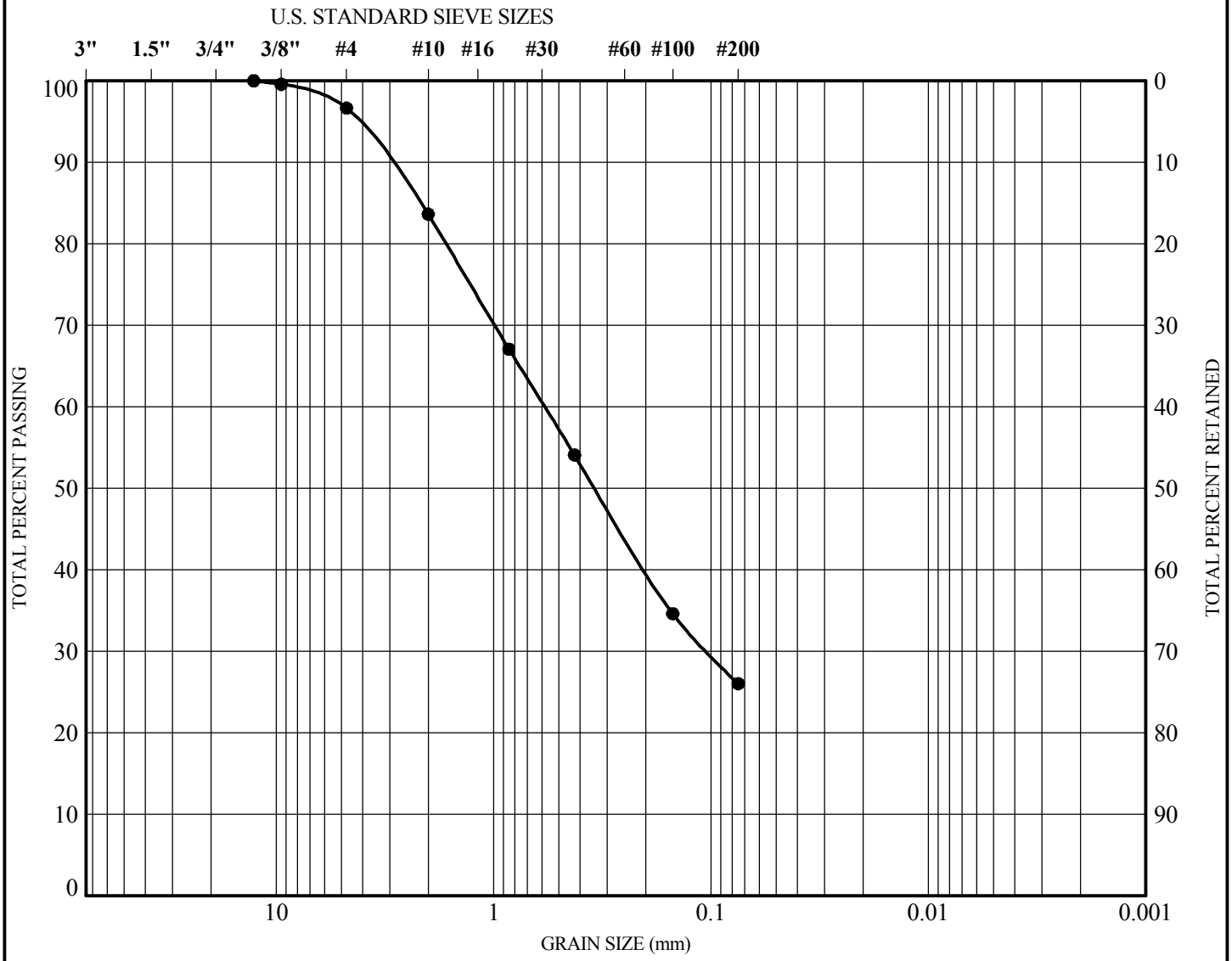
GRAIN SIZE DISTRIBUTION

PLATE

B-4

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	BS-2	2	Silty Sand	SM

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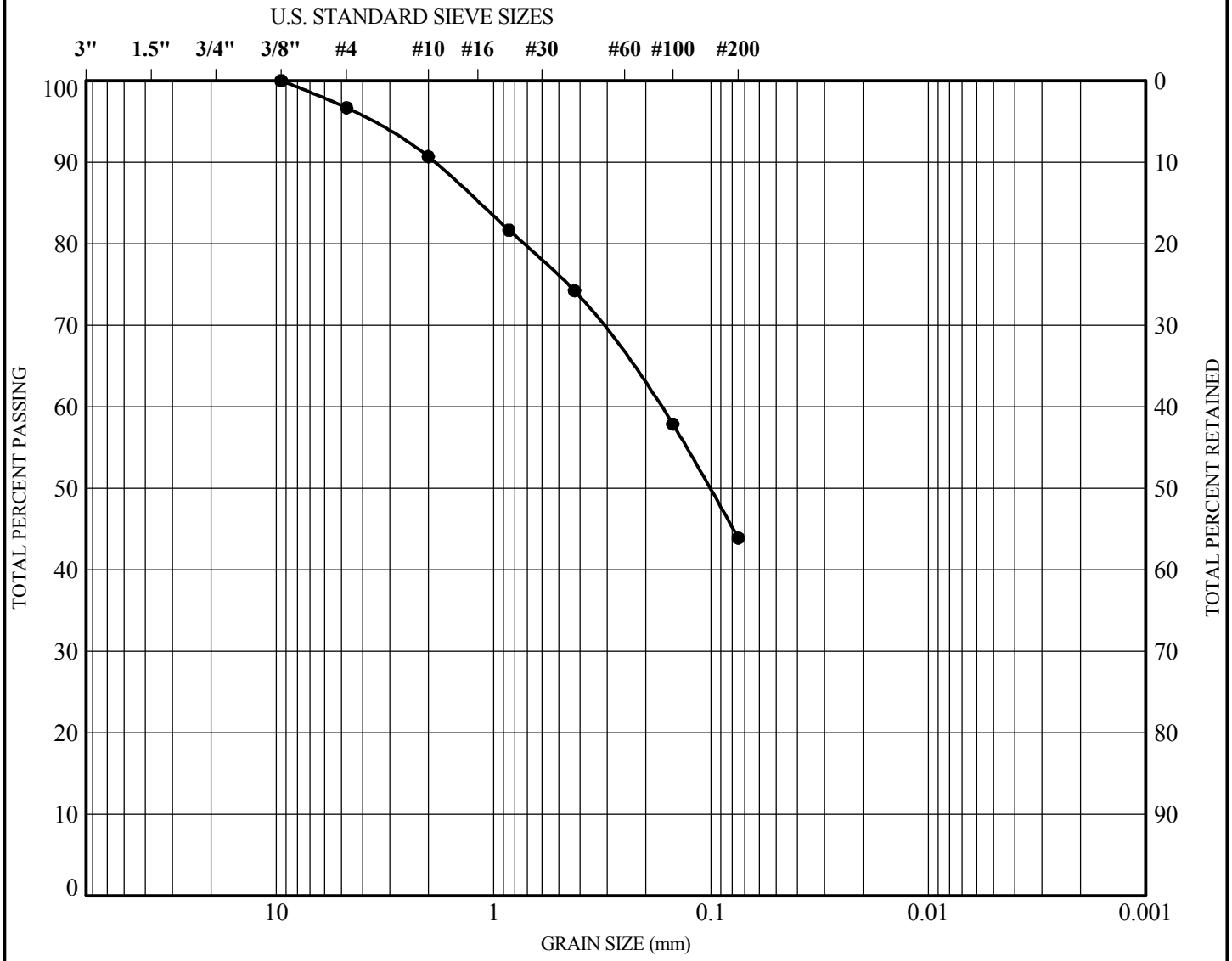
I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

GRAIN SIZE DISTRIBUTION

PLATE

B-5

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV- 1	2	Silty Sand	SM

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PROJECT NO. 76979

I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

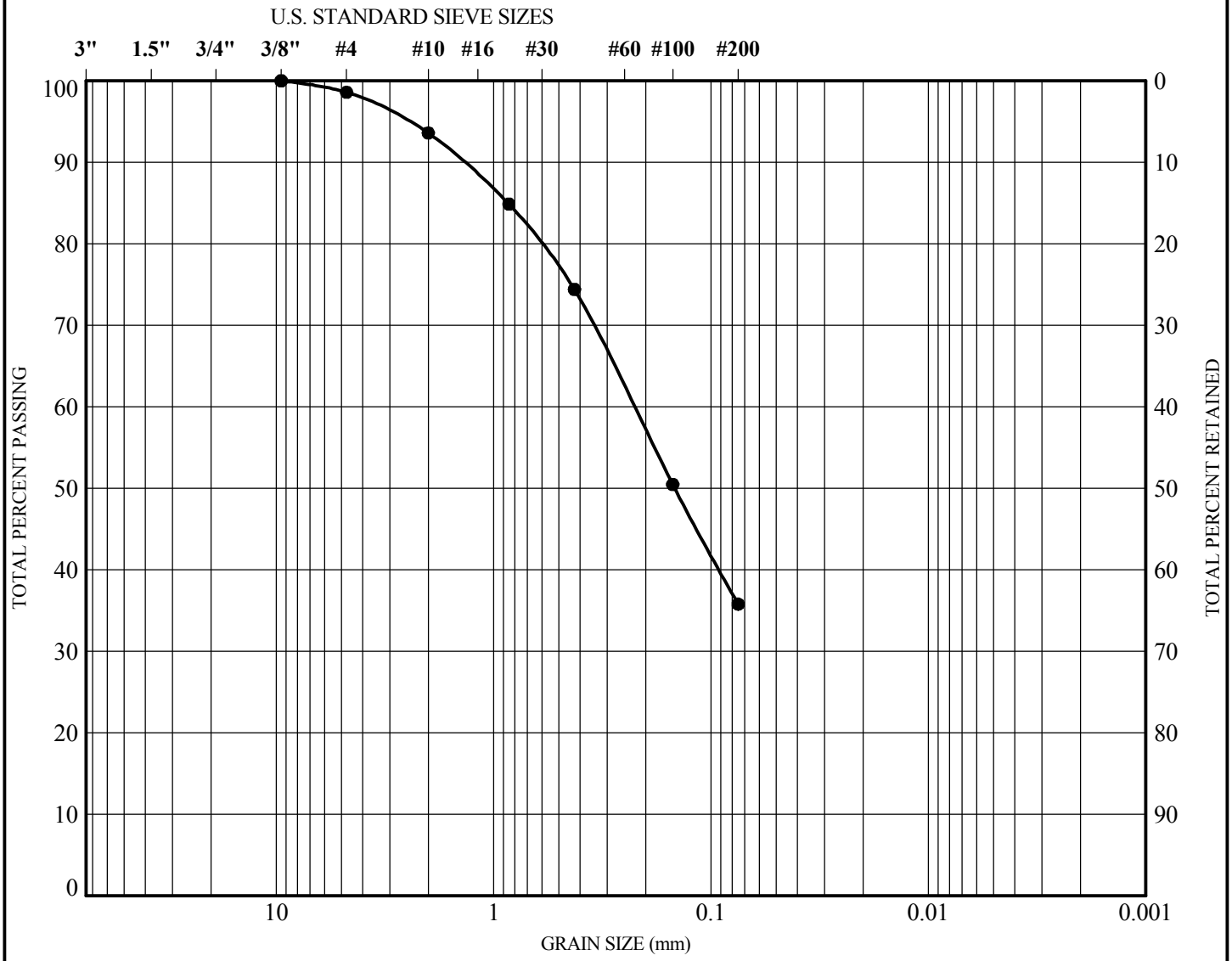
GRAIN SIZE DISTRIBUTION

PLATE

B-6

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV- 3	3	Silty Sand	SM

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I-215/SR60 East Junction
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Riverside, California

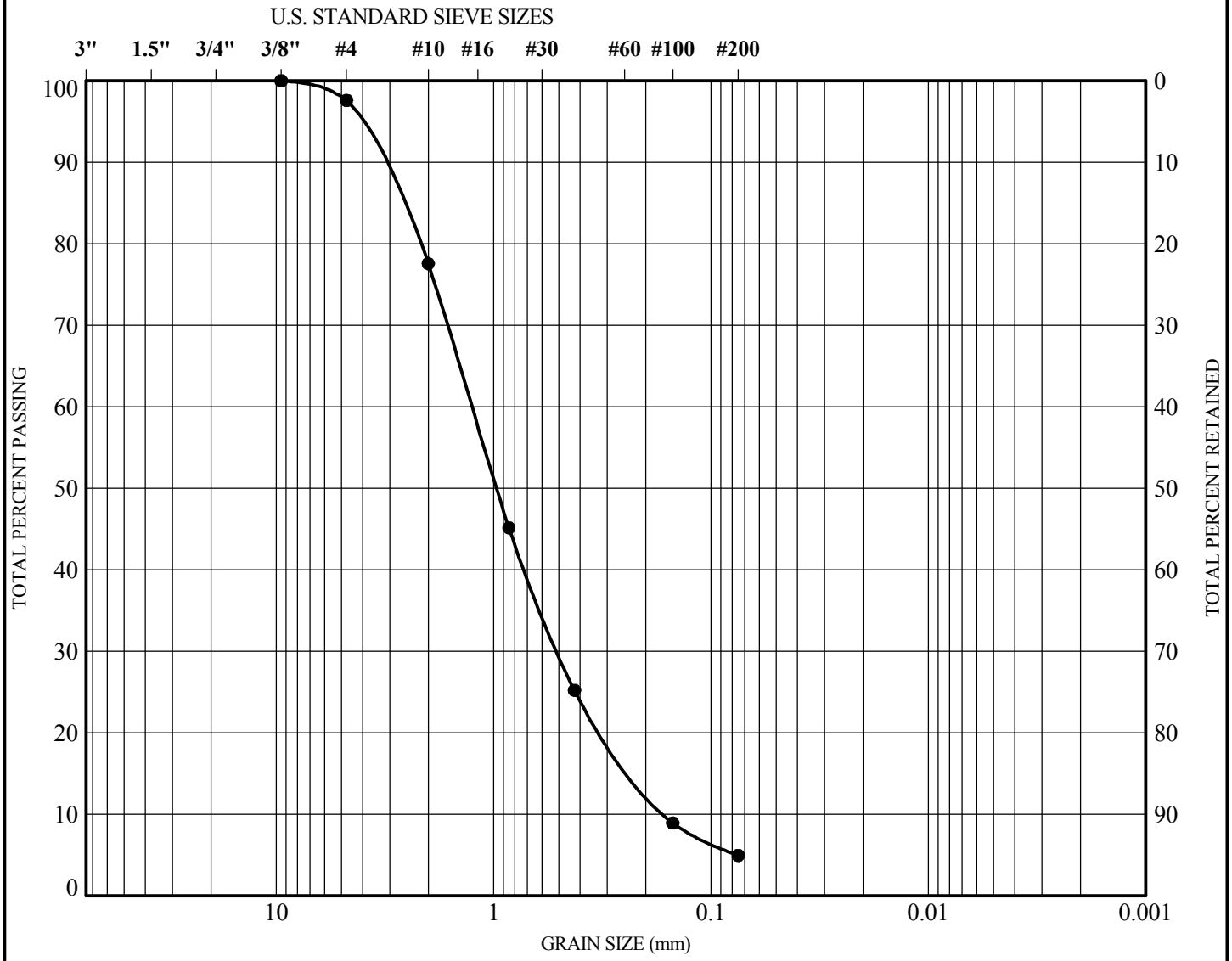
GRAIN SIZE DISTRIBUTION

PLATE

B-7

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV- 6	3	Sand with Silt	SW-SM

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PROJECT NO. 76979

I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

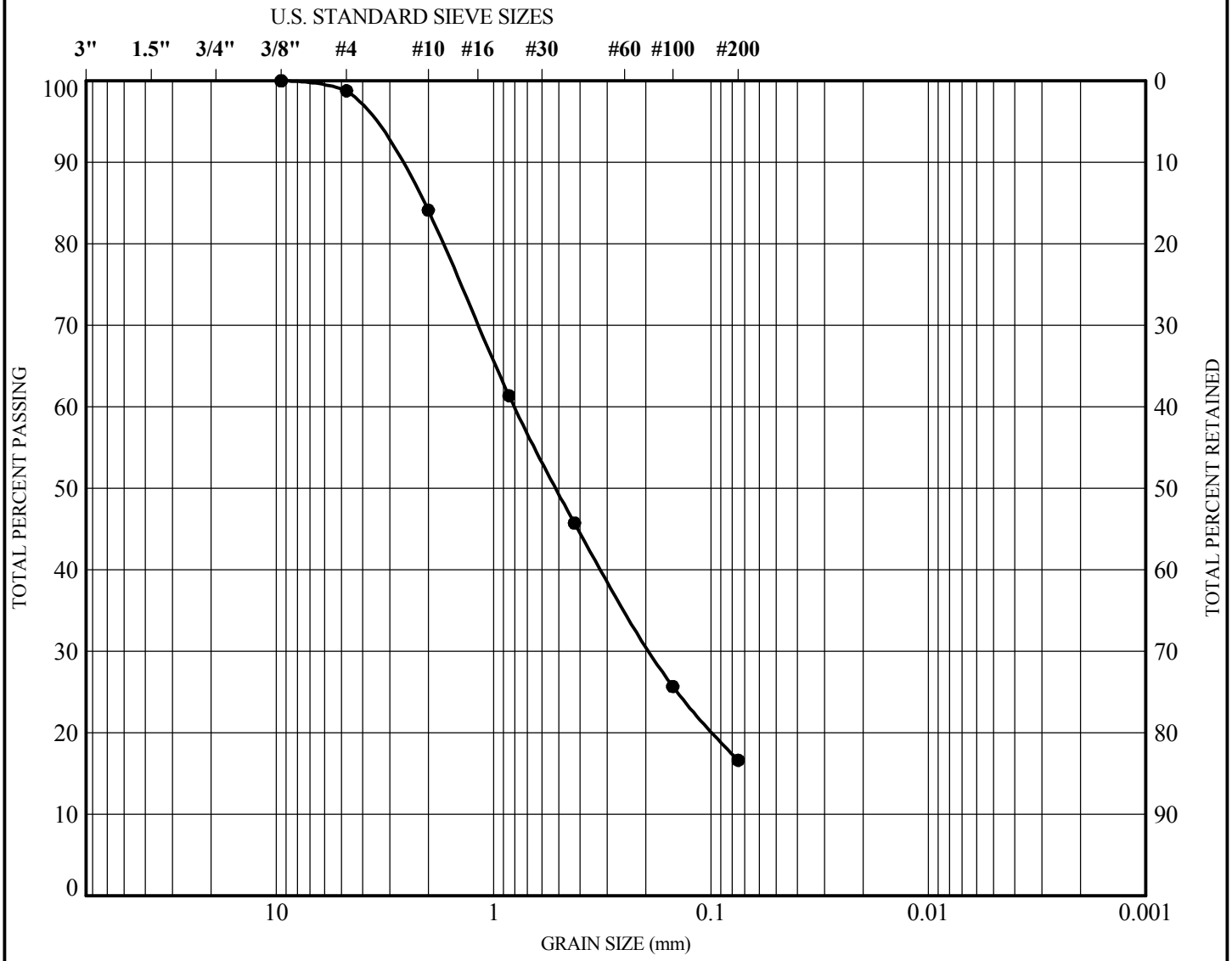
GRAIN SIZE DISTRIBUTION

PLATE

B-8

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV- 9	2	Silty Sand	SM

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

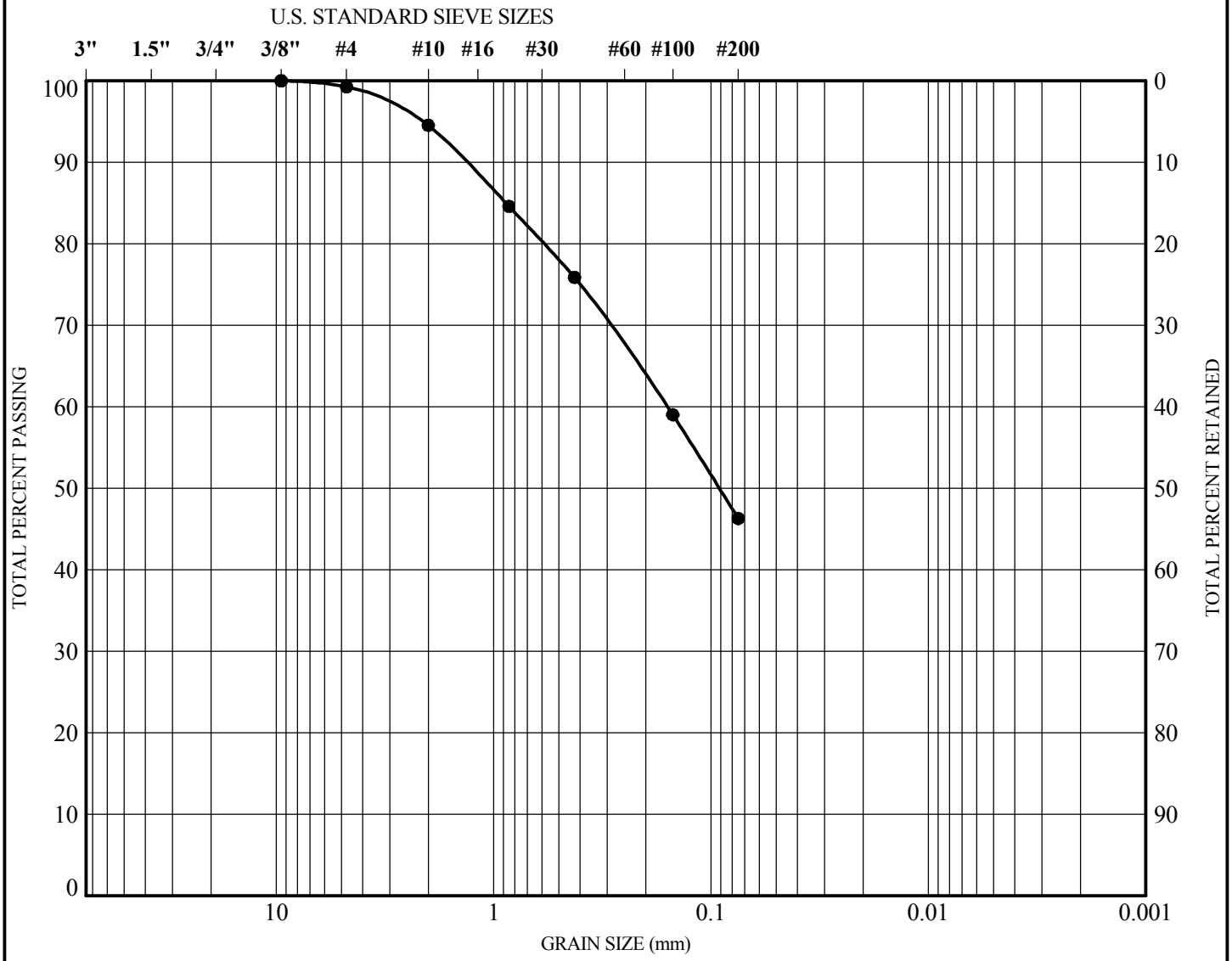
GRAIN SIZE DISTRIBUTION

PLATE

B-9

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV-13	2	Silty Sand	SM

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I-215/SR60 East Junction
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Riverside, California

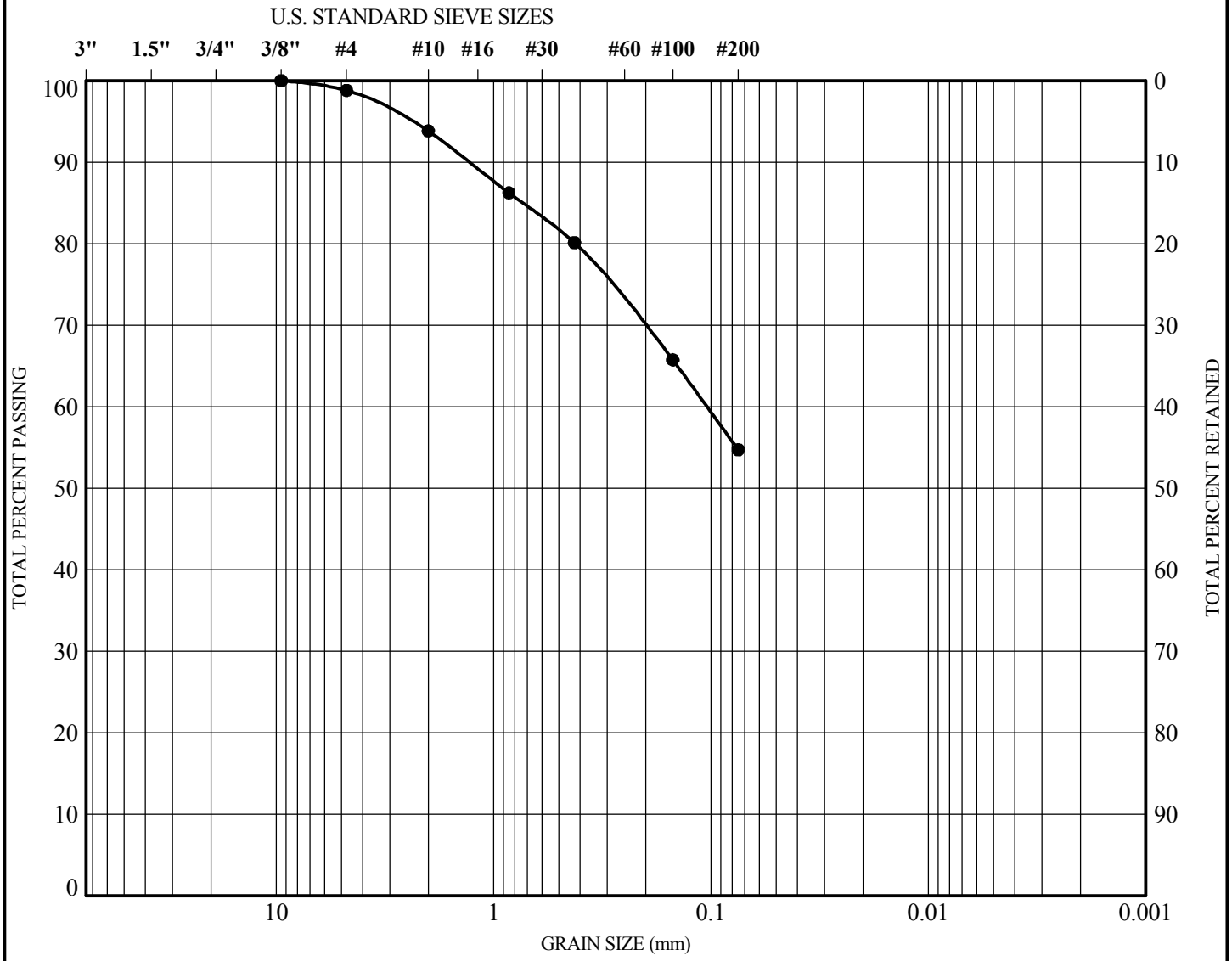
GRAIN SIZE DISTRIBUTION

PLATE

B-10

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV-14	5	Sandy Clay	CL

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WB & EB SR60 HOV Connectors
Riverside, California

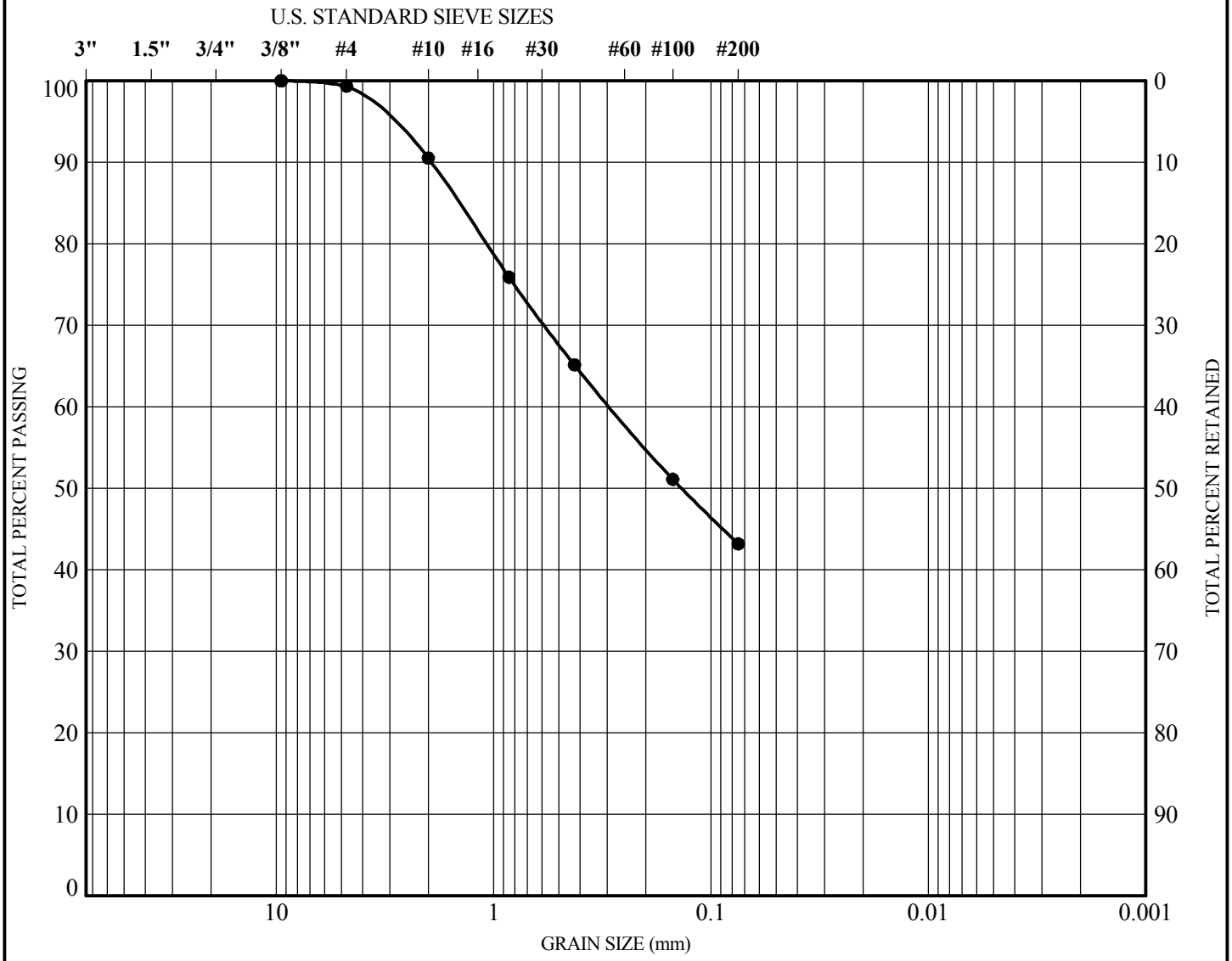
GRAIN SIZE DISTRIBUTION

PLATE

B-11

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV-15	1	Clayey Sand	SC

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PROJECT NO. 76979

I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

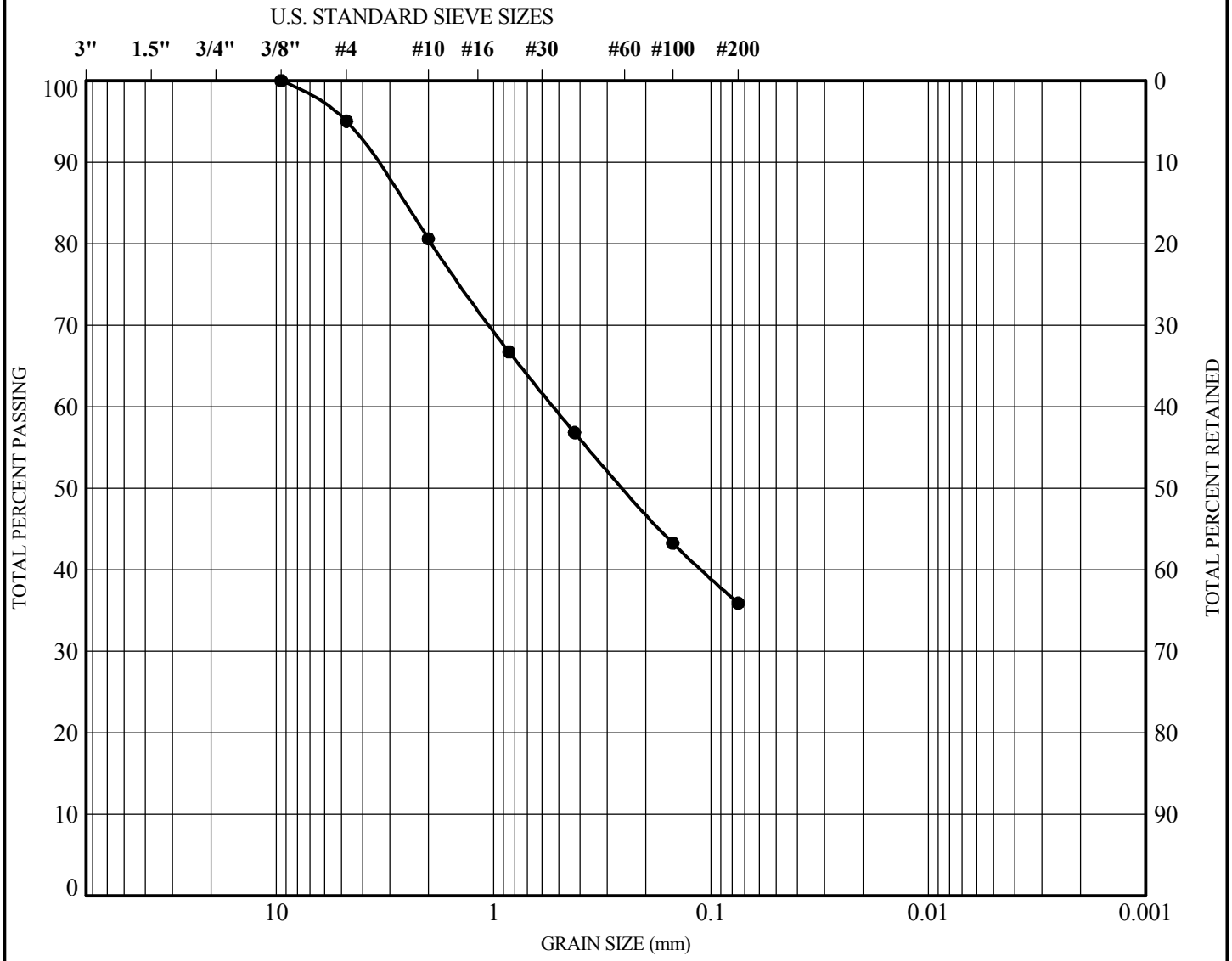
GRAIN SIZE DISTRIBUTION

PLATE

B-12

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV-17	2	Silty Sand	SM

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

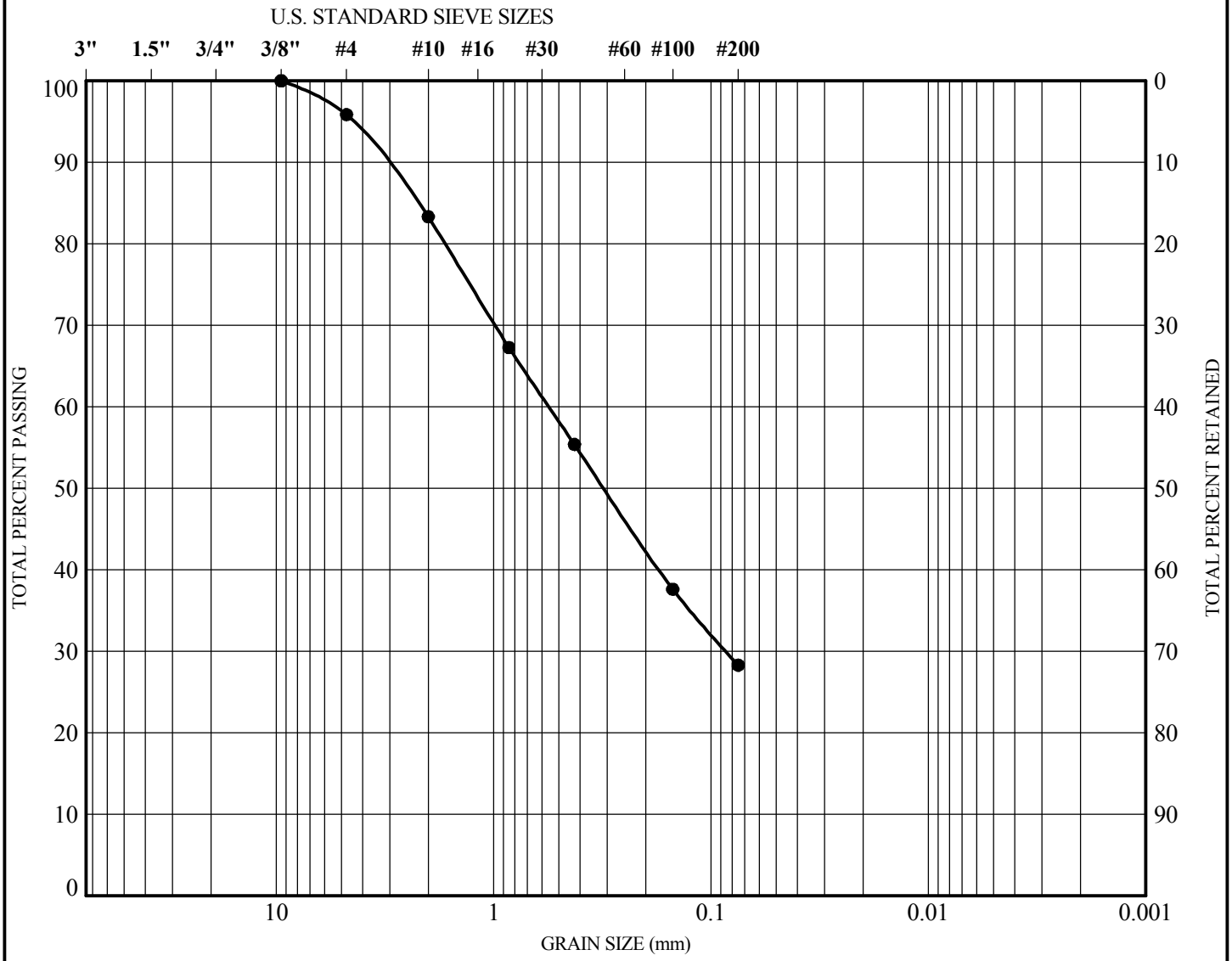
GRAIN SIZE DISTRIBUTION

PLATE

B-13

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	BD-1	6	Silty Sand	SM

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I-215/SR60 East Junction
Riverside, California

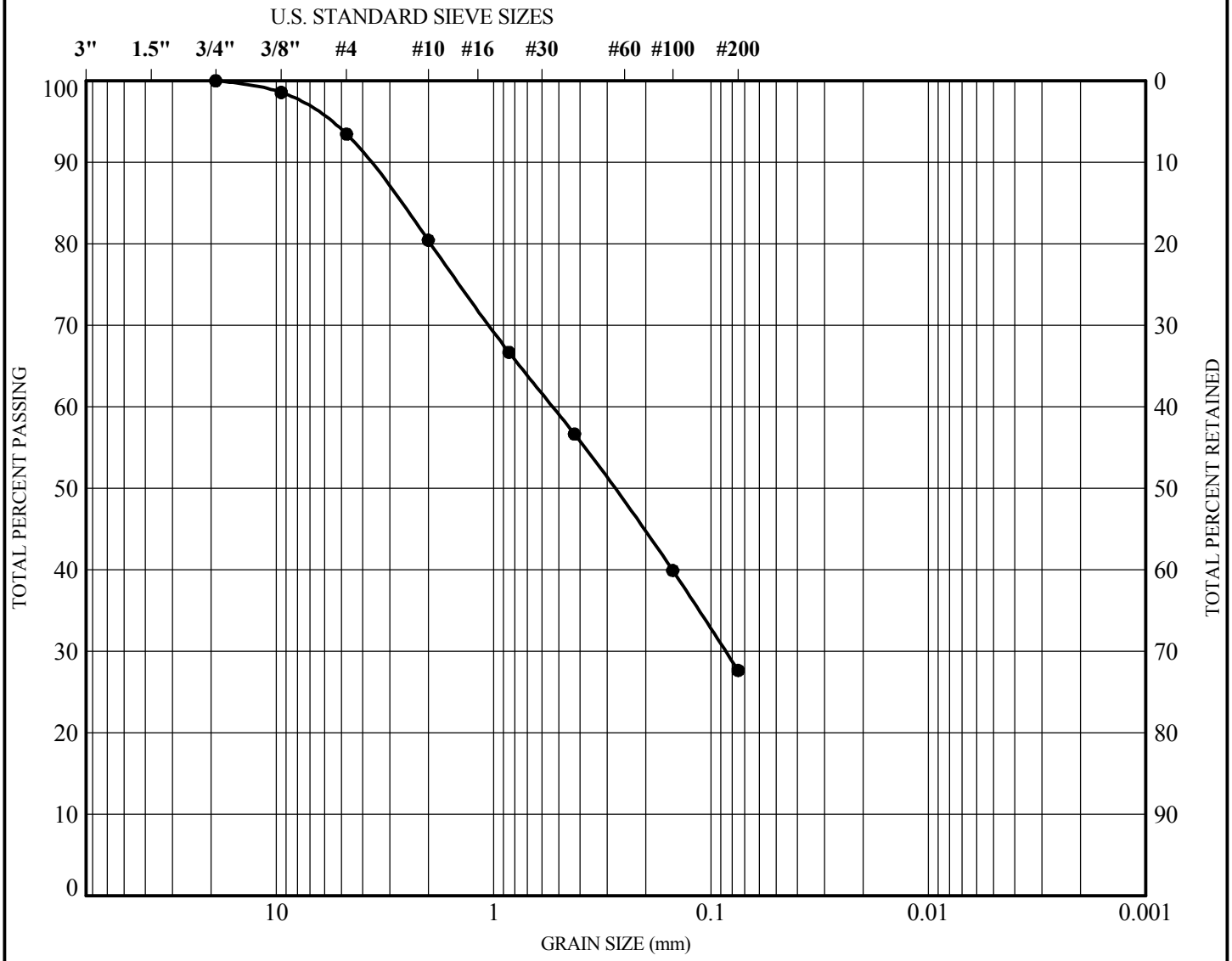
GRAIN SIZE DISTRIBUTION

PLATE

B-14

GRAIN SIZE 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	BD-2	9	Silty Sand	SM

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I-215/SR60 East Junction
Riverside, California

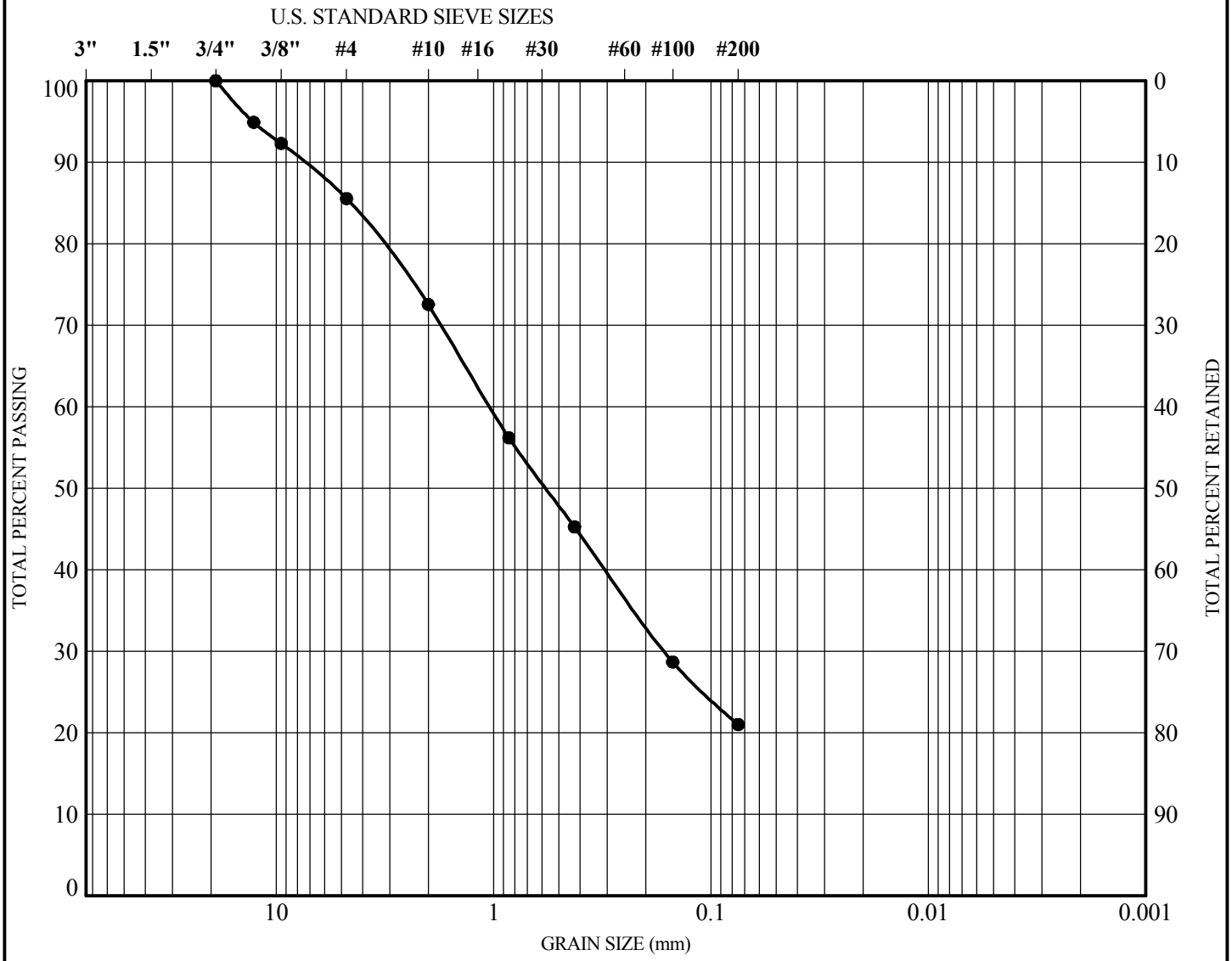
GRAIN SIZE DISTRIBUTION

PLATE

B-15

GRAIN SIZE 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	BD-3	8	Silty Sand	SM

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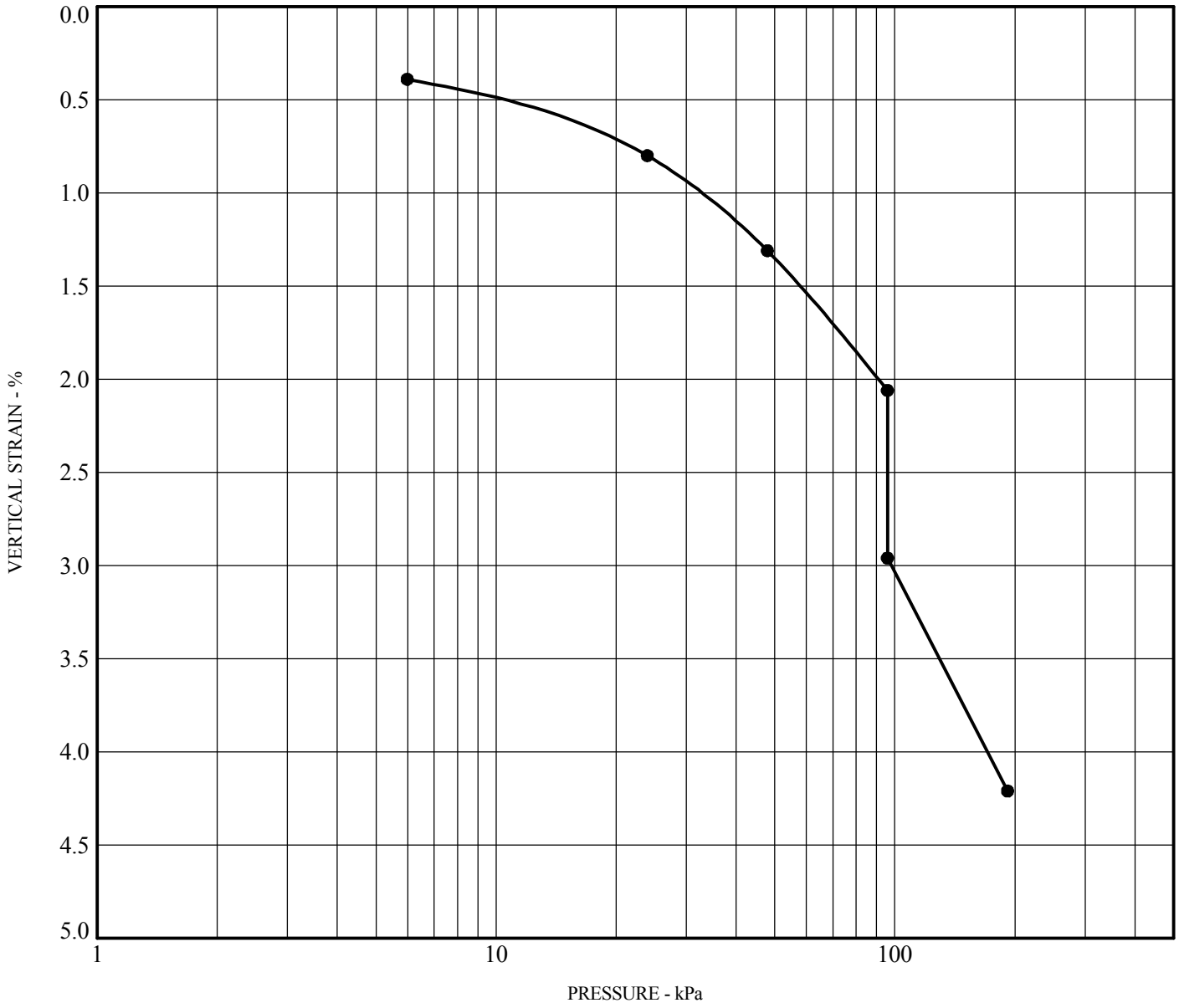
I-215/SR60 East Junction
Riverside, California

GRAIN SIZE DISTRIBUTION

PLATE

B-16

GRAIN SIZE 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09



Boring	**KB-1**
Depth (m)	**3**
Moisture Content (%)	**7.0**
Dry Density (kN/m^3)	**19.4**
Description	**Silty Sand**
Classification	**SM**
Collapse Potential (%)	**0.9**
Severity of Problem	

NOTE : 1 kPa = 21 psf

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PROJECT NO. 76979

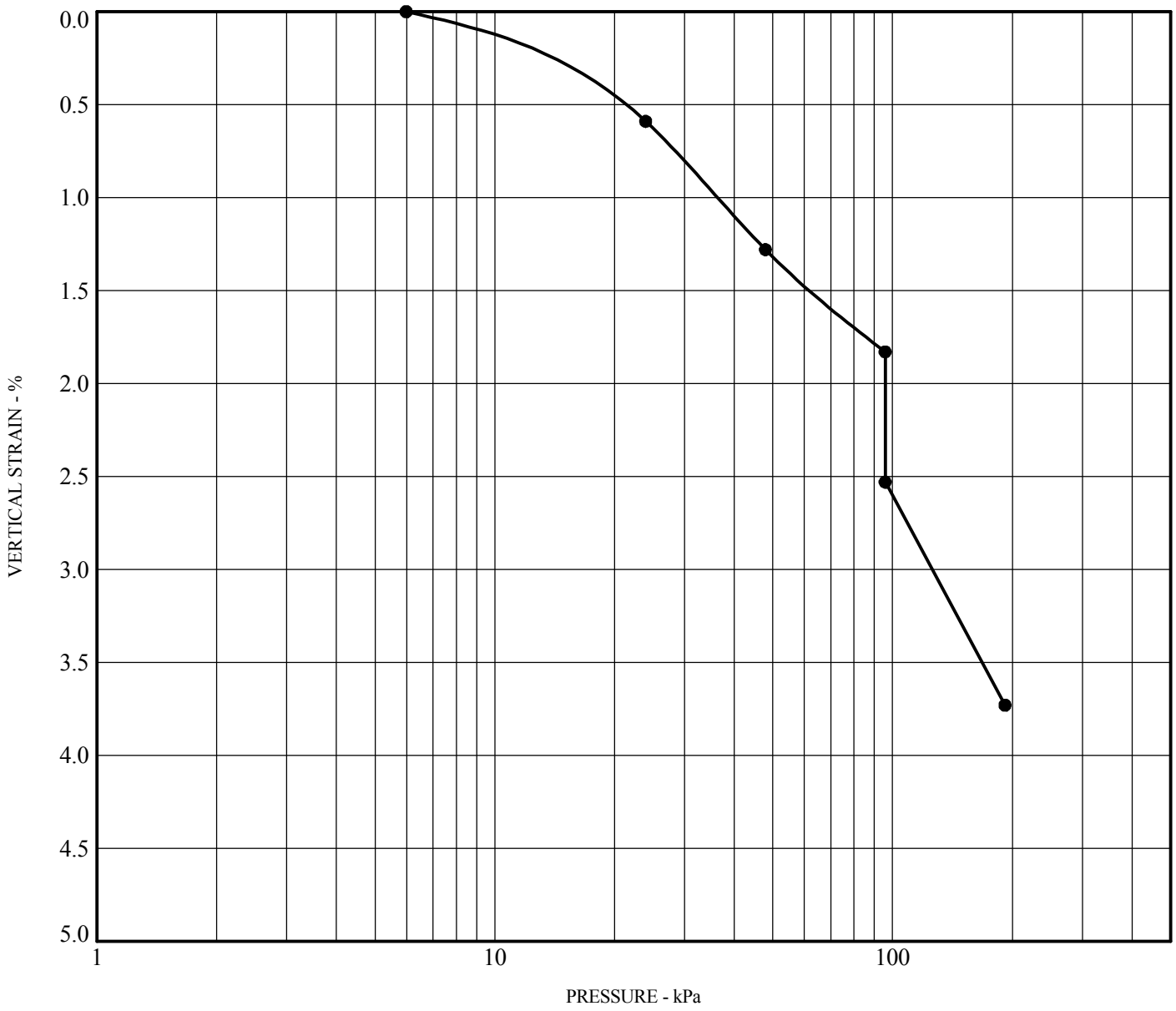
I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

COLLAPSE POTENTIAL TEST

PLATE

B-17

COLLAPSE 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09



Boring	**KB-3**
Depth (m)	**2**
Moisture Content (%)	**4.5**
Dry Density (kN/m^3)	**21.0**
Description	**Silty Sand**
Classification	**SM**
Collapse Potential (%)	**0.7**
Severity of Problem	

NOTE : 1 kPa = 21 psf

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PROJECT NO. 76979

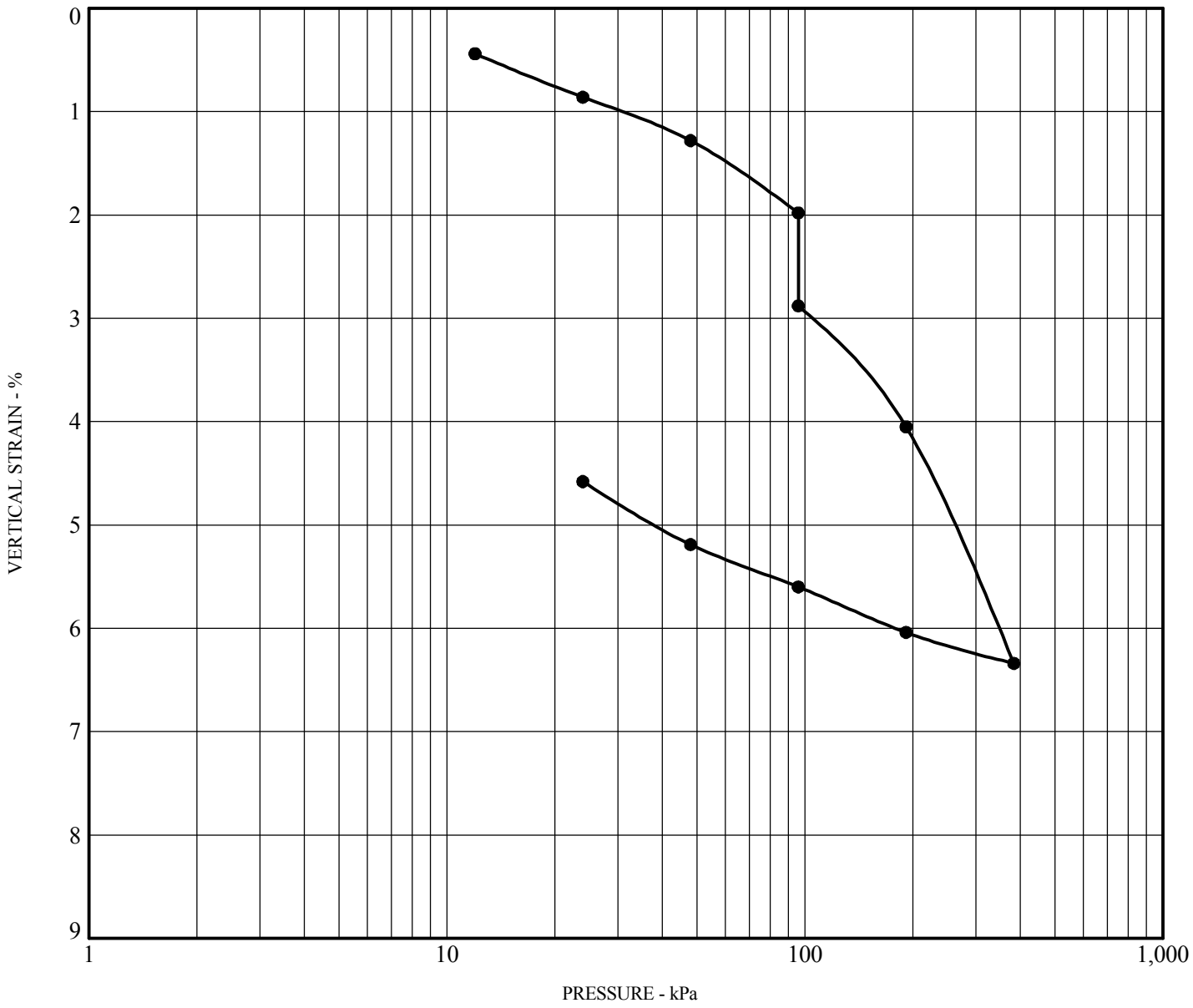
I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

COLLAPSE POTENTIAL TEST

PLATE

B-18

COLLAPSE 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09



Boring	**BS-1**			
Depth (meters)	**5**			
Moisture Content (%)	**7.9**	**Before**	**16.4**	**After**
Dry Density (kN/m^3)	**18.5**			
Description	**Silty Sand**			
Classification	**SM**			

NOTE : 1 kPa = 21 psf
SPECIMEN FLOODED
AT 2000 psf

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PROJECT NO. 76979

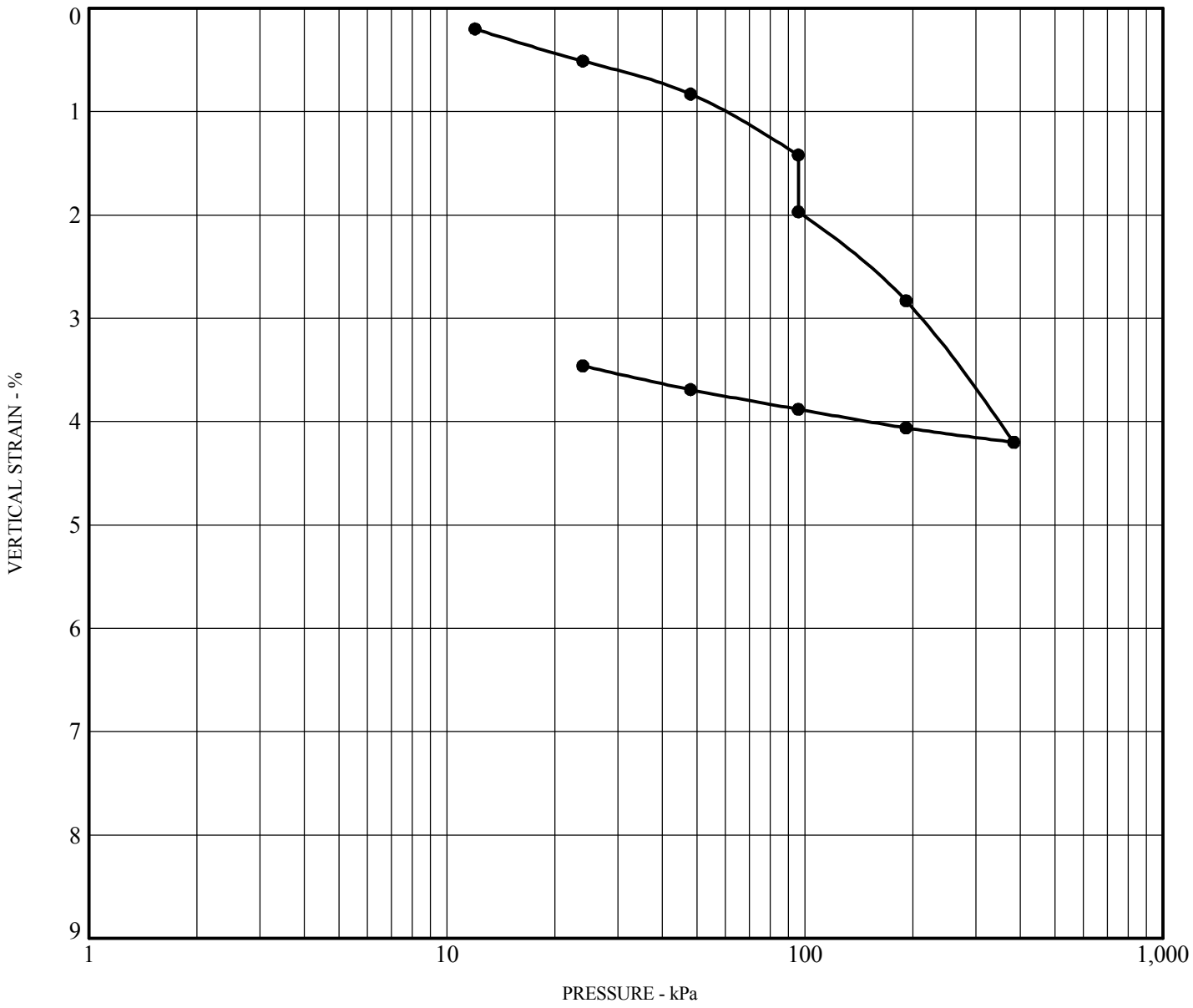
I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

CONSOLIDATION/COLLAPSE POTENTIAL TEST

PLATE

B-19

CONSOL NO INDICIES 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**BS-2**			
Depth (meters)	**2**			
Moisture Content (%)	**9.9**	**Before**	**12.9**	**After**
Dry Density (kN/m^3)	**18.8**			
Description	**Silty Sand**			
Classification	**SM**			

NOTE : 1 kPa = 21 psf
SPECIMEN FLOODED
AT 2000 psf

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I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

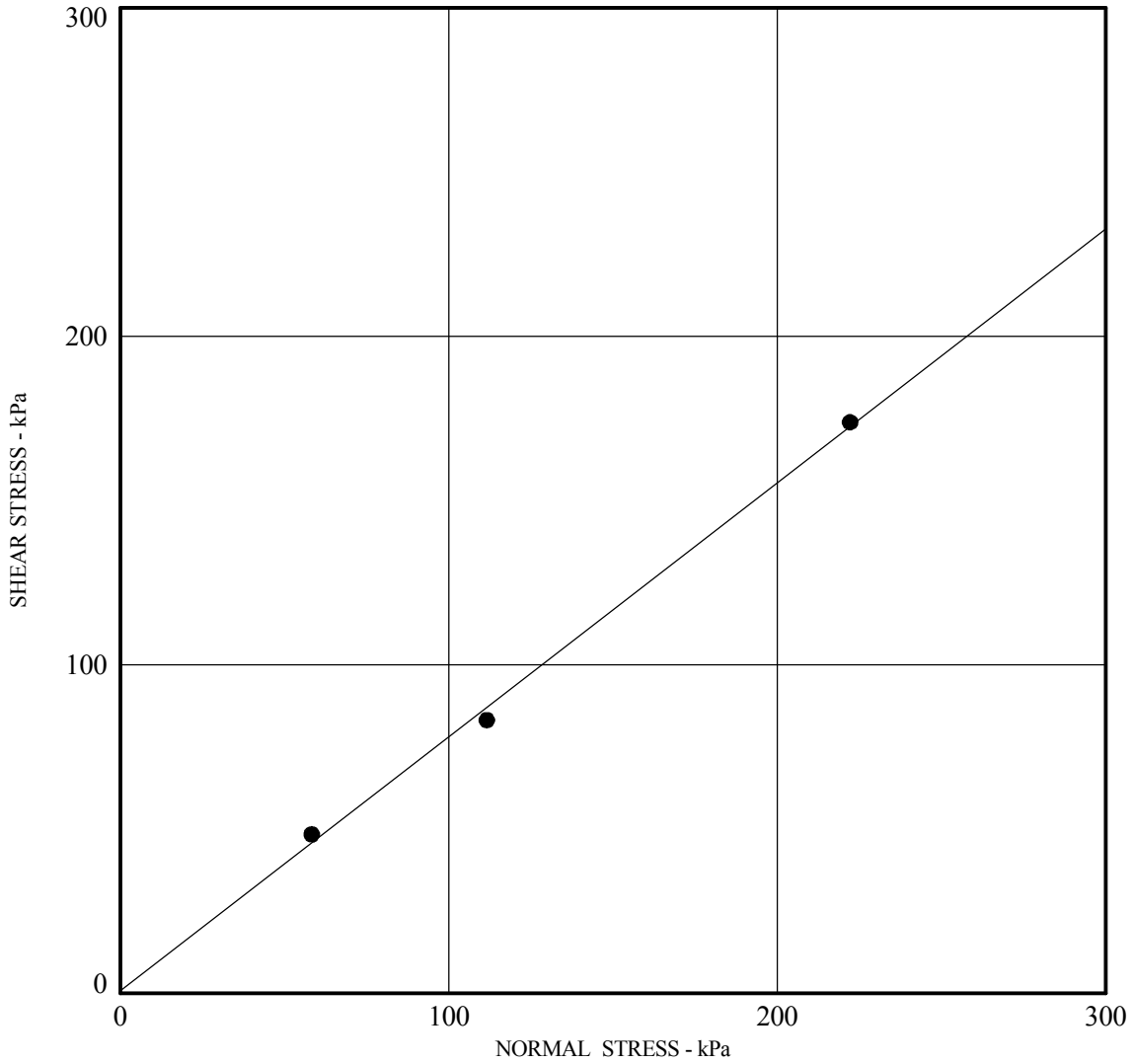
PLATE

B-20

PROJECT NO. 76979

CONSOLIDATION/COLLAPSE POTENTIAL TEST

CONSOL NO INDICIES 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**KB-1**
Depth (m)	**0 - 1.5**
Friction Angle - deg	**38**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**18.5**
Moisture Content (%) *	**9.0**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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PROJECT NO. 76979

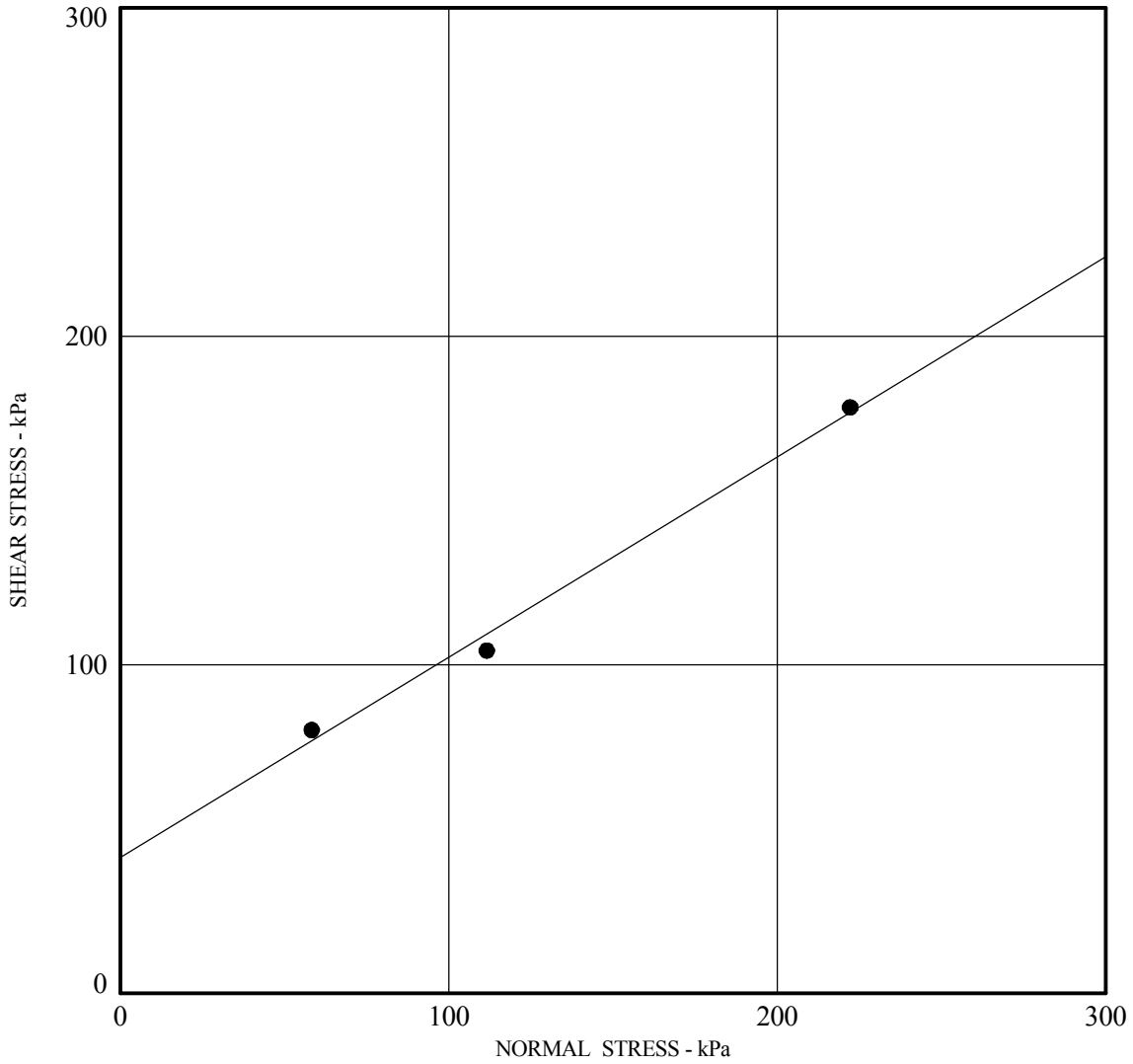
I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

DIRECT SHEAR TEST

PLATE

B-21

DIRECT SHEAR STATION 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09



Boring	**KB-3**
Depth (m)	**2**
Friction Angle - deg	**31**
Cohesion (kPa)	**41.2**
Dry Density (kN/m^3)	**21.0**
Moisture Content (%) *	**4.5**
Description	**Tonalite**
Classification	**SM**

*** In-situ Test**

KLEINFELDER
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PROJECT NO. 76979

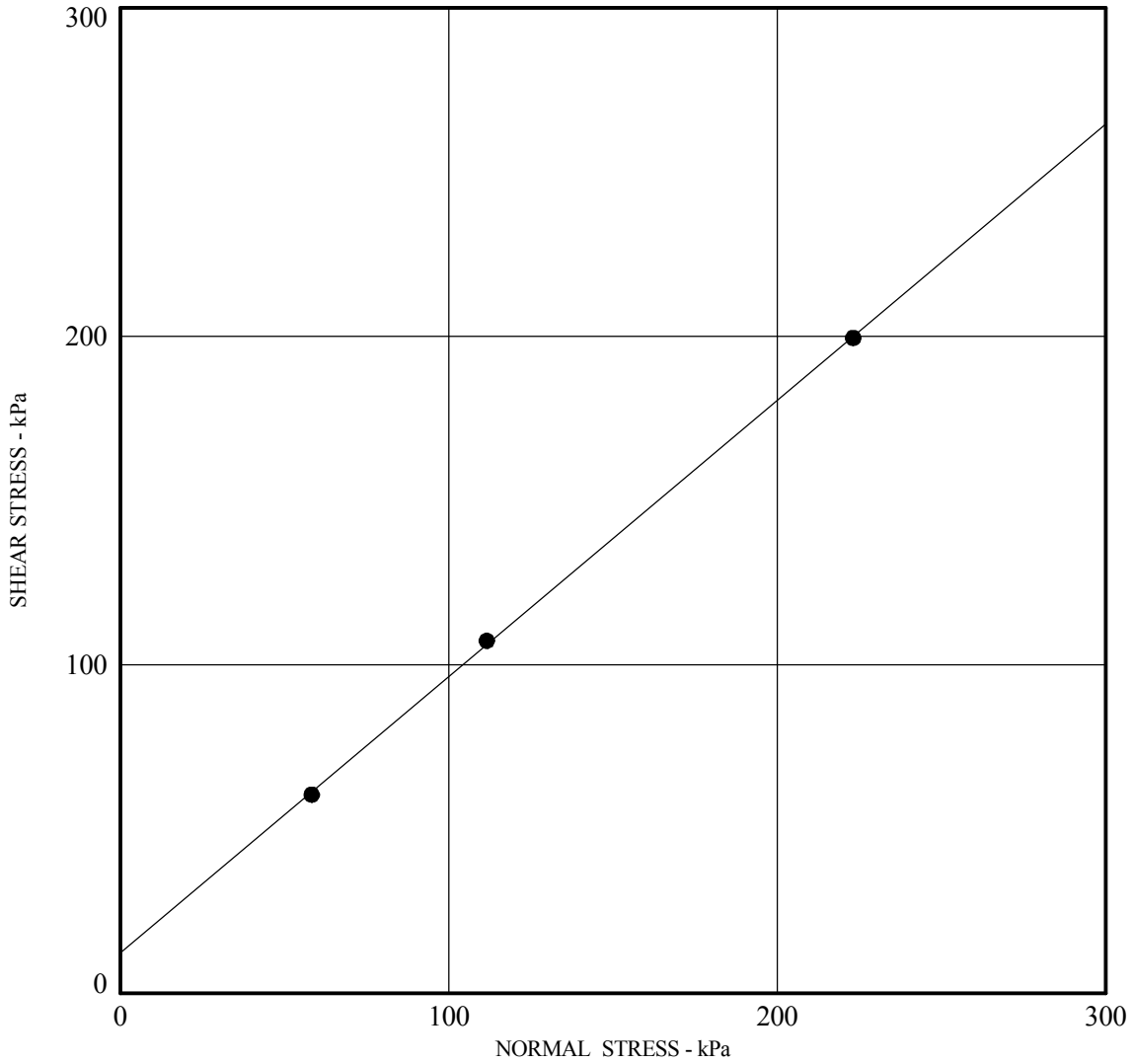
I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

DIRECT SHEAR TEST

PLATE

B-22

DIRECT SHEAR STATION 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09



Boring	**HV- 1**
Depth (m)	**3**
Friction Angle - deg	**40**
Cohesion (kPa)	**12.3**
Dry Density (kN/m^3)	**20.8**
Moisture Content (%) *	**6.1**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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PROJECT NO. 76979

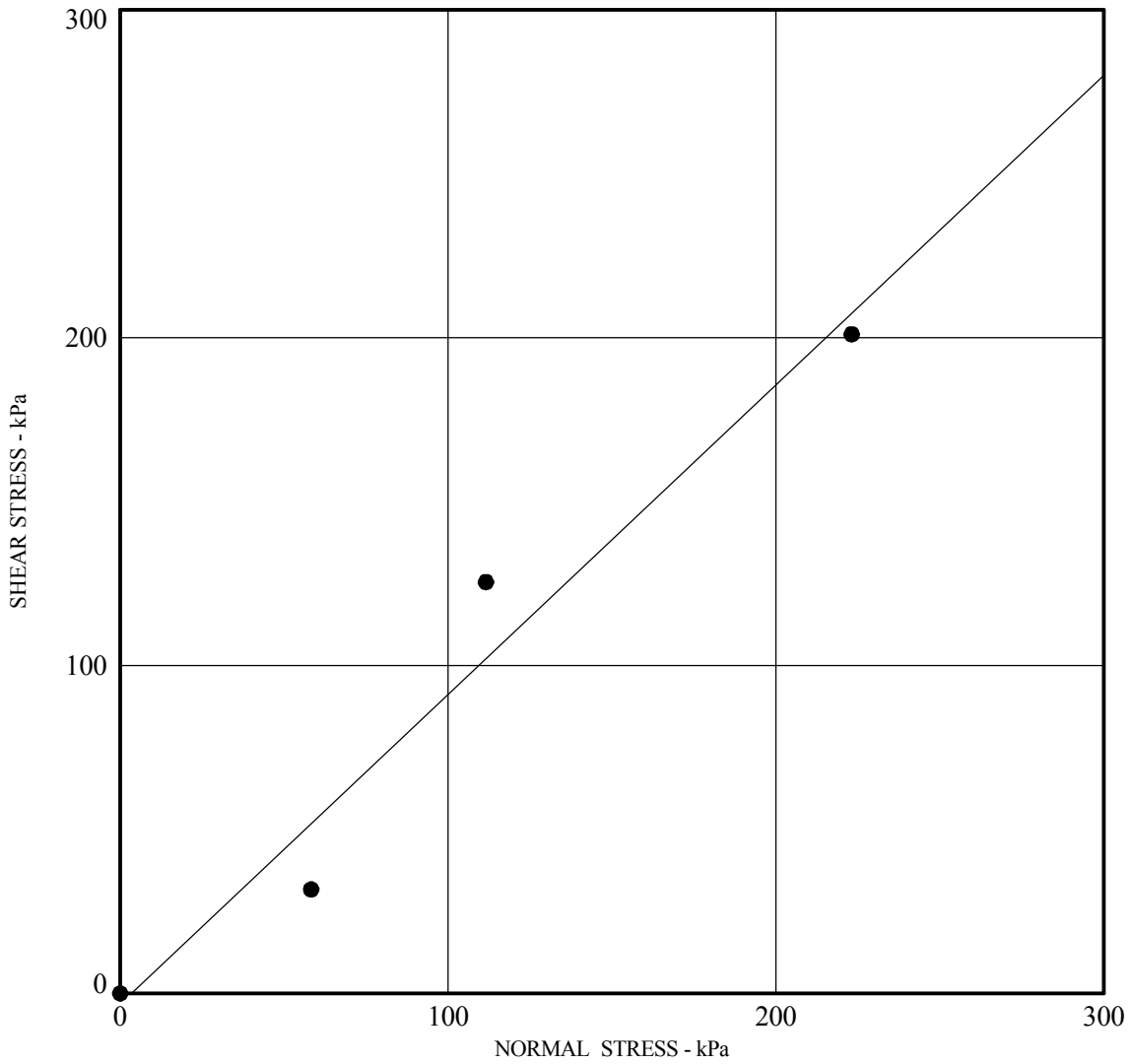
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-23

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**HV- 3**
Depth (m)	**15**
Friction Angle - deg	**43**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**20.0**
Moisture Content (%) *	**3.0**
Description	**Tonalite**
Classification	

*** In-situ Test**

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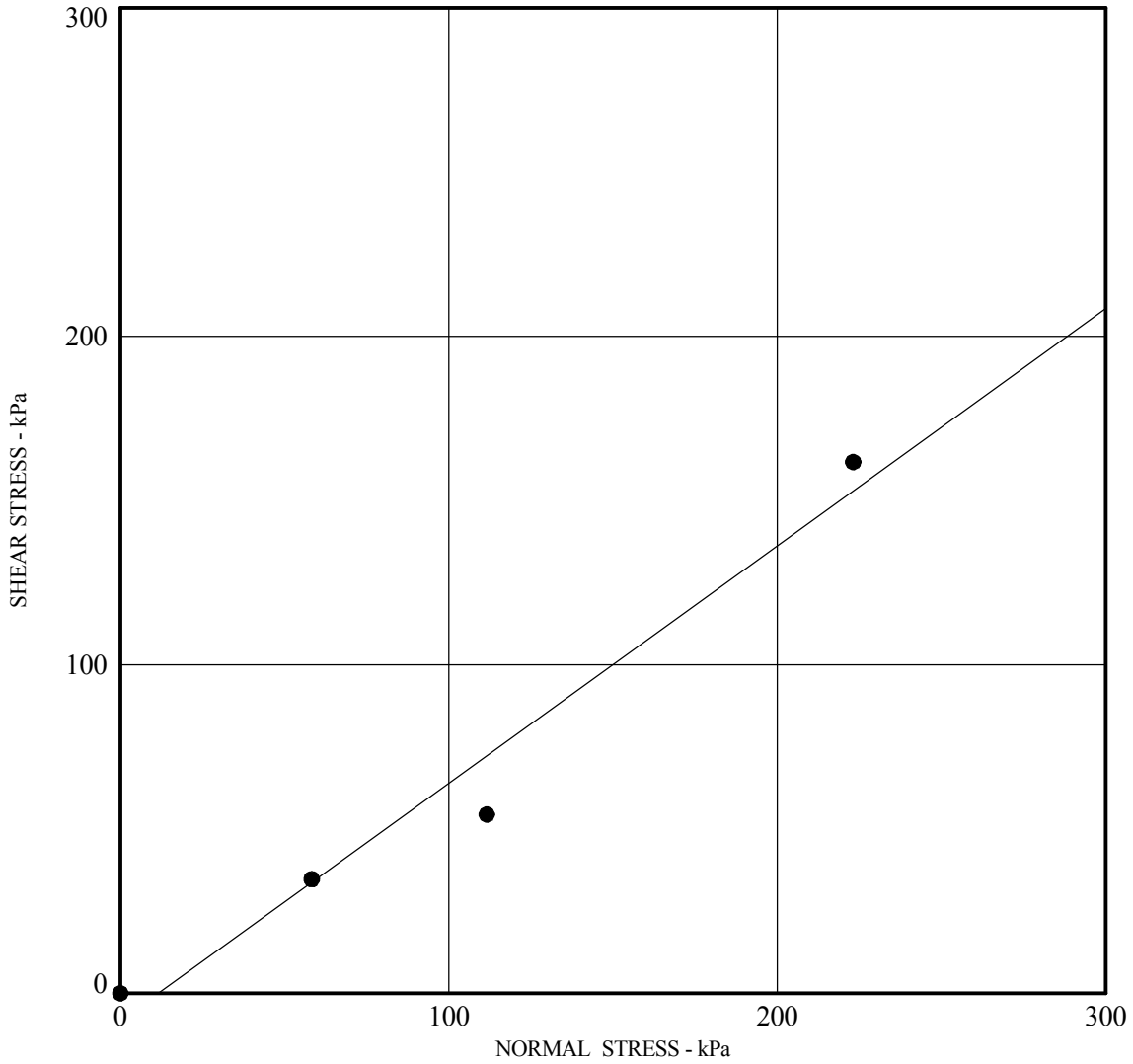
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-24

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**HV- 5**
Depth (m)	**9**
Friction Angle - deg	**36**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**20.0**
Moisture Content (%) *	**9.4**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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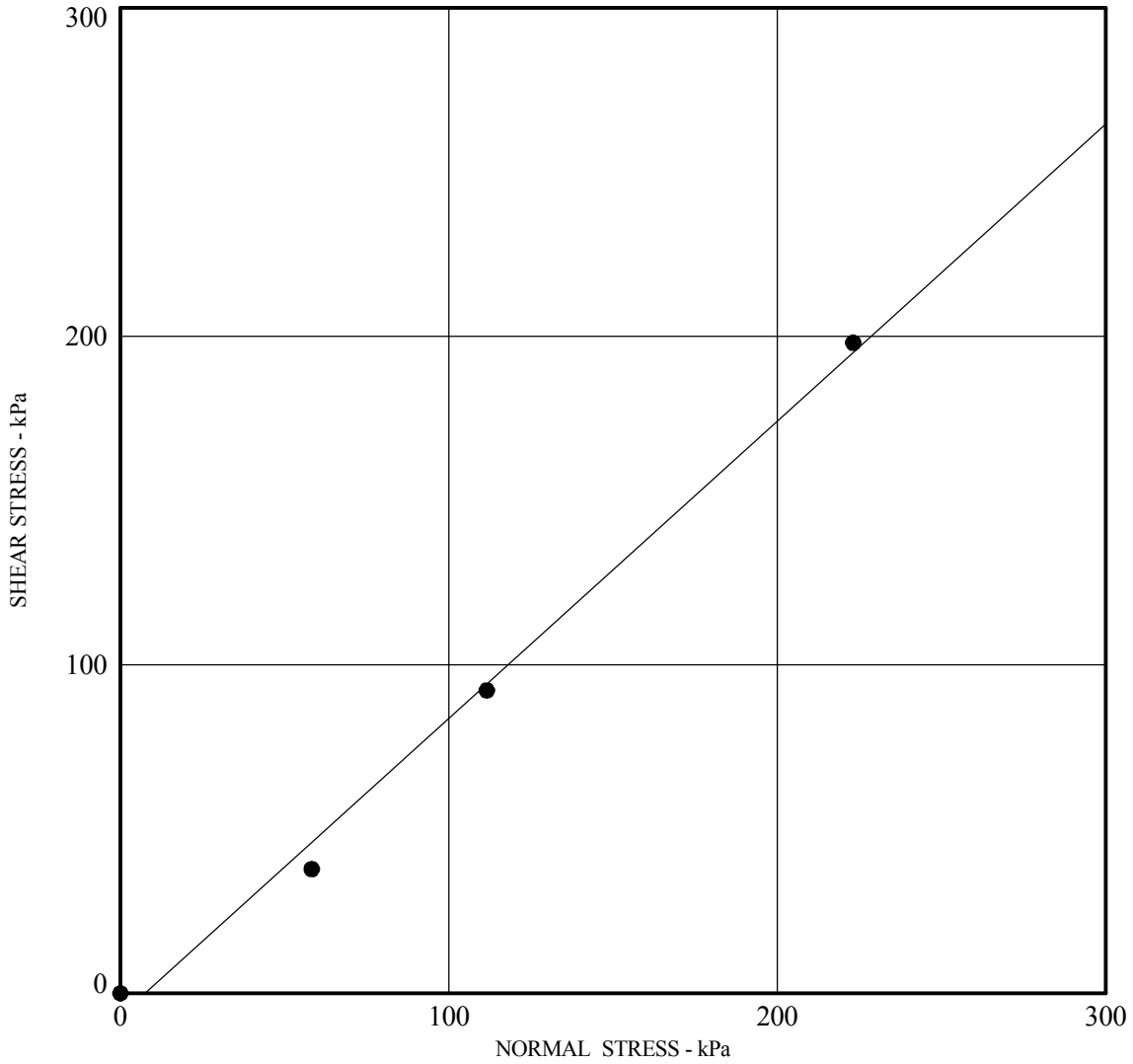
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-25

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**HV- 6**
Depth (m)	**2**
Friction Angle - deg	**42**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**17.2**
Moisture Content (%) *	**1.2**
Description	**Sand with Silt**
Classification	**SW-SM**

*** In-situ Test**

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PROJECT NO. 76979

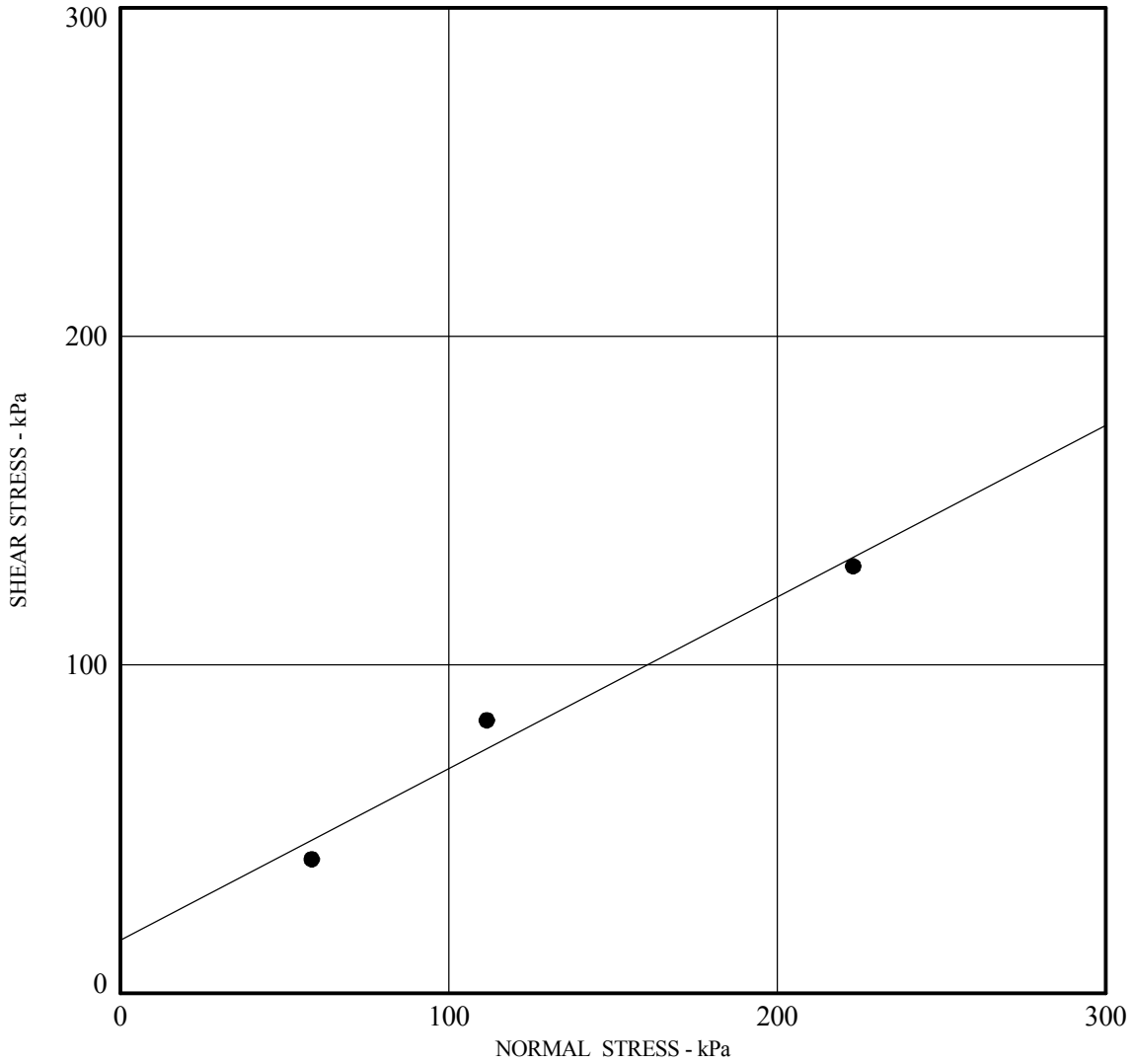
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-26

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**HV- 8**
Depth (m)	**6**
Friction Angle - deg	**28**
Cohesion (kPa)	**16.2**
Dry Density (kN/m^3)	**20.3**
Moisture Content (%) *	**8.1**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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PROJECT NO. 76979

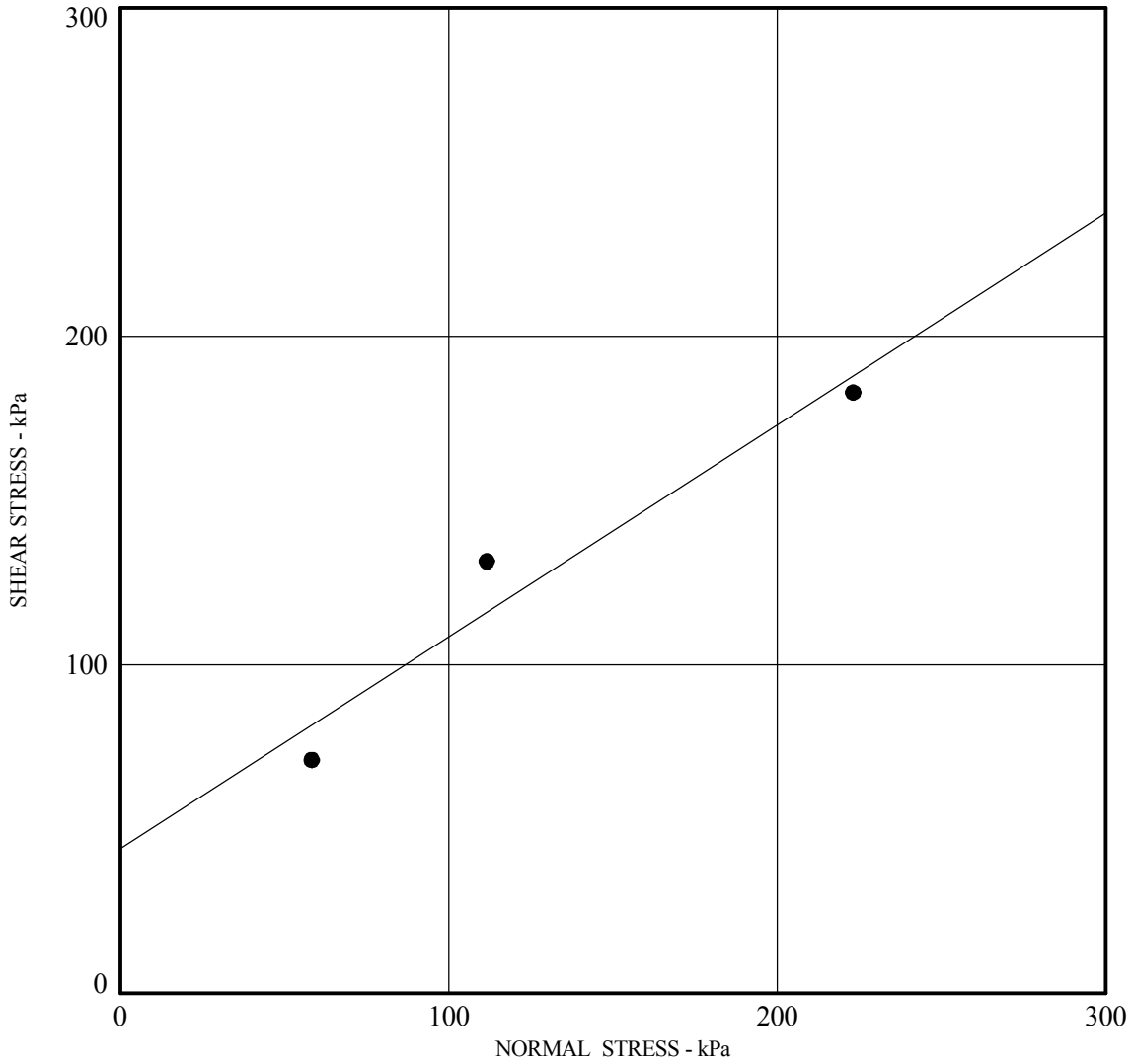
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-27

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**BS-1**
Depth (m)	**2**
Friction Angle - deg	**33**
Cohesion (kPa)	**44.0**
Dry Density (kN/m^3)	**20.4**
Moisture Content (%) *	**7.2**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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PROJECT NO. 76979

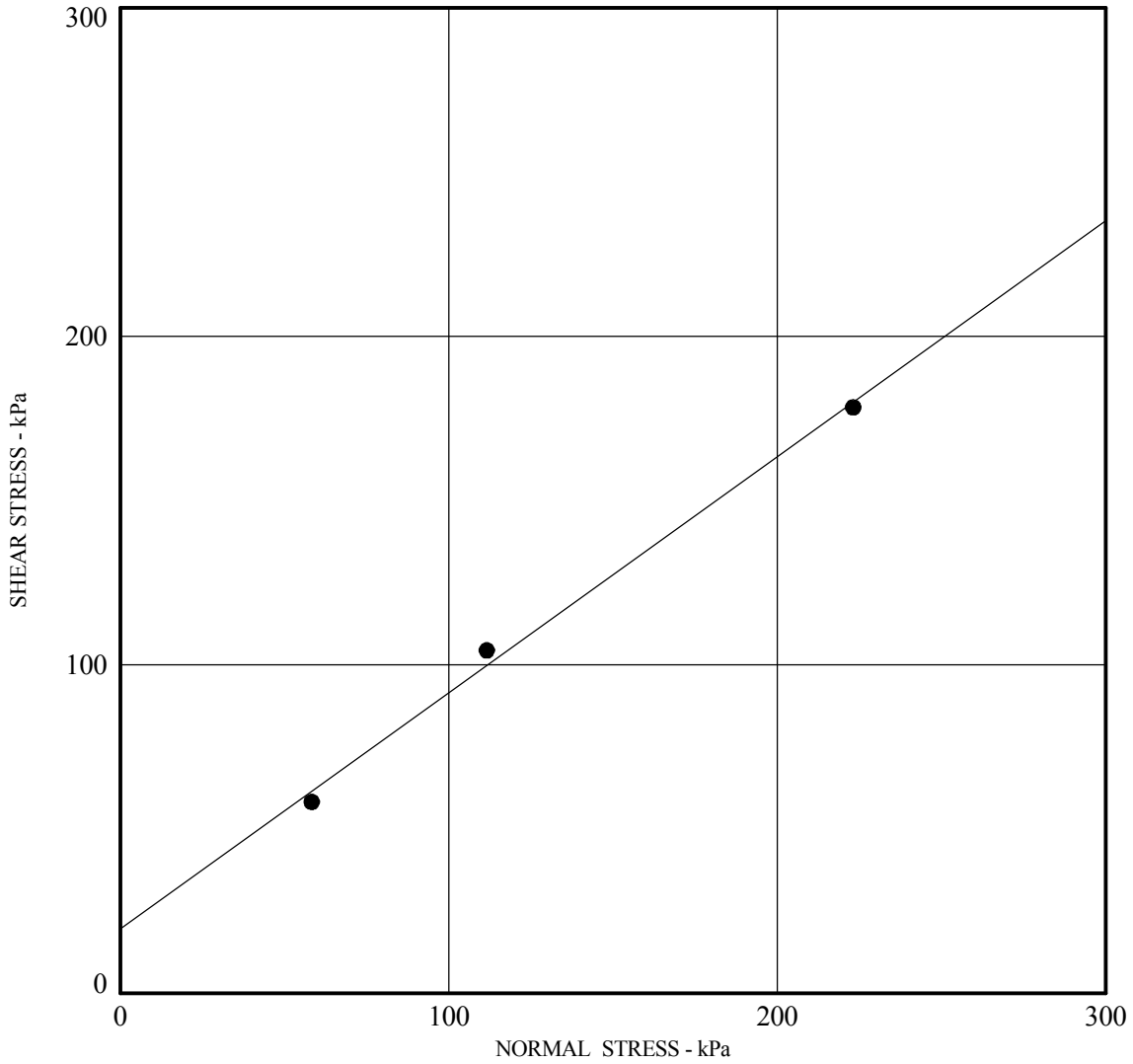
I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

DIRECT SHEAR TEST

PLATE

B-28

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**BD-1**
Depth (m)	**5**
Friction Angle - deg	**35**
Cohesion (kPa)	**19.6**
Dry Density (kN/m^3)	**20.1**
Moisture Content (%) *	**7.8**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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PROJECT NO. 76979

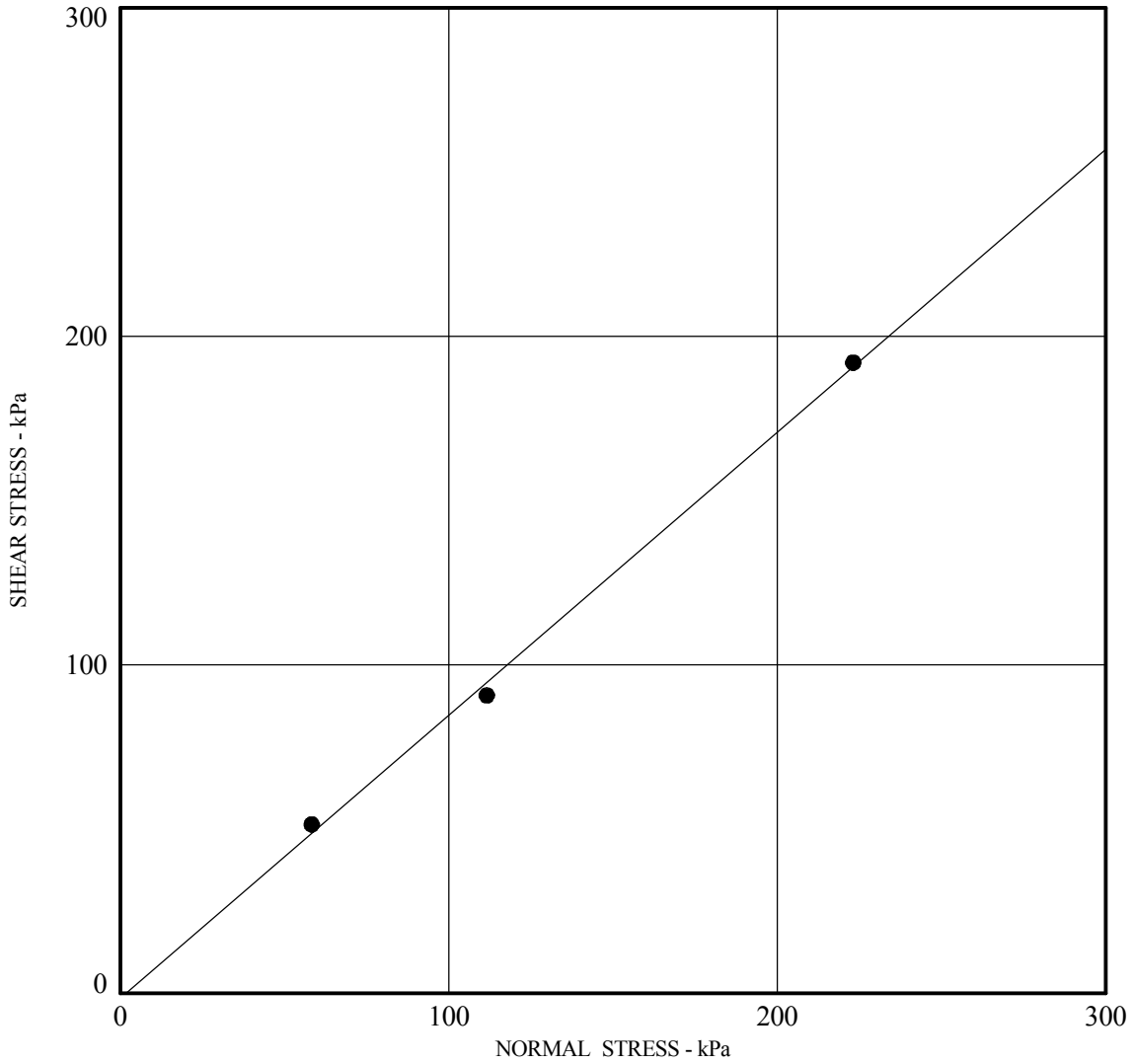
I-215/SR60 East Junction
Riverside, California

DIRECT SHEAR TEST

PLATE

B-29

DIRECT SHEAR STATION 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09



Boring	**BD-1**
Depth (m)	**8**
Friction Angle - deg	**40**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**18.5**
Moisture Content (%) *	**5.6**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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PROJECT NO. 76979

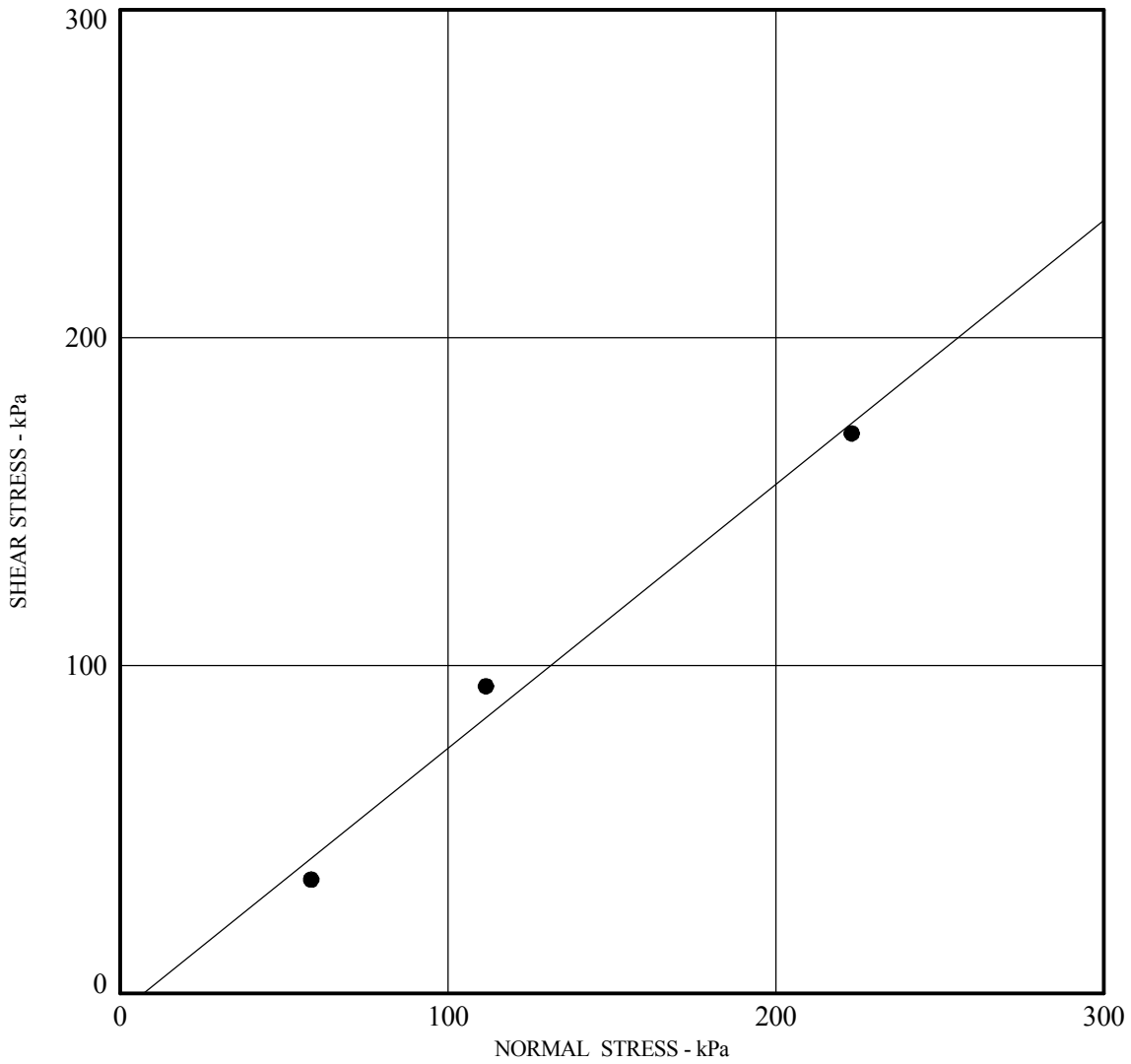
I-215/SR60 East Junction
Riverside, California

DIRECT SHEAR TEST

PLATE

B-30

DIRECT SHEAR STATION 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09



Boring	**BD-2**
Depth (m)	**0 - 1.5**
Friction Angle - deg	**37**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**19.3**
Moisture Content (%) *	**7.0**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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PROJECT NO. 76979

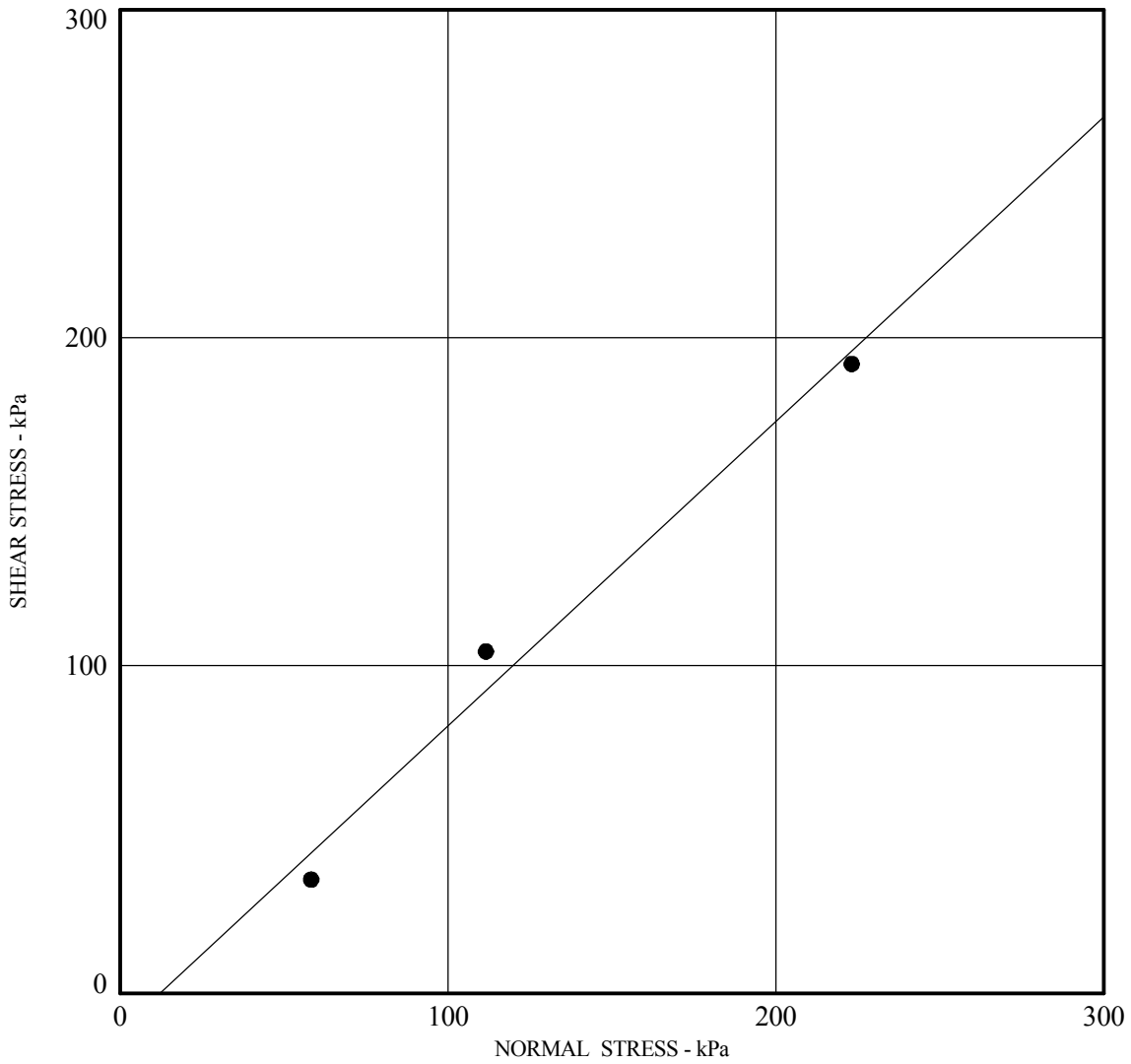
I-215/SR60 East Junction
Riverside, California

DIRECT SHEAR TEST

PLATE

B-31

DIRECT SHEAR STATION 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09



Boring	**BD-2**
Depth (m)	**11**
Friction Angle - deg	**40**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**17.3**
Moisture Content (%) *	**3.9**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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PROJECT NO. 76979

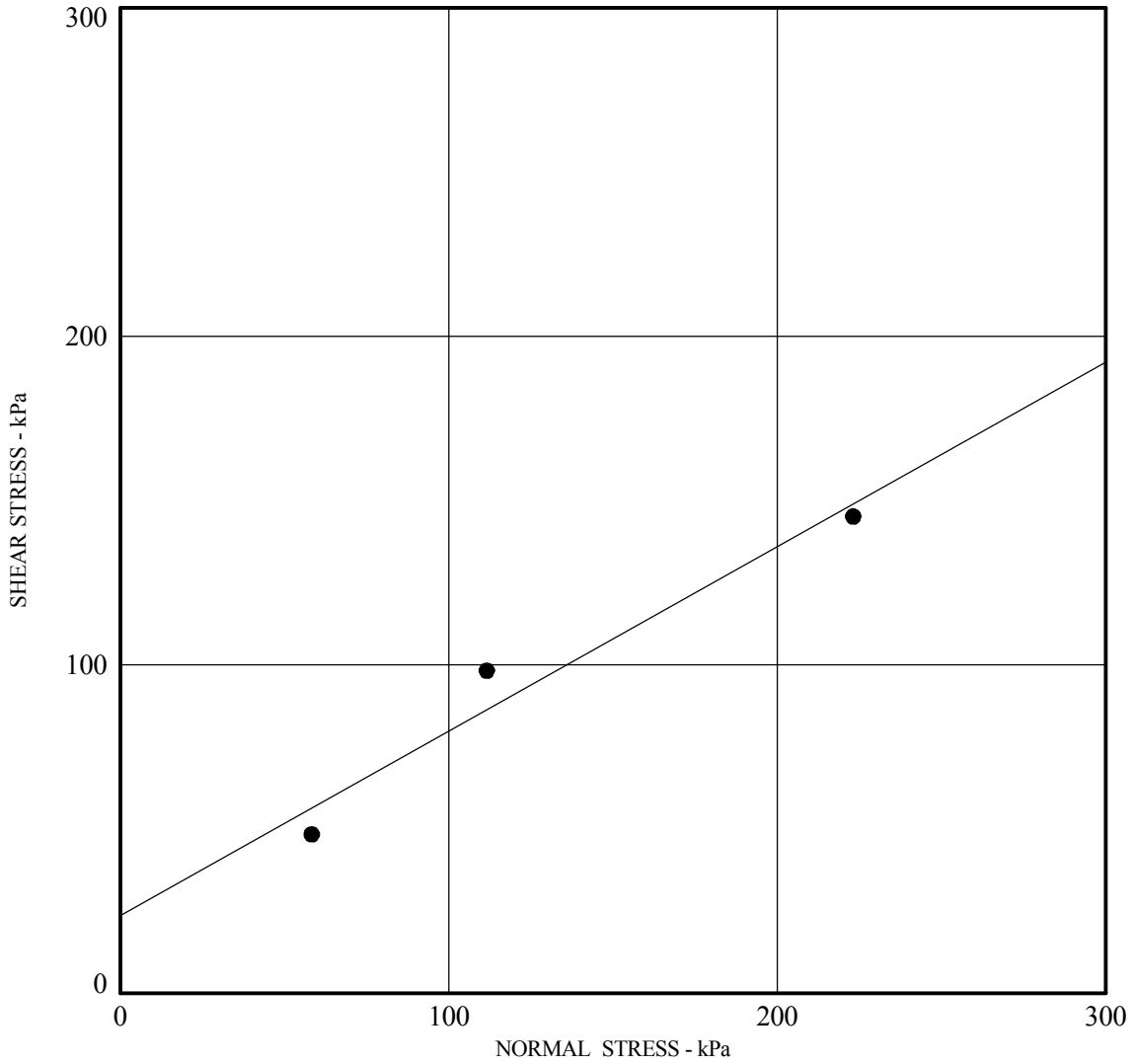
I-215/SR60 East Junction
Riverside, California

DIRECT SHEAR TEST

PLATE

B-32

DIRECT SHEAR STATION 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09



Boring	**BD-3**
Depth (m)	**9**
Friction Angle - deg	**29**
Cohesion (kPa)	**23.7**
Dry Density (kN/m^3)	**19.2**
Moisture Content (%) *	**11.6**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

DIRECT SHEAR TEST

PLATE

B-33

DIRECT SHEAR STATION 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09

REVISED MATERIALS REPORT
INTERSTATE 215/STATE ROUTE 60
EAST JUNCTION IMPROVEMENTS
RIVERSIDE AND MORENO VALLEY, CALIFORNIA
08-RIV-215/60, KP 60.7/70.6, 22.0/18.5
CALTRANS EA NO. 449311

Prepared for:

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER WEST, INC.
1220 Research Drive, Suite B
Redlands, California 92374
Phone: (909) 793-2691

Project No. 76979

March 12, 2009

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kleinfelder.com

March 12, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

Subject: **Revised Materials Report**
Interstate 215/State Route 60 East Junction Improvements
Riverside and Moreno Valley, California
08-RIV-215/60, KP 60.7/70.6, 22.0/18.5
Caltrans EA No. 449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) is pleased to present this Revised Materials Report for the proposed improvements at the east junction of Interstate 215 and State Route 60 in the Cities of Riverside and Moreno Valley, California. The purpose of this report is to provide geotechnical design and construction recommendations related to pavement structural sections, subsurface soil and groundwater conditions, and materials. Geotechnical recommendations for other elements of the project are presented in separate *Structure Foundation Reports* (SFR) and *Geotechnical Design Report (GDR)*. This report also incorporates the revisions based on Caltrans comments dated March 09, 2009.

We appreciate the opportunity to provide geotechnical services to Lim & Nascimento Engineering Corporation and trust the information in this report meets the current project needs. If you have any questions, please contact the undersigned at your convenience.

Respectfully submitted,
KLEINFELDER WEST, INC.

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1.0 INTRODUCTION

1.1 GENERAL

This Materials Report presents the results of our geotechnical study for the proposed improvements at the east junction of Interstate 215 (I-215) and State Route 60 (SR-60), located in the Cities of Riverside and Moreno Valley, California. The study area is shown on the attached Plate 1, *Site Vicinity Map*. The project is planned to meet the area's needs based on recent and projected growth trends throughout both cities and the County. The purpose of this study is to provide geotechnical information related to pavement structural sections, subsurface conditions, and materials information for use by the project designers for further planning, design and economic evaluations of the proposed interchange improvements. Our understanding of the project is based on our discussions with Lim & Nascimento Engineering Corporation (LAN Engineering) and our review of the documents listed in Section 1.3 of this report.

1.2 PURPOSE AND SCOPE OF SERVICES

The purpose of this report is to document subsurface conditions, provide analyses of anticipated conditions along the proposed alignment as they pertain to the project and to recommend geotechnical design and construction criteria for the proposed pavements. This report establishes a geotechnical baseline to be used by the project roadway design team in developing the project plans and specifications. The scope of our services included the following tasks:

- Review of existing geotechnical and geologic data pertaining to the proposed project.
- Drilling and sampling of 27 soil borings in the project area.
- Laboratory testing of selected samples to characterize the subsurface conditions.
- Engineering analyses to develop geotechnical recommendations for pavement design.
- Preparation of this report.

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1.3 PERTINENT REPORTS AND INVESTIGATIONS

The following documents were reviewed for this study:

- *Structure Foundation Report, Proposed Box Springs Overhead Right Bridge Widening, Bridge Number 56-0082R*, I-215/SR60 East Junction, Riverside, California, 08-RIV-215/60, KP 60.7/70.6, 22.0/18.5, Caltrans EA No. 449311**,** Kleinfelder Project No. 76979, dated October 10, 2008.

- *Structure Foundation Report, Proposed Frontage Road Overhead Replacement, Bridge Number 56C-0056*, I-215/SR60 East Junction, Riverside, California, 08-RIV-215/60, KP 60.7/70.6, 22.0/18.5, Caltrans EA No. 449311**,** Kleinfelder Project No. 76979, dated October 13, 2008.

- *Structure Foundation Report,* Proposed Eastbound and Westbound SR60 HOV Connectors*,* I-215/SR60 East Junction, Riverside, California, 08-RIV-215/60, Caltrans EA No. 449311**,** Kleinfelder Project No. 76979, dated July 18, 2008.

- *Structure Foundation Report, Proposed Box Springs Overhead Left Bridge Widening, Bridge Number 56-0082L*, I-215/SR60 East Junction, Riverside, California, 08-RIV-215/60, KP R38.6, Caltrans EA No. 449311**,** Kleinfelder Project No. 76979, dated March 14, 2008.

- *Memorandum, Supplemental Materials Report, Revised Two Layer Sections*, File Number Riv-215-R37.7/43.9, Riv-60-R12.1/13.7 and Riv-91-20.3/21.6, 08-334841, dated May 18, 200, Bruce W. Kean, District 8 Materials Engineer, department of Transportation.

Geologic data compiled and reviewed for this study were obtained from the Geologic Map of the Riverside East 7.5' Quadrangle, scale 1:24,000 (Morton, D.M. and Cox, D.F., 2001), and the Geologic Map of the Riverside East/South ½ of the San Bernardino South Quadrangles, map scale 1:24,000 (Dibblee, 2003). Other maps and publications we reviewed addressing regional geology include the *Geologic Map of the San Bernardino and Santa Ana 30' x 60' Quadrangles*, California, map scale 1 :100,000 (Morton, D.M., and Millen, F.K., 2006).

Maps, reports, and other studies reviewed addressing faulting and seismicity included "*Fault Rupture Hazard Zones in California*," (Bryant, W.A., and Hart, E.W., 2007); "*Fault*

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Activity Map of California and Adjacent Areas, California," Jennings, C.W. (1994); and *Map showing Quaternary faults and 1978-84 seismicity of the Los Angeles Region, California*, Ziony, J.I., and Jones, L. (1989).

Groundwater information from wells within the study area was researched based on records available through the Cooperative Well Measuring Program covering the Upper Santa Ana River, San Jacinto, and Upper Santa Margarita Watersheds (Western Municipal Water District (WMWD)).

Additional references used are listed in Section 8.0 of this report.

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2.0 EXISTING FACILITIES AND PROPOSED IMPROVEMENTS

2.1 EXISTING FACILITIES

The study area includes the existing I-215 and SR-60 freeways, Metrolink railroad, Box Springs Overhead (Bridge Nos. 56-0082R/L), Lawless Road Overhead (Bridge No. 56C-0056), Box Springs Truck Overhead (Bridge No. 56-0805G), Box Springs Overcrossing (Bridge No. 56-0804) and the Box Springs Road. The site is shown on the attached Plate 1, *Site Vicinity Map*.

I-215 and SR-60 are four-lane roadways in the subject area. The existing bridges crossing the Metrolink railroad are three- and five-span structures supported on two abutments and two to four bents, all founded on spread footings. The embankments for the bridges consists of fill slopes having a gradient of 1:1.5 (Vertical: Horizontal, V:H). We understand that the existing Right Bridge was recently constructed to replace an older bridge but was only partially completed and will be widened in the future.

Metrolink railroad in the project area consists of a single track and runs in north-south direction. Box Springs Road is a two lane roadway located to the north of I-215/SR-60 interchange, running parallel to I-215/SR-60 in east-west direction in the subject area.

2.2 PROPOSED IMPROVEMENTS

The project consists of the improvements at the east junction of I-215 and SR-60 in the City of Riverside and City of Moreno Valley. This includes construction of new eastbound and westbound SR-60 HOV structures, widening of the existing Box Springs Overhead, replacement of the existing Lawless Road Overhead, and construction of jacked drainage pipe across the freeway. Separate Structure Foundation Reports (SFR) and Materials Report (MR) were prepared for this project by Kleinfelder.

2.2.1 Eastbound and Westbound SR-60 HOV Bridge Structures

Eastbound and westbound SR-60 HOV structures will be built between the existing Box Springs Overcrossing and the Day Street Undercrossing, extending the existing HOV lanes. This project will also include lowering and widening of the existing northbound I-215 connector ramp to the westbound SR-60 and widening of the existing northbound I-215 mainline to the West. The three-span SR-60 HOV structures will be constructed

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with cast-in-place, prestressed concrete box girders with total lengths of 109.2 and 130.7 meters (for the eastbound and westbound structures, respectively) and width of 9.105 meters for both structures.

2.2.2 Box Springs Overhead Bridge Widening

The proposed Box Springs Overhead Right Bridge widening consists of a 39.55-meter long, three-span bridge to be constructed with cast-in-place, prestressed slab. The bridge abutments and bents will be supported on spread footings.

The proposed Box Springs Overhead Left Bridge widening consists of a 44.81-meter long, three-span bridge to be constructed with either precast, prestressed rectangular girders or cast-in-place T-girder. The bridge abutments and bents will be supported on spread footings.

To provide for proposed railroad maintenance road under the bridge, a tieback wall will be constructed at Abutment 1 slope. The widened bridges are proposed to be founded on shallow foundations similar to the existing bridges.

2.2.3 Lawless Road Overhead Bridge Replacement

The widening of the Box Spring Overhead Right Bridge requires that the existing Lawless Road Overhead be relocated. The existing bridge will be demolished and replaced with a new three-span, cast-in-place, prestressed concrete box girder bridge on the north side of the existing bridge. The bridge will be approximately 70 meters long and 22 meters wide. The bridge abutments and bents will be supported on spread footings. The proposed bridge will be called Frontage Road Overhead. In addition to the construction of the bridge, a railroad maintenance road with an approximate width of 10 meters is proposed to be constructed near the toe of west embankment.

2.2.4 Jacked Drainage Pipe

According to the plan provided by LAN Engineering, a jacked drainage pipe consists of either a single 2.6-meter diameter or a double 2.4-meter diameter Reinforced Concrete Pipe (RCP) will be constructed approximately 25.8 meters to the east of and parallel to the Metrolink Railroad tracks. The drainage pipe will be 149-meter long and will have invert elevations of 451.5 meters (MSL) at its southern terminus and 450.0 meters

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(MSL) at its northern terminus. The southern terminus of the drainage pipe is located approximately 60.7 meters south of Sta. 15+23.10 of “3CC” Line, and its northern terminus is located approximately 12.3 meters north of Sta. 14+10.63 of “H” Line.

It is our understanding that the jacked pipe will be constructed in three sections. The first section of the pipe is 43 meters long and the second and third sections of the pipe are 54 and 52 meters long, respectively. Ground cover over the pipe is anticipated to be on the order of 7 to 11 meters.

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3.0 GEOTECHNICAL INVESTIGATION PROGRAM

3.1 FIELD EXPLORATION

Prior to conducting the field exploration, our proposed exploration locations were cleared of known existing utility lines through Underground Service Alert (USA). Our subsurface exploration program for the proposed interchange improvement consisted of drilling and logging 27 exploratory soil borings (KA-1 through KA-3, BS-1 and BS-2, HV-1 through HV-18, and BD-1 through BD-4) between March 5, 2007 and October 21, 2008. These borings were advanced to depths ranging from approximately 5.0 to 25.3 meters below the existing ground surface (bgs). Locations of our borings are shown on Plates 2a through 2d, *Exploration Location Map*. The borings were advanced using a Mobile B-61, truck-mounted drill rig and a CME/Mobile L10-T hybrid track drill rig equipped with 200-mm diameter hollow-stem augers and an automatic hammer delivery system for sample collection.

The borings were logged and sampled by a staff engineer/geologist from our office using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Each soil sample was observed and described in general accordance with the Unified Soil Classification System (USCS). Following drilling, sampling and logging, the borings were backfilled with native cuttings. The boring logs are presented in Appendix A, *Field Exploration*.

3.2 LABORATORY TESTING

Laboratory testing was performed on soil samples collected during our field exploration to substantiate field classifications and to evaluate the physical characteristics of the subsurface soils. Testing consisted of in-situ moisture content and unit weight, grain size distribution, laboratory maximum dry unit weight and optimum moisture content, shear strength, R-value, sand equivalent and corrosion analyses. The laboratory tests performed for this geotechnical study are described and the test results are presented in Appendix B, *Laboratory Testing*.

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4.0 PHYSICAL SETTING

4.1 CLIMATE

The climate in the region of the site is generally characterized by dry, moderate to warm summers and moist, cool winters. On average, the warmest month is July, with temperature ranging from 16° to 34° C. The coolest month is December, with temperature ranging from 5° to 20° C. The highest recorded temperature was 45° C in 1960 and the lowest recorded temperature was -6° C in 1990. The maximum average precipitation is 63 mm which typically occurs in January, and the minimum average precipitation is less than 2.5 mm which typically occurs in July. On average, the precipitation in Riverside is less than 25.4 mm, between the months of April and October. Water usually freezes and thaws when the air temperature is at approximately 4° C. Therefore, the subject project site is not within a freeze-thaw area.

4.2 TOPOGRAPHY AND DRAINAGE

Topographically, the project site is an area of locally steep graded slopes adjacent to each side of the active Metrolink railroad tracks. The slopes are approximately 7.62 meters high, descending to the railbed which gently slopes to north. The areas at the top of each slope are relatively level with a gentle gradient to the north. Surface drainage for the study area is via sheet flow runoff toward the north. Drainage in the area is along the railroad tracks and flows north to Box Springs Canyon.

4.3 MAN-MADE AND NATURAL FEATURES OF ENGINEERING AND CONSTRUCTION SIGNIFICANCE

The project alignment is situated in the Cities of Riverside and Moreno Valley, Riverside County. Existing man-made features in the area include the I-215, SR-60, several overhead bridges crossing over Metrolink railroad, Box Springs Road, and several commercial facilities and residential properties in the vicinity of the alignment. Two drainage pipe culverts approximately 910 mm in diameter were observed on the south side of the eastern embankment of existing Box Springs Truck Overhead (Bridge No. 56-0805G). A drainage pipe approximately 300 mm in diameter running in north-south direction and buried approximately halfway beneath the eastern embankment of Box Springs Truck Overhead was also observed during our site reconnaissance.

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4.4 REGIONAL AND LOCAL GEOLOGY

The project site is situated within the northern Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are a northwest-southeast oriented complex of blocks separated by similarly trending faults which extend 200 km from the Transverse Ranges south to the Mexican border and beyond another 1250 km to the tip of Baja California. The province varies in width from 50 to 160 km and is bounded on the east by the Colorado Desert and the Gulf of California and on the west by the Pacific Ocean.

The Peninsular Ranges contain Jurassic-age and Cretaceous-age igneous and metamorphic rocks, as well as a thick sequence of marine and non-marine sedimentary rock. The Peninsular Ranges Province is further described by sub-units, which include the Perris Block, the Santa Ana Mountains, and the San Jacinto Mountains. The Perris Block is characterized as a broad area of intermixed valleys and low mountain ranges situated between the Elsinore and San Jacinto fault zones.

The project site is located in the northern portion of the Perris Block and Perris Valley. Typical lithographic units within this area consist of Quaternary alluvial deposits overlying granitic and metamorphic bedrock. Sporadic outcrops of bedrock dot the valley floor and represent remnants of eroded hills and mountains. Bedrock consists of mostly Cretaceous-age igneous rock (tonalite) forming the bedrock hills north of the site.

4.5 FAULTING AND SEISMICITY

The project site is located in the highly seismic southern California region within the influence of several fault systems that are considered to be active or potentially active. An active fault is defined by the State of California as “a sufficiently active and well defined fault, which has exhibited surface displacement within the Holocene time (the last 11,000 years).” The definition of “potentially active” varies. A generally accepted definition of “potentially active” is a fault showing evidence of displacement that is older than 11,000 years (Holocene age) and younger than 1.7 million years (Pleistocene age). However, “potentially active” is no longer used as criteria for zoning by the California Geologic Survey (CGS). The terms “sufficiently active” and “well-defined” are now used by the CGS as criteria for zoning faults under the Alquist-Priolo Earthquake Fault Act. A “sufficiently active fault” is a fault that shows evidence of Holocene surface displacement along one of more of its segments and branches, while a “well-defined fault” is a fault whose trace is clearly detectable by a trained geologist as

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a physical feature at or just below the ground surface. The definition “inactive” generally implies that a fault has not been active since the beginning of the Pleistocene Epoch (older than 1.7 million years old). These sufficiently active and well defined faults are capable of producing seismic shaking at the site that could potentially be damaging to structures. It is anticipated that the study area will periodically experience ground acceleration as a result of moderate to large magnitude earthquakes.

The San Jacinto fault zone is the nearest major active fault to the site. Numerous other faults may also represent significant hazards. However, this fault is considered to have the greatest impact to the site due to anticipated high peak ground accelerations resulting from a maximum credible earthquake.

The most significant geologic hazard to this project is the potential for moderate to severe seismic shaking that is likely to occur during the design life of the proposed bridge structure. The recommended seismic design parameters are provided in a separate Geotechnical Design Report prepared by Kleinfelder.

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5.0 SUBSURFACE CONDITIONS

5.1 EARTH MATERIALS

Based on the results of our geotechnical investigation, the subsurface conditions anticipated at the project site consists of undocumented fill soil, alluvial sandy soil deposits, and granitic bedrock. Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the Boring Logs provided in Appendix A.

5.1.1 Undocumented Artificial Fill (Qaf)

Undocumented fill soils were encountered in borings KB-1, KB-2, BS-1, BS-2, HV-3, HV-4, HV-10, HV-11, HV-12, HV-16, BD-1, BD-2, BD-3, and BD-4 to depths ranging from approximately 1 to 7.5 meters below ground surface. The fill soils were likely placed as part of the development of the existing interchange and the railroad crossing. In general, the undocumented fill soils consist of silty sand (SM). Additional areas of undocumented fill soils may be encountered during earthwork operations that were not identified during this investigation.

5.1.2 Alluvium (Qal)

Alluvial soils were encountered below the fill soils in borings KB-1, KB-3, BS-1, BS-2, HV-3, HV-4, HV-10, HV-11, HV-12, HV-16, BD-1, BD-2, BD-3, and BD-4 and in the remaining borings excavated for the proposed project, except KB-2 where no alluvial soil was encountered. The alluvial soils extend to depths ranging from approximately 1 to 19.5 meters below existing grades. In general, the alluvial soil deposits encountered during our investigation consisted of silty sand (SM), poorly graded and well graded sand with silt (SP-SM and SW-SM), and clayey sand (SC). The alluvial soils encountered are generally medium dense to very dense.

5.1.3 Granitic Bedrock (Kt)

Tonalite granitic bedrock was encountered in 14 of our 27 borings excavated for the proposed Interchange Improvement. The bedrock was encountered at depths ranging from approximately 1.1 to 9.1 meters below existing grades and extended to the maximum depth explored of 25.3 meters below the existing grade. In general, the

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tonalite rock is moderately to highly weathered and decomposed near the contact with the alluvial soils and becomes less weathered with depth.

Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the Boring Logs provided in Appendix A.

5.2 WATER

5.2.1 Surface Water

Surface drainage flows primarily by surficial sheet flow over the existing contour of the land. Proposed roadway improvements should be designed to provide positive surface drainage to prevent ponding and/or saturation of the soils in the vicinity of foundations or pavements. The site is not located within a Federal Emergency Management Agency (FEMA) flood hazard zone based on the latest Flood Insurance Rate Maps (FIRM) for the region.

5.2.2 Groundwater

Groundwater was encountered in twelve of our twenty seven borings excavated for the proposed Interchange Improvement at depths ranging from approximately 3 to 20 meters below existing grades. These depths to groundwater correspond to groundwater elevations of approximately 447.31 to 439.52 meters, above Mean Sea Level (MSL).

Fluctuations of the groundwater level, localized zones of perched water, and soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas on or immediately adjacent to the site can also cause a fluctuation of local groundwater levels.

5.3 EXPANSIVE SOILS

Expansive soils generally contain clay particles that swell considerably when wetted and shrink when dried. Foundations constructed on these soils are subjected to uplifting forces caused by the swelling.

Based on our observation of soil samples obtained from the excavations, soil materials at the project site appear to have a “very low” expansion potential. Testing of the final

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subgrade soils after completion of backfilling should be conducted to evaluate their expansion potential and confirm or modify the recommendations presented herein.

5.4 COLLAPSIBLE SOILS

A collapsible soil is generally defined as a soil that will undergo a sudden decrease in volume after wetting when its internal support structure is lost. The internal support is considered to be a temporary strength and is derived from any number of sources, including capillary tension, cementing agents (e.g. iron oxide and calcium carbonate), clay-welding of grains, silt bonds, clay bonds and clay bridges. Collapse can occur even when there is no increase in vertical stress. Soils found to be most susceptible to collapse include loess deposits (fine-grained, wind-deposited soils), valley alluvium deposited within a semi-arid to arid climate, and residual soil deposits.

Based on the results of our field exploration and laboratory testing, the general collapse potential of encountered on-site soils deposits is considered to be “low”.

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6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CUTS AND EXCAVATION

Project grading plans were not available at the time this report was prepared. However, we anticipate that temporary excavations will be required during construction of drainage improvements and underground utilities. Bedrock may be anticipated within the required depths of excavation. Conventional earth-moving equipment is expected to be capable of performing the excavations required. Groundwater may be anticipated within the excavations at the site for bridge widening, bridge replacement, drainage improvements, underground utilities, or pavement subgrade. We anticipate that the on-site soils encountered during construction of the project, excluding cobbles and boulders, organics, debris, and/or other deleterious materials, may be suitable for reuse as engineered fill.

6.2 EMBANKMENTS AND FILL

Approach embankments constructed of compacted fill soils will be required for the proposed bridge widening and new ramps. In accordance with the latest edition (2006) of Caltrans Highway Design Manual, fill slopes should be 1:4 (V:H) or flatter. Slopes steeper than 1:4 (V:H) must be approved by the District Landscape Architect.

Engineered fill to be used in general embankment areas should be free of organic and other deleterious debris, well-graded with maximum dimension of 76.2 mm, essentially non-plastic (liquid limit less than 30, plasticity index less than 12), with less than 50 percent passing the No. 200 sieve, and an Expansion Index (EI) of less than 50. In general, well-graded mixtures of gravel, sand, and non-plastic silt and clay meeting the above requirements are acceptable for use as engineered fill in general embankment areas. It should be noted that as the percentage of fines (% passing No. 200 sieve) increases, the magnitude of in-fill settlement and the settlement duration (waiting period) will increase. Engineered fill placed as subgrade below pavements (within 1.2 meters of finished grade) should have an R-value of 25 or greater.

In general, structure backfill soils should conform to Section 19 of the Caltrans Standard Specifications.

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6.3 PAVEMENT DESIGN

The appropriate pavement design section depends primarily on the shear strength of the subgrade soil exposed after grading and anticipated traffic over the useful life of the pavement.

Kleinfelder performed R-value testing on representative near-surface soil samples from the borings excavated for this project. Test results for three near-surface samples from borings HV-9, HV-12 and HV-18 show native materials with R-values of 52, 36 and 16, respectively. We recommend an R-value of 25 for design of pavement sections.

The pavement sections for the proposed improvements were evaluated based upon the Traffic Index (TI) values provided to Kleinfelder by LAN Engineering. Changes in the traffic indices will affect the corresponding pavement section. Minimum recommended pavement sections were developed in general accordance with Chapter 600 of the July 2008 edition of the Caltrans Highway Design Manual (HDM).

Table 1 presents the minimum recommended flexible pavement sections for the proposed roadway improvements. Flexible pavement sections were evaluated using Caltrans software CalFP v1.1 (dated January 2008).

Table 1
Minimum Recommended Flexible Pavement Sections

Location	Traffic Index	Design R-value For Soil	Structural Section (mm)	
			Alternative 1	Alternative 2
SR-60 (Outside Lanes)	14.5	25	290 HMA 490 Class 2 AB 780 Total	230 HMA 230 Class 2 AB 430 Class 1 AS 890 Total
SR-60 (Shoulders)	9.0	25	155 HMA 335 Class 2 AB 490 Total	140 HMA 140 Class 2 AB 245 Class 1 AS 525 Total
I-215 (Inside Lanes)	13.5	25	260 HMA 475 Class 2 AB 735 Total	215 HMA 215 Class 2 AB 400 Class 1 AS 830 Total

Notes: HMA: Hot Mix Asphalt
Class 1 AS: Caltrans Class 1 Aggregate Subbase
Class 2 AB: Caltrans Class 2 Aggregate Base

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Table 1 (Continued)
Minimum Recommended Flexible Pavement Sections

Location	Traffic Index	Design R-value For Soil	Structural Section (mm)	
			Alternative 1	Alternative 2
I-215 (Shoulders)	9.5	25	170 HMA 355 Class 2 AB 525 Total	155 HMA 140 Class 2 AB 260 Class 1 AS 555 Total
Local/Frontage Roads (Lanes)	8.0	25	155 HMA 260 Class 2 AB 415 Total	125 HMA 125 Class 2 AB 215 Class 1 AS 465 Total
Local/Frontage Roads (Shoulders)	5.0	25	95 HMA 125 Class 2 AB 220 Total	65 HMA 110 Class 2 AB 110 Class 1 AS 285 Total
Ramps (Lanes)	10.0	25	200 HMA 320 Class 2 AB 520 Total	155 HMA 170 Class 2 AB 275 Class 1 AS 600 Total
Ramps (Shoulders)	6.5	25	95 HMA 245 Class 2 AB 340 Total	95 HMA 110 Class 2 AB 155 Class 1 AS 360 Total
Ramp Meter Pads	--	25	105 HMA ---- PRF (optional) 95 HMA 320 Class 2 AB 520 Total	80 HMA ---- PRF (optional) 75 HMA 170 Class 2 AB 275 Class 1 AS 600 Total
Temporary I-215 Northbound (Max. Duration = 2 months)	7.5	25	245 HMA (full depth) 245 Total	--
Temporary Detour A and Detour B (Max. Duration = 1 year)	6.0	25	155 HMA 105 AB 260 Total	--
Temporary SR-60 Westbound - Using Existing Shoulder (Max. Duration = 1 year)	8.0	25	155 HMA (new) 205 PMCTB (existing) 230 AS (existing) 590 Total	--

Notes: HMA: Hot Mix Asphalt
PRF: Pavement Reinforcing Fabric (optional)
Class 1 AS: Caltrans Class 1 Aggregate Subbase
Class 2 AB: Caltrans Class 2 Aggregate Base

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In accordance with Section 626.1 of the HDM, rigid pavement may be required at ramp termini. Rigid pavement will be required for any traveled way with TI value of greater than 15. The rigid pavement sections are based on the "Inland Valley" climate region for the I-215/SR-60 interchange study area as indicated by the Caltrans Pavement Climate Regions map dated October 5, 2005. The minimum recommended rigid pavement sections for the proposed roadway improvements are presented in Table 2.

Table 2
Minimum Recommended Rigid Pavement Sections

Location	Traffic Index	Design R-value For Soil	Lateral Support	Structural Section Alternatives (mm)	
Ramp Termini	10.0	25 (Subgrade Type II)	Yes	215 JPCP 110 LCB 155 AS 480 Total	215 JPCP 110 HMA-A 155 AS 480 Total
			No	245 JPCP 110 LCB 155 AS 510 Total	260 JPCP 110 HMA-A 155 AS 525 Total
I-215 (Outside Lanes)	15.5	25 (Subgrade Type II)	Yes	320 JPCP 155 LCB 215 AS 690 Total	320 JPCP 155 HMA-A 215 AS 690 Total
			No	370 JPCP 155 LCB 215 AS 740 Total	370 JPCP 155 HMA-A 215 AS 740 Total

Notes: JPCP: Jointed Plain Concrete Pavement
LCB: Lean Concrete Base
AS: Class 2 Aggregate Subbase
HMA-A: Hot Mix Asphalt (Type A)

6.3.1 Rehabilitation of Existing Pavements

During our site reconnaissance, we noticed some alligator cracks and patches at various locations along the existing pavements, but no significant pavement distress is evident along these pavements. Pavement rehabilitation is recommended for existing roadways that will remain in place.

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The Caltrans document "New Criteria for Selecting Overlay Thickness for Scoping of Pavement Rehabilitation Projects" dated April 2004, may be used for preliminary estimating purposes. A condensed version of this document is available for download from the following website:

http://www.dot.ca.gov/hq/esc/Translab/OPD/Flex_Pav_Rehab_Final_071101.pdf

A Deflection Study is recommended for the existing AC-paved roadways that will remain in place. The Deflection Study will help determine the recommended thickness of existing AC pavements to be cold-planed (if any), and the recommended thickness of any Hot Mix Asphalt (HMA) overlays.

For preliminary estimating purposes, a minimum of 137 mm (0.45- foot) of HMA overlay over the existing AC pavement may be assumed, per the Caltrans document "New Criteria for Selecting Overlay Thickness for Scoping of Pavement Rehabilitation Projects".. A minimum cold plane depth and thickness of 61 mm (0.20- foot) may also be assumed.

6.4 CORROSION ASSESSMENT

According to Section 5.5 of Caltrans *Corrosion Guidelines Version 1.1* (2003), a site is considered corrosive to foundation elements if one or more of the following conditions exist for the soil and/or water samples taken at the site:

- Chloride concentration is greater than or equal to 500 ppm,
- Sulfate concentration is greater than or equal to 2,000 ppm, and/or
- pH is 5.5 or less.

Five representative soil samples were tested to determine the corrosion potential of encountered near-surface soils. The tests included minimum electrical resistivity, pH, soluble sulfate content, and soluble chloride content using procedures described in California Test Methods 643, 532, 417, and 422, respectively.

Test results, presented in Table B-2 in Appendix B, indicate a minimum resistivity ranging from 1200 to 3200 Ohm-cm, pH value ranging from 7.1 to 8.1, sulfate content ranging from 5 and 20 ppm, and chloride content ranging from 126 to 323 ppm. Based on these results and Caltrans Corrosion Guidelines, the on-site soils are not considered corrosive to concrete and ferrous metals. As a minimum, the Caltrans standard Type II

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modified cement with a maximum water-cement ratio of 0.45 should be used for the proposed project in accordance with Section 90-1.01 of Caltrans Standard Specifications.

We used CULVERT4 program to estimate the service lives of CSP culverts for different samples tested for corrosion potential. If soils different than those tested are used for backfilling culverts, additional corrosivity testing should be considered. Table 3 presents a summary of corrosion characteristics of the soils in the project area and provides recommendations for pipe selection and alternative culvert materials.

Table 3
Summary of Corrosion Assessment

Soil Sample Location		Corrosivity Test Results				Reinforced Concrete Culverts		Estimated Minimum Gauges for 50-yr Service Life of Metal Culverts			
Boring No.	Sample Depth (m)	pH	Minimum Reistivity (Ohm-cm)	Chloride Content (ppm)	Sulfate Content (ppm)	Estimated Years to Corrosion	Minimum Cement Type	CSP	CSP with Bituminous Coating	CAP	CASP (Type 2)
KB-1	0-1.5	8.1	1900	131	11	>50	Type II	14	16	18	18
KB-2	3.0-3.5	7.7	2300	148	17	>50	Type II	14	16	18	18
BS-2	2-3	7.7	3000	131	8	>50	Type II	16	16	18	18
HV-2	0.9-2.4	7.4	1200	254	7	>50	Type II	12	14	18	18
HV-7	0.9-2.4	7.9	3200	126	5	>50	Type II	16	16	18	18
BD-1	0-1.5	7.2	1500	318	20	>50	Type II	12	12	18	18
BD-1	8.2-8.8	7.2	1600	323	16	>50	Type II	12	12	18	18
BD-4	0-1.5	7.1	2000	186	14	>50	Type II	12	12	18	18

6.5 MATERIAL SOURCES

Based on our current understanding of the project, we anticipate it will be necessary to import borrow material for the fill embankments. Other construction materials such as aggregates, asphalt, Portland cement, and fly ash should also be imported from local commercial sources. No potential import fill material sources have been pre-tested for this project. Prior to import, testing of potential material sources should be performed and approved by the Geotechnical Engineer and the District Materials Engineer.

Suppliers for the construction materials can be found on the internet at:

http://www.thebluebook.com.

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A current listing of mining operations eligible to sell materials to the State of California can also be found on the internet at:

http://www.consrv.ca.gov/omr/index.htm.

6.6 MATERIAL DISPOSAL

Surface debris, topsoil, vegetation, etc. will be present at existing grade. These materials are unsuitable for use in construction and should be properly disposed of at an approved location, or stockpiled and reused for landscaping purposes as suitable along the project. Disposal of spoils from excavated soils is expected during construction. It is the responsibility of the contractor to make arrangements to dispose such materials and follow guidelines provided in Section 7-1.13 of the Caltrans Standard Specifications.

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7.0 LIMITATIONS

The conclusions and recommendations presented in this report are for the design of the proposed improvements at the east junction of I-215 and SR-60 in the Cities of Riverside and Moreno Valley, Riverside County, California, as described in the text of this report. The findings, conclusions and recommendations were prepared in accordance with generally accepted geotechnical engineering practice. No warranty, expressed or implied, is made. This report was based on the proposed project information provided to Kleinfelder. If any change (i.e., structure type, location, etc.) is implemented which materially alters the project, additional geotechnical services may be required, which could include revisions to the geotechnical recommendations presented herein.

Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

This report may be used only by the project designers and Caltrans and only for the purposes stated, within a reasonable time from its issuance, but in no event later than one year from the date of the report. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party, and client agrees to defend, indemnify, and hold harmless Kleinfelder from any claim or liability associated with such unauthorized use or non-compliance.

The scope of our geotechnical services did not include any environmental site assessment for the presence or absence of hazardous/toxic materials. Kleinfelder will assume no responsibility or liability whatsoever for any claim, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials.

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8.0 REFERENCES

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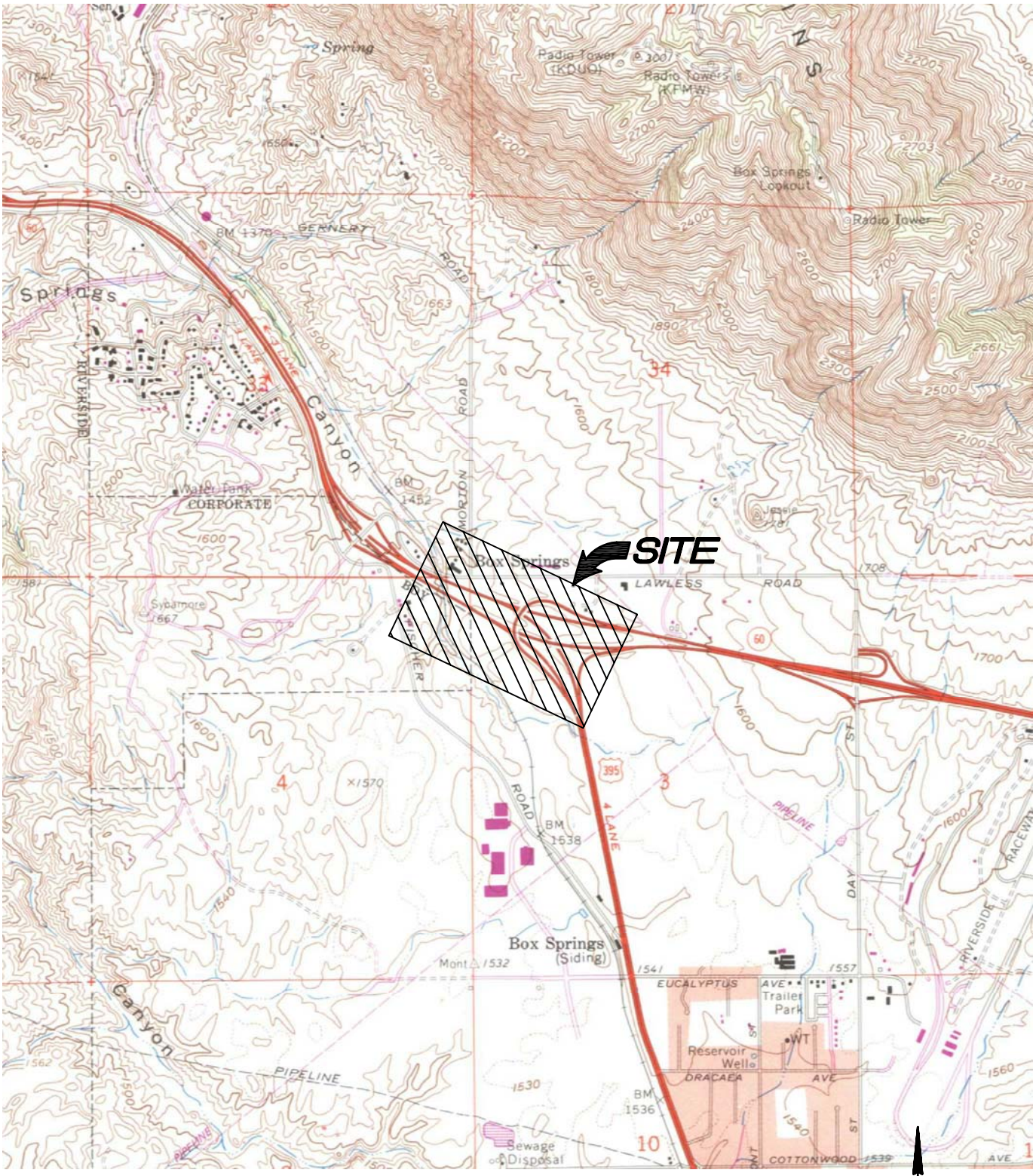
PLATES



SOURCE: U.S.G.S. 7.5' topographic series, Riverside East, California quadrangle dated 1967, photorevised 1980.

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FILE NAME: 76979p1.dwg	

SITE LOCATION MAP

I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE, CALIFORNIA

PLATE 1

PLOTTED: 24 Oct 2008, 4:25pm, MGriffin
LAYOUT: 1
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Images: 76979p1.jpg
ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

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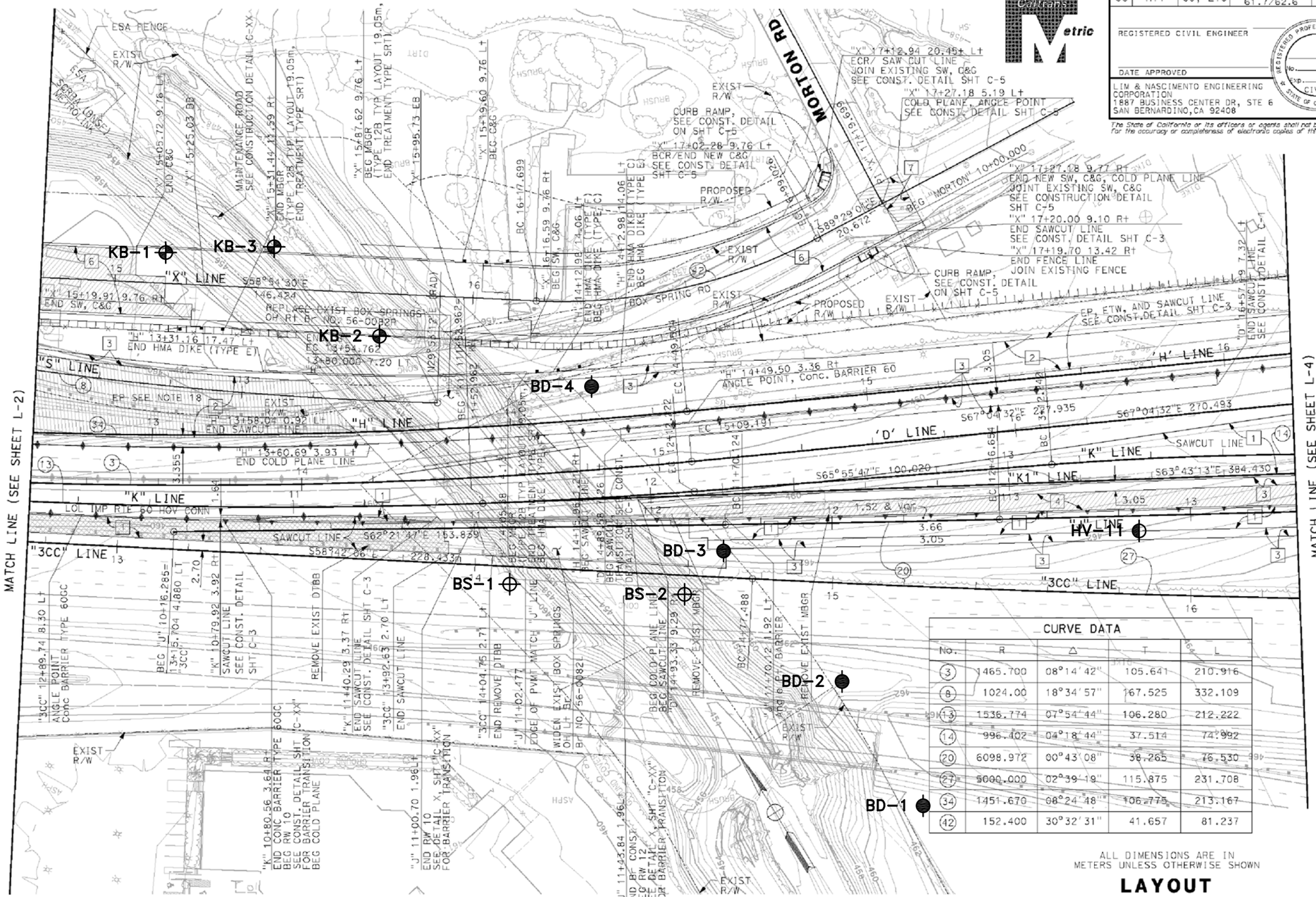

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34	1451.670	08°24'48"	106.775	213.167
42	152.400	30°32'31"	41.657	81.237

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

LAYOUT

SCALE: 1:500

L-3

EXPLANATION

KB-3	APPROXIMATE KLEINFELDER BORING LOCATION, SEPTEMBER 2008.
HV-11	APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.
BS-2	APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.
BD-4	APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

REFERENCE:

BASE MAP PROVIDED BY LAN ENIGINEERING, DATED 8/20/2008.

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FILE NAME:	76979p2a.dwg

EXPLORATION LOCATION MAP

I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE, CALIFORNIA

PLATE **2a**

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ATTACHED XREFS:
DIAMOND BAR, CA

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23	900.000	28°08'59"	225.645	442.176
27	5000.000	02°39'19"	115.875	231.708
28	910.000	29°50'16"	242.454	473.999
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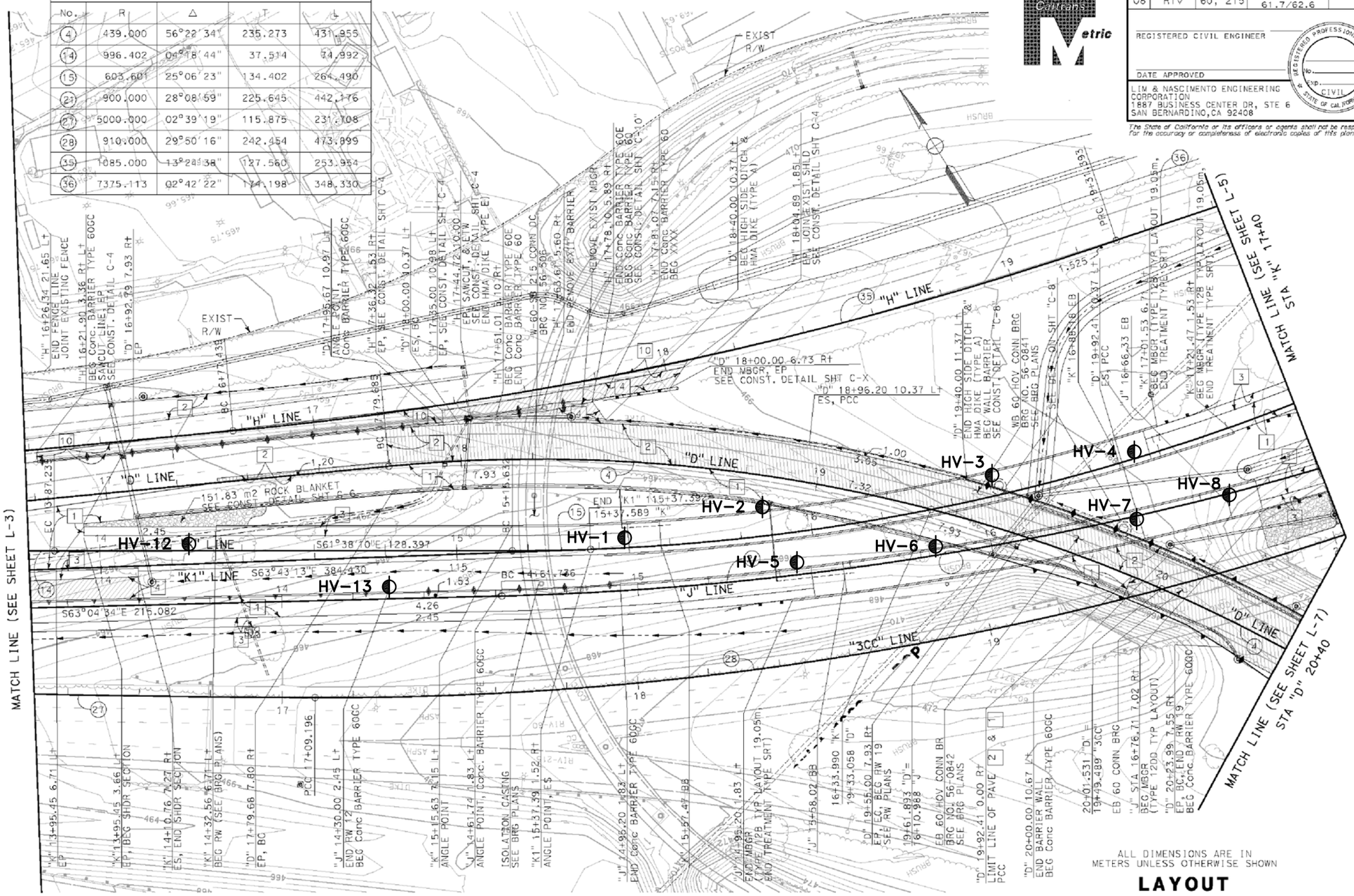

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EXPLANATION

HV-13 APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

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EXPLORATION LOCATION MAP

I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE, CALIFORNIA

PLATE **2b**

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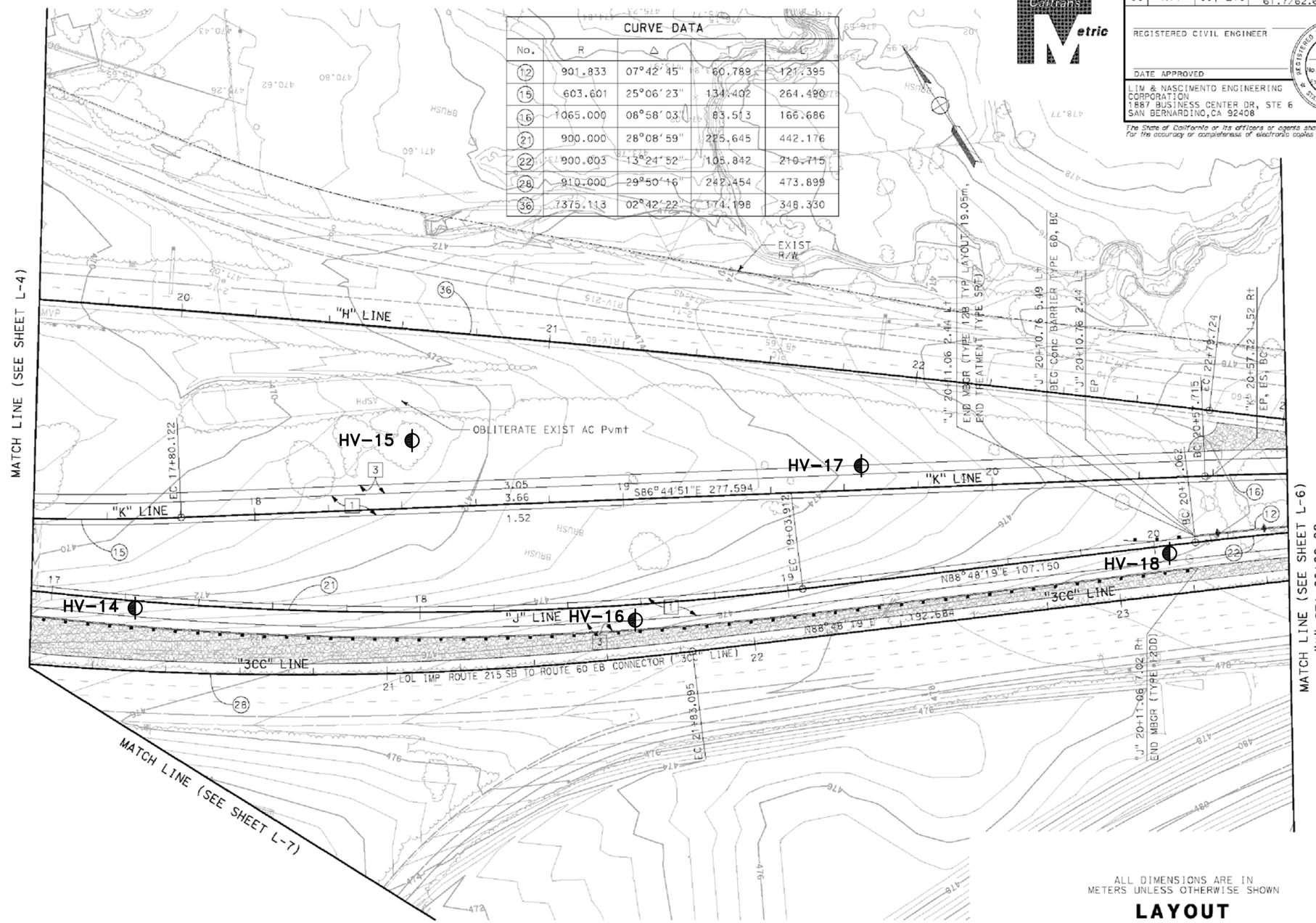
22	900.003	13°24'52"	105.842	210.715
28	910.000	29°50'16"	242.454	473.899
36	7375.113	02°42'22"	174.198	348.330



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LAYOUT

SCALE: 1:500

L-5

EXPLANATION

HV-18 APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

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EXPLORATION LOCATION MAP

I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE, CALIFORNIA

PLATE **2c**

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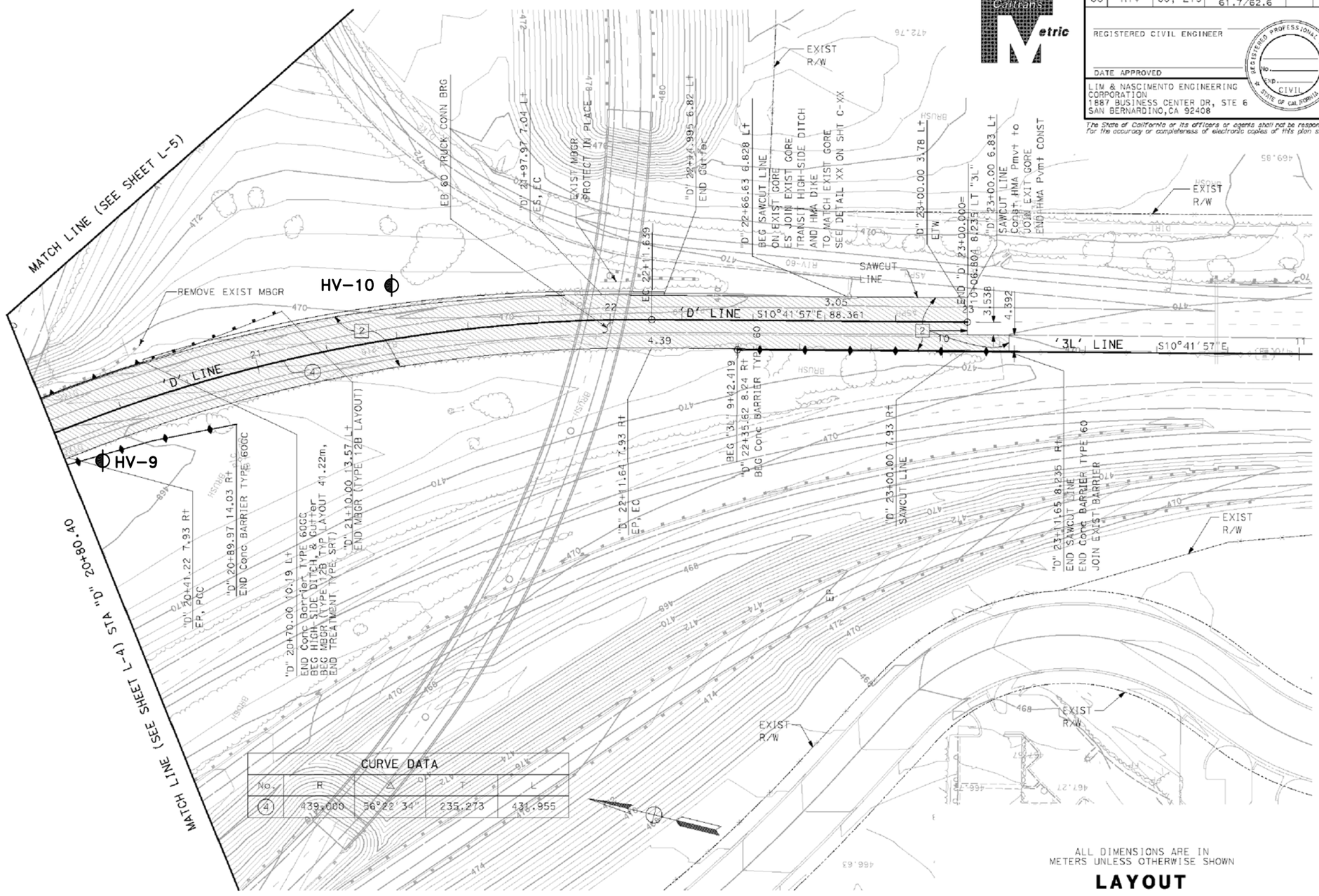

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LAYOUT

SCALE: 1:500

L-7

EXPLANATION

HV-10 APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

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EXPLORATION LOCATION MAP

I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE, CALIFORNIA

PLATE **2d**

APPENDIX A

FIELD EXPLORATION

APPENDIX A
FIELD EXPLORATION

The subsurface exploration program for the proposed improvements at the east junction of I-215 and SR-60 consisted of drilling and logging a total of 27 exploratory borings in the project area. The borings were drilled for the proposed Frontage Road Overhead bridge replacement (borings KA-1 through KA-3), Box Springs Overhead bridge widening (borings BS-1 and BS-2), Eastbound and Westbound SR-60 HOV Connectors (borings HV-1 through HV-18), and Jacked Drainage Pipe (borings BD-1 through BD-4) between March 5, 2007 and October 21, 2008. These borings were advanced to depths ranging from approximately 15.7 to 25.3 meters below the existing ground surface (bgs). The borings were advanced using a Mobile B-61, truck-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer delivery system for borings drilled for proposed Frontage Road Overhead replacement bridge, Box Springs Overhead bridge widening, and Eastbound and Westbound SR60 HOV Connectors. A CME/Mobile L-10T hybrid track drill rig was used for the drilling of borings proposed for Jacked Drainage Pipe. The borings were logged and sampled using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Following drilling, sampling and logging, the borings were backfilled with native cuttings.

The *Field Exploration Summary* is presented in Table A-1 below, and the boring logs are presented on Plates A-2a through A-27b at the end of this appendix. The logs describe the earth materials encountered during drilling, and indicate the locations of the samples obtained. The excavations were logged by a staff professional from Kleinfelder using methods outlined in the Unified Soil Classification System (USCS) and general procedures established in ASTM D2488. The boundaries between soil and rock type(s) shown on the logs are approximate because the transition between different soil and rock layer(s) may be gradual.

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Table A-1
Summary of Field Exploration

Boring Number	Boring Depth (m)	Groundwater Depth (m)	Approximate Station No. and Offset (m)	Ground Surface Elevation (m)	Associated Structure
KB-1	21.0	20	Sta. 15+22.71 (1.25 LT from "X" Line)	459.52	Frontage Road Overhead
KB-2	15.7	3	Sta. 15+44.25 (11.25 LT from "X" Line)	450.31	Frontage Road Overhead
KB-3	14.6	4	Sta. 15+77.25 (11.5 RT from "X" Line)	450.52	Frontage Road Overhead
BS-1	15.1	Not Encountered	Sta. 14+61.83 (7.92 LT from "3CC" Line)	461.48	Box Springs Left Overhead
BS-2	11.3	Not Encountered	Sta. 14+11.81 (7.92 LT from "3CC" Line)	452.75	Box Springs Left Overhead
HV-1	15.7	8.8	Sta. 15+92.02 (3.84 LT from "K" Line)	464.70	WB SR-60 HOV Connector
HV-2	25.0	10	Sta. 15+50.15 (8.09 LT from "K" Line)	464.82	WB SR-60 HOV Connector
HV-3	17.1	11	Sta. 16+56.35 (6.84 LT from "K" Line)	466.87	WB SR-60 HOV Connector
HV-4	15.7	11.6	Sta. 16+94.75 (3.66 LT from "K" Line)	468.15	WB SR-60 HOV Connector
HV-5	15.7	10.7	Sta. 115+53.84 (3.85 LT from "J" Line)	466.17	EB SR-60 HOV Connector
HV-6	25.3	10.4	Sta. 115+85.37 (3.99 LT from "J" Line)	465.91	EB SR-60 HOV Connector
HV-7	21.3	10.7	Sta. 116+41.09 (0.68 LT from "J" Line)	467.86	EB SR-60 HOV Connector
HV-8	15.7	12.5	Sta. 116+71.89 (0.33 LT from "J" Line)	469.78	EB SR-60 HOV Connector
HV-9	5.0	Not Encountered	Sta. 20+49.62 (11.60 RT from "D" Line)	466.83	WB SR-60 HOV Connector
HV-10	5.0	Not Encountered	Sta. 21+34.41 (17.60 LT from "D" Line)	470.00	WB SR-60 HOV Connector
HV-11	6.6	Not Encountered	Sta. 112+78.84 (4.23 LT from "J" Line)	462.96	EB SR-60 HOV Connector
HV-12	6.6	Not Encountered	Sta. 14+25.00 (2.12 LT from "K" Line)	463.89	WB SR-60 HOV Connector
HV-13	6.6	Not Encountered	Sta. 114+28.45 (3.84 LT from "J" Line)	465.54	EB SR-60 HOV Connector

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Table A-1 (Continued)
Summary of Field Exploration

Boring Number	Boring Depth (m)	Groundwater Depth (m)	Approximate Station No. and Offset (m)	Ground Surface Elevation (m)	Associated Structure
HV-14	7.8	Not Encountered	Sta. 117+23.08 (3.08 LT from "J" Line)	472.41	EB SR-60 HOV Connector
HV-15	6.6	Not Encountered	Sta. 18+42.31 (21.15 LT from "K" Line)	470.82	WB SR-60 HOV Connector
HV-16	9.6	Not Encountered	Sta. 118+57.69 (3.85 LT from "J" Line)	477.74	EB SR-60 HOV Connector
HV-17	5.0	Not Encountered	Sta. 19+65.38 (3.85 LT from "K" Line)	--	WB SR-60 HOV Connector
HV-18	5.0	Not Encountered	Sta. 120+3.85 (2.31 LT from "J" Line)	476.98	EB SR-60 HOV Connector
BD-1	15.7	Not Encountered	Sta. 15+28.5 (61.9 RT from "3CC" Line)	462.6	Jacked Drainage Pipe
BD-2	15.7	Not Encountered	Sta 15+2.1 (25.8 RT from "3CC" Line)	461.5	Jacked Drainage Pipe
BD-3	14.6	Not Encountered	Sta 14+66.5 (8.2 LT from "3CC" Line)	461.3	Jacked Drainage Pipe
BD-4	15.7	11.9	Sta 16+24.7 (25.8 RT from "X" Line)	459.7	Jacked Drainage Pipe

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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	ID	DESCRIPTION	MAJOR DIVISION		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Well-graded gravels, gravel-sand mixtures	FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands
		GP		Poorly-graded gravels, gravel-sand mixtures			CL		Inorganic clays of low to medium plasticity; gravelly clays silty clays,sandy clays, lean clays
		GM		Silty gravels, gravel-sand-silt mixtures			OL		Organic silts and organic silt-clays of low plasticity
		GC		Clayey gravels, gravel-sand-clay mixtures					
	SAND AND SANDY SOILS	SW		Well-graded sands, gravelly sands		SILTS AND CLAYS LL > 50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		SP		Poorly-graded sands and gravelly sands			CH		Inorganic clays of medium to high plasticity
		SM		Silty sands, sand-silt mixture			OH		Organic clays of medium to high plasticity
		SC		Clayey sands, sand-clay mixture		HIGHLY ORGANIC SOILS	Pt		Peat, muck and other highly organic soils

▼ Approximate water level observed in boring following drilling

SOIL SAMPLE

- Bulk Sample
- Drive Sample - California Sample
- Shelby Tube Sample
- Standard Penetration Test (SPT) Sample

ADDITIONAL TESTS

CN	- Consolidation
COR	- Corrosion
CP	- Collapse Potential
DS	- Direct Shear
EI	- Expansion Potential
MAX	- Maximum Dry Density
OC	- Organic Content
PI	- Plasticity Index
RV	- R-Value
SE	- Sand Equivalent
GS	- Grain Size Distribution

NOTES:

Blow counts represent the number of blows of a 64-kilogram hammer falling 760 mm required to drive a sampler through the last 300 mm of a 460 mm penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

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LEGEND TO LOGS

PLATE A-1

Date Drilled	9/15/08	Water Depth:	20 meters
Drilled By:	Cal Pac Drilling	Date Measured:	9/15/08
Drilling Method:	200mm Hollow-stem auger	Elevation:	1507.6 feet (approx.)
Logged By:	L. Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Brown, moist, fine to coarse grained sand, with trace fine gravel to 6.4 mm, with some clay			GS, DS, COR, MAX
459		2	32				--olive, medium dense, fine to coarse grained sand with trace fine gravel to 12.7 mm, with trace calcium carbonate, with clay	19.6	7.0	
	1									
458		3	7				--dark brown, loose, fine to medium grained sand, with trace clay, with trace fine gravel to 6.4 mm			
	2									
457										
	3	4	30				--brown, medium dense, medium grained sand, weakly cemented, with trace calcium carbonate, with trace fine gravel to 12.7 mm			CP
456										
	4					SM	**Alluvium (Qal): Silty Sand:** Gray-brown, moist, very dense, fine to coarse grained sand, with trace fine gravel to 12.7 mm			
455		5	26 50/130				--very dense, with trace fine gravel to 12.7 mm, fractured coarse gravel to 19.1 mm in sampler			GS
	5									
454										
	6	6	52/170				--medium grained sand --interbedded a thin layer of Poorly-graded Sand, medium to coarse grained sand			
453										
	7						--red-brown			
452		7	22 50/130				--fine to medium grained sand, weakly cemented, with trace calcium carbonate			
	8									
451										
	9	8	10 50/130				**Bedrock (Kt):** Tonalite, mottled black, white, and olive-brown, moist, hard, moderately weathered,	18.2	6.2	
450										

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-1

PLATE
A-2a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						recovered as fine to coarse grained sand, with trace mica			
449	9	26 50/100							
11									
448									
12	10	50/80				--less weathered	18.3	2.8	
447									
13									
446	11	50/100				--increase in moisture content			
14									
445									
15	12	50/130					19.0	5.1	
444									
16									
443	13	50/100							
17									
442									
18	14	50/80				--moist to wet			
441									
19									
440	15	50/100			▼	--wet, moderately weathered			
20									
439									
21		50/130							

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-1

PLATE A-2b

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
438	16					Boring terminated at 21.5 meters. Groundwater was encountered at 20.0 meters. Hole backfilled using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-1

PLATE

A-2c

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Date Drilled	9/15/08	Water Depth:	3 meters
Drilled By:	Cal Pac Drilling	Date Measured:	9/15/08
Drilling Method:	200mm Hollow-stem auger	Elevation:	1478.1 feet (approx.)
Logged By:	L. Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Dark brown, moist, fine to medium grained sand			
450		2	9				--loose, fine grained sand			
	1									
449		3	1				--very dark gray-brown, moist to wet, very loose, fine to medium grained sand			
	2									
448										
	3	4	4			▼	--wet, fine to medium grained sand, with trace mica	16.8	20.0	COR
447										
	4									
446		5	58				**Bedrock (Kt):** Tonalite, mottled olive, white, and brown, wet, hard, slightly weathered, recovered as fine to coarse grained sand, with trace mica			GS
	5									
445										
	6	6	25 50/80				--moderately weathered	17.6	15.8	
444										
	7									
443		7	16 50/80				--moderately weathered, with trace calcium carbonate, with some fine sand, with trace silt			
	8									
442										
	9	8	50/100				--increase in silt content, with trace calcium carbonate			
441										

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-2

PLATE
A-3a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
440	9	50/130							
11									
439									
12	10	50/130				--mottled white, black, and gray, moderately weathered, with some silt			
438									
13									
437	11	50/130							
14									
436									
15	12	50/100							

Boring terminated at 15.1 meters.
Groundwater was encountered at 3.0 meters.
Hole backfilled using soil from cuttings.

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-2

PLATE
A-3b

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Date Drilled	9/15/08	Water Depth:	4 meters
Drilled By:	Cal Pac Drilling	Date Measured:	9/15/08
Drilling Method:	200mm Hollow-stem auger	Elevation:	1477.4 feet (approx.)
Logged By:	L. Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1					A layer of 101.6 mm riprap consists of rocks to 38.1 mm			
450		2	36				**Alluvium (Qal): Silty Sand:** Olive, moist, fine grained sand, with trace mica			
	1						--medium dense, with trace clay			
449		3	33 50/130				**Bedrock (Kt):** Tonalite, mottled black, white, and olive-brown, moist, hard, moderately weathered, recovered as fine to coarse grained sand, with trace mica, with trace clay	21.0	4.5	DS, CP
	2						--very dense			
448										
	3	4	12 50/130				--increase in quartz content, with trace calcium carbonate, with trace mica			
447										
	4					▼				
446		5	50/150				--wet, with trace mica	17.4	21.7	
	5									
445										
	6	6	50/130				--with trace silt			
444										
	7									
443		7	50/100				--moderately weathered			
	8									
442										
	9	8	50/100							
441										

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-3

PLATE A-4a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
440									
	9	50/80							
11									
439									
12						--increase in silt content			
438	10	50/100				--mottled white, black, and, dark gray, with trace mica			
13									
437									
	11	50/100							
14									
436									
15									
435	12	50/100							
						Boring terminated at 15.4 meters. Groundwater was encountered at 4.0 meters. Hole backfilled using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING KB-3

PLATE

A-4b

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC-FOR I-215_SR60 MATERIAL REPORT.GPJ KA_RDLND.GDT 10/24/08

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1514.052 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
461		1 2	40			SM	**Undocumented Fill** **Silty Sand:** brown, dry, medium dense, fine to medium grained sand			
460	1	3	35				--olive-brown, iron staining	18.7	9.0	
459	2	4	31				--slightly moist, medium dense, fine to coarse grained sand	20.4	7.2	DS
458	3	5	15				--brown, some clay			GS
457	4	6	22					18.5	7.9	CN
456	5									
455	6	7	22							
454	7						--drilling effort increases			
453	8	8	98			SM	**Alluvium** **Silty Sand:** light brown, dry, very dense, fine to medium grained	19.6	6.3	
452	9	9	30, 50/15							

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING BS-1

PLATE A-5a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
451									
11	10	50/150				--orange-brown			
450						--auger bit chatter			
12									
449	11	50							
13									
448									
14	12	6, 50/15				--brown to dark gray			
447									
15		50/25				**Bedrock:** Sampler refusal and practical drill refusal on bedrock			

Boring terminated at 15.1 meters due to practical refusal.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING BS-1

PLATE

A-5b

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1485.413 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
							Undocumented Fill			
452	1	1	6			SM	**Silty Sand:** brown, slightly moist, loose, fine to medium grained sand			
							--dark brown			
451	2	2	5				--moist	15.4	9.6	
		3								GS, COR
		4	16				--medium dense, trace clay	18.8	9.9	CN
450	3	5	53			SM	**Alluvium** **Silty Sand:** olive, moist, dense, fine to medium grained sand	18.8	13.5	
449	4						--some clay			
448	5	6	78				--orange-brown, very dense, fine to coarse grained sand, coarse gravel in upper 0.3 meters of sample			
							--trace to some clay			
447	6	7	22, 50/10							
446	7									
							--auger bit chatter			
445	8	8	50/100				**Bedrock**: Tonalite, brown, moderately weathered, recovered as fine to coarse grained sand	16.9	7.5	
444	9	9	50/130				--brown, moderately to highly weathered, recovered as fine to medium grained sand			
443										

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING BS-2

PLATE

A-6a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
442 11	10	26, 50/5				--light brown, less weathered			
						Practical drill refusal on bedrock at approximately 11.3 meters			
						Boring terminated at 11.3 meters due to practical refusal. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
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LOG OF BORING BS-2

PLATE

A-6b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/5/07	Water Depth:	9 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/5/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1524.610 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
464		1	36, 50/130			SM	**Alluvium** **Silty Sand:** light brown, dry, fine grained sand			
	1	2								
463		3	32, 50/130				--fine to medium grained sand	19.6	5.6	
	2									
		4	42				--olive-brown, dense			GS
462										
	3	5	68				--very dense	20.8	6.1	DS
461										
	4									
460		6	37				--dense, trace iron staining			
	5									
459										
	6	7	62				--very dense	18.5	3.7	
458										
	7									
457		8	40				--dense, fine to medium grained sand			
	8									
456							--groundwater encountered at 8.3 meters after drilling			
	9	9	62				--very dense, trace clay			
455										

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 1

PLATE

A-7a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
454 11	10	59							
453 12	11	48				--dense			
452 13									
451 14	12	48							
450 15	13	72				--very dense			

Boring terminated at 15.7 meters.
Groundwater encountered at 8.8 meters after drilling.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 1

PLATE

A-7b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/5/07	Water Depth:	10 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/5/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1524.987 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
464	1	1 34, 50/150				SM	**Alluvium** **Silty Sand:** light brown, dry, very dense, fine to medium grained sand			
		2								COR
463	2	3 33, 50/100					--fine to coarse grained sand, caliche			
		4	50/130				--fine grained sand		10.2	
462	3	5	28				--medium dense			
461	4									
460	5	6	74				--red-brown, very dense	20.0	7.7	
459	6	7	51			SP-SM	**Sand with Silt:** brown, dry, very dense, fine to coarse grained sand			
458	7									
457	8	8	66			SM	**Silty Sand:** light brown, dry, fine to medium grained sand, trace clay			
456	9	9	67				--slightly moist			
455										

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 2

PLATE A-8a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--groundwater encountered at 10 meters after drilling			
454 11	10	70				--trace clay	18.8	13.0	
453 12	11	28, 50/13							
452 13						--some clay			
451 14	12	34				--moist, dense			
450 15	13	72			SC	**Clayey Sand:** red-brown, slightly moist, very dense, fine to medium grained sand	19.5	12.8	
449 16									
448 17	14	43				--dense			
447 18	15	46, 50/7				--very dense			
446 19									
445 20	16	46, 50/7				**Bedrock:** Tonalite, moderately weathered			
444 21									

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 2

PLATE

A-8b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
		17	50							
443	22									
442	23	18	50/75							
441	24									
		19	50/50							
440							Practical drill refusal at 25 meters			

Boring terminated at 25 meters due to practical refusal, lead auger sheared in half at 25 meters due to tight drilling in bedrock.
Groundwater encountered at 10 meters after drilling.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 2

PLATE
A-8c

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	11 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1531.719 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1					**Fill**			
466	1	2	39			SM	**Silty Sand:** dark brown, dense, fine to coarse grained sand, with fine gravel and asphalt grindings			
465	2	3	29				--medium dense, asphalt grindings	15.3	6.6	
		4	13				--fine grained sand, trace medium sand, iron staining, gravel content decreasing			
464	3	5	4			SM	**Alluvium** **Silty Sand:** brown, slightly moist, loose			GS
463	4									
462	5	6	77			SM	**Silty Sand:** red-brown, slightly moist, very dense, fine to medium grained sand, trace clay	20.7	7.0	
461	6	7	33				--dense, fine grained sand			
460	7									
459	8	8	64			SC	**Clayey Sand:** brown, moist, very dense, fine grained sand			
458	9	9	33, 50/13				--very dense			
457										

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 3

PLATE

A-9a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
456 / 11	10	3, 50/13				--groundwater encountered at 11 meters			
455 / 12	11	50/75				**Bedrock:** Tonalite, gray-brown, wet, moderately weathered --drilling effort increases			
454 / 13									
453 / 14	12	50/75				--gray			
452 / 15						--very difficult drilling			
	13	50/75				--less weathered, moist, gray-brown, fine to medium grained	20.0	3.0	DS
451 / 16									
450 / 17	14	50/50				--wet Practical drill refusal at 17.1 meters			

Boring terminated at 17.1 meters due to practical refusal.
Groundwater encountered at 11 meters.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 3

PLATE
A-9b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	12 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1535.925 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
468		1					**Fill**			
		2	14			SM	**Silty Sand:** red-brown, dry, medium dense, fine to medium grained sand, trace coarse sand			
467	1									
		3	32			SM	**Alluvium** **Silty Sand:** brown, slightly moist, medium dense, fine to coarse grained sand	20.3	5.8	
466	2									
		4	14				--roots			
465	3	5	58				--brown, slightly moist, very dense, fine grained sand			
464	4									
		6	48				--orange-brown, dry, dense			
463	5									
462	6	7	36, 50/13							
461	7									
		8	37				--dense			
460	8									
459	9	9	30, 50/13			SC	**Clayey Sand:** red-brown, moist, very dense	20.3	10.2	

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 4

PLATE
A-10a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
458									
11 / 457	10	34, 50/5				**Bedrock:** Tonalite, tan-brown, dry, moderately weathered, recovered as fine to medium grained sand			
					▼	--groundwater encountered at approximately 11.6 meters			
12 / 456	11	50/150							
13 / 455									
14 / 454	12	50/130							
15 / 453	13	50/130							
						Boring terminated at 15.7 meters. Groundwater encountered at 11.6 meters. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 4

PLATE

A-10b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/5/07	Water Depth:	11 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/5/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1529.439 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
466		1					**Alluvium**			
		2	88			SM	**Silty Sand:** light brown, dry, very dense, fine grained sand			
465	1									
		3	23, 50/120				--fine to medium grained sand	19.2	2.5	
464	2									
		4	48				--dense, trace clay			
463	3	5	83				--very dense			
462	4									
		6	54				--dense			
461	5									
460	6	7	49, 50/75				--very dense	20.7	6.4	
459	7									
		8	40				--dense			
458	8									
457	9	9	41, 50/100				--very dense	20.0	9.4	DS

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 5

PLATE A-11a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
456						--drilling effort increases			
	10	43				--slightly moist, dense, trace clay, groundwater encountered at 10.7 meters			
11 455									
12 454	11	56				--very dense			
13 453									
	12	47				--dense			
14 452									
15 451									
	13	47, 50/10				--very dense			
						Boring terminated at 15.7 meters. Groundwater encountered at 10.7 meters. Some caving observed in borehole after removal of augers. Hole backfilled and tamped using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 5

PLATE

A-11b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/6/07	Water Depth:	10 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/6/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1528.576 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1	27			SM	**Alluvium** **Silty Sand:** brown, dry, medium dense, fine grained sand			
465	1	2								
		3	22							
464	2									
		4	23			SW-SM	**Sand with Silt:** light brown, dry, medium dense, fine to coarse grained sand	17.2	1.2	DS
463	3	5	6				--loose			
462	4									
		6	43			SM	**Silty Sand:** brown, dry, dense, fine grained sand			
461	5									
460	6	7	29				--medium dense, trace clay			
459	7									
458	8	8	33, 50/13				--very dense, fine to medium grained, sand			
457	9	9	27, 50/13				--slightly moist			
456										

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 6

PLATE

A-12a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
							--groundwater encountered at 10.4 meters			
455	11	10	35, 50/13				--moist			
454	12	11	28, 50/10				--wet			
453	13									
452	14	12	41				--dense			
451	15	13	20, 50/13				--very dense, trace clay			
450	16									
449	17	14	44, 50/13				**Bedrock:** Tonalite, moderately weathered			
448	18	15	50/100				--less weathered			
447	19									
446	20	16	50/130							
445	21									

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 6

PLATE

A-12b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
	17	50/130					18.4	20.8	
444 22									
443 23	18	50/100							
442 24									
	19	50/50							
441 25									
						Practical drill refusal on on bedrock at approximately 25.3 meters			

Boring terminated at 25.3 meters due to practical refusal.
Groundwater encountered at 10.4 meters.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 6

PLATE

A-12c

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/6/07	Water Depth:	11 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/6/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1534.980 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium** **Silty Sand:** light brown, dry, dense, fine to medium grained sand			
467	1	1 2	45							COR
466	2	3 2	4, 50/130				--very dense, light brown to olive-brown, mottled, trace clay	19.7	7.8	
		4 4	0, 50/130				--iron staining			
465	3	5	64							
464	4									
463	5	6	84				--brown, dry, fine to medium grained sand, trace clay	20.1	7.4	
462	6	7	37				--dense			
461	7									
460	8	8 3	5, 50/130				--very dense			
459	9	9	70							
458	10									

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 7

PLATE

A-13a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters)	Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
457	11	10	50/130				--groundwater at 10.7 meters			
456	12	11	64							
455	13									
454	14	12	50/130				**Bedrock:** Tonalite, moderately weathered, fine to medium grained			
453	15	13	50/130				--less weathered, fine to coarse grained	17.4	6.1	
452	16									
451	17	14	50/100							
450	18									
		15	50/100							
449	19									
448	20	16	50/100							
447	21	17	50/25				--difficult drilling Practical drill refusal at approximately 21.3 meters			

Boring terminated at 21.3 meters due to practical refusal.
Groundwater encountered at 10.7 meters.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 7

PLATE
A-13b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	12 meters
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1541.266 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
469	1	2	12			SM	**Alluvium** **Silty Sand:** red-brown, dry, medium dense, fine grained sand			
		1								
468	2	3	40, 50/130				--very dense, mottled, iron staining	19.6	9.3	
		4	69				--iron staining, caliche veins, trace clay			
467	3	5	88				--orange-brown, dry, fine to medium grained sand	19.4	6.9	
466	4									
465	5	6	31				--dense			
464	6	7	46					20.3	8.1	DS
463	7									
462	8	8	17, 50/10				--very dense			
461	9	9	50/100				**Bedrock:** Tonalite, gray-brown, slightly moist, moderately weathered, recovered as fine to medium grained sand			
460										

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 8

PLATE A-14a

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--drilling effort increases			
459 11	10	50/100				--gray-brown, slightly moist, recovered as fine to medium grained sand			
						--drilling effort increases			
458 12									
	11	50/100			▼	--groundwater encountered at 12.5 meters			
457 13									
456 14	12	5, 50/10				--less weathered			
455 15									
	13	50/100				--gray-brown, slightly moist, fine to medium grained			
						Boring terminated at 15.7 meters. Groundwater encountered at 12.5 meters. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 8

PLATE

A-14b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1534.583 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1								
467	1	2	50/130			SM	**Alluvium** **Silty Sand:** light brown, slightly moist, very dense, fine to medium grained	19.9	6.6	
466	2	3	76				--slightly moist	19.6	9.4	
465	3	4	42				--dry, dense			GS
		5	40, 50/13				--light brown, very dense, fine to medium grained sand			
464	4									
463	5	6	48				--dense, trace clay			

Boring terminated at 5.0 meters.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV- 9

PLATE
A-15

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1542.008 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1								
469	1	2	28			SM	**Fill** **Silty Sand:** brown, slightly moist, medium dense, fine to medium grained sand, trace clay	19.1	5.7	
468	2	3	35			SM	**Alluvium** **Silty Sand:** red-brown, slightly moist, medium dense	19.1	7.2	
		4	8, 50/15			CL	**Sandy Clay:** mottled brown, moist, hard, fine grained sand			
467	3	5	28			SM	**Silty Sand:** brown, dry to slightly moist, medium dense, fine to medium grained sand			
466	4	6	24, 50/10			SC	**Clayey Sand:** mottled-brown, slightly moist, very dense, fine grained sand			
465	5						Boring terminated at 5.0 meters. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-10

PLATE
A-16

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1518.901 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1 2	73			SM	**Fill** **Silty Sand:** light brown, dry, very dense, fine to medium grained sand	20.3	6.5	
462	1									
		3	58			SM	**Alluvium** **Silty Sand:** light brown, dry, very dense, iron staining, trace clay and caliche			
461	2									
460	3	4	38			CL-ML	**Sandy Silty Clay:** mottled olive-brown, dry, very stiff, fine grained sand, iron staining	17.6	16.8	
459	4									
		5	18			SM	**Silty Sand:** gray, dry, medium dense, fine graine sand, trace clay and iron staining			
458	5									
457	6									
		6	33				--olive, slightly moist, increased percentage of fines			
							Boring terminated at 6.6 meters. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-11

PLATE
A-17

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1521.936 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1	43			SM	**Fill** **Silty Sand:** brown, dry, dense, fine to medium grained sand, trace caliche			
463	1	2								
		3	64				--brown to dark brown, very dense	19.4	1.9	
462	2					GP	Interbedded layer of Sandy Gravel			
							Alluvium			
461	3	4	51			SM	**Silty Sand:** brown, dry, very dense, fine to medium grained sand, trace clay and caliche			
460	4									
		5	54			SP	**Sand:** light brown, slightly moist, dense, fine to medium grained, trace silt	18.0	3.2	
459	5	7				SM	**Silty Sand:** dark brown, slightly moist, fine to medium grained sand			
458	6	648, 50/15					--light brown, dry, very dense			

Boring terminated at 6.6 meters.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
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LOG OF BORING HV-12

PLATE A-18

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1527.346 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
465		1 2	27			SM	**Alluvium** **Silty Sand:** brown, dry, medium dense, fine to medium grained	18.8	5.5	
464	1	3	33				--dense			GS
463	2									
462	3	4	77			SC-SM	**Silty Clayey Sand:** brown, slightly moist, very dense, fine to medium grained sand	20.3	5.7	
461	4									
460	5	5	36			SM	**Silty Sand:** brown, dry, dense, fine to medium grained sand, trace caliche and iron staining			
459	6	6	79				--red-brown, very dense, less silt			

Boring terminated at 6.6 meters.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-13

PLATE A-19

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1549.915 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
472		1 2	26			SM	**Alluvium** **Silty Sand:** olive-brown, dry, medium dense, fine grained sand	18.8	8.9	
471	1	3	11				--dark brown, slightly moist, fine to medium grained sand			
470	2									
469	3	4	38				--dense, fine to coarse grained sand, with gravel	20.5	8.0	
468	4						--auger bit chatter through gravel			
467	5	5	5			CL	**Sandy Clay:** brown, moist, medium stiff, fine grained sand, trace coarse sand			GS
466	6	6	50/150				**Bedrock:** Tonalite, orange brown, dry, slightly weathered, very dense, recovered as fine to medium grained sand			
465	7	7	50/100				Boring terminated at 7.8 meters. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-14

PLATE A-20

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1544.669 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
470	1	1 2	29			SC	**Alluvium** **Clayey Sand:** red-brown, dry, medium dense, fine grained sand			GS
469	2	3	50/130			SM	**Silty Sand:** brown, dry, very dense, fine grained sand	19.7	9.8	
468 467	3 4	4	46, 50/7			SM	**Silty Sand:** gray-brown, dry, very dense, fine to medium grained sand			
466 465	5 6	5 6	50/100 38, 50/13				**Bedrock:** Tonalite, slightly to moderately weathered, very dense, recovered as fine to coarse grained sand			
							Boring terminated at 21.5 feet. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-15

PLATE
A-21

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1567.398 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
477	1						**Stockpiled Fill:** Soil stockpiled during on-going construction activity at site			
476	2									
475	3	1	15							
474	4									
473	5	2	26							
472	6	3	15			SM	**Alluvium** **Silty Sand:** red-brown, slightly moist, medium dense, trace clay	18.7	4.2	
471	7									
470	8	4	52				--very dense, cemented			
469	9	5	43, 50/10				--mottled red-brown to brown			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-16

PLATE A-22a

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Elevation (approx.) (meters) Depth	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						Boring terminated at 9.6 meters. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-16

PLATE

A-22b

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	N.A. feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
	1								
1	2	41, 50/100			SM	**Alluvium** **Silty Sand:** brown, dry, very dense, fine to medium grained sand	18.2	6.2	
2	3	82				--red-brown, trace clay			GS
3	4	36, 50/100				--orange-brown, dry, fine to medium grained sand			
4	5	46				--light brown, dense			
5						Boring terminated at 5.0 meters. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-17

PLATE
A-23

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/8/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	1564.898 feet (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per Foot	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1								
476	1	2	27			SM	**Alluvium** **Silty Sand:** red-brown, dry, medium dense, fine to medium grained sand, trace clay			
475	2	3	10, 50/15"				--very dense, iron staining, trace caliche	17.4	3.9	
474	3	4	70				--cemented, trace clay			
473	4									
472	5	5	25, 50/13"					19.1	6.0	

Boring terminated at 5.0 meters.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Riverside, California

LOG OF BORING HV-18

PLATE
A-24

GEOTECH 76979 I-215 SR-60.GPJ KA_RDLND.GDT 10/24/08

Note: The boundaries between soil types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	10/21/08	Water Depth:	Not Encountered(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	10/21/08
Drilling Method:	Mobile L-10T, 200mm HSA	Elevation:	463 meters (approx.)
Logged By:	L.Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Brown to dark brown, slightly moist, medium dense to dense, fine grained sand, with trace fine gravel to 19 mm			COR
463		2	32				--dark brown, moist, dense, with trace fine gravel to 6 mm			
	1									
462		3	40 50/100				--brown-gray, very dense, weakly to moderately cemented, with trace fine gravel to 6 mm, with trace calcium carbonate			
	2									
461										
	3	4	30				--medium dense, with trace fine gravel to 6 mm, with trace medium to coarse grained sand			
460										
	4									
459		5	47				--dark gray-brown, dense, with trace coarse grained sand, with trace calcium carbonate	20.1	7.8	DS
	5									
458							--with trace clay			
	6	6	12				--medium dense, with trace calcium carbonate			GS
457										
	7									
456		7	21 50/50			SM	**Alluvium (Qal): Silty Sand:** Light olive-brown, moist, very dense, moderately cemented, fine grained sand, with trace medium grained sand, with trace fine gravel to 6 mm, with trace calcium carbonate	18.5	5.6	DS
	8	13								COR
455										
	9									
454		8	28			ML	**Sandy Silt:** Brown-gray to olive-brown, moist, very stiff, with fine grained sand			

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I-215/SR60 East Junction
Riverside, California

PLATE
A-25a

PROJECT NO. 76979

LOG OF BORING BD-1

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--with trace fine gravel to 6 mm, more coarse sand appeared			
453					SP				
11	9	70				**Sand:** Brown, moist, very dense, moderately cemented, fine to medium grained sand, with trace fine gravel to 6 mm	17.7	2.6	
452									
12					SM	**Silty Sand:** Redd-brown, moist, very dense, fine grained sand, with trace fine gravel to 6 mm			
451	10	52							
13									
450									
14	11	80				-- fine to medium grained sand, with trace fine gravel to 6 mm			
449									
15									
448	12	39				--dense, fine grained sand, with trace fine gravel to 6 mm			
						Borehole terminated at approximately 15.7 meters without refusal No groundwater encountered Borehole backfilled with soil cuttings			

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING BD-1

PLATE

A-25b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Date Drilled	10/21/08	Water Depth:	Not Encountered(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	10/21/08
Drilling Method:	Mobile L-10T, 200mm HSA	Elevation:	460 meters (approx.)
Logged By:	L.Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
460		1				SM	**Fill (Qaf): Silty Sand:** Light brown, dry to slightly moist, loose to medium dense, with trace fine gravel to 12.5 mm			DS, SE, MAX
	1	2	6				--dark brown, moist, loose, fine grained sand, with trace coarse grained sand			
459							--increase in silt content			
		3	17			ML	**Sandy Silt:** Dark oilve-brown, moist, stiff, with very fine to fine grained sand	15.7	6.6	
	2						--100 mm debries appeared, decrease in silt content			
458										
	3	4	33			SM	**Alluvium (Qal): Silty Sand:** Olive-gray, moist, dense, weakly to moderately cemented, fine grained sand, with trace calcium carbonate			
457										
	4	13								
456										
		5	23 50/125				--very dense, weakly to moderately cemented, with trace fine gravel to 6 mm			
	5									
455							--with trace fine grvel to 6 mm			
	6	6	29				--medium dense, weakly cemented, with trace fine gravel to 6 mm, with trace calcium carbonate, decrease in silt content			
454										
	7									
453						SP	**Sand:** Brown, moist, very dense, fine grained sand, with trace coarse grained sand, with trace silt			
		7	26 50/150							
	8									
452										
	9									
		8	51			SM	**Silty Sand:** Olive-brown, moist, very dense, weakly cemented, fine grained sand, with trace coarse grained sand, with trace calcium carbonate			GS
451										

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I-215/SR60 East Junction
Riverside, California

PLATE
A-26a

PROJECT NO. 76979

LOG OF BORING BD-2

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
450						--water was added while drilling due to difficult drilling			
						--with trace fine gravel to 19 mm			
	9	32 50/75				--fine to medium grained sand, weakly to moderately cemented at about 11 meters, light brown at about 11 meters, with trace calcium carbonate, with trace fine gravel to 6 mm	17.3	3.9	DS
11									
449									
					SP	**Sand:** Mottled white, brown, and black, moist, dense, weakly to moderately cemented, fine to medium grained sand			
12									
	10	48							
448					SM	**Silty Sand:** Dark Brown, moist, dense, with trace gravel to 6 mm, with trace calcium carbonate			
13									
447									
	11	22 50/150			SM-SP	**Sand with Silt:** Dark red-brown, moist, very dense, weakly cemented, fine to medium grained sand, with trace clay, with trace calcium carbonate, with trace fine gravel to 12.5 mm			
14									
446									
						--with trace fine gravel to 6 mm			
15						--perched water appeared			
	12	70				--moist to wet, fine grained sand, with trace coarse grained sand			
						Borehole terminated at approximately 15.7 meters without refusal			
						Perched water encountered at approximately 14.6 meters			
						Borehole backfilled with soil cuttings			

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Riverside, California

PLATE
A-26b

PROJECT NO. 76979

LOG OF BORING BD-2

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Date Drilled	10/21/08	Water Depth:	Not Encountered(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	10/21/08
Drilling Method:	Mobile L-10T, 200mm HSA	Elevation:	461 meters (approx.)
Logged By:	L.Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Olive-brown, dry to slightly moist, very fine to fine grained sand, with trace fine gravel to 12.5 mm			
460	1	2	77				--slightly moist, very dense, weakly cemented, with trace fractured rock to 6 mm			
		3	27				--olive-brown to gray-brown, medium dense, weakly cemented, with trace gravel to 6 mm			
459	2						--increase in silt content			
458	3	4	42 50/75			SM	**Alluvium (Qal): Silty Sand:** Light brown to white-gray, dry to slightly moist, very dense, with trace coarse grained sand, with trace fine gravel to 6 mm	17.6	4.1	
457	4						--more coarse grained sand appeared			
		5	28			SM-SP	**Sand with Silt:** Brown, slightly moist, medium dense, fine to medium grained sand, with trace gravel to 6 mm			
456	5									
455	6	6	88			SM / ML	**Silty Sand to Sandy Silt:** Olive-brown, moist, very dense, moderately cemented, very fine to fine grained sand, with trace fine gravel to 6 mm			
454	7	13					--with trace fine gravel to 19 mm			
							--decrease in silt content			
		7	41			SM	**Silty Sand** Dark brown with mottled white and black, moist, dense, weakly to moderately cemented, with trace fractured rock to 12.5 mm, with trace fine gravel to 12.5 mm, with trace calcium carbonate			GS
453	8						--with trace coarse gravel to 25 mm, decrease in silt content			
452	9	8	46 50/75				--difficult drilling, rig chatter	19.2	11.6	DS
451							--olive-brown, very dense, fine to medium grained sand, with trace fine gravel to 6 mm, with trace clay, with			

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PLATE
A-27a

PROJECT NO. 76979

LOG OF BORING BD-3

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						weathered rock to 30 mm --difficult drilling, rig chatter --with trace gravel to 25 mm			
450 11	9	17 50/130			SP	**Sand:** Mottled brown, gray, and white, moist, very dense, fine to medium grained sand, moderately cemented, with trace fine gravel to 19 mm, with trace calcium carbonate, with trace crushed rock to 10 mm at 35 m			
449 12	10	27 50/100				--water was added due to difficult drilling, rig chatter -- red-brown with mottled black and white, fine to medium grained sand, strongly cemented, with trace calcium carbonate, with trace clay			
448 13									
447 14	11	55			SM	**Silty Sand:** Dark olive-brown, moist, very dense, fine grained sand, weakly to moderately cemented --very difficult drilling, rig chatter excessively			
						Borehole terminated at approximately 14.6 meters Refusal was encountered at approximately 14.6 meters No groundwater encountered Borehole backfilled with soil cuttings			

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LOG OF BORING BD-3

PLATE

A-27b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Date Drilled	10/21/08	Water Depth:	12 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	10/21/08
Drilling Method:	Mobile L-10T, 200mm HSA	Elevation:	460 meters (approx.)
Logged By:	L.Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Brown, dry to slightly moist, medium dense to dense, very fine to fine grained sand, with trace fine gravel to 12.5 mm			COR
459	1	2	39				--dense, very fine to fine grained sand, with fractured rock to 6 mm, with trace calcium carbonate --with trace coarse gravel to 27 mm			
458	2	3	56				--mottled black, white, and brown, slightly moist to moist, with trace calcium carbonate, with fractured rock to 60 mm in sampler with trace fine gravel to 12.5 mm	20.5	4.4	
457	3	4	13				--brown, moist, medium dense, fine grained sand, with trace fine gravel to 6 mm, with a thin layer of moderately cemented sand at approximately 3.3 meters			
456	4						--with trace fine gravel to 12.5 mm			
455	5	5	36 50/100			SM	**Alluvium (Qal): Silty Sand:** Light brwon-olive, slightly moist, very dense, moderately to strongly cemented, fine grained sand, with trace fine gravel to 6 mm, increase in silt content			
454	6	6	48				--dense, weakly cemented, very fine to fine grained sand, with trace coarse grained sand			
453	7						--decrease in silt content, increase in coarse grained sand content			
452	8	7	30 50/150			SP	**Sand:** Mottled white, dark brown, and dark gray, moist, very dense, with fractured rock on the top portion of the sampler to 25 mm, with 45 mm rock in the tip of the sampler, with trace of silt	19.2	8.0	
451	9						--encountered difficult drilling			
450		8	40 50/50				**Bedrock (Kt):** Tonalite, mottled white, orange brown, and gray, moist, moderately weathered, recovered as very fine to fine grained silty sand, with trace clay			

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PLATE
A-28a

PROJECT NO. 76979

LOG OF BORING BD-4

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
449 11	9	50/75				--orange-brown, moist, slightly weathered, recovered as fine grained silty sand			
448 12	10	42 50/100				--encountered groundwater at 11.9 meters --mottled white, black and brown, slightly to moderately weathered, recovered as fine to medium grained sand			
447 13									
446 14	11	50/100							
445 15	12	50/100							
						Borehole terminated at approximately 15.7 meters with refusal Groundwater was encountered at approximately 11.9 meters Borehole backfilled with soil cuttings			

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Riverside, California

PLATE
A-28b

PROJECT NO. 76979

LOG OF BORING BD-4

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

APPENDIX B

LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

Geotechnical laboratory tests were performed on selected drive and bulk soil samples to estimate engineering characteristics of various earth materials encountered at the site. Testing was performed in general accordance with procedures outlined by the American Society for Testing and Materials (ASTM) and the California Department of Transportation test methods (CTM).

IN-SITU MOISTURE CONTENT AND DRY UNIT WEIGHT

In-situ moisture content and dry unit weight tests were performed on samples that could be recovered in a relatively undisturbed condition. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937. The test results are presented on the Logs of Borings in Appendix A, *Field Exploration*.

GRAIN SIZE DISTRIBUTION

Sieve analyses were performed on selected samples of the materials encountered at the site to evaluate the grain size distribution characteristics of the soils and to aid in their classification. The tests were performed in general accordance with ASTM Standard Test Method D 422. The results of these tests are presented on Plates B-1 through B-13, *Grain Size Distribution*.

COMPACTION TEST

A laboratory compaction test (ASTM D1557) was performed on two representative bulk sample to determine the maximum dry unit weight and optimum moisture content of the material tested. Test results are summarized in Table B-1.

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Table B-1
Summary of Compaction Test Results

Location	Depth (m)	USCS Soil Type	Maximum Unit Weight (kN/m^3)	Optimum Moisture Content (%)
KB-1	0 – 1.5	SM	21.0	7.5
BD-2	0 – 1.5	SM	21.5	7.0

DIRECT SHEAR TEST

Thirteen direct shear tests were performed on samples to evaluate the drained shear strength of the soils. The samples were soaked and tested in a near-saturated condition in general accordance with ASTM Test Method D 3080 (consolidated, drained). The results of these tests are presented on Plates B-21 through B-33, *Direct Shear Test*, and summarized in Table B-2, below.

Table B-2
Direct Shear Test Results

Boring No.	Depth (m)	USCS Soil Type	Dry Unit Weight (kN/m^3)	Friction Angle (degrees)	Cohesion (kPa)
KB-1*	0 - 1.5	SM	18.5	38	0
KB-3	1.5 - 2.0	Tonalite	19.8	31	41.2
BS-1	2.3	SM	20.4	33	44
HV-1	3.0	SM	20.8	40	12.3
HV-3	15.2	Tonalite	20.0	43	0
HV-5	9.1	SM	20.0	36	0
HV-6	2.3	SW-SM	17.2	42	0
HV-8	6.1	SM	20.3	28	16.2
BD-1	4.6	SM	20.1	35	19.6
BD-1	7.6	SM	18.5	40	0
BD-2*	0 – 1.5	SM	19.3	37	0
BD-2	10.7	SM	17.3	40	1.0
BD-3	9.1	SM	19.2	29	23.7

* Remolded to 90% of Maximum Density

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CONSOLIDATION / COLLAPSE POTENTIAL TEST

Consolidation/ collapse potential tests were performed on two representative drive soil samples to evaluate the settlement characteristics of the in-situ soils when subjected to typical foundation loads and wetting. The tests were performed in accordance with ASTM D5333. Test results are presented on Plates B-16 and B-17, Consolidation/*Collapse Potential Test*.

CORROSIVITY TESTS

Corrosivity tests were performed on five bulk samples to estimate pH, resistivity, soluble sulfate, and chloride contents of encountered earth materials, in general accordance with the following Caltrans Standard Test Methods: CTM 643 for electrical resistivity, CTM 532 for pH, CTM 417 for sulfate content, and CTM 422 for chloride content. Test results are summarized in Table B-2, below.

Table B-2
Corrosion Test Results

Boring No.	Depth (m)	Minimum Resistivity (Ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
KB-1	0 -1.5	1900	8.1	11	131
KB-2	3.0 - 3.5	2300	7.7	17	148
BS-2	2 - 3	3000	7.7	8	131
HV-2	0.9 - 2.4	1200	7.4	7	254
HV-7	0.9 - 2.4	3200	7.9	5	126
BD-1	0 – 1.5	1500	7.2	20	318
BD-1	8.2 – 8.8	1600	7.2	16	323
BD-4	0 - 1.5	2000	7.1	14	186

R-VALUE TESTS

Three resistance value (R-value) tests were performed on bulk soil samples to evaluate pavement support characteristics of the near-surface onsite soils. R-value testing was performed in general accordance with Caltrans Standard Test Method 301. Test results are presented in Table B-3 and Plates B-34 through B-36.

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Table B-3
Summary of R-Value Test Results

Location	Depth (m)	USCS Soil Type	R-Value
HV-9	0 – 1.5	SM	52
HV-12	0.6 – 2.1	SM	36
HV-18	0 – 1.5	SM	16

SAND EQUIVALENT TEST

One sand equivalent test was performed on near-surface soil to determine the suitability of the onsite materials for use as engineered fill during construction. The test was performed in accordance with ASTM D2419. The test results are presented in Table B-4, below.

Table B-4
Sand Equivalent Test Results

Location	Depth (m)	USCS Soil Type	Sand Equivalent (SE)
BD-2	0 – 1.5	SM	21

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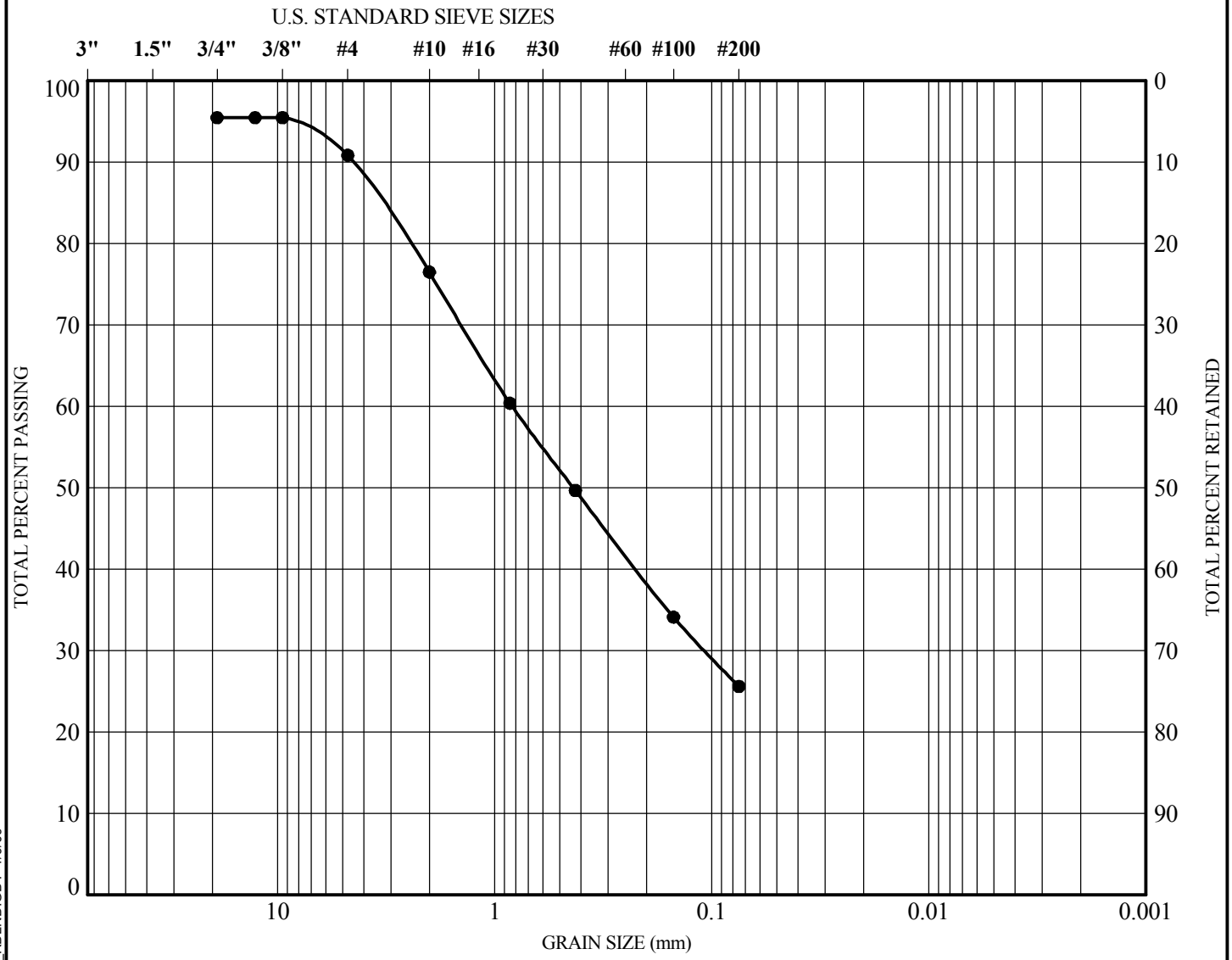
SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	KB-1	0 - 1.5	Silty Sand	SM

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Frontage Road OH Replacement
Riverside, California

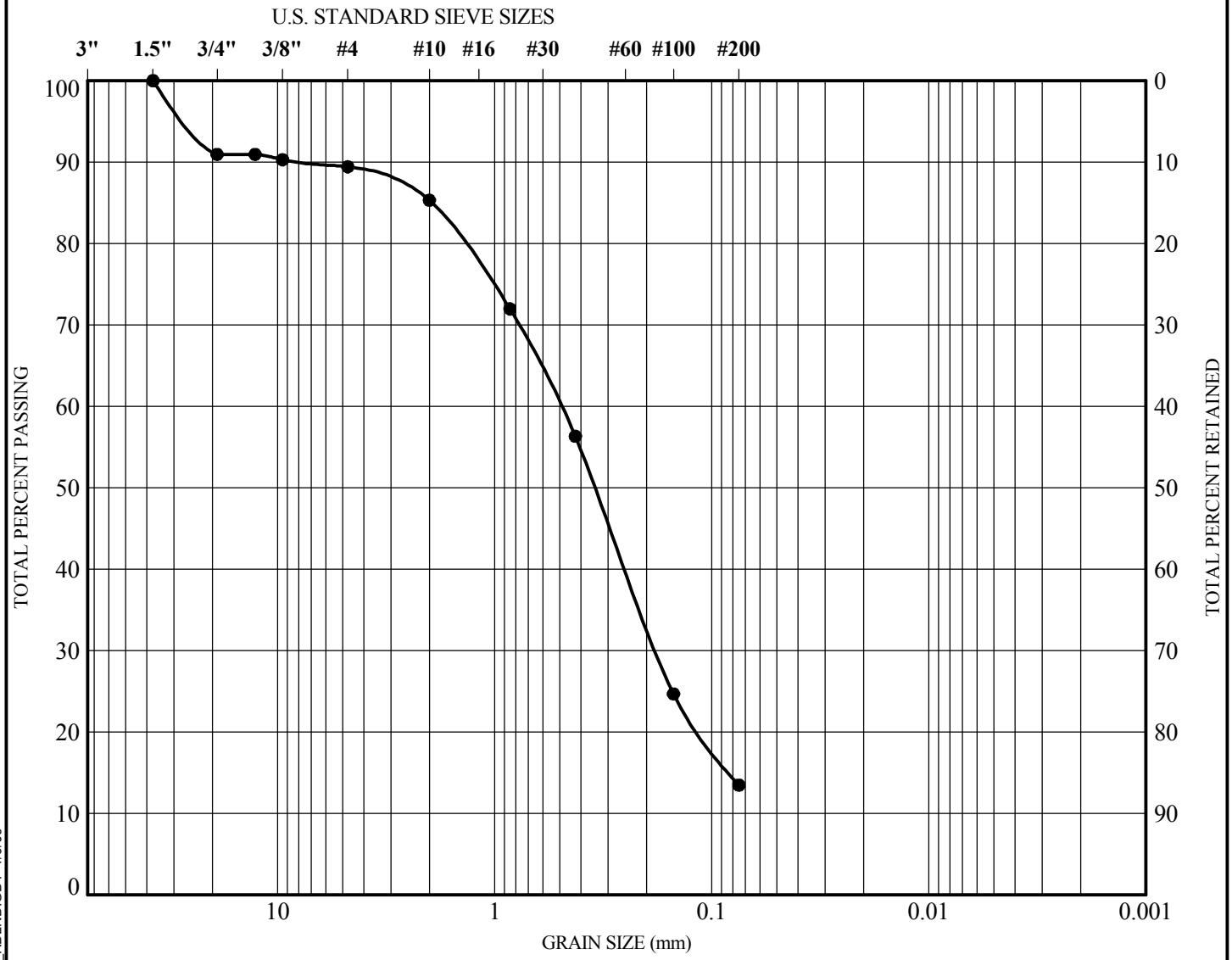
GRAIN SIZE DISTRIBUTION

PLATE

B-1

GRAIN SIZE 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	KB-1	5	Silty Sand	SM

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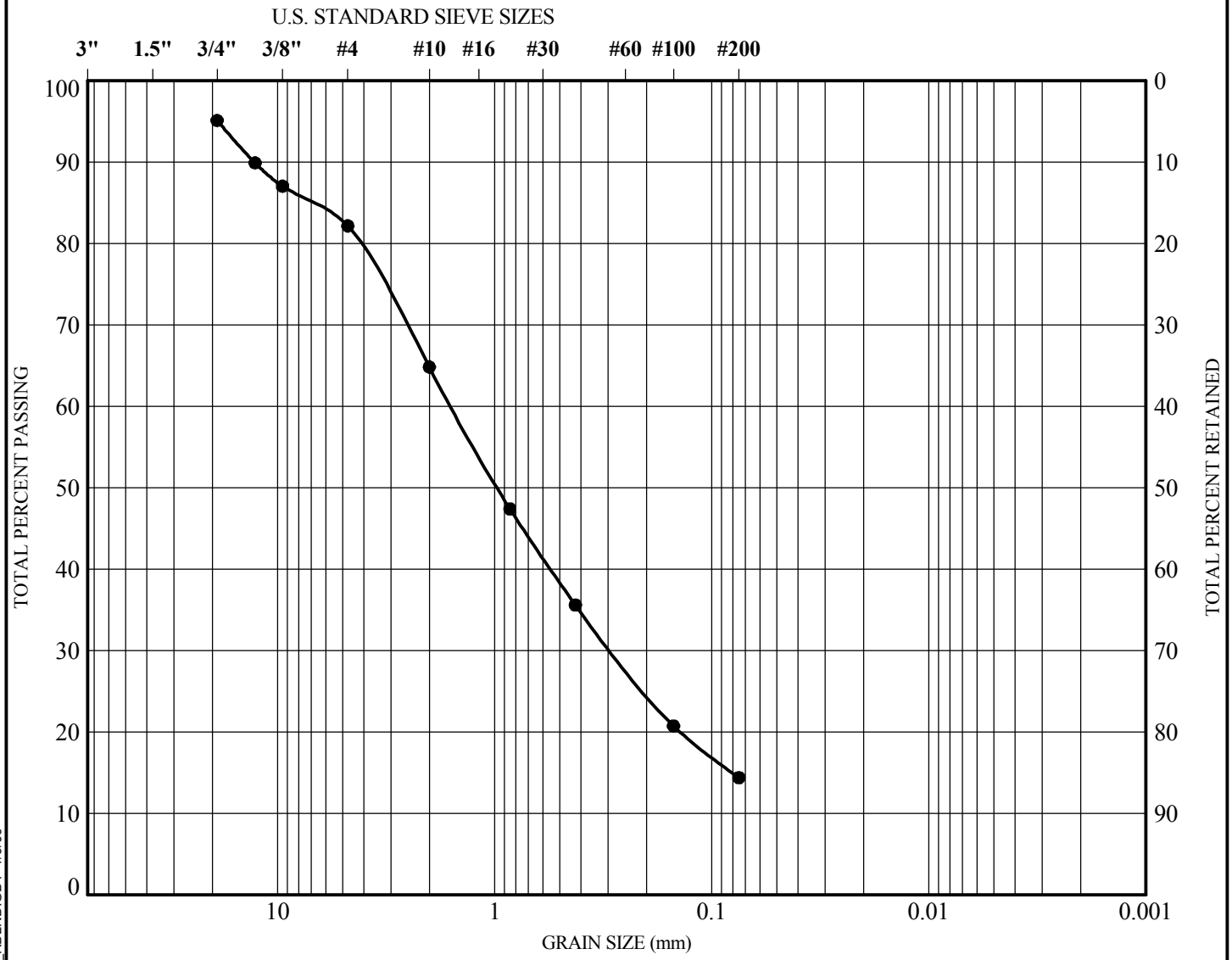
GRAIN SIZE DISTRIBUTION

PLATE

B-2

GRAIN SIZE 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	KB-2	5	Silty Sand with Gravel	SM

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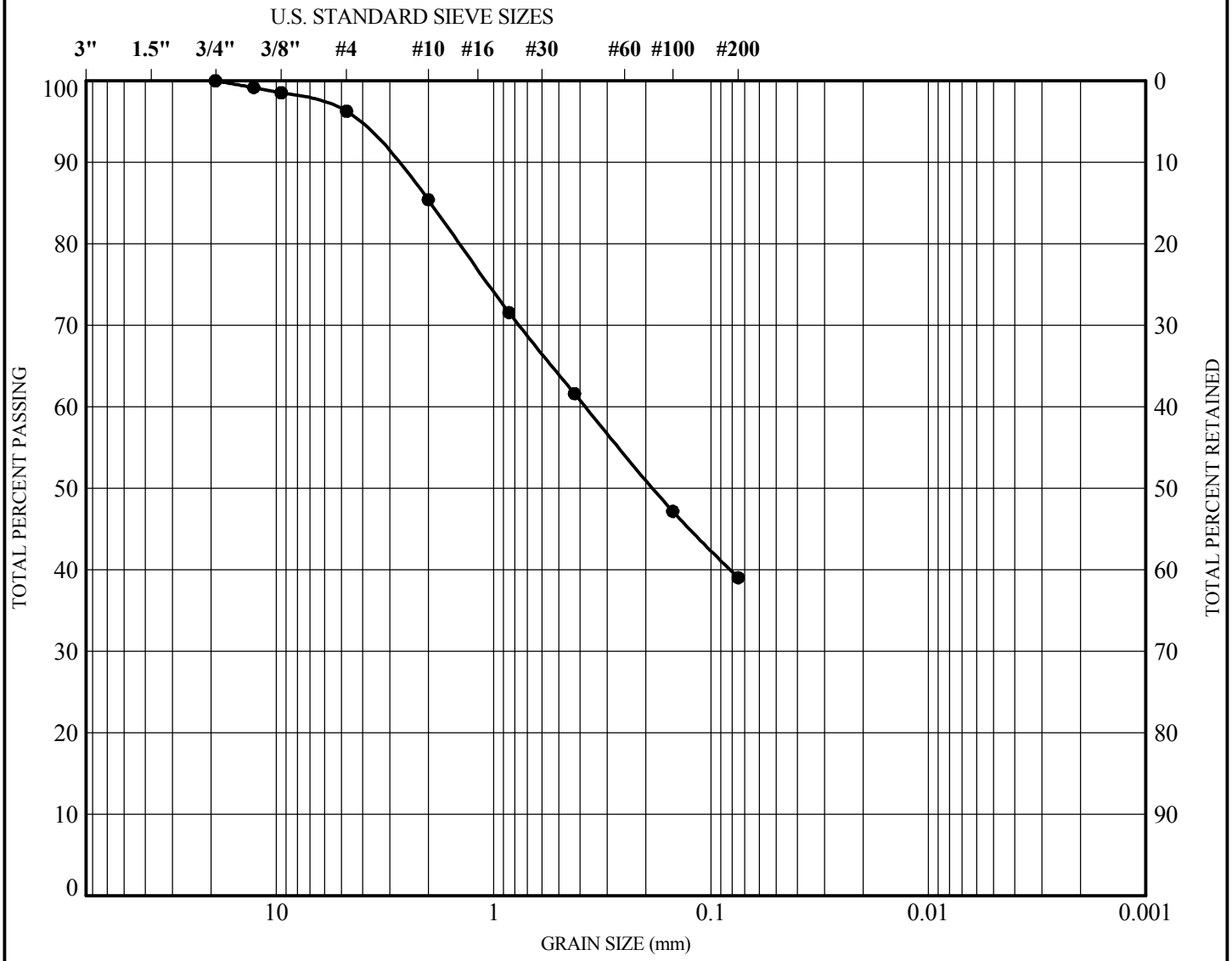
GRAIN SIZE DISTRIBUTION

PLATE

B-3

GRAIN SIZE 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	BS-1	3	Silty Sand	SM

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I-215/SR60 East Junction
Box Springs Overhead Widening
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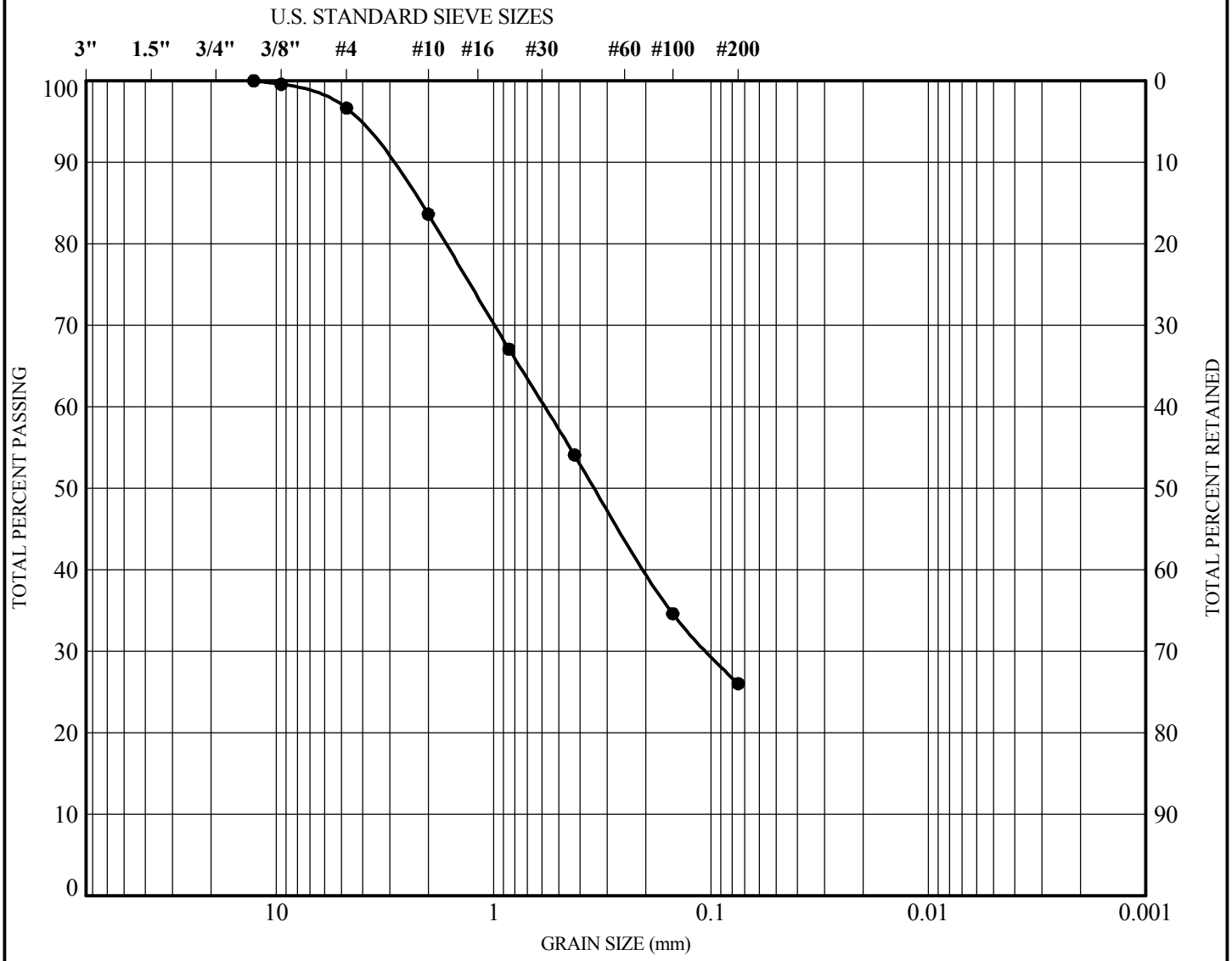
GRAIN SIZE DISTRIBUTION

PLATE

B-4

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	BS-2	2	Silty Sand	SM

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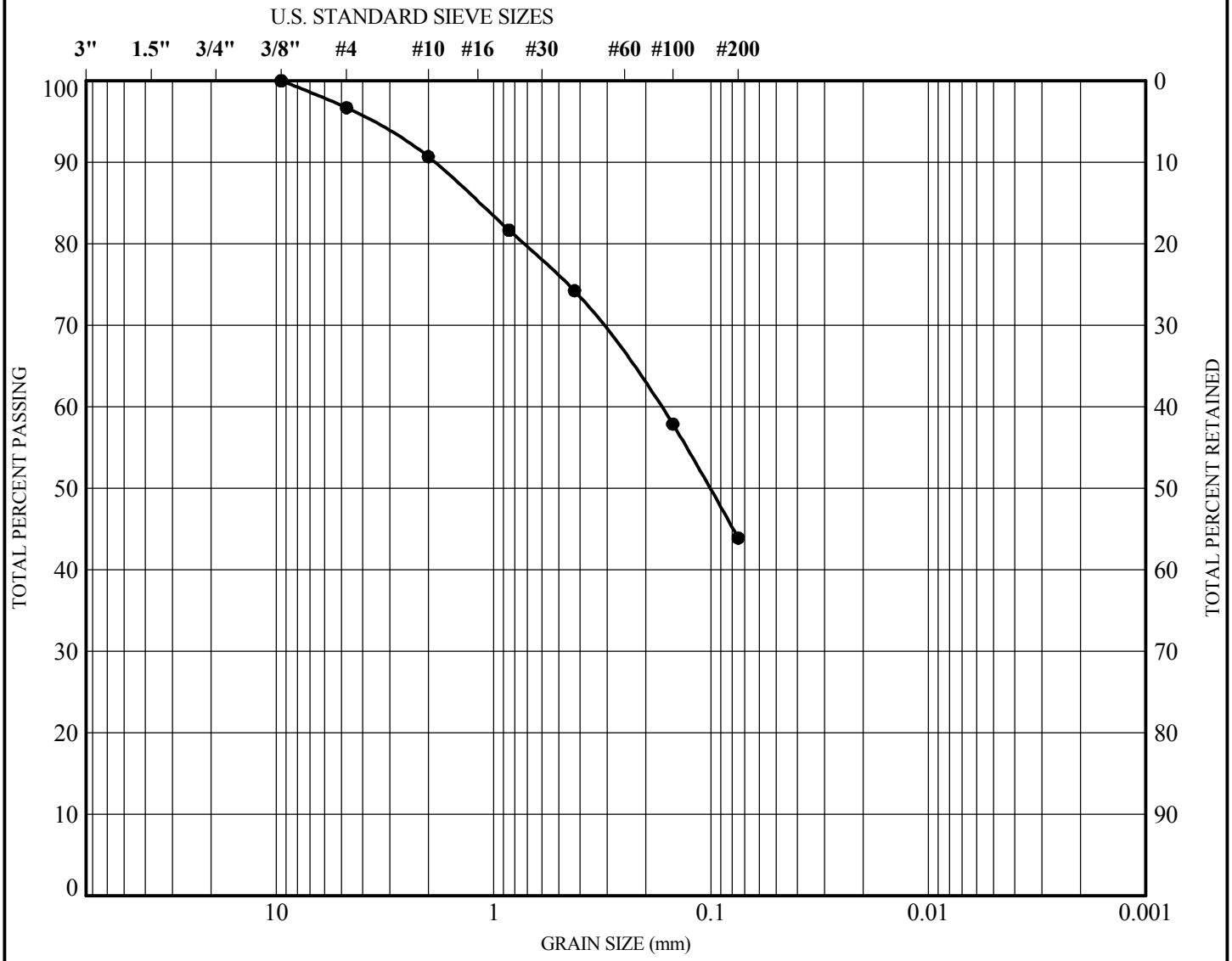
I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

GRAIN SIZE DISTRIBUTION

PLATE

B-5

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV- 1	2	Silty Sand	SM

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WB & EB SR60 HOV Connectors
Riverside, California

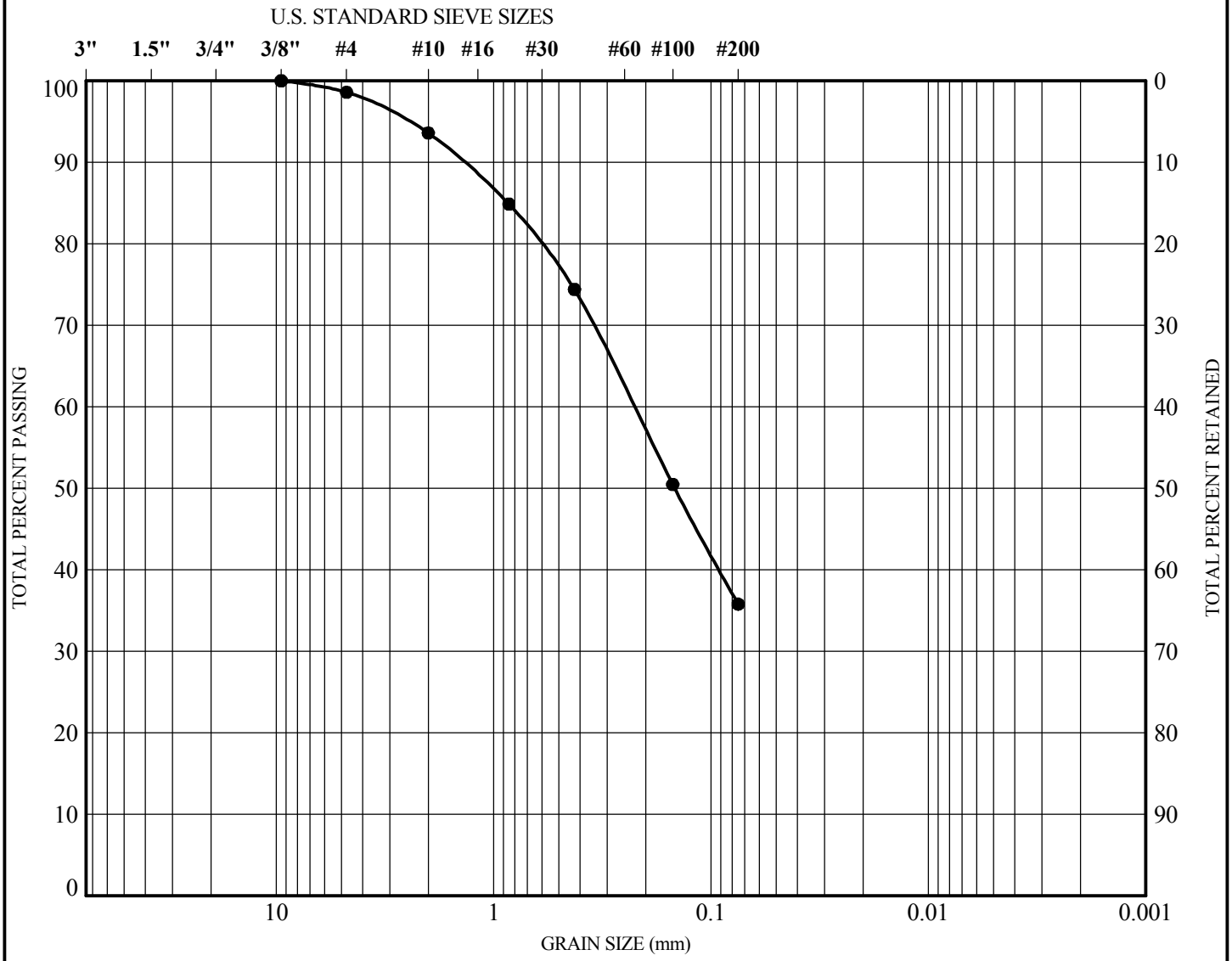
GRAIN SIZE DISTRIBUTION

PLATE

B-6

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV- 3	3	Silty Sand	SM

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Riverside, California

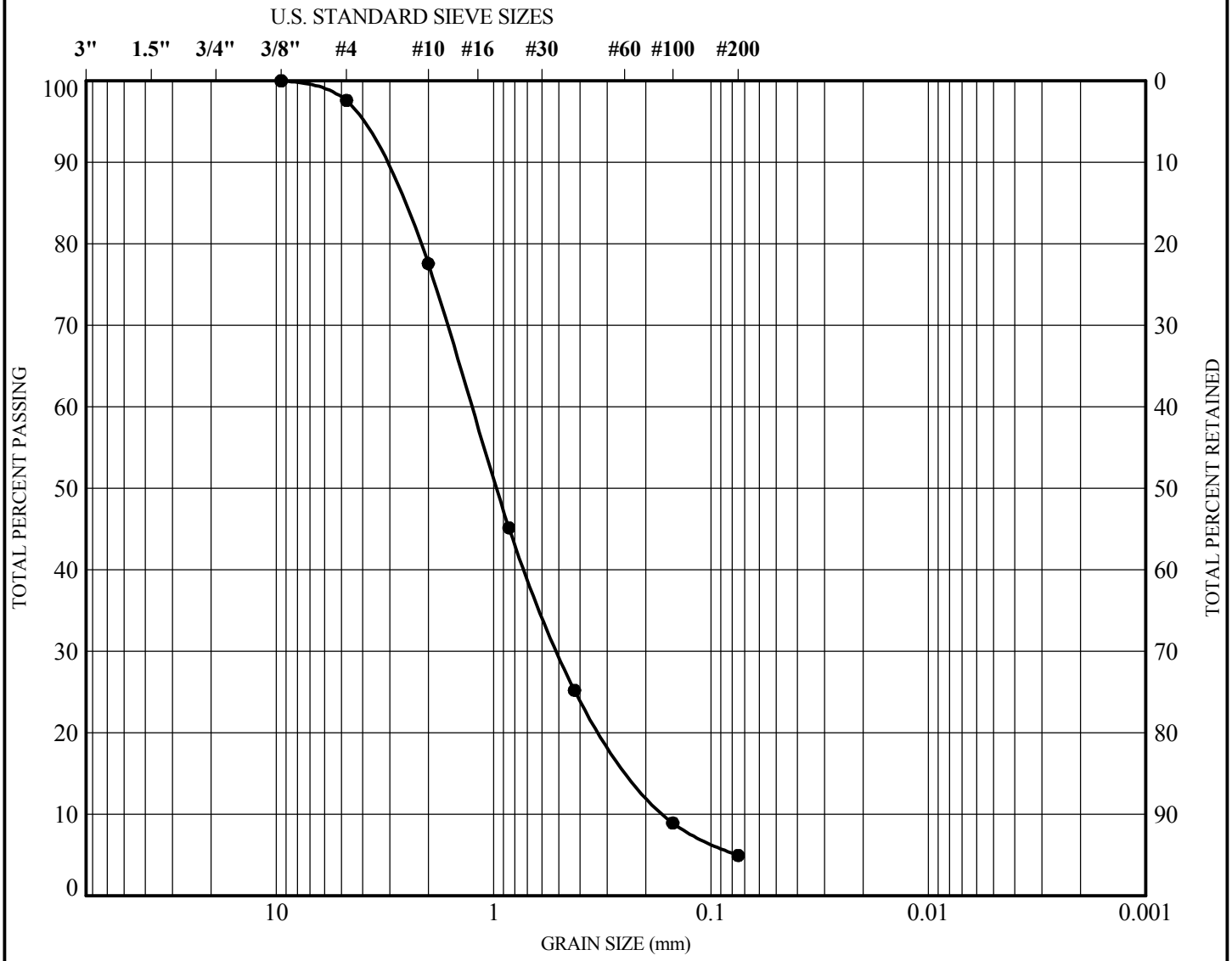
GRAIN SIZE DISTRIBUTION

PLATE

B-7

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV- 6	3	Sand with Silt	SW-SM

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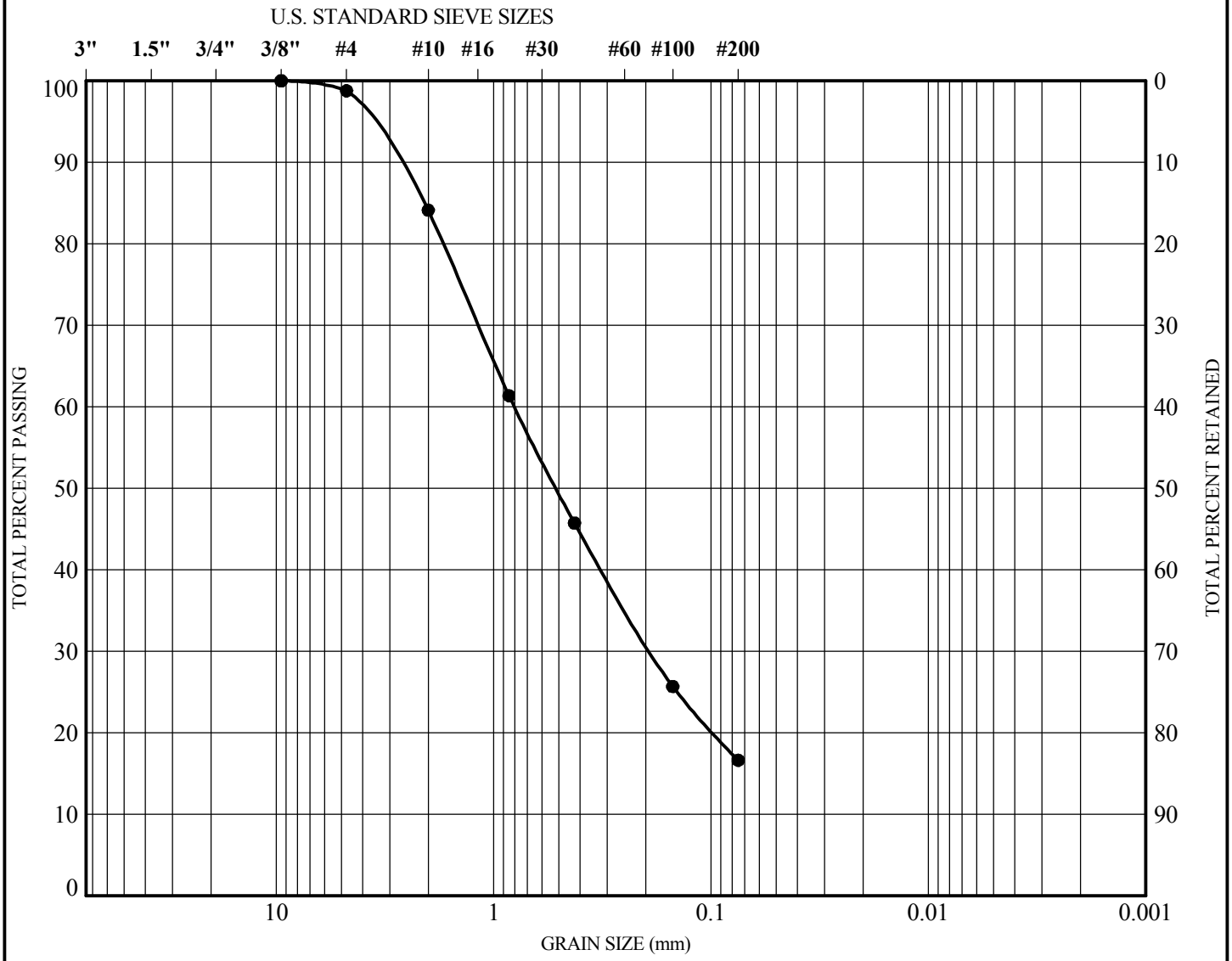
GRAIN SIZE DISTRIBUTION

PLATE

B-8

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV- 9	2	Silty Sand	SM

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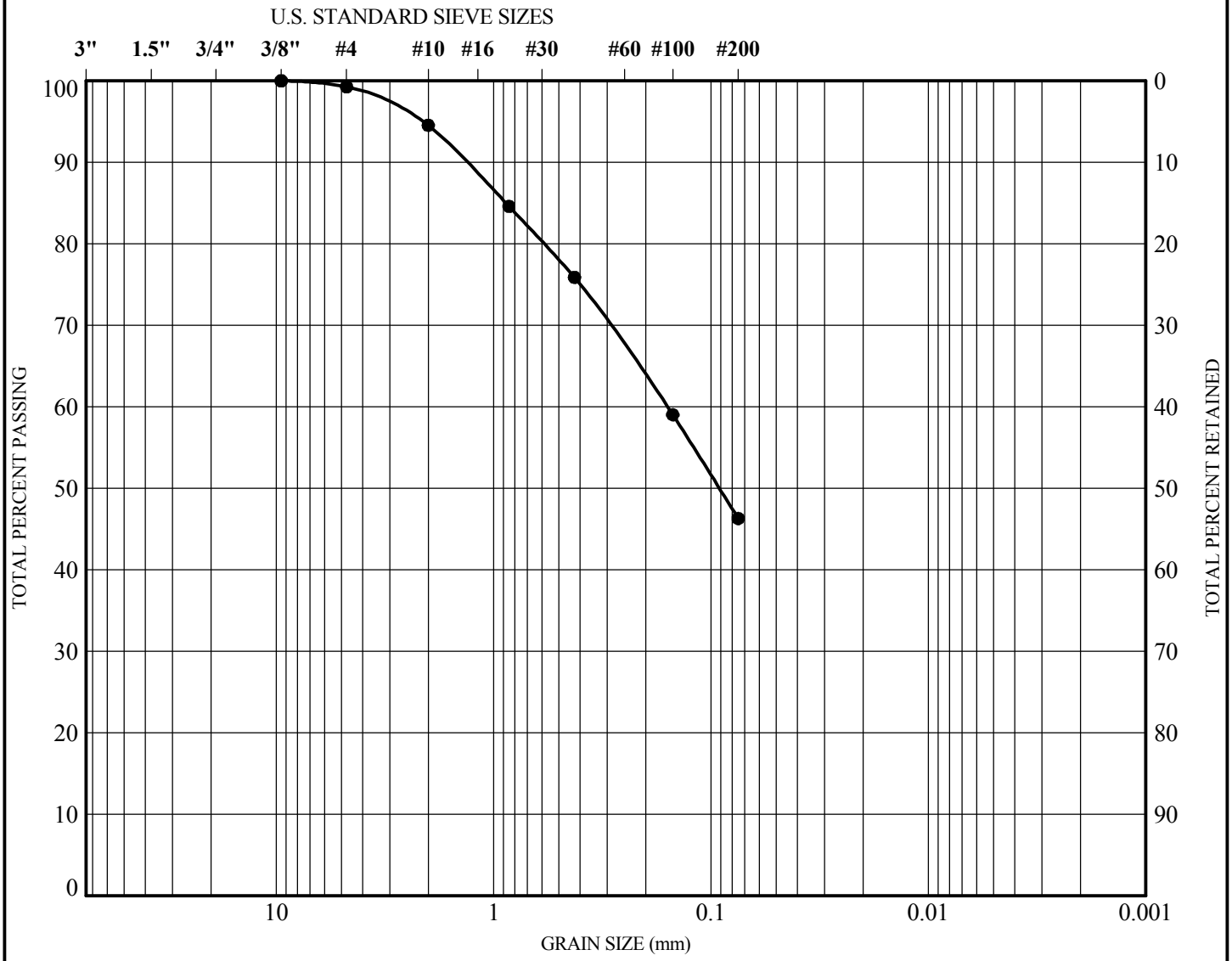
GRAIN SIZE DISTRIBUTION

PLATE

B-9

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV-13	2	Silty Sand	SM

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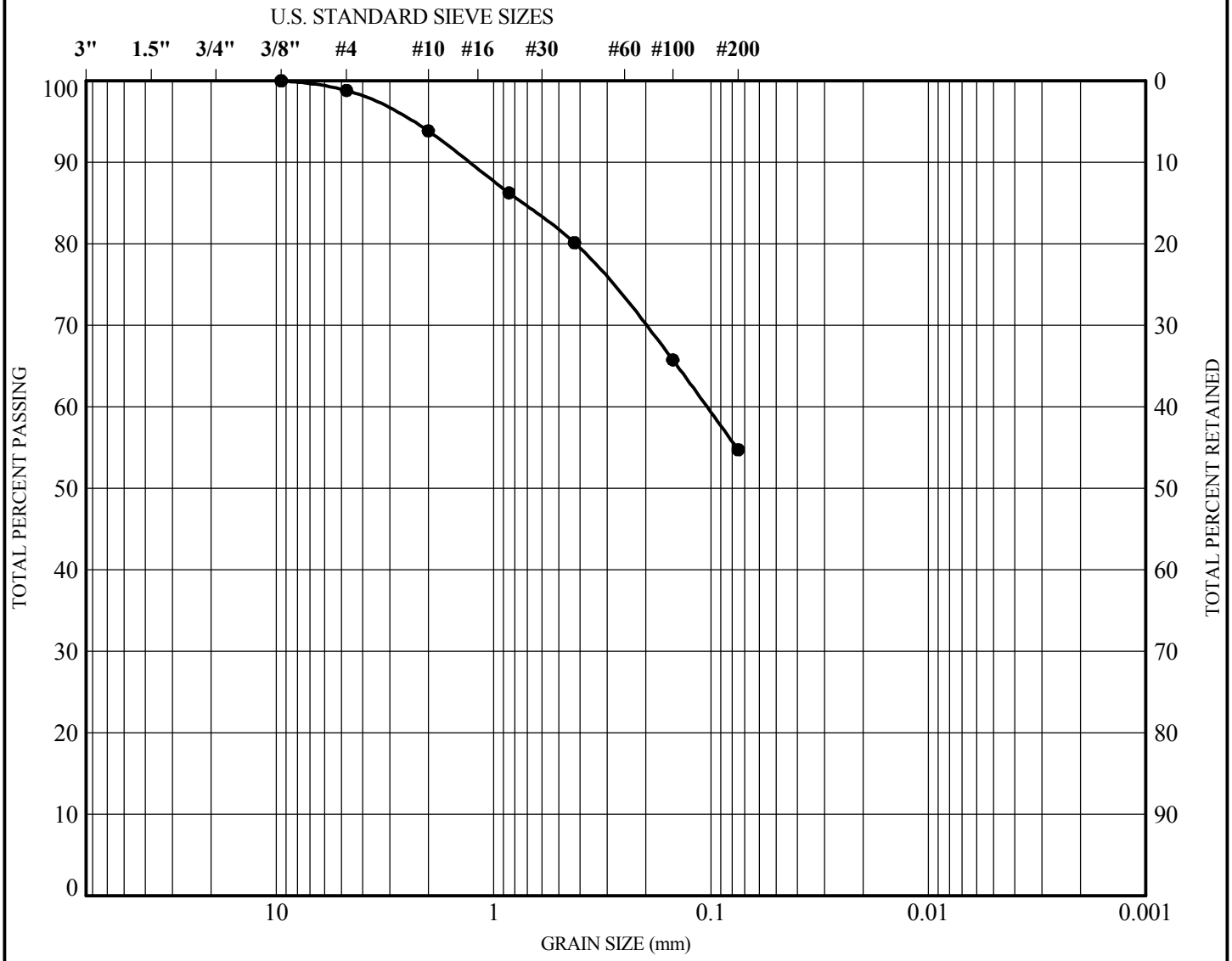
GRAIN SIZE DISTRIBUTION

PLATE

B-10

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV-14	5	Sandy Clay	CL

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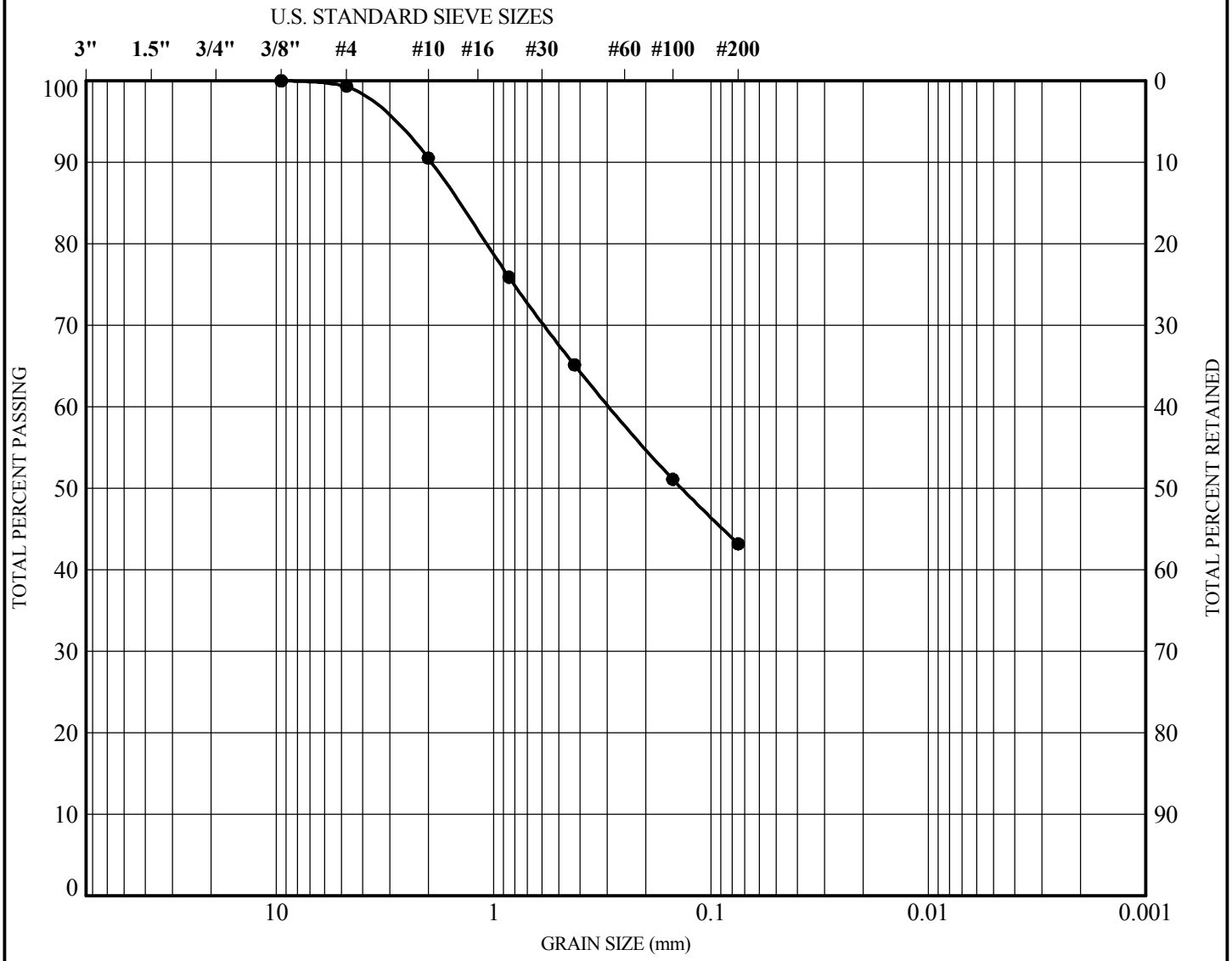
GRAIN SIZE DISTRIBUTION

PLATE

B-11

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV-15	1	Clayey Sand	SC

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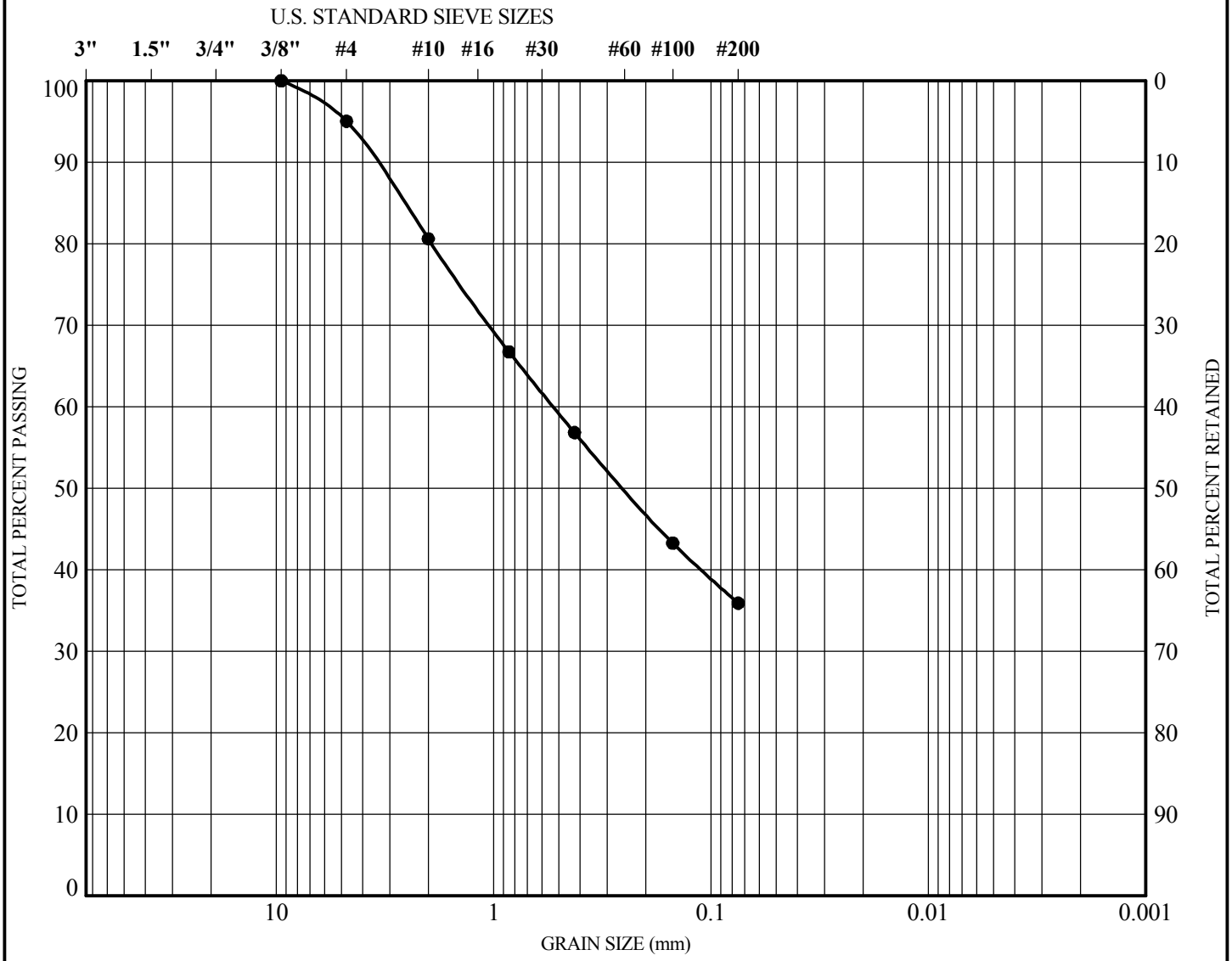
GRAIN SIZE DISTRIBUTION

PLATE

B-12

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV-17	2	Silty Sand	SM

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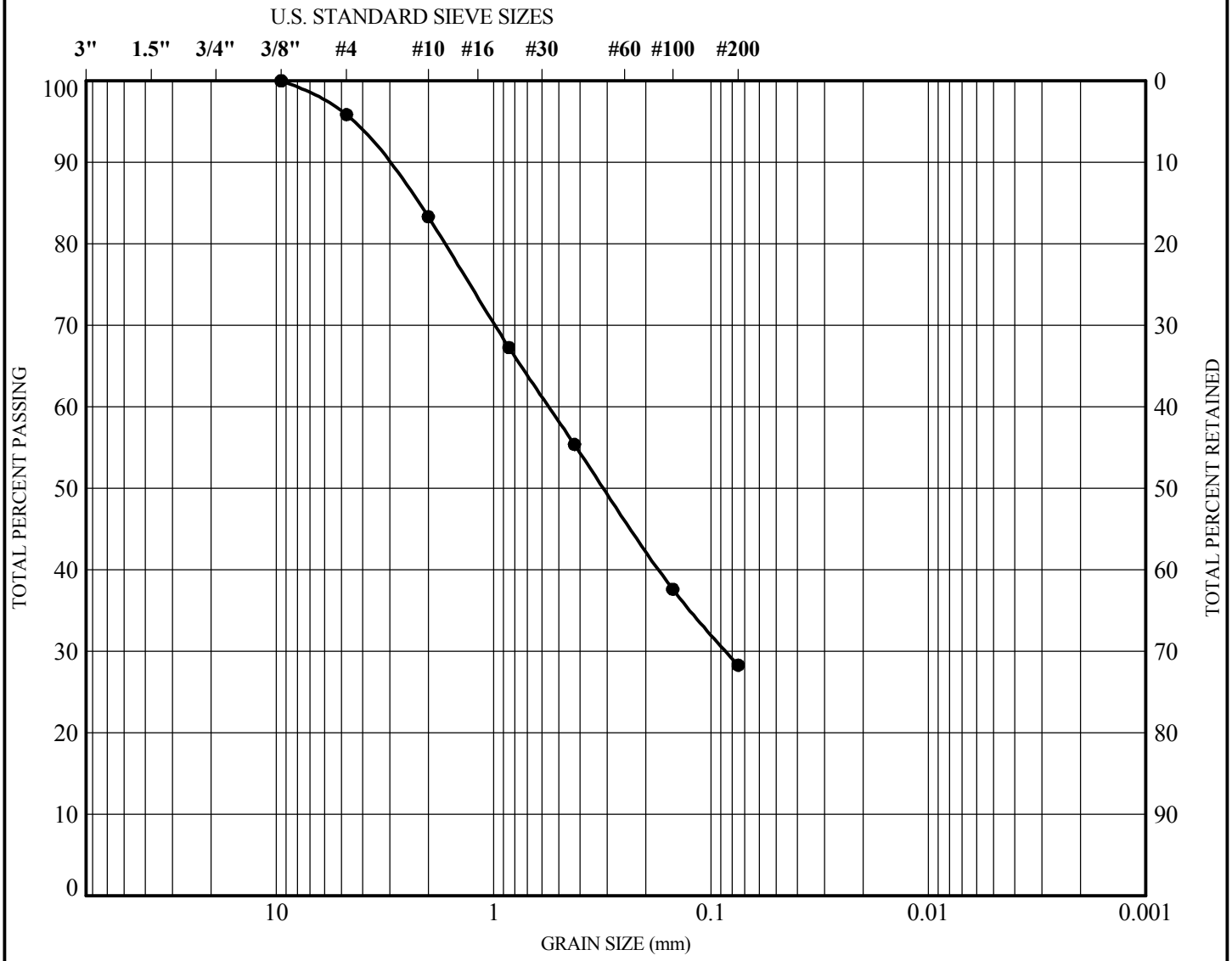
GRAIN SIZE DISTRIBUTION

PLATE

B-13

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	BD-1	6	Silty Sand	SM

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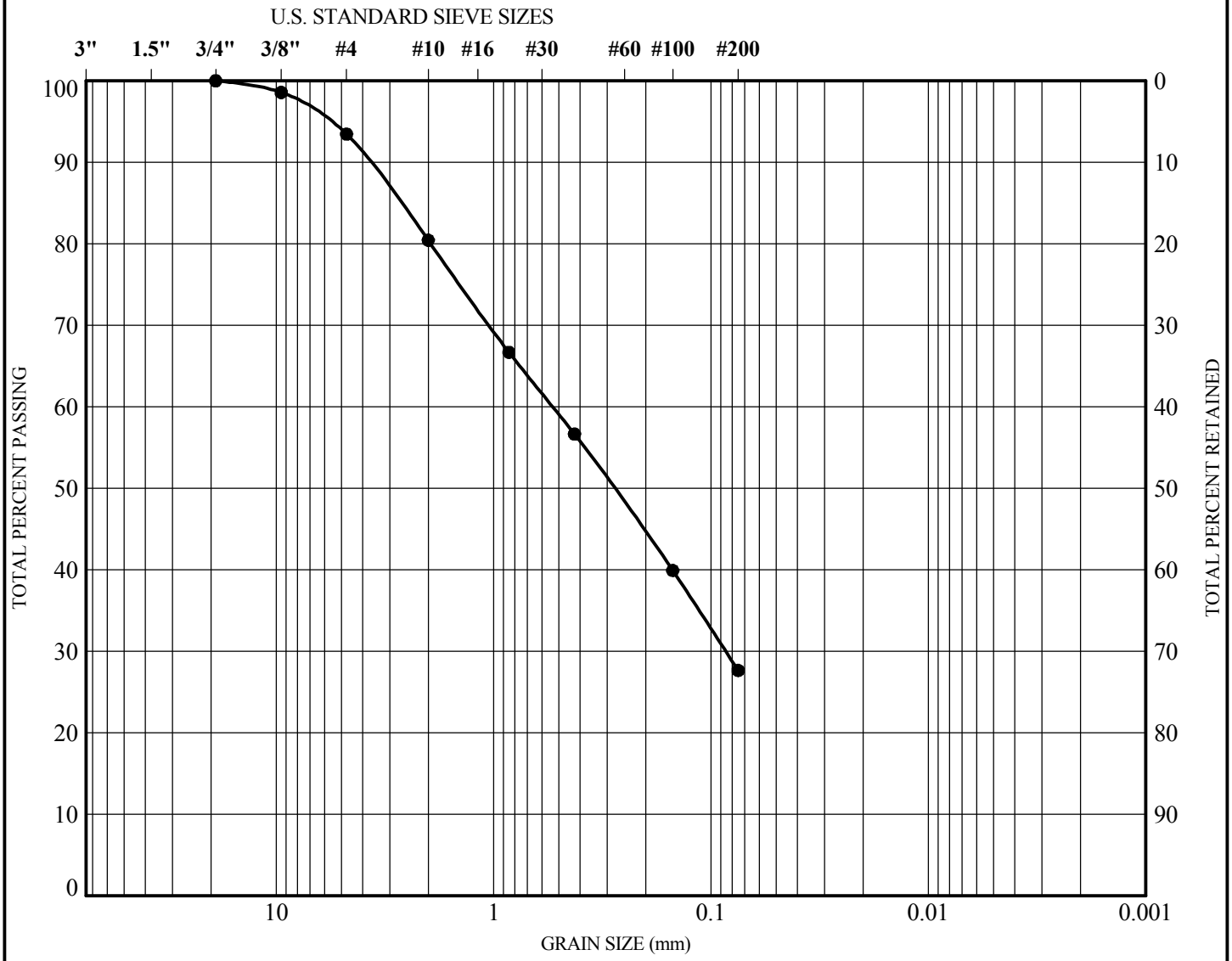
GRAIN SIZE DISTRIBUTION

PLATE

B-14

GRAIN SIZE 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	BD-2	9	Silty Sand	SM

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

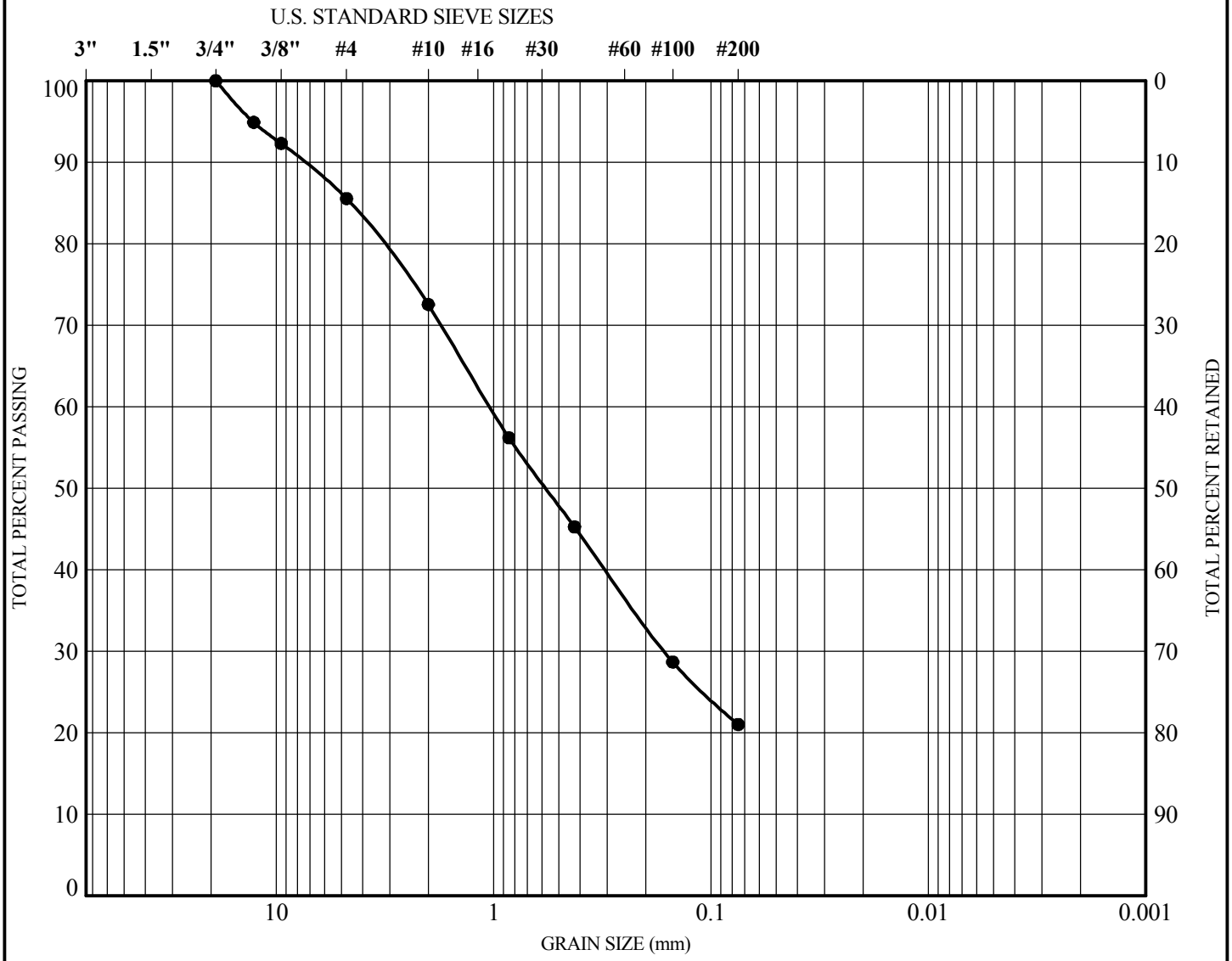
GRAIN SIZE DISTRIBUTION

PLATE

B-15

GRAIN SIZE 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	BD-3	8	Silty Sand	SM

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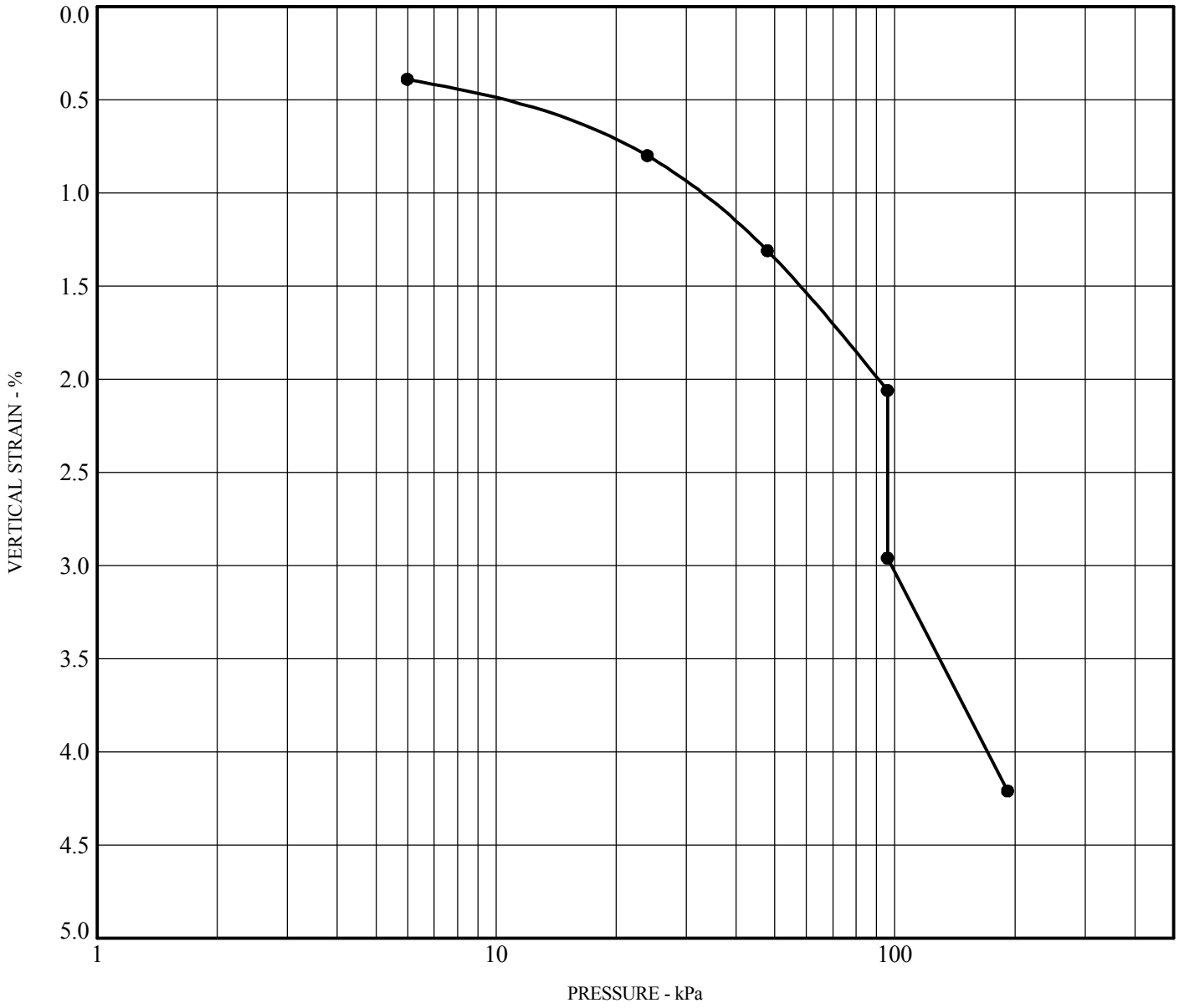
I-215/SR60 East Junction
Riverside, California

GRAIN SIZE DISTRIBUTION

PLATE

B-16

GRAIN SIZE 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09



Boring	**KB-1**
Depth (m)	**3**
Moisture Content (%)	**7.0**
Dry Density (kN/m^3)	**19.4**
Description	**Silty Sand**
Classification	**SM**
Collapse Potential (%)	**0.9**
Severity of Problem	

NOTE : 1 kPa = 21 psf

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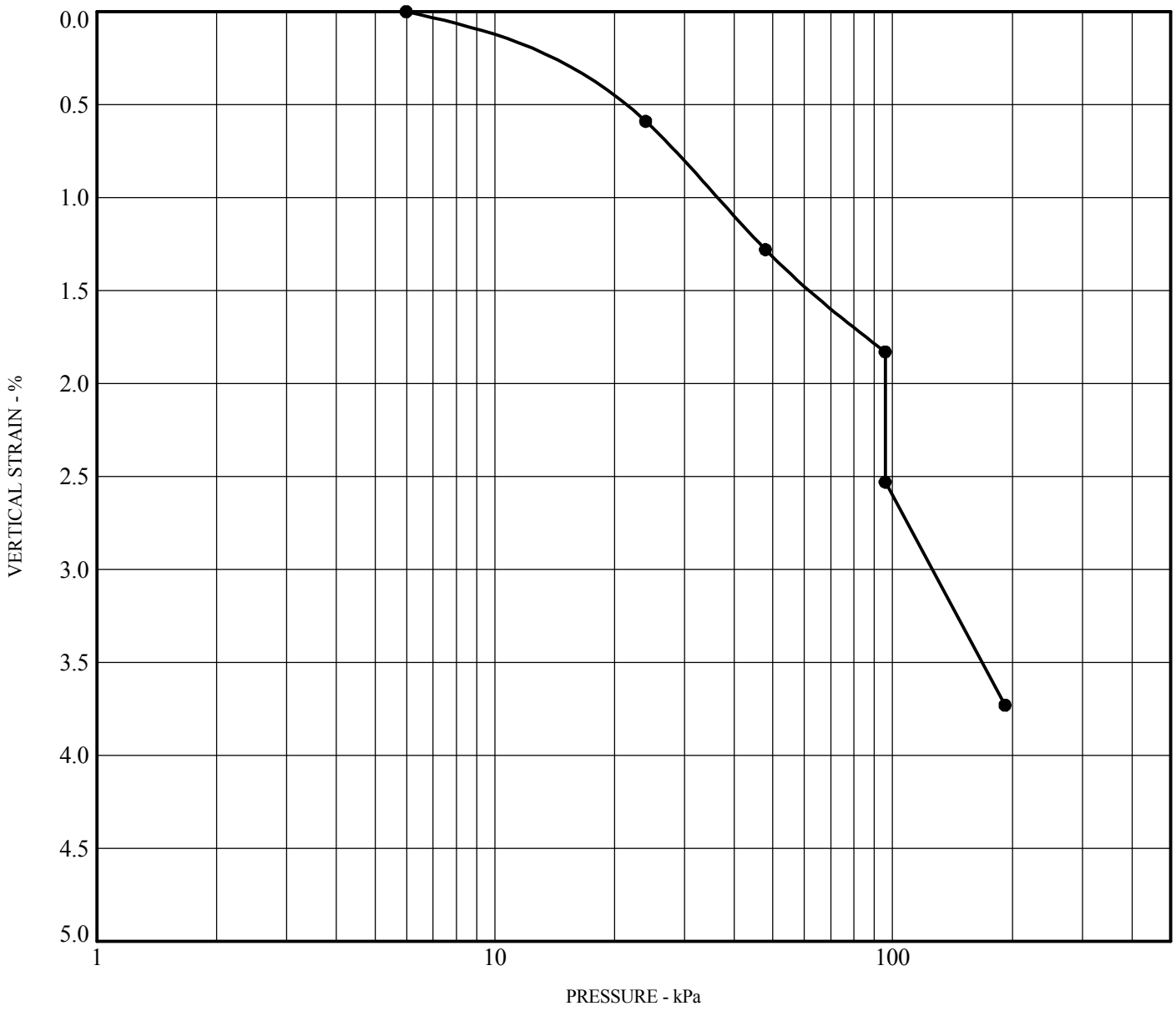
I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

COLLAPSE POTENTIAL TEST

PLATE

B-17

COLLAPSE 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09



Boring	**KB-3**
Depth (m)	**2**
Moisture Content (%)	**4.5**
Dry Density (kN/m^3)	**21.0**
Description	**Silty Sand**
Classification	**SM**
Collapse Potential (%)	**0.7**
Severity of Problem	

NOTE : 1 kPa = 21 psf

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PROJECT NO. 76979

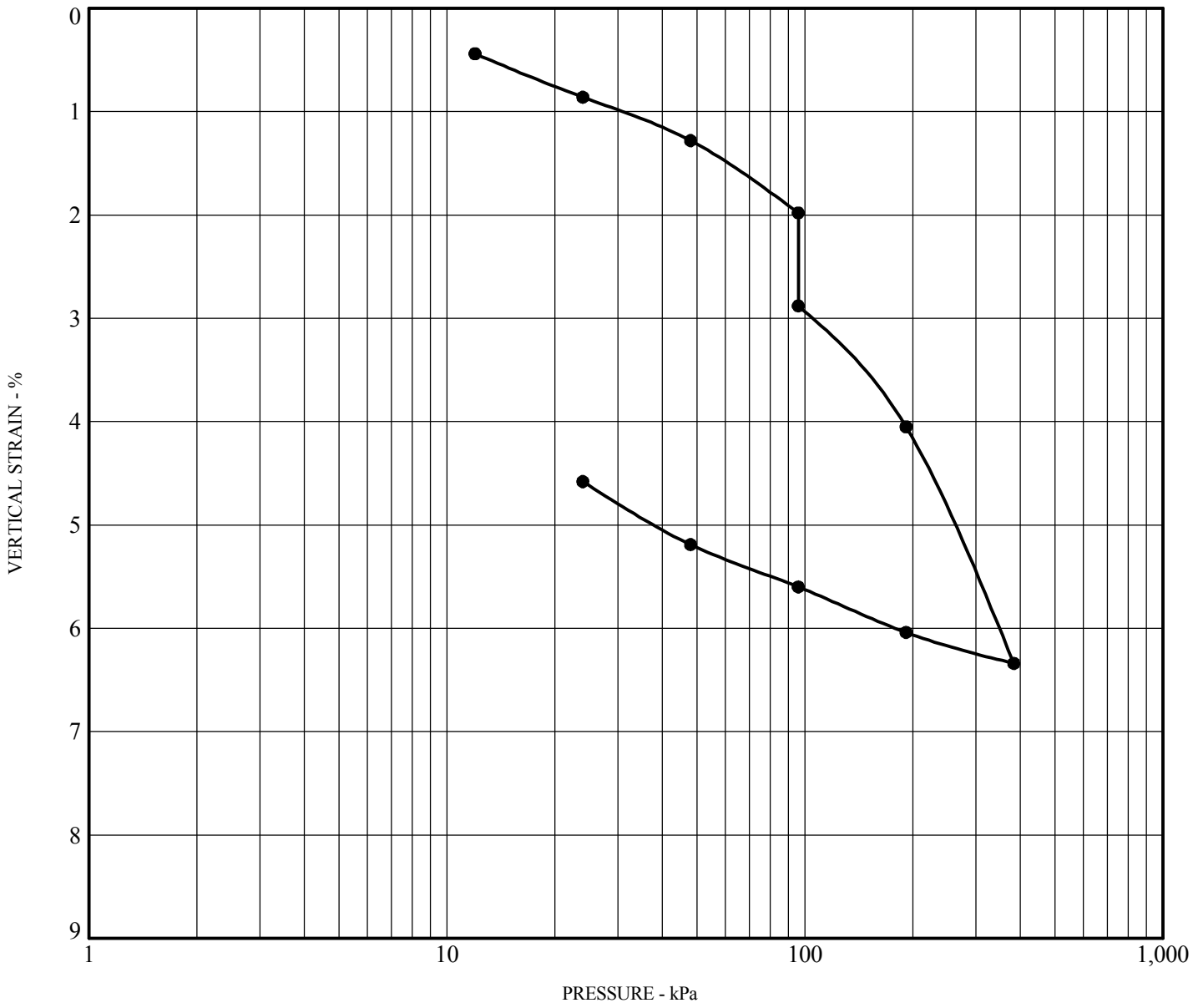
I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

COLLAPSE POTENTIAL TEST

PLATE

B-18

COLLAPSE 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09



Boring	**BS-1**			
Depth (meters)	**5**			
Moisture Content (%)	**7.9**	**Before**	**16.4**	**After**
Dry Density (kN/m^3)	**18.5**			
Description	**Silty Sand**			
Classification	**SM**			

NOTE : 1 kPa = 21 psf
SPECIMEN FLOODED
AT 2000 psf

KLEINFELDER
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PROJECT NO. 76979

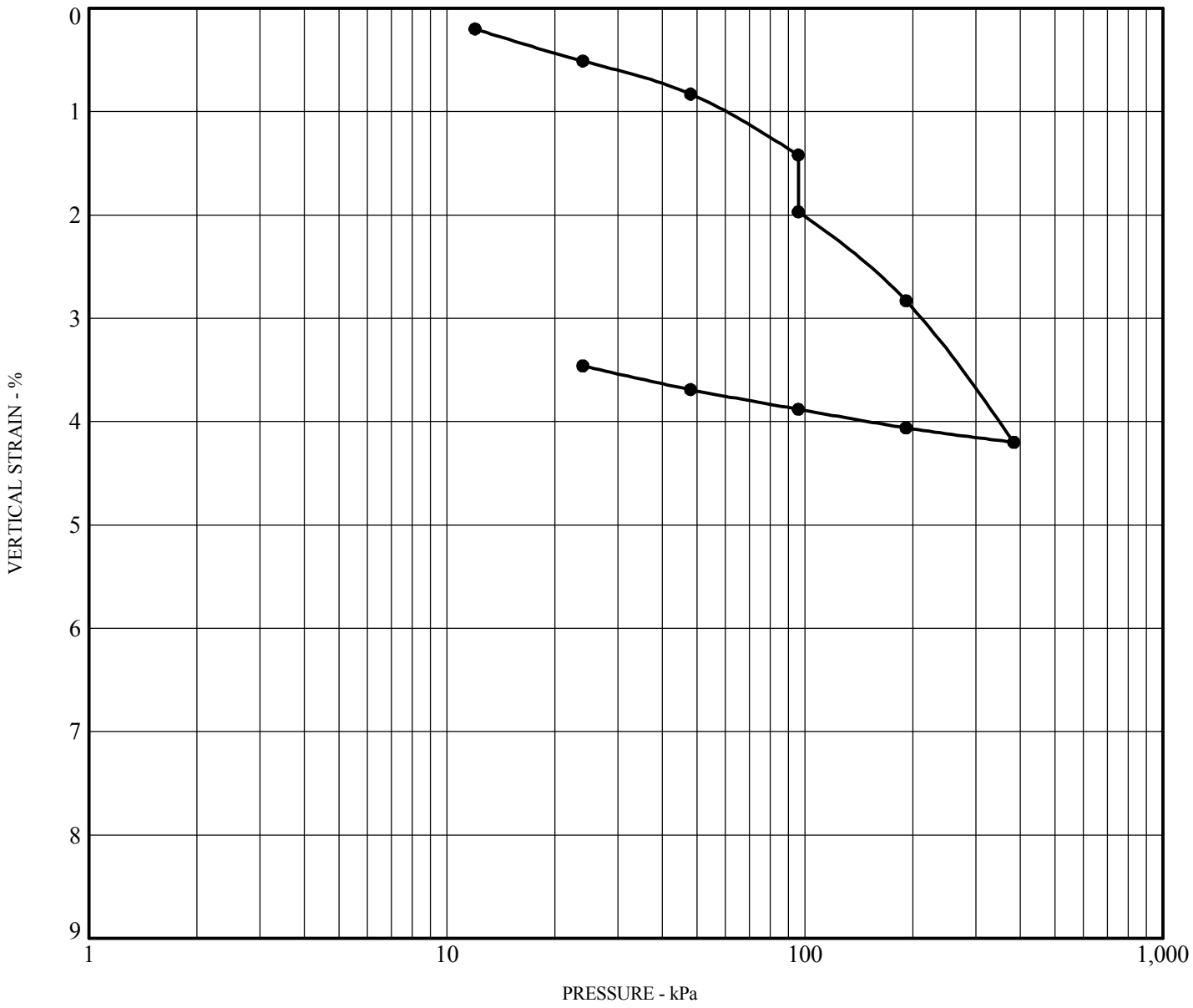
I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

CONSOLIDATION/COLLAPSE POTENTIAL TEST

PLATE

B-19

CONSOL NO INDICIES 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**BS-2**			
Depth (meters)	**2**			
Moisture Content (%)	**9.9**	**Before**	**12.9**	**After**
Dry Density (kN/m^3)	**18.8**			
Description	**Silty Sand**			
Classification	**SM**			

NOTE : 1 kPa = 21 psf
SPECIMEN FLOODED
AT 2000 psf

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I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

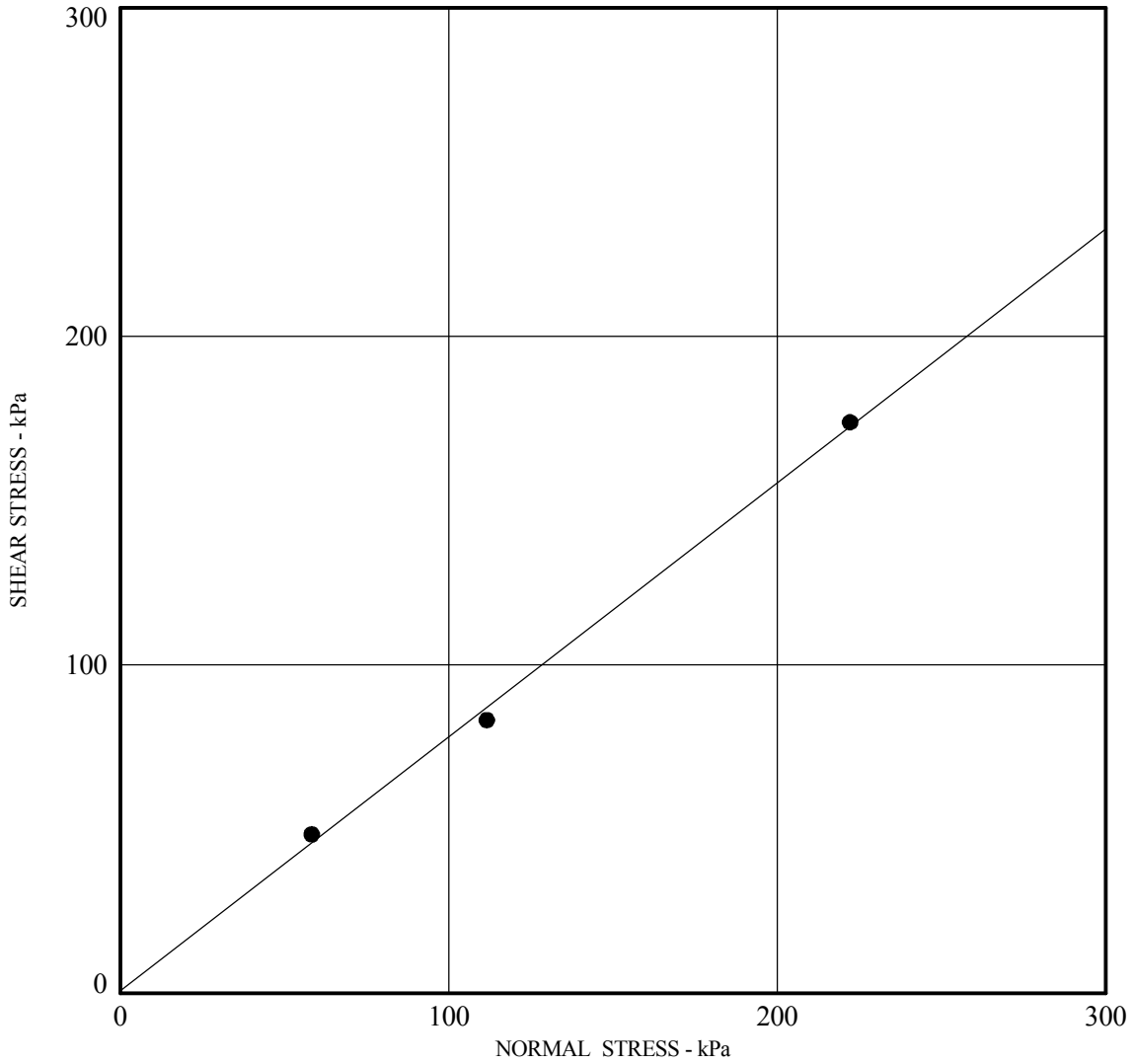
PLATE

B-20

PROJECT NO. 76979

CONSOLIDATION/COLLAPSE POTENTIAL TEST

CONSOL NO INDICIES 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**KB-1**
Depth (m)	**0 - 1.5**
Friction Angle - deg	**38**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**18.5**
Moisture Content (%) *	**9.0**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 76979

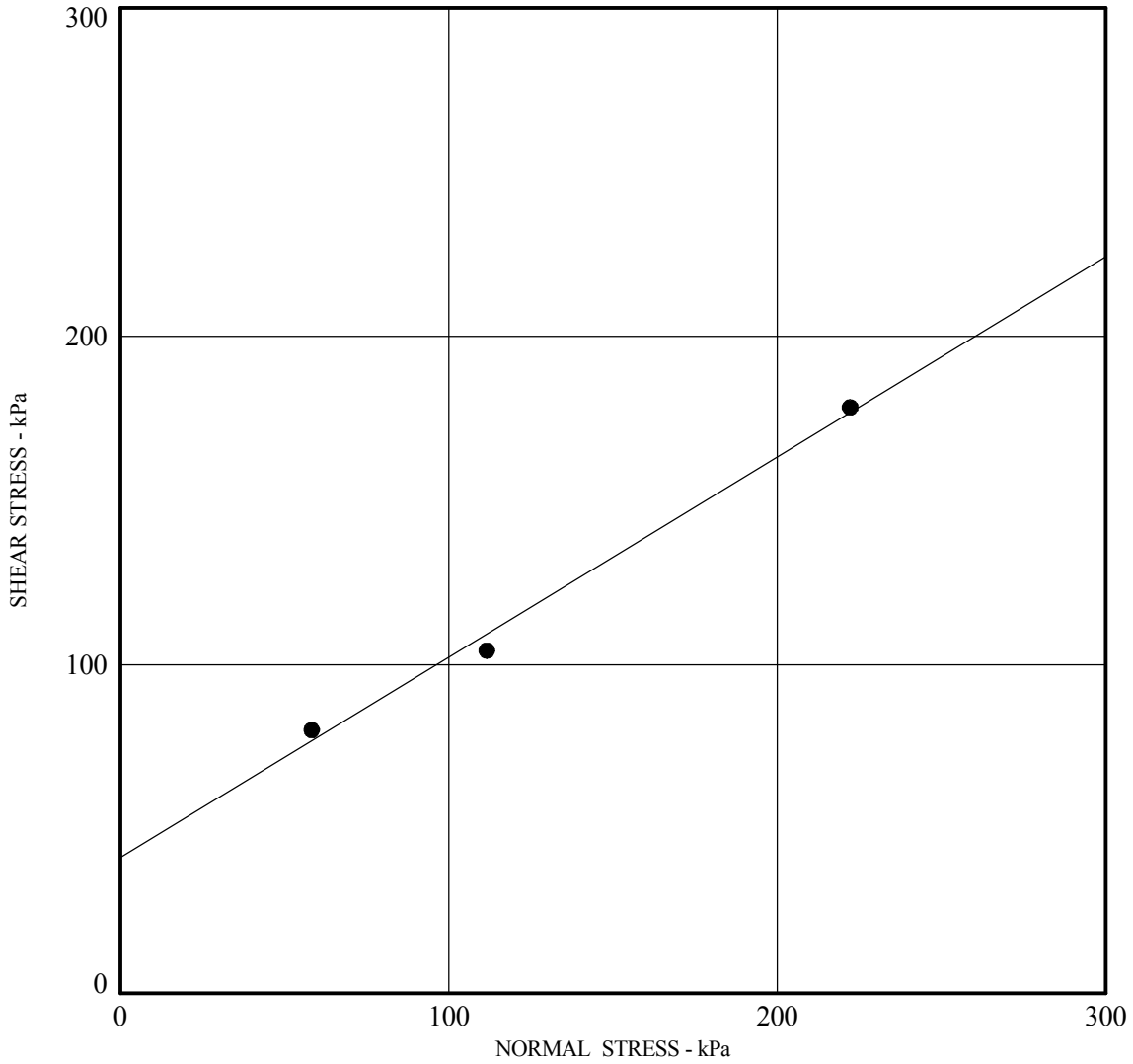
I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

DIRECT SHEAR TEST

PLATE

B-21

DIRECT SHEAR STATION 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09



Boring	**KB-3**
Depth (m)	**2**
Friction Angle - deg	**31**
Cohesion (kPa)	**41.2**
Dry Density (kN/m^3)	**21.0**
Moisture Content (%) *	**4.5**
Description	**Tonalite**
Classification	**SM**

*** In-situ Test**

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PROJECT NO. 76979

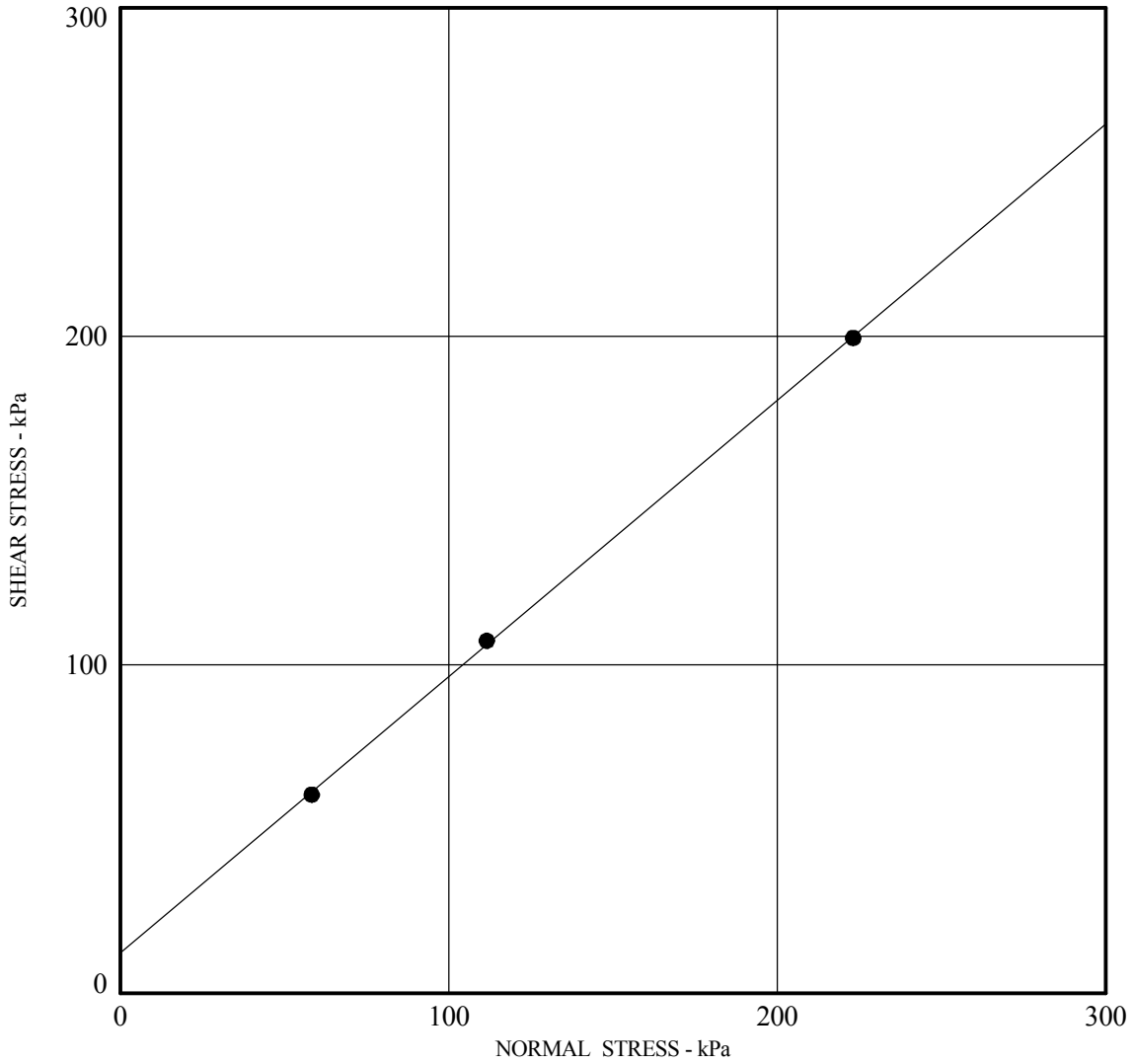
I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

DIRECT SHEAR TEST

PLATE

B-22

DIRECT SHEAR STATION 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 1/9/09



Boring	**HV- 1**
Depth (m)	**3**
Friction Angle - deg	**40**
Cohesion (kPa)	**12.3**
Dry Density (kN/m^3)	**20.8**
Moisture Content (%) *	**6.1**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

KLEINFELDER
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PROJECT NO. 76979

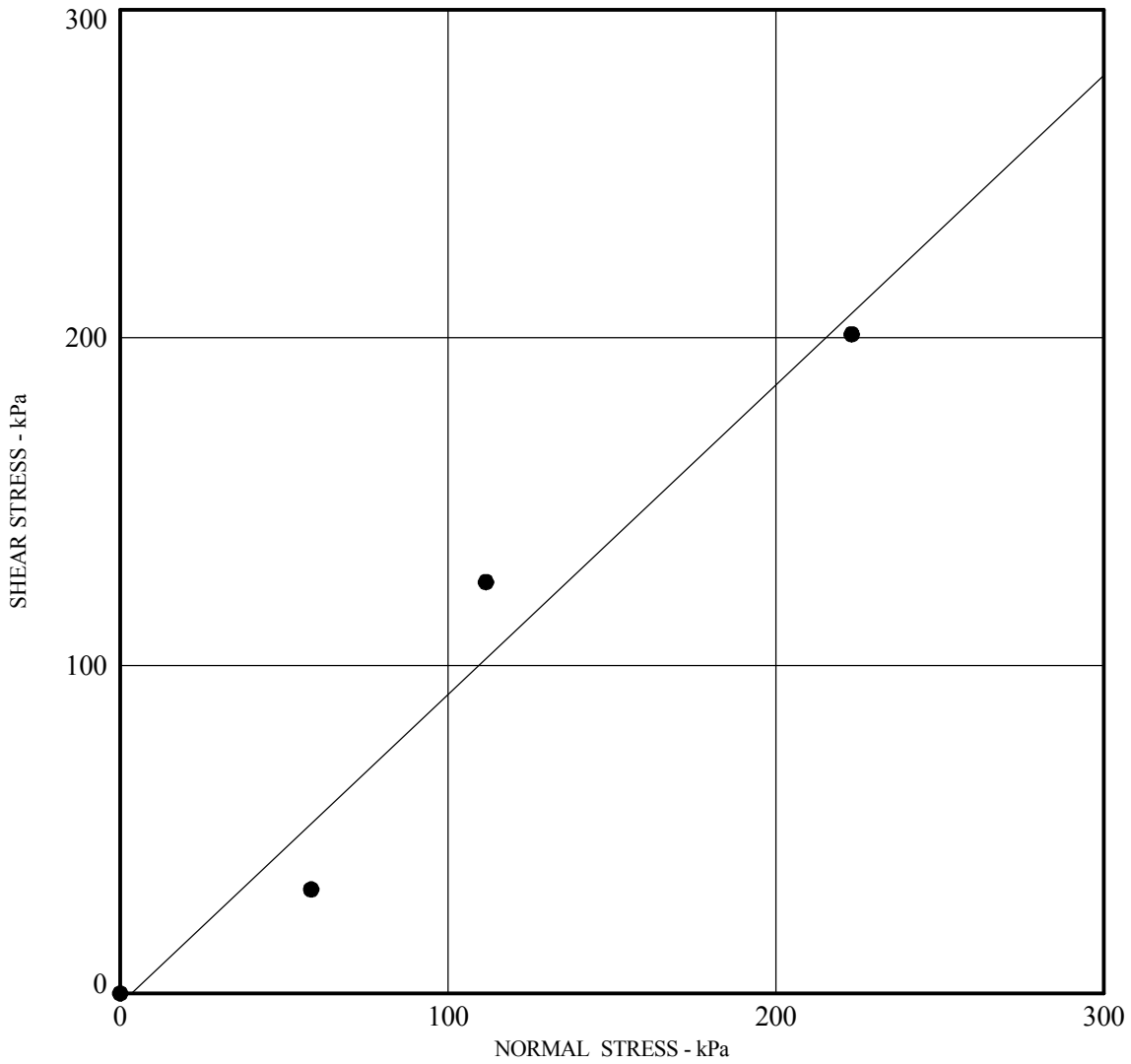
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-23

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**HV- 3**
Depth (m)	**15**
Friction Angle - deg	**43**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**20.0**
Moisture Content (%) *	**3.0**
Description	**Tonalite**
Classification	

*** In-situ Test**

KLEINFELDER
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PROJECT NO. 76979

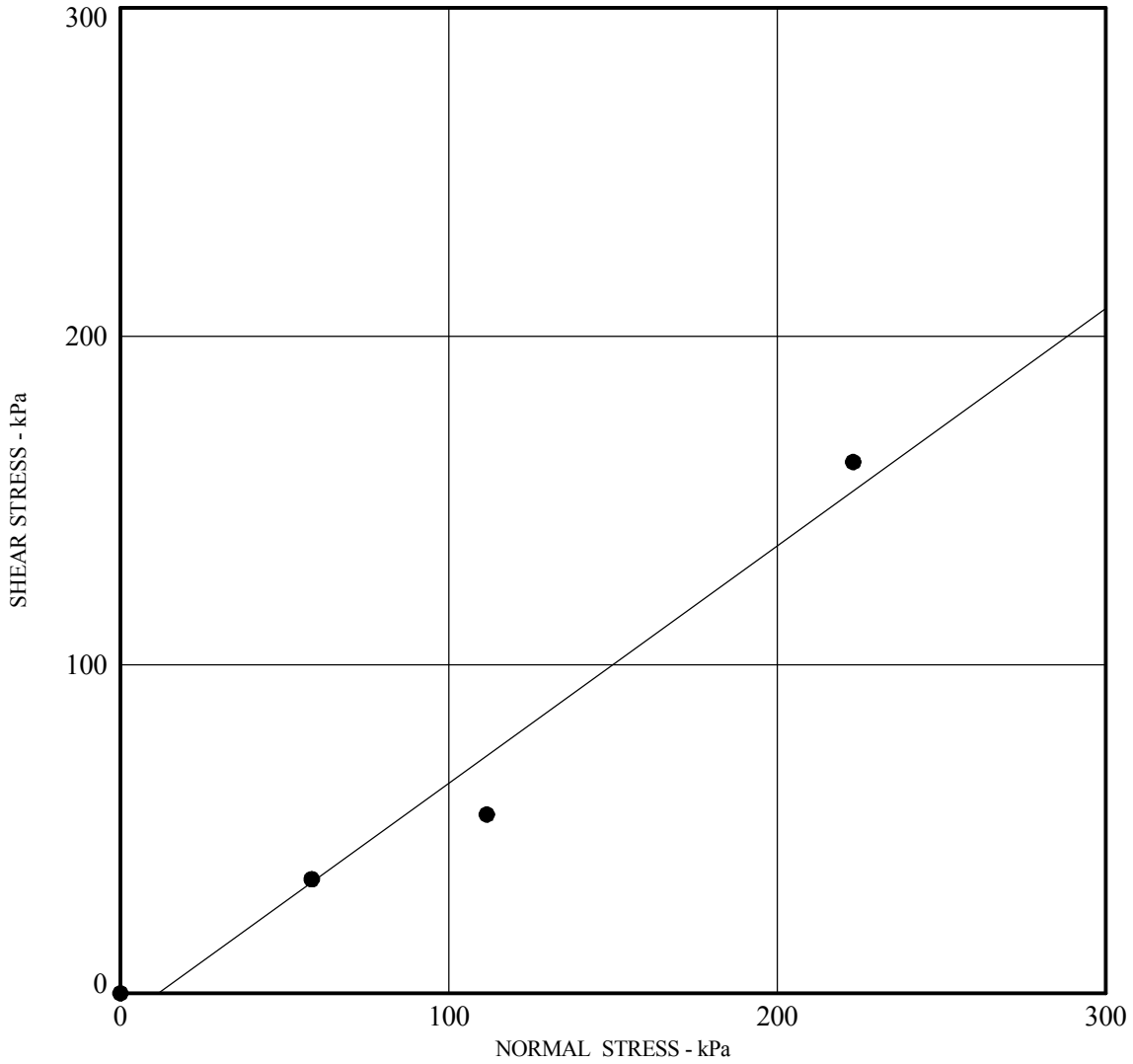
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-24

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**HV- 5**
Depth (m)	**9**
Friction Angle - deg	**36**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**20.0**
Moisture Content (%) *	**9.4**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

KLEINFELDER
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PROJECT NO. 76979

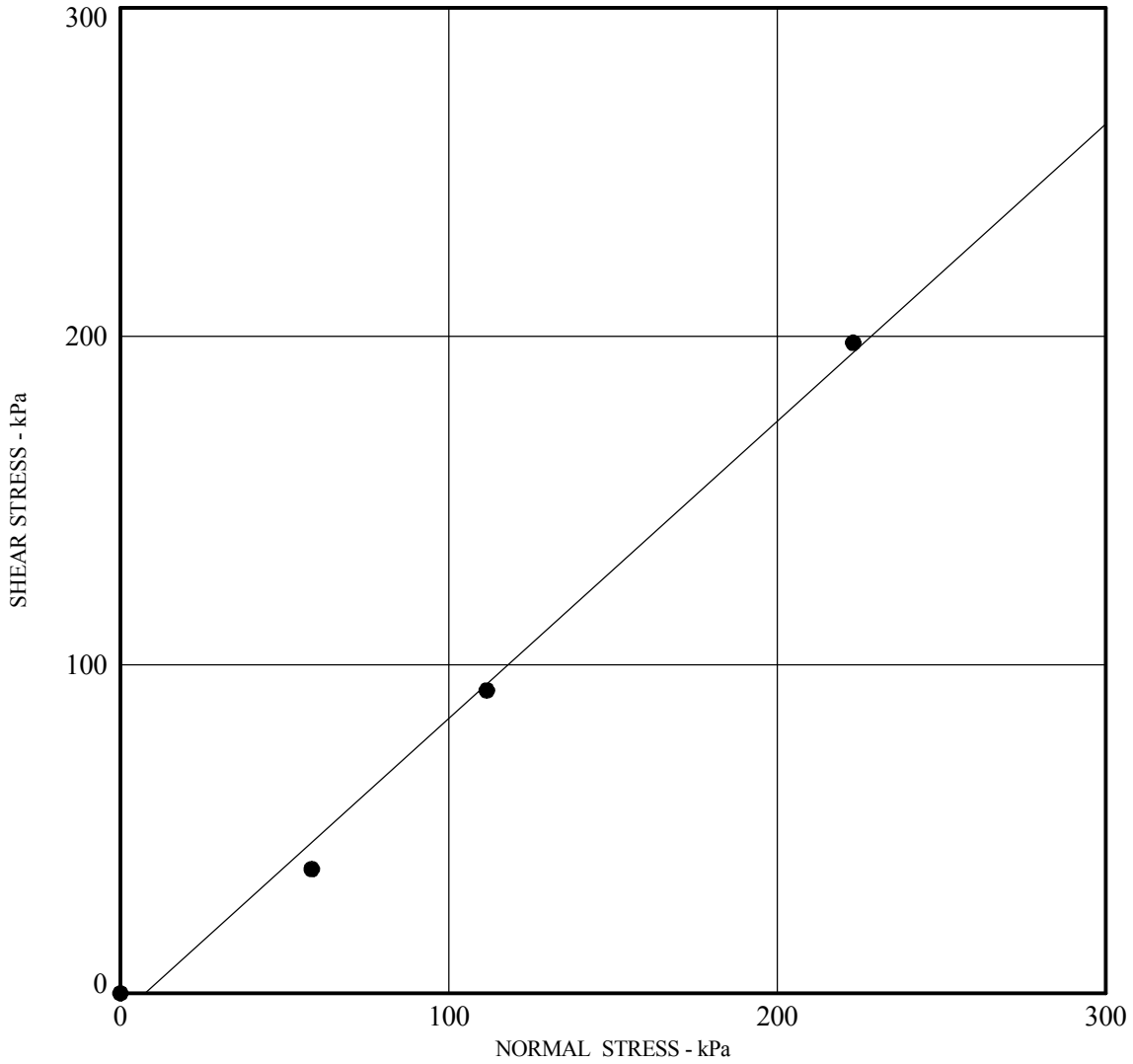
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-25

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**HV- 6**
Depth (m)	**2**
Friction Angle - deg	**42**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**17.2**
Moisture Content (%) *	**1.2**
Description	**Sand with Silt**
Classification	**SW-SM**

*** In-situ Test**

KLEINFELDER
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PROJECT NO. 76979

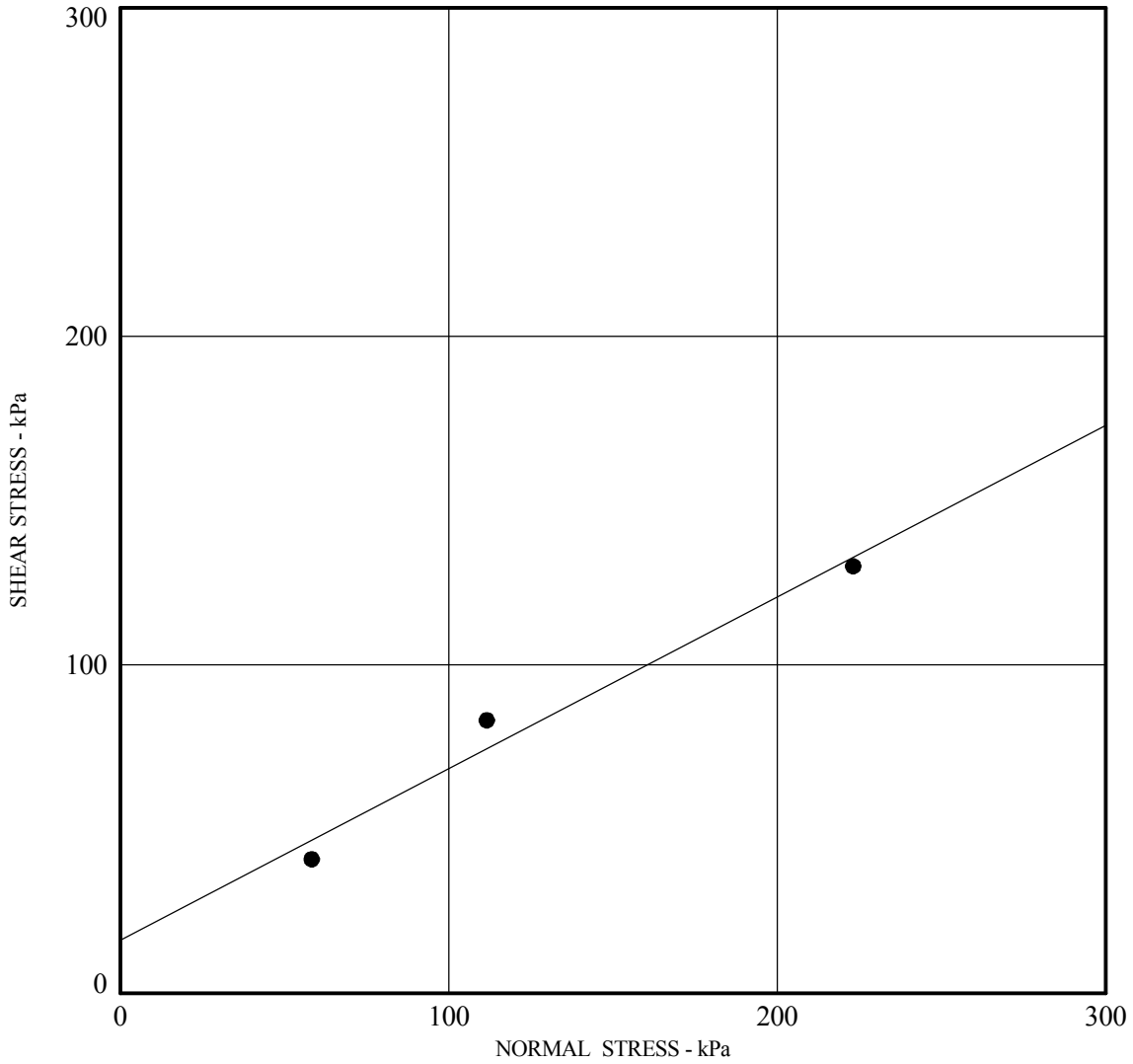
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-26

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**HV- 8**
Depth (m)	**6**
Friction Angle - deg	**28**
Cohesion (kPa)	**16.2**
Dry Density (kN/m^3)	**20.3**
Moisture Content (%) *	**8.1**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

KLEINFELDER
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PROJECT NO. 76979

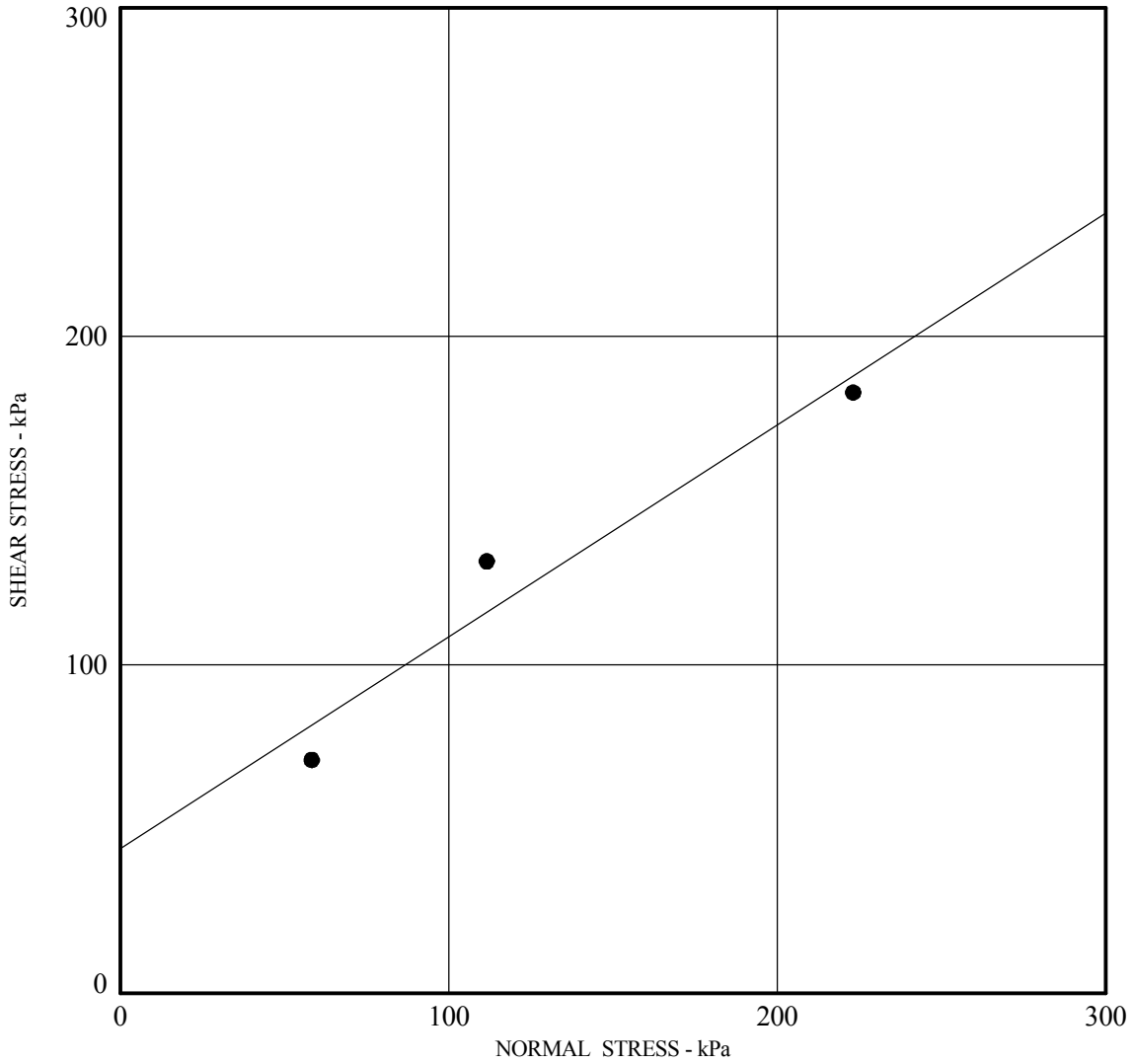
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-27

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**BS-1**
Depth (m)	**2**
Friction Angle - deg	**33**
Cohesion (kPa)	**44.0**
Dry Density (kN/m^3)	**20.4**
Moisture Content (%) *	**7.2**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

KLEINFELDER
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PROJECT NO. 76979

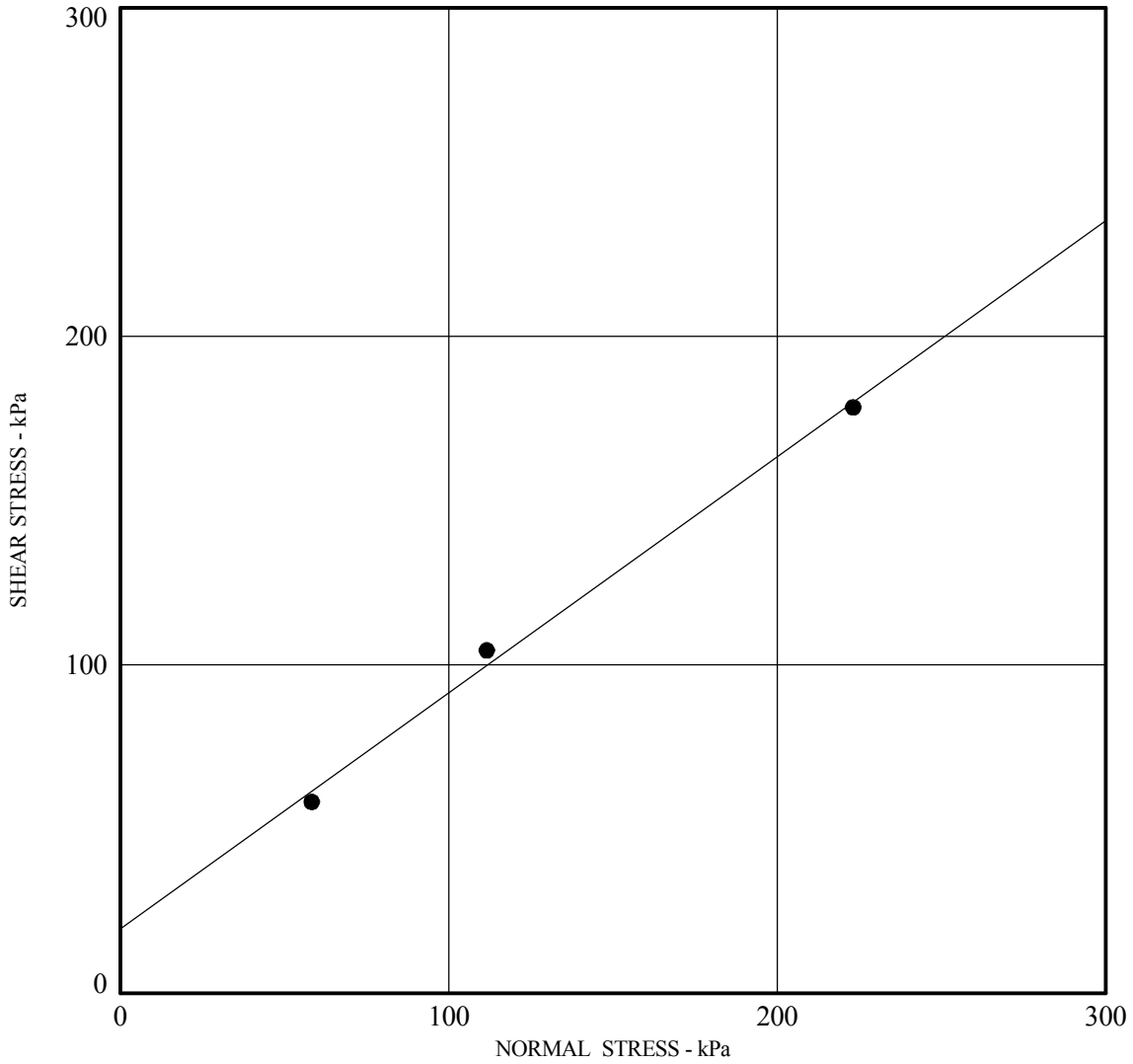
I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

DIRECT SHEAR TEST

PLATE

B-28

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/9/09



Boring	**BD-1**
Depth (m)	**5**
Friction Angle - deg	**35**
Cohesion (kPa)	**19.6**
Dry Density (kN/m^3)	**20.1**
Moisture Content (%) *	**7.8**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

KLEINFELDER
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PROJECT NO. 76979

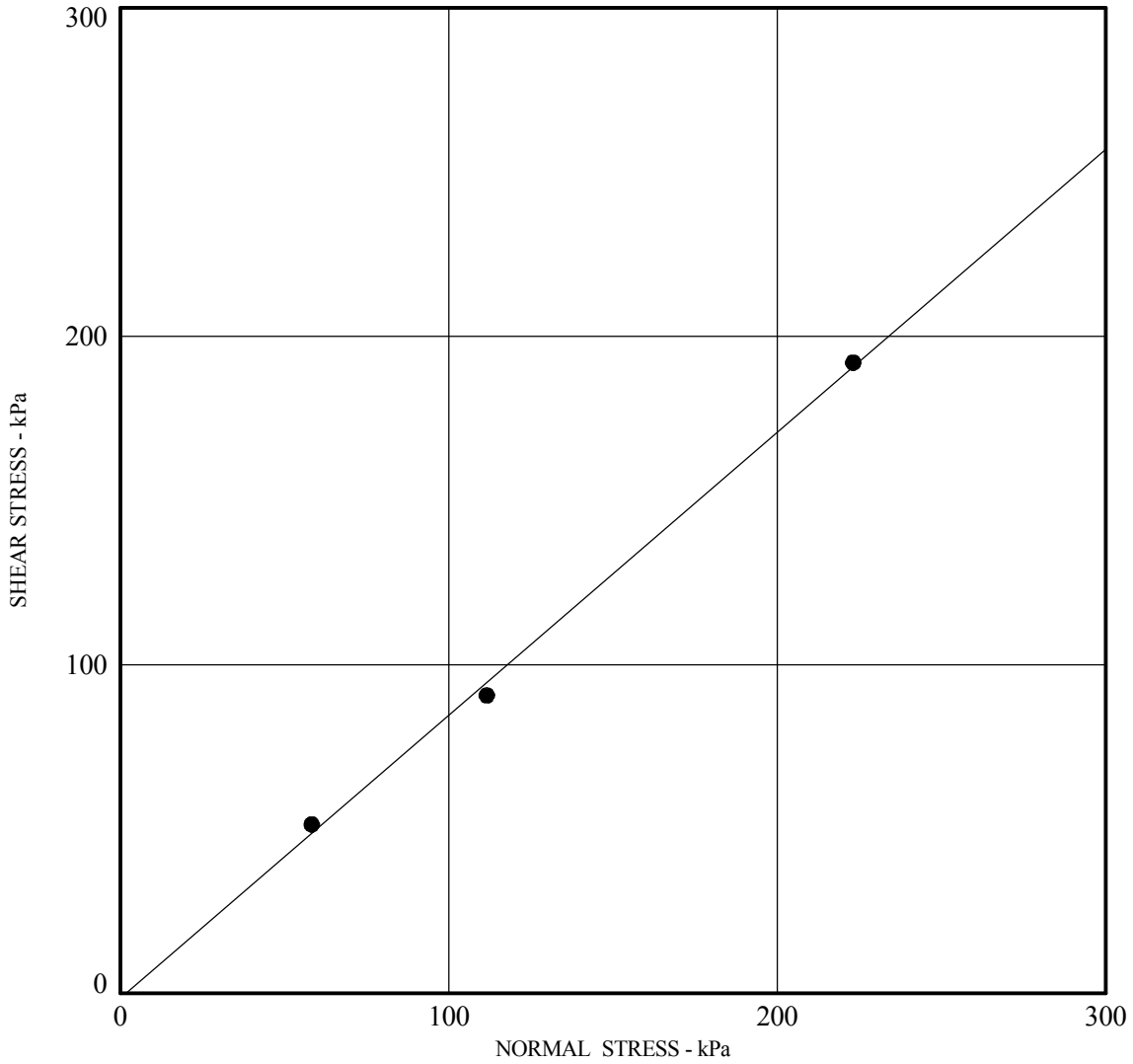
I-215/SR60 East Junction
Riverside, California

DIRECT SHEAR TEST

PLATE

B-29

DIRECT SHEAR STATION 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09



Boring	**BD-1**
Depth (m)	**8**
Friction Angle - deg	**40**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**18.5**
Moisture Content (%) *	**5.6**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

KLEINFELDER
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PROJECT NO. 76979

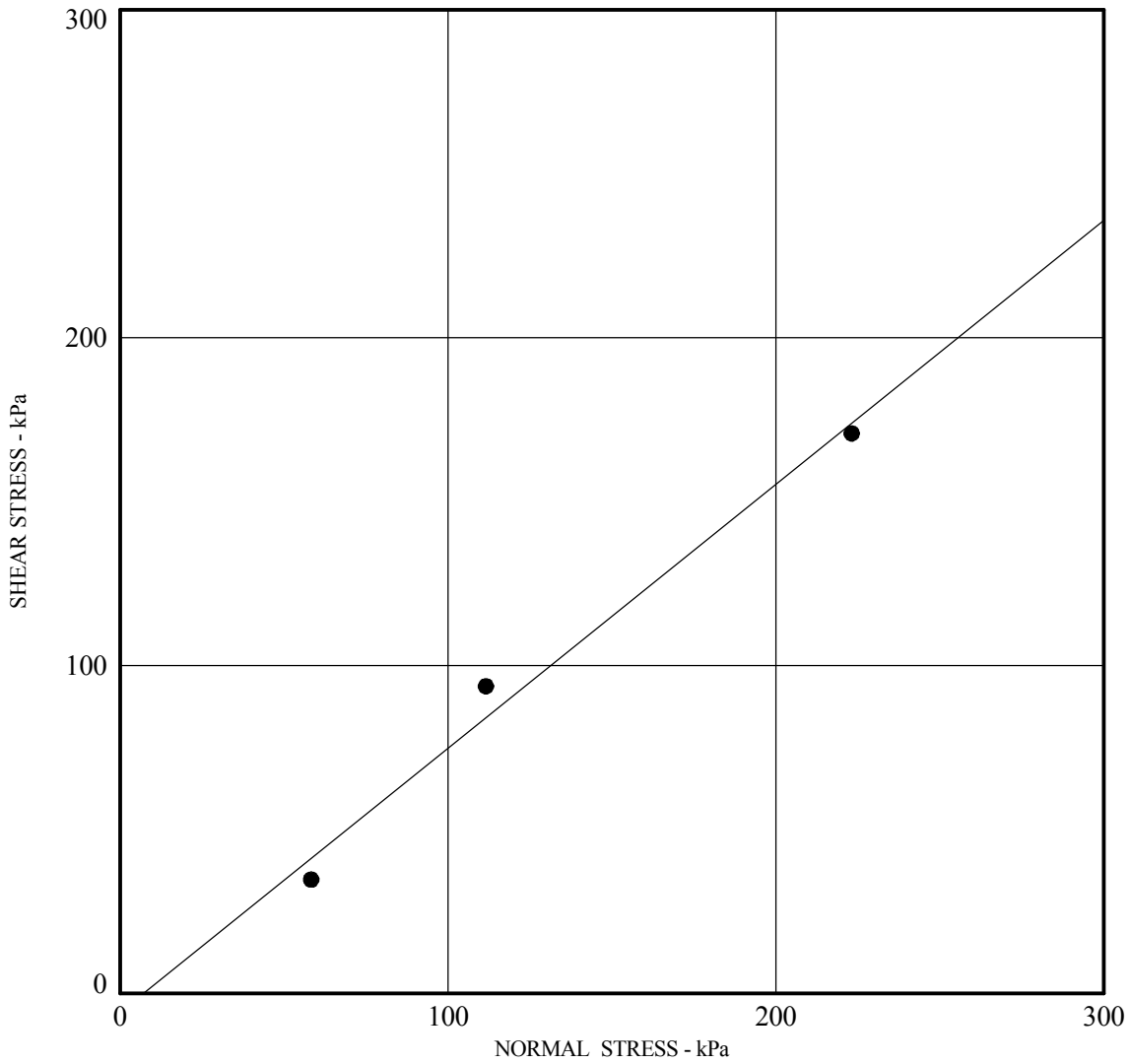
I-215/SR60 East Junction
Riverside, California

DIRECT SHEAR TEST

PLATE

B-30

DIRECT SHEAR STATION 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09



Boring	**BD-2**
Depth (m)	**0 - 1.5**
Friction Angle - deg	**37**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**19.3**
Moisture Content (%) *	**7.0**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

KLEINFELDER
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PROJECT NO. 76979

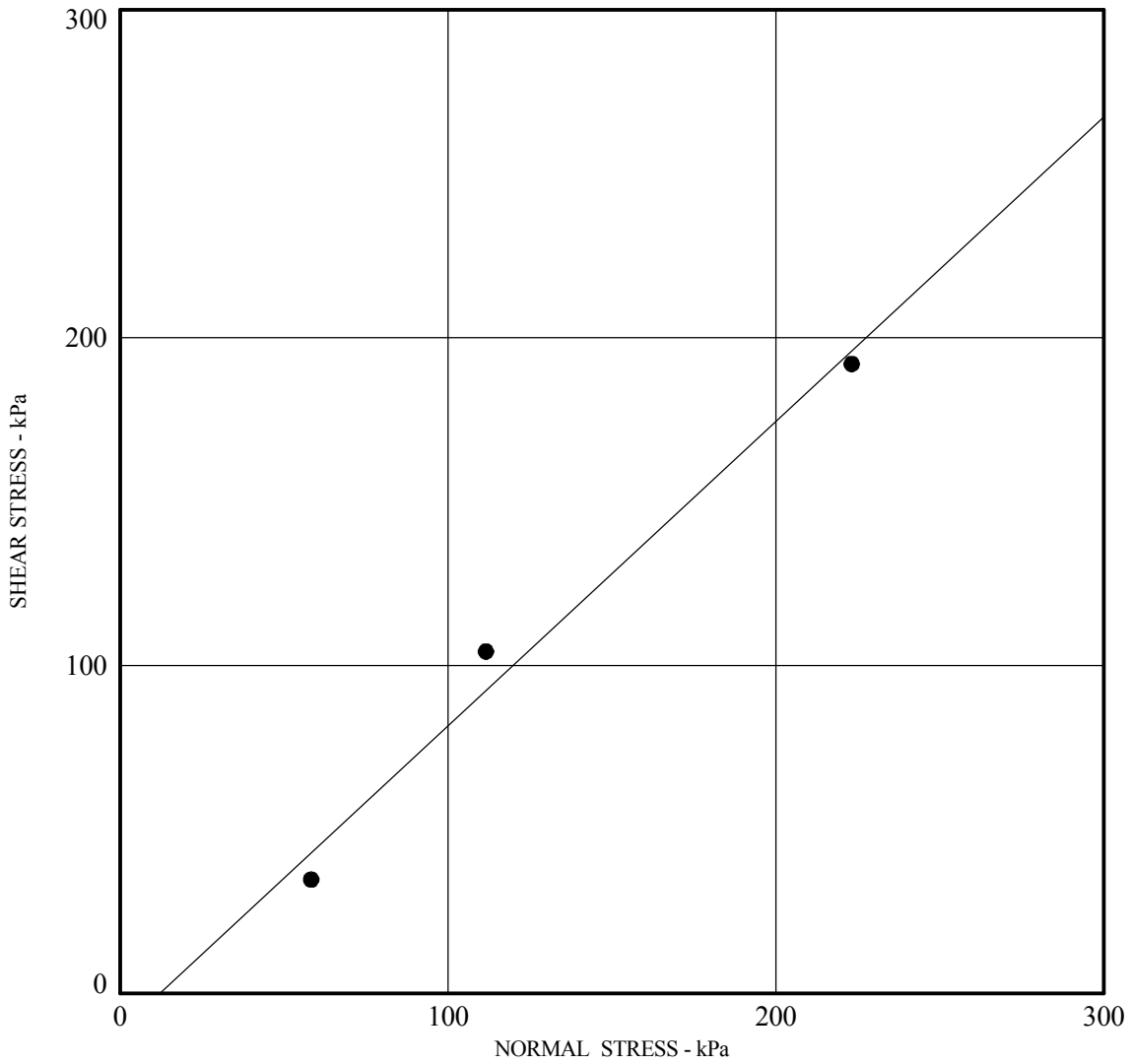
I-215/SR60 East Junction
Riverside, California

DIRECT SHEAR TEST

PLATE

B-31

DIRECT SHEAR STATION 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09



Boring	**BD-2**
Depth (m)	**11**
Friction Angle - deg	**40**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**17.3**
Moisture Content (%) *	**3.9**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

KLEINFELDER
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PROJECT NO. 76979

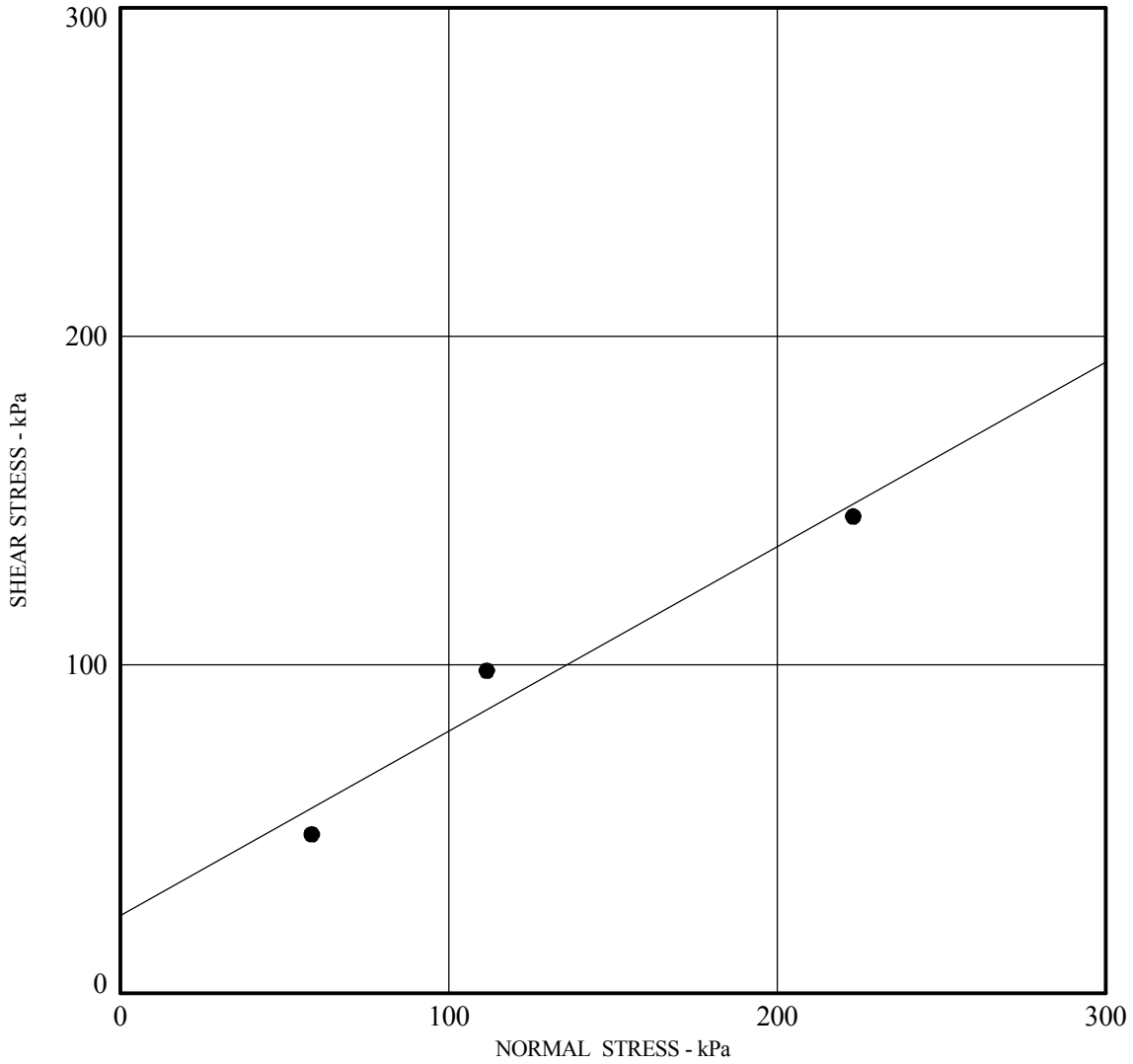
I-215/SR60 East Junction
Riverside, California

DIRECT SHEAR TEST

PLATE

B-32

DIRECT SHEAR STATION 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09



Boring	**BD-3**
Depth (m)	**9**
Friction Angle - deg	**29**
Cohesion (kPa)	**23.7**
Dry Density (kN/m^3)	**19.2**
Moisture Content (%) *	**11.6**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

DIRECT SHEAR TEST

PLATE

B-33

DIRECT SHEAR STATION 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 1/9/09

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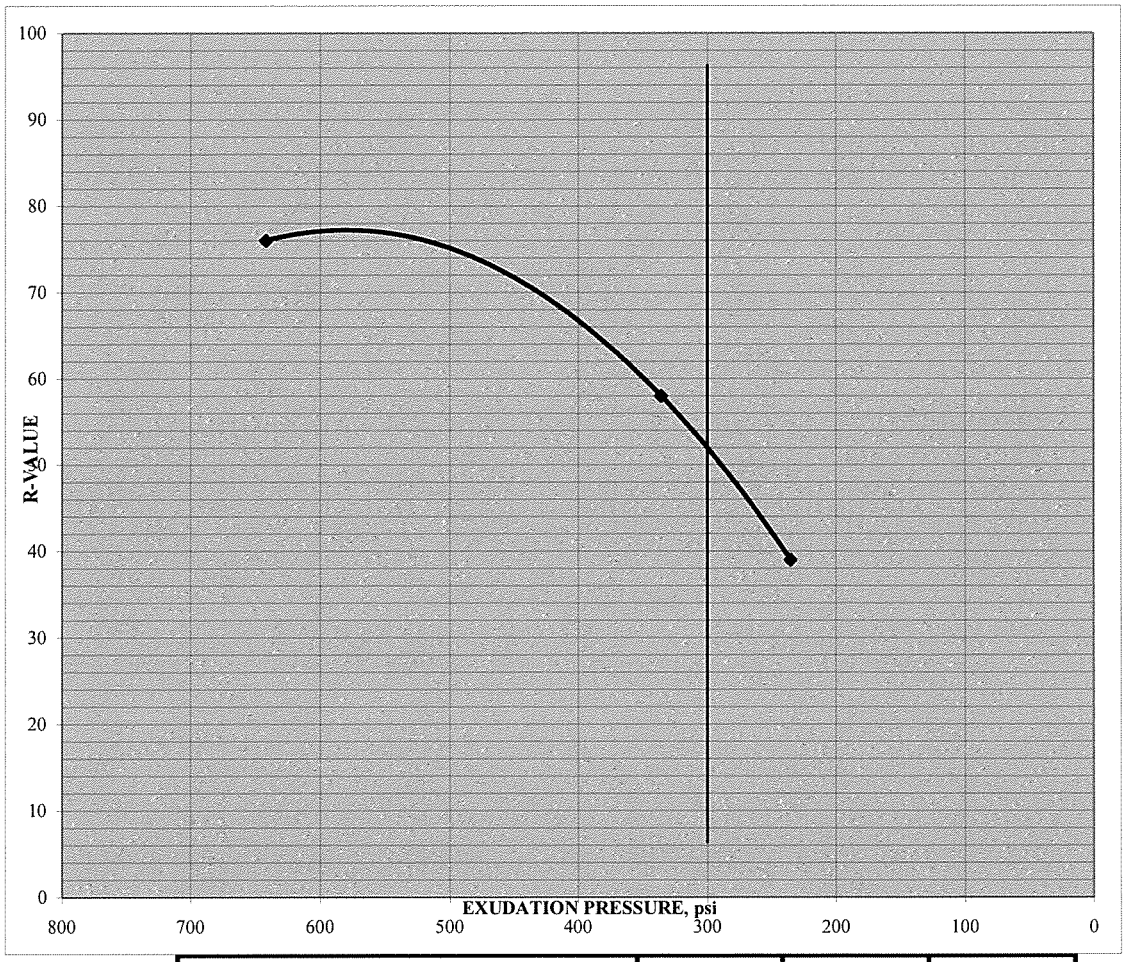
RESISTANCE VALUE

Project Name: I-215/SR-60 East Junction
Project No.: 76979
Sample No.: HV-9 @ 0-5'
Material Description: Silty Sand (SM)
Report Date:



Specimen No.	A	B	C
Moisture at Test, %	11.0	10.5	9.6
Dry Unit Weight at Test, pcf	126.8	126.8	127.6
Expansion Pressure, psf	0	0	26
Exudation Pressure, psi	236	336	642
Resistance Value	39	58	76

R - VALUE AT 300 PSI EXUDATION PRESSURE	52

Test Procedure: California Test No. 301

1220 Research Drive, Suite B Redlands, CA 92374

KLEINFELDER
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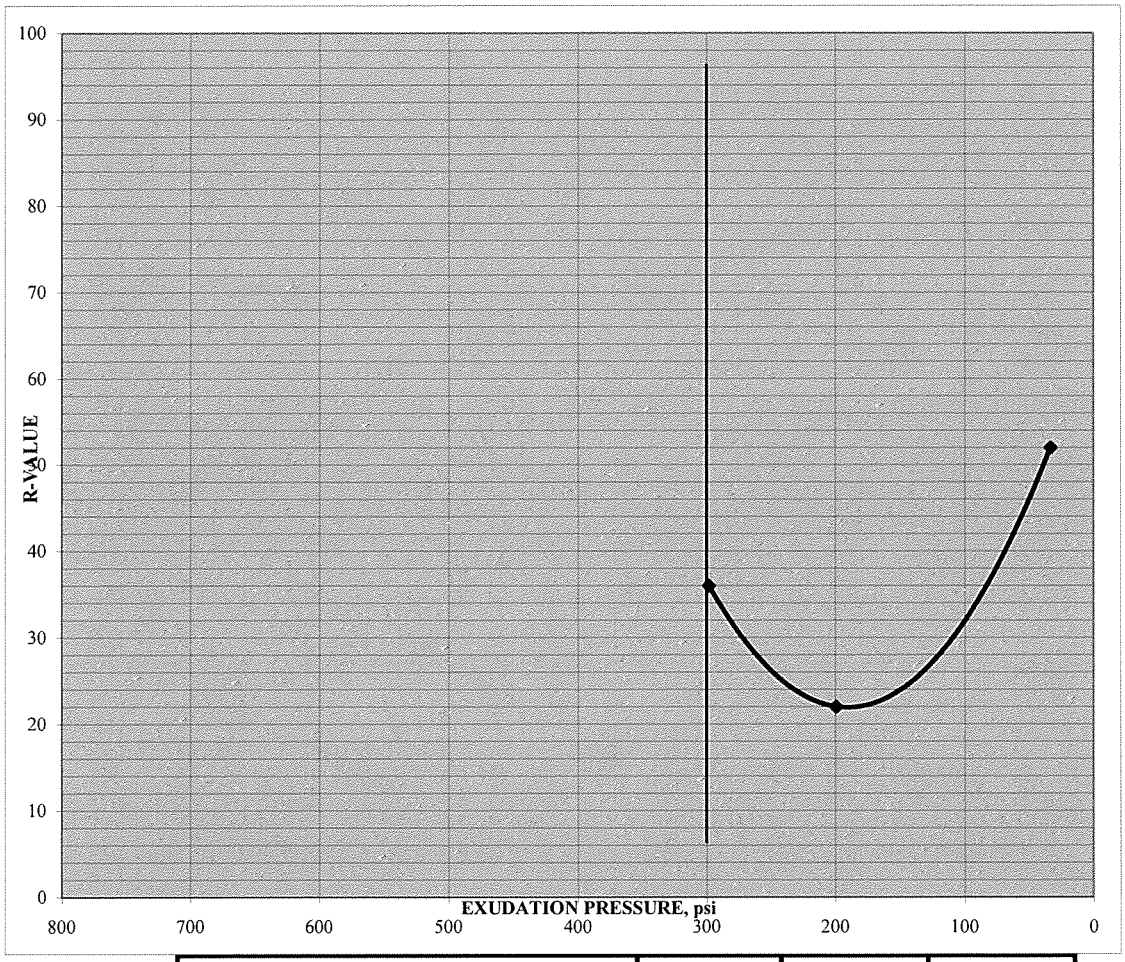
RESISTANCE VALUE

Project Name: I-215/SR-60 East Junction
Project No.: 76979
Sample No.: HV-12 @ 2-7'
Material Description: Silty Sand (SM)
Report Date:



Specimen No.	A	B	C
Moisture at Test, %	44.2	45.0	46.1
Dry Unit Weight at Test, pcf	97.7	96.5	95.0
Expansion Pressure, psf	48	30	9
Exudation Pressure, psi	33	298	200
Resistance Value	52	36	22

R - VALUE AT 300 PSI EXUDATION PRESSURE	36

Test Procedure: California Test No. 301

1220 Research Drive, Suite B Redlands, CA 92374

KLEINFELDER
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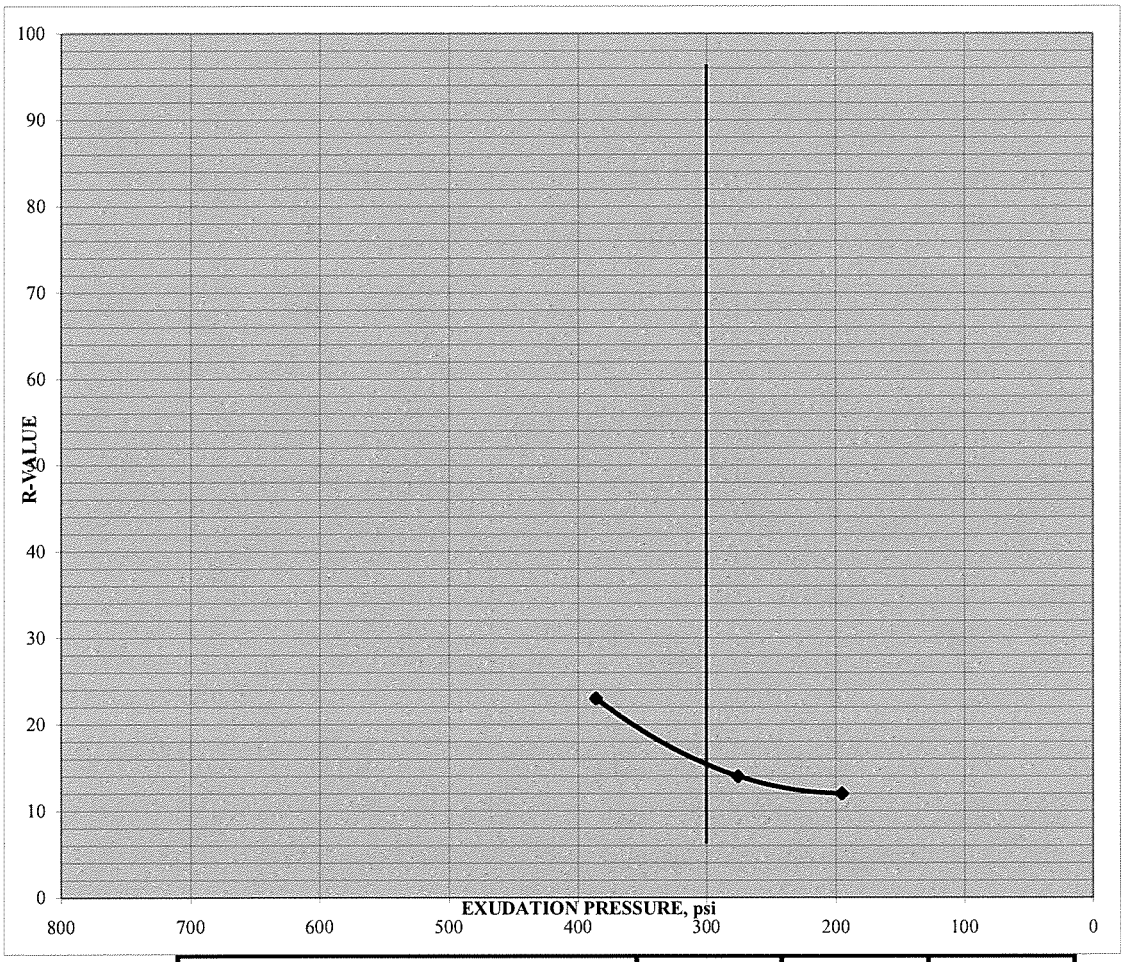
RESISTANCE VALUE

Project Name: I-215/SR-60 East Junction
Project No.: 76979
Sample No.: HV-18 @ 0-5'
Material Description: Silty Sand (SM)
Report Date:



Specimen No.	A	B	C
Moisture at Test, %	11.9	11.3	10.6
Dry Unit Weight at Test, pcf	122.6	124.4	126.9
Expansion Pressure, psf	0	0	26
Exudation Pressure, psi	196	276	386
Resistance Value	12	14	23

R - VALUE AT 300 PSI EXUDATION PRESSURE	16

Test Procedure: California Test No. 301

1220 Research Drive, Suite B Redlands, CA 92374

REVISED FINAL
STRUCTURE FOUNDATION REPORT
BOX SPRINGS OVERHEAD LEFT BRIDGE (WIDEN)
BRIDGE NO. 56-0082L
INTERSTATE 215/STATE ROUTE 60
EAST JUNCTION IMPROVEMENTS
CITY OF RIVERSIDE, CALIFORNIA
08-RIV-215/60, KP 61.7/62.6, 19.4/21.5
CALTRANS EA NO. 08-449311

Prepared for:

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER WEST, INC.
1220 Research Drive, Suite B
Redlands, CA 92374

Kleinfelder Project No. 76979

Revised June 15, 2009
July 18, 2008

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APPROVAL LETTER

State of California | Business, Transportation and Housing Agency

Flex your power!
Be energy efficient!

Memorandum

To: Mr. Denix D. Anbiah
Department of Transportation
Division of Engineering Services
Office of Special Funded Projects MS #9- 2/7G

Date: September 17, 2009

File: EA 08-449311
08-RIV-56-0082L
(Widen)

Attention: Robert Zezoff

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES - MS #5
OFFICE OF GEOTECHNICAL DESIGN SOUTH-2

Subject: Caltrans OSFP Review Comments

References: Addendum to Structure Foundation Report (dated June 15, 2009), Box Springs Overhead Left Bridge (Widen), Bridge No. 56-0082L, Interstate 215/State Route 60 East Junction Improvements, City of Riverside, California, 08-Riv-215/60, KP 61.7/62.6, 19.4/21.5, Caltrans EA No. 08-449311, dated August 19, 2009, by Kleinfelder West, Inc., Project No. 76979.

The submitted Addendums to the Structure Foundation Report by Kleinfelder West, Inc. for the above-proposed project was found to generally satisfy the requirements of Caltrans' Structure Foundation Report Guidelines, based upon the responses to the review comments (dated July 28, 2009)

Any questions regarding the review comments and recommendations should be directed to the attention of K. Douglas Cook (916) 227-4514 or Angel Perez-Cobo (916) 227-7167, Office of Geotechnical Design South-2 A.

Prepared by:

K. Douglas Cook , CEG date:_____
Engineering Geologist

KDC/AW

Reviewed by:

Angel Perez-Cobo, PE date:_____
Senior Transportation Engineer
Office of Geotechnical Design South-2

Distribution: (2) Addressee

ADDENDUM

1220 Research Drive
Suite B
Redlands, CA 92374
p| 909.793.2691
f| 909.792.1704
kleinfelder.com

August 19, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

via Electronic Mail
Mohan.Char@lanengineering.com
Kimberly.Gee@lanengineering.com

Subject: Addendum to Revised Final Structure Foundation Report (Dated June 15, 2009)
Box Springs Overhead Left Bridge (Widen)
Bridge No. 56-0082L
Interstate 215/State Route 60 East Junction Improvements
City of Riverside, California
08-RIV-215/60, KP 61.7/62.6, 19.4/21.5
Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder has prepared this addendum report in response to comments provided by the California Department of Transportation (Caltrans), Division of Engineering Services, Geotechnical Services- MS #5, Office of Geotechnical Design South-2, pertaining to their review of our report entitled Revised Final Structure Foundation Report, Box Springs Overhead Left Bridge (Widen), Bridge No. 56-0082L, Interstate 215/State Route 60 East Junction Improvements, City of Riverside, California, dated June 15, 2009. The Caltrans review comments and our responses to these comments are attached.

CLOSURE

The information contained in this report/letter is subject to the conditions and limitations contained within the structure foundation report. We appreciate the opportunity to be of service on this project. If you have any questions, comments or require additional information, please do not hesitate to contact our office at your convenience.

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Respectfully submitted,
KLEINFELDER WEST, INC.

Madan Chirumalla, PE
Staff Engineer

REGISTERED PROFESSIONAL ENGINEER
MADAN CHIRUMALLA, PE
No. 74186
Exp. 6/30/2011
CIVIL
STATE OF CALIFORNIA

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

for: Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

PROFESSIONAL GEOLOGIST
MICHAEL O COOK
CEG #1716
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

MC/CVA:lg

Attachments: Response to Comments Form
Index to Plans Sheet
Revised LOTB sheets

REGISTERED PROFESSIONAL ENGINEER
CARLOS V. AMANTE
No. 2724
Exp. 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

Project Name: **I-215/SR-60 East Junction**
08-RIV-215/60 CU08 -EA449311
Review Phase: **Foundation Report Review**
Box Springs OH Left (Widen) Bridge No 56-0082L
Responses by: Carlos Amante/ Madan Chirumalla

RESPONSE TO COMMENTS ON FOUNDATION REPORT REVIEW –BOX SPRINGS OH LEFT (WIDEN)

Comment No.	Sheet No.	Review Comments by Douglas Cook, Farzad Omehr, & Asef Wardak	Consultant Response
1	Earth Materials	Evidently all elevations referenced in this report are based on the NGVD 29 Vertical datum. Reference to this fact was not observed in the text (body) of the report.	The vertical elevations referenced in the report are based on the National Geodetic Vertical Datum of 1929 (NGVD 29).
2	Pgs. 1 and 2	Please note that additional borings at the respective abutment and bent locations may be necessary prior to acceptance of subject report	In our opinion, additional borings are not necessary since the subsurface conditions can be adequately evaluated using the two on-site borings and existing Caltrans borings for the nearby Box Springs OH Right Bridge.
3	Pgs. 6,7,10 Sec. 4.2	Review of the cited USGS Geologic Map of the San Bernardino and Santa Ana 30'x60' Quadrangles (Morton, 2006) indicated that the site is transected by an inferred fault. Please include a copy of the geological map for the site vicinity, discuss this fault in the test of the report. Provide recommendations to address and mitigate it in the design of the project as necessary.	The inferred fault depicted on the San Bernardino and Santa Ana 30'x60' quadrangle, sheet 1of 4, (USGS Open-File Report OF-2006-1217) is a pre-Pleistocene fault. The fault does not cut Late Pleistocene or Holocene deposits as indicated on Sheet 3 of 4 of OF-2006-1217. As such the fault is not considered a "sufficiently active" or "well-defined" active fault based on the California Geological Survey criterion in CGS Special Publication 42 (2007). In addition the fault is not identified as an active fault by Caltrans on the Seismic Hazards Map used for bridge seismic design. Bridge design parameters were developed based on current Caltrans seismic design criteria and no additional mitigation recommendations for this subject fault are necessary.
4	Pgs. 12, Sec.6.1.4	Please reference the source cited for County of Riverside Liquefaction information provided.	Riverside County Land Information System http://www3.tlma.co.riverside.ca.us/pa/rclis/index.html

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Project Name: **I-215/SR-60 East Junction**
08-RIV-215/60 CU08 -EA449311
Review Phase: **Foundation Report Review**
Box Springs OH Left (Widen) Bridge No 56-0082L
Responses by: Carlos Amante/ Madan Chirumalla

Comment No.	Sheet No.	Review Comments by Douglas Cook, Farzad Omehr, & Asef Wardak	Consultant Response
5	**Pg. 15**	A Peak Bedrock Acceleration (PBA) of 0.5g is reported for the site on pages 10 and 11 of the report, yet a peak ground acceleration (PGA) of 0.39g is reported on page 15. For a Type C site the PBA and PGA should be the same. It appears that the reported PGA value of 0.39g was used in determining the horizontal peak ground acceleration (HPGA) of 0.13g as reported on page 15 and used in the analysis. If 0.5g were to be used than a HPGA of 0.17g should be used. Please review and justify the use of the lower value or revised the analysis using the larger value accordingly.	Based on Sadigh et al. (1997) attenuation relationship for soil, the peak ground acceleration (PGA) for this bridge site is 0.39g. In our opinion, the use of PBA of 0.5g is not appropriate since the bridge is founded on soil. New Generation Attenuation (NGA) relationships also indicate that peak bedrock acceleration and peak ground acceleration for Soil Profile Type C are not the same.
6	**Plans**	The 'Spread Footing Data table' appears to be still missing from the attached plan sheets (refer to Memo to Designer 4-1).	The Spread Footing Data Table is presented in the Index to Plans sheet attached in this addendum report.

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Business, Transportation and Housing Agency

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Memorandum

To: Mr. Denix D. Anbiah
Department of Transportation
Division of Engineering Services
Office of Special Funded Projects MS #9- 2/7G

Date: July 28, 2009

File: 08-RIV-56-0082L
EA 08-449311
Box Springs OH
Left Bridge Widen

Attention: Robert Zezoff

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES - MS #5
OFFICE OF GEOTECHNICAL DESIGN SOUTH-2

Subject: Caltrans OSFP Review Comments

References: Revised Final Structural Foundation Report, Box Springs Overhead Left Bridge (Widen), Bridge No. 56-0082L, Interstate 215/State Route 60 East Junction, City of Riverside, California, 08-Riv-215/60, KP 61.7/62.6, 19.4/21.5, Caltrans EA No. 08-449311, dated Revised June 15, 2009 (July 18, 2008), by Kleinfelder West, Inc., Project No. 76979.

The submitted Revised Final Foundation Report by Kleinfelder West, Inc. for the above-proposed project **GENERALLY SATISFIES** the requirements of Caltrans' Geotechnical Design Report Guidelines. Please incorporate your response to the attached comments as an addendum to the current report.

Any questions regarding the review comments and recommendations should be directed to attention of K. Douglas Cook (916) 227-4514 or Angel Perez-Cobo (916) 227-7167, Office of Geotechnical Design South-2.

Prepared by:

K. Douglas Cook, CEG date: 7/28/09
Engineering Geologist

Reviewed by:

Bill Lewis for Angel Perez-Cobo

Angel Perez-Cobo, PE date: 7/28/09
Senior Transportation Engineer
Office of Geotechnical Design South-2

KDC/FQ/AW

Attachment: OSFP Review Comment & Response Form, dated July 28, 2009

Distribution: (2) Addressee

OSFP Review Comment & Response Form

General Project Information	Review Phase	Reviewer Information
Dist: 08 EA: 449311 Project Name: I-215/SR 60 Box Springs OH Left (Widen) OSFP Liaison: Rober Zezoff Phone: 916 227-8892 e-mail: robert_zezoff@dot.ca.gov	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. 1) ☐ APS/PR (Review No. 2) ☐ Type Selection ☐ 65% PS&E Unchecked Details ☐ PS&E (Review No. _) ☐ Construction Support ☒ Other: FR Review **Structure Information** (Use when necessary to document comments by individual structure) Structure Name: I-215/SR60 BoxSprings OH Left (Widen) Br No: 56-0082L	Reviewer Name: Douglas Cook, Farzad Qmehr & Asef Wardak Functional Unit: OGDS-2 Phone Number: 227-4514 e-mail: doug_cook@dot.ca.gov Date of Review: 07/28/09

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date
Carlos Amante	Kleinfelder	909 793-2691		

Comment No.	Document (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
1	FR	Earth Materials	Evidently all elevations referenced in this report are based on the NGVD 29 vertical datum. Reference to this fact was not observed in the text (body) of the report.		
2	FR	Pgs. 1 and 2	Please note that additional borings at the respective abutment and bent locations may be necessary prior to acceptance of subject report.		
3	FR	Pgs. 6,7,10 Sec. 4.2	Review of the cited USGS Geologic Map of the San Bernardino and Santa Ana 30'x60' Quadrangles (Morton, 2006) indicated that the site is transected by an inferred fault. Please include a copy of the geologic map for the site vicinity, discuss this fault in the text of the report. Provide recommendations to address and mitigate it in the design of the project as necessary.		
4	FR	Pgs. 12, Sec.6.1.4	Please reference the source cited for the County of Riverside Liquefaction information provided		

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel Report	QCC=Quant Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant Calcs	

✓ = Comment Resolved (for Reviewer's use)

Comment No.	Document (See Note 1)	Page, Section, or SSP	Review Comments	Consultant Responses	✓
5	FR	Pg. 15	A Peak Bedrock Acceleration (PBA) of 0.5g is reported for the site on pages 10 and 11 of the report, yet a peak ground acceleration (PGA) of 0.39g is reported on page 15. For a Type C site the PBA and PGA should be the same. It appears that the reported PGA value of 0.39g was used in determining the horizontal peak ground acceleration (HPGA) of 0.13g as reported on page 15 and used in the analysis. If 0.5g were to be used then a HPGA of 0.17g should be used. Please review and justify the use of the lower value or revised the analysis using the larger value accordingly.		
6	Plates	Plans	The 'Spread Footing Data Table' appears to be still missing from the attached plan sheets (refer to Memo to Designers 4-1).		

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant Calcs	

✓= Comment Resolved
(for Reviewer's use)

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215			

Caltrans Metric

John Bishop 8/14/09
REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER J. S. BISHOP No. 50616 Exp. 9-30-11 CIVIL STATE OF CALIFORNIA

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Dokken Engineering
2365 Iron Point Rd, Suite 200
Folsom, CA 95630

INDEX TO PLANS

Sheet No.	Title
1	General Plan
2	Index To Plans
3	Foundation Plan
4	Abutment 1 Footing Layout
5	Bent Footing Layout
6	Abutment 4 Footing Layout
7	Abutment 1 Layout
8	Abutment 4 Layout
9	Abutment Details No. 1
10	Abutment Details No. 2
11	Abutment Details No. 3
12	Abutment Details No. 4
13	Bent 2 Layout
14	Bent 3 Layout
15	Bent Details
16	Typical Section - Spans 1 & 3
17	Typical Section - Span 2
18	Girder Layout
19	Precast Girder Details No. 1
20	Precast Girder Details No. 2
21	Girder Details
22	Top Longidudinal Reinforcement
23	Top Reinforcement Details
24	Structure Approach Layout
25	Structure Approach Type N(9S)
26	Structure Approach Drainage Details
27	Slope Paving - Full Slope
28	Log of Test Borings - Soil Legend 1 of 2
29	Log of Test Borings - Soil Legend 2 of 2
30	Rock Legend
31	Log of Test Borings

STANDARD PLANS DATED JULY, 2004

Sheet No.	Title
A10A	Acronyms And Abbreviations (Sheet 1 Of 2)
A10B	Acronyms And Abbreviations (Sheet 2 Of 2)
A10C	Symbols (Sheet 1 Of 2)
A10D	Symbols (Sheet 1 Of 2)
A62C	Limits of Payment For Excavation And Backfill Bridge
B0-1	Bridge Details
B0-3	Bridge Details
B0-5	Bridge Details
B0-13	Bridge Details
B3-1	Retaining Wall Type 1 H = 1200 Through 9100 mm
B3-8	Retaining Wall Details No. 1
B6-1	T-Beam Details
RSP B6-21	Joint Seals (Maximum Movement Rating = 50 mm)
B11-56	Concrete Barrier Type 736

Standard plan sheet no.

Detail no.

GENERAL NOTES
LOAD AND RESISTANCE FACTOR DESIGN

DESIGN: AASHTO LRFD Bridge Design Specifications, 4th Edition with 2005 & 2006 Interims and Caltrans Amendments V3.06.01 except for Geotechnical design of deep foundations and retaining walls.

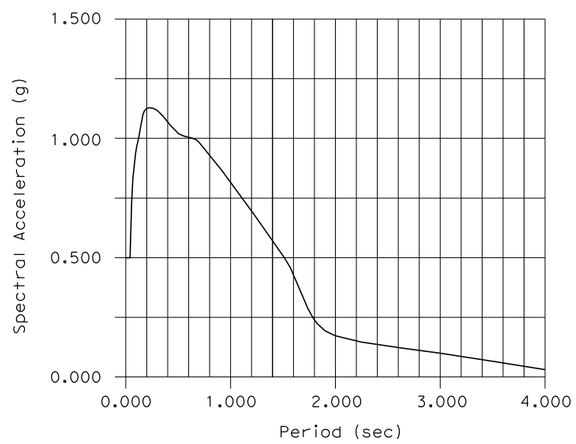
For geotechnical design of deep foundations and earth retaining systems: Bridge Design Specifications (1996 AASHTO with Interims and Revisions by Caltrans

SEISMIC DESIGN: CALTRANS SEISMIC DESIGN CRITERIA (SDC) Version 1.4, June 2006

DEAD LOAD: Includes 1.68 KPa for future wearing surface. Includes 10% additional dead load for permanent steel deck forms for Span 2 only.

LIVE LOAD: HL93 with "Low'Boy" and permit design load.

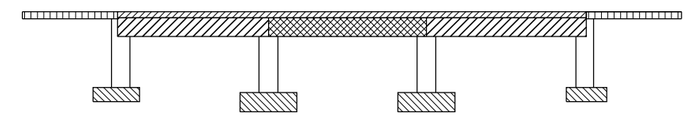
SEISMIC LOAD: Seismic Loading:
SDC Figure B.5, Soil Type C, Magnitude 7.25 ±0.25, Peak Rock Acceleration = 0.5g modified to account for near source effects:
- No change in spectral accelerations for T < 0.5 sec
- 20% increase in spectral accelerations for T > 1.0 sec
- Linear interpolation of spectral accelerations for T between 0.5 and 1.0 sec.



REINFORCED CONCRETE: f_y = 420 MPa
f'_c = 25 MPa, unless otherwise noted
n = 8

PRESTRESSED CONCRETE: See "Prestressing Notes" on "Precast Girder Details No. 1" sheet.

FOUNDATIONS: See "Spread Footing Data Table"



Structural Concrete, Bridge

Structural Concrete, Approach Slab

Structural Concrete, Bridge (28 MPa at 28 days)

Precast Concrete, see "Precast Girder Details No. 1" sheet

Structural Concrete, Bridge Footing

CONCRETE STRENGTH AND TYPE LIMITS

No Scale

SPREAD FOOTING DATA TABLE

SUPPORT LOCATION	WORKING STRESS DESING (WSD)		LOAD AND RESISTANCE FACTOR DESIGN (LRFD)		
	Permissible Gross Contact Stress (Settlement) (kPa)	Allowable Gross Bearing Capacity (kPa)	Service Permissible Net Contact Stress (Settlement) (kPa)	Strength Factored Gross Nominal Bearing Resistance φ_b = 0.45 (kPa)	Extreme Event Factored Gross Nominal Bearing Resistance φ_b = 1.00 (kPa)
Abut 1 (all segments)	235	290	N/A	N/A	N/A
Bent 2	N/A	N/A	335	648	1440
Bent 3	N/A	N/A	380	648	1440
Abut 4 (all segments)	200	325	N/A	N/A	N/A

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/05)

	BY	CHECKED
DESIGN	J. Bishop	M. Maechler
DETAILS	C. Houghton	M. Maechler
QUANTITIES	J. Bishop	N. Bieniek

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

John Bishop
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R62.2

BOX SPRINGS OVERHEAD (WIDEN)
INDEX TO PLANS

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 2-28-08 6-26-08 7-14-08 10-8-08 12-29-08 2-3-09 5-26-09 8/14/09

SHEET 2 OF 31

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

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

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVALDATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

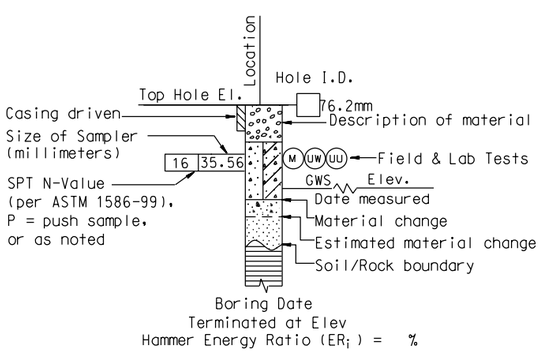
BOREHOLE IDENTIFICATION

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 (25.4mm soil tube) Hand Auger
◉	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

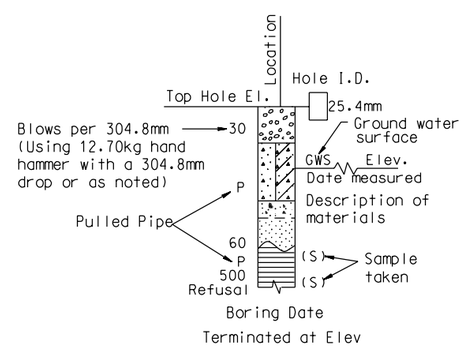
Note: Size in millimeters.

PLASTICITY OF FINE-GRAINED SOILS

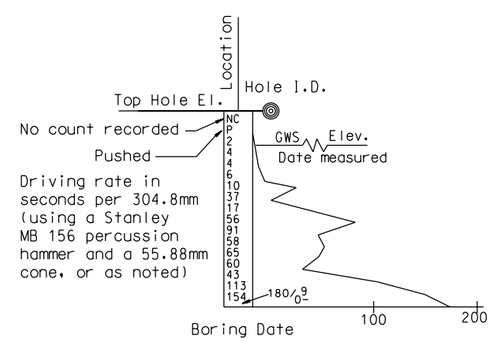
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



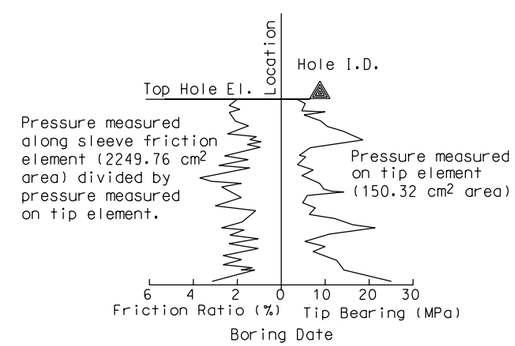
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

C. AMANTE
DESIGN OVERSIGHT
11/17/08
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R62.2

BOX SPRINGS OH (WIDEN)

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/14/08 5/20/09

REVISION DATES

SHEET 28 OF 31

FILE ·) $REQUEST

USERNAME ·)$USER DATE PLOTTED ·) $DATE TIME PLOTTED ·) $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

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REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

C. AMANTE
DESIGN OVERSIGHT
11/17/08
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R62.2

BOX SPRINGS OH (WIDEN)
SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/4/08 5/20/09

REVISION DATES

SHEET 29 OF 31

FILE •) $REQUEST

USERNAME •)$USER DATE PLOTTED •)$DATE TIME PLOTTED •)$TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVALDATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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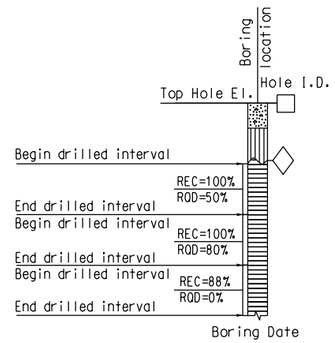
REDLANDS, CALIFORNIA 92374

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

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features: Chemical Weathering-Discoloration and/or oxidation: Body of Rock	Chemical Weathering-Discoloration and/or oxidation: Fracture Surfaces	Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning: Texture	Texture and Solutioning: Solutioning	General Characteristics
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

C. AMANTE
DESIGN OVERSIGHT
11/17/08
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R62.2

BOX SPRINGS OH (WIDEN)

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/4/08 5/20/09

SHEET 30 OF 31

FILE •) $REQUEST

USERNAME •) $USER DATE PLOTTED •) $DATE TIME PLOTTED •) $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	---		

Caltrans Metric

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVALDATE

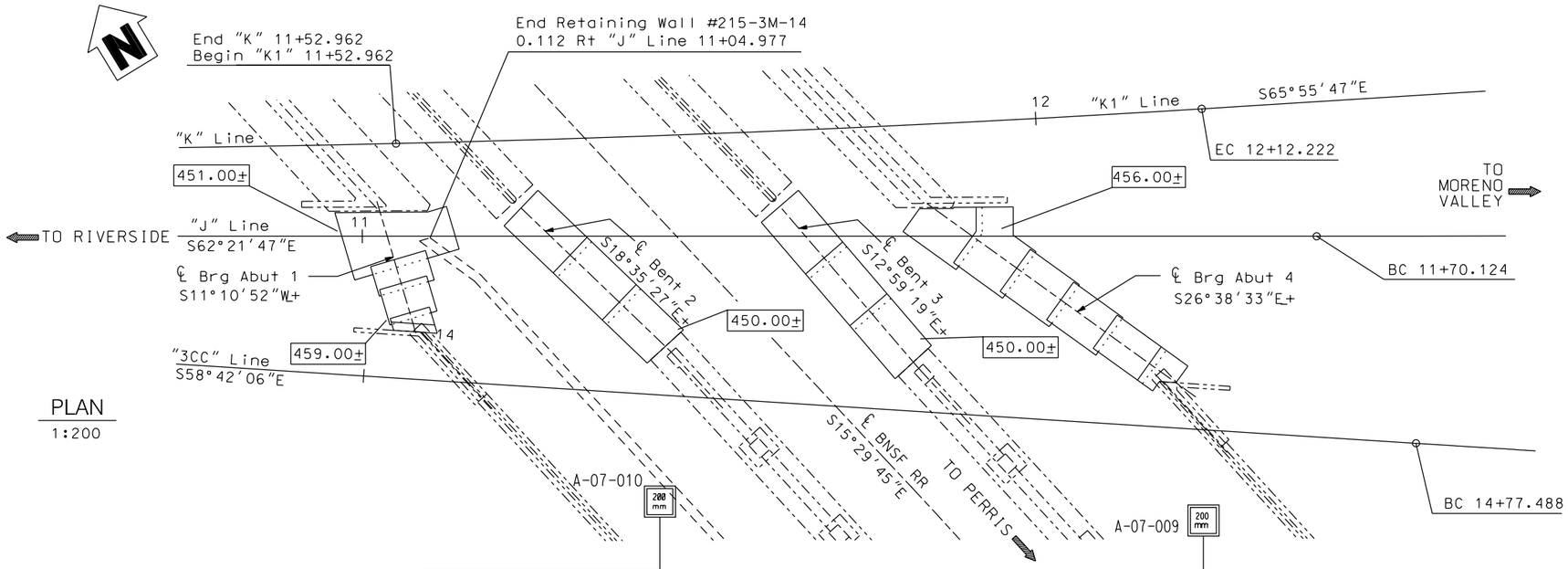
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

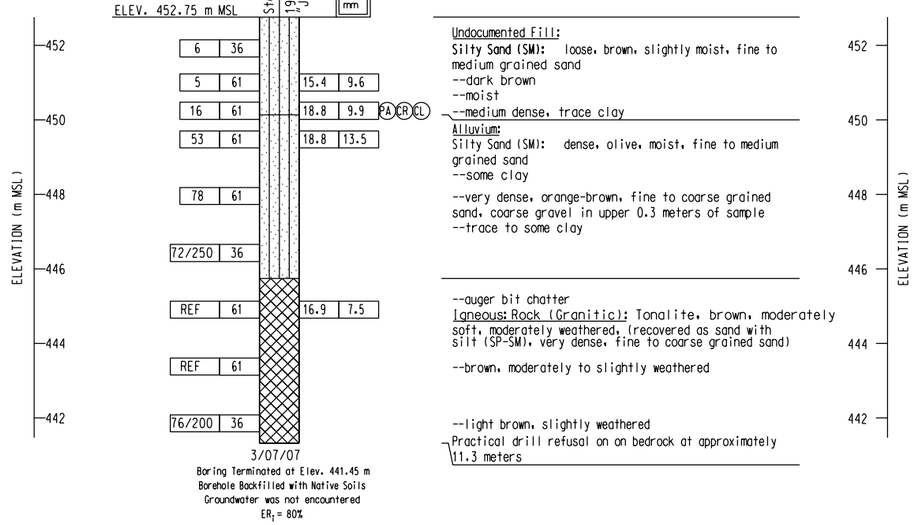
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

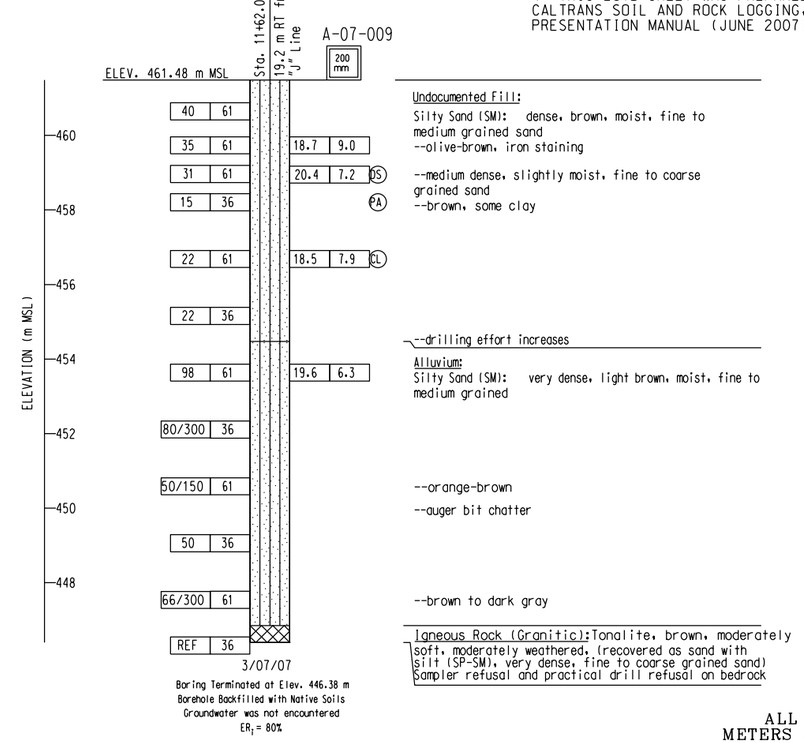
KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:200



PROFILE
VERTICAL 1:2





BENCH MARK

BM Elev. 459.600 m
NP 3031 2-Inch Brass disk NGVD29

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

C. AMANTE
DESIGN OVERSIGHT
11/17/08
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R62.2

BOX SPRINGS OH (WIDEN)
LOG OF TEST BORINGS

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/17/08 5/20/09

SHEET 31 OF 31

FILE •) $REQUEST

USERNAME •)$USER DATE PLOTTED •)$DATE TIME PLOTTED •)$TIME

REVISED FINAL STRUCTURE FOUNDATION REPORT

REVISED FINAL
STRUCTURE FOUNDATION REPORT
BOX SPRINGS OVERHEAD LEFT BRIDGE (WIDEN)
BRIDGE NO. 56-0082L
INTERSTATE 215/STATE ROUTE 60
EAST JUNCTION IMPROVEMENTS
CITY OF RIVERSIDE, CALIFORNIA
08-RIV-215/60, KP 61.7/62.6, 19.4/21.5
CALTRANS EA NO. 08-449311

Prepared for:

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER WEST, INC.
1220 Research Drive, Suite B
Redlands, CA 92374

Kleinfelder Project No. 76979

Revised June 15, 2009
July 18, 2008

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Revised June 15, 2009
July 18, 2008
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

Subject: **Revised Final Structure Foundation Report**
Box Springs Overhead Left Bridge (Widen)
Bridge No. 56-0082L
Interstate 215/State Route 60 East Junction Improvements
City of Riverside, California
08-RIV-215/60, KP 61.7/62.6, 19.4/21.5,
Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) is pleased to present this Final Structure Foundation Report for the proposed Box Springs Overhead Bridge Widening, located at the east junction of existing Interstate 215 (I-215) and State Route 60 (SR60) in the City of Riverside, California. The purpose of this report is to provide geotechnical engineering recommendations for design and construction of the proposed project. Furthermore, this report incorporates our response to Caltrans review comments dated April 17, 2008 (see Appendix E).

The proposed project is geotechnically feasible provided that our recommendations in this report are properly incorporated into the design and construction of the project. Recommendations provided herein are contingent on the provisions outlined in the Additional Services and Limitations section of this report. The project Owner should become familiar with these provisions in order to assess potential impacts to the proposed project and further involvement by Kleinfelder.

We appreciate the opportunity to be of service on this project. If you have any questions and comments or require additional information, please do not hesitate to contact the undersigned.

Sincerely,
KLEINFELDER WEST, INC.

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

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1.0 INTRODUCTION

1.1 GENERAL

Kleinfelder West, Inc., (Kleinfelder) was retained by Lim & Nascimento Engineering Corporation (LAN Engineering) to conduct a geotechnical investigation at the site of the proposed Box Springs Overhead Left Bridge widening at the Interstate 215/State Route 60 East Junction in the City of Riverside, Riverside County, California (see Plate 1, *Site Location Map*). The scope of our services was provided in our proposal entitled *Revised Proposal for Geotechnical Support Services For Plans, Specifications, and Cost Estimates (PS&E), Two New SR 60 HOV Connectors at the I-215/SR 60 East Junction, Riverside, California, dated July 11, 2007.*

This report presents our recommendations relative to the geotechnical aspects of design and construction for the proposed project. Conclusions and recommendations presented in this report are based on the subsurface conditions encountered at the locations of our field excavations, and the provisions and requirements outlined in the Additional Services and Limitations sections of this report. Recommendations presented in this report should not be extrapolated to other areas or be used for other projects without our prior review.

1.2 PROJECT DESCRIPTION

The project consists of widening the existing Box Springs Overhead (OH) Left Bridge, Bridge No. 56-0082L, at the east junction of I-215 and SR-60 (see Plates 2 and 3a, *General Plan and Foundation Plan*). Based on design plans prepared for the existing Box Springs Overhead Bridge Left and Right Bridge structures, the existing structures are founded on shallow spread footings at the abutments and bents. The bridge as-built plans are provided in Appendix D.

The proposed bridge widening is a three-span bridge to be constructed with either prescast/prestressed rectangular girders or cast-in-place T-girder, with a total length of 44.81 meters.

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To provide for proposed railroad maintenance road under the bridge, we understand that a tieback wall with three levels of tieback anchors will be constructed at Abutment 1 slope (see Plate 2).

At the time of our field exploration, another bridge was under construction immediately to the north of the area proposed for the Box Springs Overhead Left Bridge widening. According to LAN Engineering, this bridge was completed recently and referred to as Box Springs OH Right Bridge (Replace), Bridge No. 56-0082R.

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2.0 GEOTECHNICAL INVESTIGATION

The purpose of this investigation was to evaluate subsurface conditions at the site and provide geotechnical recommendations for design and construction of the proposed development. A description of the scope of services performed is presented below.

Task 1 – Literature Review

We began our services by reviewing the as-built plans of the existing structures (see Appendix D, *Bridge As-Built Plans*), as well as the soils and geologic data in our files and from select public agencies (see References). We have completed a computerized search of appropriate seismic and faulting information as it relates to the site.

Task 2 – Field Exploration

Our subsurface exploration program for the Box Springs Overhead Left Bridge widening consisted of drilling and logging two exploratory soil borings A-07-009 and A-07-010 (BS-1 and BS-2) on March 7, 2007. Locations of our borings are shown on Plate 4d, *Log of Test Borings.* These borings were advanced to depths ranging from approximately 11.3 to 15.1 meters below the existing ground surface (bgs).

The borings were advanced using an L10T track-mounted drill rig equipped with 200-mm diameter hollow-stem augers and an automatic hammer delivery system. The borings were logged and sampled by a staff professional from our office using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Each soil sample was observed and described in general accordance with the Unified Soil Classification System (USCS). Following drilling, sampling and logging, the borings were backfilled with native cuttings. The boring logs are presented in Appendix A, *Field Exploration*.

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Task 3 – Laboratory Soil Testing

A laboratory testing program was developed and performed to characterize and evaluate the engineering properties of the subsurface soils. Tests performed consisted of moisture content and in situ dry unit weight (ASTM D2216 and D2937); grain size distribution (ASTM D 422); direct shear test (ASTM D 3080); consolidation test (ASTM D 5333); and corrosivity tests consisting of electrical resistivity test (CTM 532), pH (CTM 643), sulfate content (CTM 417), and chloride content (CTM 422). The laboratory test procedures and results are presented in Appendix B, *Laboratory Testing*.

Task 4 – Geotechnical Analyses and Report Preparation

Field and laboratory findings were evaluated in conjunction with the proposed use project. This report includes conclusions and recommendations regarding the following:

- Regional geologic setting, geologic features, and geologic hazards including the potential for ground rupture due to surface faulting, liquefaction potential, and other seismically induced hazards;
- Subsurface materials encountered within the exploratory borings, anticipated groundwater levels and excavation characteristics of these materials;
- Corrosion potential of the near-surface soils;
- Acceleration Response Spectra (ARS) curves, including standard Caltrans ARS curve and modified (design) ARS curve;
- Recommendations for design and construction of spread footing foundations including recommended bearing capacities and total and differential settlements
- Recommended active, passive, at-rest and seismically-induced lateral earth pressures for retaining walls and other below grade structures;
- Lateral pressure diagrams and bond strength values for tiebacks; and
- Guidelines for earthwork including recommendations for site preparation, fill placement, and compaction.

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3.0 PERTINENT REPORTS AND INVESTIGATIONS

The following documents were reviewed for this study:

- Abutment 1 Footing Layout, Bent Footing Layout, and Abutment 4 Footing Layout for Box Springs Overhead Left (Widen), I-215/SR60 East Junction, prepared for the State of California, Department of Transportation, CU 08, EA 4493111, by Dokken Engineering, Revision Date February 3, 2009.
- Foundation Plan for Box Springs Overhead Left (Widen), I-215/SR60 East Junction, prepared for the State of California, Department of Transportation, CU 08, EA 4493111, by Dokken Engineering, Revision Date February 3, 2009.
- General Plan for Box Springs Overhead Left (Widen), I-215/SR60 East Junction, prepared for the State of California, Department of Transportation, CU 08, EA 4493111, by Lim & Nascimento Engineering, Revision Date February 3, 2009.
- Preliminary Foundation Report, Proposed Box Springs Overhead Bridge Widening, I-215/SR60 East Junction, Riverside, California, Kleinfelder Project No. 76979, dated June 14, 2007.
- United States Geological Survey, 7-1/2 Minute Series, Riverside East Quadrangle, California, 1967, Photorevised 1980.
- United States Geological Survey, Geologic Map of the San Bernardino and Santa Ana 30’ X 60’ Quadrangle, California, Version 1.0, 2006.

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4.0 GEOLOGY AND SEISMICITY

4.1 REGIONAL AND LOCAL GEOLOGY

The project site is situated within the northern Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are a northwest-southeast oriented complex of blocks separated by similarly trending faults which extend 200 kilometers from the Transverse Ranges south to the Mexican border and beyond another 1250 kilometers to the tip of Baja California. The province varies in width from 50 to 160 kilometers and is bounded on the east by the Colorado Desert and the Gulf of California and on the west by the Pacific Ocean.

The Peninsular Ranges contain Jurassic-age and Cretaceous-age igneous and metamorphic rocks, as well as a thick sequence of marine and non-marine sedimentary rock. The Peninsular Ranges Province is further described by sub-units, which include the Perris Block, the Santa Ana Mountains, and the San Jacinto Mountains. The Perris Block is characterized as a broad area of intermixed valleys and low mountain ranges situated between the Elsinore and San Jacinto fault zones.

The project site is located in the northern portion of the Perris Block and Perris Valley. Typical lithographic units within this area consist of Quaternary alluvial deposits overlying granitic and metamorphic bedrock. Sporadic outcrops of bedrock dot the valley floor and represent remnants of eroded hills and mountains. Bedrock consists of mostly Cretaceous-age igneous rock (tonalite) forming the bedrock hills north of the site.

4.2 FAULTING AND SEISMICITY

The project site is located in the highly seismic southern California region within the influence of several fault systems that are considered to be active or potentially active. An active fault is defined by the State of California as “a sufficiently active and well defined fault, which has exhibited surface displacement within the Holocene time (the last 11,000 years).” A potentially active fault is defined by the State as “a fault with a history of movement within Pleistocene time (between 11,000 and 1.6 million years ago).” These active and potentially active faults are capable of producing potentially damaging seismic shaking at the site. It is anticipated that the project site will

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periodically experience ground acceleration as the result of moderate to large magnitude earthquakes. Other active faults without surface expression (blind faults) that are capable of generating an earthquake, or other potentially active seismic sources may be present that are not currently zoned.

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5.0 SUBSURFACE CONDITIONS

5.1 EARTH MATERIALS

5.1.1 Undocumented Fill (Afu)

Embankment fill soil was encountered in boring A-07-009 (BS-1) near the proposed location of Abutment 4 at the existing east embankment to an elevation of approximately 454.4 meters above MSL (approximately 7 meters below the existing grade). Undocumented fill soil was also encountered in boring A-07-010 (BS-2) near the proposed location of Bent 2 to a depth of approximately 2.8 meters below the existing grade, near the toe of the existing west embankment. The fill soils were likely placed as part of the development of the existing bridges. In general, the fill soils consist of loose to medium dense silty sand (SM). Additional areas of undocumented fill soils may be encountered during earthwork operations that were not identified during this investigation.

5.1.2 Alluvium (Qal)

Alluvial soils were encountered below the fill soils in both borings. The alluvial soils extend to elevations ranging from approximately 446.6 to 445.6 meters above MSL (approximately 14.8 to 7.2 meters below the existing grade). In general, the alluvial soil deposits encountered during our investigation consist of dense to very dense silty sand (SM).

5.1.3 Granitic Bedrock (Kgr)

Tonalite granitic bedrock was encountered in both of our borings A-07-009 and A-07-010 (BS-1 and BS-2) excavated for this project. The bedrock was encountered below the alluvial soils at elevations ranging from approximately 446.6 to 445.6 meters above MSL (or approximately 14.8 to 7.2 meters below the existing grade). The bedrock extends to the lowest elevation explored in A-07-009 and A-07-010 (BS-1 and BS-2) of approximately 446.4 meters and 441.5 meters above MSL (or approximately 15.1 meters and 11.3 meters below existing grade), respectively. In general, the tonalite rock is moderately to highly weathered and decomposed near the contact with the alluvial soils and becomes less weathered with depth.

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The locations of our exploratory borings are shown on the attached Plate 4d, *Log of Testing Borings*. Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the Boring Logs provided in Appendix A.

5.2 GROUNDWATER

Groundwater was not encountered in either of the two borings excavated for the Box Springs Overhead Left Bridge widening. Boring A-07-010 (BS-2) was advanced to a depth of approximately 11.3 meters below the existing grade, which corresponds to the lowest elevation explored of approximately 441.5 meters above Mean Sea Level (MSL). According to As-Built Log of Test Borings prepared for the original bridge in 1965, groundwater was not encountered at that time to the lowest elevation explored of approximately 443.5 meters above MSL.

Fluctuations of the groundwater level, localized zones of perched water, and soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas on or immediately adjacent to the site can also cause a fluctuation of local groundwater levels.

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6.0 DISCUSSION AND RECOMMENDATIONS

6.1 SEISMIC DESIGN CRITERIA

6.1.1 Ground Surface Rupture and Deformation Potential

The site is not located within a currently delineated State of California Alquist-Priolo Earthquake Fault Zone (Hart and Bryant, 1997). No known active faults have been identified on the site, thus, the potential for future surface fault rupture at the site is considered to be "low." While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

6.1.2 Seismic Shaking

The 1996 California Seismic Hazard Map prepared by Caltrans (Mualchin, 1996a) indicates that the controlling fault for this project is the San Jacinto Fault (SJO), a strike slip fault with a maximum credible earthquake (MCE) moment magnitude of 7.5. The closest fault distance to the project site is approximately 8.8 km.

The horizontal peak bedrock acceleration (PBA) at the site based on the 1996 Caltrans Seismic Hazard Map is 0.5g, as shown on Plate 5, *Fault and PBA Map*. Caltrans Guidelines for Structures Foundation Reports (Version 2.0, dated March 2006) requires that the PBA determined above be verified with well-established attenuation relationships such as Sadigh et al. (1997) for controlling faults. The PBA value for the site, estimated using Sadigh et al. (1997) attenuation relationship, is 0.46g. Therefore, a PBA of 0.5g is recommended in accordance with Caltrans design practice.

Based on the results of our field exploration, dense to very dense conditions are encountered in alluvium and bedrock, with standard penetration resistance (N) greater than 50. Therefore, the site can be classified as Soil Profile Type C, in accordance with Table B.1 of Caltrans Seismic Design Criteria (SDC) (Version 1.4, dated June 2006),. The recommended seismic design parameters are summarized in the following Table 1.

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Table 1
Seismic Design Parameters

Seismic Parameters	Design Recommendation and Reference
Controlling Fault	San Jacinto (SJO), (Mualchin, 1996a)
Type of Fault	Strike-Slip (Mualchin, 1996b)
Closest Distance to the Fault	8.8 km (Mualchin, 1996a)
Earthquake Magnitude (MCE)	7.5 (Mualchin, 1996a,b)
Horizontal Peak Bedrock Acceleration (PBA)	0.5g
Soil Profile Type	C (Table B.1, 2006 Caltrans Seismic Design Criteria)

6.1.3 Design ARS Curve

The standard acceleration response spectra (ARS) curve presented in Figure B.5 of Caltrans SDC for PBA of 0.5g, magnitude 7.5 and Soil Profile Type C was selected for seismic design of the proposed bridges. This standard ARS curve was modified to account for near-source fault rupture directivity effect as follows:

- 20% increase in spectral values for periods equal to or greater than 1.0 second;
- No change for periods less than 0.5 seconds; and
- Spectral ordinates for periods between 0.5 and 1 second determined by linear interpolation.

The standard Caltrans SDC ARS curve, modified ARS curve and their ordinate values are presented on Plate 6, *Design ARS Curve*.

6.1.4 Liquefaction Potential

Seismically induced soil liquefaction generally occurs in loose, saturated, cohesionless soil when pore pressures within the soil increase during ground shaking. The increase in pore pressure transforms the soil from a solid to a semi-liquid state. The primary factors affecting the liquefaction potential of a soil deposit are: 1) intensity and duration of earthquake shaking, 2) soil type and relative density, 3) overburden pressures, and 4) depth to groundwater. Soils most susceptible to liquefaction are clean, loose, uniformly

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graded, fine-grained sands, and non-plastic silts that are saturated. Silty sands have also been shown to be susceptible to liquefaction. These soils typically lose a portion or all of their shear strength and regain strength sometime after shaking stops. Soil movements (both vertical and lateral) have been observed under these conditions due to consolidation of the liquefied soils and the reduced shear resistance of slopes.

According to a Liquefaction Hazard Map prepared by the County of Riverside (Generalized Liquefaction Figure S-3, 2002), the site is located in an area designated as having a "low" liquefaction susceptibility. Groundwater was not encountered in any of the borings drilled for this project. Based on the simplified liquefaction analysis approach (Youd and Idriss, 2001), it is our professional opinion that due to the dense nature of subsurface soils encountered on-site and the observed depth to groundwater, the site has a "low" liquefaction potential. The liquefaction potential calculations are presented in Appendix C-1.

6.1.5 Seismically Induced Settlement

Unconsolidated, loose to medium dense sandy soil deposits tend to densify or become more tightly packed during strong ground shaking, thereby causing ground settlement. Using an empirical procedure developed by Tokimatsu and Seed (1987), seismically induced settlements due to seismic compaction of dry or unsaturated soils below the foundations were estimated to be on the order of less than 13 mm. The seismically induced settlement calculations are presented in Appendix C-1.

6.2 BRIDGE FOUNDATION DESIGN RECOMMENDATIONS

6.2.1 Foundation Type Selection

To match the existing foundations, we understand that the proposed bridge widening will also be supported on spread footings at the abutments and bents. Selection of this foundation type was made by Dokken Engineering after consultation with Kleinfelder.

6.2.2 Recommended Bearing Limits

The recommended bearing limits for the abutment and bent foundations are presented in Table 2 based on Caltrans Memo to Designers 4-1, dated April 2008.

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Table 2
Footing Data Table
Box Springs OH Left bridge (Widen)

Support Location	Footing Size [1] (meters)		Bottom of Footing Elevation [1] (meters)	Minimum Footing Embedment Depth [1] (meters)	WSD (LRFD Service-I Limit State Load Combination)		LRFD [2]		
							Service	Strength $\Phi_b = 0.45$	Extreme Event $\Phi_b = 1.00$
	B	L			Permissible Gross Contact Stress (kPa)	Allowable Gross Bearing Capacity (kPa)	Permissible Net Contact Stress (kPa)	Factored Gross Nominal Bearing Resistance (kPa)	Factored Gross Nominal Bearing Resistance (kPa)
Abut 1 (Seg. 1.1)	8.0	3.7	449.80	1.5	235	290	N/A	N/A	N/A
Abut 1 (Seg. 1.2)	4.2	1.8	456.40	1.5	235	290	N/A	N/A	N/A
Abut 1 (Seg. 1.3)	3.6	1.8	457.60	1.5	235	290	N/A	N/A	N/A
Abut 1 (Seg. 1.4)	3.0	1.9	459.13	1.5	235	290	N/A	N/A	N/A
Bent 2	3.6	15.0	450.13	1.5	N/A	N/A	335	648	1440
Bent 3	3.6	15.0	450.80	1.5	N/A	N/A	380	648	1440
Abut. 4 (Seg. 4.1)	4.6	3.4	455.50	1.5	200	325	N/A	N/A	N/A
Abut. 4 (Seg. 4.2)	4.2	4.0	456.40	1.5	200	325	N/A	N/A	N/A
Abut. 4 (Seg. 4.3)	3.8	4.0	457.30	1.5	200	325	N/A	N/A	N/A
Abut. 4 (Seg. 4.4)	3.4	4.0	458.20	1.5	200	325	N/A	N/A	N/A
Abut. 4 (Seg. 4.5)	3.0	4.0	459.10	1.5	200	325	N/A	N/A	N/A
Abut. 4 (Seg. 4.6)	3.0	2.4	459.68	1.5	200	325	N/A	N/A	N/A

Notes:
[1] Footing sizes and elevations are obtained from Box Springs Road OH Left Bridge (Widen) Foundation Plan and Layout sheets.
[2] Recommended design parameters are provided in accordance with Caltrans Memo to Designers 4-1, April 2008 (including attachments).

Bearing capacity of spread footings was evaluated based on footing geometry, settlement potential of foundation soils, and slope stability. The calculations for bearing capacities and foundation settlements were provided in Appendices C-2 and C-3, respectively.

We recommend that the abutment and pier footings be founded on a minimum of 0.6 meter of structure backfill material compacted to at least 95 percent relative compaction.

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We anticipate that subsurface materials exposed at the bottom of footing elevation for the bents may consist of bedrock material. In these instances, the bent footings should be founded on undisturbed bedrock material. If undisturbed bedrock material is not exposed at the bottom of bent footing elevations during construction, the existing soils should be overexcavated 0.30 meter beyond the edge of footing and 1:1 slope projected downward until bedrock material is encountered, and the excavation backfilled with lean or Class 3 concrete.

The project geotechnical engineer or engineering geologist should visually evaluate the soil and/or bedrock conditions exposed at the bottom of the overexcavation in foundation areas for presence of soft, loose, or otherwise unsuitable materials. If the material encountered at the overexcavation bottom is considered to be unsuitable by the project geotechnical engineer or geologist, this material should be additionally overexcavated and replaced with structure backfill material at the abutments or lean or Class 3 concrete at the bents as described previously. Soil placed as engineered fill below foundations should be compacted to at least 95 percent relative compaction per ASTM D1557. Foundation excavations should be performed such that footings are founded entirely in engineered fill or bedrock material or lean/Class 3 concrete to reduce the potential for differential settlement due to dissimilar soil types. At a minimum, we recommend that foundations be embedded at least 1.5 meters below the lowest adjacent final grade.

Footings may experience an overall loss in bearing capacity or an increased potential to settle where located in close proximity to existing or future utility trenches. Furthermore, stresses imposed by the foundations on the utility lines may cause cracking, collapse and/or a loss of serviceability. To reduce this risk, footings should extend below a 1:1 plane projected upward from the closest bottom corner of the trench.

To achieve design grades for the proposed bridge widening, modifications to the existing fill embankments will likely be required. Recommendations for remedial earthwork, if necessary, can be provided by Kleinfelder at a later stage in the design process. All areas to receive fill should be stripped of existing pavements, cleared of any structures, all existing vegetation, debris, and other deleterious materials in accordance with Section 16 of Caltrans *Standard Specifications*.

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6.2.3 Foundation Settlement

Total settlement of the foundations will vary depending on the plan dimensions of the foundations and the actual loads supported. Total settlements due to the net allowable footing service loads are in the order of 3 to 8 mm at the abutments and 3 to 4 mm at the bents. The differential settlements between adjacent supports are expected to be less than 6 mm. The footing settlement calculations are presented in Appendix C-2.

Due to the granular nature of the on site soil materials, the settlement of foundations is expected to occur relatively short during construction and should be essentially complete shortly after initial application of the loads.

6.2.4 Slope Stability

The abutment footings will be constructed on existing 1:2 (Vertical:Horizontal, V:H) fill slope at Abutment 1 and 1:2.5 (V:H) fill slope at Abutment 4. The proposed slope gradient at both abutments is 1:1.5 (V:H). The overall global stability of abutment slopes was analyzed assuming a footing pressure of 210 kPa for Abutment 1 and 150 kPa for Abutment 4. Slope stability was calculated using Modified Bishop's Method for circular slip surfaces implemented in the computer program GSTABL7 with STEDWin3.0 (Van Aller and Gregory, 2001). The design criteria utilized are as follows: permanent abutment slopes are required to have a minimum factor of safety of 1.5 for the static condition; and a minimum factor of safety of 1.1 for the pseudostatic condition using the Caltrans recommended horizontal earthquake loading coefficient equal to one-third (1/3) of the horizontal peak ground acceleration or 0.13g. The results of slope stability analyses for both abutments indicate that the required minimum static and pseudostatic factors of safety would be satisfied provided the minimum shear strength parameters for the new compacted fill are equal to or exceed the following values: (1) a friction angle of 32 degrees, and (2) a cohesion of 7.2 kPa. Slope stability analysis results are included in Appendix C-4.

Although the approach abutment slopes are expected to be grossly stable, erosion and surficial instability may be a concern during periods of heavy or intense rainfall. Erosion control and highway planting should be performed in accordance with Section 20 of Caltrans Standard Specifications. Excessive irrigation of slopes should be avoided. Appropriate drainage devices should be placed at the top of all slopes such that water does not flow over slope faces in an uncontrolled manner.

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6.3 EARTH RETAINING SYSTEMS

To provide for proposed railroad maintenance road under the bridge, we understand that a tieback wall with three levels of tieback anchors will be constructed at Abutment 1 slope (see Plate 2). Preliminary geotechnical design recommendations for the proposed tieback wall are presented in the following sections.

6.3.1 Lateral Earth Pressures

Lateral earth pressures acting on the tieback wall can be estimated using the lateral earth pressure diagram presented in Section 5.5.5.7.1 of Caltrans Bridge Design Specifications (2004) when detailed wall design plans become available.

6.3.2 Tieback Anchors

Tieback design should follow procedures described in Chapter 5 of Caltrans Bridge Design Specifications (2004) for anchored walls. The tiebacks should be vertically spaced a minimum of 1.2 meters and horizontally spaced a minimum of 2.5 meters. The tieback design should be reviewed by Kleinfelder, who should also monitor the construction including tieback anchor testing.

Due to the collapse or caving potential for drilled anchor holes in granular alluvial materials, specialized installation methods such as casing or injection anchors will likely be required. Soil-to-grout bond stresses are highly dependent on installation technique, drilling and grouting method, grouting pressure and anchor diameter. In consideration of these factors and required load capacity, the design typically optimizes tieback anchor diameter, bonded length and installation methods. For the purposes of estimating anchor lengths for preliminary design and cost estimating, the bond length may be estimated using a maximum transfer load of 50 kN/m between pressurized concrete/grout and in-situ soil materials.

The pullout resistance of the anchors is calculated by applying these bond stresses to the bonded or fixed length of the anchors, located a distance of H/5 (where H=height of wall) behind the active wedge or 1.5 meters, whichever is greater. The active wedge should be calculated from an angle of 62 degrees from the horizontal (simplified depiction for all soil units), passing through the bottom of the excavation. In addition, the anchors should have a minimum unbonded length of either 3 meters or 4.5 meters,

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depending on the type of tendons used as described in FHWA-99-105. In developing these values, we have assumed the following:

- Factor of safety of 2.5 for a permanent wall system and 1.5 for temporary shoring;
- Minimum anchor diameter of 150 mm;
- Conventional grout pressures greater than 350 kPa but not excessively high to cause damage to existing facilities; and
- Anchors are installed at inclinations between 15 and 20 degrees with the horizontal.

Utilization of post-grouted anchors or small-diameter high-pressure injection anchors is common and would result in higher allowable bond stresses than provided above. Caltrans requires testing of all anchors. Permanent anchors are to be tested to either 150% of the design load exclusive of seismic, or 110% including seismic, whichever is greater. Tieback testing should be performed in accordance with current Caltrans specifications.

Based on the design criteria and testing of all anchors, movement of the wall after construction should be limited to approximately 6 mm. This amount of movement is typical for these types of walls. The geotechnical engineer should observe and record the installation of the anchors to verify the assumed soil and geologic conditions and record the testing and lock-off of the anchors.

6.4 CORROSION POTENTIAL

To evaluate corrosion potential of the on-site soils, one soil sample collected during our field investigation was tested for pH, resistivity, sulfate and chloride concentrations in accordance with Caltrans Standard Test Methods 532, 643, 417, and 422. Testing was performed by AP Engineering and Testing, Inc. in Pomona, California. The test results are presented in Appendix B.

To evaluate corrosion potential of the on-site soils, one soil sample collected from boring A-07-010 (BS-2) was tested for pH, resistivity, sulfate and chloride concentrations in accordance with Caltrans Standard Test Methods 532, 643, 417, and

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422, respectively. Testing was performed by AP Engineering and Testing, Inc. in Pomona, California. The test results are presented below in Table 3, below.

Table 3
Corrosion Test Results

Boring No.	Depth (m)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
A-07-010 (BS-2)	2 - 3	3,000	7.7	8	131

In accordance with Section 4.1 of Caltrans *Corrosion Guidelines* (dated September 2003), a corrosive area is defined as an area where the soil and/or water contains more than 500 ppm of chlorides, more than 2,000 ppm of sulfates, or has a pH of less than 5.5. In general, a minimum resistivity for soil and/or water less than 1,000 ohm-cm indicates the presence of high quantities of soluble salts and a higher propensity for corrosion. Based on the laboratory test results and the above guidelines, the project site soils may generally be considered as non-corrosive.

6.5 EXPANSION POTENTIAL

Expansive soils generally contain clay particles that swell considerably when wetted and shrink when dried. Foundations constructed on these soils are subjected to uplifting forces caused by the swelling. Based on our field exploration and the results of our laboratory testing, it is our opinion that soils within the upper portion of the project site have a low potential for expansion. Testing of the final subgrade soils after completion of grading should be conducted to evaluate their expansion potential and confirm or modify the recommendations presented herein.

6.6 SCOUR POTENTIAL

The proposed bridge widening will cross over the existing BNSF railroad tracks and is not located in a flood/drainage or river channel. Therefore, scour potential is not considered a design issue.

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7.0 CONSTRUCTION CONSIDERATIONS

7.1 SITE PREPARATION

All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations, and other local, state, or federal specifications. All references to maximum unit weight should be established in accordance with the current ASTM Standard Test Method D1557 and may supersede references cited herein.

7.1.1 Stripping and Grubbing

Prior to general site grading, existing pavement, vegetation, organic topsoil, existing fill soils, and debris shall be stripped and disposed of outside the construction limits. Deeper stripping or grubbing may be required where concentrations of fill debris, organic soils, existing trees, or thick root mats are encountered during site grading. Stripped topsoil (less any debris) may be stockpiled and reused for landscape purposes elsewhere on the project; however, this material should not be incorporated into any engineered fill.

In areas where existing trees will be removed, care should be taken to remove the root-ball, roots exceeding 25 mm in diameter, and remaining organics, and to backfill the excavations with compacted engineered fill. We strongly recommend having a representative of Kleinfelder present during tree removal in areas to receive fill or beneath foundations to observe removal of large roots and subsequent scarification and recompaction. Engineered fill should be placed and compacted in accordance with recommendations provided below.

7.1.2 Earthwork and Backfill

After clearing and stripping, the surface should be excavated to a minimum depth of 0.6 meter before placement of new fill. The undocumented fill soils (if encountered) shall be removed during site development and grading and replaced with structural backfill. In addition, any compressible soils encountered shall be removed and replaced with compacted structural backfill in accordance with Caltrans Standard Specifications Section 19-3.06. The exposed surface should be proof-rolled with loaded heavy equipment. Any areas of loose or yielding soils should be over-excavated and re-

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compacted. Any soils that cannot be compacted, or are otherwise unsuitable for the planned use, should be excavated and disposed of from the project site. The exposed surface should then be scarified and compacted to the specified density before placement of new fill. New fill placed on or adjacent to the existing slopes should be properly benched into the existing fill in accordance with Caltrans Standard Specifications.

All earthwork should be performed in accordance with Caltrans Standard Specification Section 19. All materials to be placed as fill should be free of vegetation, organics, debris, and other deleterious materials. All fill placed around foundations and behind walls should be placed in thin loose lifts, moisture-conditioned, and compacted to Caltrans Standard Specification.

Abutment wall backfill shall be structural backfill according to Caltrans standard specifications. In addition, we recommend that abutment backfill be well-graded soil with maximum dimension of 100 mm, essentially non-plastic (liquid limit less than 30, plasticity index less than 12, and with less than 50 percent passing the No. 200) and non-expansive. Expansive soils, defined as soils with Expansion Index (EI) greater than 50 and/or soils with Sand Equivalent (SE) less than 20, should be excluded from the bridge abutments as required by Caltrans guidelines and shown on Plate 7, *Expansive Soil Exclusion Zone in Bridge Embankment*. Expansion Index should be determined in accordance with ASTM D4829. Sand Equivalent should be determined in accordance with California Test Method (CTM) 217.

The limits of bridge approach zone are considered to extend longitudinally 46 meters measured horizontally from the bridge abutment and either parallel or concentric with the roadway centerline, and transversely the full width of embankment except the outer 1.5 meters measured horizontally from the embankment side slopes. Fills placed within 46 meters of abutments should be compacted to 95 percent relative compaction per ASTM D1557.

7.1.3 Temporary Excavations and Shoring

All excavations must comply with the current CAL-OSHA Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We

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are providing the information below solely as a service to our client. Under no circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

A shoring design and safety plan should be required from the contractor and submitted to the Engineer for review and approval. Likewise, measures to control impact of both groundwater and surface water on the stability of temporary excavations and shoring should be employed and should remain the sole responsibility of the contractor.

7.2 FOOTING OBSERVATIONS

Prior to placing steel and concrete, foundation excavations should be cleaned of all debris, loose or soft soil, and water. All foundation excavations should be observed by a qualified engineer or geologist from our firm just prior to placing steel or concrete to verify that the recommendations contained herein are implemented during construction.

7.3 SURFACE WATER CONTROL

Ponding of water adjacent to the structure should be avoided. During and after construction, positive drainage should be provided to direct surface water away from structures and all excavations toward suitable, non-erosive drainage devices.

7.4 ACCESS TO THE SITE

The presence of steep slopes on both sides of the railroad will make the direct access to the project site very difficult for construction crews as well as their equipments. It is recommended that the construction crews and equipments to enter the site through the gate located on River Crest Drive on the south side of SR-60. Moreover, the project site is situated in the proximity of a number of bridges; access to the site may be restricted or made difficult due to limited vertical clearance for construction equipments to pass underneath the existing bridges.

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8.0 ADDITIONAL SERVICES AND LIMITATIONS

8.1 ADDITIONAL SERVICES

The review of plans and specifications, and the observation and testing by Kleinfelder of earthwork and foundation related construction activities, are an integral part of the conclusions and recommendations made in this report. If Kleinfelder is not retained for these services, the client will be assuming our responsibility for any potential claims that may arise during or after construction. The recommended tests, observations, and consultation by Kleinfelder during construction include, but are not limited to:

- A review of preliminary plans and specifications;
- Observation of site clearing, undocumented fill removal, and subgrade preparation;
- Engineered fill placement and compaction;
- Construction observation and density testing of fill material placement, trench backfill, and subgrade preparation;
- Footing excavations;
- Tieback anchor testing; and
- When any unusual conditions are encountered during construction.

These services may be performed in accordance with our current fee schedule.

8.2 LIMITATIONS

The conclusions and recommendations presented in this report are intended to assist the type selection study for the proposed Box Springs Overhead Left Bridge widening to be located at the I-215/SR-60 east junction in the City of Riverside, California. The findings, conclusions and recommendations were prepared in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made. This report was based on the proposed project information provided to Kleinfelder. If any change (i.e., structure type, location, etc.) is implemented which materially alters the project, additional geotechnical services may be required, which could include revisions to the geotechnical recommendations presented herein.

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Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard. They are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

This report may be used only by the project designers and Caltrans and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on-site and off-site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party, and client agrees to defend, indemnify, and hold harmless Kleinfelder from any claim or liability associated with such unauthorized use or non-compliance.

Environmental site assessment for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater or atmosphere, or the presence of wetlands was not included in the scope of our services for this report.

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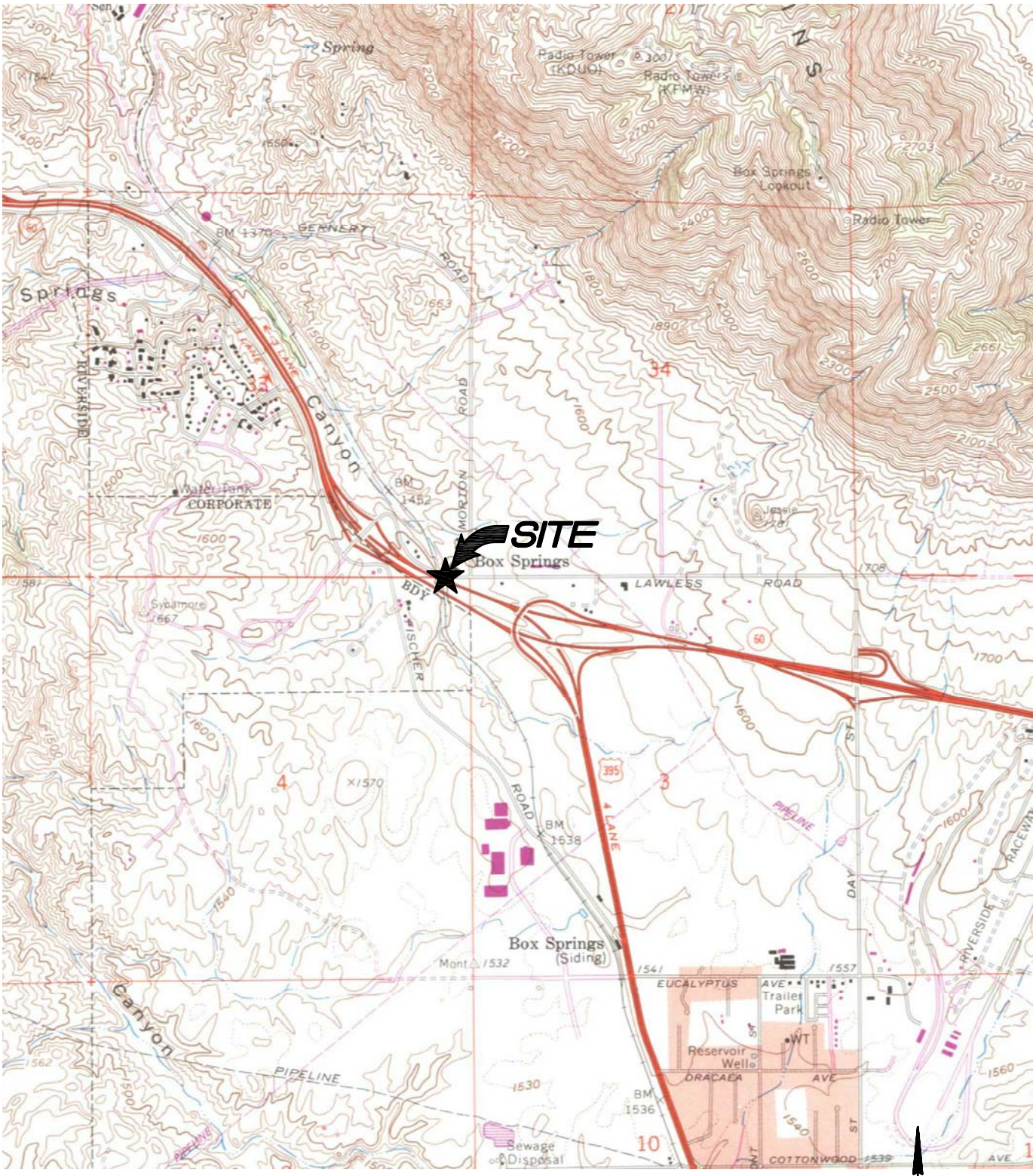
PLATES



SOURCE: U.S.G.S. 7.5' topographic series, Riverside East, California quadrangle dated 1967, photorevised 1980.

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SITE LOCATION MAP

I-215/SR-60 EAST JUNCTION
BOX SPRINGS OVERHEAD WIDENING
RIVERSIDE, CALIFORNIA

PLATE
1

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

Caltrans Metric

John Bishop 2-3-09
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER J. S. BISHOP No. 50616 Exp. 9-30-09 CIVIL STATE OF CALIFORNIA

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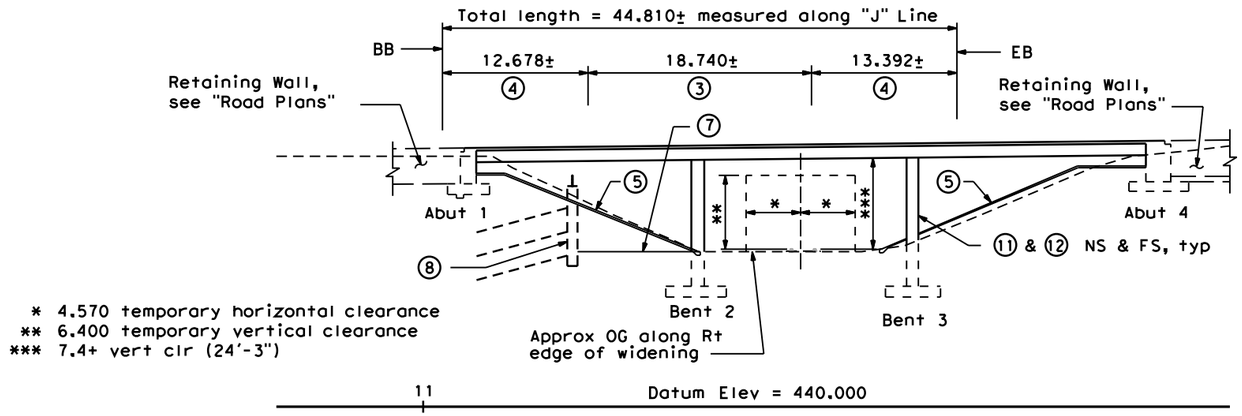
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

Dokken Engineering
2365 Iron Point Rd, Suite 200
Folsom, CA 95630



* 4.570 temporary horizontal clearance
** 6.400 temporary vertical clearance
*** 7.4+ vert clr (24'-3")

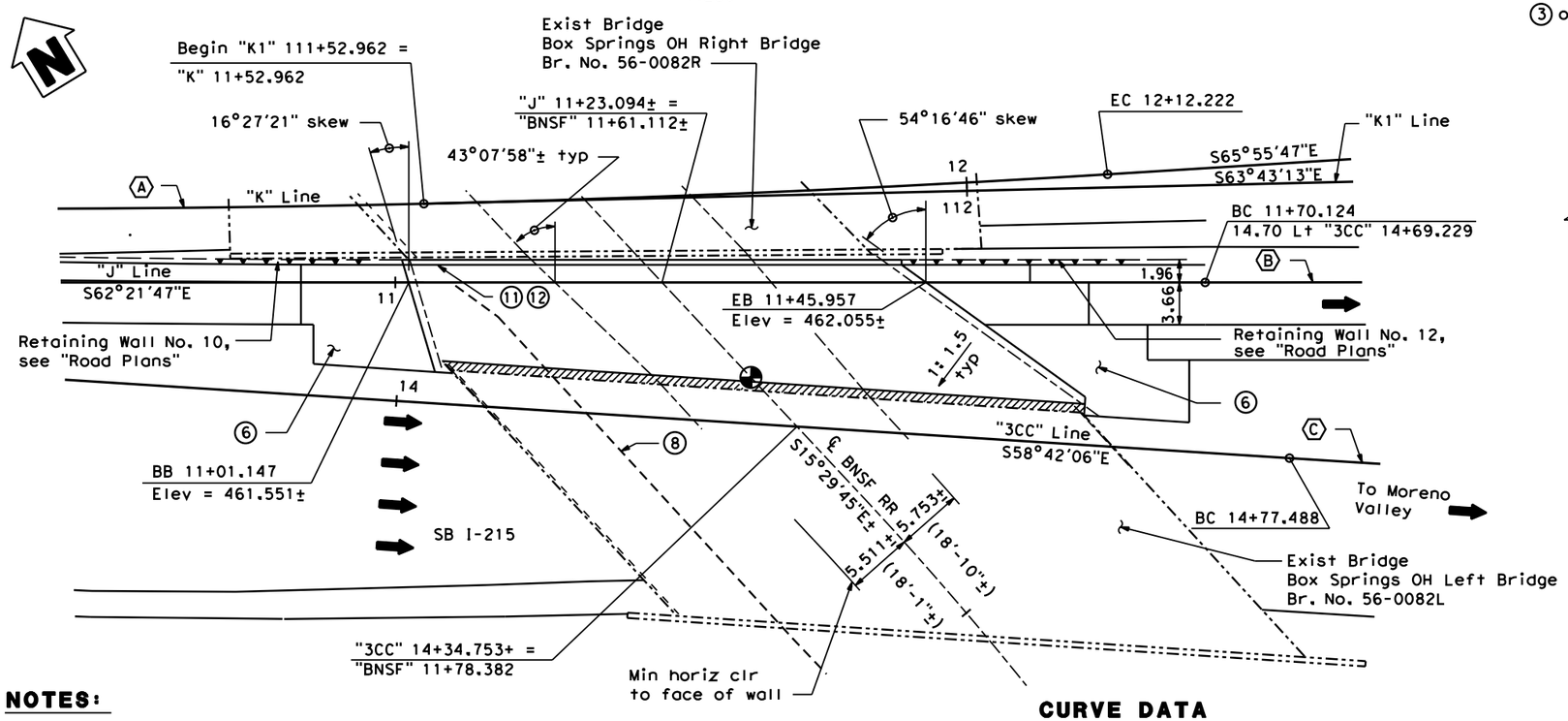
SECTION ALONG RIGHT EDGE OF WIDENING

1:250

LEGEND

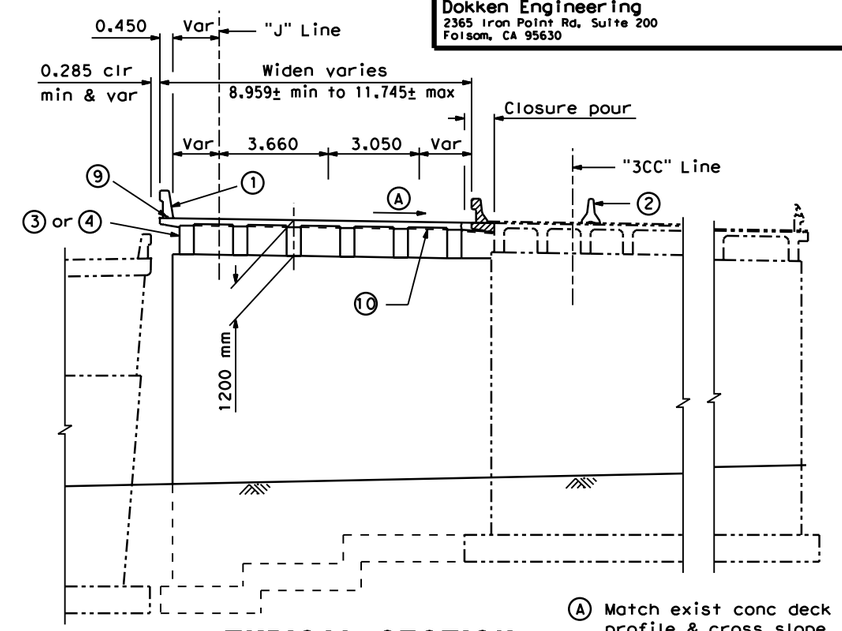
1. Concrete Barrier Type 736
2. Temporary Railing Type K
3. Precast/prestressed rectangular girders (Span 2)
4. CIP Concrete T-girder (Spans 1 & 3)
5. Slope paving
6. Structure Approach Type N(9S)
7. Future RR maintenance road
8. Future Retaining Wall
9. 41 mm lighting conduit, see "Road Plans"
10. Permanent steel deck forms required, Span 2 only.
11. Paint bridge name
12. Paint bridge number

Point of min vert clearance
Denotes existing structure
Denotes concrete removal limits



PLAN

1:250



TYPICAL SECTION

1:100

(Span 2 shown)

Ⓐ Match exist conc deck profile & cross slope

CURVE DATA

No.	R	Δ	T	L
Ⓐ	1536.774	5°42' 10"	76.544	152.962
Ⓑ	6098.972	0°43' 08"	38.265	76.530
Ⓒ	5000.000	2°39' 19"	115.875	231.708

NOTES:

1. The contractor shall verify all controlling field dimensions before ordering or fabricating any material.
2. For General Notes, Index To Plans and Standard Plans, see "Index To Plans" sheet.

0 - 1.5

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DESIGN	BY J. Bishop	CHECKED M. Moechler	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: HL-93 W/ "LOW-BOY" AND PERMIT DESIGN VEHICLE
	DETAILS	BY C. Houghton	CHECKED M. Moechler	LAYOUT BY J. Bishop	CHECKED M. Moechler
SIGN OFF DATE	QUANTITIES	BY J. Bishop	CHECKED N. Bieniek	SPECIFICATIONS BY J. Bishop	PLANS AND SPECS COMPARED M. Moechler

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

John Bishop
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R 62.2

BOX SPRINGS OVERHEAD LEFT (WIDEN)
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (METRIC) (REV. 3/1/99)
...\517\100%\56-00821-a-gp01.dgn 2/10/2009

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 7-20-07 8-16-07 2-29-08 6-26-08 7-16-08 10-8-08 2-3-09

SHEET 1 OF 31

FILE => J:\1656_1215_SR60_HOV_Conn\517\100%\56-00821-a-gp01.dgn

USERNAME => untitled DATE PLOTTED => 2/10/2009 TIME PLOTTED => 12:37:30 PM

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL
08	Riv	60, 215	19.4/21.5 61.7/62.6		

Caltrans Metric

John Bishop 2-3-09
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER J. S. BISHOP No. 50616 Exp. 9-30-09 CIVIL STATE OF CALIFORNIA

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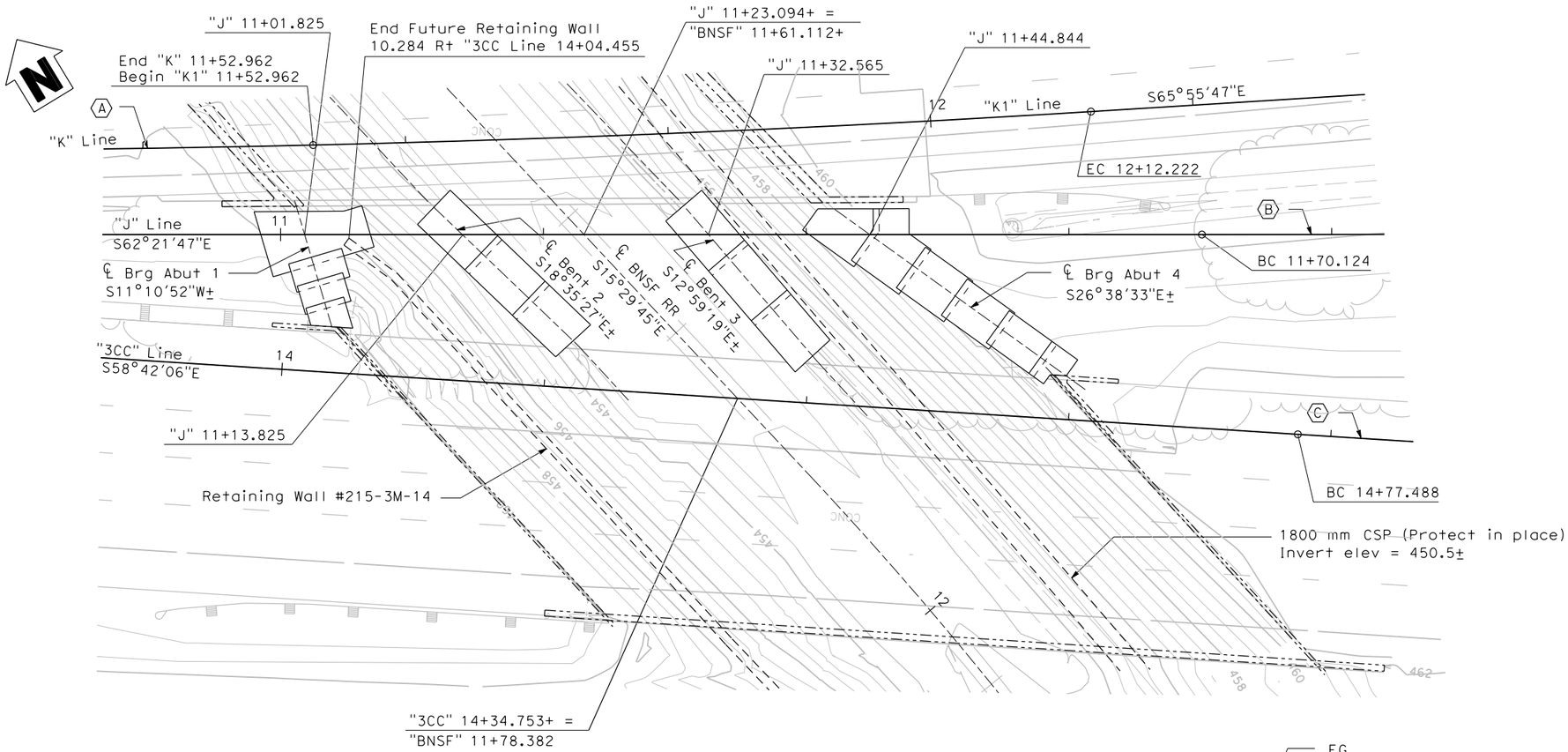
Folsom, CA 95630



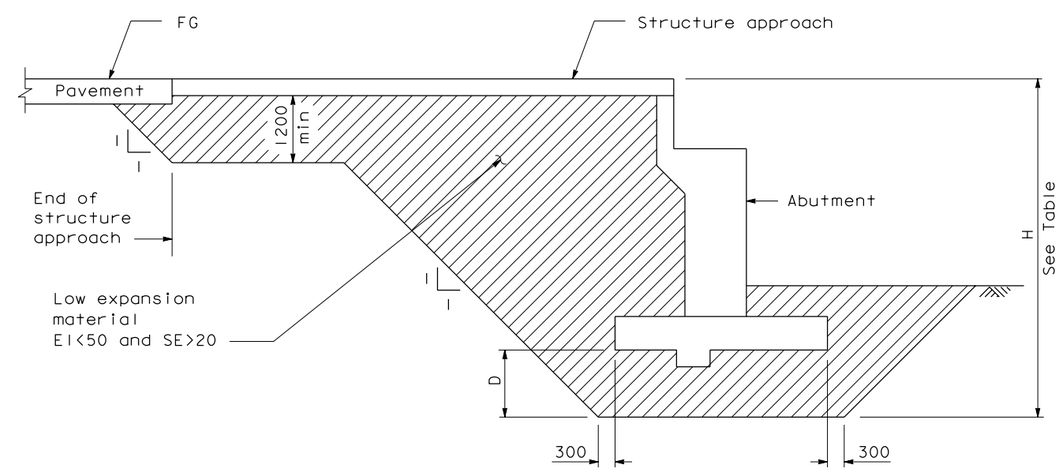
PLAN

1:200

NOTE:

Expansion Index (EI):
to be determined by ASTM D4829

Sand Equivalent (SE):
to be determined by California Test Method 217



LOW EXPANSION INDEX MATERIAL

No Scale

LEGEND

-·-·-·- Denotes existing structure

NOTES:

1. The contractor shall verify all controlling field dimensions before ordering or fabricating any material.
2. For footing layout and elevations, see "Foundation Details" sheets.
3. For curve data, see "General Plan" sheet.

BENCH MARKS

PT #865 Elevation 460.668 m

Found 25 mm iron pipe with Caltrans RP plug
North side of Box Springs Road.
N = 698034.479
E = 1903003.479

PT #3030 Elevation 472.840 m

Found 50 mm iron pipe with Brass Cap Stamped
"Dept of Trans RIV 60-12.7 1990"
34.14 m Southwesterly of bridge.
N = 697603.049
E = 1903554.738

Vertical Datum: NGVD-1929
Horizontal Datum: NAD-83, Zone 3(EPOCH 1984.0)

Page 2 of 2

ALL DIMENSIONS ARE IN
METERS UNLESS OTHERWISE SHOWN

GEOTECHNICAL PROFESSIONAL APPROVAL DATE

DESIGN OVERSIGHT	SCALE: 1:200	VERT. DATUM NAVD 29	HORZ. DATUM NAD 83	DESIGN	BY J. Bishop	CHECKED M. Maechler	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
	PHOTOGRAMMETRY AS OF:	ALIGNMENT TIES		DETAILS	BY C. Houghton	CHECKED M. Maechler	
SIGN OFF DATE	SURVEYED BY J. Terry	DRAFTED BY		QUANTITIES	BY J. Bishop	CHECKED N. Blenlek	
	FIELD CHECKED BY M. Wilson	CHECKED BY					

John Bishop
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R62.2

BOX SPRINGS OVERHEAD LEFT (WIDEN)
FOUNDATION PLAN

FOUNDATION PLAN SHEET (METRIC) (REV. 3/1/99)
$FILEABBREV$ $DATE$

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 7-20-07 8-16-07 2-28-08 6-26-08 7-16-08 10-8-08 2-3-09

SHEET 3 OF 31

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

Caltrans Metric

John Bishop 2-3-09
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER J. S. BISHOP No. 50616 Exp. 9-30-09 CIVIL STATE OF CALIFORNIA

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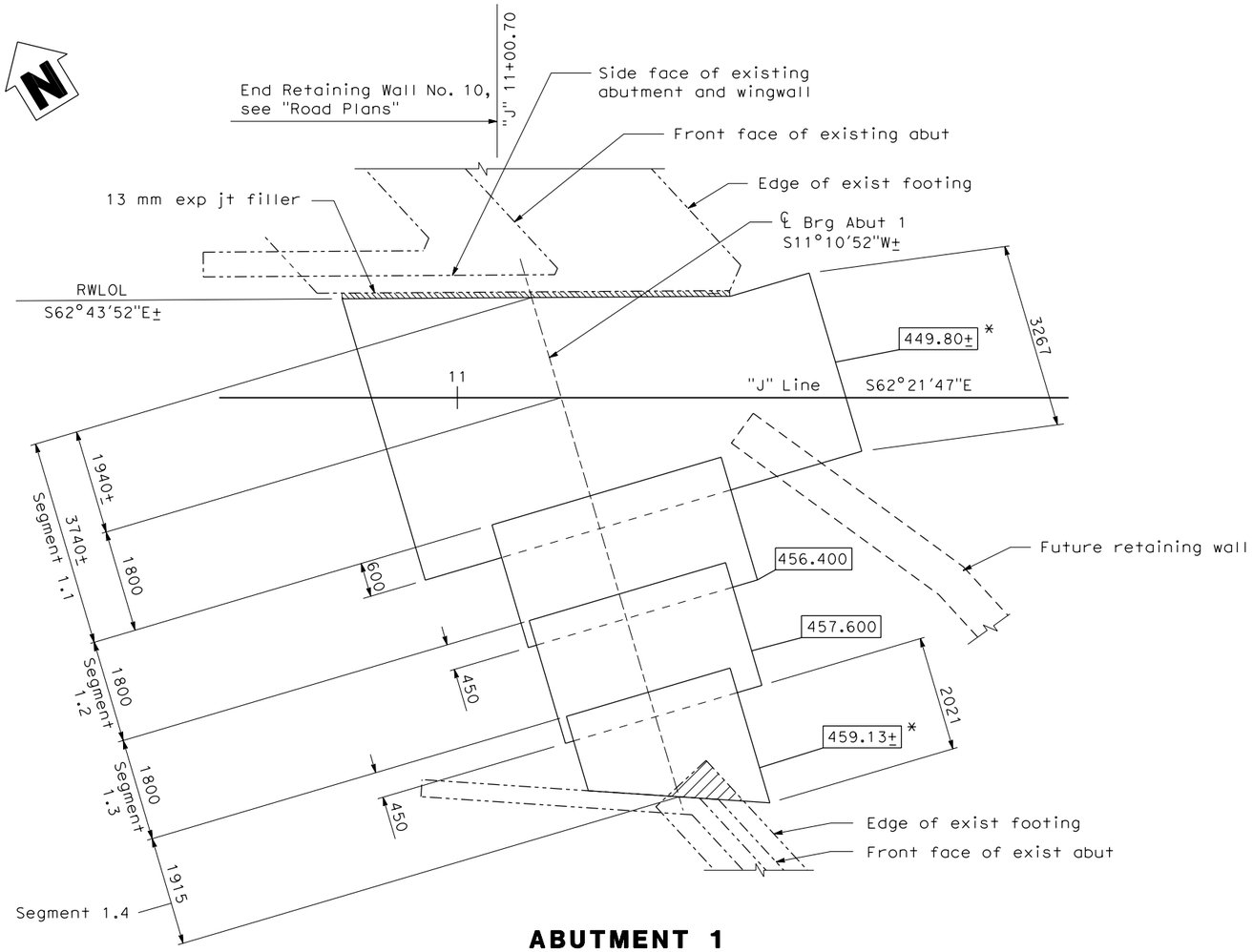

ABUTMENT 1

1:50

*Match exist bottom of footing elevation

NOTE:

1. The contractor shall verify all controlling field dimensions before ordering or fabricating any material.

LEGEND

Denotes bottom of footing elev

Denotes existing structure

Denotes portion of exist footing to be removed. Exist reinf to remain undamaged.

PLATE 3b

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

	BY	CHECKED
DESIGN	J. Bishop	M. Maechler
DETAILS	C. Houghton	M. Maechler
QUANTITIES	J. Bishop	N. Bieniek

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

John Bishop
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R62.2

BOX SPRINGS OVERHEAD LEFT (WIDEN)

ABUTMENT 1 FOOTING LAYOUT

DESIGN DETAIL SHEET (METRIC) (REV. 3/1/98)
$FILEABBREV$ $DATE$

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 2-28-08 6-26-08 7-14-08 10-8-08 2-3-09

SHEET 4 OF 31

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

John Bishop 2-3-09
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
J. S. BISHOP
No. 50616
Exp. 9-30-09
CIVIL
STATE OF CALIFORNIA

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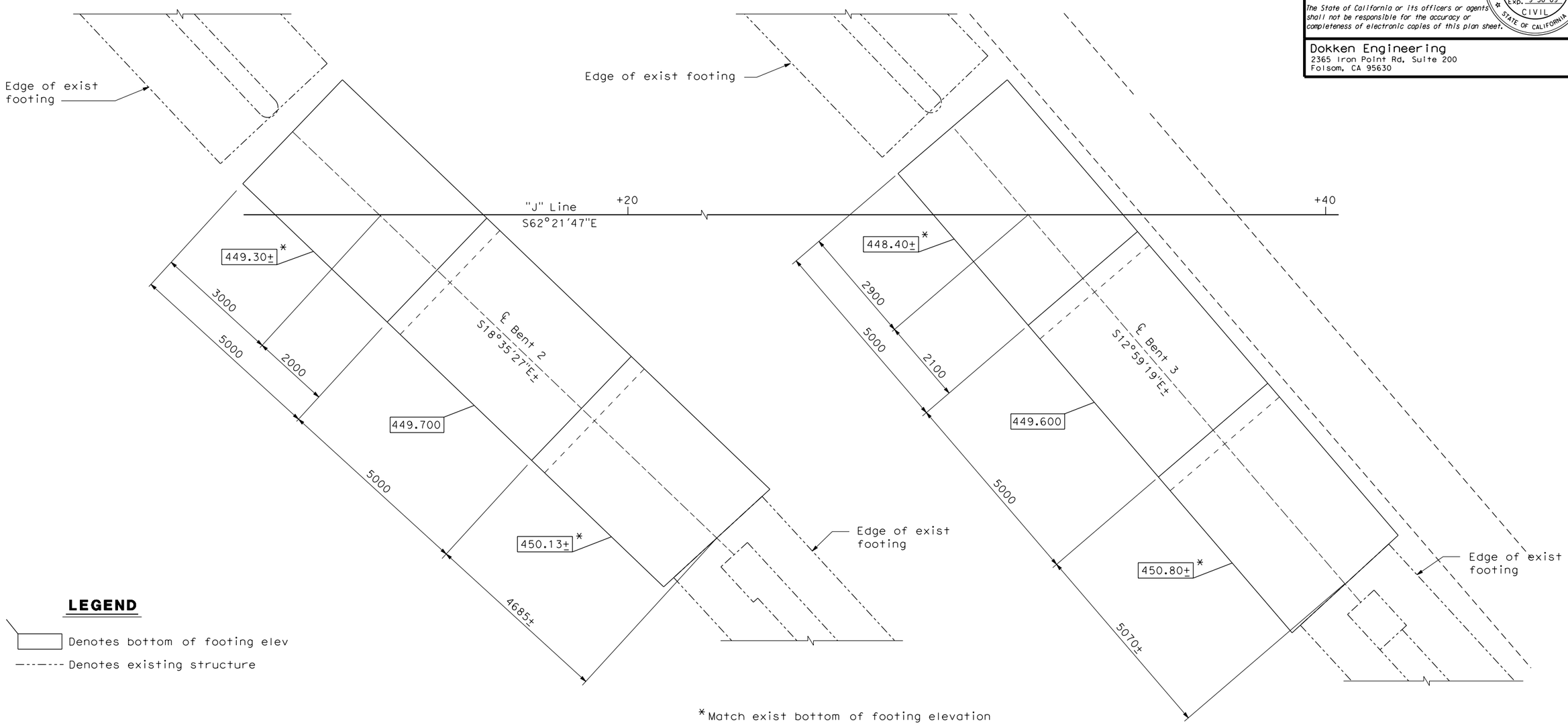
Folsom, CA 95630



BENT 2
1:50

BENT 3
1:50

NOTES:

1. The contractor shall verify all controlling field dimensions before ordering or fabricating any material.

PLATE 3c

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN	BY J. Bishop	CHECKED M. Maechler	
DETAILS	BY C. Houghton	CHECKED M. Maechler	
QUANTITIES	BY J. Bishop	CHECKED N. Bieniek	

DESIGN OVERSIGHT
SIGN OFF DATE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

John Bishop
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R62.2

BOX SPRINGS OVERHEAD LEFT (WIDEN)
BENT FOOTING LAYOUT

DESIGN DETAIL SHEET (METRIC) (REV. 3/1/98)
$FILEABBREV$ $DATE$

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 2-28-08 6-26-08 7-14-08 10-3-08 2-3-09

SHEET 5 OF 31

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

Caltrans Metric

John Bishop 2-3-09
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER J. S. BISHOP No. 50616 Exp. 9-30-09 CIVIL STATE OF CALIFORNIA

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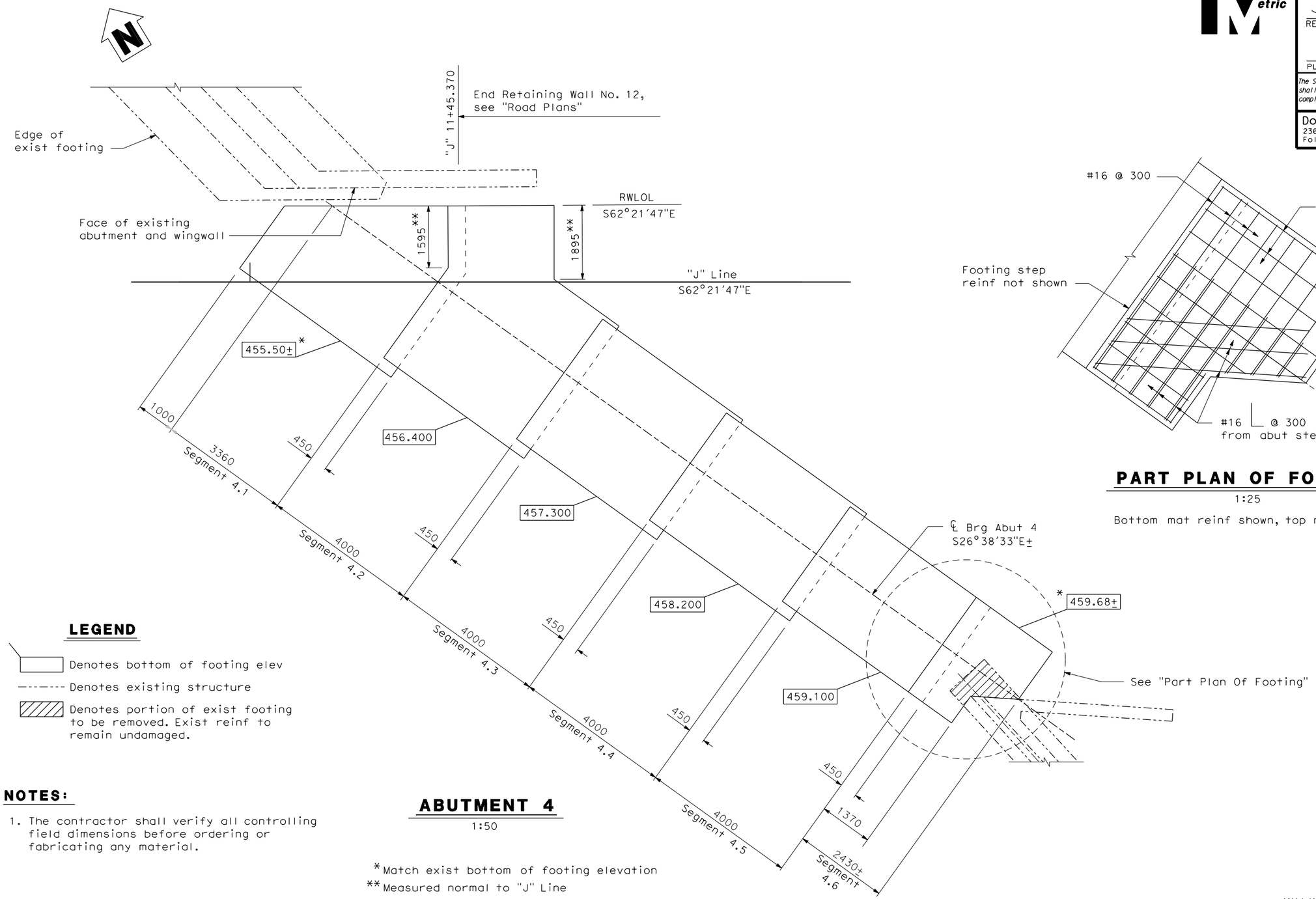
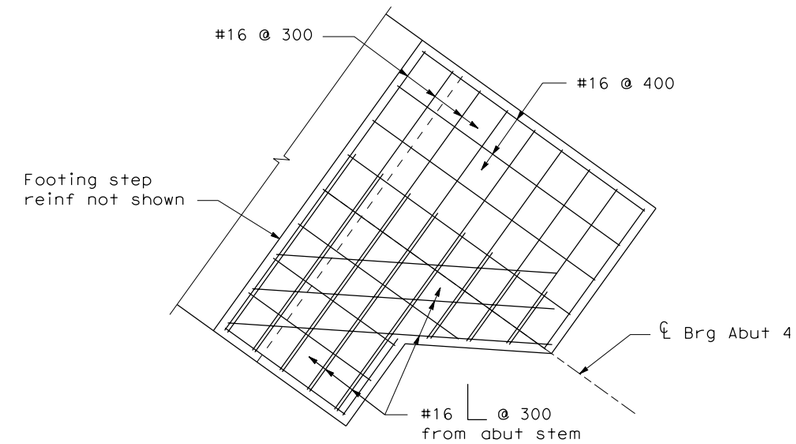
Folsom, CA 95630



ABUTMENT 4

1:50

*Match exist bottom of footing elevation
**Measured normal to "J" Line



PART PLAN OF FOOTING

1:25

Bottom mat reinf shown, top mat similar

LEGEND

Denotes bottom of footing elev

Denotes existing structure

Denotes portion of exist footing to be removed. Exist reinf to remain undamaged.

NOTES:

1. The contractor shall verify all controlling field dimensions before ordering or fabricating any material.

PLATE 3d

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN	BY J. Bishop	CHECKED M. Maechler	
DETAILS	BY C. Houghton	CHECKED M. Maechler	
QUANTITIES	BY J. Bishop	CHECKED N. Bieniek	

DESIGN OVERSIGHT

SIGN OFF DATE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

John Bishop
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R62.2

BOX SPRINGS OVERHEAD LEFT (WIDEN)
ABUTMENT 4 FOOTING LAYOUT

DESIGN DETAIL SHEET (METRIC) (REV. 3/1/98)
$FILEABBREV$ $DATE$

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 2-29-08 6-25-08 7-14-08 10-3-08 2-3-09

SHEET 6 OF 31

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

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

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVALDATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

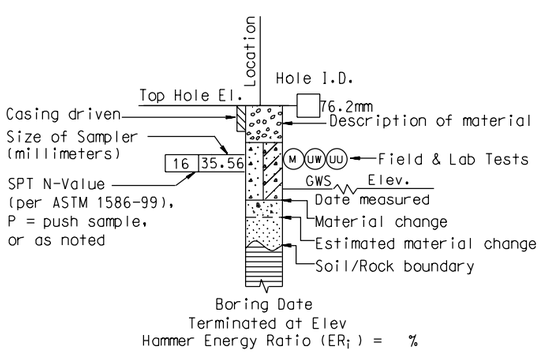
BOREHOLE IDENTIFICATION

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 (25.4mm soil tube) Hand Auger
	D	Dynamic Cone Penetration Boring
	CPT	Cone Penetration Test (ASTM D 5778-95)
	O	Other

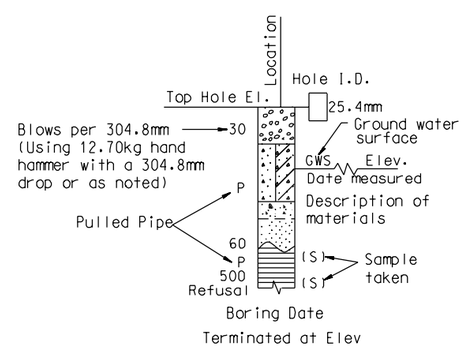
Note: Size in millimeters.

PLASTICITY OF FINE-GRAINED SOILS

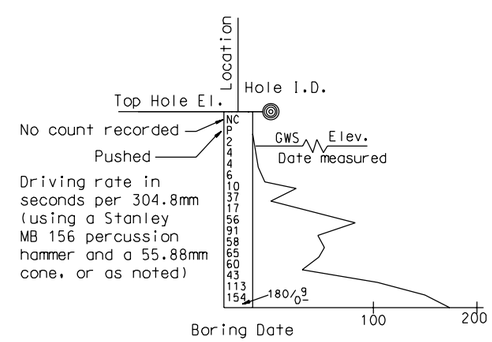
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



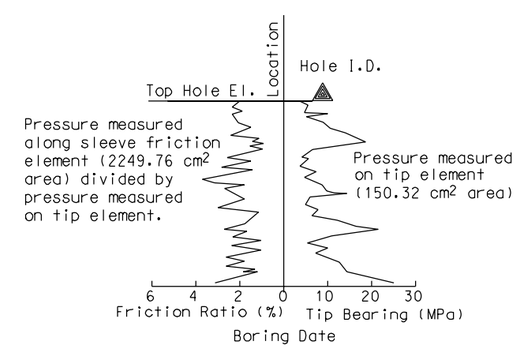
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

PLATE 4a

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

C. AMANTE
DESIGN OVERSIGHT
11/17/08
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R62.2

BOX SPRINGS OH LEFT (WIDEN)
SOIL LEGEND NO.1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/14/08 5/20/09

REVISION DATES

SHEET 28 OF 31

FILE -) $REQUEST

USERNAME -$USER DATE PLOTTED -) $DATE TIME PLOTTED -) $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVALDATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

PLATE 4b

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

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CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R62.2

BOX SPRINGS OH LEFT (WIDEN)
SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

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PLATE 4c

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVALDATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

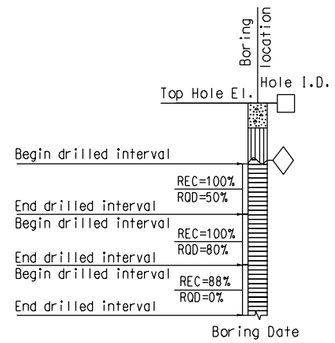
KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

C. AMANTE
DESIGN OVERSIGHT
11/17/08
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CHECKED BY C. AMANTE

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R62.2

BOX SPRINGS OH LEFT (WIDEN)

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

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PLATE 4d

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	---		

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
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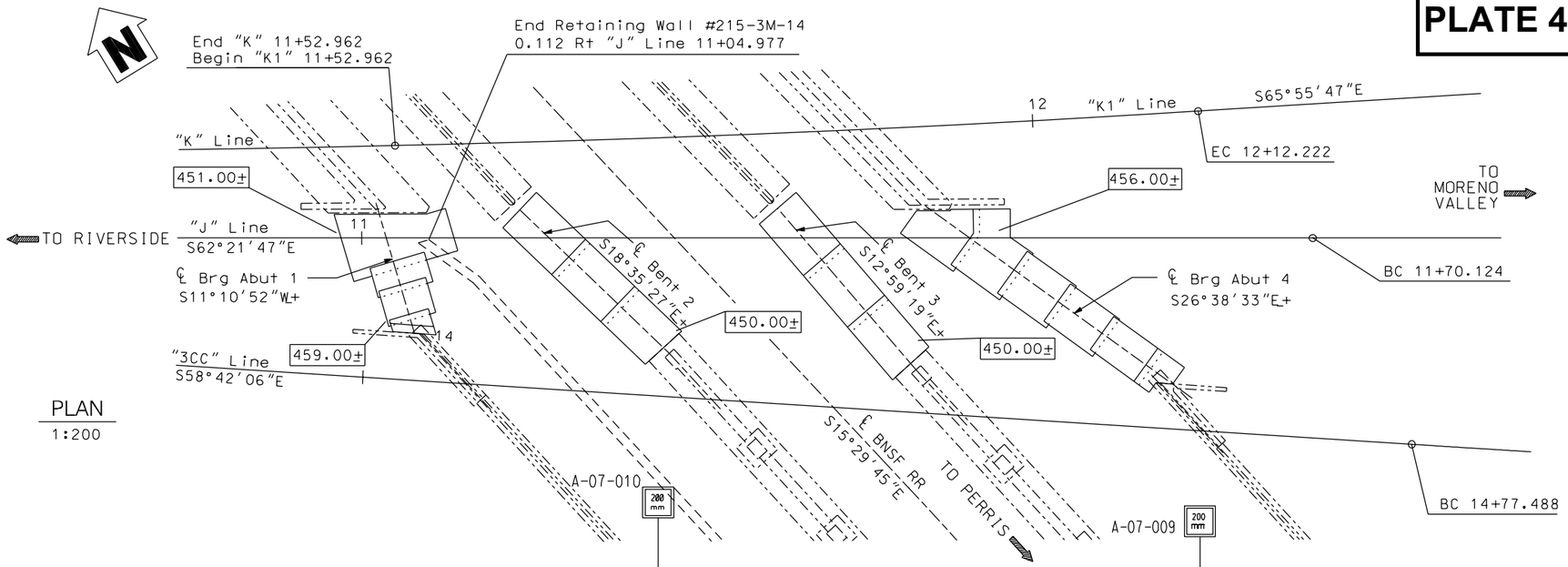
REDLANDS, CALIFORNIA 92374



PLAN
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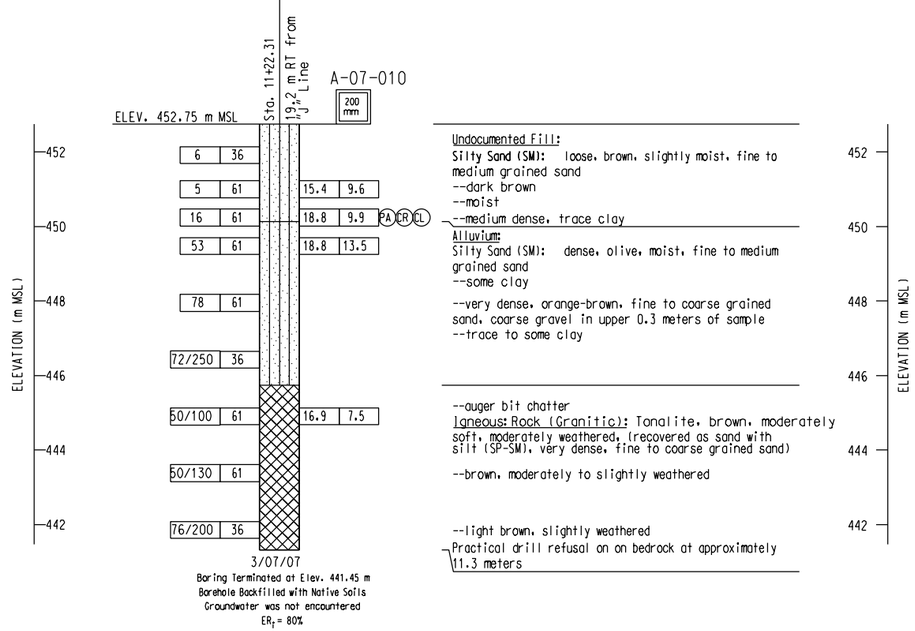

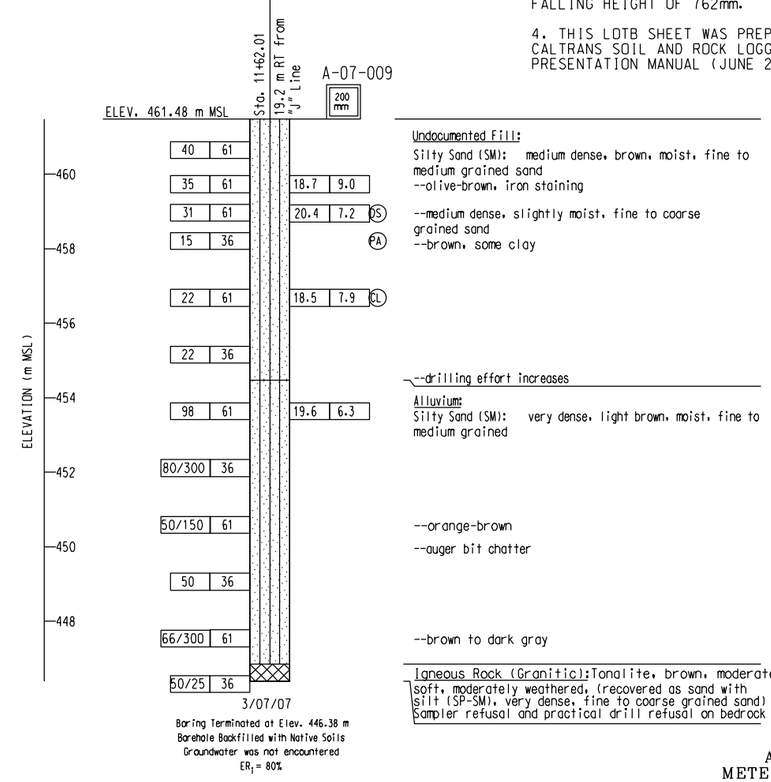

PROFILE
VERTICAL 1:2

BENCH MARK

BM Elev. 459.600 m
NP 3031 2-Inch Brass disk NGVD29

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

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C. AMANTE
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PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0082L
KILOMETER POST R62.2

BOX SPRINGS OH LEFT (WIDEN)
LOG OF TEST BORINGS

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
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REVISION DATES | SHEET 31 | OF 31

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ATTACHED XREFS:
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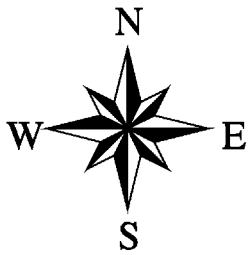

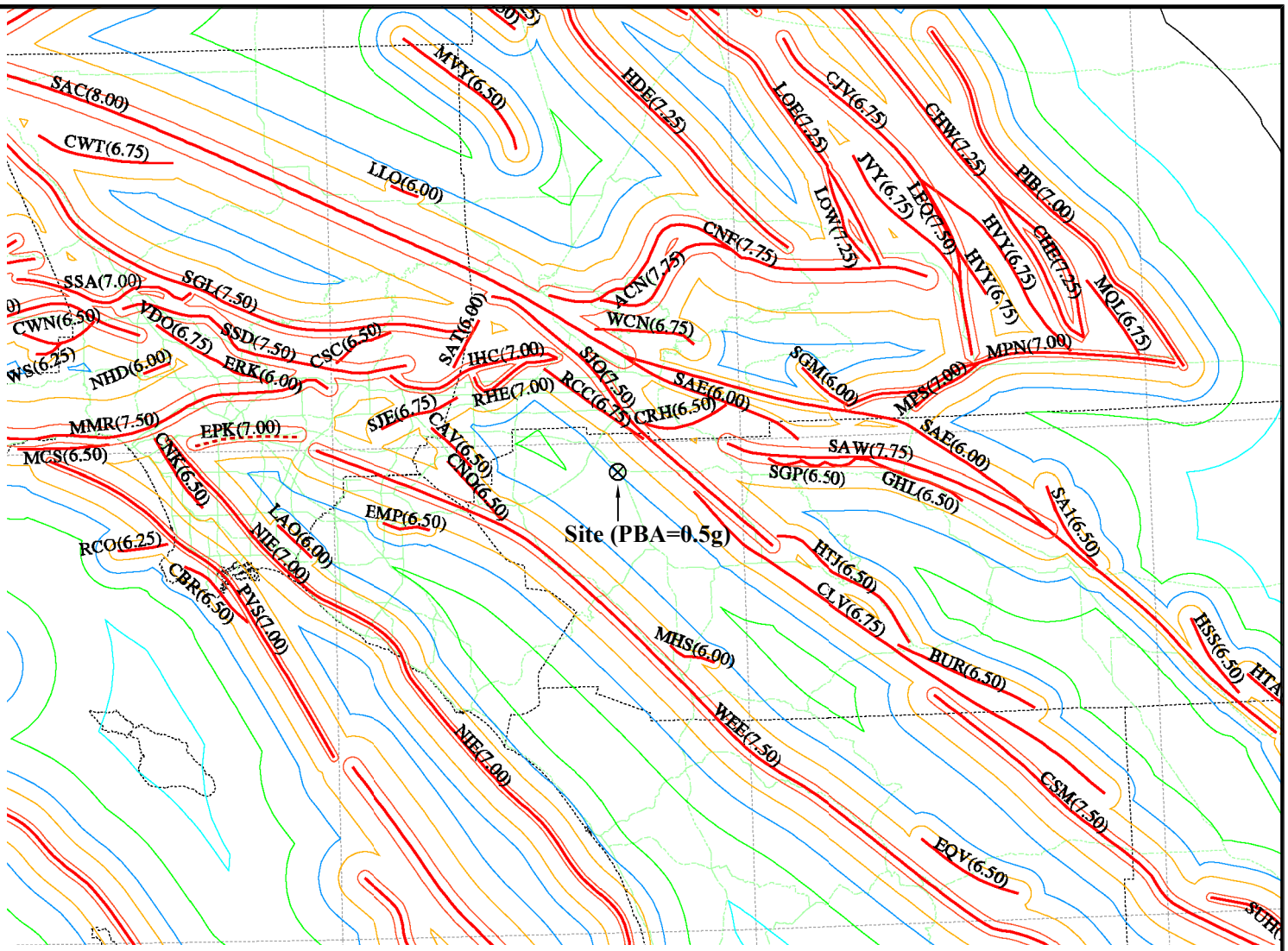

LEGEND:

- 0.7g Peak Acceleration Contour
- 0.6g Peak Acceleration Contour
- 0.5g Peak Acceleration Contour
- 0.4g Peak Acceleration Contour
- 0.3g Peak Acceleration Contour
- 0.2g Peak Acceleration Contour
- 0.1g Peak Acceleration Contour
- Special Seismic Source (SSS)
- Faults with Fault Codes (MCE)
- State Highways
- County Boundary
- Latitude & Longitude

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DRAWN BY:	DMF
CHECKED BY:	MC
FILE NAME:	76979p5.dwg

FAULT AND PBA MAP

I-215/SR-60 EAST JUNCTION
BOX SPRINGS OVERHEAD WIDENING
RIVERSIDE, CALIFORNIA

PLATE
5

CALTRANS BRIDGE DESIGN ARS CURVE

(Version 4.0, Copyright 2007, Developed By: GeoSoftware Solutions, All Rights Reserved, http://www.geosoftwaresolutions.com)
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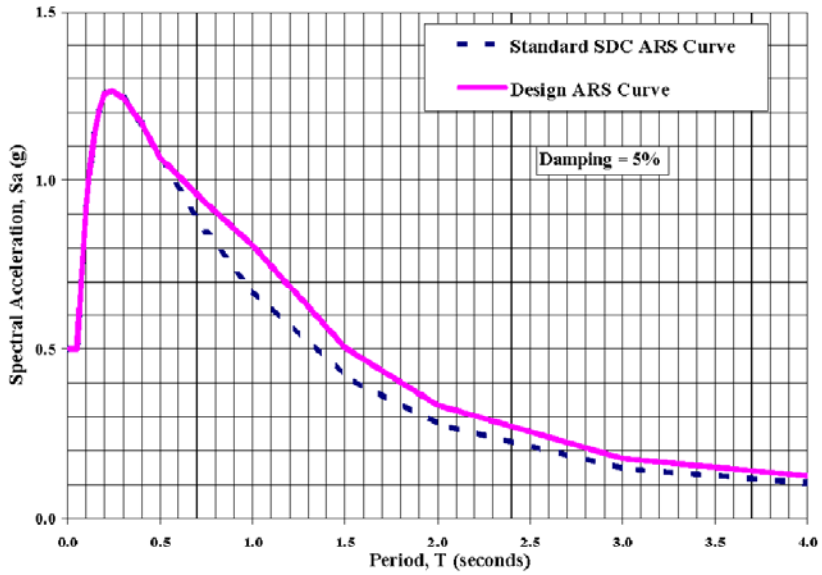
PROJECT INFORMATION	
Project Name	I-215/SR60 East Junction
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS	
Controlling Fault Name	San Jacinto (SJO)
Fault Type	Strike-slip (SS)
MCE Moment Magnitude	7.50
Distance to Fault	8.80 kilometers
Peak Bedrock Acceleration Based on 1996 California Seismic Hazard Map	0.5 g
Soil Profile Type	C

COMPUTED RESULTS	
Peak Bedrock Acceleration Based on Sadigh et al. (1997)[1]	0.46 g
Design Peak Bedrock Acceleration (g)	0.50 g



COMPUTED ARS CURVES

Period T (seconds)	Standard SDC ARS Curve[2] Sa (g)	Design ARS Curve[3] Sa (g)
0.010	0.500	0.500
0.020	0.500	0.500
0.030	0.500	0.500
0.050	0.500	0.500
0.075	0.719	0.719
0.100	0.919	0.919
0.120	1.037	1.037
0.150	1.155	1.155
0.170	1.207	1.207
0.200	1.256	1.256
0.240	1.264	1.264
0.300	1.244	1.244
0.400	1.168	1.168
0.500	1.067	1.067
0.750	0.847	0.932
1.000	0.674	0.808
1.500	0.419	0.503
2.000	0.278	0.334
3.000	0.147	0.177
4.000	0.104	0.125

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

NOTES:

[1]Peak Bedrock Acceleration (PBA):
Estimated using attenuation relationship by Sadigh et al. (1997) for rock site.
Sadigh et al. (1997) recommended no increase for Strike-Slip Fault, 10% increase for Oblique Fault; and 20% increase for Reverse/Thrust Fault. If type of fault is unknown, a 10% increase is assumed.

[2]Standard Seismic Design Criteria (SDC) ARS Curve:
Used Caltrans standard SDC ARS curve for the given PBA, magnitude, and soil profile type.

[3]Design ARS Curve:
When the bridge is located within 15 km of the controlling fault, the standard SDC ARS curve was modified as follows to account for fault rupture directivity effect:
- For Periods < 0.5 sec, no increase in standard SDC spectral acceleration values.
- For Periods > 1.0 sec, the standard SDC spectral acceleration values were increased by 20%.
- For Periods between 0.5 sec and 1.0 sec, spectral acceleration values were linearly interpolated.

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FILE NAME:	76979p6.dwg

PRELIMINARY DESIGN ARS CURVE

I-215/SR-60 EAST JUNCTION
BOX SPRINGS OVERHEAD WIDENING
RIVERSIDE, CALIFORNIA

PLATE
6

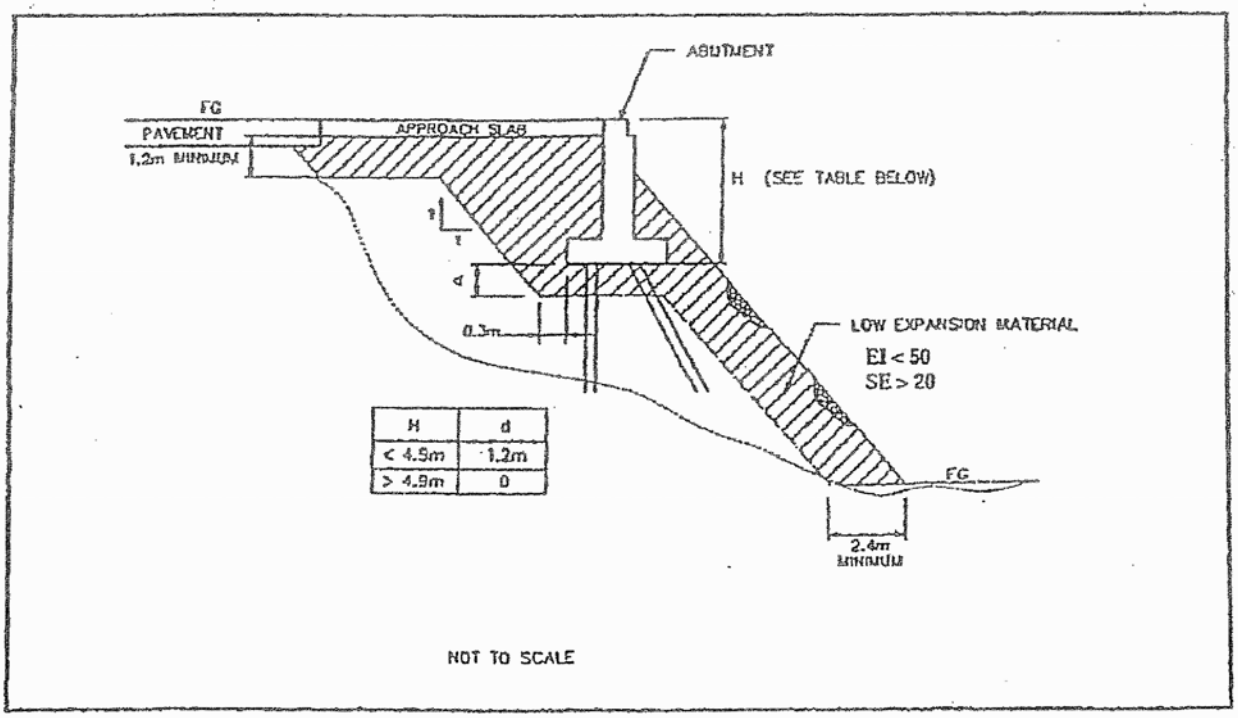
ATTACHED IMAGES: Images: Plate6-ARS Curve_1.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: U:\MGriffin\CADD\2008\76979\I-215_SR60\081008_Box-Springs_OH_Wid\ LAYOUT: 6 PLOTTED: 08 Oct 2008, 9:58am, MGriffin

EXPANSIVE SOIL EXCLUSION ZONE

GUIDELINE FOR DEFINING EXPANSIVE SOIL AND THE ZONE AROUND BRIDGE ABUTMENTS IN WHICH EXPANSIVE SOIL IS TO BE EXCLUDED (ALSO APPLICABLE TO WINGWALLS AND RETAINING WALLS).

Expansive soil materials shall not be placed as part of the embankment within the limits of a bridge abutment as shown in Figure 7 below for the full width of the embankment. Expansive soil materials for this requirement are defined as having either an Expansion Index (EI) greater than 50, (Expansion Index to be determined in accordance with ASTM D 4829) or a Sand Equivalent (SE) less than 20 (Sand Equivalent to be determined in accordance with California Test Method 217). This requirement is exclusive of the structure backfill and pervious backfill material requirements as shown on the plans and set forth in the Standard Specifications under Sections 19-3.06 and 19-3.065 respectively.

TYPICAL SECTION - EXPANSIVE SOIL EXCLUSION ZONE IN BRIDGE EMBANKMENT



H	d
< 4.9m	1.2m
> 4.9m	0

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DRAWN:	5/19/09
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME: 76979p7.dwg	

EXPANSIVE SOIL EXCLUSION ZONE

I-215/SR-60 EAST JUNCTION
BOX SPRINGS ROAD OH LEFT (WIDEN)
RIVERSIDE, CALIFORNIA

PLATE
7

ATTACHED IMAGES: Images: For Plate 9.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\051909_Box-Spring_OH_Left_(Widen)\ LAYOUT: 7 PLOTTED: 19 May 2009, 2:49pm, MGriffin

APPENDIX A

FIELD EXPLORATION

APPENDIX A
FIELD EXPLORATION

The subsurface exploration program for the Box Springs OH Left Bridge widening consisted of drilling and logging two exploratory soil borings BS-1 and BS-2 (LOTB Nos. A-07-009 and A-07-010) on March 7, 2007. These borings were advanced to depths ranging from approximately 11.3 to 15.1 meters below the existing ground surface (bgs) using a Mobile B-61, truck-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer delivery system. The borings were logged and sampled using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Following drilling, sampling and logging, the borings were backfilled with native cuttings.

Plate 4d shows the locations of the exploratory borings BS-1 and BS-2 (LOTB Nos. A-07-009 and A-07-010). The boring locations, including stations and offsets were surveyed by LAN Engineering.

The boring logs are presented in Plates A2 and A3 in the following section. The logs describe the earth materials encountered and indicate the locations of the samples obtained and infill thickness measured in the bedrock. The excavations were logged by a staff professional from Kleinfelder using methods outlined in the Unified Soil Classification System (USCS) and general procedures established in ASTM D 2488. The boundaries between soil and rock type(s) shown on the logs are approximate because the transition between different soil and rock layer(s) may be gradual.

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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	ID	DESCRIPTION	MAJOR DIVISION		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Well-graded gravels, gravel-sand mixtures	FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands
		GP		Poorly-graded gravels, gravel-sand mixtures			CL		Inorganic clays of low to medium plasticity; gravelly clays silty clays,sandy clays, lean clays
		GM		Silty gravels, gravel-sand-silt mixtures			OL		Organic silts and organic silt-clays of low plasticity
		GC		Clayey gravels, gravel-sand-clay mixtures					
	SAND AND SANDY SOILS	SW		Well-graded sands, gravelly sands		SILTS AND CLAYS LL > 50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		SP		Poorly-graded sands and gravelly sands			CH		Inorganic clays of medium to high plasticity
		SM		Silty sands, sand-silt mixture			OH		Organic clays of medium to high plasticity
		SC		Clayey sands, sand-clay mixture		HIGHLY ORGANIC SOILS	Pt		Peat, muck and other highly organic soils

▼ Approximate water level observed in boring following drilling

SOIL SAMPLE

- Bulk Sample
- Drive Sample - California Sample
- Shelby Tube Sample
- Standard Penetration Test (SPT) Sample

ADDITIONAL TESTS

CN	- Consolidation
COR	- Corrosion
CP	- Collapse Potential
DS	- Direct Shear
EI	- Expansion Potential
MAX	- Maximum Dry Density
OC	- Organic Content
PI	- Plasticity Index
RV	- R-Value
SE	- Sand Equivalent
GS	- Grain Size Distribution

NOTES:

Blow counts represent the number of blows of a 64-kilogram hammer falling 760 mm required to drive a sampler through the last 300 mm of a 460 mm penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

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LEGEND TO LOGS

PLATE A-1

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	461 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
461							**Undocumented Fill**			
	1	1 2	40			SM	**Silty Sand:** brown, dry, medium dense, fine to medium grained sand			
460		3	35				--olive-brown, iron staining	18.7	9.0	
	2	4	31				--slightly moist, medium dense, fine to coarse grained sand	20.4	7.2	DS
459	3	5	15				--brown, some clay			GS
458										
	4									
457		6	22					18.5	7.9	CN
	5									
456										
	6	7	22							
455							--drilling effort increases			
	7									
454							**Alluvium**			
	8	8	98			SM	**Silty Sand:** light brown, dry, very dense, fine to medium grained	19.6	6.3	
453										
	9	9	30, 50/150							
452										

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PROJECT NO. 76979

I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

LOG OF BORING BS-1

PLATE A-2a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT-BOX SPRINGS OH LEFT.GPJ KA_RDLND.GDT 2/16/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
451									
11	10	50/150				--orange-brown			
450						--auger bit chatter			
12									
449	11	50							
13									
448									
14	12	16, 50/150				--brown to dark gray			
447									
15		50/25				**Bedrock:** Sampler refusal and practical drill refusal on bedrock			

Boring terminated at 15.1 meters due to practical refusal .
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

LOG OF BORING BS-1

PLATE

A-2b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT-BOX SPRINGS OH LEFT.GPJ KA_RDLND.GDT 2/16/09

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	453 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
							Undocumented Fill			
452	1	1	6			SM	**Silty Sand:** brown, slightly moist, loose, fine to medium grained sand			
							--dark brown			
451	2	2	5				--moist	15.4	9.6	
		3								GS, COR
		4	16				--medium dense, trace clay	18.8	9.9	CN
450	3						**Alluvium**			
		5	53			SM	**Silty Sand:** olive, moist, dense, fine to medium grained sand	18.8	13.5	
449	4						--some clay			
448	5	6	78				--orange-brown, very dense, fine to coarse grained sand, coarse gravel in upper 0.3 meters of sample			
							--trace to some clay			
447	6	7	22, 50/100							
446	7									
							--auger bit chatter			
445	8	8	50/100				**Bedrock**: Tonalite, brown, moderately weathered, recovered as fine to coarse grained sand	16.9	7.5	
444	9									
		9	50/130				--brown, moderately to highly weathered, recovered as fine to medium grained sand			
443										

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I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

PLATE
A-3a

PROJECT NO. 76979

LOG OF BORING BS-2

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT-BOX SPRINGS OH LEFT.GPJ KA_RDLND.GDT 2/16/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
442 11	10	26, 50/5				--light brown, slightly weathered			
						Practical drill refusal on on bedrock at approximately 11.3 meters			
						Boring terminated at 11.3 meters due to practical refusal. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

LOG OF BORING BS-2

PLATE A-3b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT-BOX SPRINGS OH LEFT.GPJ KA_RDLND.GDT 2/16/09

APPENDIX B

LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

Laboratory tests were performed on drive and bulk soil samples to estimate engineering characteristics of the various earth materials encountered. Testing was performed in general accordance with procedures outlined by the American Society for Testing and Materials, the California Department of Transportation, or other accepted procedures.

IN-SITU MOISTURE CONTENT AND DRY UNIT WEIGHT

In-situ moisture content and dry unit weight tests were performed on samples that could be recovered in a relatively undisturbed condition. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937. The results are presented on the Logs of Borings.

GRAIN SIZE DISTRIBUTION

Two sieve analyses were performed on selected samples of the materials encountered at the site to evaluate the grain size distribution characteristics of the soils and to aid in their classification. The tests were performed in general accordance with ASTM Standard Test Method D 422. The test results are presented on Plate B- 1, *Grain Size Distribution*.

CONSOLIDATION TEST

Two consolidation tests were performed on representative drive soil samples to evaluate the settlement characteristics of the in-situ soils when subjected to typical foundation loads and wetting. The tests were performed in accordance with ASTM Standard Test Method D 5333. The test results are presented on Plates B-2 and B-3, *Consolidation/Collapse Potential Test*.

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DIRECT SHEAR TEST

One direct shear test was performed on a selected sample to evaluate the drained shear strength of the soils. The sample was soaked and tested in a near-saturated condition in general accordance with ASTM Test Method D3080 (consolidated, drained). The results of this test is presented on Plate B-4 and summarized in Table B-1, below.

Table B-1
Direct Shear Test Results

Boring No.	Depth (m)	USCS Soil Type	Dry Unit Weight (kN/m^3)	Angle of Internal Friction (degrees)	Cohesion (kPa)
BS-1	2.3	SM	20.4	33	44

CORROSIVITY TESTS

Chemical analyses were performed on a selected sample of the sub-surface soil to estimate pH, resistivity, soluble sulfate, and chloride contents in general accordance with Caltrans Standard Test Methods 532 (pH), 643 (resistivity), 417 (sulfates), and 422 (chlorides). The test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to the construction materials. The results of the tests are presented in Table B-2, below.

Table B-2
Corrosion Test Results

Boring No.	Depth (m)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
BS-2	2 - 3	3,000	7.7	8	131

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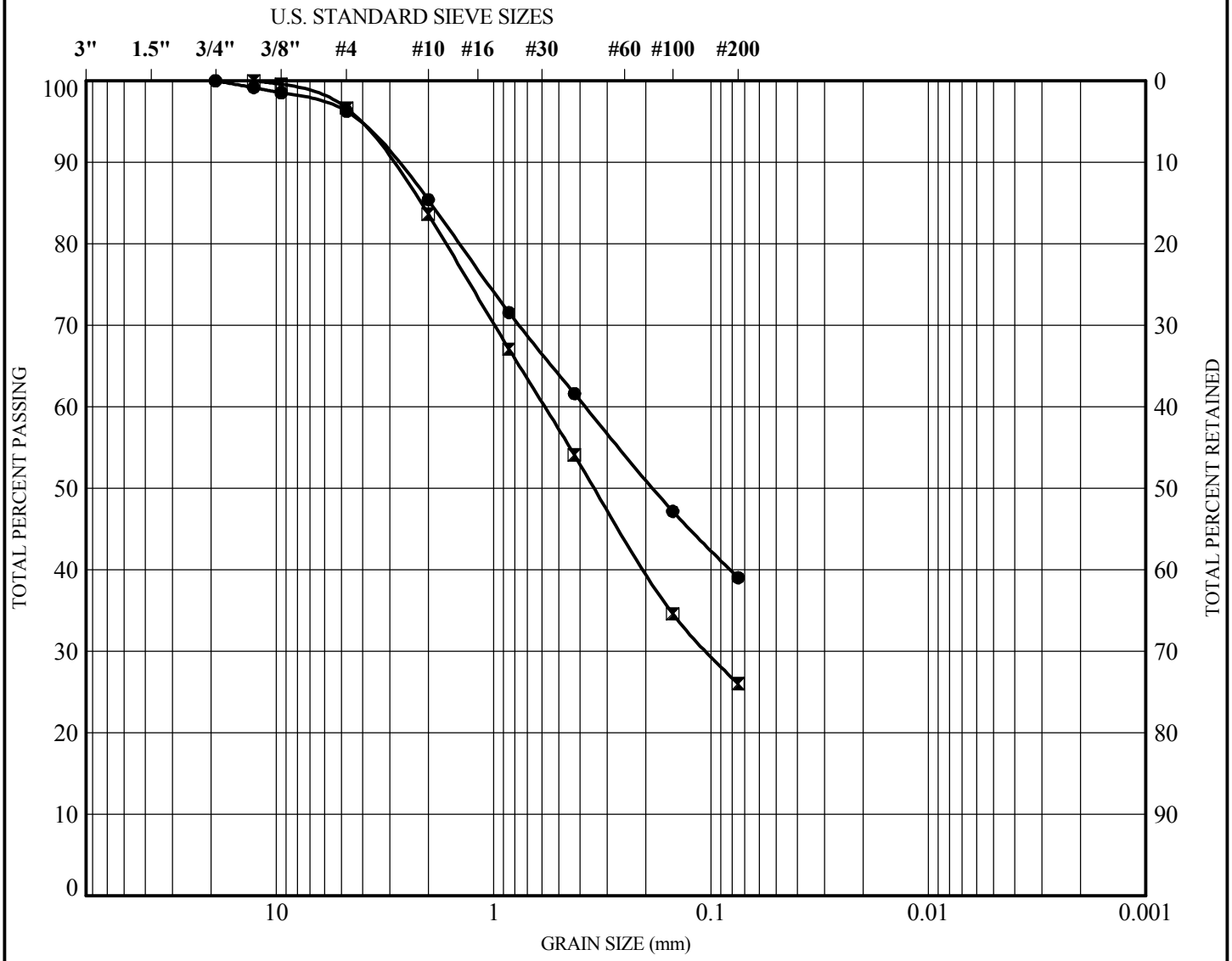
SIEVE ANALYSIS	HYDROMETER



GRAVEL	SAND					SILT	CLAY
	Very Coarse	Coarse	Medium	Fine	Very Fine		

Symbol	Test Pit	Depth (m)	USDA Description	USCS Classification
●	BS-1	3	Silty Sand	SM
⧗	BS-2	2	Silty Sand	SM

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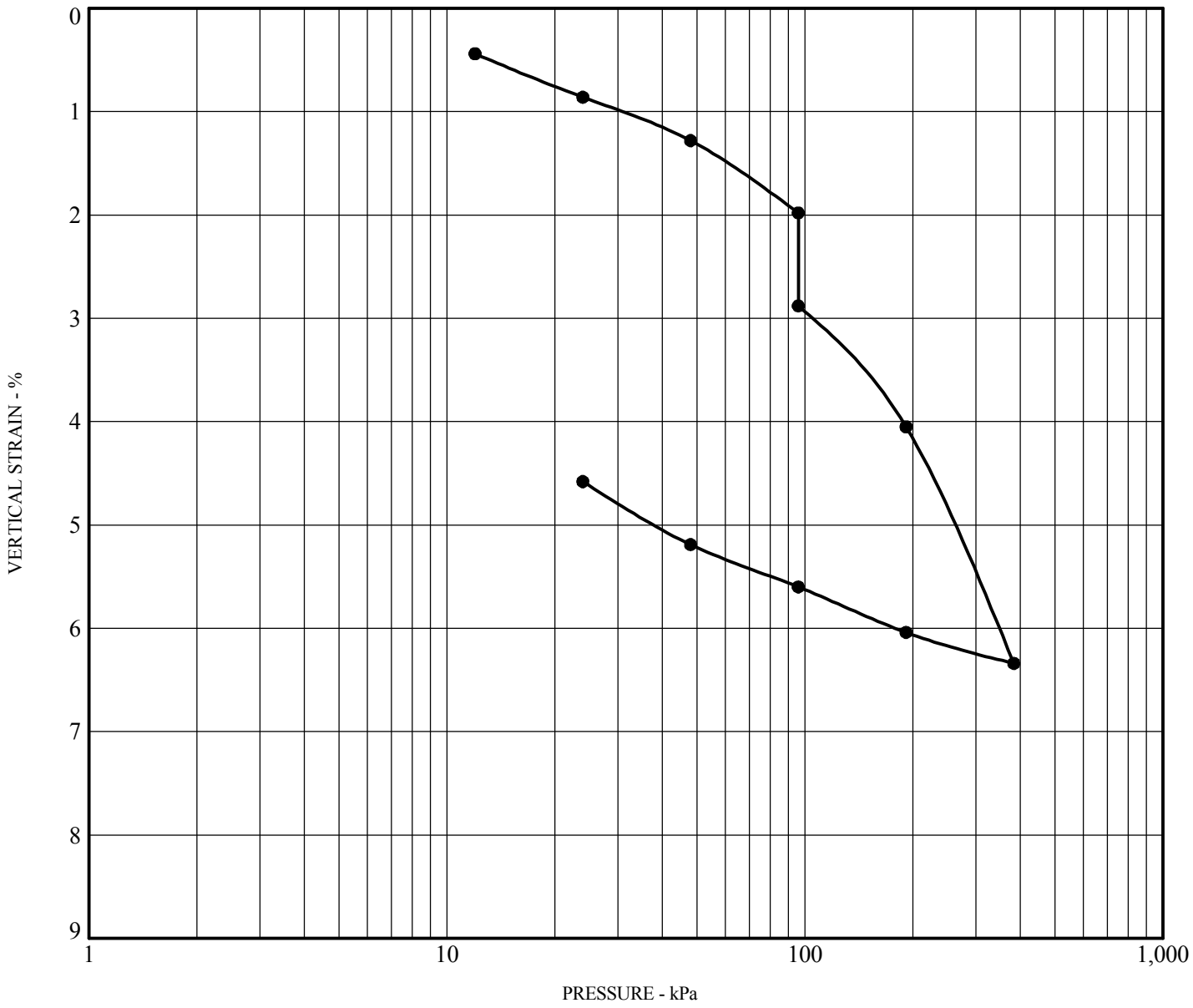
I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

GRAIN SIZE DISTRIBUTION

PLATE

B-1

GRAIN SIZE USDA 76979 I-215 SR-60-KA FORMAT-BOX SPRINGS OH LEFT.GPJ KA_RDLND.GDT 2/16/09



Boring	**BS-1**			
Depth (meters)	**5**			
Moisture Content (%)	**7.9**	**Before**	**16.4**	**After**
Dry Density (kN/m^3)	**18.5**			
Description	**Silty Sand**			
Classification	**SM**			

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PROJECT NO. 76979

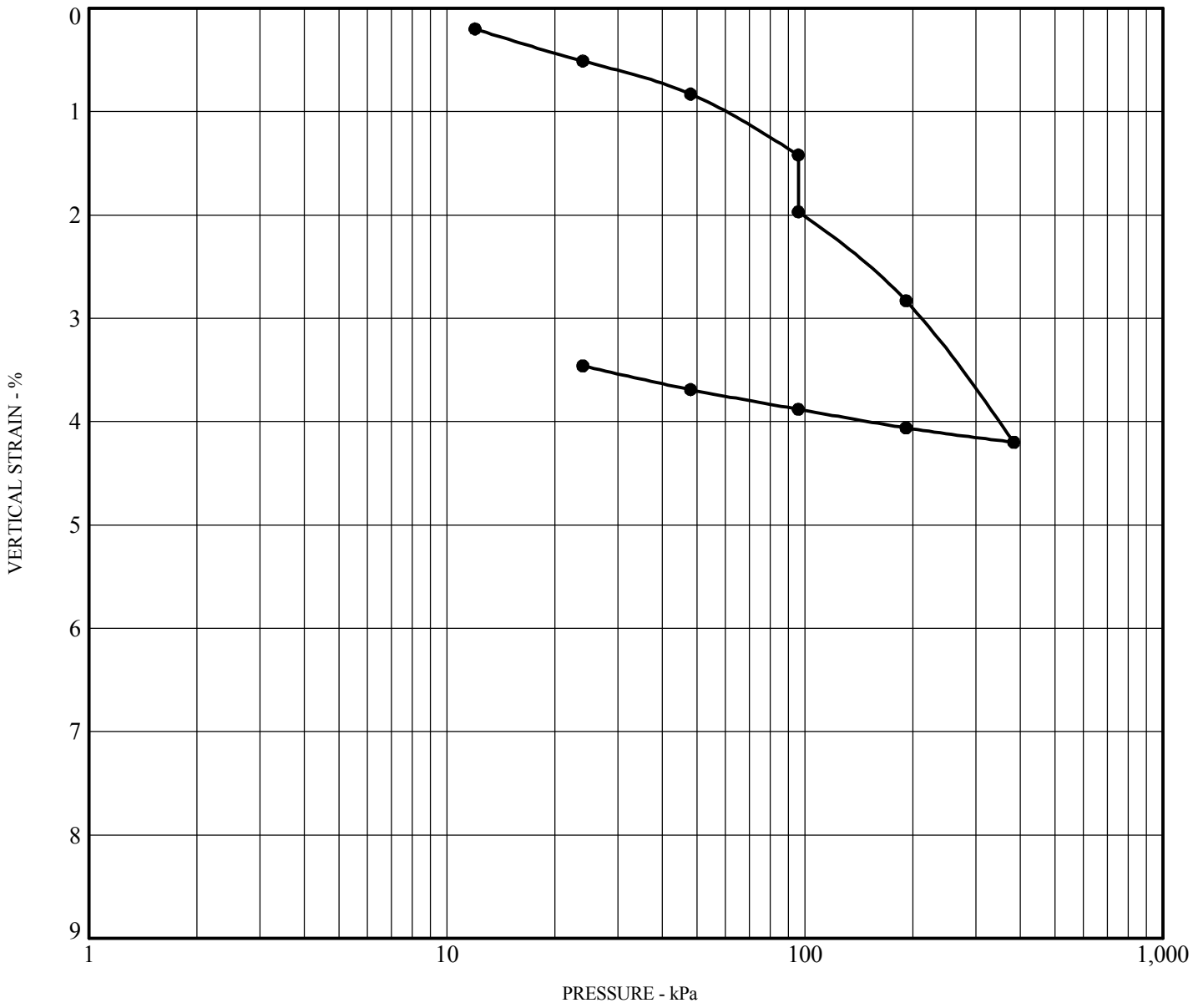
I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

CONSOLIDATION/COLLAPSE POTENTIAL TEST

PLATE

B-2

CONSOL NO INDICIES 76979 I-215 SR-60-KA FORMAT-BOX SPRINGS OH LEFT.GPJ KA_RDLND.GDT 2/16/09



Boring	**BS-2**			
Depth (meters)	**2**			
Moisture Content (%)	**9.9**	**Before**	**12.9**	**After**
Dry Density (kN/m^3)	**18.8**			
Description	**Silty Sand**			
Classification	**SM**			

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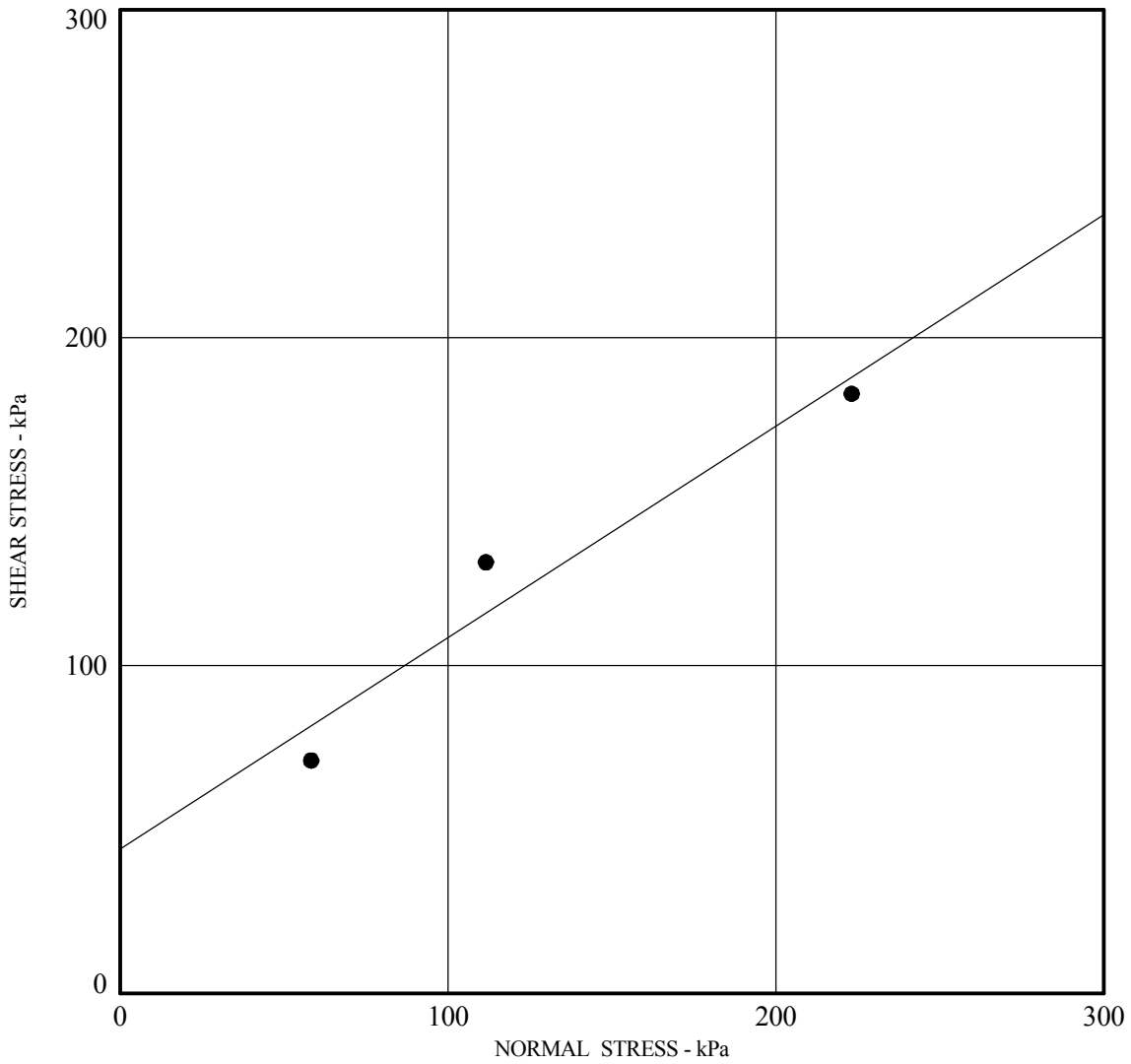
I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

CONSOLIDATION/COLLAPSE POTENTIAL TEST

PLATE

B-3

CONSOL NO INDICIES 76979 I-215 SR-60-KA FORMAT-BOX SPRINGS OH LEFT.GPJ KA_RDLND.GDT 2/16/09



Boring	**BS-1**
Depth (m)	**2**
Friction Angle - deg	**33**
Cohesion (kPa)	**44.0**
Dry Density (kN/m^3)	**20.4**
Moisture Content (%) *	**7.2**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

DIRECT SHEAR TEST

PLATE

B-4

DIRECT SHEAR STATION 76979 I-215 SR-60-KA FORMAT-BOX SPRINGS OH LEFT.GPJ KA_RDLND.GDT 2/16/09

APPENDIX C

ENGINEERING ANALYSES

C-1

LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	I-215/SR-60 East Junction, Box Springs Overhead
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA	
Exploration No.	BS-1
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1514.0 feet
Proposed Grade Elevation	1505.0 feet
Unit Weight of Proposed Fill on Surface	0.0 pcf
GWT Elevation During Test	1414.0 feet
GWT Elevation For Design	1414.0 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1514.0	1509.0	5.0	SM	Y	119.0	28.00	20.0
1509.0	1505.0	9.0	SM	Y	130.0	25.00	20.0
1505.0	1504.0	10.0	SM	Y	130.0	25.00	20.0
1504.0	1499.0	15.0	SM	Y	118.0	15.00	20.0
1499.0	1494.0	20.0	SM	Y	118.0	20.00	20.0
1494.0	1489.0	25.0	SM	Y	118.0	20.00	20.0
1489.0	1484.0	30.0	SM	Y	125.0	68.00	20.0
1484.0	1479.0	35.0	SM	Y	125.0	60.00	20.0
1479.0	1474.0	40.0	SM	Y	125.0	65.00	20.0
1474.0	1469.0	45.0	SM	Y	125.0	35.00	15.0
1469.0	1464.0	50.0	BEDROCK/FORMATION	N	125.0	65.00	0.0

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction, Box Springs Overhead
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	BS-1
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1514.00 feet
Proposed Grade Elevation	1505.00 feet
Unit Weight of Proposed Fill on Surface	0.00 pcf
GWT Elevation During Test	1414.00 feet
GWT Elevation For Design	1414.00 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<=== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<=== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.15 inches	<=== Dry or Unsaturated Soils (Above GWT)
	0.15 inches	<=== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d
* FS_{liq} = (CRR/CSR), where CRR = $CRR_{7.5}$ MSF K_σ K_α ; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_σ=1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. LPI = $\sum(1-FS_{liq})$ x H_i (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)							SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +												RESIDUAL STRENGTH AND GROUND SETTLEMENT					
Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_T (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1514.0	1513.0	SM	Y	119.0	28	20.0	0.5																	
1513.0	1512.0	SM	Y	119.0	28	20.0	1.5																	
1512.0	1511.0	SM	Y	119.0	28	20.0	2.5																	
1511.0	1510.0	SM	Y	119.0	28	20.0	3.5																	
1510.0	1509.0	SM	Y	119.0	28	20.0	4.5																	
1509.0	1508.0	SM	Y	130.0	25	20.0	5.5																	
1508.0	1507.0	SM	Y	130.0	25	20.0	6.5																	
1507.0	1506.0	SM	Y	130.0	25	20.0	7.5																	
1506.0	1505.0	SM	Y	130.0	25	20.0	8.5																	
1505.0	1504.0	SM	Y	130.0	25	20.0	9.5	1.229	0.850	46.7	0.999	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	41.6	N/A	0.010	0.000	0.00	0.15
1504.0	1503.0	SM	Y	118.0	15	20.0	10.5	1.188	0.850	28.6	0.997	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	24.8	N/A	0.022	0.028	0.00	0.14
1503.0	1502.0	SM	Y	118.0	15	20.0	11.5	1.151	0.850	27.8	0.994	N/A	0.252	N/A	N/A	NO	N/A	Soil above GWT	24.1	N/A	0.028	0.038	0.00	0.14
1502.0	1501.0	SM	Y	118.0	15	20.0	12.5	1.117	0.850	27.1	0.992	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	23.4	N/A	0.033	0.046	0.01	0.13
1501.0	1500.0	SM	Y	118.0	15	20.0	13.5	1.084	0.850	26.4	0.990	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	22.8	N/A	0.038	0.054	0.01	0.13
1500.0	1499.0	SM	Y	118.0	15	20.0	14.5	1.054	0.850	25.8	0.987	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	22.2	N/A	0.042	0.062	0.01	0.12
1499.0	1498.0	SM	Y	118.0	20	20.0	15.5	1.025	0.950	35.8	0.985	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	31.4	N/A	0.040	0.039	0.00	0.12
1498.0	1497.0	SM	Y	118.0	20	20.0	16.5	0.997	0.950	34.9	0.983	N/A	0.249	N/A	N/A	NO	N/A	Soil above GWT	30.6	N/A	0.043	0.044	0.01	0.11
1497.0	1496.0	SM	Y	118.0	20	20.0	17.5	0.971	0.950	34.1	0.980	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	29.9	N/A	0.046	0.048	0.01	0.11
1496.0	1495.0	SM	Y	118.0	20	20.0	18.5	0.947	0.950	33.3	0.978	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	29.2	N/A	0.049	0.053	0.01	0.10
1495.0	1494.0	SM	Y	118.0	20	20.0	19.5	0.923	0.950	32.6	0.976	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	28.5	N/A	0.051	0.057	0.01	0.09
1494.0	1493.0	SM	Y	118.0	20	20.0	20.5	0.901	0.950	31.9	0.973	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	27.8	N/A	0.054	0.062	0.01	0.08
1493.0	1492.0	SM	Y	118.0	20	20.0	21.5	0.880	0.950	31.2	0.971	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	27.2	N/A	0.057	0.067	0.01	0.08
1492.0	1491.0	SM	Y	118.0	20	20.0	22.5	0.859	0.950	30.6	0.969	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	26.6	N/A	0.059	0.071	0.01	0.07
1491.0	1490.0	SM	Y	118.0	20	20.0	23.5	0.840	0.950	30.0	0.966	N/A	0.245	N/A	N/A	NO	N/A	Soil above GWT	26.1	N/A	0.062	0.076	0.01	0.06
1490.0	1489.0	SM	Y	118.0	20	20.0	24.5	0.822	0.950	29.4	0.964	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	25.5	N/A	0.064	0.081	0.01	0.05
1489.0	1488.0	SM	Y	125.0	68	20.0	25.5	0.803	0.950	89.3	0.962	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	81.0	N/A	0.043	0.000	0.00	0.05
1488.0	1487.0	SM	Y	125.0	68	20.0	26.5	0.785	0.950	87.4	0.959	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	79.3	N/A	0.045	0.000	0.00	0.05
1487.0	1486.0	SM	Y	125.0	68	20.0	27.5	0.768	0.950	85.5	0.957	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	77.6	N/A	0.046	0.000	0.00	0.05
1486.0	1485.0	SM	Y	125.0	68	20.0	28.5	0.752	1.000	88.0	0.955	N/A	0.242	N/A	N/A	NO	N/A	Soil above GWT	79.9	N/A	0.047	0.000	0.00	0.05
1485.0	1484.0	SM	Y	125.0	68	20.0	29.5	0.736	1.000	86.3	0.952	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	78.2	N/A	0.048	0.000	0.00	0.05
1484.0	1483.0	SM	Y	125.0	60	20.0	30.5	0.721	1.000	75.0	0.950	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	67.8	N/A	0.051	0.000	0.00	0.05
1483.0	1482.0	SM	Y	125.0	60	20.0	31.5	0.707	1.000	73.6	0.948	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	66.5	N/A	0.053	0.000	0.00	0.05
1482.0	1481.0	SM	Y	125.0	60	20.0	32.5	0.693	1.000	72.2	0.945	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	65.2	N/A	0.054	0.000	0.00	0.05
1481.0	1480.0	SM	Y	125.0	60	20.0	33.5	0.679	1.000	70.9	0.943	N/A	0.239	N/A	N/A	NO	N/A	Soil above GWT	64.0	N/A	0.055	0.000	0.00	0.05
1480.0	1479.0	SM	Y	125.0	60	20.0	34.5	0.666	1.000	69.6	0.941	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	62.8	N/A	0.057	0.000	0.00	0.05
1479.0	1478.0	SM	Y	125.0	65	20.0	35.5	0.654	1.000	73.8	0.938	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	66.7	N/A	0.057	0.000	0.00	0.05
1478.0	1477.0	SM	Y	125.0	65	20.0	36.5	0.642	1.000	72.5	0.936	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	65.5	N/A	0.058	0.000	0.00	0.05
1477.0	1476.0	SM	Y	125.0	65	20.0	37.5	0.631	1.000	71.3	0.934	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	64.4	N/A	0.059	0.000	0.00	0.05
1476.0	1475.0	SM	Y	125.0	65	20.0	38.5	0.620	1.000	70.1	0.931	N/A	0.236	N/A	N/A	NO	N/A	Soil above GWT	63.3	N/A	0.060	0.000	0.00	0.05
1475.0	1474.0	SM	Y	125.0	65	20.0	39.5	0.609	1.000	68.9	0.926	N/A	0.235	N/A	N/A	NO	N/A	Soil above GWT	62.2	N/A	0.061	0.000	0.00	0.05
1474.0	1473.0	SM	Y	125.0	35	15.0	40.5	0.598	1.000	36.1	0.918	N/A	0.233	N/A	N/A	NO	N/A	Soil above GWT	33.4	N/A	0.079	0.078	0.01	0.04
1473.0	1472.0	SM	Y	125.0	35	15.0	41.5	0.588	1.000	35.5	0.909	N/A	0.231	N/A	N/A	NO	N/A	Soil above GWT	32.8	N/A	0.079	0.080	0.01	0.03
1472.0	1471.0	SM	Y	125.0	35	15.0	42.5	0.579	1.000	35.0	0.900	N/A	0.228	N/A	N/A	NO	N/A	Soil above GWT	32.3	N/A	0.080	0.082	0.01	0.02
1471.0	1470.0	SM	Y	125.0	35	15.0	43.5	0.569	1.000	34.4	0.893	N/A	0.226	N/A	N/A	NO	N/A	Soil above GWT	31.8	N/A	0.081	0.084	0.01	0.01
1470.0	1469.0	SM	Y	125.0	35	15.0	44.5	0.560	1.000	33.9	0.885	N/A	0.224	N/A	N/A	NO	N/A	Soil above GWT	31.3	N/A	0.081	0.086	0.01	0.00
1469.0	1468.0	BEDROCK/FORMATION	N	125.0	65	0.0	45.5	0.552	1.000	N/A	0.877	N/A	0.222	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1468.0	1467.0	BEDROCK/FORMATION	N	125.0	65	0.0	46.5	0.543	1.000	N/A	0.869	N/A	0.220	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1467.0	1466.0	BEDROCK/FORMATION	N	125.0	65	0.0	47.5	0.535	1.000	N/A	0.861	N/A	0.218	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1466.0	1465.0	BEDROCK/FORMATION	N	125.0	65	0.0	48.5	0.527	1.000	N/A	0.852	N/A	0.216	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction, Box Springs Overhead
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	BS-1
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1514.00 feet
Proposed Grade Elevation	1505.00 feet
Unit Weight of Proposed Fill on Surface	0.00 pcf
GWT Elevation During Test	1414.00 feet
GWT Elevation For Design	1414.00 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<=== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<=== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.15 inches	<=== Dry or Unsaturated Soils (Above GWT)
	0.15 inches	<=== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count $(N_1)_{60cs}$ = $N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%; Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d
* FS_{liq} = (CRR/CSR), where CRR = $CRR_{7.5}$ MSF K_σ K_α; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K=1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. LPI = $\Sigma w(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA) / SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (Inches)
1465.0	1464.0	BEDROCK/FORMATION	N	125.0	65	0.0	49.5	0.519	1.000	N/A	0.844	N/A	0.214	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	I-215/SR-60 East Junction, Box Springs Overhead
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA	
Exploration No.	BS-2
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1485.0 feet
Proposed Grade Elevation	1476.0 feet
Unit Weight of Proposed Fill on Surface	0.0 pcf
GWT Elevation During Test	1385.0 feet
GWT Elevation For Design	1385.0 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1485.0	1480.0	5.0	SM	Y	98.0	6.00	20.0
1480.0	1476.0	9.0	SM	Y	120.0	7.00	20.0
1476.0	1475.0	10.0	SM	Y	120.0	7.00	20.0
1475.0	1470.0	15.0	SM	Y	120.0	37.00	20.0
1470.0	1465.0	20.0	SM	Y	120.0	55.00	20.0
1465.0	1460.0	25.0	SM	Y	122.0	70.00	20.0
1460.0	1455.0	30.0	BEDROCK/FORMATION	N	125.0	70.00	0.0
1455.0	1450.0	35.0	BEDROCK/FORMATION	N	125.0	70.00	0.0
1450.0	1445.0	40.0	BEDROCK/FORMATION	N	125.0	70.00	0.0

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction, Box Springs Overhead
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	BS-2
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1485.00 feet
Proposed Grade Elevation	1476.00 feet
Unit Weight of Proposed Fill on Surface	0.00 pcf
GWT Elevation During Test	1385.00 feet
GWT Elevation For Design	1385.00 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<===	LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet		LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sand boils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<===	Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.00 inches	<===	Dry or Unsaturated Soils (Above GWT)
	0.00 inches	<===	Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count ($(N_1)_{60cs}$= N_m C_N C_E C_B C_R C_S x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d
* FS_{liq} = (CRR/CSR), where CRR = $CRR_{7.5}$ MSF K_σ K_α ; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K=1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. LPI = $\sum F(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)							SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +												RESIDUAL STRENGTH AND GROUND SETTLEMENT					
Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1485.0	1484.0	SM	Y	98.0	6	20.0	0.5																	
1484.0	1483.0	SM	Y	98.0	6	20.0	1.5																	
1483.0	1482.0	SM	Y	98.0	6	20.0	2.5																	
1482.0	1481.0	SM	Y	98.0	6	20.0	3.5																	
1481.0	1480.0	SM	Y	98.0	6	20.0	4.5																	
1480.0	1479.0	SM	Y	120.0	7	20.0	5.5																	
1479.0	1478.0	SM	Y	120.0	7	20.0	6.5																	
1478.0	1477.0	SM	Y	120.0	7	20.0	7.5																	
1477.0	1476.0	SM	Y	120.0	7	20.0	8.5																	
1476.0	1475.0	SM	Y	120.0	7	20.0	9.5	1.283	0.850	16.2	0.999	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	13.3	N/A	0.016	0.040	0.00	0.00
1475.0	1474.0	SM	Y	120.0	37	20.0	10.5	1.239	0.850	68.0	0.997	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	61.3	N/A	0.015	0.000	0.00	0.00
1474.0	1473.0	SM	Y	120.0	37	20.0	11.5	1.199	0.850	65.9	0.994	N/A	0.252	N/A	N/A	NO	N/A	Soil above GWT	59.3	N/A	0.020	0.000	0.00	0.00
1473.0	1472.0	SM	Y	120.0	37	20.0	12.5	1.161	0.850	63.9	0.992	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	57.5	N/A	0.023	0.000	0.00	0.00
1472.0	1471.0	SM	Y	120.0	37	20.0	13.5	1.125	0.850	62.0	0.990	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	55.8	N/A	0.027	0.000	0.00	0.00
1471.0	1470.0	SM	Y	120.0	37	20.0	14.5	1.092	0.850	60.3	0.987	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	54.2	N/A	0.030	0.000	0.00	0.00
1470.0	1469.0	SM	Y	120.0	55	20.0	15.5	1.060	0.950	95.1	0.985	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	86.4	N/A	0.027	0.000	0.00	0.00
1469.0	1468.0	SM	Y	120.0	55	20.0	16.5	1.030	0.950	92.5	0.983	N/A	0.249	N/A	N/A	NO	N/A	Soil above GWT	84.0	N/A	0.030	0.000	0.00	0.00
1468.0	1467.0	SM	Y	120.0	55	20.0	17.5	1.002	0.950	90.1	0.980	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	81.8	N/A	0.032	0.000	0.00	0.00
1467.0	1466.0	SM	Y	120.0	55	20.0	18.5	0.976	0.950	87.8	0.978	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	79.6	N/A	0.034	0.000	0.00	0.00
1466.0	1465.0	SM	Y	120.0	55	20.0	19.5	0.950	0.950	85.6	0.976	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	77.6	N/A	0.036	0.000	0.00	0.00
1465.0	1464.0	SM	Y	122.0	70	20.0	20.5	0.926	0.950	105.3	0.973	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	95.9	N/A	0.035	0.000	0.00	0.00
1464.0	1463.0	SM	Y	122.0	70	20.0	21.5	0.903	0.950	102.7	0.971	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	93.5	N/A	0.036	0.000	0.00	0.00
1463.0	1462.0	SM	Y	122.0	70	20.0	22.5	0.881	0.950	100.3	0.969	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	91.3	N/A	0.038	0.000	0.00	0.00
1462.0	1461.0	SM	Y	122.0	70	20.0	23.5	0.860	0.950	98.0	0.966	N/A	0.245	N/A	N/A	NO	N/A	Soil above GWT	89.1	N/A	0.040	0.000	0.00	0.00
1461.0	1460.0	SM	Y	122.0	70	20.0	24.5	0.840	0.950	95.8	0.964	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	87.1	N/A	0.041	0.000	0.00	0.00
1460.0	1459.0	BEDROCK/FORMATION	N	125.0	70	0.0	25.5	0.821	0.950	N/A	0.962	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1459.0	1458.0	BEDROCK/FORMATION	N	125.0	70	0.0	26.5	0.802	0.950	N/A	0.959	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1458.0	1457.0	BEDROCK/FORMATION	N	125.0	70	0.0	27.5	0.784	0.950	N/A	0.957	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1457.0	1456.0	BEDROCK/FORMATION	N	125.0	70	0.0	28.5	0.767	1.000	N/A	0.955	N/A	0.242	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1456.0	1455.0	BEDROCK/FORMATION	N	125.0	70	0.0	29.5	0.751	1.000	N/A	0.952	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1455.0	1454.0	BEDROCK/FORMATION	N	125.0	70	0.0	30.5	0.735	1.000	N/A	0.950	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1454.0	1453.0	BEDROCK/FORMATION	N	125.0	70	0.0	31.5	0.720	1.000	N/A	0.948	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1453.0	1452.0	BEDROCK/FORMATION	N	125.0	70	0.0	32.5	0.705	1.000	N/A	0.945	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1452.0	1451.0	BEDROCK/FORMATION	N	125.0	70	0.0	33.5	0.692	1.000	N/A	0.943	N/A	0.239	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1451.0	1450.0	BEDROCK/FORMATION	N	125.0	70	0.0	34.5	0.678	1.000	N/A	0.941	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1450.0	1449.0	BEDROCK/FORMATION	N	125.0	70	0.0	35.5	0.665	1.000	N/A	0.938	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1449.0	1448.0	BEDROCK/FORMATION	N	125.0	70	0.0	36.5	0.653	1.000	N/A	0.936	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1448.0	1447.0	BEDROCK/FORMATION	N	125.0	70	0.0	37.5	0.641	1.000	N/A	0.934	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1447.0	1446.0	BEDROCK/FORMATION	N	125.0	70	0.0	38.5	0.630	1.000	N/A	0.931	N/A	0.236	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1446.0	1445.0	BEDROCK/FORMATION	N	125.0	70	0.0	39.5	0.619	1.000	N/A	0.926	N/A	0.235	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00

C-2

FOOTING BEARING CAPACITY

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, Chlifornia

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 1 (WSD)
Footing Description	Segment 1.1
Footing Width, B	12.14 feet
Footing Length, L	26.24 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,475.34 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	300.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Design Method	WSD
Normal Gravity Load, Q	1,378.00 kips
Shear Load (along X-axis), P_x	382.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,480.34 feet
Depth to Design GWT, Z_w	32.38 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	382.00 kips
Effective Footing Width, $B' = B - 2e_x$	12.14 feet
Effective Footing Length, $L' = L - 2e_y$	26.24 feet
Effective Footing Area, $A_f = B' L'$	318.55 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	4.33 ksf
Effective Cohesion, c_{eff}	300.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\ c_{eff}$	165.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45^o + \phi_{eff}/2)$	10.95 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\ \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.41
Exponent, n	1.32

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.14	1.30	1.30	1.30
s_q	N/A	1.15	1.25	1.29
s_γ	0.80	1.15	0.81	0.81
Depth Factors, d_c	N/A	1.15	1.16	1.16
d_q	N/A	1.07	1.11	1.11
d_γ	N/A	1.07	1.00	1.00
Inclination Factors, i_c	N/A	0.69	0.99	1.00
i_q	N/A	0.69	0.99	1.00
i_γ	N/A	0.27	0.99	0.99
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\ S_u\ (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	16.5	20.2

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	18.4 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	6.1 ksf (292 kip)
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 1 (WSD)
Footing Description	Segment 1.2
Footing Width, B	5.90 feet
Footing Length, L	13.78 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,496.99 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	300.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Design Method	WSD
Normal Gravity Load, Q	264.00 kips
Shear Load (along X-axis), P_x	44.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,501.99 feet
Depth to Design GWT, Z_w	54.03 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	44.00 kips
Effective Footing Width, $B' = B - 2e_x$	5.90 feet
Effective Footing Length, $L' = L - 2e_y$	13.78 feet
Effective Footing Area, $A_f = B' L'$	81.30 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	3.25 ksf
Effective Cohesion, c_{eff}	300.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	165.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45^o + \phi_{eff}/2)$	5.32 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.85
Exponent, n	1.30

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.13	1.28	1.28	1.28
s_q	N/A	1.14	1.23	1.27
s_γ	0.80	1.14	0.83	0.83
Depth Factors, d_c	N/A	1.31	1.34	1.34
d_q	N/A	1.15	1.23	1.23
d_γ	N/A	1.15	1.00	1.00
Inclination Factors, i_c	N/A	0.80	1.00	1.00
i_q	N/A	0.80	1.00	1.00
i_γ	N/A	0.50	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	17.6	21.6

Ultimate Gross Bearing Capacity, $q_{ult-ave}$	19.6 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	6.5 ksf (311 kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 1 (WSD)
Footing Description	Segment 1.3
Footing Width, B	5.90 feet
Footing Length, L	11.81 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,500.93 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	300.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Design Method	WSD
Normal Gravity Load, Q	214.00 kips
Shear Load (along X-axis), P_x	29.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,505.93 feet
Depth to Design GWT, Z_w	57.97 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	29.00 kips
Effective Footing Width, $B' = B - 2e_x$	5.90 feet
Effective Footing Length, $L' = L - 2e_y$	11.81 feet
Effective Footing Area, $A_f = B' L'$	69.68 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	3.07 ksf
Effective Cohesion, c_{eff}	300.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	165.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	5.32 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.85
Exponent, n	1.33

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.15	1.33	1.33	1.33
s_q	N/A	1.16	1.26	1.31
s_γ	0.80	1.16	0.80	0.80
Depth Factors, d_c	N/A	1.31	1.34	1.34
d_q	N/A	1.15	1.23	1.23
d_γ	N/A	1.15	1.00	1.00
Inclination Factors, i_c	N/A	0.84	1.00	1.00
i_q	N/A	0.84	1.00	1.00
i_γ	N/A	0.58	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	18.2	22.3

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	20.2 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	6.7 ksf (321 kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 1 (WSD)
Footing Description	Segment 1.4
Footing Width, B	6.23 feet
Footing Length, L	9.84 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,505.95 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	300.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Design Method	WSD
Normal Gravity Load, Q	126.00 kips
Shear Load (along X-axis), P_x	13.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,510.95 feet
Depth to Design GWT, Z_w	62.99 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	13.00 kips
Effective Footing Width, $B' = B - 2e_x$	6.23 feet
Effective Footing Length, $L' = L - 2e_y$	9.84 feet
Effective Footing Area, $A_f = B' L'$	61.30 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	2.06 ksf
Effective Cohesion, c_{eff}	300.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	165.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45^o + \phi_{eff}/2)$	5.62 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.80
Exponent, n	1.39

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.19	1.41	1.41	1.41
s_q	N/A	1.21	1.34	1.40
s_γ	0.80	1.21	0.75	0.75
Depth Factors, d_c	N/A	1.29	1.32	1.32
d_q	N/A	1.14	1.22	1.22
d_γ	N/A	1.14	1.00	1.00
Inclination Factors, i_c	N/A	0.87	1.00	1.00
i_q	N/A	0.87	1.00	1.00
i_γ	N/A	0.67	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	19.1	23.4

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	21.2 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	7.1 ksf (340kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION	
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY	
Footing Location	Bent 2 (LRFD - Strength)
Footing Description	
Footing Width, B	11.81 feet
Footing Length, L	16.40 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,476.43 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS	
Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	0.00 psf
Soil Friction Angle, ϕ	34.00 degrees

FOOTING LOADS	
Design Method	LRFD (Strength)
Normal Gravity Load, Q	1,706.00 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS	
LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS	
Min. Ground Surface Elevation	1,481.43 feet
Depth to Design GWT, Z_w	33.47 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	0.00 kips
Effective Footing Width, $B' = B - 2e_x$	11.81 feet
Effective Footing Length, $L' = L - 2e_y$	16.40 feet
Effective Footing Area, $A_f = B' L'$	193.68 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	8.81 ksf
Effective Cohesion, c_{eff}	0.00 psf
Effective Friction Angle, ϕ_{eff}	34.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	0.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	11.11 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	22.67 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.54
Depth Factor Parameter, k	0.42
Exponent, n	1.42

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	42.16	42.16	42.16	42.16
N_q	36.50	29.44	29.44	29.44
N_γ	37.98	31.15	28.77	41.06
Shape Factors, s_c	1.22	1.51	1.50	1.50
s_q	N/A	1.25	1.40	1.49
s_γ	0.80	1.25	0.71	0.71
Depth Factors, d_c	N/A	1.16	1.17	1.17
d_q	N/A	1.08	1.11	1.11
d_γ	N/A	1.08	1.00	1.00
Inclination Factors, i_c	N/A	1.00	1.00	1.00
i_q	N/A	1.00	1.00	1.00
i_γ	N/A	1.00	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	1.00	1.00
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	48.8	53.8	42.0	49.9

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	48.6 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	21.9 ksf (1049 kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:
* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Bent 2 (LRFD - Extreme Event)
Footing Description	
Footing Width, B	11.81 feet
Footing Length, L	49.20 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,476.43 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	0.00 psf
Soil Friction Angle, ϕ	34.00 degrees

FOOTING LOADS

Design Method	LRFD (Extreme Event)
Normal Gravity Load, Q	978.00 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,481.43 feet
Depth to Design GWT, Z_w	33.47 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	0.00 kips
Effective Footing Width, $B' = B - 2e_x$	11.81 feet
Effective Footing Length, $L' = L - 2e_y$	49.20 feet
Effective Footing Area, $A_f = B' L'$	581.05 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	1.68 ksf
Effective Cohesion, c_{eff}	0.00 psf
Effective Friction Angle, ϕ_{eff}	34.00 degrees
Footing Base Adhesion, $C_a = 0.55\ c_{eff}$	0.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45^o + \phi_{eff}/2)$	11.11 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\ \phi_{eff}$	22.67 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o + \phi_{eff}/2)$	3.54
Depth Factor Parameter, k	0.42
Exponent, n	1.19

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	42.16	42.16	42.16	42.16
N_q	36.50	29.44	29.44	29.44
N_γ	37.98	31.15	28.77	41.06
Shape Factors, s_c	1.07	1.17	1.17	1.17
s_q	N/A	1.08	1.13	1.16
s_γ	0.80	1.08	0.90	0.90
Depth Factors, d_c	N/A	1.16	1.17	1.17
d_q	N/A	1.08	1.11	1.11
d_γ	N/A	1.08	1.00	1.00
Inclination Factors, i_c	N/A	1.00	1.00	1.00
i_q	N/A	1.00	1.00	1.00
i_γ	N/A	1.00	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	1.00	1.00
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\ S_u\ (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	48.8	46.5	40.7	49.1

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	46.3 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	46.3 ksf (2217 kPa)

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION	
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY	
Footing Location	Bent 3 (LRFD - Strength)
Footing Description	
Footing Width, B	11.81 feet
Footing Length, L	16.40 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,478.62 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS	
Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	0.00 psf
Soil Friction Angle, ϕ	34.00 degrees

FOOTING LOADS	
Design Method	LRFD (Strength)
Normal Gravity Load, Q	1,706.00 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS	
LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS	
Min. Ground Surface Elevation	1,483.62 feet
Depth to Design GWT, Z_w	35.66 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	0.00 kips
Effective Footing Width, $B' = B - 2e_x$	11.81 feet
Effective Footing Length, $L' = L - 2e_y$	16.40 feet
Effective Footing Area, $A_f = B' L'$	193.68 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	8.81 ksf
Effective Cohesion, c_{eff}	0.00 psf
Effective Friction Angle, ϕ_{eff}	34.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	0.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	11.11 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	22.67 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.54
Depth Factor Parameter, k	0.42
Exponent, n	1.42

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	42.16	42.16	42.16	42.16
N_q	36.50	29.44	29.44	29.44
N_γ	37.98	31.15	28.77	41.06
Shape Factors, s_c	1.22	1.51	1.50	1.50
s_q	N/A	1.25	1.40	1.49
s_γ	0.80	1.25	0.71	0.71
Depth Factors, d_c	N/A	1.16	1.17	1.17
d_q	N/A	1.08	1.11	1.11
d_γ	N/A	1.08	1.00	1.00
Inclination Factors, i_c	N/A	1.00	1.00	1.00
i_q	N/A	1.00	1.00	1.00
i_γ	N/A	1.00	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	1.00	1.00
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	48.8	53.8	42.0	49.9

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	48.6 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	21.9 ksf (1049 kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:
* The footing should be checked for tolerable settlement.

REFERENCES:
1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION	
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY	
Footing Location	Bent 3 (LRFD - Extreme Event)
Footing Description	
Footing Width, B	11.81 feet
Footing Length, L	49.20 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,478.62 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS	
Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	0.00 psf
Soil Friction Angle, ϕ	34.00 degrees

FOOTING LOADS	
Design Method	LRFD (Extreme Event)
Normal Gravity Load, Q	978.00 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS	
LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS	
Min. Ground Surface Elevation	1,483.62 feet
Depth to Design GWT, Z_w	35.66 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	0.00 kips
Effective Footing Width, $B' = B - 2e_x$	11.81 feet
Effective Footing Length, $L' = L - 2e_y$	49.20 feet
Effective Footing Area, $A_f = B' L'$	581.05 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	1.68 ksf
Effective Cohesion, c_{eff}	0.00 psf
Effective Friction Angle, ϕ_{eff}	34.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	0.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	11.11 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	22.67 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.54
Depth Factor Parameter, k	0.42
Exponent, n	1.19

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	42.16	42.16	42.16	42.16
N_q	36.50	29.44	29.44	29.44
N_γ	37.98	31.15	28.77	41.06
Shape Factors, s_c	1.07	1.17	1.17	1.17
s_q	N/A	1.08	1.13	1.16
s_γ	0.80	1.08	0.90	0.90
Depth Factors, d_c	N/A	1.16	1.17	1.17
d_q	N/A	1.08	1.11	1.11
d_γ	N/A	1.08	1.00	1.00
Inclination Factors, i_c	N/A	1.00	1.00	1.00
i_q	N/A	1.00	1.00	1.00
i_γ	N/A	1.00	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	1.00	1.00
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	48.8	46.5	40.7	49.1

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	46.3 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	46.3 ksf (2217 kPa)

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION	
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY	
Footing Location	Abutment 4 (WSD)
Footing Description	Segment 4.1
Footing Width, B	11.15 feet
Footing Length, L	15.09 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,494.04 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS	
Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	300.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS	
Design Method	WSD
Normal Gravity Load, Q	529.00 kips
Shear Load (along X-axis), P_x	131.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS	
LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS	
Min. Ground Surface Elevation	1,499.04 feet
Depth to Design GWT, Z_w	51.08 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	131.00 kips
Effective Footing Width, $B' = B - 2e_x$	11.15 feet
Effective Footing Length, $L' = L - 2e_y$	15.09 feet
Effective Footing Area, $A_f = B' L'$	168.25 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	3.14 ksf
Effective Cohesion, c_{eff}	300.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\ c_{eff}$	165.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45^\circ + \phi_{eff}/2)$	10.06 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\ \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^\circ + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.45
Exponent, n	1.42

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.22	1.48	1.48	1.48
s_q	N/A	1.24	1.39	1.46
s_γ	0.80	1.24	0.70	0.70
Depth Factors, d_c	N/A	1.16	1.18	1.18
d_q	N/A	1.08	1.12	1.12
d_γ	N/A	1.08	1.00	1.00
Inclination Factors, i_c	N/A	0.71	1.00	1.00
i_q	N/A	0.71	1.00	1.00
i_γ	N/A	0.32	0.99	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\ S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	18.4	22.6

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	20.5 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	6.8 ksf (326 kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:
* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 4 (WSD)
Footing Description	Segment 4.2
Footing Width, B	13.12 feet
Footing Length, L	13.78 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,496.99 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	300.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Design Method	WSD
Normal Gravity Load, Q	497.00 kips
Shear Load (along X-axis), P_x	112.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,501.99 feet
Depth to Design GWT, Z_w	54.03 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	112.00 kips
Effective Footing Width, $B' = B - 2\,e_x$	13.12 feet
Effective Footing Length, $L' = L - 2\,e_y$	13.78 feet
Effective Footing Area, $A_f = B'\,L'$	180.79 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	2.75 ksf
Effective Cohesion, c_{eff}	300.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\,c_{eff}$	165.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45^o + \phi_{eff}/2)$	11.83 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\,\phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.38
Exponent, n	1.49

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.29	1.62	1.62	1.62
s_q	N/A	1.31	1.50	1.59
s_γ	0.80	1.31	0.62	0.62
Depth Factors, d_c	N/A	1.14	1.15	1.15
d_q	N/A	1.07	1.11	1.11
d_γ	N/A	1.07	1.00	1.00
Inclination Factors, i_c	N/A	0.74	1.00	1.00
i_q	N/A	0.74	1.00	1.00
i_γ	N/A	0.36	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\,S_u\,(1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	19.6	24.2

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	21.9 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	7.3 ksf (350 kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION	
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY	
Footing Location	Abutment 4 (WSD)
Footing Description	Segment 4.3
Footing Width, B	12.46 feet
Footing Length, L	13.12 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,499.94 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS	
Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	300.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS	
Design Method	WSD
Normal Gravity Load, Q	415.00 kips
Shear Load (along X-axis), P_x	81.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS	
LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS	
Min. Ground Surface Elevation	1,504.94 feet
Depth to Design GWT, Z_w	56.98 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	81.00 kips
Effective Footing Width, $B' = B - 2e_x$	12.46 feet
Effective Footing Length, $L' = L - 2e_y$	13.12 feet
Effective Footing Area, $A_f = B' L'$	163.48 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	2.54 ksf
Effective Cohesion, c_{eff}	300.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	165.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45^o + \phi_{eff}/2)$	11.24 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.40
Exponent, n	1.49

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.28	1.62	1.62	1.62
s_q	N/A	1.31	1.50	1.59
s_γ	0.80	1.31	0.62	0.62
Depth Factors, d_c	N/A	1.14	1.16	1.16
d_q	N/A	1.07	1.11	1.11
d_γ	N/A	1.07	1.00	1.00
Inclination Factors, i_c	N/A	0.77	1.00	1.00
i_q	N/A	0.77	1.00	1.00
i_γ	N/A	0.43	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	19.7	24.2

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	22.0 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	7.3 ksf (350 kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION	
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY	
Footing Location	Abutment 4 (WSD)
Footing Description	Segment 4.4
Footing Width, B	11.15 feet
Footing Length, L	13.12 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,502.90 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS	
Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	300.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS	
Design Method	WSD
Normal Gravity Load, Q	348.00 kips
Shear Load (along X-axis), P_x	58.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS	
LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS	
Min. Ground Surface Elevation	1,507.90 feet
Depth to Design GWT, Z_w	59.94 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	58.00 kips
Effective Footing Width, $B' = B - 2\,e_x$	11.15 feet
Effective Footing Length, $L' = L - 2\,e_y$	13.12 feet
Effective Footing Area, $A_f = B'\,L'$	146.29 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	2.38 ksf
Effective Cohesion, c_{eff}	300.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\,c_{eff}$	165.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45^o + \phi_{eff}/2)$	10.06 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\,\phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.45
Exponent, n	1.46

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.25	1.55	1.55	1.55
s_q	N/A	1.28	1.45	1.53
s_γ	0.80	1.28	0.66	0.66
Depth Factors, d_c	N/A	1.16	1.18	1.18
d_q	N/A	1.08	1.12	1.12
d_γ	N/A	1.08	1.00	1.00
Inclination Factors, i_c	N/A	0.80	1.00	1.00
i_q	N/A	0.80	1.00	1.00
i_γ	N/A	0.50	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\,S_u\,(1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	19.2	23.6

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	21.4 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	7.1 ksf (340 kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, Californin

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 4 (WSD)
Footing Description	Segment 4.5
Footing Width, B	9.84 feet
Footing Length, L	13.12 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,505.85 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	300.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Design Method	WSD
Normal Gravity Load, Q	291.00 kips
Shear Load (along X-axis), P_x	39.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,510.85 feet
Depth to Design GWT, Z_w	62.89 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	39.00 kips
Effective Footing Width, $B' = B - 2\,e_x$	9.84 feet
Effective Footing Length, $L' = L - 2\,e_y$	13.12 feet
Effective Footing Area, $A_f = B'\,L'$	129.10 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	2.25 ksf
Effective Cohesion, c_{eff}	300.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\,c_{eff}$	165.00 psf
Depth of Wedge Zone, $D = 0.5B\,\tan(45^o+\phi_{eff}/2)$	8.88 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\,\phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o+\phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.51
Exponent, n	1.43

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.23	1.49	1.49	1.49
s_q	N/A	1.24	1.40	1.47
s_γ	0.80	1.24	0.70	0.70
Depth Factors, d_c	N/A	1.18	1.20	1.20
d_q	N/A	1.09	1.14	1.14
d_γ	N/A	1.09	1.00	1.00
Inclination Factors, i_c	N/A	0.84	1.00	1.00
i_q	N/A	0.84	1.00	1.00
i_γ	N/A	0.58	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\,S_u\,(1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	18.7	23.0

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	20.9 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	7.0 ksf (335 kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 4 (WSD)
Footing Description	Segment 4.6
Footing Width, B	7.87 feet
Footing Length, L	9.84 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,507.75 feet
Design GWT Elevation	1,447.96 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	300.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Design Method	WSD
Normal Gravity Load, Q	156.00 kips
Shear Load (along X-axis), P_x	17.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,512.75 feet
Depth to Design GWT, Z_w	64.79 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	17.00 kips
Effective Footing Width, $B' = B - 2e_x$	7.87 feet
Effective Footing Length, $L' = L - 2e_y$	9.84 feet
Effective Footing Area, $A_f = B' L'$	77.44 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	2.01 ksf
Effective Cohesion, c_{eff}	300.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	165.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45^\circ + \phi_{eff}/2)$	7.10 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^\circ + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.64
Exponent, n	1.44

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.24	1.52	1.52	1.52
s_q	N/A	1.26	1.42	1.50
s_γ	0.80	1.26	0.68	0.68
Depth Factors, d_c	N/A	1.23	1.25	1.25
d_q	N/A	1.11	1.18	1.18
d_γ	N/A	1.11	1.00	1.00
Inclination Factors, i_c	N/A	0.87	1.00	1.00
i_q	N/A	0.87	1.00	1.00
i_γ	N/A	0.65	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	19.6	24.1

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	21.8 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	7.3 ksf (350 kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

C-3

FOOTING SETTLEMENT

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

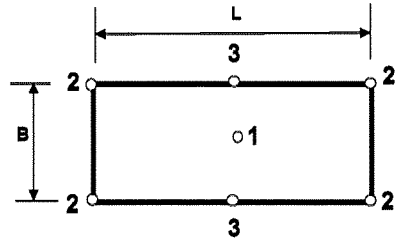
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1
Footing Description	Segment 1.1
Stress Analysis Method	Boussinesq Method
Footing Width, B	12.13 feet
Footing Length, L	26.24 feet
Applied Net Bearing Pressure, p	4.32 ksf (207 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,475.34 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.51	0.12	0.25
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.51	0.12	0.25



Performed By: _____ Date: _____

Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,480.34	1,475.34	Cohesionless Soil	120.0					
1,475.34	1,472.00	Cohesionless Soil	120.0	510.0	0.35			1.0
1,472.00	1,469.00	Cohesionless Soil	120.0	670.0	0.35			1.0
1,469.00	1,465.00	Cohesionless Soil	120.0	1,000.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.67	3.34	1.00	0.80	N/A	4.28	1.08	2.16	0.266	0.056	0.120	0.000	0.000	0.000
4.84	3.00	1.36	1.18	N/A	3.77	1.05	2.08	0.147	0.036	0.076	0.000	0.000	0.000
8.34	4.00	1.84	1.60	N/A	2.91	0.98	1.87	0.095	0.030	0.059	0.000	0.000	0.000

* Settlement under service load = 0.51" (13mm)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

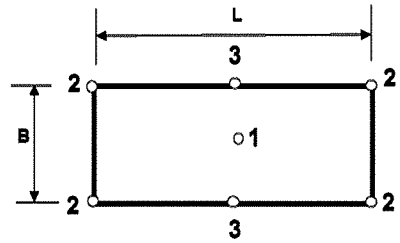
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1
Footing Description	Segment 1.2
Stress Analysis Method	Boussinesq Method
Footing Width, B	5.90 feet
Footing Length, L	13.78 feet
Applied Net Bearing Pressure, p	3.24 ksf (155 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,496.99 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.73	0.28	0.48
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.73	0.28	0.48



Performed By: _____ Date: _____
Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,501.99	1,496.99	Cohesionless Soil	120.0					
1,496.99	1,492.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,492.00	1,487.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,487.00	1,482.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,482.00	1,477.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,477.00	1,472.00	Cohesionless Soil	120.0	510.0	0.35			1.0
1,472.00	1,469.00	Cohesionless Soil	120.0	670.0	0.35			1.0
1,469.00	1,465.00	Cohesionless Soil	120.0	1,000.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
2.50	4.99	1.20	0.90	N/A	2.79	0.79	1.56	0.410	0.103	0.214	0.000	0.000	0.000
7.49	5.00	1.80	1.50	N/A	1.26	0.58	1.00	0.165	0.074	0.130	0.000	0.000	0.000
12.49	5.00	2.40	2.10	N/A	0.62	0.38	0.56	0.080	0.049	0.071	0.000	0.000	0.000
17.49	5.00	3.00	2.70	N/A	0.36	0.26	0.34	0.046	0.033	0.043	0.000	0.000	0.000
22.49	5.00	3.60	3.30	N/A	0.23	0.18	0.22	0.017	0.013	0.016	0.000	0.000	0.000
26.49	3.00	3.96	3.78	N/A	0.17	0.14	0.16	0.006	0.005	0.005	0.000	0.000	0.000
29.99	4.00	4.44	4.20	N/A	0.13	0.12	0.13	0.004	0.003	0.004	0.000	0.000	0.000

* Settlement under service load = 0.73" (18.5 mm)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

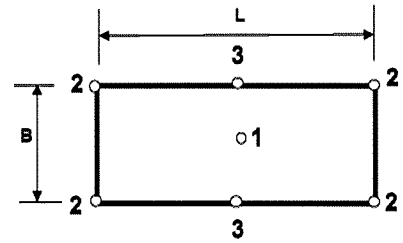
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1
Footing Description	Segment 1.3
Stress Analysis Method	Boussinesq Method
Footing Width, B	5.90 feet
Footing Length, L	11.81 feet
Applied Net Bearing Pressure, p	3.07 ksf (147 KPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,500.93 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (Inches)	0.63	0.27	0.45
Total Consol. Settlement (Inches)	0.00	0.00	0.00
Total Footing Settlement (Inches)	0.63	0.27	0.45



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Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,505.93	1,500.93	Cohesionless Soil	120.0					
1,500.93	1,492.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,492.00	1,487.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,487.00	1,482.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,482.00	1,477.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,477.00	1,472.00	Cohesionless Soil	120.0	510.0	0.35			1.0
1,472.00	1,469.00	Cohesionless Soil	120.0	670.0	0.35			1.0
1,469.00	1,465.00	Cohesionless Soil	120.0	1,000.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
4.46	8.93	1.67	1.14	N/A	1.90	0.68	1.26	0.467	0.157	0.299	0.000	0.000	0.000
11.43	5.00	2.27	1.97	N/A	0.61	0.38	0.54	0.079	0.049	0.069	0.000	0.000	0.000
16.43	5.00	2.87	2.57	N/A	0.33	0.25	0.31	0.043	0.032	0.040	0.000	0.000	0.000
21.43	5.00	3.47	3.17	N/A	0.21	0.17	0.20	0.026	0.022	0.025	0.000	0.000	0.000
26.43	5.00	4.07	3.77	N/A	0.14	0.12	0.13	0.010	0.009	0.010	0.000	0.000	0.000
30.43	3.00	4.43	4.25	N/A	0.11	0.10	0.10	0.004	0.003	0.003	0.000	0.000	0.000
33.93	4.00	4.91	4.67	N/A	0.09	0.08	0.08	0.003	0.002	0.003	0.000	0.000	0.000

* Settlement under service load = 0.63" (16 mm)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

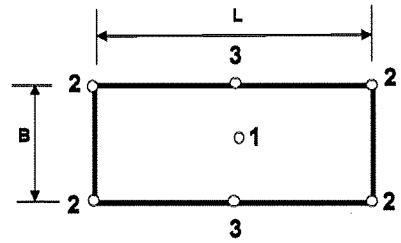
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1
Footing Description	Segment 1.4
Stress Analysis Method	Boussinesq Method
Footing Width, B	6.23 feet
Footing Length, L	9.84 feet
Applied Net Bearing Pressure, p	2.05 ksf (98 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,505.95 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.41	0.19	0.29
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.41	0.19	0.29



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REFERENCES:
1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,510.95	1,505.95	Cohesionless Soil	120.0					
1,505.95	1,497.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,497.00	1,492.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,492.00	1,487.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,487.00	1,482.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,482.00	1,477.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,477.00	1,472.00	Cohesionless Soil	120.0	510.0	0.35			1.0
1,472.00	1,469.00	Cohesionless Soil	120.0	670.0	0.35			1.0
1,469.00	1,465.00	Cohesionless Soil	120.0	1,000.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
4.48	8.95	1.67	1.14	N/A	1.25	0.45	0.81	0.299	0.105	0.189	0.000	0.000	0.000
11.45	5.00	2.27	1.97	N/A	0.38	0.25	0.33	0.048	0.032	0.042	0.000	0.000	0.000
16.45	5.00	2.87	2.57	N/A	0.20	0.16	0.19	0.026	0.020	0.024	0.000	0.000	0.000
21.45	5.00	3.47	3.17	N/A	0.12	0.10	0.12	0.016	0.013	0.015	0.000	0.000	0.000
26.45	5.00	4.07	3.77	N/A	0.08	0.07	0.08	0.010	0.009	0.010	0.000	0.000	0.000
31.45	5.00	4.67	4.37	N/A	0.06	0.05	0.06	0.004	0.004	0.004	0.000	0.000	0.000
35.45	3.00	5.03	4.85	N/A	0.05	0.04	0.05	0.002	0.001	0.002	0.000	0.000	0.000
38.95	4.00	5.51	5.27	N/A	0.04	0.04	0.04	0.001	0.001	0.001	0.000	0.000	0.000

* Settlement under service load = 0.41" (10.4 mm)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

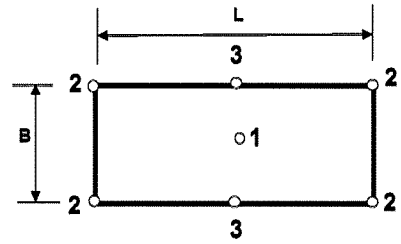
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Bent 2
Footing Description	
Stress Analysis Method	Boussinesq Method
Footing Width, B	11.81 feet
Footing Length, L	49.20 feet
Applied Net Bearing Pressure, p	2.38 ksf (114 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,476.43 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.29	0.07	0.15
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.29	0.07	0.15



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Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,481.43	1,476.43	Cohesionless Soil	120.0					
1,476.43	1,472.00	Cohesionless Soil	120.0	510.0	0.35			1.0
1,472.00	1,469.00	Cohesionless Soil	120.0	670.0	0.35			1.0
1,469.00	1,465.00	Cohesionless Soil	120.0	1,000.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
2.21	4.43	1.13	0.87	N/A	2.33	0.59	1.19	0.172	0.039	0.082	0.000	0.000	0.000
5.93	3.00	1.49	1.31	N/A	1.94	0.57	1.14	0.069	0.019	0.039	0.000	0.000	0.000
9.43	4.00	1.97	1.73	N/A	1.52	0.52	1.04	0.047	0.016	0.032	0.000	0.000	0.000

* Settlement under service load = 0.29" (7.4 mm)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

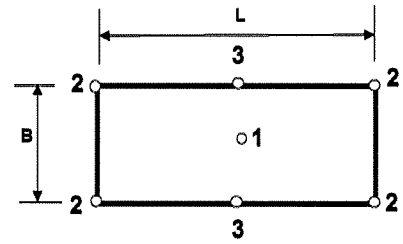
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Bent 3
Footing Description	
Stress Analysis Method	Boussinesq Method
Footing Width, B	11.81 feet
Footing Length, L	49.20 feet
Applied Net Bearing Pressure, p	2.38 ksf (114 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,478.62 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.25	0.07	0.14
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.25	0.07	0.14



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REFERENCES:

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3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,483.62	1,478.62	Cohesionless Soil	120.0					
1,478.62	1,475.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.81	3.62	1.03	0.82	N/A	2.35	0.59	1.19	0.091	0.021	0.043	0.000	0.000	0.000
6.12	5.00	1.63	1.33	N/A	1.92	0.57	1.13	0.095	0.027	0.055	0.000	0.000	0.000
11.12	5.00	2.23	1.93	N/A	1.35	0.50	0.98	0.064	0.023	0.046	0.000	0.000	0.000

* Settlement under service load = 0.25" (6.3 mm)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

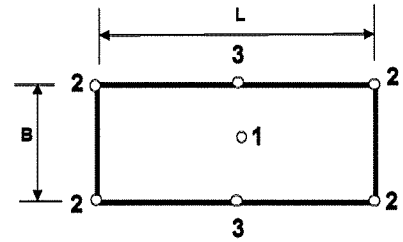
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 4
Footing Description	Segment 4.1
Stress Analysis Method	Boussinesq Method
Footing Width, B	11.15 feet
Footing Length, L	15.09 feet
Applied Net Bearing Pressure, p	3.13 ksf (150 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,494.04 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.61	0.19	0.34
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.61	0.19	0.34



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3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,499.04	1,494.04	Cohesionless Soil	120.0					
1,494.04	1,490.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,485.00	1,475.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
2.02	4.04	1.08	0.84	N/A	3.06	0.78	1.55	0.374	0.083	0.174	0.000	0.000	0.000
6.54	5.00	1.68	1.38	N/A	2.15	0.72	1.29	0.108	0.034	0.063	0.000	0.000	0.000
14.04	10.00	2.88	2.28	N/A	0.93	0.51	0.72	0.088	0.048	0.068	0.000	0.000	0.000
21.54	5.00	3.48	3.18	N/A	0.47	0.33	0.41	0.022	0.015	0.019	0.000	0.000	0.000
26.54	5.00	4.08	3.78	N/A	0.32	0.25	0.29	0.015	0.012	0.014	0.000	0.000	0.000

* Settlement under service load = 0.61" (15.5 mm)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

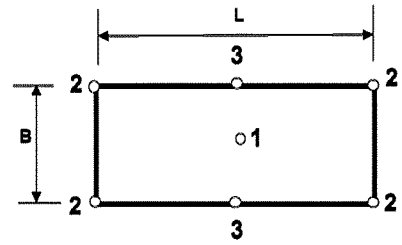
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 4
Footing Description	Segment 4.2
Stress Analysis Method	Boussinesq Method
Footing Width, B	13.12 feet
Footing Length, L	13.78 feet
Applied Net Bearing Pressure, p	2.53 ksf (121 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,496.99 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.61	0.19	0.33
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.61	0.19	0.33



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3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,501.99	1,496.99	Cohesionless Soil	120.0					
1,496.99	1,490.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,485.00	1,475.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
3.50	6.99	1.44	1.02	N/A	2.33	0.62	1.21	0.463	0.113	0.225	0.000	0.000	0.000
9.49	5.00	2.04	1.74	N/A	1.31	0.53	0.83	0.063	0.025	0.039	0.000	0.000	0.000
16.99	10.00	3.24	2.64	N/A	0.60	0.37	0.47	0.056	0.034	0.044	0.000	0.000	0.000
24.49	5.00	3.84	3.54	N/A	0.32	0.24	0.28	0.015	0.011	0.013	0.000	0.000	0.000
29.49	5.00	4.44	4.14	N/A	0.23	0.19	0.21	0.011	0.009	0.010	0.000	0.000	0.000

* Settlement under service load = 0.61" (15.5 mm)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

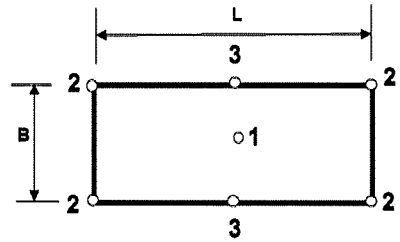
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 4
Footing Description	Segment 4.3
Stress Analysis Method	Boussinesq Method
Footing Width, B	12.46 feet
Footing Length, L	13.12 feet
Applied Net Bearing Pressure, p	2.53 ksf (121 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,499.94 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.66	0.22	0.37
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.66	0.22	0.37



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REFERENCES:
1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,504.94	1,499.94	Cohesionless Soil	120.0					
1,499.94	1,495.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,495.00	1,490.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,485.00	1,475.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
2.47	4.94	1.19	0.90	N/A	2.44	0.63	1.24	0.349	0.081	0.165	0.000	0.000	0.000
7.44	5.00	1.79	1.49	N/A	1.58	0.57	0.94	0.209	0.073	0.123	0.000	0.000	0.000
12.44	5.00	2.39	2.09	N/A	0.88	0.45	0.63	0.042	0.021	0.030	0.000	0.000	0.000
19.94	10.00	3.59	2.99	N/A	0.42	0.29	0.35	0.040	0.027	0.033	0.000	0.000	0.000
27.44	5.00	4.19	3.89	N/A	0.24	0.19	0.22	0.011	0.009	0.010	0.000	0.000	0.000
32.44	5.00	4.79	4.49	N/A	0.18	0.15	0.16	0.008	0.007	0.008	0.000	0.000	0.000

* Settlement under service load = 0.66" (16.8 mm)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

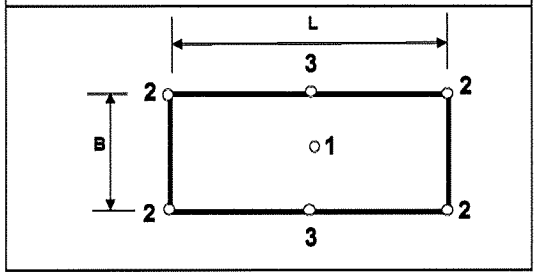
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 4
Footing Description	Segment 4.4
Stress Analysis Method	Boussinesq Method
Footing Width, B	11.15 feet
Footing Length, L	13.12 feet
Applied Net Bearing Pressure, p	2.38 ksf (114 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,502.90 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.65	0.22	0.38
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.65	0.22	0.38



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,507.90	1,502.90	Cohesionless Soil	120.0					
1,502.90	1,495.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,495.00	1,490.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,485.00	1,475.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
3.95	7.90	1.55	1.07	N/A	2.06	0.58	1.10	0.453	0.119	0.231	0.000	0.000	0.000
10.40	5.00	2.15	1.85	N/A	0.97	0.46	0.68	0.126	0.058	0.088	0.000	0.000	0.000
15.40	5.00	2.75	2.45	N/A	0.56	0.34	0.44	0.026	0.016	0.021	0.000	0.000	0.000
22.90	10.00	3.95	3.35	N/A	0.28	0.21	0.25	0.026	0.020	0.023	0.000	0.000	0.000
30.40	5.00	4.55	4.25	N/A	0.17	0.14	0.16	0.008	0.007	0.007	0.000	0.000	0.000
35.40	5.00	5.15	4.85	N/A	0.13	0.11	0.12	0.006	0.005	0.006	0.000	0.000	0.000

* Settlement under service load = 0.65" (16.5 mm)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

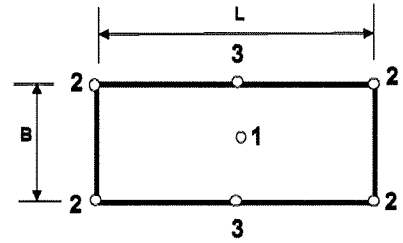
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 4
Footing Description	Segment 4.6
Stress Analysis Method	Boussinesq Method
Footing Width, B	7.87 feet
Footing Length, L	9.84 feet
Applied Net Bearing Pressure, p	2.00 ksf (96 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,507.75 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.44	0.18	0.28
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.44	0.18	0.28



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REFERENCES:
1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,512.75	1,507.75	Cohesionless Soil	120.0					
1,507.75	1,500.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,500.00	1,495.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,495.00	1,490.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,485.00	1,475.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
3.88	7.75	1.53	1.07	N/A	1.51	0.47	0.86	0.317	0.094	0.175	0.000	0.000	0.000
10.25	5.00	2.13	1.83	N/A	0.53	0.31	0.42	0.068	0.039	0.054	0.000	0.000	0.000
15.25	5.00	2.73	2.43	N/A	0.28	0.20	0.24	0.035	0.026	0.031	0.000	0.000	0.000
20.25	5.00	3.33	3.03	N/A	0.17	0.14	0.15	0.008	0.006	0.007	0.000	0.000	0.000
27.75	10.00	4.53	3.93	N/A	0.09	0.08	0.09	0.009	0.008	0.008	0.000	0.000	0.000
35.25	5.00	5.13	4.83	N/A	0.06	0.05	0.06	0.003	0.003	0.003	0.000	0.000	0.000
40.25	5.00	5.73	5.43	N/A	0.04	0.04	0.04	0.002	0.002	0.002	0.000	0.000	0.000

* Settlement under service load = 0.44" (11.2mm)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

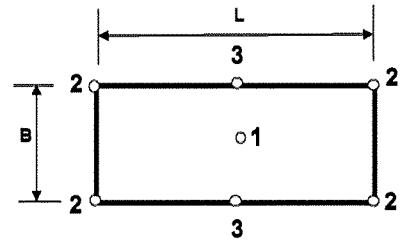
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1
Footing Description	Segment 1.1
Stress Analysis Method	Boussinesq Method
Footing Width, B	12.13 feet
Footing Length, L	26.24 feet
Applied Net Bearing Pressure, p	7.70 ksf (369 KPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,475.34 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	1.00	0.23	0.49
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	1.00	0.23	0.49



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,480.34	1,475.34	Cohesionless Soil	120.0					
1,475.34	1,472.00	Cohesionless Soil	120.0	510.0	0.35			1.0
1,472.00	1,469.00	Cohesionless Soil	120.0	670.0	0.35			1.0
1,469.00	1,465.00	Cohesionless Soil	120.0	1,000.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.67	3.34	1.00	0.80	N/A	7.63	1.92	3.84	0.532	0.106	0.234	0.000	0.000	0.000
4.84	3.00	1.36	1.18	N/A	6.73	1.88	3.71	0.289	0.068	0.144	0.000	0.000	0.000
8.34	4.00	1.84	1.60	N/A	5.19	1.75	3.33	0.181	0.055	0.110	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

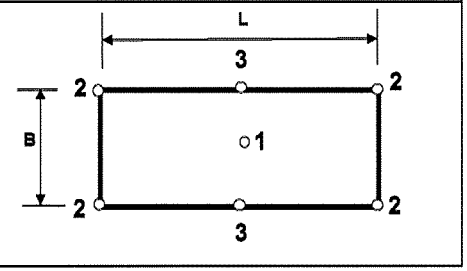
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1
Footing Description	Segment 1.2
Stress Analysis Method	Boussinesq Method
Footing Width, B	5.90 feet
Footing Length, L	13.78 feet
Applied Net Bearing Pressure, p	4.30 ksf (206 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,496.99 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.99	0.38	0.65
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.99	0.38	0.65



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3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,501.99	1,496.99	Cohesionless Soil	120.0					
1,496.99	1,492.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,492.00	1,487.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,487.00	1,482.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,482.00	1,477.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,477.00	1,472.00	Cohesionless Soil	120.0	510.0	0.35			1.0
1,472.00	1,469.00	Cohesionless Soil	120.0	670.0	0.35			1.0
1,469.00	1,465.00	Cohesionless Soil	120.0	1,000.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
2.50	4.99	1.20	0.90	N/A	3.70	1.05	2.07	0.569	0.139	0.293	0.000	0.000	0.000
7.49	5.00	1.80	1.50	N/A	1.67	0.77	1.32	0.223	0.099	0.174	0.000	0.000	0.000
12.49	5.00	2.40	2.10	N/A	0.83	0.51	0.74	0.106	0.065	0.095	0.000	0.000	0.000
17.49	5.00	3.00	2.70	N/A	0.47	0.35	0.45	0.060	0.044	0.057	0.000	0.000	0.000
22.49	5.00	3.60	3.30	N/A	0.30	0.24	0.29	0.022	0.018	0.021	0.000	0.000	0.000
26.49	3.00	3.96	3.78	N/A	0.22	0.19	0.22	0.007	0.006	0.007	0.000	0.000	0.000
29.99	4.00	4.44	4.20	N/A	0.18	0.15	0.17	0.005	0.005	0.005	0.000	0.000	0.000

* Permissible Net Contact Stress = 4.3 ksf (206 kPa)
Permissible Gross Contact Stress = 4.3 ksf + 5' x 120/1000 ksf = 4.9 ksf (235 kPa)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

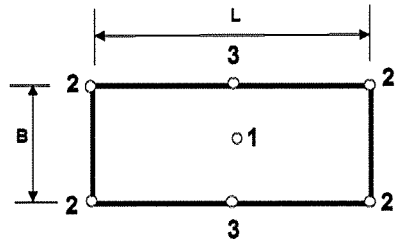
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1
Footing Description	Segment 1.3
Stress Analysis Method	Boussinesq Method
Footing Width, B	5.90 feet
Footing Length, L	11.81 feet
Applied Net Bearing Pressure, p	4.70 ksf (225 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,500.93 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	1.00	0.42	0.70
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	1.00	0.42	0.70



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,505.93	1,500.93	Cohesionless Soil	120.0					
1,500.93	1,492.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,492.00	1,487.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,487.00	1,482.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,482.00	1,477.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,477.00	1,472.00	Cohesionless Soil	120.0	510.0	0.35			1.0
1,472.00	1,469.00	Cohesionless Soil	120.0	670.0	0.35			1.0
1,469.00	1,465.00	Cohesionless Soil	120.0	1,000.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
4.46	8.93	1.67	1.14	N/A	2.91	1.04	1.93	0.749	0.244	0.474	0.000	0.000	0.000
11.43	5.00	2.27	1.97	N/A	0.94	0.58	0.83	0.121	0.075	0.106	0.000	0.000	0.000
16.43	5.00	2.87	2.57	N/A	0.51	0.38	0.48	0.065	0.049	0.061	0.000	0.000	0.000
21.43	5.00	3.47	3.17	N/A	0.32	0.26	0.30	0.040	0.033	0.038	0.000	0.000	0.000
26.43	5.00	4.07	3.77	N/A	0.21	0.19	0.21	0.016	0.014	0.015	0.000	0.000	0.000
30.43	3.00	4.43	4.25	N/A	0.16	0.15	0.16	0.005	0.005	0.005	0.000	0.000	0.000
33.93	4.00	4.91	4.67	N/A	0.13	0.12	0.13	0.004	0.004	0.004	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

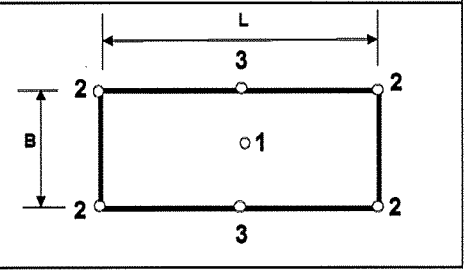
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1
Footing Description	Segment 1.4
Stress Analysis Method	Boussinesq Method
Footing Width, B	6.23 feet
Footing Length, L	9.84 feet
Applied Net Bearing Pressure, p	4.70 ksf (225 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,505.95 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.99	0.43	0.68
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.99	0.43	0.68



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1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,510.95	1,505.95	Cohesionless Soil	120.0					
1,505.95	1,497.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,497.00	1,492.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,492.00	1,487.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,487.00	1,482.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,482.00	1,477.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,477.00	1,472.00	Cohesionless Soil	120.0	510.0	0.35			1.0
1,472.00	1,469.00	Cohesionless Soil	120.0	670.0	0.35			1.0
1,469.00	1,465.00	Cohesionless Soil	120.0	1,000.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
4.48	8.95	1.67	1.14	N/A	2.88	1.04	1.86	0.740	0.246	0.455	0.000	0.000	0.000
11.45	5.00	2.27	1.97	N/A	0.86	0.57	0.75	0.111	0.073	0.096	0.000	0.000	0.000
16.45	5.00	2.87	2.57	N/A	0.46	0.36	0.43	0.059	0.046	0.054	0.000	0.000	0.000
21.45	5.00	3.47	3.17	N/A	0.28	0.24	0.27	0.036	0.031	0.034	0.000	0.000	0.000
26.45	5.00	4.07	3.77	N/A	0.19	0.17	0.18	0.024	0.022	0.023	0.000	0.000	0.000
31.45	5.00	4.67	4.37	N/A	0.14	0.12	0.13	0.010	0.009	0.010	0.000	0.000	0.000
35.45	3.00	5.03	4.85	N/A	0.11	0.10	0.11	0.004	0.003	0.004	0.000	0.000	0.000
38.95	4.00	5.51	5.27	N/A	0.09	0.08	0.09	0.003	0.003	0.003	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

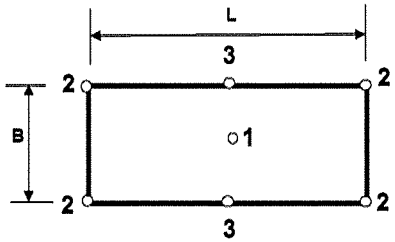
Project Name	Box Springs Road OH Left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Bent 2
Footing Description	
Stress Analysis Method	Boussinesq Method
Footing Width, B	11.81 feet
Footing Length, L	49.20 feet
Applied Net Bearing Pressure, p	7.00 ksf (335 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,476.43 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	1.00	0.23	0.50
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	1.00	0.23	0.50



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Reviewed By: _____ Date: _____

REFERENCES:
1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,481.43	1,476.43	Cohesionless Soil	120.0					
1,476.43	1,472.00	Cohesionless Soil	120.0	510.0	0.35			1.0
1,472.00	1,469.00	Cohesionless Soil	120.0	670.0	0.35			1.0
1,469.00	1,465.00	Cohesionless Soil	120.0	1,000.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
2.21	4.43	1.13	0.87	N/A	6.87	1.75	3.49	0.611	0.124	0.274	0.000	0.000	0.000
5.93	3.00	1.49	1.31	N/A	5.71	1.68	3.35	0.234	0.059	0.127	0.000	0.000	0.000
9.43	4.00	1.97	1.73	N/A	4.46	1.54	3.05	0.151	0.048	0.099	0.000	0.000	0.000

* Permissible Net Contact Stress = 7 ksf (335 kPa)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

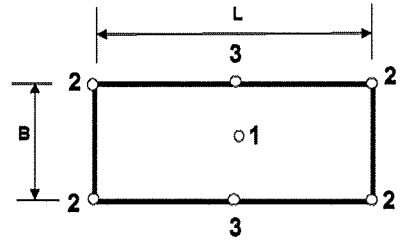
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Bent 3
Footing Description	
Stress Analysis Method	Boussinesq Method
Footing Width, B	11.81 feet
Footing Length, L	49.20 feet
Applied Net Bearing Pressure, p	8.00 ksf (383 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,478.62 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.99	0.25	0.54
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.99	0.25	0.54



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,483.62	1,478.62	Cohesionless Soil	120.0					
1,478.62	1,475.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.81	3.62	1.03	0.82	N/A	7.91	2.00	3.99	0.382	0.076	0.169	0.000	0.000	0.000
6.12	5.00	1.63	1.33	N/A	6.44	1.91	3.81	0.375	0.095	0.204	0.000	0.000	0.000
11.12	5.00	2.23	1.93	N/A	4.54	1.67	3.29	0.237	0.081	0.166	0.000	0.000	0.000

* Permissible Net Contact Stress = 8 ksf (383 kPa)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

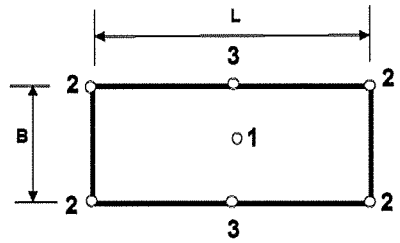
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 4
Footing Description	Segment 4.1
Stress Analysis Method	Boussinesq Method
Footing Width, B	11.15 feet
Footing Length, L	15.09 feet
Applied Net Bearing Pressure, p	4.85 ksf (232 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,494.04 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.99	0.30	0.54
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.99	0.30	0.54



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REFERENCES:

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2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,499.04	1,494.04	Cohesionless Soil	120.0					
1,494.04	1,490.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,485.00	1,475.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
2.02	4.04	1.08	0.84	N/A	4.74	1.21	2.40	0.625	0.132	0.283	0.000	0.000	0.000
6.54	5.00	1.68	1.38	N/A	3.33	1.12	2.00	0.175	0.054	0.100	0.000	0.000	0.000
14.04	10.00	2.88	2.28	N/A	1.44	0.79	1.12	0.137	0.074	0.106	0.000	0.000	0.000
21.54	5.00	3.48	3.18	N/A	0.73	0.51	0.63	0.034	0.024	0.030	0.000	0.000	0.000
26.54	5.00	4.08	3.78	N/A	0.50	0.39	0.46	0.023	0.018	0.021	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

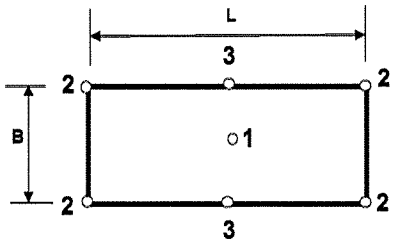
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 4
Footing Description	Segment 4.2
Stress Analysis Method	Boussinesq Method
Footing Width, B	13.12 feet
Footing Length, L	13.78 feet
Applied Net Bearing Pressure, p	3.95 ksf (189 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,496.99 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	1.00	0.30	0.53
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	1.00	0.30	0.53



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,501.99	1,496.99	Cohesionless Soil	120.0					
1,496.99	1,490.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,485.00	1,475.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
3.50	6.99	1.44	1.02	N/A	3.64	0.98	1.88	0.768	0.180	0.365	0.000	0.000	0.000
9.49	5.00	2.04	1.74	N/A	2.04	0.83	1.30	0.100	0.039	0.062	0.000	0.000	0.000
16.99	10.00	3.24	2.64	N/A	0.94	0.57	0.73	0.088	0.053	0.069	0.000	0.000	0.000
24.49	5.00	3.84	3.54	N/A	0.50	0.38	0.44	0.024	0.018	0.020	0.000	0.000	0.000
29.49	5.00	4.44	4.14	N/A	0.36	0.29	0.32	0.017	0.014	0.015	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

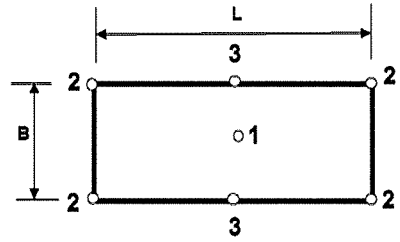
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 4
Footing Description	Segment 4.3
Stress Analysis Method	Boussinesq Method
Footing Width, B	12.46 feet
Footing Length, L	13.12 feet
Applied Net Bearing Pressure, p	3.70 ksf (177 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,499.94 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	1.00	0.32	0.55
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	1.00	0.32	0.55



Performed By: _____ Date: _____

Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,504.94	1,499.94	Cohesionless Soil	120.0					
1,499.94	1,495.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,495.00	1,490.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,485.00	1,475.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c' (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
2.47	4.94	1.19	0.90	N/A	3.57	0.92	1.81	0.540	0.120	0.250	0.000	0.000	0.000
7.44	5.00	1.79	1.49	N/A	2.30	0.83	1.38	0.314	0.107	0.182	0.000	0.000	0.000
12.44	5.00	2.39	2.09	N/A	1.29	0.66	0.92	0.061	0.031	0.044	0.000	0.000	0.000
19.94	10.00	3.59	2.99	N/A	0.62	0.43	0.52	0.058	0.040	0.048	0.000	0.000	0.000
27.44	5.00	4.19	3.89	N/A	0.35	0.28	0.32	0.016	0.013	0.015	0.000	0.000	0.000
32.44	5.00	4.79	4.49	N/A	0.26	0.22	0.24	0.012	0.010	0.011	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

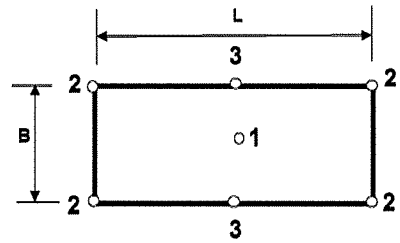
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 4
Footing Description	Segment 4.4
Stress Analysis Method	Boussinesq Method
Footing Width, B	11.15 feet
Footing Length, L	13.12 feet
Applied Net Bearing Pressure, p	3.55 ksf (170 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,502.90 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	1.00	0.34	0.57
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	1.00	0.34	0.57



Performed By: _____ Date: _____
Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,507.90	1,502.90	Cohesionless Soil	120.0					
1,502.90	1,495.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,495.00	1,490.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,485.00	1,475.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
3.95	7.90	1.55	1.07	N/A	3.08	0.87	1.65	0.700	0.179	0.354	0.000	0.000	0.000
10.40	5.00	2.15	1.85	N/A	1.45	0.68	1.02	0.190	0.087	0.132	0.000	0.000	0.000
15.40	5.00	2.75	2.45	N/A	0.83	0.51	0.66	0.039	0.024	0.031	0.000	0.000	0.000
22.90	10.00	3.95	3.35	N/A	0.42	0.32	0.37	0.040	0.030	0.035	0.000	0.000	0.000
30.40	5.00	4.55	4.25	N/A	0.25	0.21	0.23	0.012	0.010	0.011	0.000	0.000	0.000
35.40	5.00	5.15	4.85	N/A	0.19	0.17	0.18	0.009	0.008	0.008	0.000	0.000	0.000

* Permissible Net Contact Stress = 3.55 ksf (170 kPa)
Permissible Gross Contact Stress = 3.55 ksf + 5' × 120/1000 ksf
= 4.15 ksf (199 kPa)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

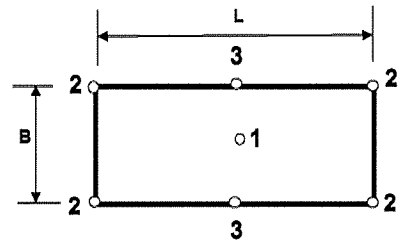
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 4
Footing Description	Segment 4,5
Stress Analysis Method	Boussinesq Method
Footing Width, B	9.84 feet
Footing Length, L	13.12 feet
Applied Net Bearing Pressure, p	3.55 ksf (170 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,505.85 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.99	0.35	0.59
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.99	0.35	0.59



Performed By: _____ Date: _____

Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,510.85	1,505.85	Cohesionless Soil	120.0					
1,505.85	1,500.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,500.00	1,495.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,495.00	1,490.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,485.00	1,475.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
2.92	5.85	1.30	0.95	N/A	3.26	0.88	1.71	0.572	0.135	0.277	0.000	0.000	0.000
8.35	5.00	1.90	1.60	N/A	1.74	0.73	1.18	0.231	0.094	0.154	0.000	0.000	0.000
13.35	5.00	2.50	2.20	N/A	0.93	0.54	0.74	0.120	0.069	0.095	0.000	0.000	0.000
18.35	5.00	3.10	2.80	N/A	0.56	0.39	0.48	0.026	0.018	0.023	0.000	0.000	0.000
25.85	10.00	4.30	3.70	N/A	0.30	0.25	0.28	0.028	0.023	0.026	0.000	0.000	0.000
33.35	5.00	4.90	4.60	N/A	0.19	0.16	0.18	0.009	0.008	0.008	0.000	0.000	0.000
38.35	5.00	5.50	5.20	N/A	0.14	0.13	0.14	0.007	0.006	0.006	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

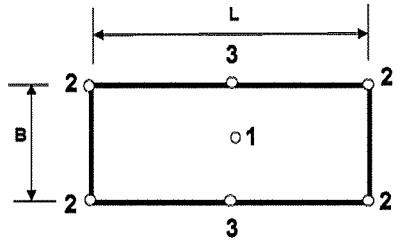
Project Name	Box Springs Road OH left Bridge (Widen)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 4
Footing Description	Segment 4.6
Stress Analysis Method	Boussinesq Method
Footing Width, B	7.87 feet
Footing Length, L	9.84 feet
Applied Net Bearing Pressure, p	4.20 ksf (201 kPa)
Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,507.75 feet
GWT Elevation for Design	1,447.96 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.99	0.38	0.61
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.99	0.38	0.61



Performed By: _____ Date: _____

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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,512.75	1,507.75	Cohesionless Soil	120.0					
1,507.75	1,500.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,500.00	1,495.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,495.00	1,490.00	Cohesionless Soil	120.0	350.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,485.00	1,475.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.00	0.60	0.30	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
3.88	7.75	1.53	1.07	N/A	3.17	0.99	1.81	0.721	0.203	0.386	0.000	0.000	0.000
10.25	5.00	2.13	1.83	N/A	1.12	0.65	0.88	0.146	0.083	0.114	0.000	0.000	0.000
15.25	5.00	2.73	2.43	N/A	0.58	0.42	0.51	0.075	0.054	0.065	0.000	0.000	0.000
20.25	5.00	3.33	3.03	N/A	0.35	0.29	0.32	0.016	0.013	0.015	0.000	0.000	0.000
27.75	10.00	4.53	3.93	N/A	0.19	0.17	0.18	0.018	0.016	0.017	0.000	0.000	0.000
35.25	5.00	5.13	4.83	N/A	0.12	0.11	0.12	0.006	0.005	0.006	0.000	0.000	0.000
40.25	5.00	5.73	5.43	N/A	0.09	0.09	0.09	0.004	0.004	0.004	0.000	0.000	0.000

C-4

SLOPE STABILITY ANALYSES

Box Springs Overhead Left, West Riverside, California

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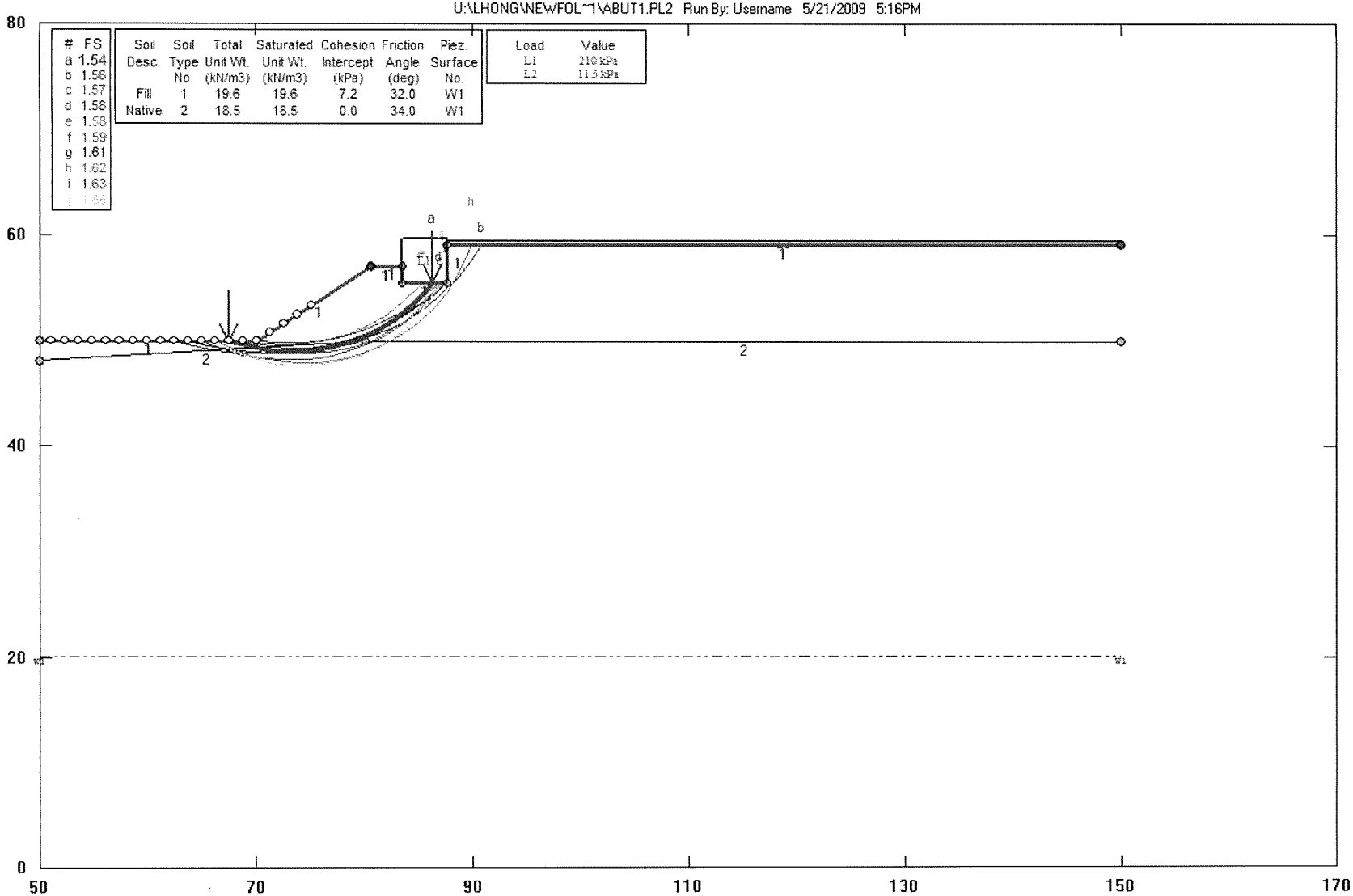

GSTABL7 v.2 FSmin=1.54

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 5/21/2009
Time of Run: 5:16PM
Run By: Username
Input Data Filename: U:abut1.in
Output Filename: U:abut1.OUT
Unit System: SI

Plotted Output Filename: U:abut1.PLT

PROBLEM DESCRIPTION: Box Springs Overhead Left, West
Riverside, California

BOUNDARY COORDINATES

7 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	50.00	50.00	70.00	50.00	1
2	70.00	50.00	80.50	57.00	1
3	80.50	57.00	83.50	57.00	1
4	83.50	57.00	83.51	55.40	1
5	83.51	55.40	87.61	55.40	1
6	87.61	55.40	87.62	59.10	1
7	87.62	59.10	150.00	59.10	1
8	50.00	48.00	80.00	50.00	2
9	80.00	50.00	150.00	50.00	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	7.2	32.0	0.00	0.0	1
2	18.5	18.5	0.0	34.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	50.00	20.00
2	150.00	20.00

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	83.51	87.61	210.0	0.0
2	87.62	150.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 51.00(m)
and X = 75.00(m)

Each Surface Terminates Between X = 80.50(m)
and X = 150.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

2.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 39.155 FS Min = 1.541 FS Ave = 5.069
Standard Deviation = 3.931 Coefficient of Variation = 77.55 %

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	67.42	50.00
2	69.32	49.38
3	71.29	49.01
4	73.28	48.88
5	75.28	49.00
6	77.25	49.36
7	79.15	49.97
8	80.97	50.81
9	82.67	51.86
10	84.22	53.12
11	85.61	54.56
12	86.23	55.40

Circle Center At X = 73.3 ; Y = 64.9 and Radius, 16.0

Factor of Safety
*** 1.541 ***

Individual data on the 17 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	1.9	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.4	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.3	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1.3	32.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	2.0	99.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	2.0	152.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	2.0	191.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1.8	205.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.1	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1.3	165.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.5	58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1.7	188.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.8	78.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.7	35.9	0.0	0.0	0.0	0.0	0.0	0.0	149.4
16	1.4	42.4	0.0	0.0	0.0	0.0	0.0	0.0	291.1
17	0.6	5.1	0.0	0.0	0.0	0.0	0.0	0.0	131.5

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	68.68	50.00

2	70.63	49.54
3	72.61	49.28
4	74.61	49.23
5	76.61	49.38
6	78.57	49.75
7	80.49	50.32
8	82.34	51.08
9	84.10	52.04
10	85.74	53.17
11	87.26	54.47
12	88.64	55.92
13	89.86	57.51
14	90.84	59.10

Circle Center At X = 74.1 ; Y = 68.3 and Radius, 19.1

Factor of Safety
*** 1.562 ***

1

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	68.68	50.00
2	70.56	49.31
3	72.51	48.87
4	74.51	48.71
5	76.50	48.82
6	78.47	49.20
7	80.36	49.84
8	82.15	50.73
9	83.80	51.86
10	85.29	53.20
11	86.57	54.73
12	86.99	55.40

Circle Center At X = 74.7 ; Y = 63.3 and Radius, 14.6

Factor of Safety
*** 1.569 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	69.95	50.00
2	71.94	49.77
3	73.94	49.75
4	75.93	49.94
5	77.89	50.33
6	79.80	50.92
7	81.64	51.70
8	83.39	52.66
9	85.03	53.80
10	86.55	55.11
11	86.83	55.40

Circle Center At X = 73.1 ; Y = 69.2 and Radius, 19.5

Factor of Safety
*** 1.577 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	68.68	50.00
2	70.65	49.64
3	72.65	49.53
4	74.65	49.65
5	76.61	50.01
6	78.52	50.60
7	80.35	51.42
8	82.06	52.45
9	83.64	53.68
10	85.06	55.09
11	85.30	55.40

Circle Center At X = 72.6 ; Y = 66.2 and Radius, 16.7

Factor of Safety
*** 1.583 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	66.73	49.20
3	68.64	48.60
4	70.60	48.22
5	72.59	48.07
6	74.59	48.14
7	76.57	48.44
8	78.50	48.95
9	80.37	49.68
10	82.14	50.61
11	83.79	51.73
12	85.31	53.04
13	86.67	54.50
14	87.33	55.40

Circle Center At X = 73.0 ; Y = 65.8 and Radius, 17.7

Factor of Safety
*** 1.592 ***

1

Failure Surface Specified By 14 Coordinate Points

Point	X-Surf	Y-Surf

No.	(m)	(m)
1	63.63	50.00
2	65.55	49.43
3	67.51	49.04
4	69.50	48.81
5	71.50	48.75
6	73.49	48.86
7	75.47	49.14
8	77.42	49.59
9	79.33	50.20
10	81.17	50.98
11	82.94	51.91
12	84.62	52.98
13	86.21	54.20
14	87.52	55.40

Circle Center At X = 71.2 ; Y = 72.1 and Radius, 23.4

Factor of Safety
*** 1.608 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	66.16	50.00
2	67.94	49.10
3	69.83	48.43
4	71.78	47.99
5	73.77	47.79
6	75.77	47.84
7	77.75	48.14
8	79.67	48.67
9	81.52	49.44
10	83.26	50.43
11	84.87	51.62
12	86.31	53.00
13	87.58	54.55
14	88.65	56.24
15	89.50	58.05
16	89.84	59.10

Circle Center At X = 74.4 ; Y = 64.0 and Radius, 16.2

Factor of Safety
*** 1.624 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	62.37	50.00
2	64.28	49.42
3	66.24	49.00
4	68.22	48.74
5	70.22	48.64
6	72.22	48.71

7	74.20	48.94
8	76.17	49.33
9	78.09	49.88
10	79.96	50.58
11	81.77	51.44
12	83.50	52.44
13	85.14	53.58
14	86.69	54.85
15	87.26	55.40

Circle Center At X = 70.4 ; Y = 73.1 and Radius, 24.5

Factor of Safety
*** 1.628 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	66.16	50.00
2	67.89	49.00
3	69.75	48.25
4	71.69	47.77
5	73.68	47.56
6	75.67	47.63
7	77.64	47.97
8	79.55	48.59
9	81.35	49.46
10	83.01	50.58
11	84.49	51.91
12	85.78	53.44
13	86.85	55.13
14	86.97	55.40

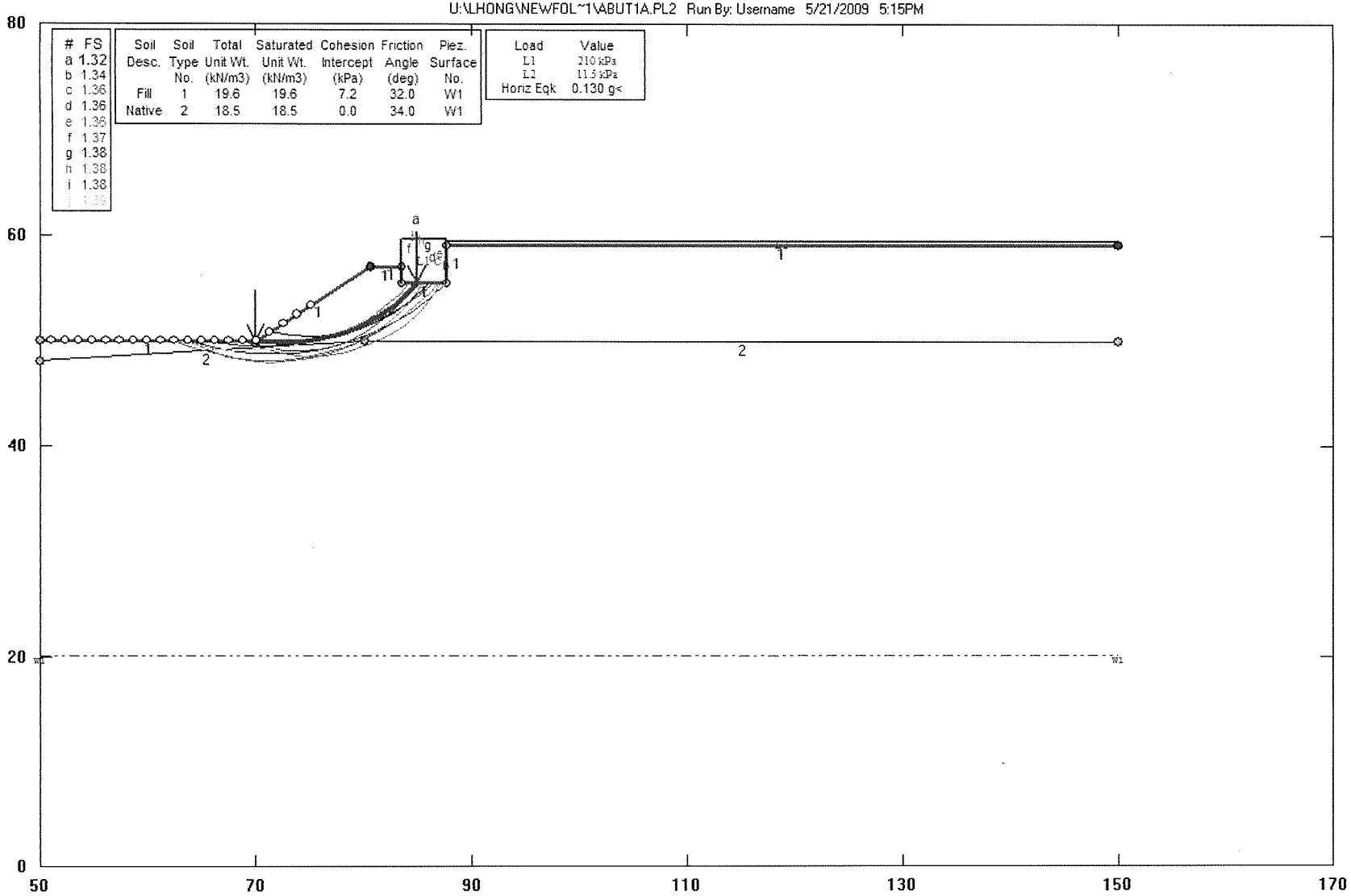
Circle Center At X = 74.2 ; Y = 61.9 and Radius, 14.3

Factor of Safety
*** 1.656 ***

**** END OF GSTABL7 OUTPUT ****

Box Springs Overhead Left, West Riverside, California

U:\LHONG\NEWFOL~1\ABUT1A.PL2 Run By: Username 5/21/2009 5:15PM



GSTABL7 v.2 FSmin=1.32

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 5/21/2009
Time of Run: 5:15PM
Run By: Username
Input Data Filename: U:abut1a.in
Output Filename: U:abut1a.OUT
Unit System: SI

Plotted Output Filename: U:abut1a.PLT

PROBLEM DESCRIPTION: Box Springs Overhead Left, West
Riverside, California

BOUNDARY COORDINATES

7 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	50.00	50.00	70.00	50.00	1
2	70.00	50.00	80.50	57.00	1
3	80.50	57.00	83.50	57.00	1
4	83.50	57.00	83.51	55.40	1
5	83.51	55.40	87.61	55.40	1
6	87.61	55.40	87.62	59.10	1
7	87.62	59.10	150.00	59.10	1
8	50.00	48.00	80.00	50.00	2
9	80.00	50.00	150.00	50.00	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	7.2	32.0	0.00	0.0	1
2	18.5	18.5	0.0	34.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	50.00	20.00
2	150.00	20.00

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	83.51	87.61	210.0	0.0
2	87.62	150.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

500 Trial Surfaces Have Been Generated.

25 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 51.00(m)
and X = 75.00(m)

Each Surface Terminates Between X = 80.50(m)
and X = 150.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

2.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 500

Statistical Data On All Valid FS Values:
FS Max = 6.652 FS Min = 1.319 FS Ave = 2.725
Standard Deviation = 1.065 Coefficient of Variation = 39.08 %

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	69.95	50.00
2	71.94	49.78
3	73.94	49.80
4	75.92	50.07
5	77.85	50.59
6	79.70	51.34
7	81.44	52.32
8	83.05	53.51
9	84.50	54.89
10	84.92	55.40

Circle Center At X = 72.7 ; Y = 65.7 and Radius, 15.9

Factor of Safety
*** 1.319 ***

Individual data on the 13 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.9	28.9	0.0	0.0	0.0	0.0	3.8	0.0	0.0
3	2.0	85.1	0.0	0.0	0.0	0.0	11.1	0.0	0.0
4	2.0	130.1	0.0	0.0	0.0	0.0	16.9	0.0	0.0
5	1.9	161.4	0.0	0.0	0.0	0.0	21.0	0.0	0.0
6	1.9	177.5	0.0	0.0	0.0	0.0	23.1	0.0	0.0
7	0.8	81.0	0.0	0.0	0.0	0.0	10.5	0.0	0.0
8	0.9	91.6	0.0	0.0	0.0	0.0	11.9	0.0	0.0
9	1.6	128.9	0.0	0.0	0.0	0.0	16.8	0.0	0.0
10	0.4	28.7	0.0	0.0	0.0	0.0	3.7	0.0	0.0
11	0.0	0.4	0.0	0.0	0.0	0.0	0.1	0.0	0.0
12	1.0	19.1	0.0	0.0	0.0	0.0	2.5	0.0	208.4
13	0.4	2.1	0.0	0.0	0.0	0.0	0.3	0.0	87.7

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	65.54	49.40
3	67.49	48.97
4	69.48	48.71
5	71.47	48.63
6	73.47	48.72
7	75.45	48.99
8	77.40	49.43
9	79.31	50.05
10	81.15	50.82
11	82.92	51.76
12	84.59	52.85
13	86.17	54.08
14	87.57	55.40

Circle Center At X = 71.4 ; Y = 71.3 and Radius, 22.7

Factor of Safety
*** 1.344 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	62.37	50.00
2	64.22	49.23
3	66.13	48.65
4	68.09	48.26
5	70.08	48.06
6	72.08	48.06
7	74.07	48.25
8	76.03	48.64
9	77.95	49.22
10	79.80	49.98
11	81.56	50.92
12	83.23	52.02
13	84.78	53.29
14	86.19	54.70
15	86.77	55.40

Circle Center At X = 71.1 ; Y = 68.4 and Radius, 20.4

Factor of Safety
*** 1.356 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	66.86	49.62
3	68.85	49.40
4	70.85	49.35
5	72.84	49.46
6	74.82	49.74

7	76.77	50.18
8	78.68	50.79
9	80.53	51.55
10	82.31	52.46
11	84.01	53.51
12	85.62	54.70
13	86.41	55.40

Circle Center At X = 70.5 ; Y = 73.4 and Radius, 24.1

Factor of Safety
*** 1.356 ***

1

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	68.68	50.00
2	70.52	49.21
3	72.45	48.69
4	74.44	48.45
5	76.44	48.50
6	78.41	48.84
7	80.31	49.46
8	82.10	50.35
9	83.75	51.49
10	85.21	52.85
11	86.46	54.41
12	87.05	55.40

Circle Center At X = 75.1 ; Y = 62.2 and Radius, 13.8

Factor of Safety
*** 1.362 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	68.68	50.00
2	70.66	49.68
3	72.66	49.61
4	74.65	49.81
5	76.60	50.26
6	78.47	50.97
7	80.24	51.90
8	81.87	53.06
9	83.33	54.42
10	84.14	55.40

Circle Center At X = 72.1 ; Y = 64.9 and Radius, 15.3

Factor of Safety
*** 1.370 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.81
2	73.17	50.43
3	75.17	50.32
4	77.16	50.48
5	79.12	50.92
6	80.99	51.62
7	82.75	52.56
8	84.36	53.75
9	85.80	55.14
10	86.01	55.40

Circle Center At X = 75.0 ; Y = 64.8 and Radius, 14.5

Factor of Safety
*** 1.375 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	65.43	49.12
3	67.32	48.46
4	69.27	48.04
5	71.26	47.87
6	73.26	47.93
7	75.24	48.25
8	77.16	48.80
9	79.00	49.58
10	80.73	50.58
11	82.33	51.79
12	83.76	53.18
13	85.02	54.73
14	85.43	55.40

Circle Center At X = 71.7 ; Y = 64.1 and Radius, 16.3

Factor of Safety
*** 1.382 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	68.68	50.00
2	70.57	49.33
3	72.54	48.97
4	74.54	48.94
5	76.51	49.24
6	78.42	49.86

7	80.19	50.78
8	81.79	51.97
9	83.18	53.42
10	84.31	55.07
11	84.46	55.40

Circle Center At X = 73.7 ; Y = 61.1 and Radius, 12.2

Factor of Safety
*** 1.383 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	62.37	50.00
2	64.30	49.50
3	66.28	49.17
4	68.27	49.02
5	70.27	49.04
6	72.26	49.25
7	74.22	49.63
8	76.15	50.19
9	78.01	50.91
10	79.80	51.80
11	81.51	52.84
12	83.11	54.03
13	84.61	55.36
14	84.64	55.40

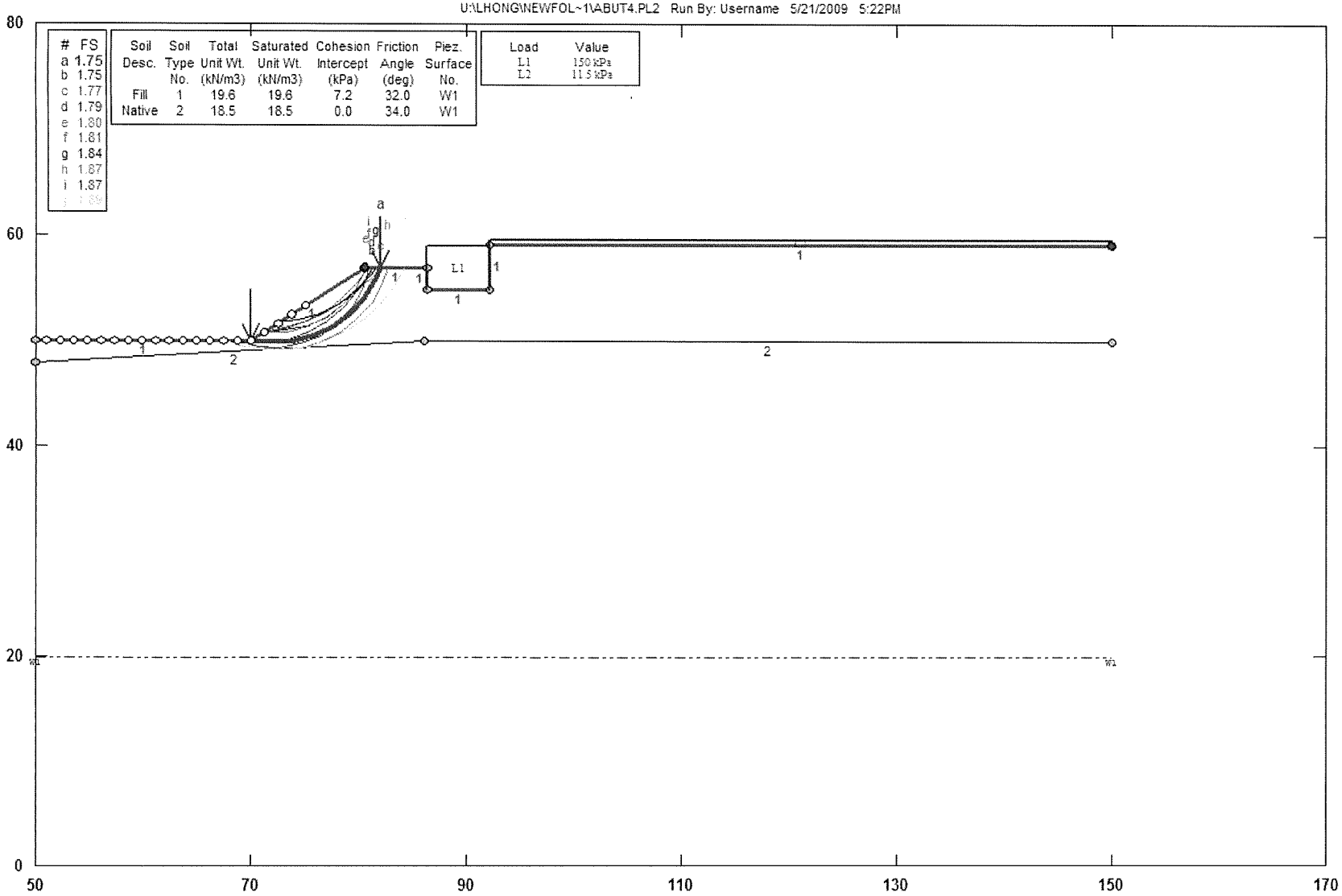
Circle Center At X = 69.0 ; Y = 71.4 and Radius, 22.4

Factor of Safety
*** 1.389 ***

**** END OF GSTABL7 OUTPUT ****

Box Springs Overhead Left, East Riverside, California

U:\LHONG\NEWFOL~1\ABUT4.PL2 Run By: Username 5/21/2009 5:22PM



#	FS
a	1.75
b	1.75
c	1.77
d	1.79
e	1.80
f	1.81
g	1.84
h	1.87
i	1.87
j	1.88

Soil Desc.	Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Piez. Surface No.
Fill	1	19.6	19.6	7.2	32.0	W1
Native	2	18.5	18.5	0.0	34.0	W1

Load	Value
L1	150 kPa
L2	11.5 kPa

GSTABL7 v.2 FSmin=1.75

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 5/21/2009
Time of Run: 5:22PM
Run By: Username
Input Data Filename: U:abut4.in
Output Filename: U:abut4.OUT
Unit System: SI

Plotted Output Filename: U:abut4.PLT

PROBLEM DESCRIPTION: Box Springs Overhead Left, East
Riverside, California

BOUNDARY COORDINATES

7 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	50.00	50.00	70.00	50.00	1
2	70.00	50.00	80.50	57.00	1
3	80.50	57.00	86.30	57.00	1
4	86.30	57.00	86.31	54.90	1
5	86.31	54.90	92.11	54.90	1
6	92.11	54.90	92.12	59.20	1
7	92.12	59.20	150.00	59.20	1
8	50.00	48.00	86.00	50.00	2
9	86.00	50.00	150.00	50.00	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	7.2	32.0	0.00	0.0	1
2	18.5	18.5	0.0	34.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	50.00	20.00
2	150.00	20.00

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	86.31	92.11	150.0	0.0
2	92.12	150.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 51.00(m)
and X = 75.00(m)

Each Surface Terminates Between X = 80.50(m)
and X = 150.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

2.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 22.245 FS Min = 1.745 FS Ave = 4.770
Standard Deviation = 2.968 Coefficient of Variation = 62.23 %

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	69.95	50.00
2	71.94	49.81
3	73.93	50.00
4	75.85	50.56
5	77.63	51.47
6	79.22	52.69
7	80.54	54.19
8	81.56	55.90
9	81.96	57.00

Circle Center At X = 71.9 ; Y = 60.5 and Radius, 10.7

Factor of Safety
*** 1.745 ***

Individual data on the 10 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.9	28.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2.0	80.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1.9	112.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1.8	121.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1.6	109.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	1.3	79.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1.0	39.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.4	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.81
2	73.21	50.94
3	75.14	51.43
4	76.95	52.29
5	78.57	53.46
6	79.95	54.91
7	81.03	56.60
8	81.19	57.00

Circle Center At X = 71.5 ; Y = 61.4 and Radius, 10.6

Factor of Safety
*** 1.747 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.81
2	73.17	51.22
3	75.06	51.86
4	76.87	52.72
5	78.57	53.78
6	80.13	55.03
7	81.53	56.45
8	81.96	57.00

Circle Center At X = 68.7 ; Y = 67.6 and Radius, 17.0

Factor of Safety
*** 1.768 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	67.42	50.00
2	69.40	49.71
3	71.40	49.76
4	73.37	50.13
5	75.24	50.83
6	76.98	51.82
7	78.53	53.08
8	79.85	54.59
9	80.90	56.29
10	81.19	57.00

Circle Center At X = 70.1 ; Y = 61.7 and Radius, 12.0

Factor of Safety
*** 1.795 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.81
2	73.21	50.85
3	75.15	51.34
4	76.94	52.23
5	78.49	53.49
6	79.73	55.06

7	80.59	56.87
8	80.63	57.00

Circle Center At X = 72.0 ; Y = 59.9 and Radius, 9.1

Factor of Safety
*** 1.803 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.81
2	73.18	51.16
3	75.07	51.82
4	76.83	52.77
5	78.42	53.98
6	79.80	55.43
7	80.89	57.00

Circle Center At X = 69.9 ; Y = 63.5 and Radius, 12.7

Factor of Safety
*** 1.807 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	72.47	51.65
2	74.45	51.93
3	76.35	52.56
4	78.12	53.50
5	79.69	54.73
6	81.03	56.22
7	81.52	57.00

Circle Center At X = 71.8 ; Y = 63.1 and Radius, 11.5

Factor of Safety
*** 1.835 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	68.68	50.00
2	70.59	49.41
3	72.58	49.19
4	74.58	49.37
5	76.50	49.92
6	78.27	50.84

7	79.84	52.08
8	81.14	53.61
9	82.12	55.35
10	82.66	57.00

Circle Center At X = 72.7 ; Y = 59.5 and Radius, 10.3

Factor of Safety
*** 1.867 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	68.68	50.00
2	70.61	49.47
3	72.61	49.37
4	74.58	49.72
5	76.42	50.50
6	78.05	51.66
7	79.38	53.16
8	80.35	54.91
9	80.90	56.83
10	80.91	57.00

Circle Center At X = 72.0 ; Y = 58.3 and Radius, 9.0

Factor of Safety
*** 1.871 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	67.42	50.00
2	69.34	49.43
3	71.32	49.15
4	73.32	49.18
5	75.29	49.50
6	77.19	50.12
7	78.98	51.02
8	80.61	52.17
9	82.05	53.56
10	83.27	55.15
11	84.23	56.90
12	84.26	57.00

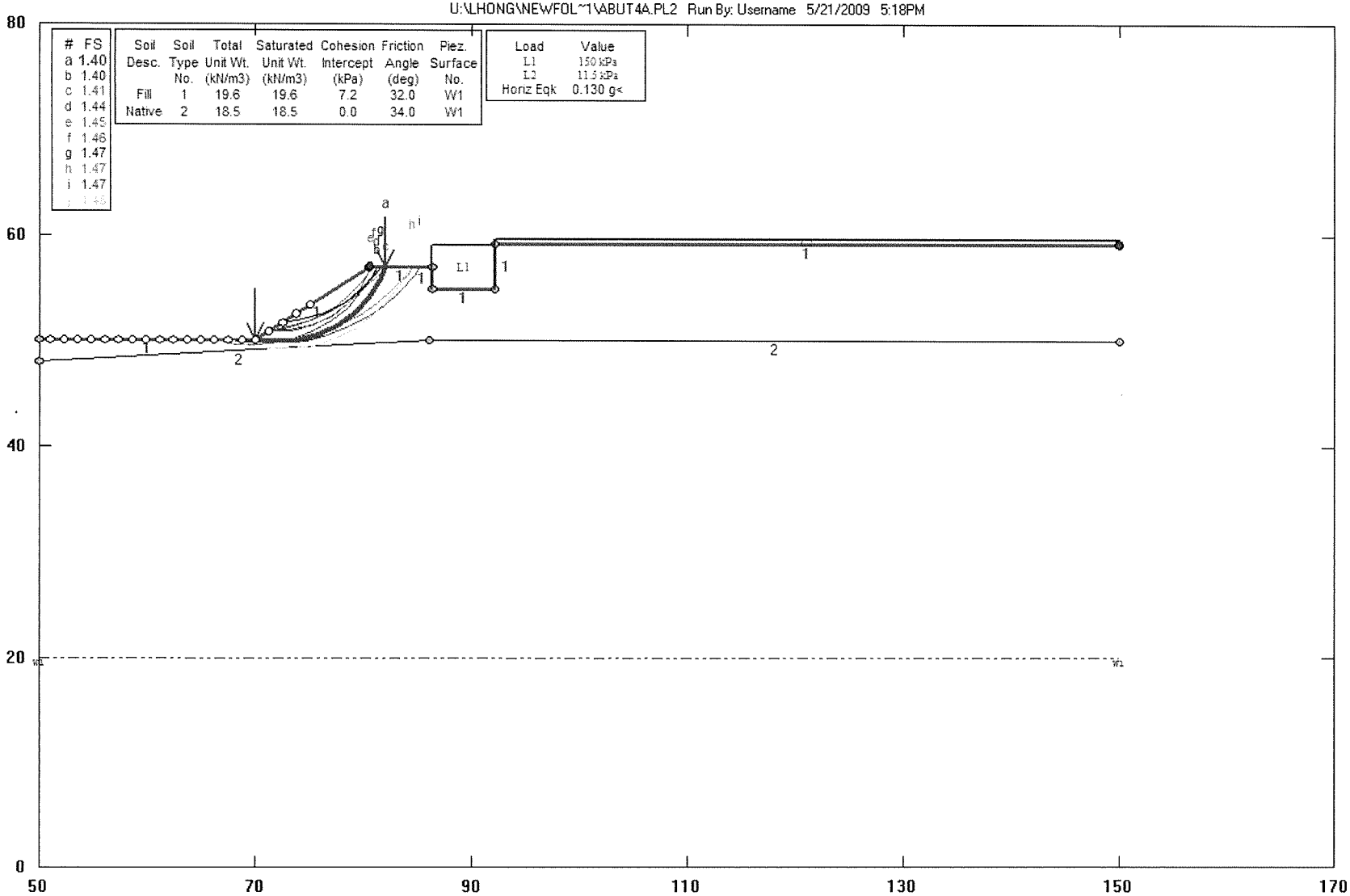
Circle Center At X = 72.2 ; Y = 62.4 and Radius, 13.2

Factor of Safety
*** 1.887 ***

**** END OF GSTABL7 OUTPUT ****

Box Springs Overhead Left, East Riverside, California

U:\LHONG\NEWFOL~1\ABUT4A.PL2 Run By: Username 5/21/2009 5:18PM



GSTABL7 v.2 FSmin=1.40

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 5/21/2009
Time of Run: 5:18PM
Run By: Username
Input Data Filename: U:abut4a.in
Output Filename: U:abut4a.OUT
Unit System: SI

Plotted Output Filename: U:abut4a.PLT

PROBLEM DESCRIPTION: Box Springs Overhead Left, East
Riverside, California

BOUNDARY COORDINATES

7 Top Boundaries
9 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	50.00	50.00	70.00	50.00	1
2	70.00	50.00	80.50	57.00	1
3	80.50	57.00	86.30	57.00	1
4	86.30	57.00	86.31	54.90	1
5	86.31	54.90	92.11	54.90	1
6	92.11	54.90	92.12	59.20	1
7	92.12	59.20	150.00	59.20	1
8	50.00	48.00	86.00	50.00	2
9	86.00	50.00	150.00	50.00	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	7.2	32.0	0.00	0.0	1
2	18.5	18.5	0.0	34.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	50.00	20.00
2	150.00	20.00

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	86.31	92.11	150.0	0.0
2	92.12	150.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 51.00(m)
and X = 75.00(m)

Each Surface Terminates Between X = 80.50(m)
and X = 150.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

2.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 5.913 FS Min = 1.398 FS Ave = 2.719
Standard Deviation = 0.900 Coefficient of Variation = 33.08 %

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	69.95	50.00
2	71.94	49.81
3	73.93	50.00
4	75.85	50.56
5	77.63	51.47
6	79.22	52.69
7	80.54	54.19
8	81.56	55.90
9	81.96	57.00

Circle Center At X = 71.9 ; Y = 60.5 and Radius, 10.7

Factor of Safety
*** 1.398 ***

Individual data on the 10 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.9	28.2	0.0	0.0	0.0	0.0	3.7	0.0	0.0
3	2.0	80.0	0.0	0.0	0.0	0.0	10.4	0.0	0.0
4	1.9	112.3	0.0	0.0	0.0	0.0	14.6	0.0	0.0
5	1.8	121.8	0.0	0.0	0.0	0.0	15.8	0.0	0.0
6	1.6	109.9	0.0	0.0	0.0	0.0	14.3	0.0	0.0
7	1.3	79.6	0.0	0.0	0.0	0.0	10.3	0.0	0.0
8	0.0	2.3	0.0	0.0	0.0	0.0	0.3	0.0	0.0
9	1.0	39.2	0.0	0.0	0.0	0.0	5.1	0.0	0.0
10	0.4	4.3	0.0	0.0	0.0	0.0	0.6	0.0	0.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.81

2	73.21	50.94
3	75.14	51.43
4	76.95	52.29
5	78.57	53.46
6	79.95	54.91
7	81.03	56.60
8	81.19	57.00

Circle Center At X = 71.5 ; Y = 61.4 and Radius, 10.6

Factor of Safety
*** 1.403 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.81
2	73.17	51.22
3	75.06	51.86
4	76.87	52.72
5	78.57	53.78
6	80.13	55.03
7	81.53	56.45
8	81.96	57.00

Circle Center At X = 68.7 ; Y = 67.6 and Radius, 17.0

Factor of Safety
*** 1.407 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	67.42	50.00
2	69.40	49.71
3	71.40	49.76
4	73.37	50.13
5	75.24	50.83
6	76.98	51.82
7	78.53	53.08
8	79.85	54.59
9	80.90	56.29
10	81.19	57.00

Circle Center At X = 70.1 ; Y = 61.7 and Radius, 12.0

Factor of Safety
*** 1.440 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.81
2	73.21	50.85
3	75.15	51.34
4	76.94	52.23
5	78.49	53.49
6	79.73	55.06
7	80.59	56.87
8	80.63	57.00

Circle Center At X = 72.0 ; Y = 59.9 and Radius, 9.1

Factor of Safety
*** 1.454 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.81
2	73.18	51.16
3	75.07	51.82
4	76.83	52.77
5	78.42	53.98
6	79.80	55.43
7	80.89	57.00

Circle Center At X = 69.9 ; Y = 63.5 and Radius, 12.7

Factor of Safety
*** 1.455 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	72.47	51.65
2	74.45	51.93
3	76.35	52.56
4	78.12	53.50
5	79.69	54.73
6	81.03	56.22
7	81.52	57.00

Circle Center At X = 71.8 ; Y = 63.1 and Radius, 11.5

Factor of Safety
*** 1.467 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	66.16	50.00
2	68.13	49.67
3	70.13	49.56
4	72.12	49.68
5	74.10	50.02
6	76.02	50.57
7	77.86	51.34
8	79.61	52.31
9	81.24	53.47
10	82.73	54.80
11	84.06	56.30
12	84.56	57.00

Circle Center At X = 70.1 ; Y = 67.3 and Radius, 17.8

Factor of Safety
*** 1.468 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	68.68	50.00
2	70.67	49.72
3	72.67	49.69
4	74.65	49.92
5	76.60	50.39
6	78.47	51.10
7	80.23	52.04
8	81.87	53.19
9	83.34	54.54
10	84.64	56.06
11	85.25	57.00

Circle Center At X = 71.9 ; Y = 65.6 and Radius, 15.9

Factor of Safety
*** 1.473 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	67.42	50.00
2	69.34	49.43
3	71.32	49.15
4	73.32	49.18
5	75.29	49.50
6	77.19	50.12
7	78.98	51.02
8	80.61	52.17
9	82.05	53.56
10	83.27	55.15
11	84.23	56.90

```
   12          84.26        57.00

Circle Center At X =   72.2 ; Y =   62.4  and Radius,   13.2

       Factor of Safety
      ***    1.476   ***


          **** END OF GSTABL7 OUTPUT ****
```

APPENDIX D

BRIDGE AS-BUILT PLANS

Note:
For "Index to Plans", "General Notes", and "Standard Plans List", see "INDEX TO PLANS" sheet.

MARK	DATE	DESCRIPTIONS	BY	CH'D
4	9-27-04	Future access road	BF	KS
3	9-27-04	Extended concrete barrier	BF	KS
2	9-27-04	Delete slope paving @ Abut 1	BF	KS
1	9-27-04	Revised Abutment 1	BF	KS

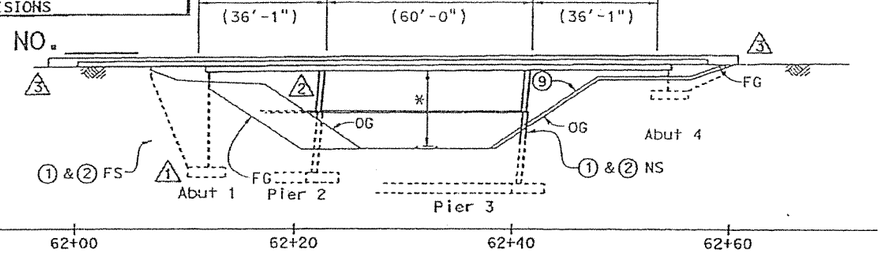
REVISIONS

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51662 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA 11-2-04

CONTRACT CHANGE ORDER NO. ____
SHEET ____ OF ____

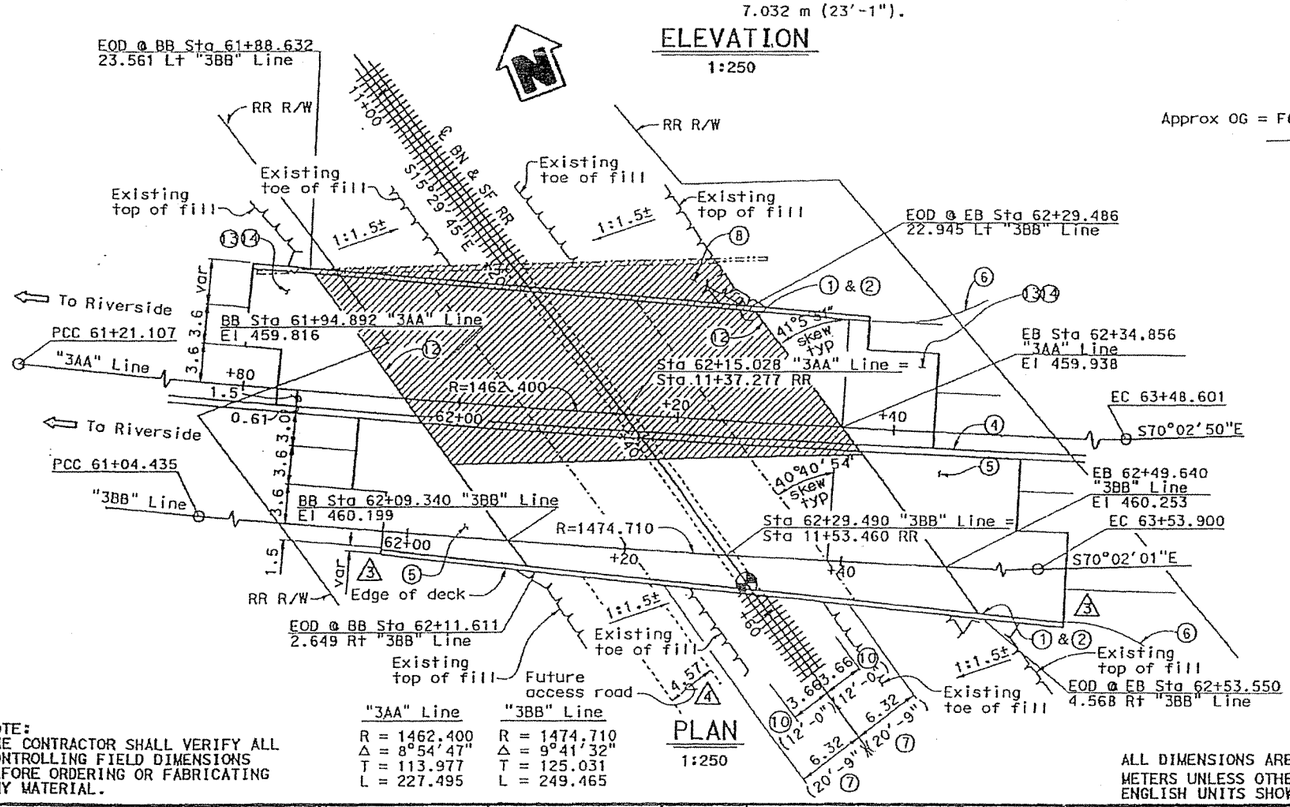
Sta 61+40.000 Elev 459.650 — +0.303% "3AA" — Sta 62+40.000 Elev 459.953
Sta 61+80.000 Elev 460.160 — +0.134% "3BB" — Sta 62+80.000 Elev 460.294

PROFILE GRADES
No Scale



* Minimum vertical clearance over widening = 7.032 m (23'-1").

ELEVATION
1:250



"3AA" Line	"3BB" Line
R = 1462.400	R = 1474.710
Δ = 8°54'47"	Δ = 9°41'32"
T = 113.977	T = 125.031
L = 227.495	L = 249.465

PLAN
1:250

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

QUANTITIES

BRIDGE REMOVAL	LUMP SUM	
STRUCTURE EXCAVATION (BRIDGE)	3 585	m^3
STRUCTURE BACKFILL (BRIDGE)	2 580	m^3
PRESTRESSING CAST-IN-PLACE CONCRETE	LUMP SUM	
STRUCTURAL CONCRETE, BRIDGE FOOTING	414	m^3
STRUCTURAL CONCRETE, BRIDGE	1 240	m^3
STRUCTURAL CONCRETE, APPROACH SLAB (TYPE N)	175	m^3
FRACTURED RIB TEXTURE	23	m^2
JOINT SEAL (MR 30 MM)	70	m
BAR REINFORCING STEEL (BRIDGE)	236 400	kg
SLOPE PAVING (CONCRETE)	55	m^3
CONCRETE BARRIER (TYPE 60SA)	69	m
CONCRETE BARRIER (TYPE 732)	119	m

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215, 60, 91	60.7/70.5, 22.0/18.5, 32.7/34.7	1748R1	2838

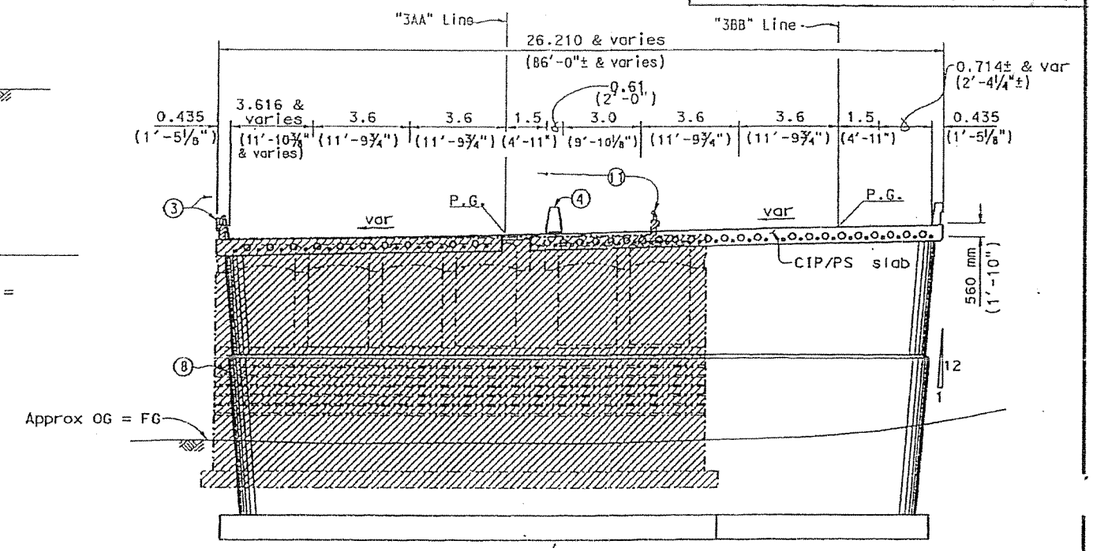
David Soon 6-2-04
REGISTERED CIVIL ENGINEER

8-4-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51662 Exp. 6-30-06 CIVIL 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.

Caltrans now has a web site! To get to the web site, go to: http://www.dot.ca.gov



TYPICAL SECTION
1:100

Note:
"Typical Section" dimensions measured perpendicular to "3AA" & "3BB" Lines.

Notes:

1. Paint "Box Springs OH Right Bridge".
2. Paint "Br. No. 56-0082R".
3. Concrete Barrier Type 732.
4. Concrete Barrier Type 60SA Mod.
5. Structure Approach Type N(9S).
6. MBGR, see "Road Plans".
7. Minimum horizontal clearance measured from ℄ RR tracks to face of column.
8. Remove existing bridge.
9. Slope Paving (concrete).
10. Mininimum horizontal clearance to footing excavation measured from ℄ RR tracks.
11. Remove concrete barriers. Salvage metal railing and parts.
12. Remove existing sacked concrete slope protection.
13. Remove existing AC approach.
14. Structure Approach Type N Mod (9S).

See "STAGE CONSTRUCTION" sheet for Traffic & Construction staging.

Indicates existing structure.
Indicates limits of removal.
Point of minimum vertical clearance.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN
ENGLISH UNITS SHOWN IN PARENTHESIS

DESIGN SEQUENCE 2

DESIGN	BY David Soon	CHECKED Keith Stillmunkes	LOAD FACTOR DESIGN	LIVE LOADING: HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD
DETAILS	BY Sandra McHealy	CHECKED Keith Stillmunkes	LAYOUT	BY David Soon / CHECKED Keith Stillmunkes
QUANTITIES	BY Keith Stillmunkes	CHECKED JP/BJ	SPECIFICATIONS	BY Mary Kopsa / PLANS AND SPECS COMPARED Mary Kopsa

Kelly Ann Holder
DESIGN ENGINEER

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

BRIDGE NO. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACE)
GENERAL PLAN

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY)
SHEET 1 OF 21

STRUCTURES DESIGN GENERAL PLAN SHEET (METRIC) (REV.4/20/00)
ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100
FILE => 56-0082r-a-gp.cco
USERNAME => sm
DATE PLOTTED => 26-JAN-2005
TIME PLOTTED => 09:45

No.	R	Δ	T	L
1	1474.710	-9°41'32"	125.031	249.465
2	1462.400	-8°54'47"	113.977	227.495

MARK	DATE	DESCRIPTIONS	BY	CH'D
2	9-13-04	Revised footing size	BF	KS
1	9-13-04	Revised elevation	BF	KS

REVISIONS

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL
08	Riv	215, 60, 91	60.7/10.6, 22.0/18.5, 32.1/34.7	1752R	2838

David Scan 6-2-04
REGISTERED CIVIL ENGINEER

8-4-03
PLANS APPROVAL DATE

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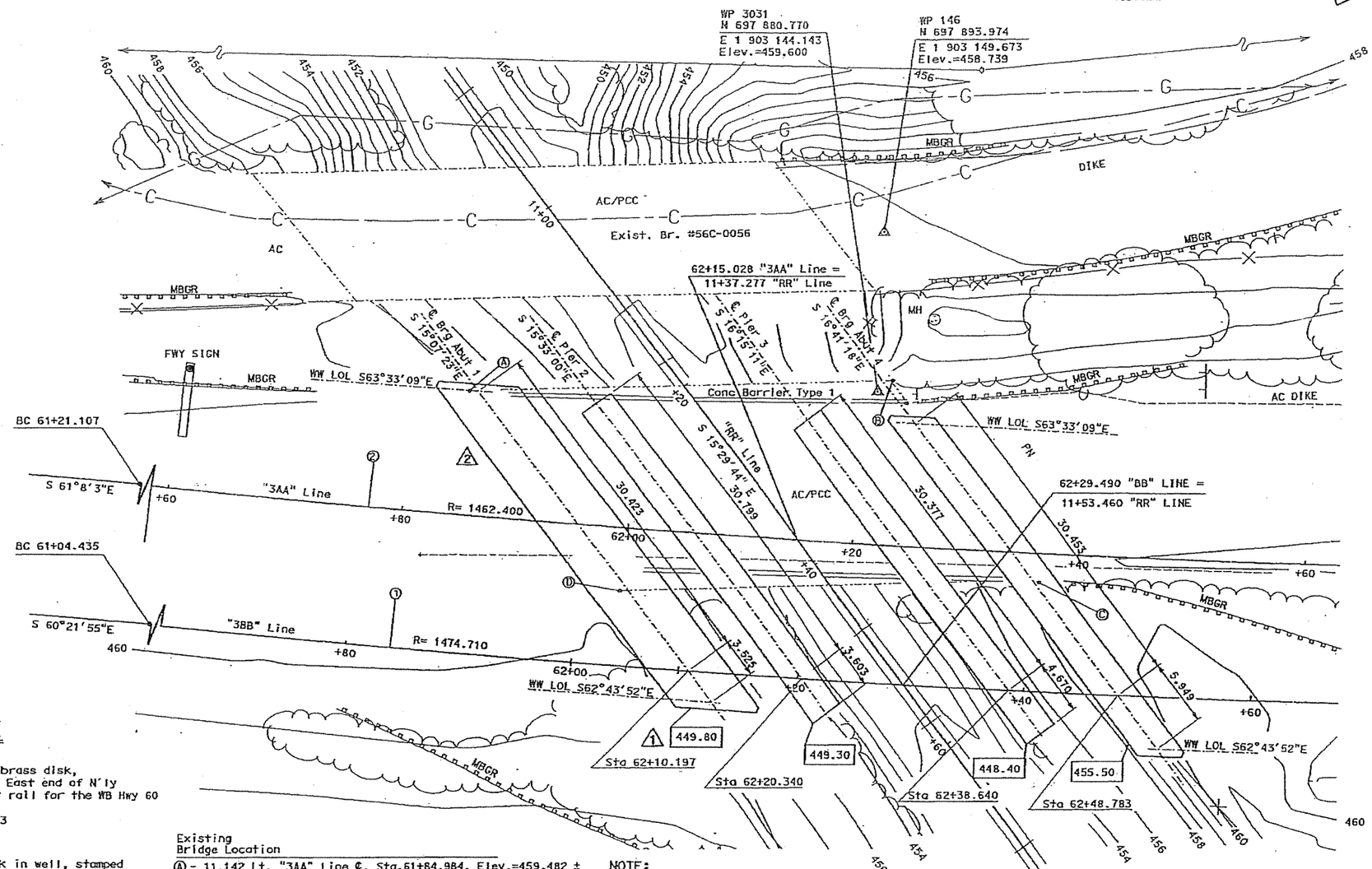
CONTRACT CHANGE ORDER NO. ____ SHEET ___ OF ___



SURVEY CONTROL

WP 3031
Fnd 5cm CDOT brass disk,
1m E'ly of the East end of N'ly
bridge barrier rail for the WB Hwy 60
N 697 880.770
E 1 903 144.143
Elev. = 459.60

WP 146
Fnd std br dsk in well, stamped
"26+89.16 BC C.L. N. FR. RD."
N 697 893.974
E 1 903 149.673
Elev. = 458.739

Existing
Bridge Location

Ⓐ - 11.142 Lt. "3AA" Line ℄, Sta.61+84.984, Elev.=459.482 ±
Ⓑ - 14.790 Lt. "3AA" Line ℄, Sta.62+22.402, Elev.=459.604 ±
Ⓒ - 2.587 Rt. "3AA" Line ℄, Sta.62+36.610, Elev.=459.920 ±
Ⓓ - 5.629 Rt. "3AA" Line ℄, Sta.61+99.805, Elev.=459.697 ±

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

NOTES:

+ Denotes spot elevation.
* Denotes spot elevation on structure on PCC.
Indicates bottom of footing elevation.
Underground utilities as shown are approximate.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN SEQUENCE 2

PRELIMINARY INVESTIGATION SECTION

SCALE 1:200	VERT. DATUM NGVD '29	PHOTOGRAMMETRY AS OF:	
	HORZ. DATUM NAD '83	SURVEYED	DRAFTED H AZARI 2/01
ALIGNMENT TIES DIST TRAVERSE SHEET		FIELD CHECKED L MANABO 2/01	CHECKED L MANABO 3/01

DESIGN	Keith Stillmunkes	CHECKED Benjamin Fontes
DETAILS	Bruno Jenko	CHECKED Benjamin Fontes
QUANTITIES	Keith Stillmunkes	CHECKED JPEU

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

CU 08
EA 334841

FILE => 56-0082r-e-fp.cco

BRIDGE No. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACE)

FOUNDATION PLAN

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)
11-8-01 1-14-02 12-26-02 4-16-04

SHEET 5 OF 21

STRUCTURES FOUNDATION PLAN SHEET (METRIC) (REV. 4/20/00)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

DATE PLOTTED => 26-JAN-2005 TIME PLOTTED => 09:45

USERNAME => BF

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215, 60, 91	60.7/10.6, 22.0/18.5, 32.7/34.7	1749R1	2838

David Soon 6-2-04
REGISTERED CIVIL ENGINEER DATE

B-4-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51862 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA

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Caltrans Metric

INDEX TO PLANS

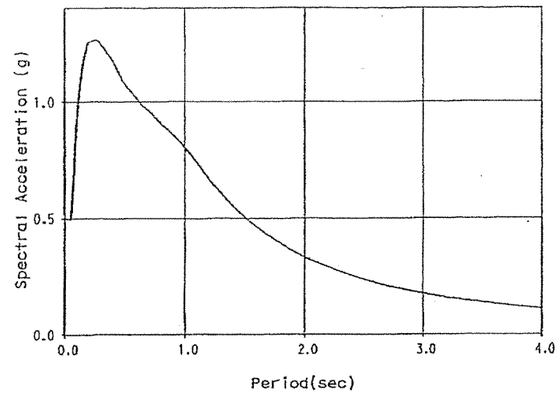
SHEET NO	TITLE
1	GENERAL PLAN
2	INDEX TO PANS
3	STAGE CONSTRUCTION
4	DECK CONTOURS
5	FOUNDATION PLAN
6	ABUTMENT 1 LAYOUT
7	ABUTMENT 4 LAYOUT
8	ABUTMENT DETAILS NO. 1
9	ABUTMENT DETAILS NO. 2
10	ABUTMENT DETAILS NO. 3
10A △3	ABUTMENT DETAILS NO. 4
11	PIER LAYOUT
12	PIER DETAILS
13	TYPICAL SECTION
14	VOID LAYOUT
15	LONGITUDINAL SECTION
15A	CONCRETE BARRIER TYPE 60SA MODIFIED
16	STRUCTURE APPROACH TYPE N(9S) AND N MOD (9S)
17	STRUCTURE APPROACH DRAINAGE DETAILS
18	SLOPE PAVING - FULL SLOPE
18A △3	MISCELLANEOUS DETAILS
19	LOG OF TEST BORINGS 1 OF 3
20	LOG OF TEST BORINGS 2 OF 3
21	LOG OF TEST BORINGS 3 OF 3

STANDARD PLANS DATED JULY 1999

A10A	ABBREVIATIONS
A10B	SYMBOLS
A62C	LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL - BRIDGE
A76G	CONCRETE BARRIER TYPE 60S
A76H	CONCRETE BARRIER TYPE 60S
B0-1	BRIDGE DETAILS
B0-3	BRIDGE DETAILS
B0-5	BRIDGE DETAILS
B0-13	BRIDGE DETAILS
B6-21	JOINT SEALS (MAXIMUM MOVEMENT RATING = 50 mm)
B8-5	CAST-IN-PLACE PRESTRESSED GIRDER DETAILS
B11-55	CONCRETE BARRIER TYPE 732
B11-47	CABLE RAILING

STANDARD PLAN SHEET NO.

DETAIL NO.



SITE SPECIFIC ACCELERATION RESPONSE SPECTRA CURVE

Modified SDC (ARS) Curve for Soil Profile C (M=7.25 ± .25)
(Peak Bedrock Acceleration = 0.5g)

SPREAD FOOTING DATA TABLE

SUPPORT LOCATION	RECOMMENDED BEARING PRESSURE		MAXIMUM CONTACT PRESSURE		STRENGTH REDUCTION FACTOR Ø or FACTOR OF SAFETY (FS) (Note 1)
	WSD	LFD	WSD	LFD	
	Gross Allowable Bearing pressure (q_{all})	Ultimate Bearing pressure (q_u)	q_{max}	$q_{max}/Ø$	
Abut 1	△1 290 kPa	N/A	△1 287 kPa	N/A	FS = 3
Pier 2	N/A	1436 kPa	N/A	1080 kPa	Ø = 0.5
Pier 3	N/A	1436 kPa	N/A	1090 kPa	Ø = 0.5
Abut 4	192 kPa	N/A	115 kPa	N/A	FS = 3

Notes:
1. Ø = 1.0 for seismic loads, otherwise Ø = 0.5.

GENERAL NOTES
LOAD FACTOR DESIGN

DESIGN: Bridge Design Specifications-April 2000 (LFD) (1996 AASHTO with Interims and Revisions by Caltrans)

SEISMIC DESIGN: Seismic Design Criteria (SDC) by Caltrans Version 1.2 December 2001

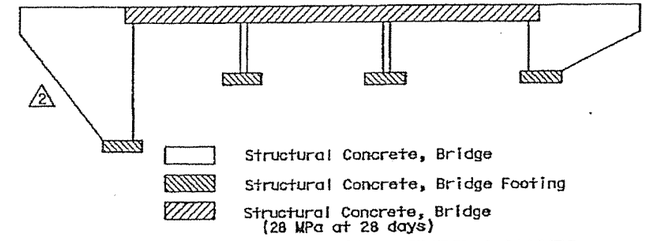
DEAD LOAD: Includes 1675 Pa for future wearing surface.

LIVE LOADING: HS20-44 and alternative and permit design load.

SEISMIC LOADING: Site Specific Acceleration Response Spectra Curve

REINFORCED CONCRETE: f_y=420 MPa
f'_c= 25 MPa
n = 8

PRESTRESSED CONCRETE: See "Prestressing Notes" on "LONGITUDINAL SECTION" sheet.



CONCRETE STRENGTH AND TYPE LIMITS

No Scale

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51862 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA 11-2-04

MARK	DATE	DESCRIPTIONS	BY	CH'D
△3	9-13-04	Revised note	BF	KS
△2	9-13-04	Modified detail	BF	KS
△1	9-13-04	Revised value	BF	KS

REVISIONS

CONTRACT CHANGE ORDER NO. ____
SHEET ___ OF ___

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN SEQUENCE 2

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

	BY	CHECKED
DESIGN	Keith Stillmunkes	Benjamin Fontes
DETAILS	Bruno Jenko	Benjamin Fontes
QUANTITIES	Keith Stillmunkes	JP/BJ

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

BRIDGE NO. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACE)
INDEX TO PLANS

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 1-1-01 2-1-01 3-2-01 4-16-01 5-1-01

SHEET 2 OF 21

STRUCTURES DESIGN DETAIL SHEET (METRIC) (REV.12-1-01)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

FILE => 56-0082r-a-iip.cco

DATE PLOTTED => 26-JAN-2005 TIME PLOTTED => 09:45

USERNAME => sm

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215, 60, 91	60.7/70.6, 22.0/18.5, 32.7/34.1	1753R1	2838

REGISTERED CIVIL ENGINEER — DATE 6-2-04

8-4-03
PLANS APPROVAL DATE

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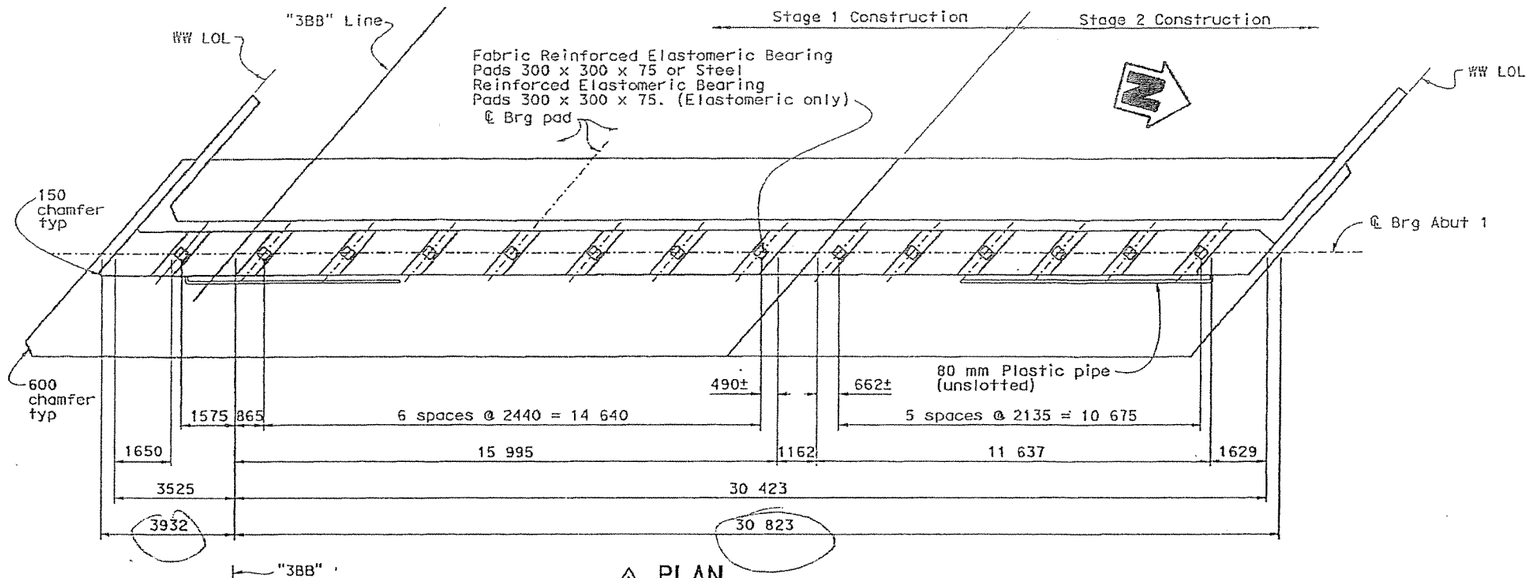
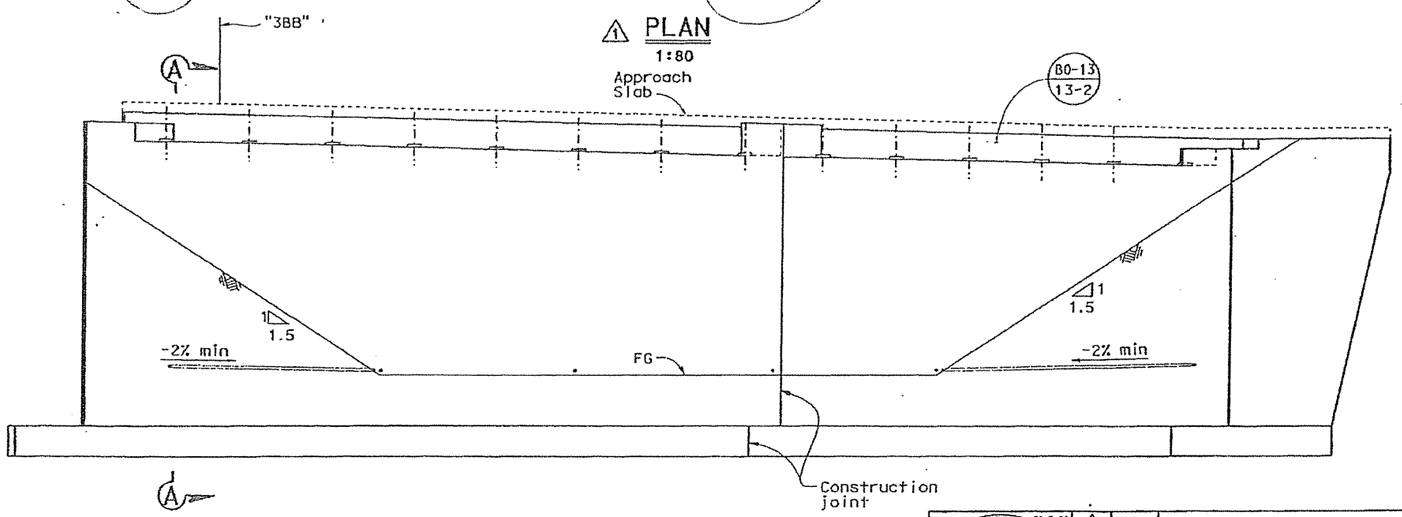
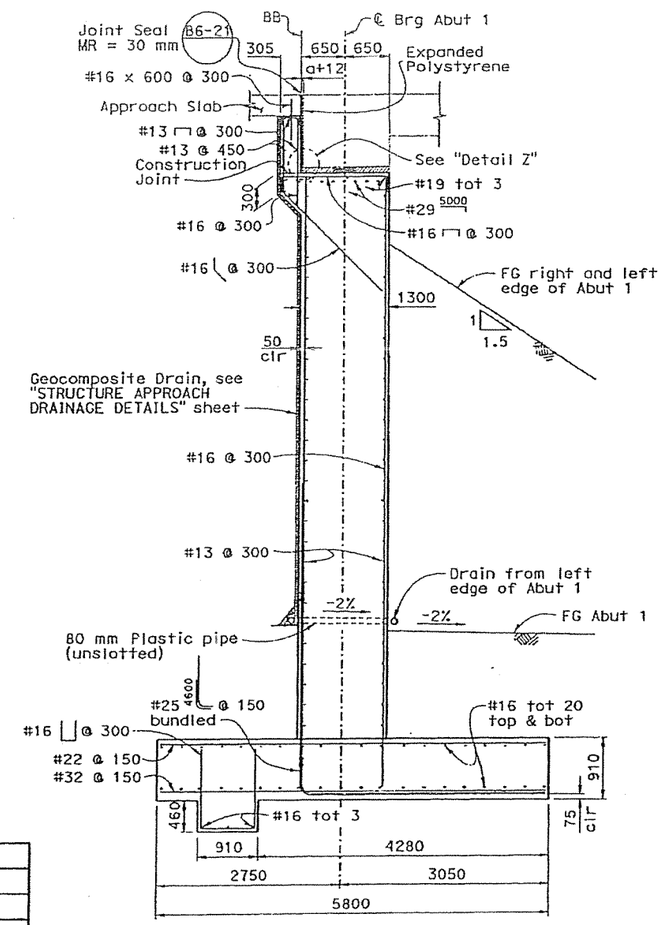


1 PLAN
1:80



1 ELEVATION
1:80



Note:
For "Detail Z", see ABUTMENT DETAILS NO. 1 sheet.

1 SECTION A-A
1:40

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

REGISTERED PROFESSIONAL ENGINEER — David Soon — No. 51862 — Exp. 6-30-06 — CIVIL — STATE OF CALIFORNIA — 11-2-04

MARK	DATE	DESCRIPTIONS	BY	CH'D
1	9-13-04	Revised detail	BF	KS

REVISIONS

CONTRACT CHANGE ORDER NO. ____
SHEET ___ OF ___

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN SEQUENCE 2

	BY	CHECKED
DESIGN	Keith Stillmunkes	Benjamin Fontes
DETAILS	Bruno Jenko	Benjamin Fontes
QUANTITIES	Keith Stillmunkes	JP/BJ

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

CU 08
EA 334841

BRIDGE NO. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACE)
ABUTMENT 1 LAYOUT

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 1-14 1-14 1-14 4-11-14

SHEET 6 OF 21

STRUCTURES DESIGN DETAIL SHEET (METRIC) (REV.12-1-01)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

FILE => 56-0082r-h-01-1a.cco

USERNAME => SI
DATE PLOTTED => 26-JAN-2005
TIME PLOTTED => 09:46

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
08	Riv	215,60, 91	60.7/10.6, 22.0/18.5, 32.7/34.1	1754R1	2838

David Soon 6-2-04
REGISTERED CIVIL ENGINEER DATE

8-4-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51862 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA

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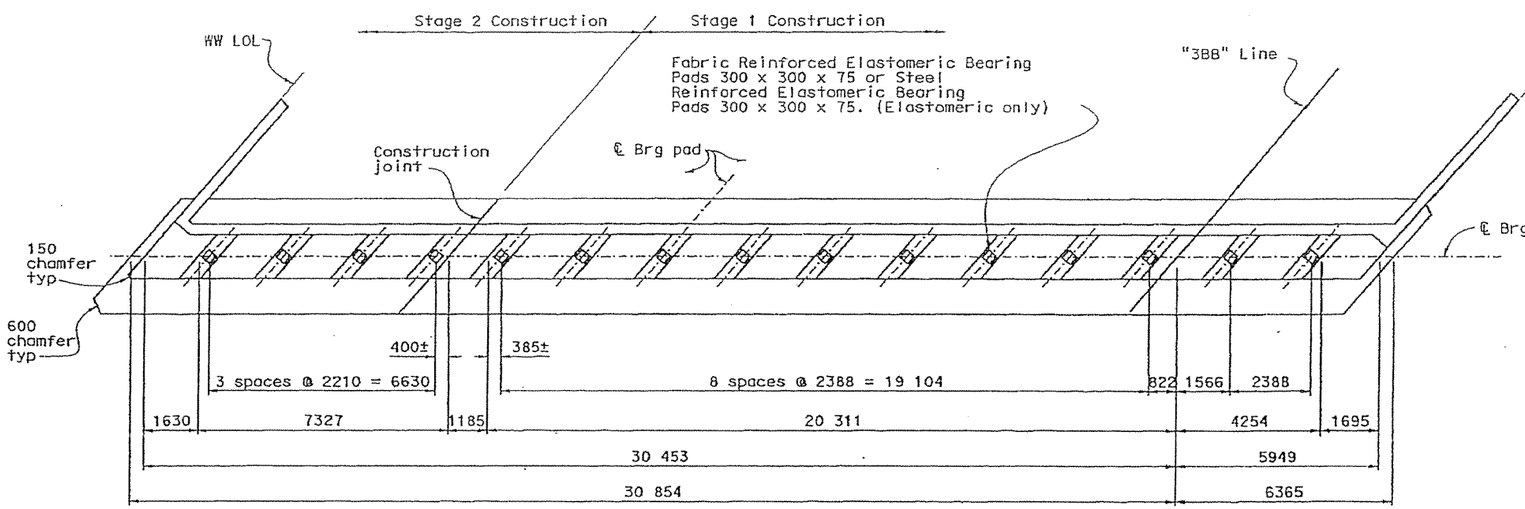
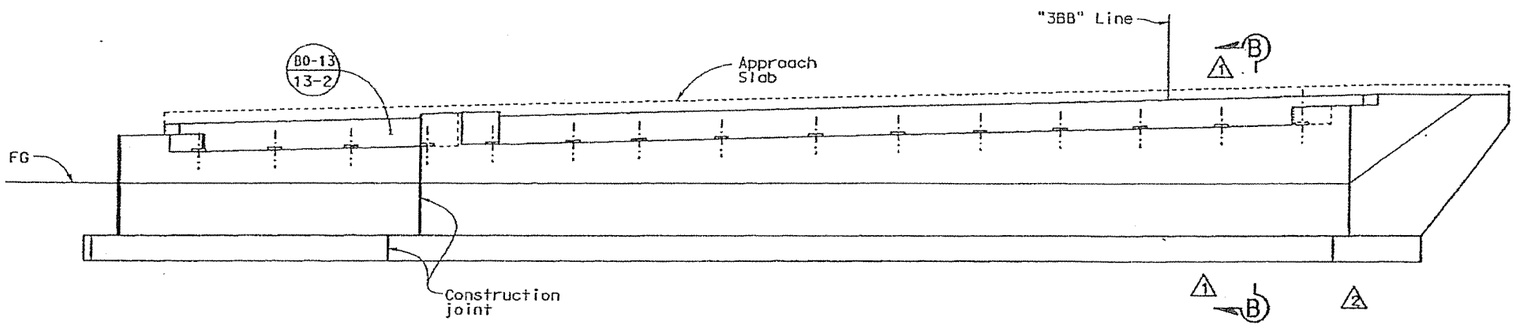
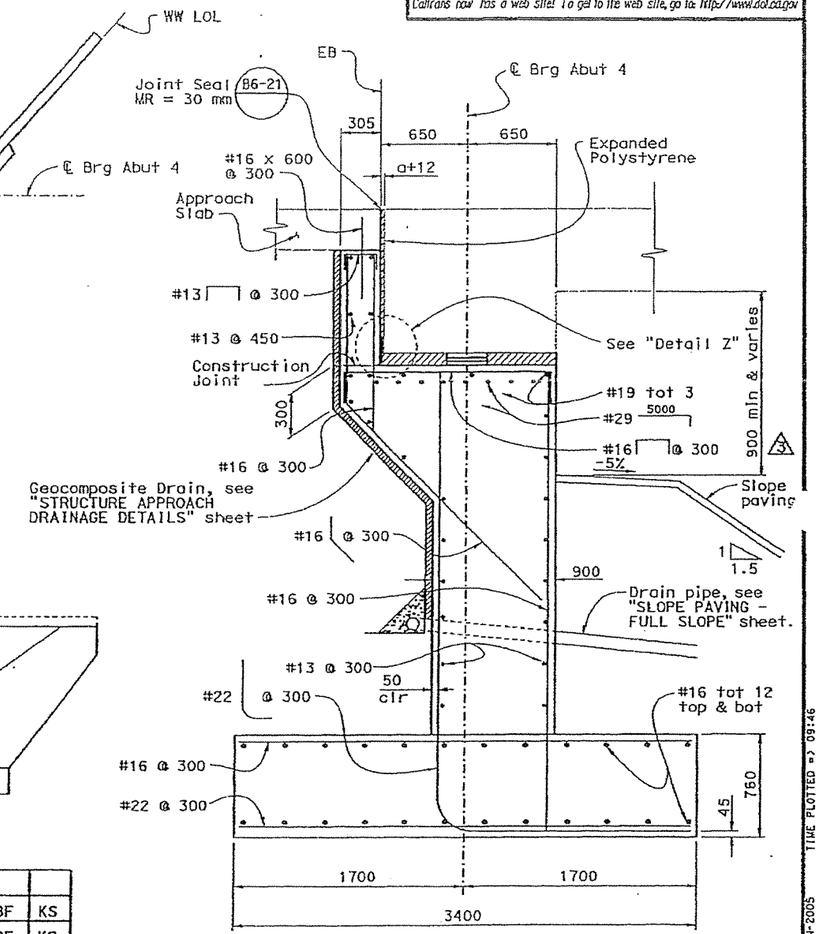


PLAN
1:80



ELEVATION
1:80



1 SECTION B-B
1:20

Note:
For "Detail Z", see ABUTMENT DETAILS NO. 1 sheet.

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

PROFESSIONAL ENGINEER David Soon No. 51862 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA 11-2-04

MARK	DATE	DESCRIPTIONS	BY	CH'D
3	9-13-04	Revised dimension	BF	KS
2	9-13-04	Deleted note	BF	KS
1	9-13-04	Added detail	BF	KS

REVISIONS

CONTRACT CHANGE ORDER NO. ____
SHEET ___ OF ___

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN SEQUENCE 2

DESIGN	BY Keith Stillmunkes	CHECKED Benjamin Fontes	
DETAILS	BY Bruno Janko	CHECKED Benjamin Fontes	
QUANTITIES	BY Keith Stillmunkes	CHECKED JP/BJ	

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

BRIDGE NO. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACE)
ABUTMENT 4 LAYOUT

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 7 OF 21

STRUCTURES DESIGN DETAIL SHEET (METRIC) (REV.12-1-01)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

FILE => 56-0082r-h-a4-lo.cco

DATE PLOTTED => 26-JAN-2005 TIME PLOTTED => 09:46

USERNAME => sti

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215, 60, 91	60.7/70.6, 22.0/18.5, 32.7/34.7	1755R1	2838

David Soon 6-2-04
REGISTERED CIVIL ENGINEER DATE

8-4-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51862 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA

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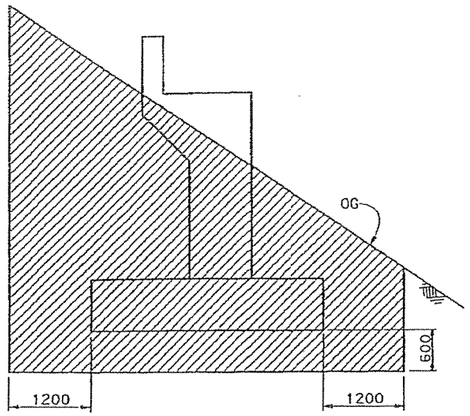
Caltrans Metric

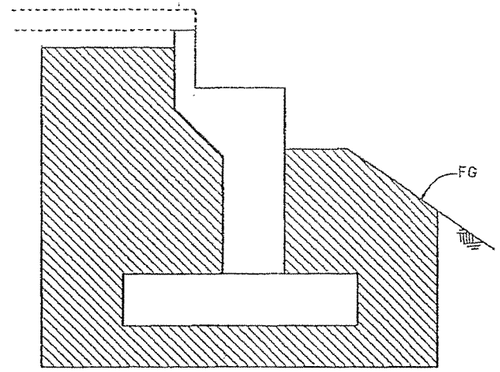
MARK	DATE	DESCRIPTIONS	BY	CH'D
3				
2				
2	9-13-04	Added note	BF	KS
1	9-13-04	Modified title	BF	KS

REVISIONS

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51862 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA 11-2-04

CONTRACT CHANGE ORDER NO. ____
SHEET ___ OF ___





Notes:

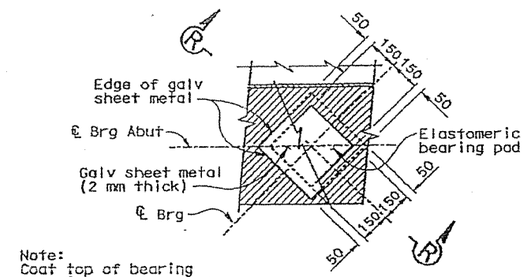
Indicates limits of excavation.

Indicates limits of backfill.

LIMITS OF PAYMENT FOR EXCAVATION & BACKFILL AT ABUTMENT 4 △1

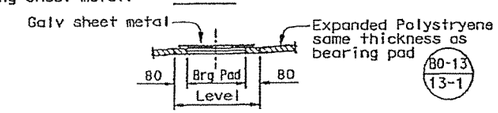
No Scale

△2 Note: Detail does not apply to Abutment 1



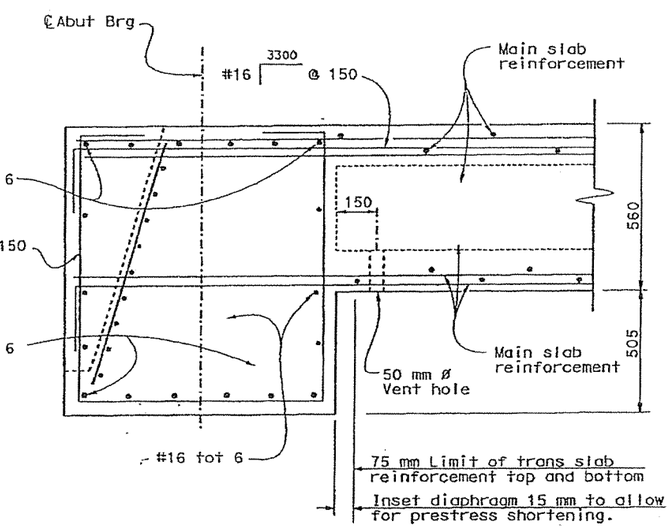
Note:
Coat top of bearing pad with grease prior to placing sheet metal.

PLAN



SECTION R-R
BEARING PAD DETAIL

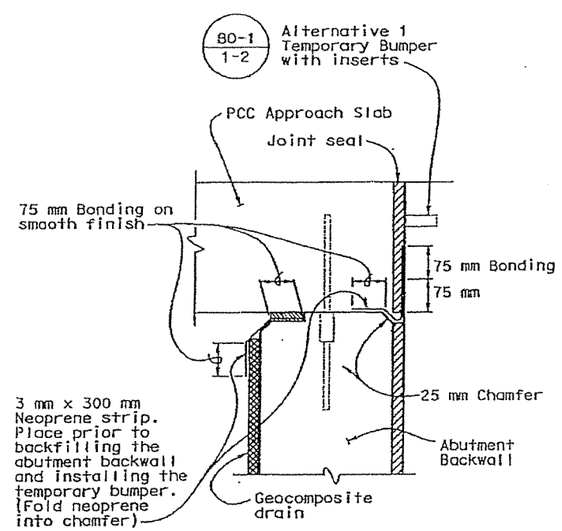
No Scale
Details typical at all bearing pads



NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

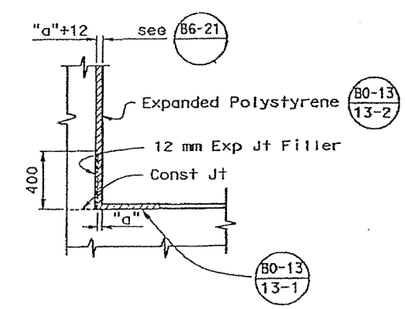
END DIAPHRAGM (B8-5)

1:10



JOINT PROTECTION DETAIL

No Scale



DETAIL Z

No scale

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN SEQUENCE 2

DESIGN	BY Keith Stillmunkes	CHECKED Benjamin Fontes	
DETAILS	BY Bruno Jenko	CHECKED Benjamin Fontes	
QUANTITIES	BY Keith Stillmunkes	CHECKED JP/BJ	

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

BRIDGE NO. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACE)
ABUTMENT DETAILS NO. 1

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 8 OF 21

STRUCTURES DESIGN DETAIL SHEET (METRIC) (REV.12-1-01)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

FILE => 56-0082r-h-ab-d01.cce

USERNAME => si DATE PLOTTED => 26-JAN-2005 TIME PLOTTED => 09:47

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215, 60, 91	60.7/70.6, 22.0/18.5, 32.7/34.7	1766	2838

Mark A. Richards 10-1-02
REGISTERED GEOLOGIST

8-4-03
PLANS APPROVAL DATE

REGISTERED GEOLOGIST Mark A. Richards No. 5240 Exp. 7-31-04 REGISTERED GEOLOGIST STATE OF CALIFORNIA

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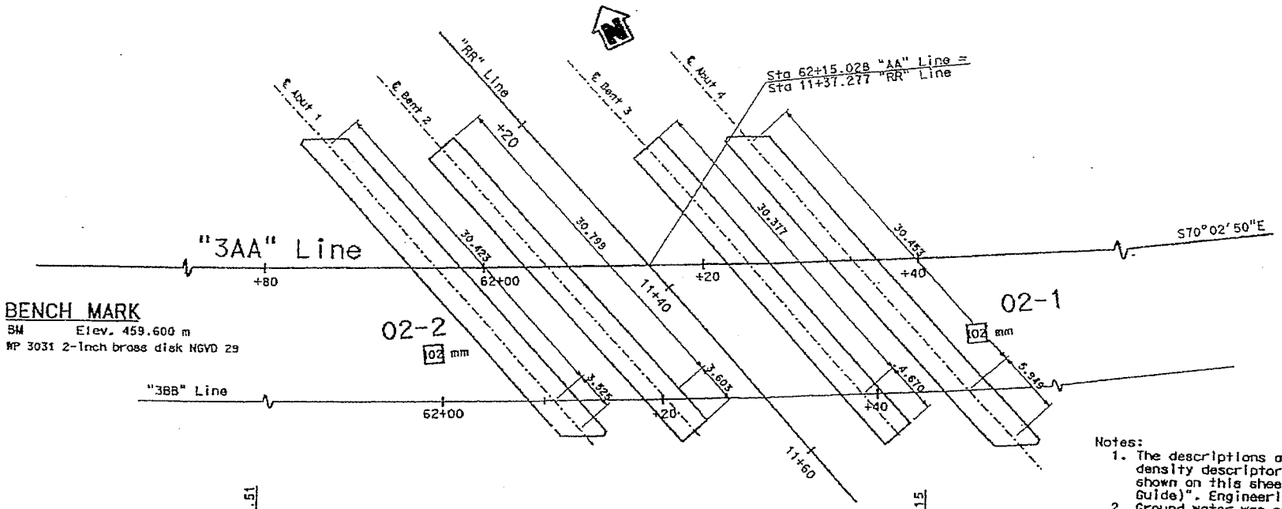
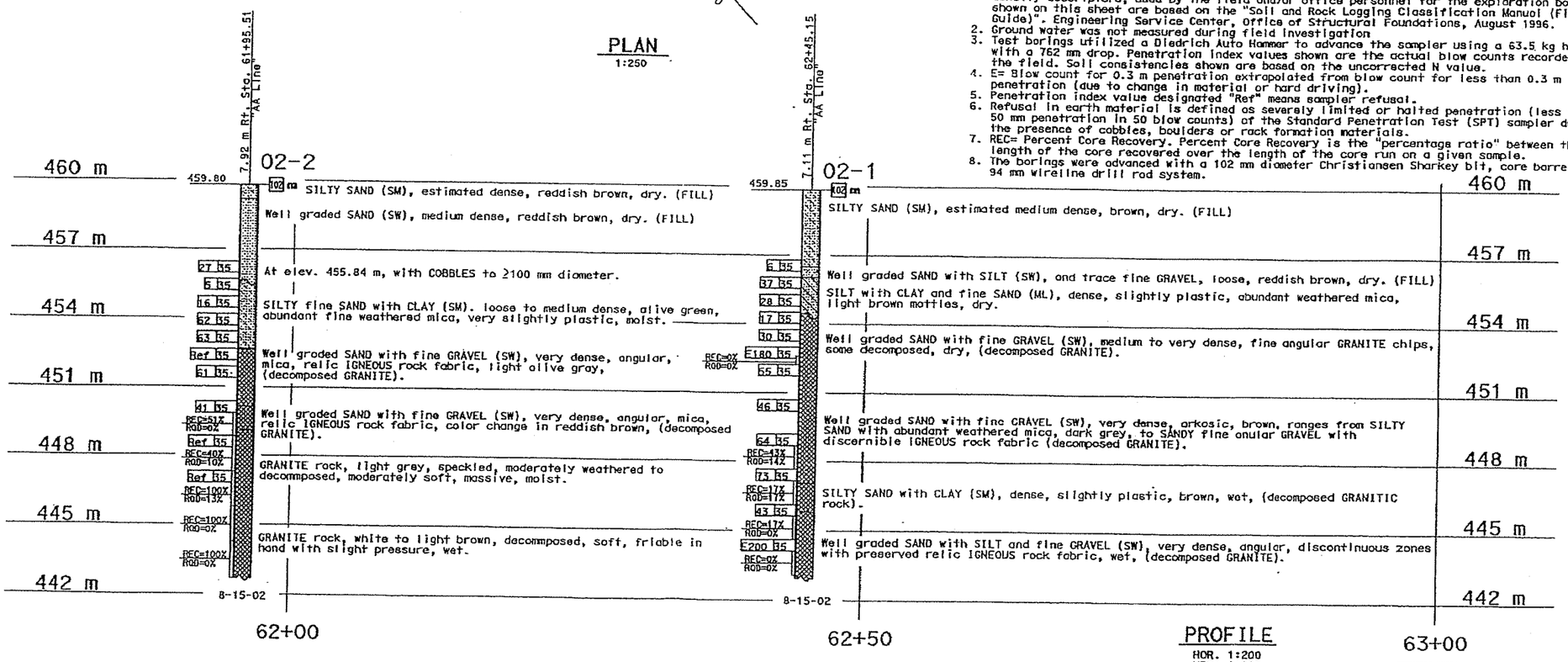


BENCH MARK
BM Elev. 459.600 m
MP 3031 2-inch brass disk NGVD 29

PLAN
1:250

Notes:
1. The descriptions and classifications of rock and/or soil, including consistency and relative density descriptors, used by the field and/or office personnel for the exploration boreholes shown on this sheet are based on the "Soil and Rock Logging Classification Manual (Field Guide)", Engineering Service Center, Office of Structural Foundations, August 1996.
2. Ground water was not measured during field investigation.
3. Test borings utilized a Diedrich Auto Hammer to advance the sampler using a 63.5 kg hammer with a 762 mm drop. Penetration index values shown are the actual blow counts recorded in the field. Soil consistencies shown are based on the uncorrected N value.
4. E= Blow count for 0.3 m penetration extrapolated from blow count for less than 0.3 m penetration (due to change in material or hard driving).
5. Penetration index value designated "Ref" means sampler refusal.
6. Refusal in earth material is defined as severely limited or halted penetration (less than 50 mm penetration in 50 blow counts) of the Standard Penetration Test (SPT) sampler due to the presence of cobbles, boulders or rock formation materials.
7. REC= Percent Core Recovery. Percent Core Recovery is the "percentage ratio" between the length of the core recovered over the length of the core run on a given sample.
8. The borings were advanced with a 102 mm diameter Christiansen Sharkey bit, core barrel, and 94 mm wireline drill rod system.



PROFILE
HOR. 1:200
VER. 1:100

DESIGN SEQUENCE 2

LEGEND OF BORING OPERATIONS

LEGEND OF EARTH MATERIALS

CONSISTENCY CLASSIFICATION FOR SOILS

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply extensive analysis.

ENGINEERING SERVICES	GEOTECHNICAL SERVICES
DRAWN BY F. Nguyen 9/02	
CHECKED BY M. Richards 9/02	

FIELD INVESTIGATION BY: M. Richards

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES STRUCTURE DESIGN 7

BRIDGE No. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACEMENT)
LOG OF TEST BORINGS 1 OF 3

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 7-15-02 11-1-02 12-12-02 4-15-03

SHEET 20 OF 22

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

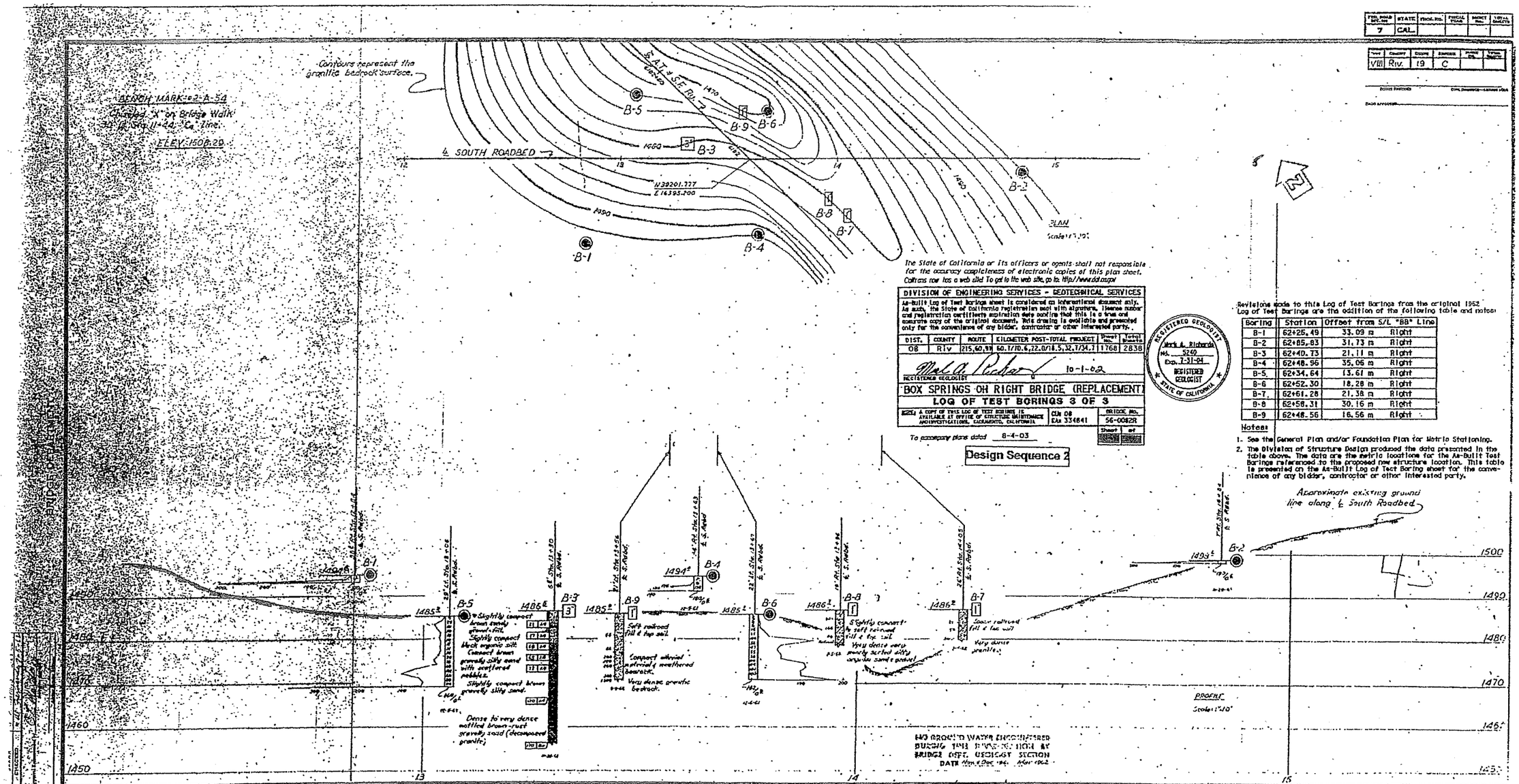
DGS GEOLOGIST LOG OF TEST BORINGS SHEET (METRIC) (REV. 2/02)

FILE => 56-0082r-z-1tb1.dgn

USERNAME => dpoto DATE PLOTTED => 04-JUN-2004 TIME PLOTTED => 14:45

FED. ROAD DIST. NO.	STATE	FISCAL YEAR	PROJ. NO.	SHEET NO.	TOTAL SHEETS
7	CAL.				

ROUTE	COUNTY	PREFIX	SUFFIX	PROJECT NO.	TOTAL SHEETS
VIII	Riv.	19	C		



The State of California or its officers or agents shall not responsible for the accuracy completeness of electronic copies of this plan sheet. Caltrans now has a web site To get to the web site, go to: http://www.dot.ca.gov

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	KILOMETER POST-TOTAL PROJECT	Sheet No.	Total Sheets
08	Riv	215,60,91	60.1/70.6,72.0/18.5,32.1/34.7	11768	2838

Mark A. Richard 10-1-02
REGISTERED GEOLOGIST

BOX SPRINGS OH RIGHT BRIDGE (REPLACEMENT)

LOG OF TEST BORINGS 3 OF 3

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CUN 08 EAA 334641

BRIDGE NO. 56-0082R

Sheet 1 of

To accompany plans dated 8-4-03

Design Sequence 2

REGISTERED GEOLOGIST Mark A. Richard No. 5240 Exp. 1-31-04 REGISTERED GEOLOGIST STATE OF CALIFORNIA

Revisions made to this Log of Test Borings from the original 1962 Log of Test Borings are the addition of the following table and notes:

Boring	Station	Offset from S/L "BB" Line	
B-1	62+25.49	33.09 m	Right
B-2	62+85.83	31.73 m	Right
B-3	62+40.73	21.11 m	Right
B-4	62+48.96	35.06 m	Right
B-5	62+34.64	13.67 m	Right
B-6	62+52.30	18.28 m	Right
B-7	62+61.28	21.38 m	Right
B-8	62+58.31	30.16 m	Right
B-9	62+48.56	16.56 m	Right

Notes:

1. See the General Plan and/or Foundation Plan for Metric Stationing.
2. The Division of Structure Design produced the data presented in the table above. The data are the metric locations for the As-Built Test Borings referenced to the proposed new structure location. This table is presented on the As-Built Log of Test Boring sheet for the convenience of any bidder, contractor or other interested party.

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

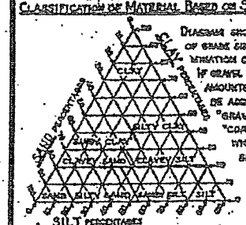


DIAGRAM SHOWS THE BASIS FOR ESTIMATES OF GRADE SIZE DISTRIBUTION USED IN DETERMINATION OF CLASS NAMES.

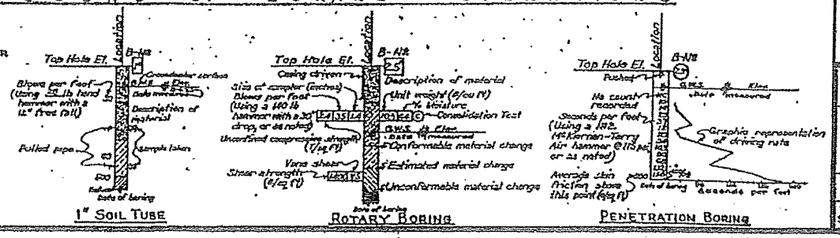
IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIZ; "GRAVELLY SAND." THE TERMS "COARSE", "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE SAND, SILT AND GRAVEL REFER TO STANDARD GRADE SIZE LIMITS.

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/OR ORGANIC MATTER
- FILL MATERIAL
- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

LEGEND OF BORING OPERATIONS

- PENETROMETER
- 2¼" CONE PENETROMETER
- SAMPLER BORING (DRY)
- ROTARY BORING (WET)
- AUGER BORING (DRY)
- JET BORING
- CORE BORING
- TEST PIT



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

BOX SPRINGS - OVERHEAD
W/ Contours

LOG OF TEST BORINGS

SCALE: 1" = 10' | BRIDGE EA 334641 | FILE - | DRAWING

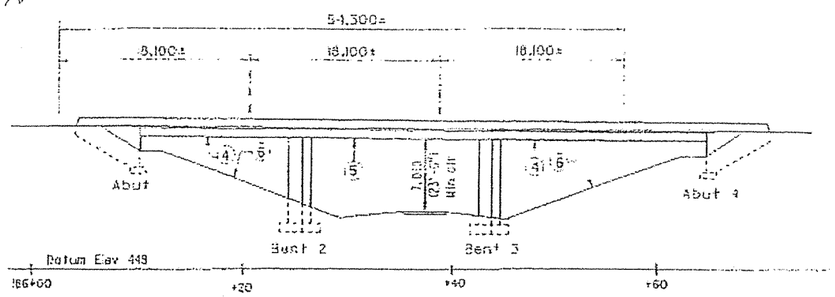
56-0082r-z-1tb3.tif

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	Riv	215.60	R6.1-8/66.3, R19.5/23.0	237	281

REGISTERED ENGINEER - CIVIL 5-4-99

4-13-00
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.



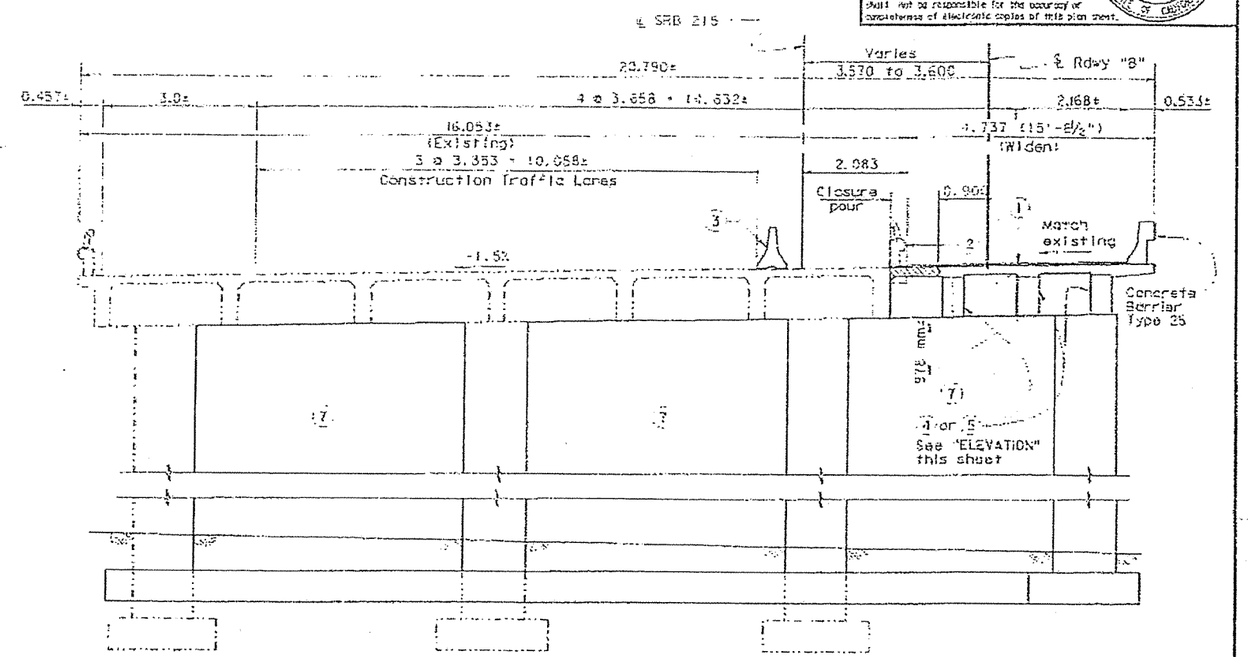
ELEVATION

1:250

Notes:

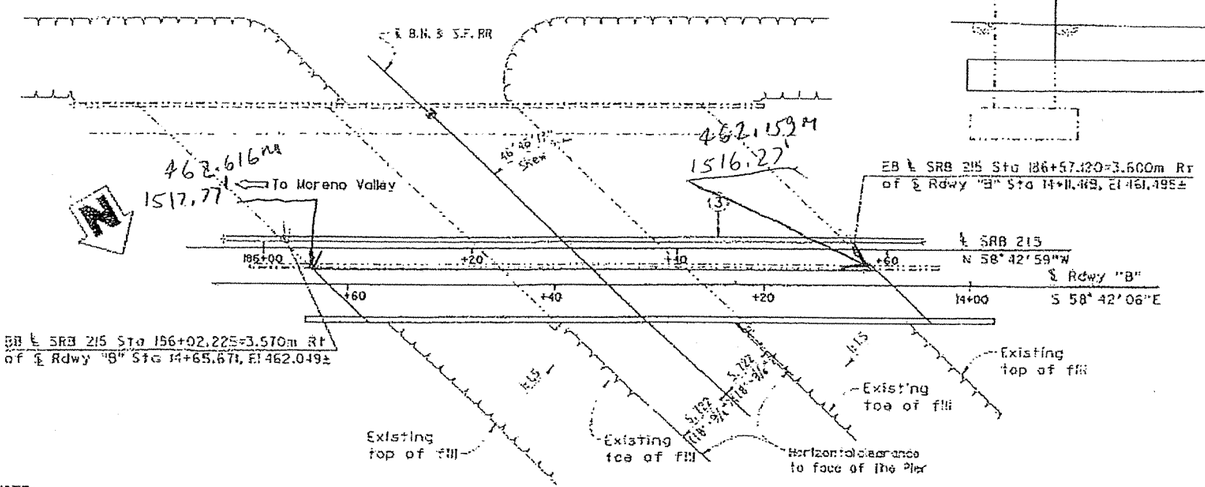
1. 30 mm overlay to match existing. (See Road Plans)
2. Remove existing type 1 railing and deck overhang.
3. Temporary railing type K. (See Road Plans)
4. CIP concrete T girder.
5. Precast/prestressed rectangular girder
6. Slope paving.
7. In-fillwall.

⊘ Point of minimum vertical clearance
— — Indicates existing structure
——— Indicates new construction



TYPICAL SECTION

1:50



NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

PLAN

1: 250

QUANTITIES

BRIDGE REMOVAL (PORTION), LOCATION B	LUMP	SUM
STRUCTURE EXCAVATION (BRIDGE)	713	m^3
STRUCTURE BACKFILL (BRIDGE)	480	m^3
STRUCTURAL CONCRETE, BRIDGE FOOTING	160	m^3
STRUCTURAL CONCRETE, BRIDGE	445	m^3
DRILL AND BOND DOWEL	150	m^3
FURNISH PRECAST PRESTRESSED CONCRETE GIRDER 115 M - 20 M	3	EA
ERECT PRECAST PRESTRESSED CONCRETE GIRDER	3	EA
BAR REINFORCING STEEL (BRIDGE)	54,840	kg
STRUCTURE DRAINAGE SYSTEM	LUMP	SUM
SLOPE PAVING (CONCRETE)	42	m^3
CONCRETE BARRIER (TYPE 25)	86	m

Note:

For General Notes and Standard Plans, see "Index to Plans" sheet

English unit is to be used for AR information only

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN	Ariel Reyes	CHECKED Lawrence Okoye	LOAD FACTOR DESIGN	LIVE LOADING: HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD
DETAILS	A. Lovato/Ed Tapanta	CHECKED Lawrence Okoye	LAYOUT	Ariel Reyes — CHECKED Lawrence Okoye
QUANTITIES	Tim Grouteert	CHECKED Lawrence Okoye	SPECIFICATIONS	Ruth Fernandez — CLASS 1 SPEC CHANGES

DESIGN ENGINEER

STRUCTURES DESIGN GENERAL PLAN SHEET (REVISED 10-1-97)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 10

CU 08
EA 452001

BRIDGE NO. 56-0082L
KILOMETER POST R62.135

BOX SPRINGS OVERHEAD (WIDEN)

GENERAL PLAN

DISREGARD PRINTS BEARING EARLIER REVISION DATES

SHEET 1 OF 14

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	Riv	215.60	R61.8/66.8, R15.5/23.0	238	261

REGISTERED ENGINEER - CIVIL 5-8-99

4-17-00

PLANS APPROVAL DATE

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INDEX TO PLANS

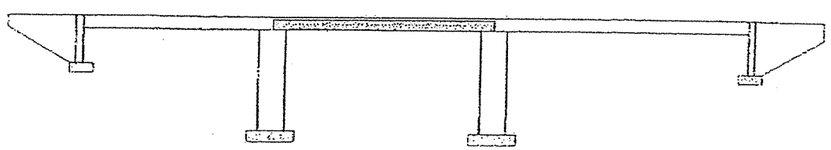
SHEET NO.	TITLE
1	GENERAL PLAN
2	INDEX TO PLANS
3	FOUNDATION PLAN
4	ABUTMENT LAYOUT
5	ABUTMENT DETAILS
6	BENT LAYOUT
7	BENT DETAILS
8	TYPICAL SECTION
9	GIRDER LAYOUT
10	GIRDER REINFORCEMENT
11	PRESTRESSED GIRDER
12	SLOPE PAVING-FULL SLOPE
13	STRUCTURE DRAINAGE DETAILS
14	LOG OF TEST BORING

STANDARD PLANS DATED JULY 1997

A62-C	LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL-BRIDGE
B0-1	BRIDGE DETAILS
B0-5	BRIDGE DETAILS
B6-1	T-BEAM DETAILS
B6-21	JOINT SEALS (MAX. MOVEMENT RATING=50)
B8-53	CONCRETE BARRIER TYPE 25

STANDARD PLAN SHEET NO.

DETAIL NO.



Structural concrete, Bridge footing (25 MPa @ 28 days)

Structural concrete, Bridge (28 MPa @ 28 days)

indicates PC/PS concrete

CONCRETE STRENGTH AND TYPE LIMITS

GENERAL NOTES
LOAD FACTOR DESIGN

DESIGN: BRIDGE DESIGN SPECIFICATIONS (1983) AASHTO with Interims and Revisions by CALTRANS)

DEAD LOAD: Includes 1675 Pc for future wearing surface.

LIVE LOADING: HS20-44 and alternative and permit design load.

SEISMIC LOADING: Peak Rock Acceleration=0.5 g
ATC-32 ARS Curve (R3=5, Soil Profile C)

REINFORCED CONCRETE: fy = 414 MPa
f'c = 28 MPa
n = 6
Transverse Deck Slabs (Working Stress Design)
fs = 138 MPa
fc = 8 MPa
n = 10

PRESTRESSED CONCRETE: See "Prestressing Notes"

STRUCTURAL STEEL: fy = 250 MPa

FOOTING PRESSURE:	ALLOWABLE	DESIGN
ABUTMENTS:	195 kPa	145 kPa
BENTS:	479 kPa	450 kPa

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN	Arlai Reyes	Lawrence Okoye
DETAILS	Ed D. Tapale 9/98	Lawrence Okoye
QUANTITIES	Jim Greuterl	Lawrence Okoye

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 10

CU 08
EA 453001

BRIDGE NO. 56-0082L
ALIGNMENT POST R62.135

BOX SPRINGS OVERHEAD (WIDEN)

INDEX TO PLANS

DISCARD PRINTS BEARING EARLIER REVISION DATES

SHEET 2 OF 261

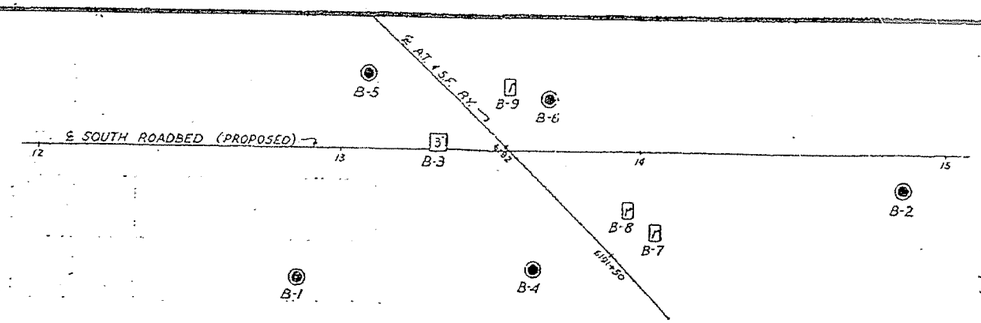
STRUCTURES DESIGN DETAIL SHEET (REVISED REV. 1/29/97)

STATE	FEDERAL AID PROJECT NO.	FISCAL YEARS	SHEET NO.	TOTAL SHEETS
CAL.				

DIST.	COUNTY	ROUTE	POST MILE	SHEET NO.	TOTAL SHEETS
VIII	RIV.	395	21.7/21.71	B3	205

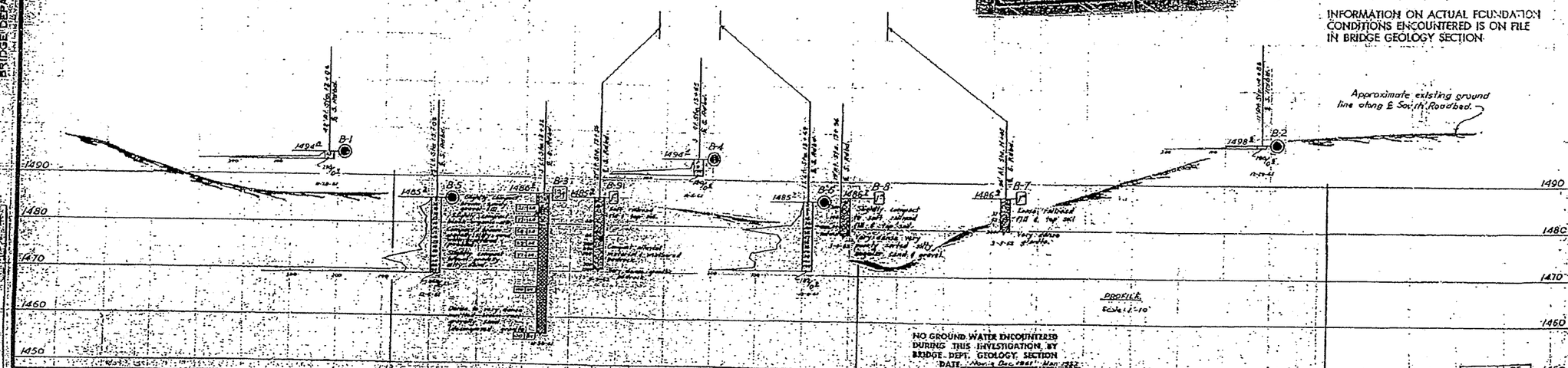
August 2 1962

BENCH MARK # 2-A-54
Chiseled "X" on Bridge Walk 30' Lt Sta. 11+44 "C" Line.
ELEV. 1508.29



AS BUILT PLANS

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 Nov. & Dec. 1961 - Mar. 1962

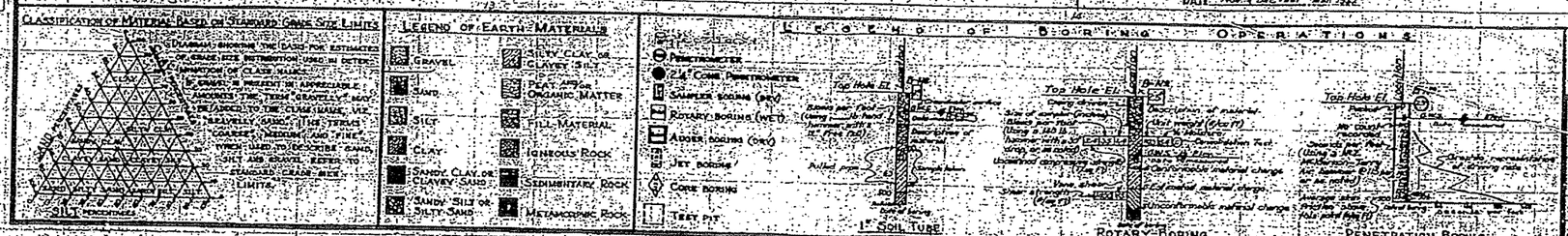
BRIDGE DEPARTMENT

SHEET	OF
8	8

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRAIN SIZE LIMITS

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

LEGEND OF BORING OPERATIONS: PENETROMETER, 2½" CORE PENETROMETER, SAMPLER BORING (PRV), ROTARY BORING (WET), AUGER BORING (DRY), JET BORING, CORE BORING, TEST PIT



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.

BOX SPRINGS OVERHEAD

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 56-82 R. | FILE | DRAWING 5682-10

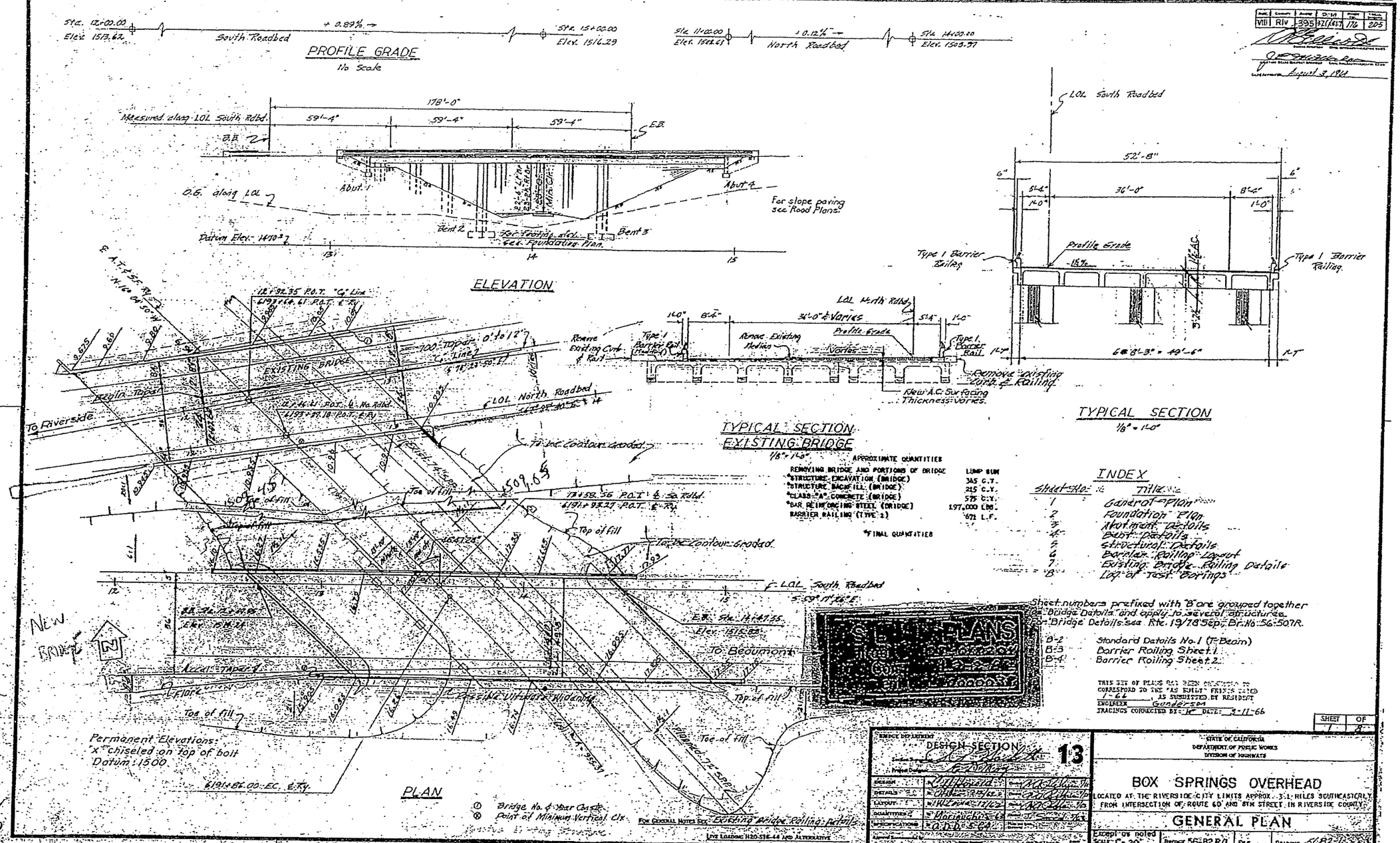
PREL. DRAWING NO. P-5442-8

183

FED. ROAD DIST. NO.	STATE	F.A. PROJECT NO.	REGIST. NO.	CONTRACT NO.
7	CALIF.			

DIST.	COUNTY	ROUTE	POST MILE	SHEET NO.	TOTAL SHEETS
VIII	Riv	395	27.6/41.7	176	205

11-057-2(3) E-057-2(4)



APPROXIMATE QUANTITIES

REMOVING BRIDGE AND PORTIONS OF BRIDGE	LUMP SUM
*STRUCTURE EXCAVATION (BRIDGE)	345 C.Y.
*STRUCTURE BACKFILL (BRIDGE)	215 C.Y.
*CLASS "A" CONCRETE (BRIDGE)	575 C.Y.
*BAR REINFORCING STEEL (BRIDGE)	197,000 LBS.
BARRIER RAILING (TYPE 2)	671 L.F.

*FINAL QUANTITIES

INDEX

Sheet No.	Title
1	General Plan
2	Foundation Plan
3	Abutment Details
4	Bent Details
5	Structural Details
6	Barrier Railing Layout
7	Existing Bridge Railing Details
8	Log of Test Borings

Sheet numbers prefixed with "B" are grouped together as "Bridge Details" and apply to several structures.
"Bridge Details" see Rte. 19/78 Sep. Br. No. 56-507R.

B-2	Standard Details No. 1 (T-Beam)
B-3	Barrier Railing Sheet 1
B-4	Barrier Railing Sheet 2

AS BUILT PLANS
Contract No. 56-82R
Contractor
Date

THIS SET OF PLANS HAS BEEN CHANGED TO CORRESPOND TO THE "AS BUILT" PRINTS DATED 1-66, AS SUBMITTED BY RESIDENT ENGINEER Gunderson
TRACINGS CORRECTED BY: W DATE: 3-11-66

SHEET 1 OF 8

BRIDGE DEPARTMENT
DESIGN SECTION 13
Chief Bridge Engineer
Project Engineer
DESIGN
DETAILS
LAYOUT
QUANTITIES
SPECIFICATIONS

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

BOX SPRINGS OVERHEAD

LOCATED AT THE RIVERSIDE CITY LIMITS APPROX. 3.1 MILES SOUTHEASTERLY FROM INTERSECTION OF ROUTE 60 AND 8TH STREET IN RIVERSIDE COUNTY

GENERAL PLAN

Except as noted SCALE 1" = 20'
BRIDGE 56-82 R/L
FILE
DRAWING 5682-1

P-3682-1

176

12.15

23

County	Route	Section	P.M.	Sheet	Total Sheets
VIII RIV.	395	31/40	17.7	2/4	

August 5, 1966

12+32.35 P.O.T. 'C4' Line
6193+64.61 POT ℄ Ry
N 39,366.417
E 16,347.741

11+15.30 E.C. 'C4' Line
N 39,405.687
E 16,237.473

EXIST BRIDGE NO. 5682

'C4' LINE
S 70° 23' 50" E

LOL NORTH ROADBED

S 67° 37' 40" E

LOL. SOUTH ROADBED

S 59° 17' 26" E

Wood Guard Rail
Exist Edge Shld.
Exist 9" Drains
Exist Curb
PMS Shld.
P.C.C. Rdwy.
Dirt
Concrete

N 39,203.074
E 16,206.348
10+86.09 EC ℄ No Rdbd

N 39,341.977
E 16,354.785
12+46.61 POT ℄ No Rdbd
6193+39.18 POT ℄ Ry

N 39,201.777
E 16,395.200
13+58.56 POT ℄ So Rdbd
6191+93.27 POT ℄ Ry

N 39,194.957
E 16,397.213
6191+86.00 EC ℄ Ry

A.T.E. SF Ry
R = 955.37
Δ = 16° 01' 00"
N 38,930.168
E 15,479.224

AS BUILT PLANS
Contract No. 08-0K520
Date Completed 2-12-66
Document No. RIV 395 P.M. 31.4

UTILITIES

① TP 10 Wires @ Elev. 1502 N-S
② TP 10 Wires @ Elev. 1507 N-S
③ TP 10 Wires @ Elev. 1509 N-W
④ TP# 496249
1 Cable @ Elev. 1526
1 Wire @ Elev. 1529 N-S

Note: indicate bottom of footing elevations

EXIST RAIL GRADES

Station	Elevation Rt. Rail	Elevation Lt. Rail
6191+00	1488.85	1488.67
+25	1488.32	1488.15
+50	1487.79	1487.61
+75	1487.20	1487.06
6192+00	1486.58	1486.53
+25	1485.99	1485.97
+50	1485.42	1485.41
+75	1484.89	1484.89
6193+00	1484.30	1484.31
+25	1483.76	1483.77
+50	1483.25	1483.23

BENCH MARKS

B.M. 2-A-54 Elev. 1508.29
Chisled X on Bridge Walk 30' Lt. Sta. 16+44 C4 Line

B.M. 2-B Elev. 1501.16
Pin in R/W Mon. 135' Lt. Sta. 13+52 C4 Line

THIS SET OF PLANS HAS BEEN CORRECTED TO REFLECT "AS BUILT" CONDITIONS AS SUPERVISED BY CSSY CPI

ENGINEER
TRACINGS CORRECTED BY: DATE:

CUSTOMS CHECKED & VERIFIED IN FIELD
DATE: 6-6-66
BY: J. S. B.

DESIGN SECTION

DESIGN: R. Lundquist
DETAILS: R. Lubic
QUANTITIES: N. Nuzzo

DRAWN BY: H. Hurtado
CHECKED BY: F. J. Hyder

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

BOX SPRINGS OVERHEAD

FOUNDATION PLAN

SCALE: 1" = 20'
STRUCTURE: 56-62 R/L
FILE:
DRAWING: 5282

SHEET 1 OF 8

	NORTH	EAST
A 187 + 94.390 B.C. ℄ SRB 215	697918.9492	1903004.3649
B 186 + 29.671 P.O.T. ℄ SRB 215 11 + 83.535 P.O.T. ℄ AT&SF RR	697826.4440	1903145.320
C 184 + 46.326 P.O.T. ℄ SRB 215 And. 3.657m Rt. 184 + 46.126 P.O.T. ℄ WRB 215 Bk.	697734.2075	1903301.8995

	NORTH	EAST
A 12 + 49.041 E.C. ℄ Rdwy "B"	697927.9574	1902985.0504
B 14 + 34.734 P.O.T. ℄ Rdwy "B" 11 + 78.200 P.O.T. ℄ BNSF RR	697831.4883	1903143.1248
C 14 + 77.474 B.C. ℄ Rdwy "B"	697809.2878	1903150.2403
D 17 + 09.181 E.C. ℄ Rdwy "B"	697693.5469	1903380.9460
E 11 + 39.122 P.O.T. ℄ BNSF RR	697865.4474	1903133.2844
F 11 + 86.339 B.C. ℄ BNSF RR	697823.5465	1903145.8993
G 12 + 55.436 E.C. ℄ BNSF RR	697755.4941	1903156.2359

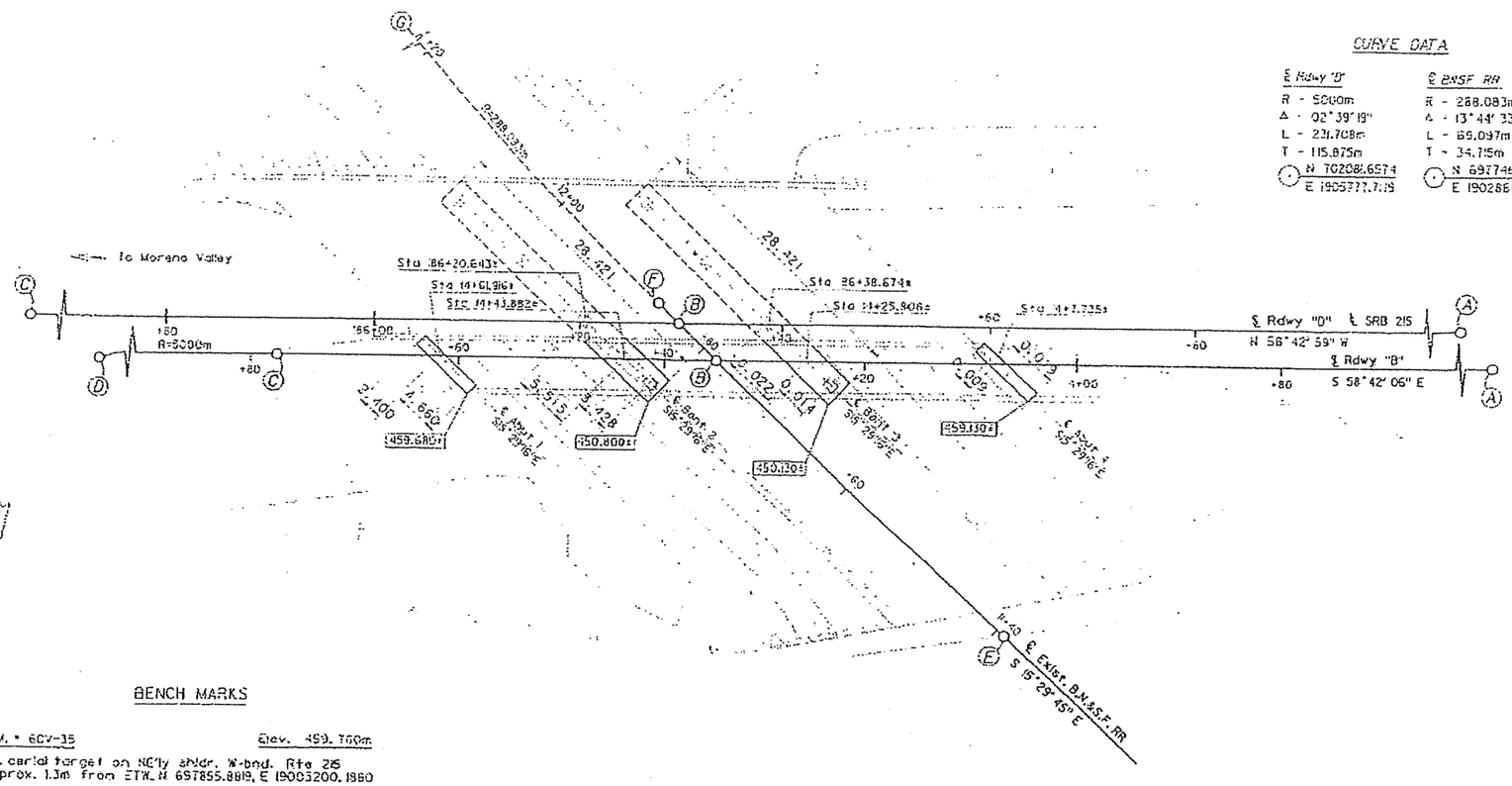
Caltrans Metric

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	Riv	215.60	R61.8/R66.8, R79.5/R83.8	238	281

REGISTERED ENGINEER - CIVIL 5-4-99

4-17-00
PLANS APPROVAL DATE

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



CURVE DATA

℄ Rdwy "B"	℄ BNSF RR
R - 5000m	R - 288.083m
Δ - 02° 39' 19"	Δ - 13° 44' 33"
L - 231.708m	L - 69.097m
T - 115.875m	T - 34.715m
N 702088.6574 E 1905777.7119	N 697746.7882 E 1902868.2771

BENCH MARKS

B.M. * 6CV-35 — Elev. 459.760m

Fd. cardal target on NE'ly shldr. W-bnd. Rte 215 approx. 1.3m from ETW. N 697855.8819, E 1900320.1860

B.M. * 303! — Elev. 459.599m

Fd. 51mm brass disk in 51mm stamped "Calif. Dept of Transportation" IBV 215-38.67 1990", NE cor. W-bnd Rte 215 bridge over AT&SF RR track. N 697880.7696, E 1903144.1431

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

NOTES

+ denotes spot elevation.
* denotes top of rail grade elevation below structure.
indicates bottom of footing elevation. plus/minus indicates adjustments to achieve minimum 0.90m ground cover.

Datum: NGVD 29, Adj. 1960.
Underground utilities as shown are approx.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

PRELIMINARY INVESTIGATION SECTION

SCALE	HORZ. DATUM	PHOTOGRAMMETRY AS OF:	DRAWN	W. HEDBLUM 2/90
1:250	VERT. DATUM	SURVEYED	TRACED	
ALIGNMENT DATE		FIELD CHECKED L. MANARO 1/98	CHECKED L. MANARO 3/98	

STRUCTURES FOUNDATION PLAN SHEET (DETAIL) (REV. 5/5/97)

DESIGN	Jalal Rayes	Lawrence Okaya
DETAILS	Ed D. Tepoa 9/98	Lawrence Okaya
QUANTITIES	Tim Greutert	Lawrence Okaya

ORIGINAL SCALE IN MILLIMETERS FOR MODIFIED TRACE 0 10 20 30 40 50 60 70 80 90 100

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

CU 08
EA 453001

UNIT NO. 56-0062L
KILOMETER POST R62.145

BOX SPRINGS OVERHEAD (WIDEN)
FOUNDATION PLAN

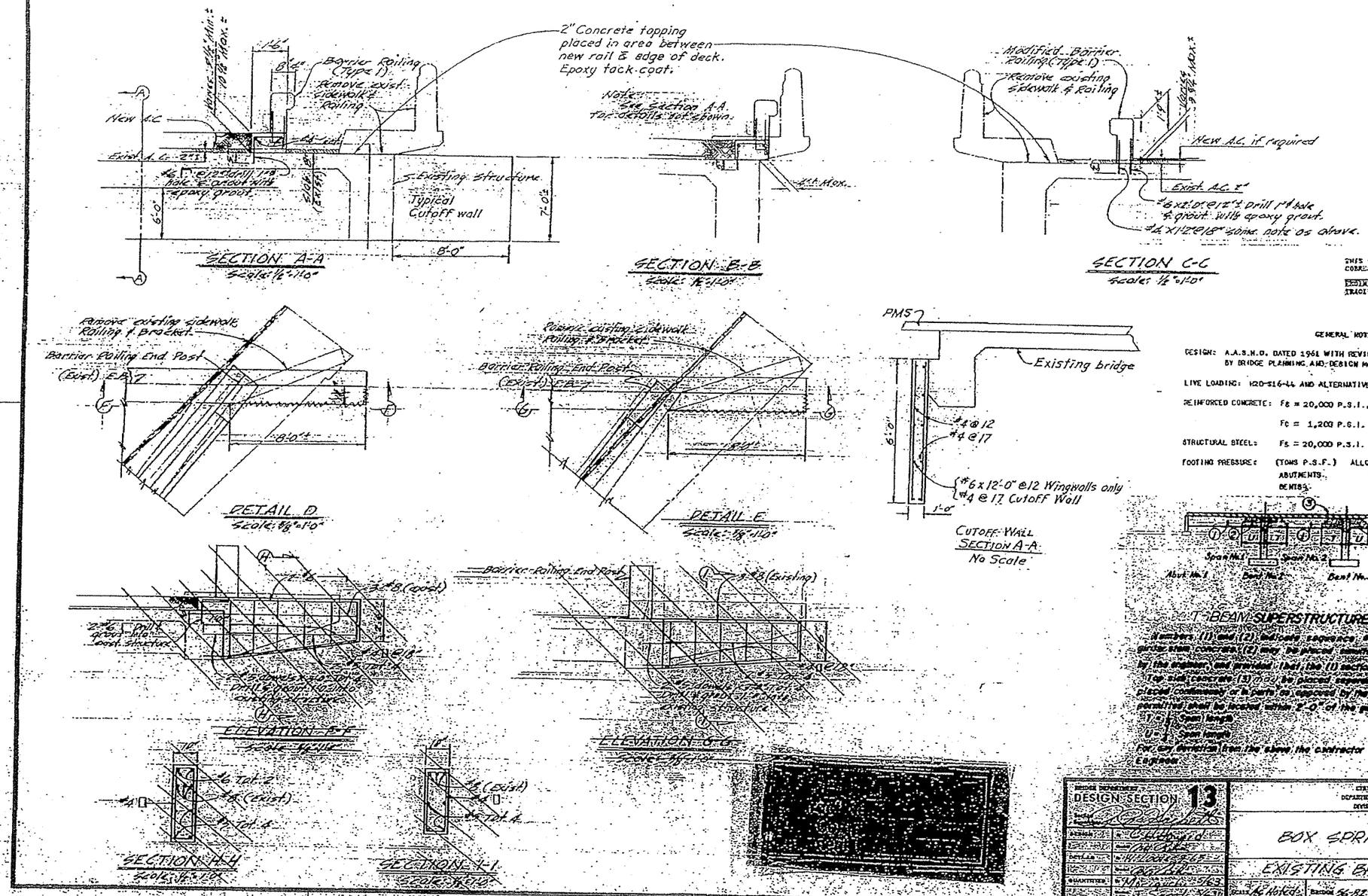
DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRE-PRIMARY STAGE ONLY) | SHEET 3 OF 34

FED. ROAD DIST. NO.	STATE	F.A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

Bridge	Structure	Sheet	P.M.	Project No.	Sheet No.
12/14	14-A	395	32.1/41.7	182	205

August 3, 1964



THIS SET OF PLANS DO NOT CORRESPOND TO THE AS SUBMITTED BY RESIDENT ENGINEER
DRAWINGS CORRECTED BY: DATE:

GENERAL NOTES

DESIGN: A.A.S.H.O. DATED 1961 WITH REVISIONS AND AS SUPPLEMENTED BY BRIDGE PLANNING AND DESIGN MANUAL.

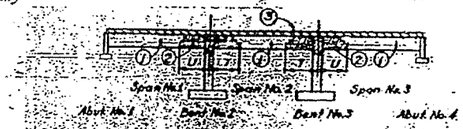
LIVE LOADING: H20-S16-44 AND ALTERNATIVE

REINFORCED CONCRETE: Fs = 20,000 P.S.I., N = 10

Fc = 1,200 P.S.I.

STRUCTURAL STEEL: Fs = 20,000 P.S.I.

FOOTING PRESSURE:	(TONS P.S.F.)	ALLOWABLE	DESIGN
	ABUTMENTS	2	1 1/2
	BENTS	6	4 1/2



T-BEAM SUPERSTRUCTURE PLACING DIAGRAM

Numbers (1) and (2) indicate sequence of placing girder stem concrete. (2) may be placed simultaneously with (1) when approved by the engineer, and provided that the (1) sections are placed in adjacent spans. Top slab concrete (3) may be placed separately from (1) and (2). (3) may be placed continuously or in parts as approved by the engineer, however the only joints permitted shall be located within 2'-0" of the center joints between (1) and (2)

T - ¼ Span length
U - ¼ Span length

For any deviation from the above the contractor shall submit a diagram to the Engineer.

SHEET	OF
7	8

BRIDGE DEPARTMENT
DESIGN SECTION 13

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

BOX SPRINGS OVERHEAD

EXISTING BRIDGE RAILING DETAILS

SCALE As Noted | BRIDGE 56-82 TL | TITLE: | DRAWING SLBR-1

182

APPENDIX E

RESPONSE TO CALTRANS REVIEW COMMENTS

OSFP Review Comment & Response Form

General Project Information	Review Phase		Reviewer Information
Dist: 08 EA: 449311 08-RIV- 215 / 60 KP 61.7/62.6, 19.4/21.5 215/60 E. Junction Improv. Proj. OSFP Liaison: Robert Zezoff Phone: 916-227-8892 e-mail: Robert Zezoff@dot.ca.gov	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. 1) ☐ APS/PR (Review No. 2) ☐ Type Selection	☐ 65% PS&E Unchecked Details ☐ PS&E (Review No. _) ☐ Construction Support ☐ Other: FR Review	Reviewer Names: Farzad Qmehr & Asef Wardak Functional Unit: Geotech. Design South-2 Phone Number: 227-4519 & 227-1219 e-mail: Farzad Qmehr@dot.ca.gov & Asef Wardak@dot.ca.gov Date of Review: 3/17/09
	Structure Information (Use when necessary to document comments by individual structure) Structure Name: Box Springs OH Left (Widen) Br No: Br. 56-0082L		

Consultant Information (to be filled in by Consultant)

Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date

#	Doc. See Note 1	Section #	Section Name	Review Comments	Consultant Responses	✓
1 fq	FR	N/A	Cover sheet	KP is shown as R38.6. This number seems to reflect the PM, not the KP.		
2 fq	FR	N/A	Cover sheet	Showing project limits in KP, indicates this project is using a metric exception. To help the reader, it would be helpful to include info & approval regarding this issue in the report.		
3 fq	FR	N/A	N/A	The report format includes some variations from the format provided in Caltrans' 'Guidelines for Structures Foundation Reports' (GSFR) dated March 20063. Following that format may allow for easier verification that all subjects/issues have been properly considered.		
4 fq	FR	1.2	Project Description	2nd Paragraph (1St Sentence): Suggest identifying the other bridge, and considering the relocation of the sentence.		
5 fq	FR	5.1	Earth Materials	Section 5.1.1 references the depths and sections 5.1.2 & 5.1.3 refer to elevations. To help the reader to get a clear picture of the subsurface, it would be nice to show both.		
6 fq	FR	5.1.3	Granitic Bedrock	Last sentence mentions that the rock becomes less weathered with depth. Can you please elaborate / be more specific.		

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	PFR= Preliminary Foundation Report

✓= Comment Resolved (for Reviewer's use)

7 fq	FR	6.1.2	Seismic Shaking	Last paragraph refers to soil type C. Since your borings identify the density of some of the soil as loose to medium dens, please elaborate on your reasons for reaching this conclusion in the report.		
8 fq	FR	6.2.2	Allowable Bearing Pressure	Table 2 refers to WSD & LFD. Is the LRFD procedure being used or do you have an exception to use other methods? Please specify in the report. Also the info provided in the report and attached plans do not seem to conform to the ASSHTO & Caltrans procedures for LRFD.		
9 fq	FR	Plates 4a-4d	LOTB Sheets	Some of the Legend sheets refer to the Soil & Rock Logging, Classification, and Presentation Manual (SRLCPM) dated June 2007. However The LOTB sheets seem to include numerous deviations from the 6/07 Manual, and a few errors. Some of the many examples include soil and rock descriptors (i.e.- rock recovery and RQD), borehole ID, hammer efficiency, notes, vertical datum, nearest cities, data that is not described in the legend, … etc. Please perform a thorough quality control. Please also refer to comment #2 from Caltrans' dated 2/16/09. The response states that the report will be revised accordingly. This is not reflected in the re-submitted report.		
10 fq	FR	Apndx A	Field Exploration	Units on the Scale (Plate 5): Response to Caltrans' 2/16/09 comment #3, states that the report is revised accordingly. This does not seem to be the case for the FR copy under review.		

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	PFR= Preliminary Foundation Report

✓= Comment Resolved (for Reviewer's use)

EXCEPTION REQUEST TO CONTINUE THE USE OF METRIC UNITS

Date: 11/29/06
District Co. Rte. 08/RIV/215, PM (38.3 / 38.9), **EA**: 44931
Program Code: HE11
Program Document and Year : PSR signed 6/12/1997, PE/ED Sept 2001
Location: ON RTE 215 FR N/O EUCALYPTUS AVE IC TO S/O BOX SPRINGS RD IC & ON RTE 60 FR 60/215 JCT TO W/O DAY ST. IC
Work Description: Construction of HOV connectors to close the gap between the existing HOV lanes and the ones built as part of the design sequence project (EA 33484).
PA&ED Complete? Yes
PS&E _20_% Compete
Scheduled PS&E Delivery to HQ OE: RCTC may perform AAA **
Proposed Advertisement Date : 01/2008
Construction. Cost Estimate: $30.5 Million
Project Manager: Nader Naguib **Phone**: (909) 388-7180
Project Engineer: Tuan A Truong **Phone**: (909) 383- 4006

Current Project Status / Progress to Date on Project:
On 10/01/2006 RCTC hired LAN engineering to prepare FINAL DESIGN.
Project 33484 (STIP Design Sequence) Segmented off this project (449311) during its final design due to funding constraints. Funding for the segmented work is now available from RCTC. We are currently using the same Metric topo map from project 33484 which is under construction. This project which is under design must be compatible with: 1) existing pavement. 2) the project currently under construction. 3) Ultimate configuration for interchange. Two metric GAD's prepared by Caltrans are being used for the current design. These 2 GAD's cover the current project and the Ultimate design at this interchange.

Reason for Request:
This project is being designed while project 33484 (A design Sequencing project) is being constructed. Numerous changes in the design are happening during construction. This project (449311) will start construction right after 33484 is completed with construction. There are no "As-Builts" which show what "exists". It was agreed that the 33484 Bid Documents will be used to show conditions which will exist when completed. In order for that to happen we must use the original topo modified with the roadway features currently being constructed. If a new English topo were flown today, it would not reflect what will be constructed over the next year. Because the design of the HOV lanes here are tightly woven through this interchange, keeping its design in metric will allow us to use the same station lines being used for the current project, facilitate faster reviews to ensure an accurate fit with the other project improvements, eliminate errors and schedule delays, reduce cost and provide a higher quality project.

Justification for Extension Request:
Cost to Convert to USCU: $250,000.00
Schedule Delay to convert to USCU: 5 Months

Requested By: Approved By:

Patricia Romo 12/1/06 — 1-17-07

Patricia Romo — Date
Deputy District Director
Design/Engineering Services

Kevin Herritt
Chief, Office of Geometric Design Standards
Division of Design

FINAL
STRUCTURE FOUNDATION REPORT
BOX SPRINGS ROAD OVERHEAD (REPLACE)
BRIDGE NO. 56C0566
INTERSTATE 215/STATE ROUTE 60
EAST JUNCTION IMPROVEMENTS
CITY OF RIVERSIDE, CALIFORNIA
08-RIV-215/60, KP 61.7/62.6, 19.4/21.5
CALTRANS EA NO. 08-449311

Prepared for:

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER WEST, INC.
1220 Research Drive, Suite B
Redlands, CA 92374

Kleinfelder Project No. 76979

Revised June 12, 2009
December 22, 2008

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APPROVAL LETTER

State of California | Business, Transportation and Housing Agency

Flex your power!
Be energy efficient!

Memorandum

To: Mr. Denix D. Anbiah
Department of Transportation
Division of Engineering Services
Office of Special Funded Projects MS #9- 2/7G

Date: October 13, 2009

File: EA 08-449311
08-RIV-56C-0056
(Replace)

Attention: Robert Zezoff

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES - MS #5
OFFICE OF GEOTECHNICAL DESIGN SOUTH-2

Subject: Caltrans OSFP Review Comments

References: Addendum Report No 2, Final Structure Foundation Report (dated June 12, 2009), Box Springs Road Overhead (Replace), Bridge No. 56C-0056, Interstate 215/State Route 60 East Junction Improvements, City of Riverside, California, 08-Riv-215/60, KP 61.7/62.6, 19.4/21.5, Caltrans EA No. 08-449311, dated October 1, 2009, by Kleinfelder West, Inc., Project No. 76979.

The submitted Addendum and Foundation Report by Kleinfelder West, Inc. for the referenced project generally satisfy the requirements of Caltrans' Foundation/Geotechnical Design Report Guidelines and is accepted.

Any questions regarding the review comments and recommendations should be directed to the attention of K. Douglas Cook (916) 227-4514 or Angel Perez-Cobo (916) 227-7167, Office of Geotechnical Design South-2 A.

Prepared by:

K. Douglas Cook, CEG date: 10-13-09
Engineering Geologist

Reviewed by:

Angel Perez-Cobo, PE date: 10/13/09
Senior Transportation Engineer
Office of Geotechnical Design South-2

KDC

Distribution: (2) Addressee

ADDENDUM No. 2

1220 Research Drive
Suite B
Redlands, CA 92374
p| 909.793.2691
f| 909.792.1704
kleinfelder.com

October 1, 2009
Project No. 76979

Mr. Norman Suydam, PE
AECOM LAN
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

via Electronic Mail
Mohan.Char@aecom.com
Kimberly.Gee@aecom.com

Subject: Addendum Report No. 2
Final Structure Foundation Report (Dated June 12, 2009)
Box Springs Road Overhead (Replace)
Bridge No. 56C-0056
Interstate 215/State Route 60 East Junction
City of Riverside, California
08-Riv-215/60, KP 61.7/62.6, 19.4/21.5
Caltrans EA No. 449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) has prepared this addendum report to respond to review comment by the California Department of Transportation (Caltrans) Office of Geotechnical Design South-2 on our Final Structure Foundation Report, dated June 12, 2009, for Box Springs Road Overhead (Replace), and Addendum Report, dated August 19, 2009. The latest Caltrans review comment and our response are presented in this letter.

Caltrans Comment. *As previously commented upon in the prior review, Caltrans specifications require using cohesionless soils for structure backfill. Therefore, cohesion value should not be used in our analyses. If there is a reason to use cohesive soils, please explain and provide a recommendation that during construction the soil materials used shall be sampled and tested to verify that suitable materials consistent with the stability analysis are used at the site.*

Response to Caltrans Comment. Based on our slope stability calculations, the values of 34 degrees for soil friction angle and 4.8 kPa for cohesion are the minimum shear strength parameters required for the new abutment fill to satisfy the minimum factors of safety of 1.5 for static condition and 1.1 for pseudostatic condition. We recommend that the proposed abutment fill materials be sampled and tested for direct shear test before construction of proposed abutment foundations to verify if the minimum required strength parameters were satisfied. We recommend that this minimum strength

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requirement for the abutment fill be included in the Special Provisions specifications for the project.

CLOSURE

The information contained in this report/letter is subject to the conditions and limitations contained within the structure foundation report. We appreciate the opportunity to be of service on this project. If you have any questions, comments or require additional information, please do not hesitate to contact our office at your convenience.

Sincerely yours,

KLEINFELDER WEST, INC.

Madan Chirumalla, PE
Staff Engineer

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

MC/CVA:lg

Attachments: Caltrans Review Comments (Dated September 17, 2009)

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State of California | Business, Transportation and Housing Agency

Flex your power!
Be energy efficient!

Memorandum

To: Mr. Denix D. Anbiah
Department of Transportation
Division of Engineering Services
Office of Special Funded Projects MS #9- 2/7G

Date: September 17, 2009

File: EA 08-449311
08-RIV-56C-0056
(Replace)

Attention: Robert Zezoff

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES - MS #5
OFFICE OF GEOTECHNICAL DESIGN SOUTH-2

Subject: Caltrans OSFP Review Comments

References: Addendum to Structure Foundation Report (dated June 12, 2009), Box Springs Road Overhead (Replace), Bridge No. 56C-0056, Interstate 215/State Route 60 East Junction Improvements, City of Riverside, California, 08-Riv-215/60, KP 61.7/62.6, 19.4/21.5, Caltrans EA No. 08-449311, dated August 19, 2009, by Kleinfelder West, Inc., Project No. 76979.

The submitted Addendum to the Structure Foundation Report by Kleinfelder West, Inc. for the above-proposed project was found to generally satisfy, with comment, the requirements of Caltrans' Structure Foundation Report Guidelines, based upon the responses to the review comments (dated July 16, 2009). As previously commented upon in the prior review, Caltrans specifications require using cohesionless soils for structure backfill. Therefore, cohesion value should not be used in your analyses. If there is a reason to use cohesive soils, please explain and provide a recommendation that during construction the soils materials used shall be sampled and tested to verify that a suitable materials consistent with the stability analysis are used at the site.

Any questions regarding the review comments and recommendations should be directed to the attention of K. Douglas Cook (916) 227-4514 or Angel Perez-Cobo (916) 227-7167, Office of Geotechnical Design South-2 A.

Prepared by:

K. Douglas Cook

K. Douglas Cook , CEG date: 9-17-09
Engineering Geologist

Reviewed by:

Angel Perez-Cobo, PE date: 9-17-09
Senior Transportation Engineer
Office of Geotechnical Design South-2

KDC/AW

Distribution: (2) Addressee

ADDENDUM

1220 Research Drive
Suite B
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p| 909.793.2691
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kleinfelder.com

August 19, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

via Electronic Mail
Mohan.Char@lanengineering.com
Kimberly.Gee@lanengineering.com

Subject: Addendum to Final Structure Foundation Report (Dated June 12, 2009) Box Springs Road Overhead (Replace) Bridge No. 56C-0056 Interstate 215/State Route 60 East Junction City of Riverside, California 08-Riv-215/60, KP 61.7/62.6, 19.4/21.5 Caltrans EA No. 449311

Dear Mr. Suydam:

Kleinfelder has prepared this addendum report in response to comments provided by the California Department of Transportation (Caltrans), Division of Engineering Services, Geotechnical Services- MS #5, Office of Geotechnical Design South-2, pertaining to their review of our report entitled Final Structure Foundation Report, Box Springs Road Overhead (Replace), Bridge No. 56C-0056, Interstate 215/State Route 60 East Junction, City of Riverside, California, dated June 12, 2009. The Caltrans review comments and our responses to these comments are attached.

CLOSURE

The information contained in this report/letter is subject to the conditions and limitations contained within the structure foundation report. We appreciate the opportunity to be of service on this project. If you have any questions, comments or require additional information, please do not hesitate to contact our office at your convenience.

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KLEINFELDER
Bright People. Right Solutions.

Respectfully submitted,
KLEINFELDER WEST, INC.

Madan Chirumalla, PE
Staff Engineer

REGISTERED PROFESSIONAL ENGINEER
MADAN CHIRUMALLA, PE
No. 74186
Exp. 6/30/2011
CIVIL
STATE OF CALIFORNIA

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

for: Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

PROFESSIONAL GEOLOGIST
MICHAEL O. COOK
CEG #1716
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

MC/CVA:lg

Attachments: Response to Comments Form
Revised Log of Test Boring (LOTB) Sheets
Revised Slope Stability Analysis

REGISTERED PROFESSIONAL ENGINEER
CARLOS V. AMANTE
No 2724
Exp 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

Project Name: **I-215/SR-60 East Junction**
08-RIV-215/60 CU08 -EA449311
Review Phase: **Foundation Report Review**
Box Springs Road OH (Replace) Bridge No 56C-0056
Responses by: Carlos Amante/ Madan Chirumalla

RESPONSE TO COMMENTS ON FINAL STRUCTURE FOUNDATION REPORT – BOX SPRINGS ROAD OH (REPLACE)

Comment No.	Sheet No.	Plan Comments by AnhDan Le	Response
1	All Report	The date of original SFR is written as December 22, 2009. Please revise it accordingly.	We agree. The date of original SFR was supposed to be December 22, 2008.
2	Plate 4D	The way of presenting SPT blow counts on LOTB is incorrect. The value recorded for the first 6" of advance is usually discarded. The second and third sets of numbers are then combined and reported as a single value for the last 12 inches (1 foot = 305 mm). Therefore, the blow counts reported should be for the last 305 mm driving penetration.	Kleinfelder will comply. Plate 4d, LOTB sheet, is revised as shown in this addendum letter.
3	Appendix A	The hammer efficiency was not mentioned in the Boring records. Some numbers SPT blow counts in Boring Records do not match with those in LOTB (Plate 4D).	"ER_i" below the bottom of every boring in Plate 4d, LOTB sheet, indicates hammer energy ratio. The value is represented in percentage as per Caltrans Soil & Rock Logging Manual, 2007. Also, the typos in SPT blow counts have been corrected.
4	Page 14	In the slope stability analysis, assumption of footing pressure of 149 kPa was used. Please justify the assumption since there are actual numbers that can be used for analyses.	The footing pressure values provided by LAN Engineering for Abutment 1 is 173 kPa at the heel and 125 kPa at the toe. We used the average of these pressures (that is 149 kPa) for our analysis, which is reasonable.
5	Page 14	In the slope stability analysis, what is the reason of selecting friction angle of 32 degree and cohesion of 9.6 kPa? Several other combinations can be selected as well. If that is the only available combination, where is the specification of backfill materials that make it meet the requirement of 9.6 kPa cohesion? It should be noted that for structure backfill, Caltrans specifications requires to use cohesionless soils. Please follow Caltrans specification.	Based on our revised analysis, the values of 34 degrees for friction angle and cohesion of 4.8 kPa are the minimum shear strength parameters for the new compacted fill to achieve the minimum required factors of safety of 1.5 for static condition and 1.1 for pseudostatic condition as mentioned in our report (see attached calculations). We recommend that the backfill materials used for the new approach embankments satisfy these minimum soil strength requirements.

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

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	---		

Carlos V Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVALDATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — 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.

RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

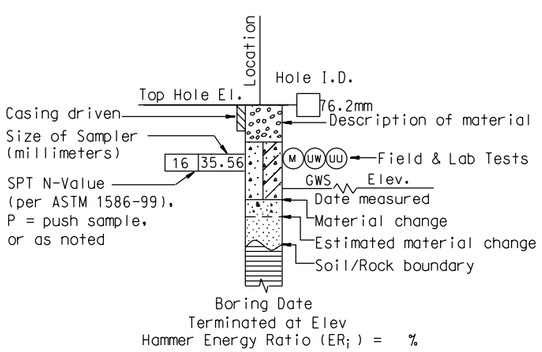
BOREHOLE IDENTIFICATION

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 (25.4mm soil tube) Hand Auger
	D	Dynamic Cone Penetration Boring
	CPT	Cone Penetration Test (ASTM D 5778-95)
	O	Other

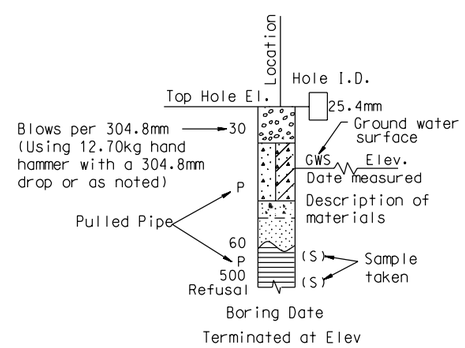
Note: Size in millimeters.

PLASTICITY OF FINE-GRAINED SOILS

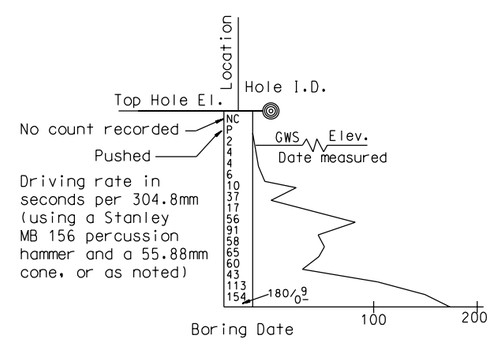
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



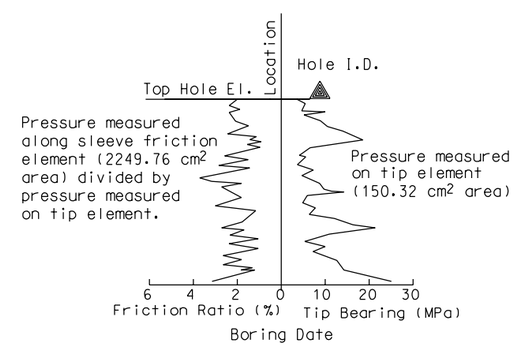
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

C. AMANTE
DESIGN OVERSIGHT
05/05/09
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY M. CHIRUMALLA

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56C-0056
KILOMETER POST R62.2

BOX SPRINGS ROAD OH (REPLACE)

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 12/17/08 05/05/09

SHEET 1 OF 4

FILE •) $REQUEST

USERNAME •)$USER DATE PLOTTED •) $DATE TIME PLOTTED •) $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	---		

Caltrans Metric

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8mm)
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		> 304.8mm
Cobble		76.2mm to 304.8mm
Gravel	Coarse	19.05mm to 76.2mm
	Fine	No. 4 to 19.05mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

C. AMANTE
DESIGN OVERSIGHT
05/05/09
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY M. CHIRUMALLA

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56C-0056
KILOMETER POST R62.2

BOX SPRINGS ROAD OH (REPLACE)

SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 12/17/08 05/05/09

SHEET 2 OF 4

FILE •) $REQUEST

USERNAME •)$USER DATE PLOTTED •)$DATE TIME PLOTTED •)$TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	---		

Caltrans Metric

Carlos V Amante
CERTIFIED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVALDATE

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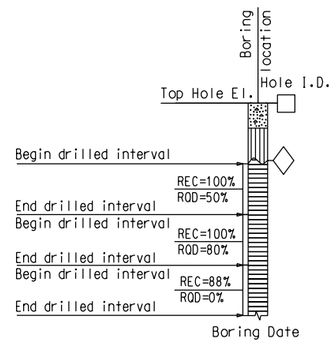
KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

C. AMANTE
DESIGN OVERSIGHT
05/05/09
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY M. CHIRUMALLA

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56C-0056
KILOMETER POST R62.2

BOX SPRINGS ROAD OH (REPLACE)

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 12/17/08 05/05/09

SHEET 3 OF 4

FILE -> $REQUEST

USERNAME -> $USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	---		

Carlos V Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVALDATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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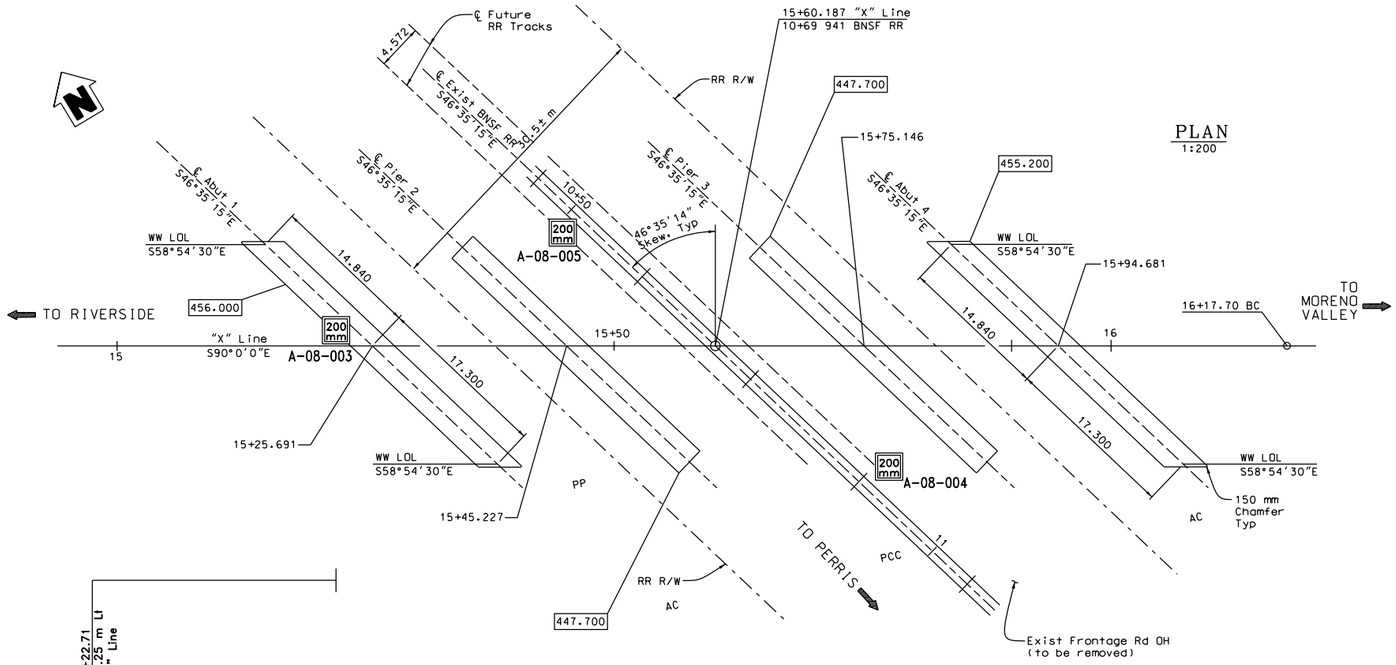
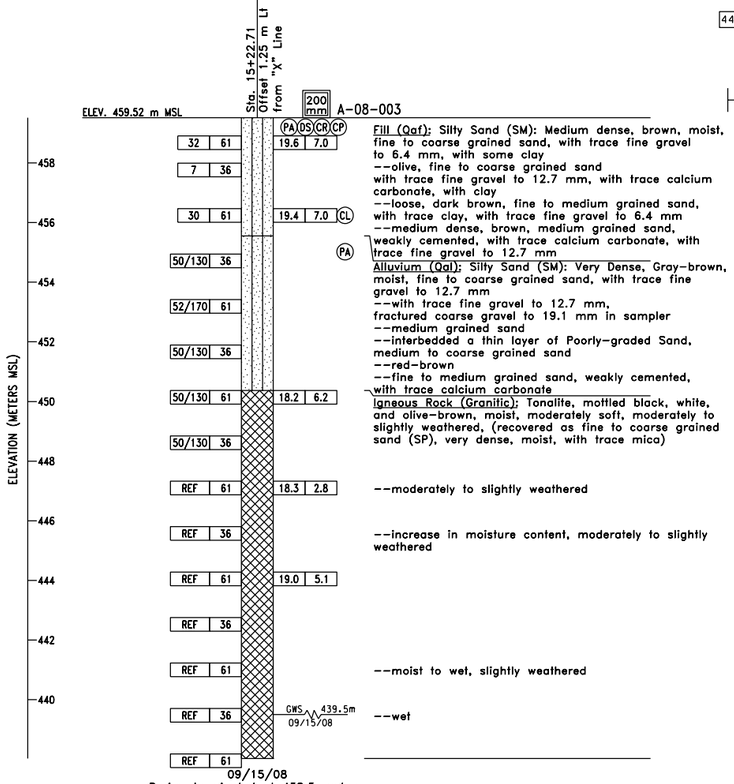
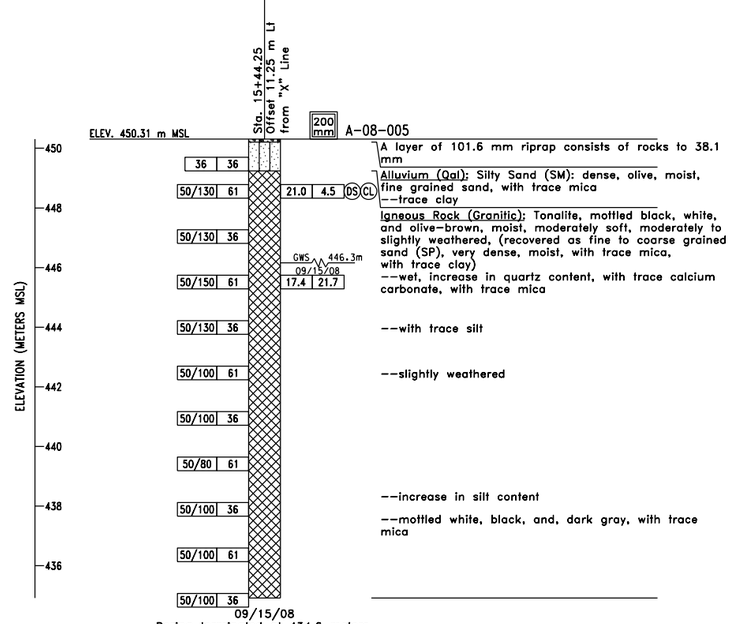


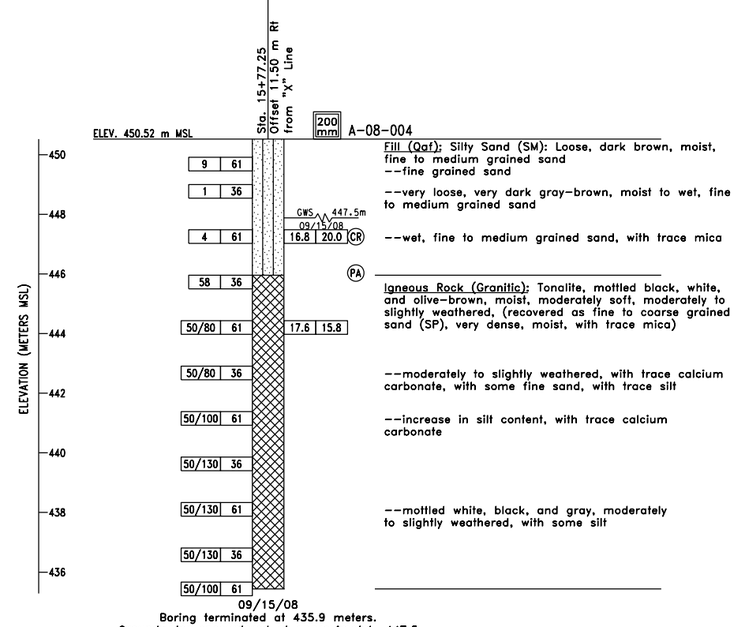


09/15/08
Boring terminated at 438.5 meters. Groundwater encountered at approximately 439.5 meters. Borehole backfilled with soil from cuttings.
ER_i = 80%



09/15/08
Boring terminated at 434.6 meters. Groundwater encountered at approximately 446.3 meters. Borehole backfilled with soil from cuttings.
ER_i = 80%

PROFILE
VERTICAL 1:2



09/15/08
Boring terminated at 435.9 meters. Groundwater encountered at approximately 447.5 meters. Borehole backfilled with soil from cuttings.
ER_i = 80%

BENCH MARK:

Pt • 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N - 697603.049
E - 1903554.738

NOTES:

1. 36mm diameter samples were taken using a Standard Penetration Test (SPT) Split Barrel Sampler with an inside diameter (ID) of 36mm and an outside diameter (OD) of 51mm.
2. 61mm diameter Ring Samples were taken using a California (Modified) Split Barrel Sampler with an ID of 61mm and an OD of 83mm.
3. An Above-Hole automatic hammer system was used to advance the drive sampler.
4. This LOTB Sheet was prepared in accordance with the CALTRANS Soil and Rock Logging, Classification, and Presentation Manual (June 2007).

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

C. AMANTE
DESIGN OVERSIGHT
05/05/09
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY M. CHIRUMALLA

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56C-0056
KILOMETER POST R62.2

BOX SPRINGS ROAD OH (REPLACE)
LOG OF TEST BORINGS

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/14/08 12/17/08 05/05/09

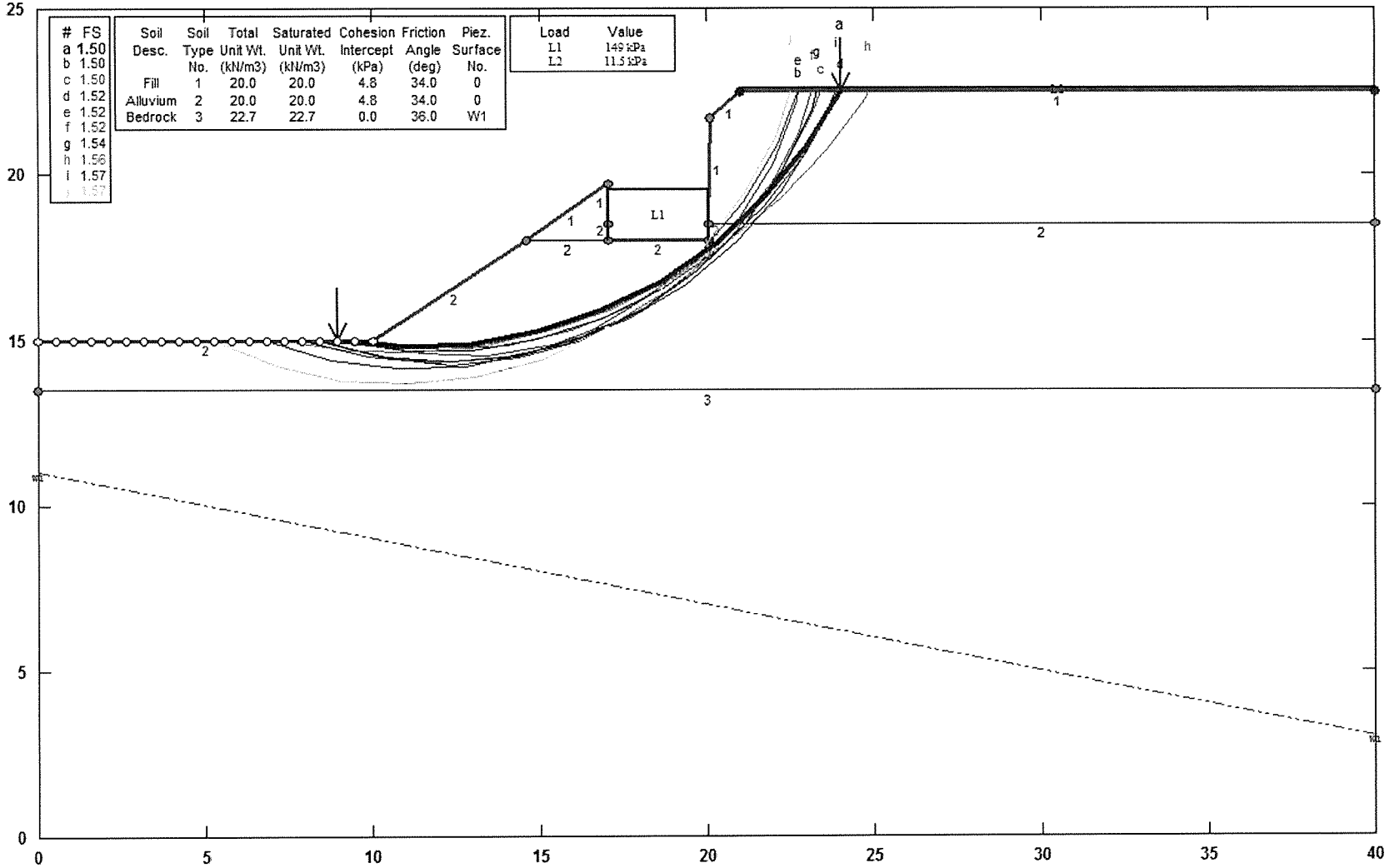
SHEET 4 OF 4

FILE •) $REQUEST

USERNAME •)$USER DATE PLOTTED •) $DATE TIME PLOTTED •) $TIME

Box Springs Overhead (Replace)-static I-215/SR-60 Interchange Improvements

U:\LHONG\PROJECTS\76979-~1\76979-~1\ENGINE~1\SLOPES~1\-ABUT.PL2 Run By: Username 8/18/2009 2:50PM



GSTABL7 v.2 FSmin=1.50

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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*

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****
*

Analysis Run Date: 8/18/2009
Time of Run: 2:50PM
Run By: Username
Input Data Filename: U:-abut.
Output Filename: U:-abut.OUT
Unit System: SI

Plotted Output Filename: U:-abut.PLT

PROBLEM DESCRIPTION: Box Springs Overhead (Replace)-static
I-215/SR-60 Interchange Improvements

BOUNDARY COORDINATES

10 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	14.99	10.01	14.99	2
2	10.01	14.99	14.60	18.01	2
3	14.60	18.01	17.03	19.68	1
4	17.03	19.68	17.05	18.50	1
5	17.05	18.50	17.07	18.01	2
6	17.07	18.01	20.05	18.01	2
7	20.05	18.01	20.07	18.50	2

8	20.07	18.50	20.09	21.72	1
9	20.09	21.72	21.00	22.50	1
10	21.00	22.50	40.00	22.50	1
11	14.60	18.01	17.07	18.01	2
12	20.07	18.50	40.00	18.50	2
13	0.00	13.52	40.00	13.52	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	20.0	20.0	4.8	34.0	0.00	0.0	0
2	20.0	20.0	4.8	34.0	0.00	0.0	0
3	22.7	22.7	0.0	36.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	0.00	10.99
2	40.00	2.99

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	17.07	20.05	149.0	0.0
2	21.00	39.99	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 10.00(m)

Each Surface Terminates Between X = 21.00(m)
and X = 40.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

2.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 6.492 FS Min = 1.497 FS Ave = 3.297
Standard Deviation = 1.035 Coefficient of Variation = 31.41

%

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.95	14.99
2	10.94	14.79
3	12.94	14.88

4	14.90	15.24
5	16.80	15.88
6	18.59	16.77
7	20.23	17.91
8	21.70	19.27
9	22.97	20.82
10	23.98	22.50

Circle Center At X = 11.3 ; Y = 29.0 and Radius, 14.2

Factor of Safety
*** 1.497 ***

Individual data on the 19 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.9	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2.0	56.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1.7	80.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.3	17.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1.9	125.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.2	16.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1.5	49.1	0.0	0.0	0.0	0.0	0.0	0.0	226.1
11	1.5	21.4	0.0	0.0	0.0	0.0	0.0	0.0	217.9
12	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.1	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.6	49.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.1	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

17	0.7	49.9	0.0	0.0	0.0	0.0	0.0	0.0
8.1								
18	1.3	62.1	0.0	0.0	0.0	0.0	0.0	0.0
14.5								
19	1.0	17.1	0.0	0.0	0.0	0.0	0.0	0.0
11.7								

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	6.84	14.99
2	8.75	14.40
3	10.73	14.13
4	12.73	14.19
5	14.69	14.59
6	16.56	15.31
7	18.28	16.33
8	19.81	17.62
9	21.10	19.14
10	22.12	20.86
11	22.76	22.50

Circle Center At X = 11.3 ; Y = 26.1 and Radius, 12.0

Factor of Safety
*** 1.502 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	10.00	14.99
2	11.99	14.76
3	13.98	14.86
4	15.93	15.31
5	17.78	16.07
6	19.47	17.14
7	20.96	18.48
8	22.20	20.05
9	23.15	21.81
10	23.38	22.50

Circle Center At X = 12.4 ; Y = 26.4 and Radius, 11.7

Factor of Safety
*** 1.503 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.95	14.99
2	10.93	14.70
3	12.93	14.72
4	14.90	15.03
5	16.81	15.63
6	18.61	16.51
7	20.25	17.65
8	21.70	19.02
9	22.94	20.60
10	23.92	22.34
11	23.99	22.50

Circle Center At X = 11.8 ; Y = 28.0 and Radius, 13.4

Factor of Safety
*** 1.521 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.42	14.99
2	10.34	14.43
3	12.33	14.24
4	14.33	14.43
5	16.25	14.98
6	18.03	15.88
7	19.62	17.10
8	20.95	18.59
9	21.99	20.30
10	22.68	22.18
11	22.74	22.50

Circle Center At X = 12.3 ; Y = 24.9 and Radius, 10.7

Factor of Safety
*** 1.524 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	9.47	14.99
2	11.43	14.59
3	13.43	14.56
4	15.41	14.89
5	17.29	15.57
6	19.01	16.58
7	20.53	17.88
8	21.78	19.44
9	22.73	21.20
10	23.15	22.50

Circle Center At X = 12.6 ; Y = 25.5 and Radius, 10.9

Factor of Safety
*** 1.524 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.42	14.99
2	10.36	14.50
3	12.36	14.36
4	14.35	14.55
5	16.27	15.08
6	18.08	15.94
7	19.72	17.09
8	21.13	18.50
9	22.28	20.14
10	23.14	21.95
11	23.29	22.50

Circle Center At X = 12.2 ; Y = 26.0 and Radius, 11.7

Factor of Safety
*** 1.538 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.37	14.99
2	9.35	14.71
3	11.35	14.67
4	13.34	14.87
5	15.29	15.31
6	17.18	15.97
7	18.97	16.86
8	20.65	17.95
9	22.18	19.23
10	23.55	20.69
11	24.73	22.30
12	24.84	22.50

Circle Center At X = 10.7 ; Y = 31.4 and Radius, 16.7

Factor of Safety
*** 1.562 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.90	14.99
2	9.83	14.50
3	11.82	14.31
4	13.82	14.44
5	15.77	14.88
6	17.63	15.63
7	19.35	16.65
8	20.88	17.93
9	22.20	19.44
10	23.26	21.13
11	23.84	22.50

Circle Center At X = 12.0 ; Y = 27.0 and Radius, 12.7

Factor of Safety
*** 1.570 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	5.26	14.99
2	7.12	14.24
3	9.07	13.80
4	11.06	13.68
5	13.05	13.89
6	14.98	14.41
7	16.80	15.25
8	18.46	16.37
9	19.91	17.74
10	21.12	19.34
11	22.05	21.10
12	22.52	22.50

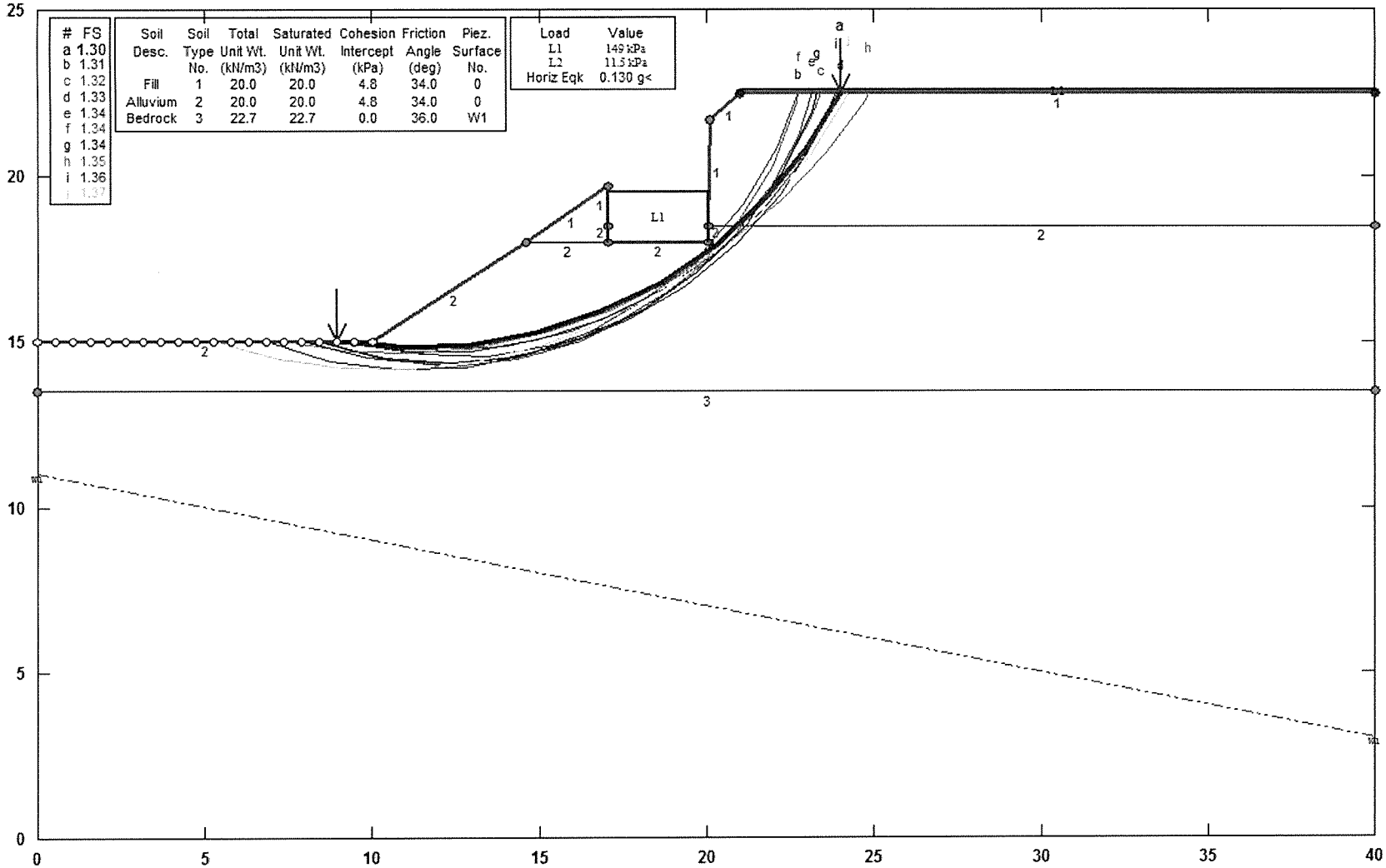
Circle Center At X = 10.8 ; Y = 25.9 and Radius, 12.2

Factor of Safety
*** 1.572 ***

**** END OF GSTABL7 OUTPUT ****

Box Springs Overhead (Replace)-seismic I-215/SR-60 Interchange Improvements

U:\LHONG\PROJECTS\76979-~1\76979-~1\ENGINE~1\SLOPES~1\-ABUTS.PL2 Run By: Username 8/18/2009 2:39PM



GSTABL7 v.2 FSmin=1.30

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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*

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****
*

Analysis Run Date: 8/18/2009
Time of Run: 2:39PM
Run By: Username
Input Data Filename: U:-abuts.
Output Filename: U:-abuts.OUT
Unit System: SI

Plotted Output Filename: U:-abuts.PLT

PROBLEM DESCRIPTION: Box Springs Overhead (Replace)-seismic
I-215/SR-60 Interchange Improvements

BOUNDARY COORDINATES

10 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	14.99	10.01	14.99	2
2	10.01	14.99	14.60	18.01	2
3	14.60	18.01	17.03	19.68	1
4	17.03	19.68	17.05	18.50	1
5	17.05	18.50	17.07	18.01	2
6	17.07	18.01	20.05	18.01	2
7	20.05	18.01	20.07	18.50	2

8	20.07	18.50	20.09	21.72	1
9	20.09	21.72	21.00	22.50	1
10	21.00	22.50	40.00	22.50	1
11	14.60	18.01	17.07	18.01	2
12	20.07	18.50	40.00	18.50	2
13	0.00	13.52	40.00	13.52	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	20.0	20.0	4.8	34.0	0.00	0.0	0
2	20.0	20.0	4.8	34.0	0.00	0.0	0
3	22.7	22.7	0.0	36.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	0.00	10.99
2	40.00	2.99

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	17.07	20.05	149.0	0.0
2	21.00	39.99	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 10.00(m)

Each Surface Terminates Between X = 21.00(m)
and X = 40.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

2.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 4.088 FS Min = 1.304 FS Ave = 2.396
Standard Deviation = 0.598 Coefficient of Variation = 24.96

%

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.95	14.99
2	10.94	14.79
3	12.94	14.88
4	14.90	15.24
5	16.80	15.88
6	18.59	16.77
7	20.23	17.91
8	21.70	19.27
9	22.97	20.82
10	23.98	22.50

Circle Center At X = 11.3 ; Y = 29.0 and Radius, 14.2

Factor of Safety
*** 1.304 ***

Individual data on the 19 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	1.1	1.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0
2	0.9	8.5	0.0	0.0	0.0	0.0	1.1	0.0	0.0
3	2.0	56.9	0.0	0.0	0.0	0.0	7.4	0.0	0.0
4	1.7	80.9	0.0	0.0	0.0	0.0	10.5	0.0	0.0
5	0.3	17.6	0.0	0.0	0.0	0.0	2.3	0.0	0.0
6	1.9	125.5	0.0	0.0	0.0	0.0	16.3	0.0	0.0
7	0.2	16.9	0.0	0.0	0.0	0.0	2.2	0.0	0.0
8	0.0	1.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0
9	0.0	0.9	0.0	0.0	0.0	0.0	0.1	0.0	0.0
10	1.5	49.1	0.0	0.0	0.0	0.0	6.4	0.0	226.1
11	1.5	21.4	0.0	0.0	0.0	0.0	2.8	0.0	217.9

12	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
0.0								
13	0.0	0.9	0.0	0.0	0.0	0.0	0.1	0.0
0.0								
14	0.1	11.2	0.0	0.0	0.0	0.0	1.5	0.0
0.0								
15	0.6	49.9	0.0	0.0	0.0	0.0	6.5	0.0
0.0								
16	0.1	10.1	0.0	0.0	0.0	0.0	1.3	0.0
0.0								
17	0.7	49.9	0.0	0.0	0.0	0.0	6.5	0.0
8.1								
18	1.3	62.1	0.0	0.0	0.0	0.0	8.1	0.0
14.5								
19	1.0	17.1	0.0	0.0	0.0	0.0	2.2	0.0
11.7								

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	6.84	14.99
2	8.75	14.40
3	10.73	14.13
4	12.73	14.19
5	14.69	14.59
6	16.56	15.31
7	18.28	16.33
8	19.81	17.62
9	21.10	19.14
10	22.12	20.86
11	22.76	22.50

Circle Center At X = 11.3 ; Y = 26.1 and Radius, 12.0

Factor of Safety
*** 1.314 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	10.00	14.99
2	11.99	14.76
3	13.98	14.86
4	15.93	15.31
5	17.78	16.07
6	19.47	17.14

7	20.96	18.48
8	22.20	20.05
9	23.15	21.81
10	23.38	22.50

Circle Center At X = 12.4 ; Y = 26.4 and Radius, 11.7

Factor of Safety
*** 1.321 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.95	14.99
2	10.93	14.70
3	12.93	14.72
4	14.90	15.03
5	16.81	15.63
6	18.61	16.51
7	20.25	17.65
8	21.70	19.02
9	22.94	20.60
10	23.92	22.34
11	23.99	22.50

Circle Center At X = 11.8 ; Y = 28.0 and Radius, 13.4

Factor of Safety
*** 1.328 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	9.47	14.99
2	11.43	14.59
3	13.43	14.56
4	15.41	14.89
5	17.29	15.57
6	19.01	16.58
7	20.53	17.88
8	21.78	19.44
9	22.73	21.20

10	23.15	22.50

Circle Center At X = 12.6 ; Y = 25.5 and Radius, 10.9

Factor of Safety
*** 1.338 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.42	14.99
2	10.34	14.43
3	12.33	14.24
4	14.33	14.43
5	16.25	14.98
6	18.03	15.88
7	19.62	17.10
8	20.95	18.59
9	21.99	20.30
10	22.68	22.18
11	22.74	22.50

Circle Center At X = 12.3 ; Y = 24.9 and Radius, 10.7

Factor of Safety
*** 1.339 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.42	14.99
2	10.36	14.50
3	12.36	14.36
4	14.35	14.55
5	16.27	15.08
6	18.08	15.94
7	19.72	17.09
8	21.13	18.50
9	22.28	20.14
10	23.14	21.95
11	23.29	22.50

Circle Center At X = 12.2 ; Y = 26.0 and Radius, 11.7

Factor of Safety
*** 1.344 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.37	14.99
2	9.35	14.71
3	11.35	14.67
4	13.34	14.87
5	15.29	15.31
6	17.18	15.97
7	18.97	16.86
8	20.65	17.95
9	22.18	19.23
10	23.55	20.69
11	24.73	22.30
12	24.84	22.50

Circle Center At X = 10.7 ; Y = 31.4 and Radius, 16.7

Factor of Safety
*** 1.353 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.90	14.99
2	9.83	14.50
3	11.82	14.31
4	13.82	14.44
5	15.77	14.88
6	17.63	15.63
7	19.35	16.65
8	20.88	17.93
9	22.20	19.44
10	23.26	21.13
11	23.84	22.50

Circle Center At X = 12.0 ; Y = 27.0 and Radius, 12.7

Factor of Safety
*** 1.363 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	5.26	14.99
2	7.19	14.46
3	9.17	14.19
4	11.17	14.17
5	13.16	14.40
6	15.10	14.88
7	16.97	15.60
8	18.72	16.56
9	20.34	17.73
10	21.81	19.10
11	23.08	20.64
12	24.15	22.33
13	24.23	22.50

Circle Center At X = 10.4 ; Y = 29.9 and Radius, 15.7

Factor of Safety
*** 1.365 ***

**** END OF GSTABL7 OUTPUT ****

REVISED FINAL STRUCTURE FOUNDATION REPORT

FINAL
STRUCTURE FOUNDATION REPORT
BOX SPRINGS ROAD OVERHEAD (REPLACE)
BRIDGE NO. 56C0566
INTERSTATE 215/STATE ROUTE 60
EAST JUNCTION IMPROVEMENTS
CITY OF RIVERSIDE, CALIFORNIA
08-RIV-215/60, KP 61.7/62.6, 19.4/21.5
CALTRANS EA NO. 08-449311

Prepared for:

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Kleinfelder Project No. 76979

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December 22, 2008

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Revised June 12, 2009
December 22, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

Subject: **Final Structure Foundation Report**
Box Springs Road Overhead (Replace)
Bridge No. 56C-0056
Interstate 215/State Route 60 East Junction
City of Riverside, California
08-Riv-215/60, KP 61.7/62.6, 19.4/21.5
Caltrans EA No. 449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) is pleased to present this Final Structure Foundation Report for the proposed Box Springs Road Overhead Replacement, to be located immediately adjacent to the north side of the existing Box Springs Road Overhead (previously called, Lawless Road Overhead), in the City of Riverside, California. The purpose of this report is to provide geotechnical engineering recommendations for design and construction of the proposed project. This report also includes our response to Caltrans review comments dated November 5, 2008 and January 30, 2009 (see Appendix D).

The proposed project is geotechnically feasible provided that our recommendations in this report are properly incorporated into the design and construction of the project. Recommendations provided herein are contingent on the provisions outlined in the Additional Services and Limitations section of this report. The project Owner should become familiar with these provisions in order to assess potential impacts to the proposed project and further involvement by Kleinfelder.

We appreciate the opportunity to be of service on this project. If you have any questions and comments or require additional information, please do not hesitate to contact the undersigned.

Sincerely,
KLEINFELDER WEST, INC.

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

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1.0 INTRODUCTION

1.1 GENERAL

Kleinfelder West, Inc., (Kleinfelder) was retained by Lim & Nascimento Engineering Corporation (LAN) to conduct a geotechnical investigation for the proposed Box Springs Road Overhead (Replace). This bridge would replace the existing Box Springs Road Overhead (previously called, Lawless Road Overhead, Bridge Number 56C-0056). The proposed Box Springs Road Overhead will be located approximately 314 meters west of Morton Road and 55 meters north of Box Springs Boulevard in the City of Riverside, Riverside County, California (see Plate 1, *Site Location Map*). The scope of our services was provided in our proposal entitled *Revised Proposal for Geotechnical Support Services For Plans, Specifications, and Cost Estimates (PS&E), I-215 East Junction Project, Riverside, California, dated July 29, 2008.*

This report presents our recommendations relative to the geotechnical aspects of design and construction for the proposed project. Conclusions and recommendations presented in this report are based on the subsurface conditions encountered at the locations of our field excavations, and the provisions and requirements outlined in the Additional Services and Limitations sections of this report. Recommendations presented in this report should not be extrapolated to other areas or be used for other projects without our prior review.

1.2 PROJECT DESCRIPTION

As part of the I-215/SR-60 East Junction improvement project, the widening of the Box Spring Right Bridge requires the existing Box Springs Road Overhead to be relocated. Therefore, a three-span concrete bridge is proposed to be constructed immediately adjacent to the north side of the existing bridge. Based on the bridge General Plan and Foundation Plan (see Plates 2 and 3, respectively), the proposed bridge will be approximately 70.3 meters long and 22.08 meters wide and will be constructed with a cast-in-place, prestressed concrete (CIP/PS) box girders.

The proposed bridge will be supported on two abutments (Abutments 1 and 4) and two bents (Bent 2 and 3), all founded on spread footings. Both Abutments 1 and 4 will be

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built on proposed 1:1.5 (Vertical: Horizontal, V:H) fill slopes, with bottom of footing elevations of 455.8 and 455.2 meters above MSL, respectively. In addition to the construction of the bridge, a railroad maintenance road with an approximate width of 4.6 meters is proposed to be constructed near the toe of west embankment, which has a surface elevation approximately 0.5 meters lower than the adjacent railroad base. Bents 2 and 3 will be constructed at the toe of west and east embankment, respectively, and will have bottom of footing elevations of 447.32 and 447.7 meters above MSL, respectively.

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2.0 GEOTECHNICAL INVESTIGATION

The purpose of this investigation was to evaluate subsurface conditions along the proposed bridge alignment and provide geotechnical recommendations for design and construction of the proposed development. A description of the scope of services performed is presented below.

Task 1 – Literature Review

We began our services by reviewing soils and geologic data in our files and from select public agencies (see References). We have completed a computerized search of appropriate seismic and faulting information as it relates to the site.

Task 2 – Field Exploration

Prior to conducting the field exploration, our proposed exploration locations were cleared of known existing utility lines through Underground Service Alert (USA). Our subsurface exploration program for this project consisted of drilling, logging and sampling three exploratory soil borings A-08-003, A-08-004, and A-08-005 (KB-1, KB-2, and KB-3, respectively) on September 15, 2008. Locations of our borings and description are shown on Plates 4A through 4D. These borings were drilled to depths ranging from approximately 20.5 to 15.1 meters below the existing ground surface (bgs). The borings were advanced using a Mobile B-61, truck-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer delivery system.

The borings were logged and sampled by a staff professional from our office using modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. In addition, representative bulk samples were collected from the borings. Each soil sample was observed and described in general accordance with the Unified Soil Classification System (USCS). Following drilling, sampling and logging, borings were backfilled with native cuttings. The boring logs are presented in Appendix A, *Field Exploration*.

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Task 3 – Laboratory Soil Testing

Laboratory testing was performed on the samples collected during our field exploration to substantiate field classifications and to assess the physical characteristics of the subsurface soils and rocks. A laboratory testing program was developed and performed to characterize and evaluate the engineering properties of the subsurface soils. Tests performed consisted of moisture content and in situ dry unit weight (ASTM D2216 and D2937); grain size distribution (ASTM D 422); direct shear (ASTM D 3080); collapse potential (ASTM D5333); Maximum Unit Weight/Optimum Moisture Content Test (ASTM D1557); and corrosivity tests consisting of electrical resistivity test (CTM 532), pH (CTM 643), sulfate content (CTM 417), and chloride content (CTM 422). The laboratory test procedures and results are presented in Appendix B, *Laboratory Testing*.

Task 4 – Geotechnical Analyses and Report Preparation

Field and laboratory findings were evaluated in conjunction with the proposed use project use. This report includes conclusions and recommendations regarding the following:

- Regional geologic setting, geologic features, and geologic hazards including the potential for ground rupture due to surface faulting, liquefaction potential, and other seismically induced hazards
- Subsurface materials encountered within the exploratory borings, anticipated groundwater levels, and excavation characteristics of these materials
- Corrosion potential of the near surface soils
- Acceleration Response Spectra (ARS) curves, including standard Caltrans ARS curve and modified (design) ARS curve
- Recommendations for design and construction of spread footing foundations including recommended bearing capacities and total and differential settlements
- Recommended active, at-rest and seismically-induced lateral earth pressures for retaining walls and other below grade structures
- Guidelines for earthwork including recommendations for site preparation, fill placement, and compaction.

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3.0 PERTINENT REPORTS AND INVESTIGATIONS

The following documents were reviewed for this study:

- Foundation Plan for Box Springs Road Overhead (Replace), prepared for the State of California, Department of Transportation, CU 08, EA 449311, by Lim & Nascimento Engineering, Revision Date May 15, 2009.
- General Plan for Box Springs Road Overhead (Replace), prepared for the State of California, Department of Transportation, CU 08, EA 449311, by Lim & Nascimento Engineering, Revision Date May 15, 2009.
- Preliminary Foundation Report, Proposed WB Frontage Road Overhead Replacement, I-215/SR60 East Junction, Riverside, California, Kleinfelder Project No. 76979, dated April 25, 2007.
- Structure Foundation Report, Box Springs Overhead Left Bridge Widening, I-215/SR-60 East Junction, Riverside, California, Kleinfelder Project No. 76979, dated March 14, 2008
- United States Geological Survey, 7-1/2 Minute Series, Riverside East Quadrangle, California, 1967, Photorevised 1980.
- United States Geological Survey, Geologic Map of the San Bernardino and Santa Ana 30' X 60' Quadrangle, California, Version 1.0, 2006.

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4.0 GEOLOGY, FAULTING AND SEISMICITY

4.1 REGIONAL AND LOCAL GEOLOGY

The project site is situated within the northern Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are a northwest-southeast oriented complex of blocks separated by similarly trending faults which extend 200 kilometers from the Transverse Ranges south to the Mexican border and beyond another 1250 kilometers to the tip of Baja California. The province varies in width from 50 to 160 kilometers and is bounded on the east by the Colorado Desert and the Gulf of California and on the west by the Pacific Ocean.

The Peninsular Ranges contain Jurassic-age and Cretaceous-age igneous and metamorphic rocks, as well as a thick sequence of marine and non-marine sedimentary rock. The Peninsular Ranges Province is further described by sub-units, which include the Perris Block, the Santa Ana Mountains, and the San Jacinto Mountains. The Perris Block is characterized as a broad area of intermixed valleys and low mountain ranges situated between the Elsinore and San Jacinto fault zones.

The project site is located in the northern portion of the Perris Block and Perris Valley. Typical lithographic units within this area consist of Quaternary alluvial deposits overlying granitic and metamorphic bedrock. Sporadic outcrops of bedrock dot the valley floor and represent remnants of eroded hills and mountains. Bedrock consists of mostly Cretaceous-age igneous rock (tonalite) forming the bedrock hills north of the site.

4.2 FAULTING AND SEISMICITY

The project site is located in the highly seismic southern California region within the influence of several fault systems that are considered to be active or potentially active. An active fault is a fault that has experienced seismic activity during historic time (since roughly 1800) or exhibits evidence of surface displacement during Holocene time (Bryant and Hart, 2007). The definition of “potentially active” varies. A generally accepted definition of “potentially active” is a fault showing evidence of displacement that is older than 11,000 years (Holocene age) and younger than 1.7 million years (Pleistocene age). However, “potentially active” is no longer used as criteria for zoning

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by the California Geologic Survey (CGS). The terms “sufficiently active” and “well-defined” are now used by the CGS as criteria for zoning faults under the Alquist-Priolo Earthquake Fault Act. A “sufficiently active fault” is a fault that shows evidence of Holocene surface displacement along one of more of its segments and branches, while a “well-defined fault” is a fault whose trace is clearly detectable by a trained geologist as a physical feature at or just below the ground surface. The definition “inactive” generally implies that a fault has not been active since the beginning of the Pleistocene Epoch (older than 1.7 million years old). These sufficiently active and well defined faults are capable of producing seismic shaking at the site that could potentially be damaging to buildings and appurtenant structures. It is anticipated that the project site will periodically experience ground acceleration as the result of moderate to large magnitude earthquakes. Other active faults without surface expression (blind faults) that are capable of generating an earthquake, or other potentially active seismic sources may be present that are not currently zoned.

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5.0 SUBSURFACE CONDITIONS

5.1 EARTH MATERIALS

Based on the results of our site-specific geotechnical investigation for the proposed bridge replacement (see Appendices A and B), the subsurface conditions anticipated at the bridge site consists of undocumented fill soil, alluvial sandy soil deposits, and granitic bedrock. Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the boring logs provided in Appendix A.

5.1.1 Undocumented Artificial Fill (Afu)

Embankment fill soil was encountered in boring A-08-003 (KB-1) near the proposed location of Abutment 1 to a depth of approximately 4.0 meters below the existing ground surface (bgs) at the top of west embankment. Undocumented fill soil was also encountered in boring A-08-004 (KB-2) near the proposed location of Bent 3 to a depth of approximately 1.1 meters, near the toe of existing east embankment. The fill soils were likely placed as part of the railroad construction or the development of the existing bridge. In general, the undocumented fill soils consist of silty sand (SM) with some fine gravel and some clay. Additional areas of undocumented fill soils may be encountered during earthwork operations that were not identified during this investigation.

5.1.2 Alluvium (Qal)

Alluvial soils were encountered below the fill soils to depths of approximately 9.1 meters bgs in boring A-07-003 (KB-1) and 4.6 meters bgs in boring A-08-005 (KB-3). The alluvial soil deposits encountered during our investigation consist of medium dense to very dense silty sand (SM) with fine gravel.

5.1.3 Granitic Bedrock (Kgr)

Tonalite granite bedrock was encountered in all three borings excavated. Bedrock was encountered at depths ranging from approximately 1.1 to 9.1 meters bgs and extended to the maximum depth explored of 21.5 meters bgs. In general, the tonalite rock is moderately weathered and decomposed near the contact with the alluvial soils and becomes less weathered with depth.

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5.2 GROUNDWATER

Groundwater was encountered in all three borings excavated for the proposed bridge at depths of 3 to 20 meters bgs. These depths to groundwater correspond to groundwater elevations of approximately 447.5 to 439.5 meters above MSL (see Plate 4d). During our site reconnaissance and subsurface investigation, it was noted that a drainage channel runs parallel to the railroad within the project site. All three borings drilled for this project are within 50 feet of the channel. The presence of shallow groundwater in the proposed bridge area may be due to its proximity to the existing drainage channel. The description of the drainage channel is provided in Section 6.5.

Fluctuations of the groundwater level, localized zones of perched water, and soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas on or immediately adjacent to the site can also cause a fluctuation of local groundwater levels.

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6.0 DISCUSSION AND RECOMMENDATIONS

6.1 SEISMIC DESIGN CRITERIA

6.1.1 Ground Surface Rupture and Deformation Potential

The site is not located within a currently delineated State of California Alquist-Priolo Earthquake Fault Zone (Bryant and Hart, 2007). No known active faults have been identified on the site, thus, the potential for future surface fault rupture at the site is considered to be "low." While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

6.1.2 Seismic Shaking

The 1996 California Seismic Hazard Map prepared by Caltrans (Mualchin, 1996a) indicates that the controlling fault for this project is the San Jacinto Fault (SJO), a strike slip fault with a maximum credible earthquake (MCE) moment magnitude of 7.5. The closest fault distance to the project site is approximately 8.8 km.

The horizontal peak bedrock acceleration (PBA) at the site based on the 1996 Caltrans Seismic Hazard Map is 0.5g, as shown on Plate 5, *Fault and PBA Map*. Caltrans Guidelines for Structures Foundation Reports (CGSFR), Version 2.0, dated March 2006, requires that the PBA determined above be verified with well-established attenuation relationships such as Sadigh et al. (1997) for controlling faults. The PBA value for the site, estimated using Sadigh et al. (1997) attenuation relationship, is 0.46g. Therefore, a PBA of 0.5g is recommended in accordance with Caltrans design practice.

Based on the results of our field exploration, our past experience, and in accordance with Table B.1 of Caltrans Seismic Design Criteria (SDC) (Version 1.4, dated June 2006), the site can be classified as Soil Profile Type C. The recommended seismic design parameters are summarized in the following Table 1.

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Table 1
Seismic Design Parameters

Seismic Parameters	Design Recommendation and Reference
Controlling Fault	San Jacinto (SJO), (Mualchin, 1996a)
Type of Fault	Strike-Slip (Mualchin, 1996b)
Closest Distance to the Fault	8.8 km (Mualchin, 1996a)
Earthquake Magnitude (MCE)	7.5 (Mualchin, 1996a,b)
Horizontal Peak Bedrock Acceleration (PBA)	0.5g
Soil Profile Type	C (Table B.1, 2006 Caltrans Seismic Design Criteria)

6.1.3 Design ARS Curve

The standard acceleration response spectra (ARS) curve presented in Figure B.5 of Caltrans SDC for PBA of 0.5g, magnitude 7.5, Soil Profile Type C, and for a damping of 5% was selected for seismic design of the proposed bridges. This standard ARS curve was modified to account for near-source fault rupture directivity effect as follows:

- 20% increase in spectral values for periods equal to or greater than 1.0 second;
- No change for periods less than 0.5 seconds; and
- Spectral ordinates for periods between 0.5 and 1 second determined by linear interpolation.

The standard Caltrans SDC ARS curve, modified ARS curve and their ordinate values are presented on Plate 6, *Design ARS Curve*.

6.1.4 Liquefaction Potential

Seismically induced soil liquefaction generally occurs in loose, saturated, cohesionless soil when pore pressures within the soil increase during ground shaking. The increase in pore pressure transforms the soil from a solid to a semi-liquid state. The primary factors affecting the liquefaction potential of a soil deposit are: 1) intensity and duration of earthquake shaking, 2) soil type and relative density, 3) overburden pressures, and 4) depth to groundwater. Soils most susceptible to liquefaction are clean, loose, uniformly graded, fine-grained sands, and non-plastic silts that are saturated. Silty sands have also been shown to be susceptible to liquefaction. These soils typically lose a portion or

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all of their shear strength and regain strength sometime after shaking stops. Soil movements (both vertical and lateral) have been observed under these conditions due to consolidation of the liquefied soils and the reduced shear resistance of slopes.

According to a Liquefaction Hazard Map prepared by the County of Riverside (Generalized Liquefaction Figure S-3, 2002), the site is located in an area designated as having a “low” liquefaction susceptibility.

In order to evaluate the liquefaction potential at the site, we used the simplified liquefaction analysis procedure recommended by NCEER (Youd and Idriss, 2001). It is our professional opinion that based on an assumed groundwater elevation of 447.5 meters and the anticipated depth to weathered bedrock, the site has a “low” liquefaction potential.

6.1.5 Seismically Induced Settlements

Unconsolidated, loose to medium dense sandy soil deposits tend to densify or become more tightly packed during strong ground shaking, thereby causing ground settlement. Using an empirical procedure developed by Tokimatsu and Seed (1987), seismically induced settlements due to seismic compaction of dry or unsaturated soils below the foundations were estimated to be on the order of 13 mm or less.

6.2 BRIDGE FOUNDATION DESIGN RECOMMENDATIONS

6.2.1 Foundation Type Selection

According to the plans provided to us, the proposed bridge will be supported on spread footings at abutments and bents. Selection of this foundation type was made by the project structural engineer, Lim & Nascimento Engineering Corporation (LAN), in consultation with Kleinfelder.

6.2.2 Recommended Bearing Limits

The recommended bearing limits for the abutment and bent foundations are presented in the following Table 2 based on Caltrans Memo to Designers 4-1, April 2008.

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Table 2
Footing Data Table

Support Location	Footing Size [1] (meters)		Design Method	Bottom of Footing Elevation [1]	Minimum Footing Embedment Depth [1] (meters)	WSD (LRFD Service-I Limit State Load Combination)		LRFD [2]		
								Service	Strength $\Phi_b = 0.45$	Extreme Event $\Phi_b = 1.00$
	B	L				Permissible Gross Contact Stress (kPa)	Allowable Gross Bearing Capacity (kPa)	Permissible Net Contact Stress (kPa)	Factored Gross Nominal Bearing Resistance (kPa)	Factored Gross Nominal Bearing Resistance (kPa)
Abut 1	3.05	33.00	WSD	455.80	1.70	315	195	N/A	N/A	N/A
Bent 2	3.05	27.45	LRFD	447.32	2.68	N/A	N/A	430	675	1480
Bent 3	3.05	27.45	LRFD	447.70	2.30	N/A	N/A	310	650	1440
Abut 4	3.05	33.00	WSD	455.20	2.30	345	210	N/A	N/A	N/A

Notes:
[1] Footing sizes and elevations are obtained from Box Springs Road OH (Replace) Foundation Plan.
[2] Recommended design parameters are provided in accordance with Caltrans Memo to Designers 4-1, April 2008 (including attachments).

Bearing capacity of spread footings was evaluated based on footing geometry, settlement potential of foundation soils, and slope stability. The calculations for bearing capacities and foundation settlements were provided in Appendices C-2 and C-3, respectively.

We recommend that the abutment and pier footings be founded on a minimum of 0.6 meter of structure backfill material compacted to at least 95 percent relative compaction. We anticipate that subsurface materials exposed at the bottom of footing elevation for the bents may consist of bedrock material. In these instances, the bent footings should be founded on undisturbed bedrock material. If undisturbed bedrock material is not exposed at the bottom of bent footing elevations during construction, the existing soils should be overexcavated 0.30 meter beyond the edge of footing with 1:1 slope projected downward until bedrock material is encountered, and the excavation backfilled with lean or Class 3 concrete.

Due to variable depth to bedrock and shallow groundwater, we recommend that the bent footings be overexcavated to the granitic bedrock contact and replaced with lean concrete. Based on our borings, we recommend a minimum of 1.8 meters of lean concrete be placed below the bottom of footing elevations.

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Footings may experience an overall loss in bearing capacity or an increased potential to settle where located in close proximity to existing or future utility trenches. Furthermore, stresses imposed by the foundations on the utility lines may cause cracking, collapse and/or a loss of serviceability. To reduce this risk, footings should extend below a 1:1 plane projected upward from the closest bottom corner of the trench.

6.2.3 Foundation Settlement

Total settlement of the foundations will vary depending on the plan dimensions of the foundations and the actual loads supported. Maximum total and differential settlements due to the net allowable footing loads are in the order of 25 mm and 13 mm, respectively. The footing settlement calculations are presented in Appendix C-3.

Due to the granular nature of the on-site soil materials, the settlement of foundations is expected to occur relatively quickly during construction and should be essentially complete shortly after initial application of the loads.

6.2.4 Slope Stability

The abutment footings will be constructed on the proposed 1:1.5 (V:H) fill slope. The overall global stability of abutment slopes was analyzed assuming a footing pressure of 149 kPa. Slope stability was calculated using Modified Bishop's Method for circular slip surfaces implemented in the computer program GSTABL7 with STEDWin3.0 (Van Aller and Gregory, 2001). The design criteria utilized are as follows: permanent abutment slopes are required to have a minimum factor of safety of 1.5 for the static condition; and a minimum factor of safety of 1.1 for the pseudostatic condition using the Caltrans recommended horizontal earthquake loading coefficient equal to 1/3 of the horizontal peak ground acceleration or 0.13g. Due to limited accessibility to conduct the subsurface soil investigation near abutment 4, soils encountered in boring A-08-003 (KB-1), which is near Abutment 1, was used in slope stability analysis for both Abutments 1 and 4. The results of slope stability analyses for both abutments indicate that the required minimum static and pseudostatic factors of safety would be satisfied provided the minimum shear strength parameters for the new compacted fill are equal to or exceed the following values: (1) a friction angle of 32 degrees, and (2) a cohesion of 9.6 kPa. Slope stability analysis results are included in Appendix C.

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According to the bridge *General Plan,* presented in Plate 2, the slope surface, at both abutment locations beneath the bridge, will be fully paved. Although the approach abutment slopes parallel to the outside shoulders of the bridge are expected to be grossly stable, erosion and surficial instability may be a concern during periods of heavy or intense rainfall. Erosion control and highway planting should be performed in accordance with Section 20 of Caltrans Standard Specifications. Excessive irrigation of slopes should be avoided. Appropriate drainage devices should be placed at the top of all slopes such that water does not flow over slope faces in an uncontrolled manner.

6.3 CORROSION POTENTIAL

To evaluate corrosion potential of the on-site soils, two of the soil samples collected from the borings were tested for pH, resistivity, sulfate and chloride concentrations in accordance with Caltrans Standard Test Methods 532, 643, 417, and 422, respectively. Testing was performed by AP Engineering and Testing, Inc. in Pomona, California. The test results are presented in Table 3, below.

Table 3
Corrosion Test Results

Boring Number	Depth of Sample (m)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
A-08-003 (KB-1)	0.0 - 1.5	1900	8.1	11	131
A-08-004 (KB-2)	3.0 - 3.5	2300	7.7	17	148

In accordance with Section 4.1 of Caltrans *Corrosion Guidelines* (dated September 2003), a corrosive area is defined as an area where the soil and/or water contains more than 500 ppm of chlorides, more than 2,000 ppm of sulfates, or has a pH of less than 5.5. In general, a minimum resistivity for soil and/or water less than 1,000 Ohm-cm indicates the presence of high quantities of soluble salts and a higher propensity for corrosion. Based on the laboratory test results and the above guidelines, the project site soils may generally be considered as non-corrosive.

Concrete in contact with the ground should be batched using a cement in accordance with the Caltrans Standard Specifications and Table 854.1A of the Highway Design Manual. In general, "Type IP (MS) Modified" or "Type II Modified" cement are

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acceptable for use along the project alignment. Adequate concrete cover over reinforcing steel should be provided in accordance with good construction practices and Caltrans design standards.

6.4 EXPANSION POTENTIAL

Expansive soils generally contain clay particles that swell considerably when wetted and shrink when dried. Foundations constructed on these soils are subjected to uplifting forces caused by the swelling. Based on the type of soil encountered at the project site and our past field exploration in the nearby areas, it is our opinion that soils within the upper portion of the project site have a low potential for expansion. Testing of the final subgrade soils after completion of grading should be conducted to evaluate their expansion potential and confirm or modify the recommendations presented herein.

6.5 FLOOD HAZARD AND SCOUR POTENTIAL

The flood hazard potential was evaluated based on Flood Hazard Maps available through the Federal Emergency Management Agency (FEMA) Map Service Center website and Flood Hazard Area Maps available through Riverside County. Based on the map (06065CIND1A) reviewed, the proposed bridge structure is not located within known flood hazard zones. Based on the types of materials encountered at the site, scour is not anticipated at the proposed bridge site.

During our field exploration, a 1.5-meter wide natural drainage channel that runs along the BNSF railroad and through the east embankment of the existing bridge with a concrete drainage pipe was noted. The portion of drainage channel near the existing bridge is lined with riprap, indicating possible intense surface flow within the channel during periods of heavy rainfall. The drainage channel was dry during our site investigation.

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7.0 CONSTRUCTION CONSIDERATIONS

7.1 SITE PREPARATION

All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations, and other local, state, or federal specifications. All references to maximum unit weight should be established in accordance with the current ASTM Standard Test Method D1557 and may supersede references cited herein.

7.1.1 Stripping and Grubbing

Prior to general site grading, existing pavement, vegetation, organic topsoil, existing fill soils, and debris shall be stripped and disposed of outside the construction limits. Deeper stripping or grubbing may be required where concentrations of fill debris, organic soils, existing trees, or thick root mats are encountered during site grading. Stripped topsoil (less any debris) may be stockpiled and reused for landscape purposes elsewhere on the project; however, this material should not be incorporated into any engineered fill.

In areas where existing trees will be removed, care should be taken to remove the root-ball, roots exceeding 25 mm in diameter, and remaining organics, and to backfill the excavations with compacted engineered fill. We strongly recommend having a representative of Kleinfelder present during tree removal in areas to receive fill or beneath foundations to observe removal of large roots and subsequent scarification and recompaction. Engineered fill should be placed and compacted in accordance with recommendations provided below.

7.1.2 Earthwork and Backfill

After clearing and stripping, the surface should be excavated to a minimum depth of 0.6 meter before placement of new fill. The undocumented fill soils (if encountered) shall be removed during site development and grading and replaced with structural backfill. In addition, any compressible soils encountered shall be removed and replaced with compacted structural backfill in accordance with Caltrans Standard Specifications Section 19-3.06. The exposed surface should be proof-rolled with loaded heavy equipment. Any areas of loose or yielding soils should be over-excavated and re-

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compacted. Any soils that cannot be compacted, or are otherwise unsuitable for the planned use, should be excavated and disposed of from the project site. The exposed surface should then be scarified and compacted to the specified density before placement of new fill. New fill placed on or adjacent to the existing slopes should be properly benched into the existing fill in accordance with Caltrans Standard Specifications.

All earthwork should be performed in accordance with Caltrans Standard Specification Section 19. All materials to be placed as fill should be free of vegetation, organics, debris, and other deleterious materials. All fill placed around foundations and behind walls should be placed in thin loose lifts, moisture-conditioned, and compacted to Caltrans Standard Specification.

Abutment wall backfill shall be structural backfill according to Caltrans standard specifications. In addition, we recommend that abutment backfill be well-graded soil with maximum dimension of 100 mm, essentially non-plastic (liquid limit less than 30, plasticity index less than 12, and with less than 50 percent passing the No. 200) and non-expansive. Expansive soils, defined as soils with Expansion Index (EI) greater than 50 and/or soils with Sand Equivalent (SE) less than 20, should be excluded from the bridge abutments as required by Caltrans guidelines and shown on Plate 8, *Expansive Soil Exclusion Zone in Bridge Embankment*. Expansion Index should be determined in accordance with ASTM D4829. Sand Equivalent should be determined in accordance with California Test Method (CTM) 217.

The limits of bridge approach zone are considered to extend longitudinally 46 meters measured horizontally from the bridge abutment and either parallel or concentric with the roadway centerline, and transversely the full width of embankment except the outer 1.5 meters measured horizontally from the embankment side slopes. Fills placed within 46 meters of abutments should be compacted to 95 percent relative compaction per ASTM D1557.

7.1.3 Temporary Excavations and Shoring

All excavations must comply with the current CAL-OSHA Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We

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are providing the information below solely as a service to our client. Under no circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

A shoring design and safety plan should be required from the contractor and submitted to the Engineer for review and approval. Likewise, measures to control impact of both groundwater and surface water on the stability of temporary excavations and shoring should be employed and should remain the sole responsibility of the contractor.

7.2 FOOTING OBSERVATIONS

Prior to placing steel and concrete, foundation excavations should be cleaned of all debris, loose or soft soil, and water. All foundation excavations should be observed by a qualified engineer or geologist from our firm just prior to placing steel or concrete to verify that the recommendations contained herein are implemented during construction.

7.3 SURFACE WATER CONTROL

Ponding of water adjacent to the structure should be avoided. During and after construction, positive drainage should be provided to direct surface water away from structures and all excavations toward suitable, non-erosive drainage devices.

7.4 ACCESS TO THE SITE

The presence of steep slopes on both sides of the railroad will make the direct access to the project site very difficult for construction crews as well as their equipments. It is recommended that the construction crews and equipments to enter the site through the gate located on River Crest Drive on the south side of Interstate 60. Moreover, the project site is situated in the proximity of a number of bridges; access to the site may be restricted or made difficult due to limited vertical clearance for construction equipments to pass underneath the existing bridges.

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8.0 ADDITIONAL SERVICES AND LIMITATIONS

8.1 ADDITIONAL SERVICES

The review of plans and specifications, and the observation and testing by Kleinfelder of earthwork and foundation related construction activities are an integral part of the conclusions and recommendations made in this report. If Kleinfelder is not retained for these services, the client will be assuming our responsibility for any potential claims that may arise during or after construction. The recommended tests, observations, and consultation by Kleinfelder during construction include, but are not limited to:

- A review of preliminary plans and specifications;
- Observation of site clearing, undocumented fill removal, and subgrade preparation;
- Engineered fill placement and compaction;
- Construction observation and density testing of fill material placement, trench backfill, and subgrade preparation;
- Monitoring device installation; and
- When any unusual conditions are encountered during construction.

These services may be performed in accordance with our current fee schedule.

8.2 LIMITATIONS

The conclusions and recommendations presented in this report are intended to provide preliminary geotechnical design data and recommendations for the proposed Box Springs Road Overhead Replacement, to be located at the east junction of the I-215 and SR-60 in the City of Riverside, California. The findings, conclusions and recommendations were prepared in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made. This report was based on the proposed project information provided to Kleinfelder. If any change (i.e., structure type, location, etc.) is implemented which materially alters the project, additional geotechnical services may be required, which could include revisions to the geotechnical recommendations presented herein.

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Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard. They are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

This report may be used only by the project designers and Caltrans and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on-site and off-site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party, and client agrees to defend, indemnify, and hold harmless Kleinfelder from any claim or liability associated with such unauthorized use or non-compliance.

Environmental site assessment for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater or atmosphere, or the presence of wetlands was not included in the scope of our services for this report.

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9.0 REFERENCES

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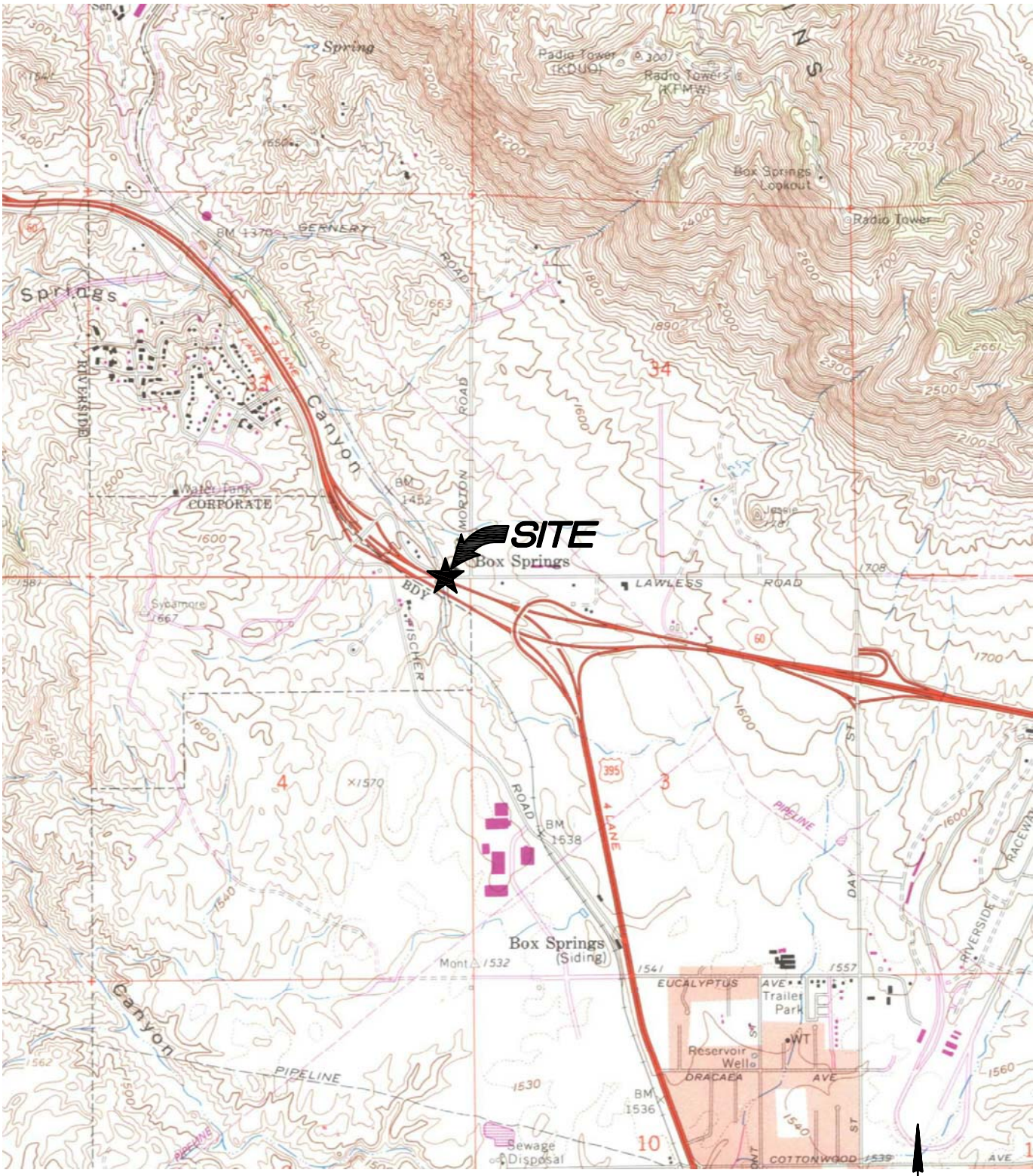
PLATES



SOURCE: U.S.G.S. 7.5' topographic series, Riverside East quadrangle, California dated 1967, photorevised 1980.

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SCALE 1:24,000

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PROJECT NO.	76979
DRAWN:	5/3/09
DRAWN BY:	MRG
CHECKED BY:	SL
FILE NAME: 76979p1.dwg	

SITE LOCATION MAP

I-215/SR-60 EAST JUNCTION
BOX SPRINGS ROAD OH (REPLACE)
RIVERSIDE, CALIFORNIA

PLATE 1

ATTACHED IMAGES: Images: 76979p1.jpg
ATTACHED XREFS:
DIAMOND BAR, CA

CAD FILE: L:\2009\CADD\76979\I-215_SR60\050309_Box-Spring_OH_(Replace)\ LAYOUT: 1 PLOTTED: 04 May 2009, 4:01pm, MGriffin

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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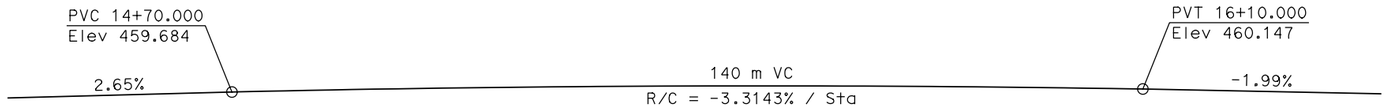
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

NOTES:

1. Paint "Br. No.56C0056 & Year Constructed"
2. Paint "Box Springs Road OH"
3. MBGR, See "Road Plans"
4. Structure Approach Type N(9S)
5. RR Maintenance Rd
6. Slope Paving
7. Exist Br.No. 56C0056 to be removed
8. Welded Steel Casing for Future Utility
9. Deck drain, Type D-2
10. Retaining Wall, see "Road Plans"

Point of minimum vertical clearance
Indicates Direction of traffic
Indicates existing structure
Indicates existing bridge removal



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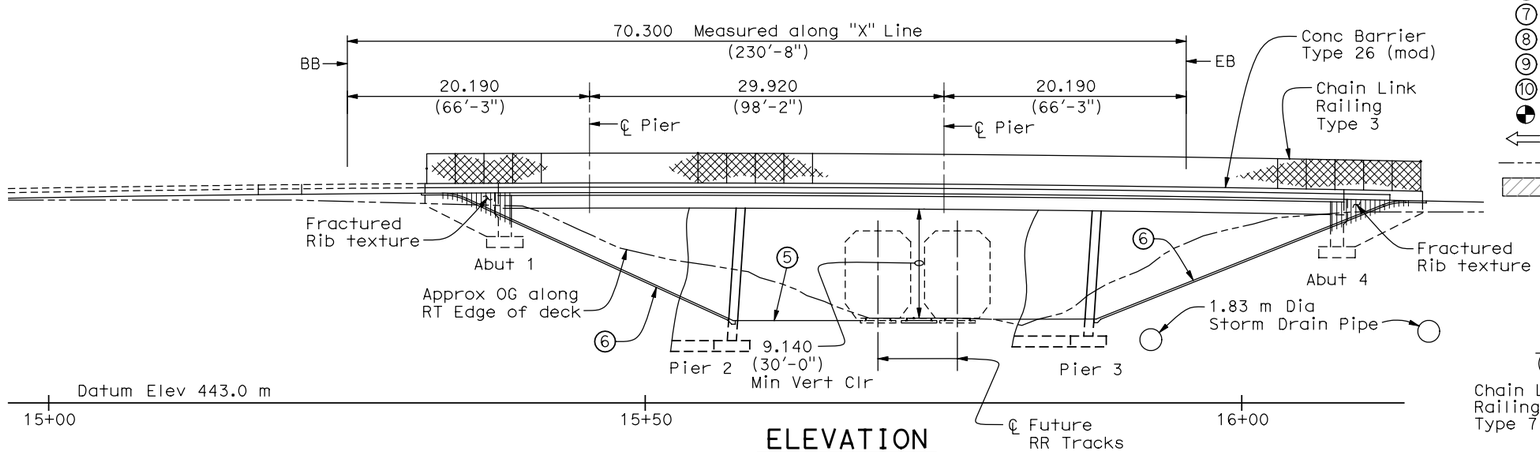

ELEVATION
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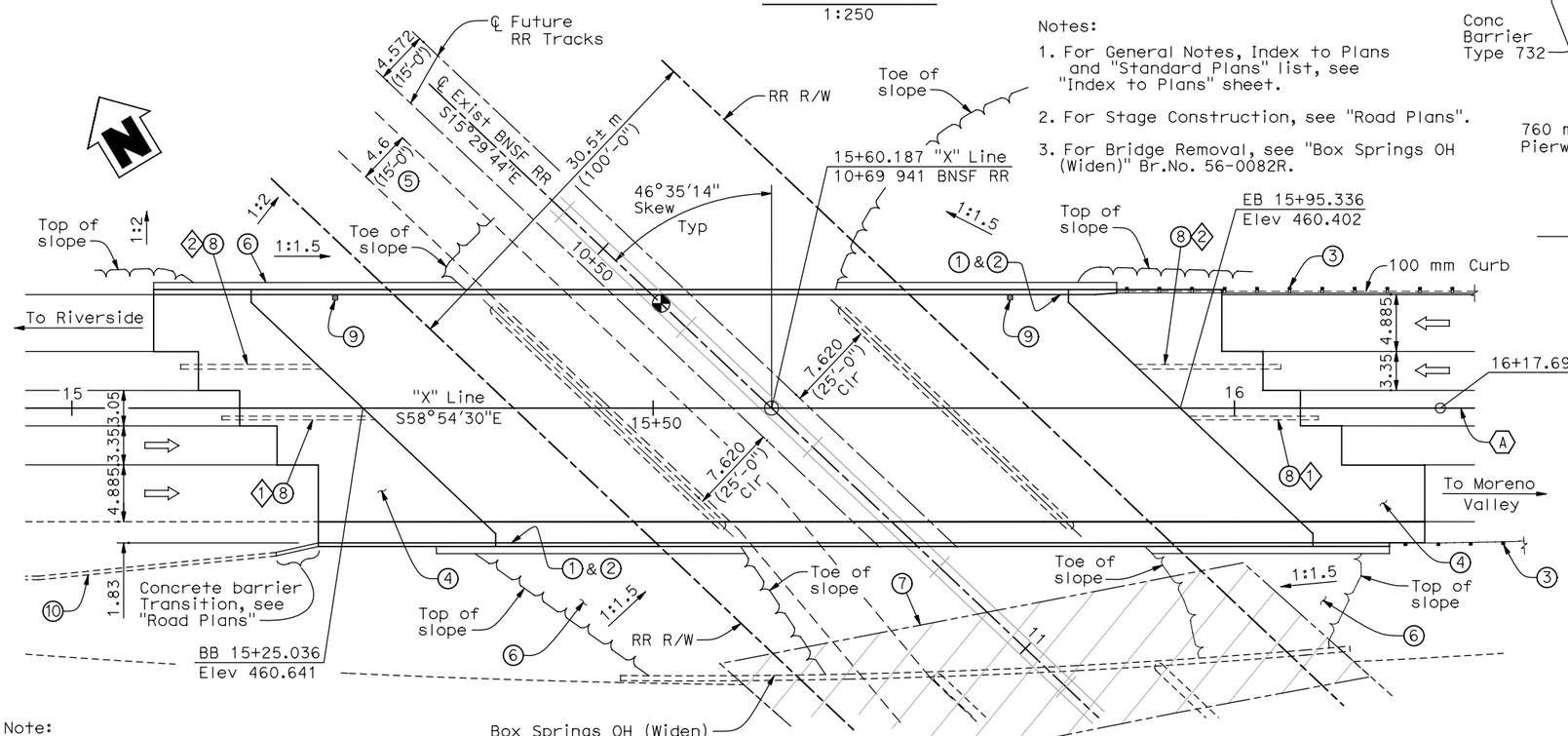
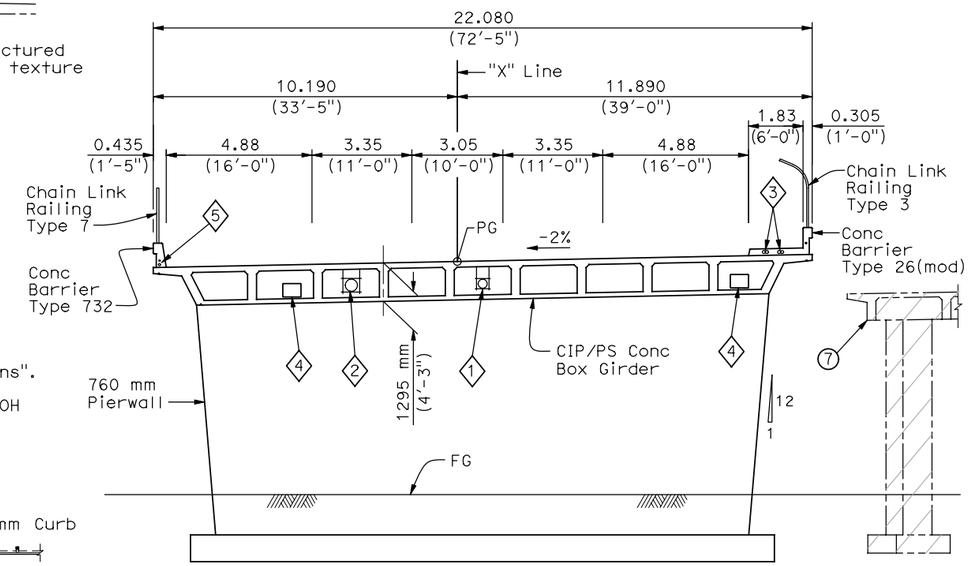


Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

PLAN
1:250

Notes:

1. For General Notes, Index to Plans and "Standard Plans" list, see "Index to Plans" sheet.
2. For Stage Construction, see "Road Plans".
3. For Bridge Removal, see "Box Springs OH (Widen)" Br.No. 56-0082R.



TYPICAL SECTION
1:100

CURVE DATA

(A)

R = 152.400 m
Δ = 30°32'31"
T = 41.657 m
L = 81.237 m

UTILITY LEGEND

1. 300 mm ø Casing for Future Gas Line
2. 400 mm ø Casing for Future Water Line
3. 4 - 100 mm ø Conduits for Future Utility
4. Future Utility Opening (610 mm x 450 mm)
5. 75 mm & 50 mm dia Electrical conduits

0 - 1.5

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. KIM / K. GEE	CHECKED T. DUDLEY/A. SIVATHASAN	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: HL-93 AND PERMIT DESIGN VEHICLE		
	DETAILS	BY R. ANDRASEK	CHECKED M. CHAR	LAYOUT	BY R. ANDRASEK	CHECKED M. CHAR	
SIGN OFF DATE	QUANTITIES	BY K. GEE	CHECKED D. SARETSKY	SPECIFICATIONS	BY M. CHAR	PLANS AND SPECS COMPARED M. CHAR	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56C0056
KILOMETER POST

BOX SPRINGS ROAD OH (REPLACE)
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 9/28/08 12/22/08 5/15/09

SHEET 1 OF 24

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08	Riv	215/60			

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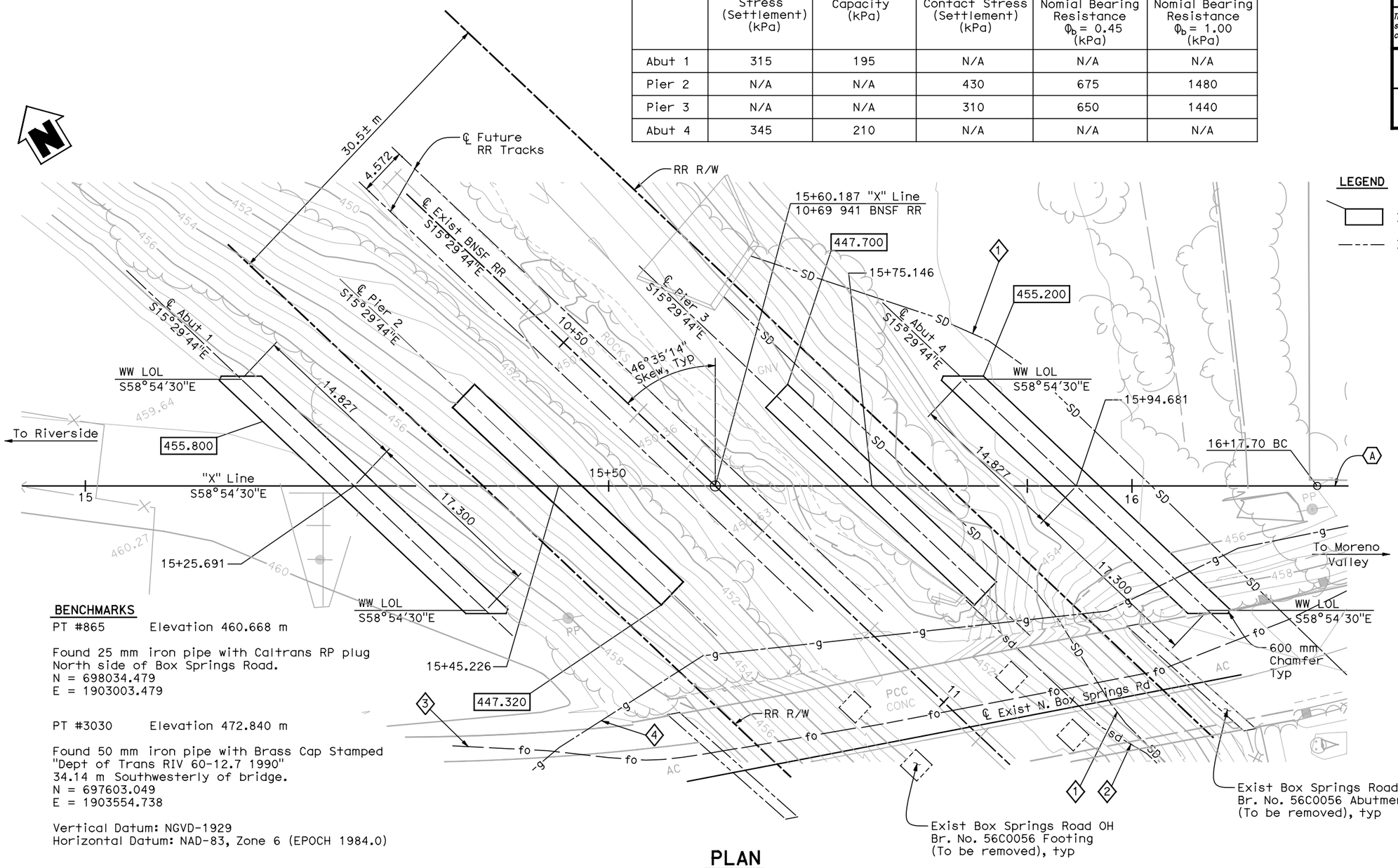
SAN BERNARDINO, CALIFORNIA 92408

SPREAD FOOTING DATA TABLE

SUPPORT LOCATION	Working Stress Design (WSD)		Load and Resistance Factor Design (LRFD)		
			Service	Strength	Extreme Event
	Permissible Gross Contact Stress (Settlement) (kPa)	Allowable Gross Bearing Capacity (kPa)	Permissible Net Contact Stress (Settlement) (kPa)	Factored Gross Nomial Bearing Resistance $\phi_b = 0.45$ (kPa)	Factored Gross Nomial Bearing Resistance $\phi_b = 1.00$ (kPa)
Abut 1	315	195	N/A	N/A	N/A
Pier 2	N/A	N/A	430	675	1480
Pier 3	N/A	N/A	310	650	1440
Abut 4	345	210	N/A	N/A	N/A



PLAN
1:200

LEGEND

Indicates bottom of footing elevation

Indicates existing footing

CURVE DATA

(A)
R = 152.400 m
Δ = 30°32'31"
T = 41.657 m
L = 81.237 m

UTILITY LEGEND

1. 1.83 m Dia Storm Drain Pipe
2. Exist 1.83 m Dia Storm Drain Pipe To be removed
3. Exist 4- 100 mm Conduit (AT&T) To be relocated
4. Exist 50 mm Dia Gas Line (TGC) Abandoned

BENCHMARKS

PT #865 Elevation 460.668 m

Found 25 mm iron pipe with Caltrans RP plug
North side of Box Springs Road.
N = 698034.479
E = 1903003.479

PT #3030 Elevation 472.840 m

Found 50 mm iron pipe with Brass Cap Stamped
"Dept of Trans RIV 60-12.7 1990"
34.14 m Southwesterly of bridge.
N = 697603.049
E = 1903554.738

Vertical Datum: NGVD-1929
Horizontal Datum: NAD-83, Zone 6 (EPOCH 1984.0)

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

Page 2 of 2

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

GEOTECHNICAL PROFESSIONAL APPROVAL DATE

DESIGN OVERSIGHT ROBERT ZEZOFF	SCALE: AS SHOWN	VERT.DATUM NGVD-1929	HORZ.DATUM NAD-83, Zone 6 (EPOCH 1984.0)	DESIGN	BY D. KIM / K. GEE	CHECKED T. DUDLEY/A. SIVATHASAN	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
	PHOTOGRAMMETRY AS OF:	ALIGNMENT TIES		DETAILS	BY R. / M. ANDRASEK	CHECKED M. CHAR	
	SURVEYED BY J. TERRY	DRAFTED BY		QUANTITIES	BY K. GEE	CHECKED D. SARETSKY	
SIGN OFF DATE	FIELD CHECKED BY M. WILSON	CHECKED BY					

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56C0056
KILOMETER POST

BOX SPRINGS ROAD OH (REPLACE)
FOUNDATION PLAN

FOUNDATION PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

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EA 449311

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

PLATE 3b

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	---		

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVALDATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

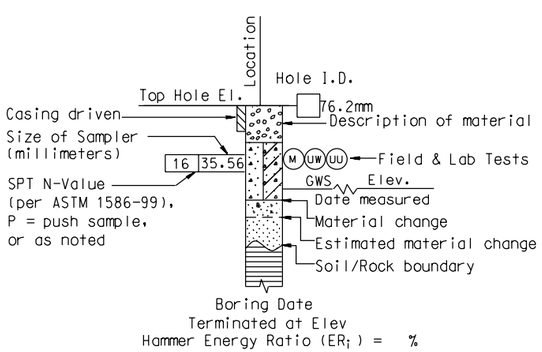
BOREHOLE IDENTIFICATION

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 (25.4mm soil tube) Hand Auger
	D	Dynamic Cone Penetration Boring
	CPT	Cone Penetration Test (ASTM D 5778-95)
	O	Other

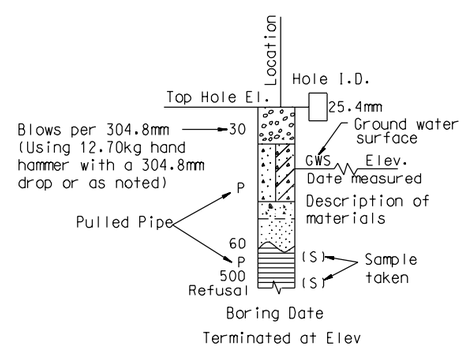
Note: Size in millimeters.

PLASTICITY OF FINE-GRAINED SOILS

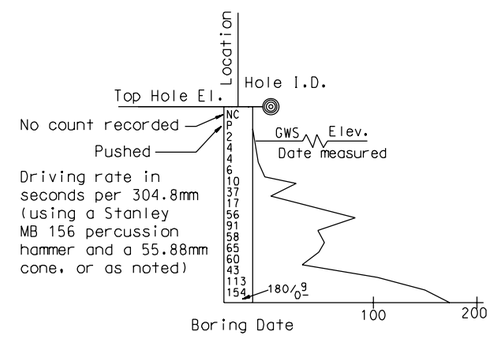
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



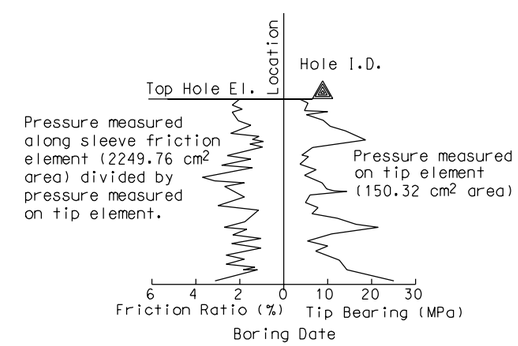
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

C. AMANTE
DESIGN OVERSIGHT
05/05/09
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY M. CHIRUMALLA

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56C-0056
KILOMETER POST R62.2

BOX SPRINGS ROAD OH (REPLACE)

SOIL LEGEND NO.1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/4/08 12/17/08 05/05/09

SHEET 1 OF 4

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PLATE 3c

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	---		

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVALDATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8mm)
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		> 304.8mm
Cobble		76.2mm to 304.8mm
Gravel	Coarse	19.05mm to 76.2mm
	Fine	No. 4 to 19.05mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

C. AMANTE
DESIGN OVERSIGHT
05/05/09
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY M. CHIRUMALLA

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56C-0056
KILOMETER POST R62.2

BOX SPRINGS ROAD OH (REPLACE)
SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 3/12/08 7/21/08 11/14/08 12/17/08 05/05/09

SHEET 2 OF 4

FILE => $REQUEST

USERNAME -$USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

PLATE 3d

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	---		

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVALDATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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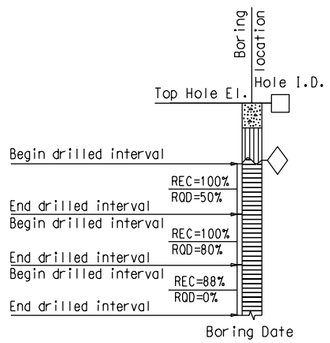
REDLANDS, CALIFORNIA 92374

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

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\ \text{mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

C. AMANTE
DESIGN OVERSIGHT
05/05/09
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY M. CHIRUMALLA

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56C-0056
KILOMETER POST R62.2

BOX SPRINGS ROAD OH (REPLACE)

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/4/08 12/11/08 05/05/09

SHEET 3 OF 4

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

PLATE 4a

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	---		

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVALDATE

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RIVERSIDE, CALIFORNIA 92501

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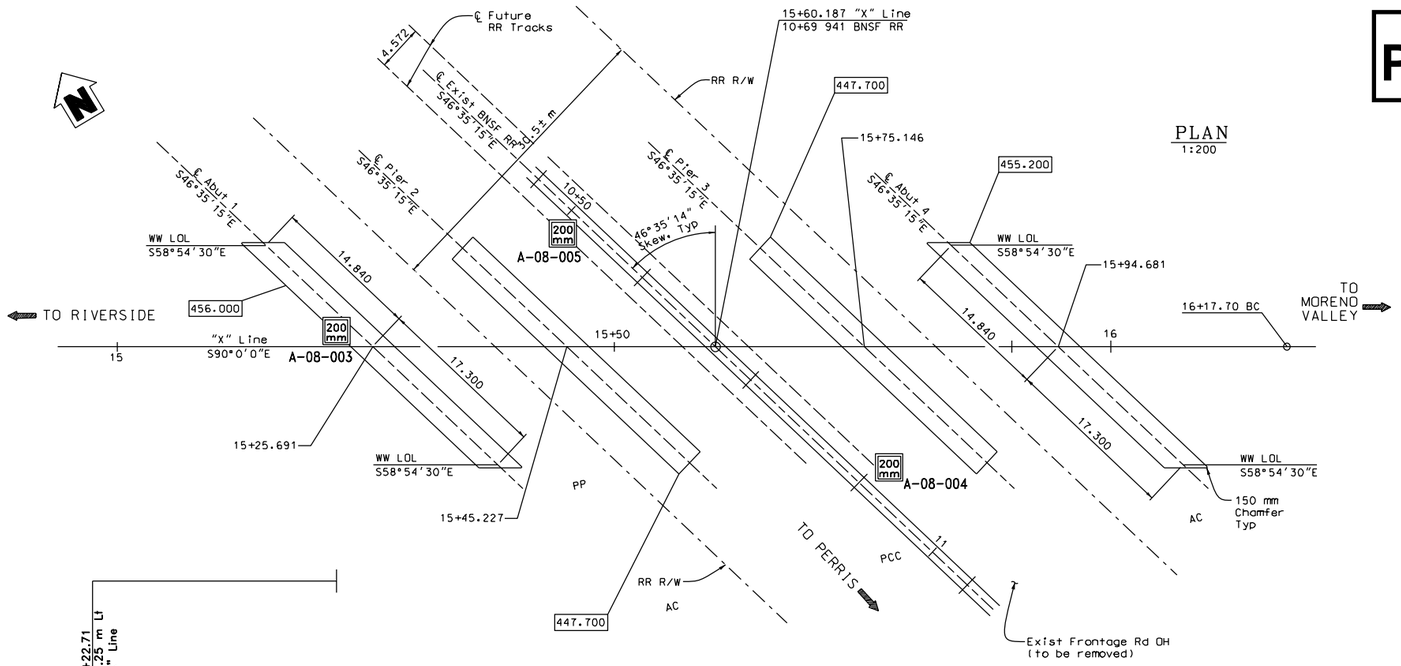
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:200

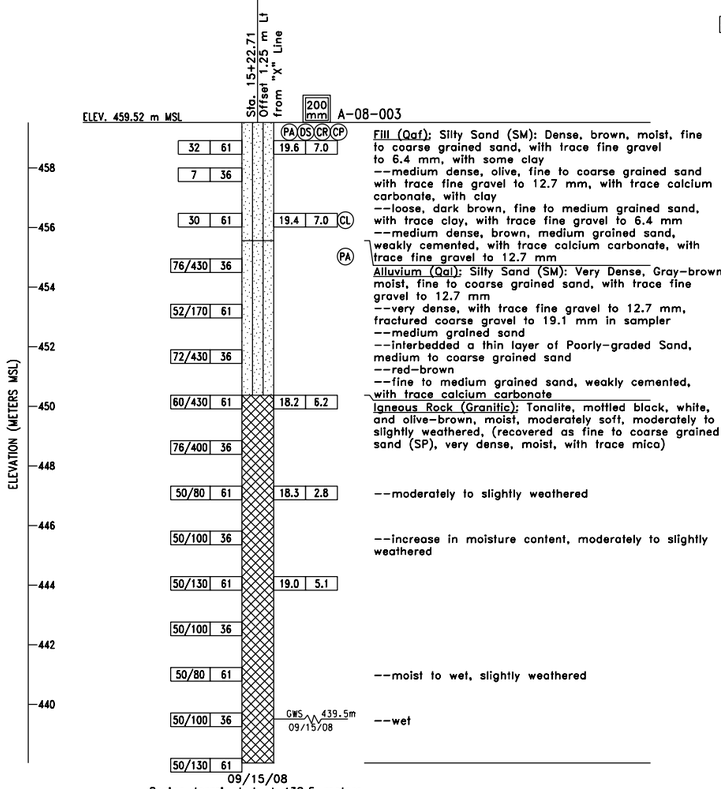


BENCH MARK:

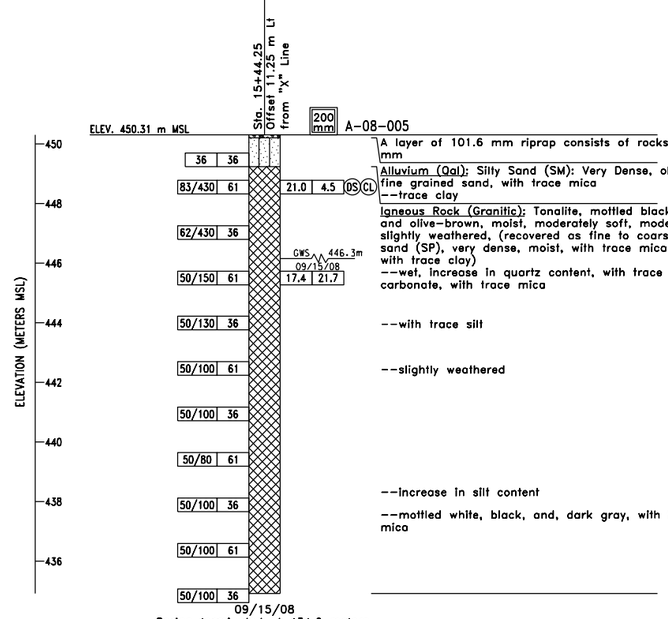
Pt • 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N - 697603.049
E - 1903554.738

NOTES:

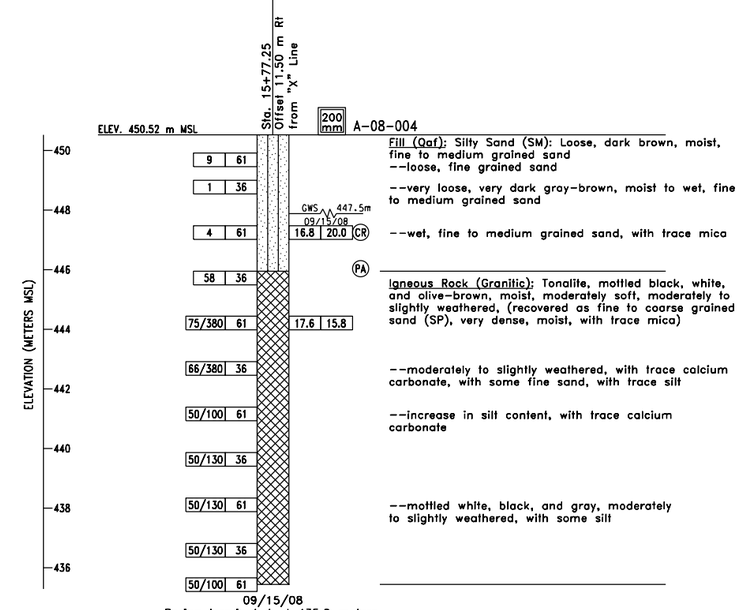
1. 36mm diameter samples were taken using a Standard Penetration Test (SPT) Split Barrel Sampler with an inside diameter (ID) of 36mm and an outside diameter (OD) of 51mm.
2. 61mm diameter Ring Samples were taken using a California (Modified) Split Barrel Sampler with an ID of 61mm and an OD of 83mm.
3. An Above-Hole automatic hammer system was used to advance the drive sampler.
4. This LOTB Sheet was prepared in accordance with the CALTRANS Soil and Rock Logging, Classification, and Presentation Manual (June 2007).



09/15/08
Boring terminated at 438.5 meters. Groundwater encountered at approximately 439.5 meters. Borehole backfilled with soil from cuttings.
ER_i = 80%



09/15/08
Boring terminated at 434.6 meters. Groundwater encountered at approximately 446.3 meters. Borehole backfilled with soil from cuttings.
ER_i = 80%



09/15/08
Boring terminated at 435.9 meters. Groundwater encountered at approximately 447.5 meters. Borehole backfilled with soil from cuttings.
ER_i = 80%

PROFILE
VERTICAL 1:2

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

C. AMANTE DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
05/05/09 SIGN OFF DATE	CHECKED BY	M. CHIRUMALLA	

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56C-0056
KILOMETER POST R62.2

BOX SPRINGS ROAD OH (REPLACE)

LOG OF TEST BORINGS

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

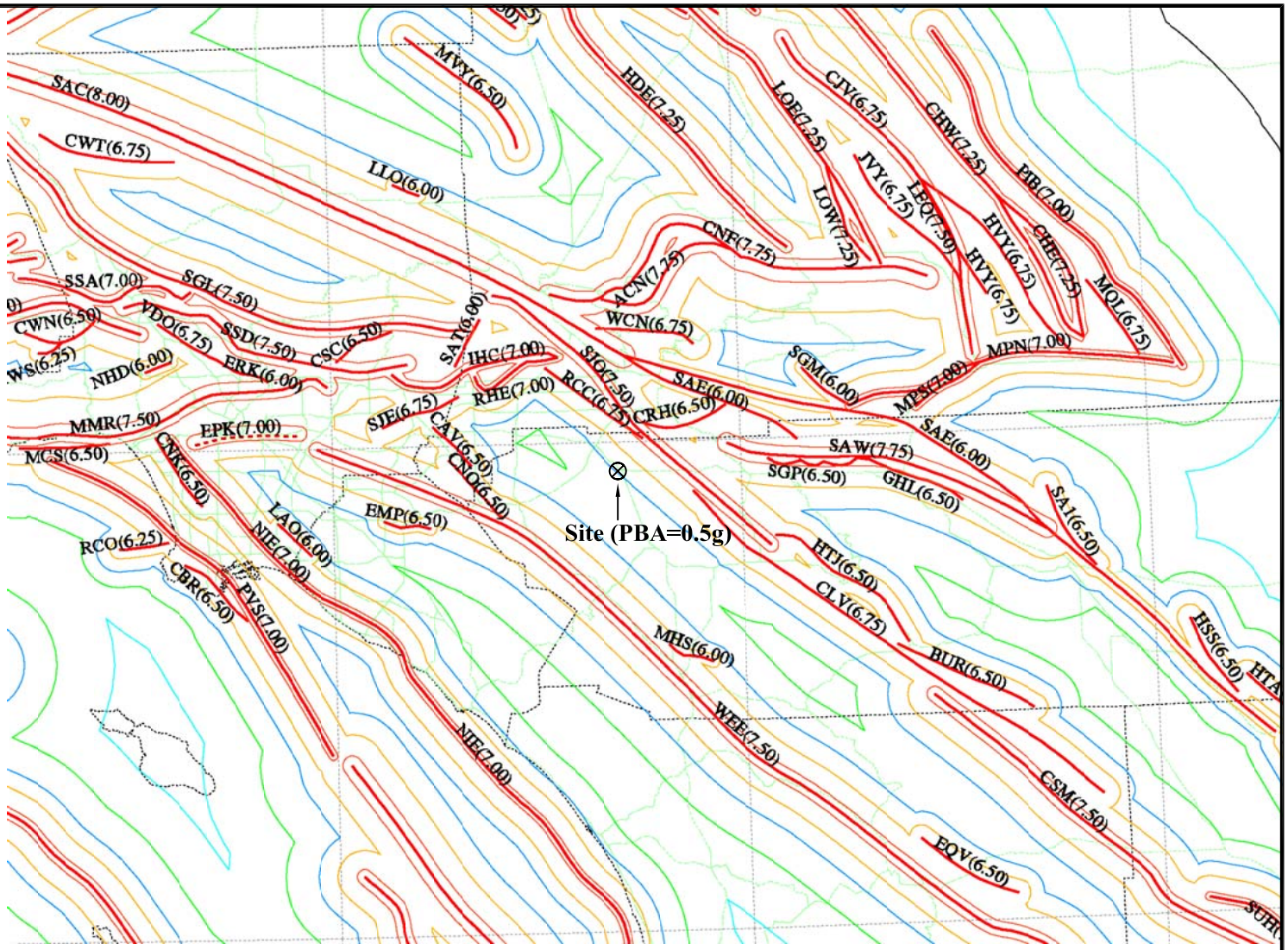
DISREGARD PRINTS BEARING EARLIER REVISION DATES → 3/12/08 7/21/08 11/4/08 12/17/08 05/05/09

REVISION DATES | SHEET 4 | OF 4

FILE -) $REQUEST

USERNAME -*$USER DATE PLOTTED -) $DATE TIME PLOTTED -) $TIME

ATTACHED IMAGES: Images: Fault.tif Images: Fault-legend.tif Images: plate 5.tif
ATTACHED XREFS:
DIAMOND BAR, CA CAD FILE: L:\2009\CADD\76979\I-215_SR60\050309_Box-Spring_OH_(Replace)\ LAYOUT: 5 PLOTTED: 04 May 2009, 4:37pm, MGriffin



LEGEND:

- 0.7g Peak Acceleration Contour
- 0.6g Peak Acceleration Contour
- 0.5g Peak Acceleration Contour
- 0.4g Peak Acceleration Contour
- 0.3g Peak Acceleration Contour
- 0.2g Peak Acceleration Contour
- 0.1g Peak Acceleration Contour
- Special Seismic Source (SSS)
- Faults with Fault Codes (MCE)
- State Highways
- County Boundary
- Latitude & Longitude

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PROJECT NO.	76979
DRAWN:	5/3/09
DRAWN BY:	DMF
CHECKED BY:	MC
FILE NAME:	76979p5.dwg

FAULT AND PBA MAP

I-215/SR-60 EAST JUNCTION
BOX SPRINGS ROAD OH (REPLACE)
RIVERSIDE, CALIFORNIA

PLATE
5

CALTRANS BRIDGE DESIGN ARS CURVE

(Version 4.0, Copyright 2007, Developed By: GeoSoftware Solutions, All Rights Reserved, http://www.geosoftwaresolutions.com)
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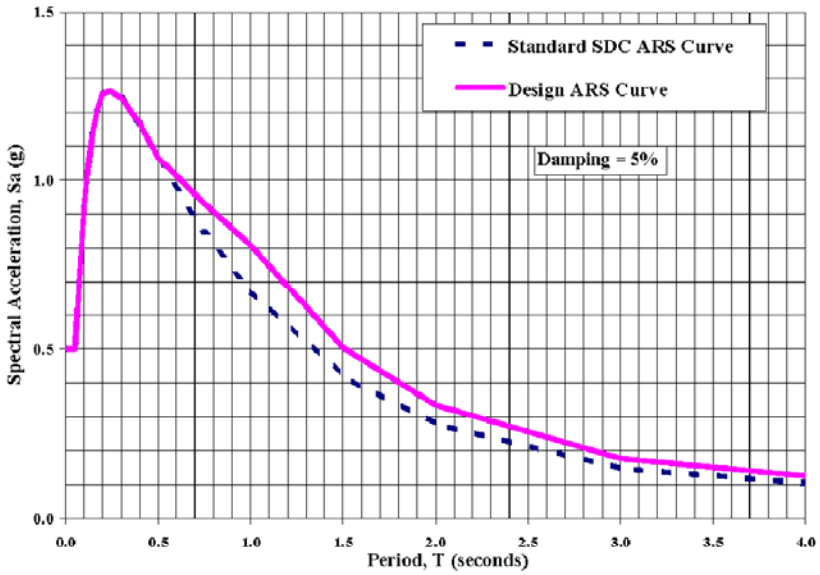
PROJECT INFORMATION	
Project Name	I-215/SR60 East Junction
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS	
Controlling Fault Name	San Jacinto (SJO)
Fault Type	Strike-slip (SS)
MCE Moment Magnitude	7.50
Distance to Fault	8.80 kilometers
Peak Bedrock Acceleration Based on 1996 California Seismic Hazard Map	0.5 g
Soil Profile Type	C

COMPUTED RESULTS	
Peak Bedrock Acceleration Based on Sadigh et al. (1997)[1]	0.46 g
Design Peak Bedrock Acceleration (g)	0.50 g



COMPUTED ARS CURVES

Period T (seconds)	Standard SDC ARS Curve[2] Sa (g)	Design ARS Curve[3] Sa (g)
0.010	0.500	0.500
0.020	0.500	0.500
0.030	0.500	0.500
0.050	0.500	0.500
0.075	0.719	0.719
0.100	0.919	0.919
0.120	1.037	1.037
0.150	1.155	1.155
0.170	1.207	1.207
0.200	1.256	1.256
0.240	1.264	1.264
0.300	1.244	1.244
0.400	1.168	1.168
0.500	1.067	1.067
0.750	0.847	0.932
1.000	0.674	0.808
1.500	0.419	0.503
2.000	0.278	0.334
3.000	0.147	0.177
4.000	0.104	0.125

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

NOTES:

[1]Peak Bedrock Acceleration (PBA):
Estimated using attenuation relationship by Sadigh et al. (1997) for rock site.
Sadigh et al. (1997) recommended no increase for Strike-Slip Fault, 10% increase for Oblique Fault; and 20% increase for Reverse/Thrust Fault. If type of fault is unknown, a 10% increase is assumed.

[2]Standard Seismic Design Criteria (SDC) ARS Curve:
Used Caltrans standard SDC ARS curve for the given PBA, magnitude, and soil profile type.

[3]Design ARS Curve:
When the bridge is located within 15 km of the controlling fault, the standard SDC ARS curve was modified as follows to account for fault rupture directivity effect:
- For Periods < 0.5 sec, no increase in standard SDC spectral acceleration values.
- For Periods > 1.0 sec, the standard SDC spectral acceleration values were increased by 20%.
- For Periods between 0.5 sec and 1.0 sec, spectral acceleration values were linearly interpolated.

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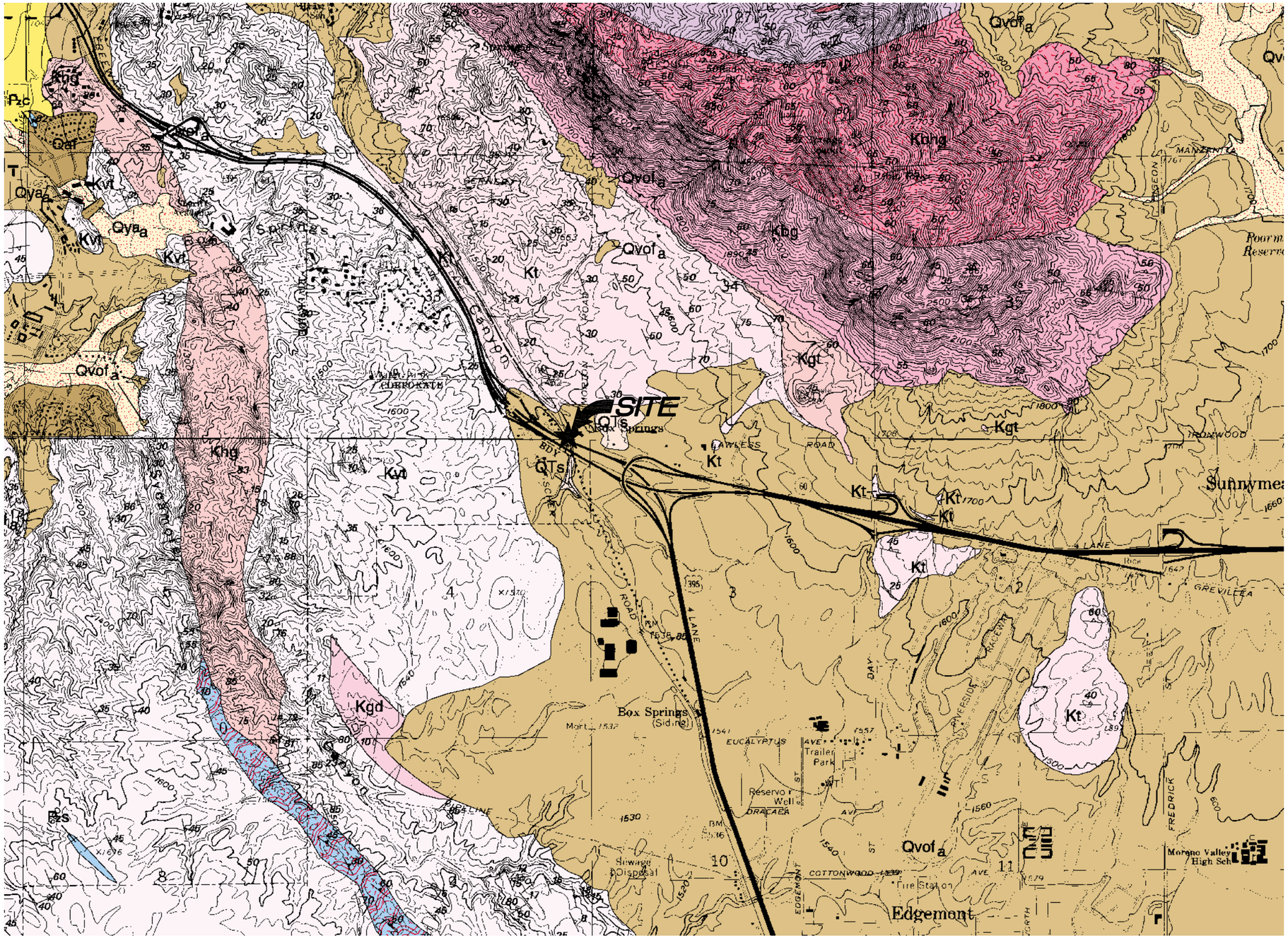
DRAWN BY:	MRG
CHECKED BY:	SL
FILE NAME:	76979p6.dwg

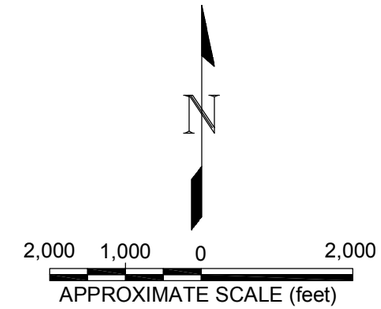
PRELIMINARY DESIGN ARS CURVE

I-215/SR-60 EAST JUNCTION
BOX SPRINGS ROAD OH (REPLACE)
RIVERSIDE, CALIFORNIA

PLATE
6

ATTACHED IMAGES: Images: Plate6-ARS Curve_1.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\050309_Box-Spring_OH_(Replace)\ LAYOUT: 6 PLOTTED: 04 May 2009, 4:03pm, MGriffin





EXPLANATION

Qvof	VERY OLD ALLUVIAL FAN DEPOSITS
QTs	UNNAMED LATE CENOZOIC SEDIMENTARY ROCK
Kvt	VAL VERDE TONALITE
Kt	TONALITE, UNDIFFERENTIATED

REFERENCE: GEOLOGIC MAP OF THE RIVERSIDE EAST QUADRANGLE 7.5' QUADRANGLE. RIVERSIDE COUNTY, CALIFORNIA. 2001 U.S. GEOLOGICAL SURVEY OPEN FILE REPORT 01-452, SCALE: 1:24,000

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REGIONAL GEOLOGIC MAP

I-215/SR60 EAST JUNCTION
BOX SPRINGS ROAD OH (REPLACE)
RIVERSIDE, CALIFORNIA

PLATE
7

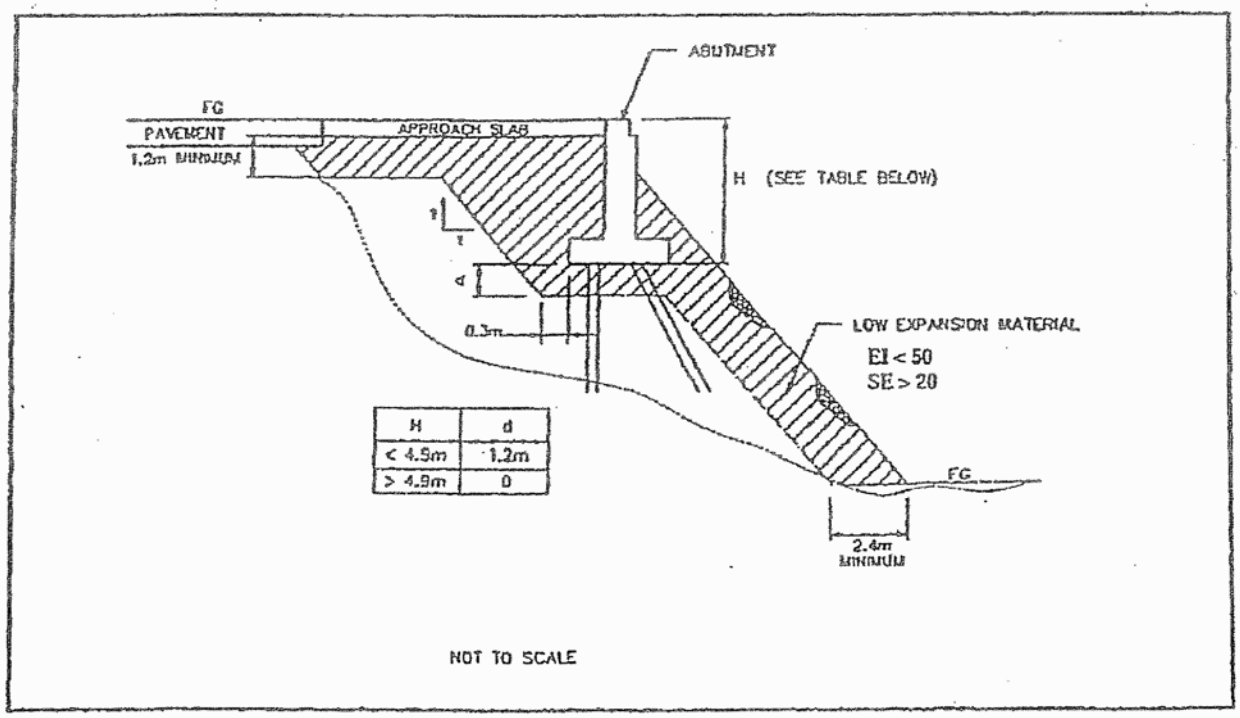
ATTACHED IMAGES: Images: Riverside East_map.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\050309_Box-Spring_OH_(Replace)\ LAYOUT: 7 PLOTTED: 04 May 2009, 4:10pm, dfahmey

EXPANSIVE SOIL EXCLUSION ZONE

GUIDELINE FOR DEFINING EXPANSIVE SOIL AND THE ZONE AROUND BRIDGE ABUTMENTS IN WHICH EXPANSIVE SOIL IS TO BE EXCLUDED (ALSO APPLICABLE TO WINGWALLS AND RETAINING WALLS).

Expansive soil materials shall not be placed as part of the embankment within the limits of a bridge abutment as shown in Figure 7 below for the full width of the embankment. Expansive soil materials for this requirement are defined as having either an Expansion Index (EI) greater than 50, (Expansion Index to be determined in accordance with ASTM D 4829) or a Sand Equivalent (SE) less than 20 (Sand Equivalent to be determined in accordance with California Test Method 217). This requirement is exclusive of the structure backfill and pervious backfill material requirements as shown on the plans and set forth in the Standard Specifications under Sections 19-3.06 and 19-3.065 respectively.

TYPICAL SECTION - EXPANSIVE SOIL EXCLUSION ZONE IN BRIDGE EMBANKMENT



H	d
< 4.9m	1.2m
> 4.9m	0

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EXPANSIVE SOIL EXCLUSION ZONE

I-215/SR-60 EAST JUNCTION
BOX SPRINGS OVERHEAD WIDENING
RIVERSIDE, CALIFORNIA

PLATE **8**

ATTACHED IMAGES: Images: For Plate 9.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\050309_Box-Spring_OH_Widening\ LAYOUT: 7 PLOTTED: 18 May 2009, 1:03pm, MGriffin

APPENDIX A

FIELD EXPLORATION

APPENDIX A
FIELD EXPLORATION

The subsurface exploration program for the Box Springs Road Overhead Replacement consisted of drilling, logging and sampling three exploratory soil borings KB-1 through KB-3 (LOTB Nos. A-08-003 through A-08-005) on September 15 2008. The *Field Exploration Summary* is presented in Table A-1. These borings were advanced to depths ranging from approximately 20.5 to 15.1 meters below the existing ground surface (bgs). The borings were advanced using a Mobile B-61, truck-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer delivery system. The borings were logged and sampled using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. In addition, representative bulk samples were collected from the borings. Following drilling, sampling and logging, the borings were backfilled with native cuttings. The boring locations are shown on Plate 4, *Logs of Test Borings*.

The boring logs are presented at the end of this appendix. The logs describe the earth materials encountered during drilling, and indicate the locations of the samples obtained. The excavations were logged by a staff professional from Kleinfelder using methods outlined in the Unified Soil Classification System (USCS) and general procedures established in ASTM D2488. The boundaries between soil and rock type(s) shown on the logs are approximate because the transition between different soil and rock layer(s) may be gradual.

Table A-1
Field Exploration Summary

Exploration Number	LOTB Number	Exploration Depth (m)	Groundwater Depth (m)	Station Number and Offset (m)	Support Location	Ground Surface Elevation (m)
KB-1	A-08-003	21.5	19.5	Sta.15+22.71 (1.25 North of “A” Line)	Abutment 1	460
KB-2	A-08-004	15.1	3.4	Sta.15+77.50 (12.08 South of “A” Line)	Bent 3	450
KB-3	A-08-005	15.4	3.8	Sta. 15+44.79 (11.67 North of “A” Line)	Bent 2	451

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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	ID	DESCRIPTION	MAJOR DIVISION		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Well-graded gravels, gravel-sand mixtures	FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands
		GP		Poorly-graded gravels, gravel-sand mixtures			CL		Inorganic clays of low to medium plasticity; gravelly clays silty clays,sandy clays, lean clays
		GM		Silty gravels, gravel-sand-silt mixtures			OL		Organic silts and organic silt-clays of low plasticity
		GC		Clayey gravels, gravel-sand-clay mixtures					
	SAND AND SANDY SOILS	SW		Well-graded sands, gravelly sands		SILTS AND CLAYS LL > 50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		SP		Poorly-graded sands and gravelly sands			CH		Inorganic clays of medium to high plasticity
		SM		Silty sands, sand-silt mixture			OH		Organic clays of medium to high plasticity
		SC		Clayey sands, sand-clay mixture		HIGHLY ORGANIC SOILS	Pt		Peat, muck and other highly organic soils

▼ Approximate water level observed in boring following drilling

SOIL SAMPLE

- Bulk Sample
- Drive Sample - California Sample
- Shelby Tube Sample
- Standard Penetration Test (SPT) Sample

ADDITIONAL TESTS

CN	- Consolidation
COR	- Corrosion
CP	- Collapse Potential
DS	- Direct Shear
EI	- Expansion Potential
MAX	- Maximum Dry Density
OC	- Organic Content
PI	- Plasticity Index
RV	- R-Value
SE	- Sand Equivalent
GS	- Grain Size Distribution

NOTES:

Blow counts represent the number of blows of a 64-kilogram hammer falling 760 mm required to drive a sampler through the last 300 mm of a 460 mm penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

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LEGEND TO LOGS

PLATE A-1

Date Drilled	9/15/08	Water Depth:	20 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	9/15/08
Drilling Method:	200mm Hollow-stem auger	Elevation:	460 meters
Logged By:	L. Hong	Datum:	MSL

Elevation (approx.) (meters)	Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Brown, moist, fine to coarse grained sand, with trace fine gravel to 6.4 mm, with some clay	18.5	9.0	GS, DS, COR, MAX
459		2	32				--olive, medium dense, fine to coarse grained sand with trace fine gravel to 12.7 mm, with trace calcium carbonate, with clay	19.6	7.0	
	1									
458		3	7				--dark brown, loose, fine to medium grained sand, with trace clay, with trace fine gravel to 6.4 mm			
	2									
457										
	3	4	30				--brown, medium dense, medium grained sand, weakly cemented, with trace calcium carbonate, with trace fine gravel to 12.7 mm	19.4	7.0	CP
456										
	4					SM	**Alluvium (Qal): Silty Sand:** Gray-brown, moist, very dense, fine to coarse grained sand, with trace fine gravel to 12.7 mm			
455		5	26 50/130				--very dense, with trace fine gravel to 12.7 mm, fractured coarse gravel to 19.1 mm in sampler			GS
	5									
454										
	6	6	52/170				--medium grained sand --interbedded a thin layer of Poorly-graded Sand, medium to coarse grained sand			
453										
	7						--red-brown			
452		7	22 50/130				--fine to medium grained sand, weakly cemented, with trace calcium carbonate			
	8									
451										
	9	8	10 50/130				**Bedrock (Kt):** Tonalite, mottled black, white, and olive-brown, moist, hard, slightly weathered, recovered as	18.2	6.2	
450										

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I-215/SR-60 East Junction
Box Springs Road OH (Replace)
Riverside, California

PLATE
A-2a

PROJECT NO. 76979

LOG OF BORING KB-1

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 5/5/09

Elevation (approx.) (meters)	Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
							fine to coarse grained sand, with trace mica			
449	11	9	26 50/100				--slightly weathered			
448	12	10	50/80				--slightly to moderately weathered	18.3	2.8	
447	13									
446	14	11	50/100				--increase in moisture content, slightly to moderately weathered			
445	15	12	50/130				--slightly to moderately weathered	19.0	5.1	
444	16									
443	17	13	50/100							
442	18									
441	19	14	50/80				--moist to wet, slightly weathered			
440	20	15	50/100			▼	--wet, moderately weathered			
439	21									

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I-215/SR-60 East Junction
Box Springs Road OH (Replace)
Riverside, California

LOG OF BORING KB-1

PLATE
A-2b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 5/5/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
438	16	50/130				Boring terminated at 21.5 meters. Groundwater was encountered at 20.0 meters. Hole backfilled using soil from cuttings.			

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I-215/SR-60 East Junction
Box Springs Road OH (Replace)
Riverside, California

LOG OF BORING KB-1

PLATE

A-2c

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 5/5/09

Date Drilled	9/15/08	Water Depth:	3 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	9/15/08
Drilling Method:	200mm Hollow-stem auger	Elevation:	451 meters
Logged By:	L. Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Dark brown, moist, fine to medium grained sand			
450		2	9				--loose, fine grained sand			
	1									
449		3	1				--very dark gray-brown, moist to wet, very loose, fine to medium grained sand			
	2									
448						▼				
	3	4	4				--wet, fine to medium grained sand, with trace mica	16.8	20.0	COR
447										
	4									
446		5	58				**Bedrock (Kt):** Tonalite, mottled olive, white, and brown, wet, hard, slightly weathered, recovered as fine to coarse grained sand, with trace mica			GS
	5									
445										
	6	6	25 50/80				--moderately weathered	17.6	15.8	
444										
	7									
443		7	16 50/80				--moderately weathered, with trace calcium carbonate, with some fine sand, with trace silt			
	8									
442										
	9	8	50/100				--increase in silt content, with trace calcium carbonate			
441										

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I-215/SR-60 East Junction
Box Springs Road OH (Replace)
Riverside, California

LOG OF BORING KB-2

PLATE
A-3a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 5/5/09

Elevation (approx.) (meters)	Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
440		9	50/130							
	11									
439										
	12	10	50/130				--mottled white, black, and gray, moderately weathered, with some silt			
438										
	13									
437		11	50/130							
	14									
436										
	15	12	50/100							
							Boring terminated at 15.1 meters. Groundwater was encountered at 3.0 meters. Hole backfilled using soil from cuttings.			

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I-215/SR-60 East Junction
Box Springs Road OH (Replace)
Riverside, California

LOG OF BORING KB-2

PLATE

A-3b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 5/5/09

Date Drilled	9/15/08	Water Depth:	4 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	9/15/08
Drilling Method:	200mm Hollow-stem auger	Elevation:	450 meters
Logged By:	L. Hong	Datum:	MSL

Elevation (approx.) (meters)	Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
450		1					A layer of 101.6 mm riprap consists of rocks to 38.1 mm			
	1	2	36				**Alluvium (Qal): Silty Sand:** Olive, moist, fine grained sand, with trace mica --medium dense, with trace clay			
449		3	33 50/130				**Bedrock (Kt):** Tonalite, mottled black, white, and olive-brown, moist, hard, slightly weathered, recovered as fine to coarse grained sand, with trace mica, with trace clay --very dense, slightly weathered	21.0	4.5	DS, CP
	2									
448										
	3	4	12 50/130				--increase in quartz content, with trace calcium carbonate, with trace mica			
447										
	4					▼				
446		5	50/150				--wet, slightly weathered, with trace mica	17.4	21.7	
	5									
445										
	6	6	50/130				--with trace silt			
444										
	7									
443		7	50/100				--moderately weathered			
	8									
442										
	9	8	50/100							
441										

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I-215/SR-60 East Junction
Box Springs Road OH (Replace)
Riverside, California

LOG OF BORING KB-3

PLATE
A-4a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 5/5/09

Elevation (approx.) (meters)	Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
440										
		9	50/80							
	11									
439										
							--increase in silt content			
	12									
438		10	50/100							
							--mottled white, black, and, dark gray, with trace mica			
	13									
437										
		11	50/100							
	14									
436										
	15									
435		12	50/100							
							Boring terminated at 15.4 meters. Groundwater was encountered at 4.0 meters. Hole backfilled using soil from cuttings.			

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I-215/SR-60 East Junction
Box Springs Road OH (Replace)
Riverside, California

LOG OF BORING KB-3

PLATE

A-4b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 5/5/09

APPENDIX B

LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

Laboratory tests were performed on drive and bulk soil samples to estimate engineering characteristics of the various earth materials encountered. Testing was performed in general accordance with procedures outlined by the American Society for Testing and Materials, the California Department of Transportation, or other accepted procedures.

IN-SITU MOISTURE CONTENT AND DRY UNIT WEIGHT

In-situ moisture content and dry unit weight tests were performed on samples that could be recovered in a relatively undisturbed condition. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937. The test results are presented on the Logs of Borings in Appendix A, *Field Exploration*.

GRAIN SIZE DISTRIBUTION

Sieve analyses were performed on selected samples of the materials encountered at the site to evaluate the grain size distribution characteristics of the soils and to aid in their classification. The tests were performed in general accordance with ASTM Standard Test Method D 422. The results of these tests are presented on Plates B-1 through B-3, *Grain Size Distribution*.

DIRECT SHEAR TEST

Two direct shear tests were performed on samples to evaluate the drained shear strength of the soils. The samples were soaked and tested in a near-saturated condition in general accordance with ASTM Test Method D 3080 (consolidated, drained). The results of these tests are presented on Plates B-4 through B-5, *Direct Shear Test*, and summarized in Table B-1, below.

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Table B-1
Direct Shear Test Results

Boring No.	Depth (m)	USCS Soil Type	Dry Unit Weight (kN/m^3)	Angle of Internal Friction (degrees)	Cohesion (kPa)
KB-1*	0 – 1.5	SM	18.5	38	0
KB-3	1.5 - 2.0	Bedrock	19.8	31	41.5

* Remolded to 90% of Maximum Density

COLLAPSE POTENTIAL

Two collapse potential tests were performed on selected on-site soil samples to determine collapse potential of the soils. The test was performed in accordance with ASTM D5333. The test results are presented on Plates B-7 through B-8 and summarized in Table B-2, below.

Table B-2
Collapse Potential Test Results

Location	Depth (m)	USCS Soil Type	Dry Density (kN/m^3)	Moisture Content (%)	Collapse Potential (%)
KB-1	3.0 - 3.5	SM	19.3	7.0	0.9
KB-3	1.5 - 2.0	SM	20.0	4.5	0.7

CORROSIVITY TESTS

Chemical analyses were performed on two samples of the sub-surface soil to estimate pH, resistivity, soluble sulfate, and chloride contents in general accordance with Caltrans Standard Test Methods 532 (pH), 643 (resistivity), 417 (sulfates), and 422 (chlorides). The test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to the construction materials. The test results are summarized in Table B-3, below.

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Table B-3
Corrosion Test Results

Boring No.	Depth (m)	Minimum Resistivity (Ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
KB-1	0 -1.5	1900	8.1	11	131
KB-2	3.0 - 3.5	2300	7.7	17	148

MAXIMUM DRY UNIT WEIGHT/OPTIMUM MOISTURE CONTENT

One maximum dry unit weight/optimum moisture content tests were performed on selected bulk samples of the on-site soils to determine compaction characteristics. The tests were performed in accordance with ASTM D1557. The test results are presented in Table B-4, below.

Table B-4
Maximum Unit Weight/Optimum Moisture Content Test Results

Location	Depth (m)	USCS Soil Type	Maximum Unit Weight (kN/m^3)	Optimum Moisture Content (%)
KB-1	0 - 1.5	SM	21.0	7.5

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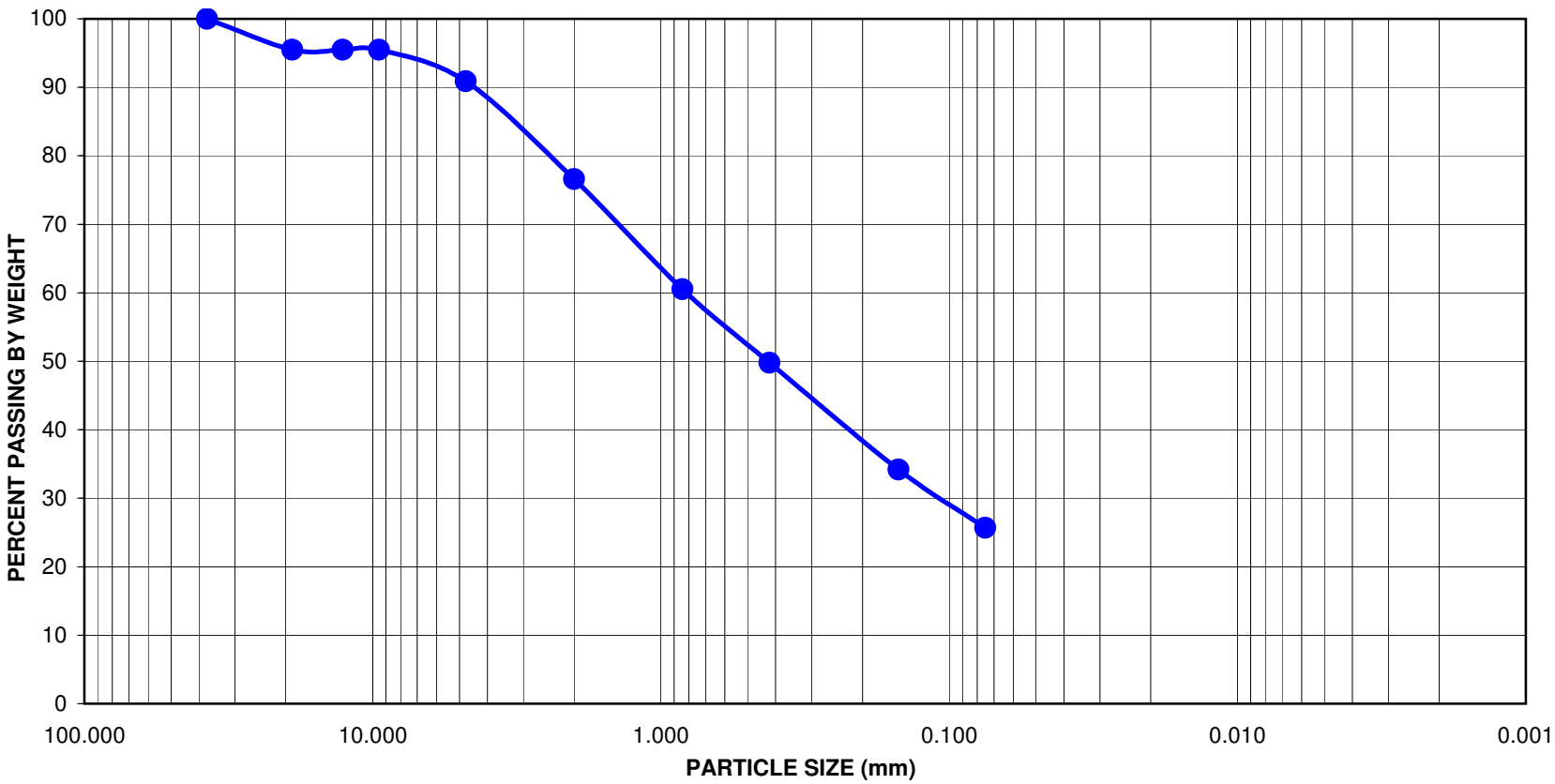
GRAIN SIZE DISTRIBUTION
ASTM D422

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
SIEVE ANALYSIS					HYDROMETER	

3" 1.5" 3/4" 3/8" #4 #10 #20 #40 #100 #200



Symbol	Exploration No.	Sample No.	Depth (feet)	Sample Description	Gravel : Sand : Fines (%)	Soil Type
●	KB-1	1	0 -5	Silty Sand	9 : 65 : 26	SM

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PROJECT NO. 76979

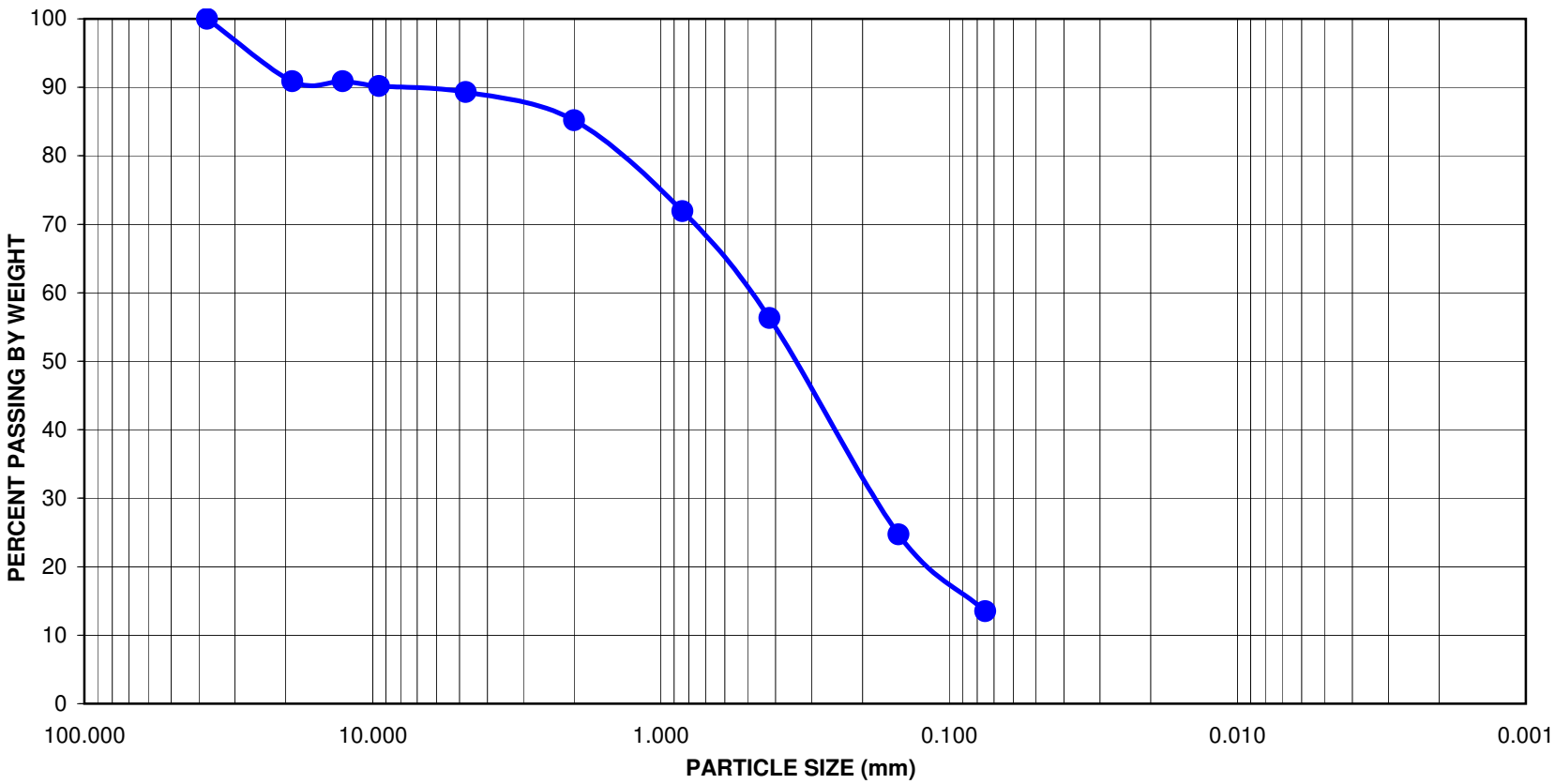
I-215/SR-60 East Junction
Box Springs Road OH (Replace)
Riverside, California

PLATE NO.
B-1

GRAIN SIZE DISTRIBUTION
ASTM D422

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
SIEVE ANALYSIS					HYDROMETER	

3" 1.5" 3/4" 3/8" #4 #10 #20 #40 #100 #200



Symbol	Exploration No.	Sample No.	Depth (feet)	Sample Description	Gravel : Sand : Fines (%)	Soil Type
●	KB-1	5	15.0 - 16.5	Silty Sand	10 : 76 : 14	SM

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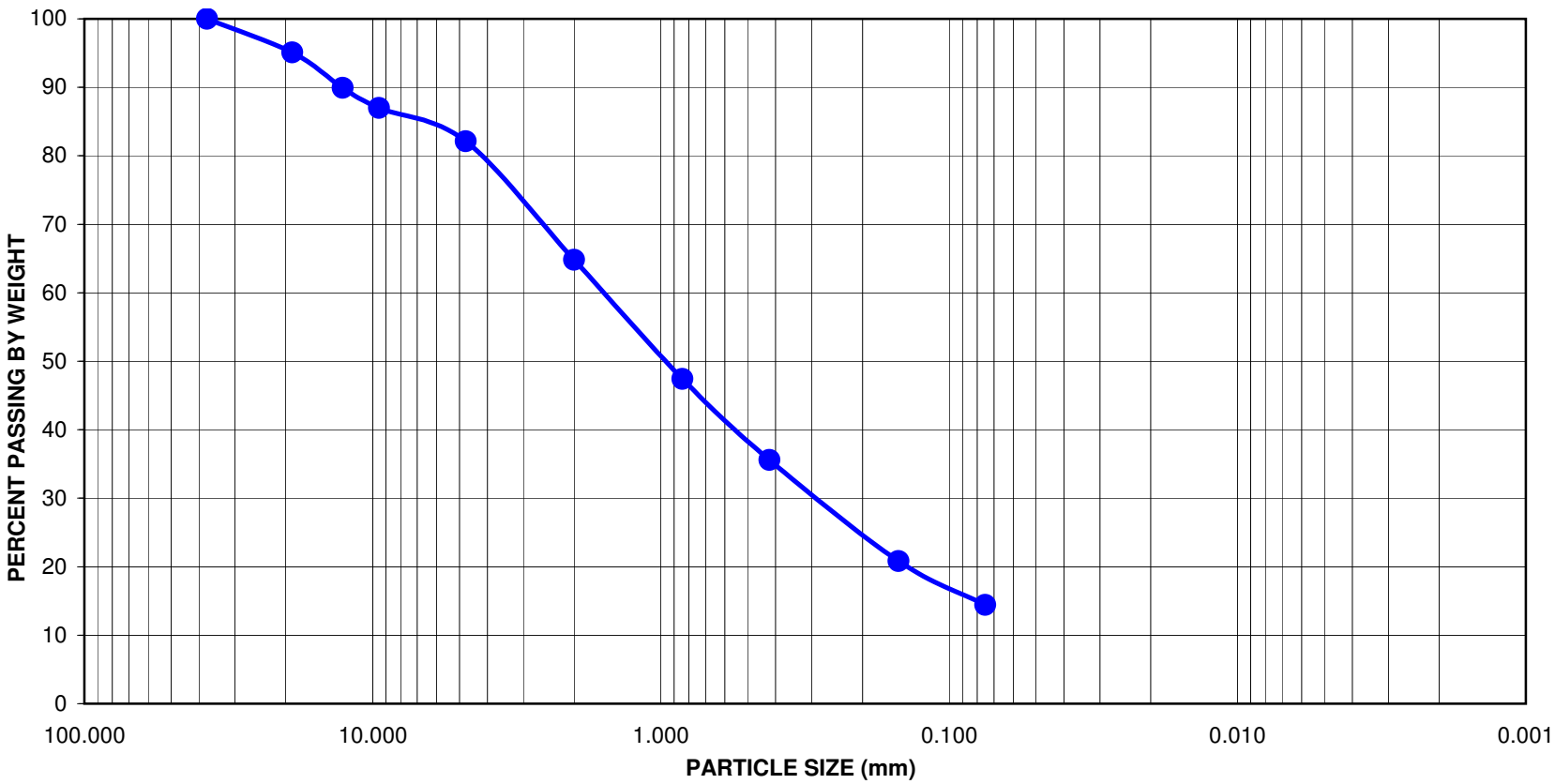
I-215/SR-60 East Junction
Box Springs Road OH (Replace)
Riverside, California

PLATE NO.
B-2

GRAIN SIZE DISTRIBUTION
ASTM D422

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
SIEVE ANALYSIS					HYDROMETER	

3" 1.5" 3/4" 3/8" #4 #10 #20 #40 #100 #200



Symbol	Exploration No.	Sample No.	Depth (feet)	Sample Description	Gravel : Sand : Fines (%)	Soil Type
●	KB-2	5	15.0 - 16.5	Silty Sand with Gravel	18 : 68 : 14	SM

KLEINFELDER
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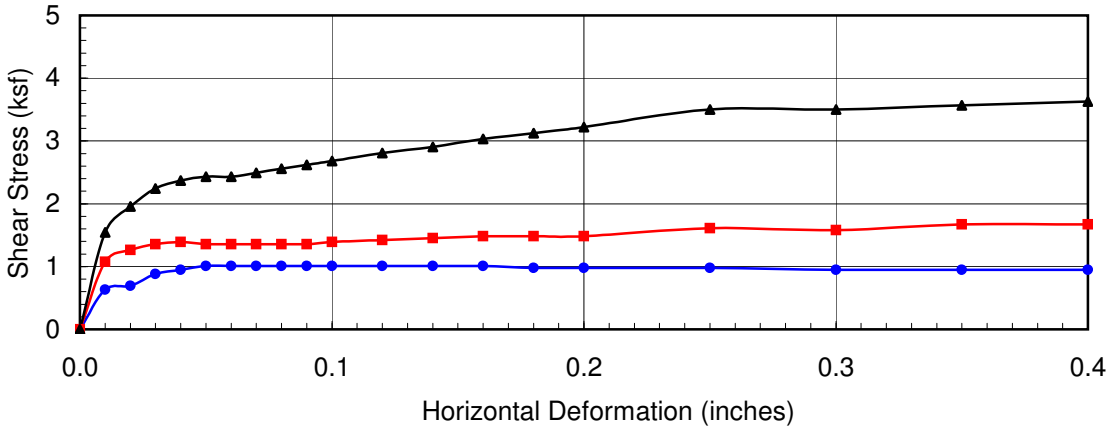
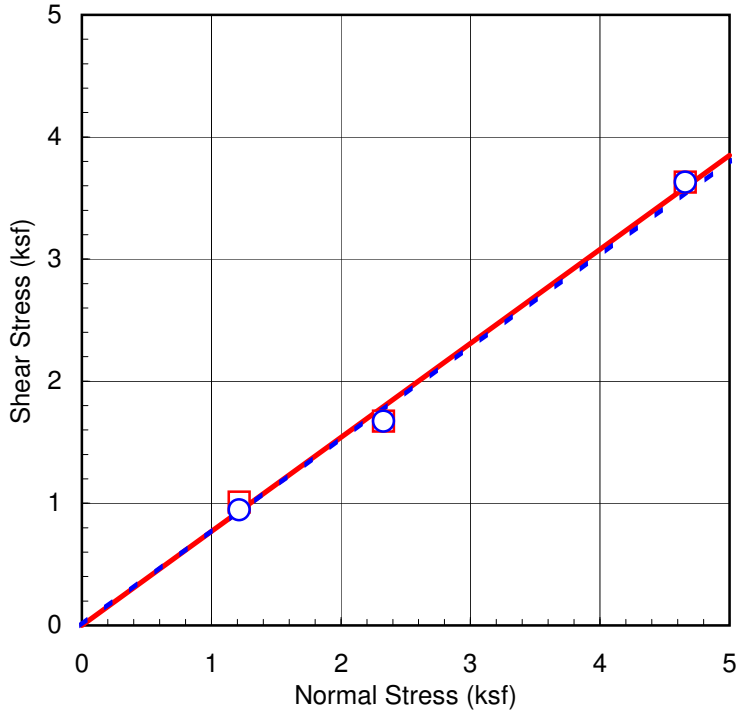
PROJECT NO. 76979

I-215/SR-60 East Junction
Box Springs Road OH (Replace)
Riverside, California

PLATE NO.
B-3

DIRECT SHEAR TEST DATA
ASTM D3080





	Load 1	Load 2	Load 3
Normal Stress (ksf)	1.216	2.329	4.658
Peak Shear Stress (ksf) □	1.010	1.673	3.630
Ultimate Shear Stress (ksf) ○	0.947	1.673	3.630
Initial Moisture Content (%)	9.0	9.0	9.0
Dry Density (pcf)	118.5	117.9	117.1

Exploration No.	KB-1
Sample No.	1
Sample Type	Remolded to 90% Relative Compaction
Depth (feet)	0 - 5.0
Description	Silty Sand (SM)

Shear Strength Parameters		
	Cohesion C (psf)	Friction Angle ϕ (°)
Peak	0	38
Ultimate	0	37

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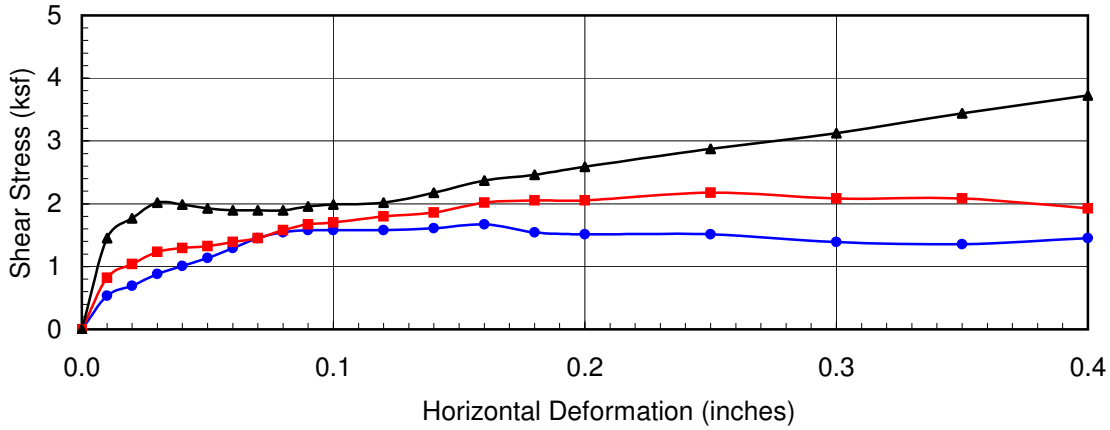
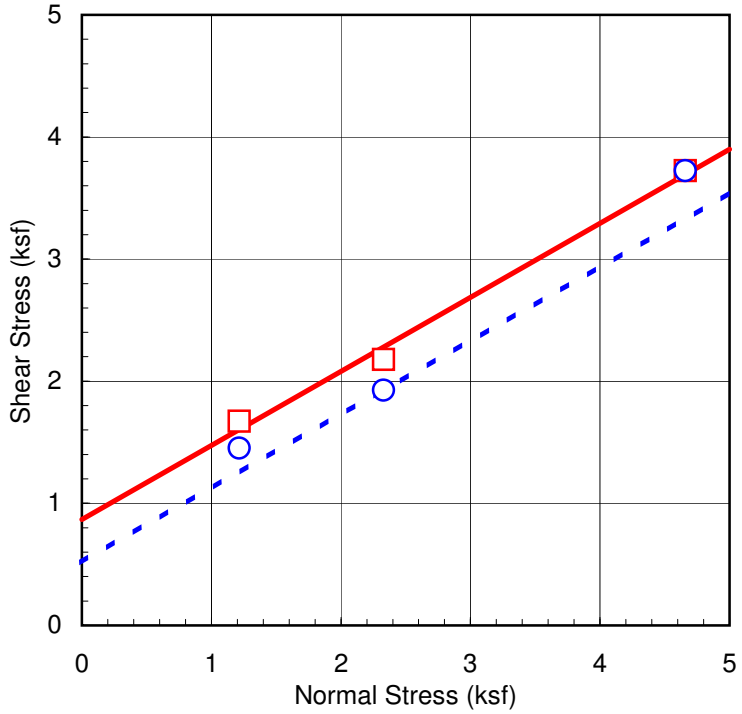
PROJECT NO. 76979

I-215/SR-60 East Junction
Box Springs Road OH (Replace)
Riverside, California

PLATE NO.
B-4

DIRECT SHEAR TEST DATA
ASTM D3080





	Load 1	Load 2	Load 3
Normal Stress (ksf)	1.216	2.329	4.658
Peak Shear Stress (ksf) □	1.673	2.178	3.725
Ultimate Shear Stress (ksf) ○	1.452	1.926	3.725
Initial Moisture Content (%)	4.5	4.5	4.5
Dry Density (pcf)	126.2	124.0	128.8

Exploration No.	KB-3
Sample No.	3
Sample Type	In-Situ (Undisturbed)
Depth (feet)	5.0 - 6.5
Description	Weathered Granitic Rock

Shear Strength Parameters		
	Cohesion C (psf)	Friction Angle ϕ (°)
Peak	867	31
Ultimate	515	31

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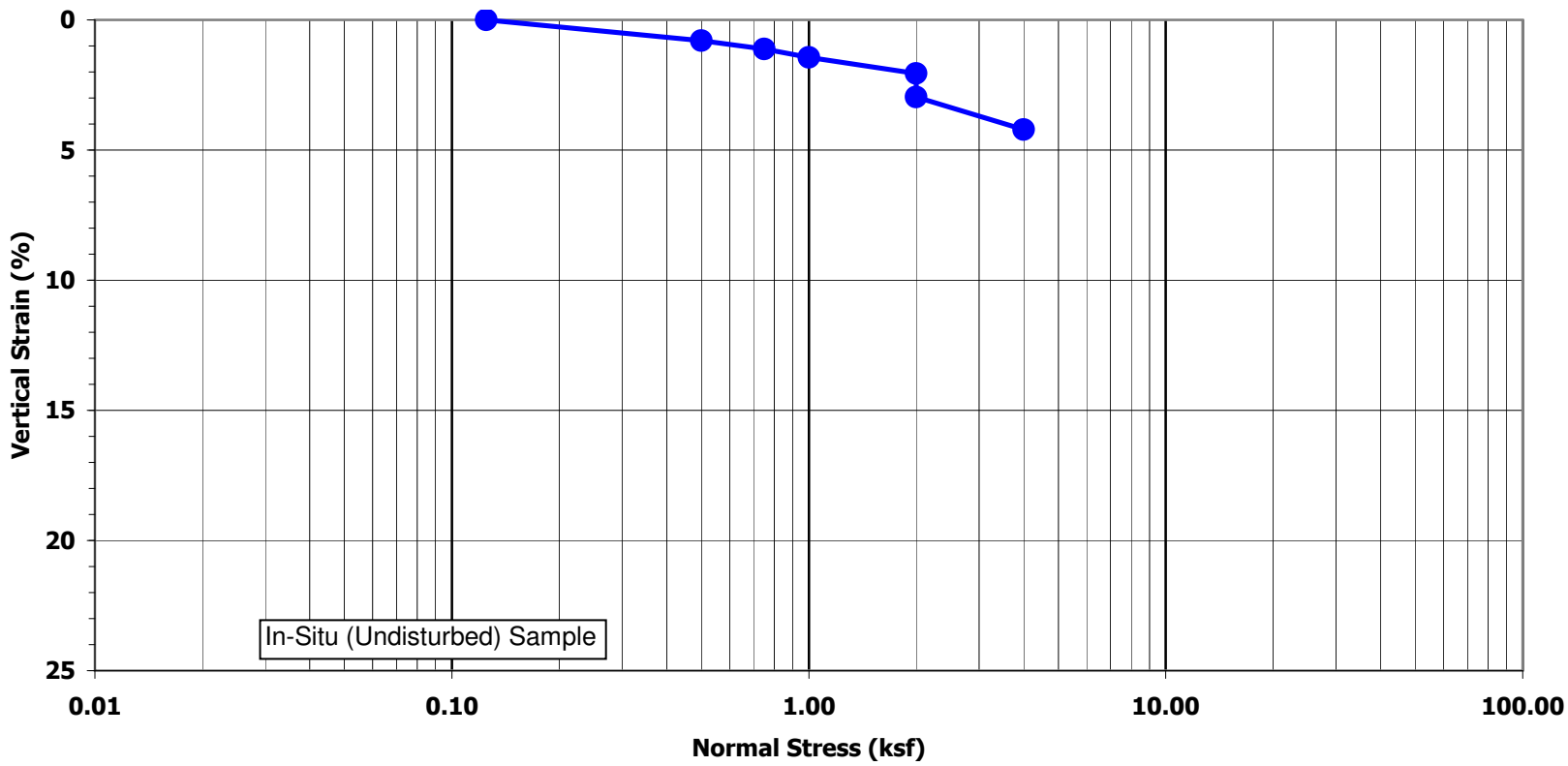
PROJECT NO. 76979

I-215/SR-60 East Junction
Box Springs Road OH (Replace)
Riverside, California

PLATE NO.
B-5

COLLAPSE POTENTIAL TEST DATA
ASTM D5333

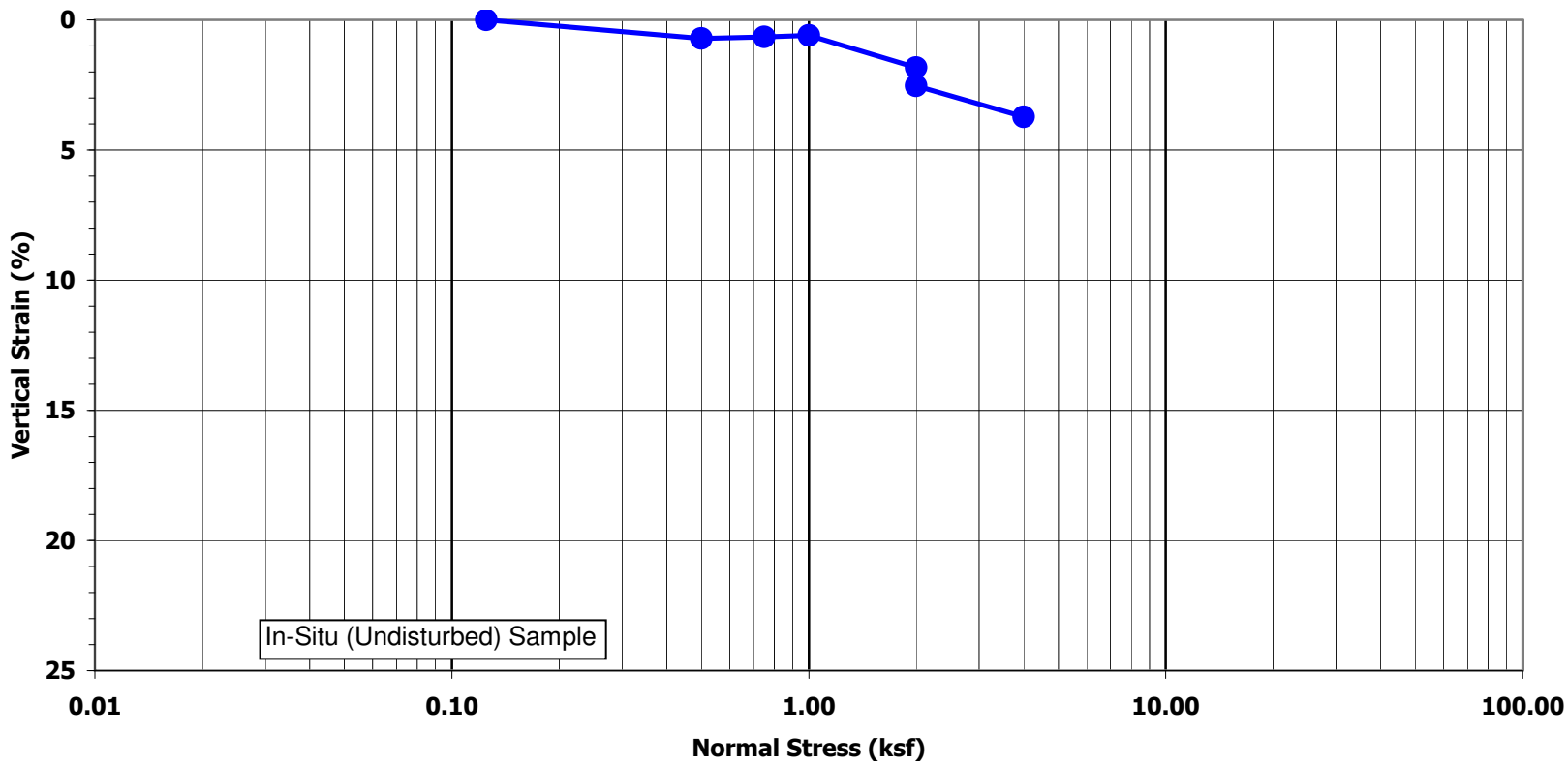


Note: Specimen inundated at a normal stress of 2 ksf during test.

Symbol	Exploration No.	Depth (feet)	Sample Description	Dry Unit Weight (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Collapse Potential (%)
●	KB-1	10.0 - 11.5	Silty Sand (SM)	123.3	7.0	14.6	0.9

KLEINFELDER Bright People. Right Solutions.	I-215/SR-60 East Junction Box Springs Road OH (Replace)	PLATE NO.
PROJECT NO. 76979	Riverside, California	B-6

COLLAPSE POTENTIAL TEST DATA
ASTM D5333



Note: Specimen inundated at a normal stress of 2 ksf during test.

Symbol	Exploration No.	Depth (feet)	Sample Description	Dry Unit Weight (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Collapse Potential (%)
●	KB-3	5.0 - 6.5	Silty Sand (SM)	127.4	4.5	11.1	0.7

KLEINFELDER Bright People. Right Solutions.	I-215/SR-60 East Junction Box Springs Road OH (Replace)	PLATE NO.
PROJECT NO. 76979	Riverside, California	B-7

APPENDIX C

ENGINEERING ANALYSES

C-1

LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	KB-1
Liquefaction Analysis Method	1996+1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1507.20 feet
Proposed Grade Elevation	1507.20 feet
Unit Weight of Proposed Fill on Surface	120.00 pcf
GWT Elevation During Test	1441.60 feet
GWT Elevation For Design	1467.80 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<====	LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet		LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<====	Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.13 inches	<====	Dry or Unsaturated Soils (Above GWT)
	0.13 inches	<====	Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d
* FS_{liq} = (CRR/CSR), where CRR = $CRR_{7.5}$ MSF K_σ K_α ; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_α =1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. LPI = Σ w_i x f(FS_{liq}) x H_i (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1507.2	1506.2	SM	Y	120.0	20	15.0
1506.2	1505.2	SM	Y	120.0	20	15.0
1505.2	1504.2	SM	Y	120.0	20	15.0
1504.2	1503.2	SM	Y	120.0	20	15.0
1503.2	1502.2	SM	Y	120.0	20	15.0
1502.2	1501.2	SM	Y	120.0	20	15.0
1501.2	1500.2	SM	Y	120.0	20	15.0
1500.2	1499.2	SM	Y	120.0	20	15.0
1499.2	1498.2	SM	Y	120.0	20	15.0
1498.2	1497.2	SM	Y	120.0	20	15.0
1497.2	1496.2	SM	Y	120.0	7	15.0
1496.2	1495.2	SM	Y	120.0	7	15.0
1495.2	1494.2	SM	Y	120.0	7	15.0
1494.2	1493.2	SM	Y	120.0	19	15.0
1493.2	1492.2	SM	Y	120.0	19	15.0
1492.2	1491.2	SM	Y	120.0	100	25.0
1491.2	1490.2	SM	Y	120.0	100	25.0
1490.2	1489.2	SM	Y	120.0	100	25.0
1489.2	1488.2	SM	Y	120.0	100	25.0
1488.2	1487.2	SM	Y	120.0	100	25.0
1487.2	1486.2	SM	Y	120.0	49	25.0
1486.2	1485.2	SM	Y	120.0	49	25.0
1485.2	1484.2	SM	Y	120.0	49	25.0
1484.2	1483.2	SM	Y	120.0	49	25.0
1483.2	1482.2	SM	Y	120.0	49	25.0
1482.2	1481.2	SM	Y	120.0	97	25.0
1481.2	1480.2	SM	Y	120.0	97	25.0
1480.2	1479.2	SM	Y	120.0	97	25.0
1479.2	1478.2	SM	Y	120.0	97	25.0
1478.2	1477.2	SM	Y	120.0	97	25.0
1477.2	1476.2	BEDROCK/FORMATION	Y	123.0	54	15.0
1476.2	1475.2	BEDROCK/FORMATION	Y	123.0	54	15.0
1475.2	1474.2	BEDROCK/FORMATION	Y	123.0	54	15.0
1474.2	1473.2	BEDROCK/FORMATION	Y	123.0	54	15.0
1473.2	1472.2	BEDROCK/FORMATION	Y	123.0	54	15.0
1472.2	1471.2	BEDROCK/FORMATION	Y	123.0	100	15.0
1471.2	1470.2	BEDROCK/FORMATION	Y	123.0	100	15.0
1470.2	1469.2	BEDROCK/FORMATION	Y	123.0	100	15.0
1469.2	1468.2	BEDROCK/FORMATION	Y	123.0	100	15.0
1468.2	1467.2	BEDROCK/FORMATION	Y	123.0	100	15.0
1467.2	1466.2	BEDROCK/FORMATION	Y	123.0	100	16.0
1466.2	1465.2	BEDROCK/FORMATION	Y	123.0	100	16.0
1465.2	1464.2	BEDROCK/FORMATION	Y	123.0	100	16.0
1464.2	1463.2	BEDROCK/FORMATION	Y	123.0	100	16.0
1463.2	1462.2	BEDROCK/FORMATION	Y	123.0	100	16.0
1462.2	1461.2	BEDROCK/FORMATION	Y	123.0	100	12.0
1461.2	1460.2	BEDROCK/FORMATION	Y	123.0	100	12.0
1460.2	1459.2	BEDROCK/FORMATION	Y	123.0	100	12.0
1459.2	1458.2	BEDROCK/FORMATION	Y	123.0	100	12.0

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60fines}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio +++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60fines}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
0.5	1.700	0.750	43.4	0.999	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	40.3	N/A	0.010	0.000	0.00	0.13
1.5	1.700	0.750	43.4	0.997	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	40.3	N/A	0.018	0.000	0.00	0.13
2.5	1.630	0.750	41.7	0.994	N/A	0.252	N/A	N/A	NO	N/A	Soil above GWT	38.7	N/A	0.023	0.000	0.00	0.13
3.5	1.560	0.750	40.0	0.992	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	37.1	N/A	0.028	0.000	0.00	0.13
4.5	1.497	0.750	38.5	0.990	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	35.7	N/A	0.032	0.029	0.00	0.13
5.5	1.438	0.750	37.1	0.987	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	34.3	N/A	0.036	0.034	0.00	0.13
6.5	1.384	0.750	35.8	0.985	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	33.1	N/A	0.040	0.039	0.00	0.12
7.5	1.333	0.750	34.6	0.983	N/A	0.249	N/A	N/A	NO	N/A	Soil above GWT	31.9	N/A	0.043	0.045	0.01	0.12
8.5	1.287	0.850	37.6	0.980	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	34.8	N/A	0.044	0.041	0.00	0.11
9.5	1.243	0.850	36.4	0.978	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	33.7	N/A	0.047	0.046	0.01	0.11
10.5	1.202	0.850	14.0	0.976	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	12.3	N/A	0.073	0.224	0.03	0.08
11.5	1.164	0.850	13.6	0.973	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	11.9	N/A	0.077	0.244	0.03	0.05
12.5	1.128	0.850	13.3	0.971	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	11.6	N/A	0.080	0.263	0.03	0.02
13.5	1.095	0.850	30.8	0.969	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	28.4	N/A	0.059	0.071	0.01	0.01
14.5	1.063	0.850	30.0	0.966	N/A	0.245	N/A	N/A	NO	N/A	Soil above GWT	27.6	N/A	0.062	0.076	0.01	0.00
15.5	1.033	0.950	171.6	0.964	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	152.1	N/A	0.034	0.000	0.00	0.00
16.5	1.005	0.950	167.0	0.962	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	148.0	N/A	0.035	0.000	0.00	0.00
17.5	0.978	0.950	162.7	0.959	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	144.1	N/A	0.036	0.000	0.00	0.00
18.5	0.952	0.950	158.6	0.957	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	140.4	N/A	0.038	0.000	0.00	0.00
19.5	0.928	0.950	154.7	0.955	N/A	0.242	N/A	N/A	NO	N/A	Soil above GWT	136.9	N/A	0.039	0.000	0.00	0.00
20.5	0.905	0.950	76.2	0.952	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	66.5	N/A	0.050	0.000	0.00	0.00
21.5	0.884	0.950	74.4	0.950	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	64.9	N/A	0.051	0.000	0.00	0.00
22.5	0.863	0.950	72.8	0.948	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	63.4	N/A	0.053	0.000	0.00	0.00
23.5	0.843	0.950	71.2	0.945	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	62.0	N/A	0.054	0.000	0.00	0.00
24.5	0.824	0.950	69.7	0.943	N/A	0.239	N/A	N/A	NO	N/A	Soil above GWT	60.7	N/A	0.056	0.000	0.00	0.00
25.5	0.806	0.950	130.9	0.941	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	115.6	N/A	0.046	0.000	0.00	0.00
26.5	0.789	0.950	128.2	0.938	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	113.1	N/A	0.047	0.000	0.00	0.00
27.5	0.772	0.950	125.6	0.936	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	110.8	N/A	0.048	0.000	0.00	0.00
28.5	0.756	1.000	129.4	0.934	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	114.2	N/A	0.048	0.000	0.00	0.00
29.5	0.741	1.000	126.8	0.931	N/A	0.236	N/A	N/A	NO	N/A	Soil above GWT	111.9	N/A	0.049	0.000	0.00	0.00
30.5	0.726	1.000	65.3	0.926	N/A	0.235	N/A	N/A	NO	N/A	Soil above GWT	61.3	N/A	0.062	0.000	0.00	0.00
31.5	0.711	1.000	64.1	0.918	N/A	0.233	N/A	N/A	NO	N/A	Soil above GWT	60.1	N/A	0.062	0.000	0.00	0.00
32.5	0.698	1.000	62.9	0.909	N/A	0.231	N/A	N/A	NO	N/A	Soil above GWT	58.9	N/A	0.063	0.000	0.00	0.00
33.5	0.684	1.000	61.7	0.901	N/A	0.228	N/A	N/A	NO	N/A	Soil above GWT	57.8	N/A	0.064	0.000	0.00	0.00
34.5	0.671	1.000	60.6	0.893	N/A	0.226	N/A	N/A	NO	N/A	Soil above GWT	56.8	N/A	0.064	0.000	0.00	0.00
35.5	0.659	1.000	108.1	0.885	N/A	0.224	N/A	N/A	NO	N/A	Soil above GWT	102.1	N/A	0.053	0.000	0.00	0.00
36.5	0.647	1.000	106.2	0.877	N/A	0.222	N/A	N/A	NO	N/A	Soil above GWT	100.3	N/A	0.053	0.000	0.00	0.00
37.5	0.636	1.000	104.4	0.869	N/A	0.220	N/A	N/A	NO	N/A	Soil above GWT	98.5	N/A	0.054	0.000	0.00	0.00
38.5	0.625	1.000	102.6	0.861	N/A	0.218	N/A	N/A	NO	N/A	Soil above GWT	96.9	N/A	0.054	0.000	0.00	0.00
39.5	0.614	1.000	100.9	0.852	0.708	0.217	N/A	N/A	NO	N/A	Dense/stiff soil	95.2	N/A	N/A	0.000	0.00	0.00
40.5	0.603	1.000	100.0	0.844	0.703	0.217	N/A	N/A	NO	N/A	Dense/stiff soil	93.7	N/A	N/A	0.000	0.00	0.00
41.5	0.593	1.000	98.4	0.836	0.700	0.218	N/A	N/A	NO	N/A	Dense/stiff soil	92.2	N/A	N/A	0.000	0.00	0.00
42.5	0.584	1.000	96.9	0.828	0.696	0.218	N/A	N/A	NO	N/A	Dense/stiff soil	90.7	N/A	N/A	0.000	0.00	0.00
43.5	0.574	1.000	95.4	0.820	0.693	0.218	N/A	N/A	NO	N/A	Dense/stiff soil	89.3	N/A	N/A	0.000	0.00	0.00
44.5	0.565	1.000	93.9	0.812	0.690	0.219	N/A	N/A	NO	N/A	Dense/stiff soil	87.9	N/A	N/A	0.000	0.00	0.00
45.5	0.557	1.000	89.4	0.804	0.686	0.219	N/A	N/A	NO	N/A	Dense/stiff soil	86.3	N/A	N/A	0.000	0.00	0.00
46.5	0.548	1.000	88.0	0.795	0.683	0.219	N/A	N/A	NO	N/A	Dense/stiff soil	84.9	N/A	N/A	0.000	0.00	0.00
47.5	0.540	1.000	86.7	0.787	0.680	0.219	N/A	N/A	NO	N/A	Dense/stiff soil	83.7	N/A	N/A	0.000	0.00	0.00
48.5	0.532	1.000	85.4	0.779	0.677	0.219	N/A	N/A	NO	N/A	Dense/stiff soil	82.5	N/A	N/A	0.000	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	KB-1
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1507.20 feet
Proposed Grade Elevation	1507.20 feet
Unit Weight of Proposed Fill on Surface	120.00 pcf
GWT Elevation During Test	1441.60 feet
GWT Elevation For Design	1467.80 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<====	LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet		LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<====	Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.13 inches	<====	Dry or Unsaturated Soils (Above GWT)
	0.13 inches	<====	Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_R C_B C_S C_H$ x f(FC)

++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit

+++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$

* FS_{liq} = (CRR/CSR), where $CRR = CRR_{7.5}\ MSF\ K_\sigma\ K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_σ =1.0 (level ground), and MSF = magnitude scaling factor

** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).

*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).

**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma\ w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA) / SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio +++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1458.2	1457.2	BEDROCK/FORMATION	Y	123.0	100	12.0	49.5	0.524	1.000	84.2	0.771	0.674	0.218	N/A	N/A	NO	N/A	Dense/stiff soil	81.3	N/A	N/A	0.000	0.00	0.00
1457.2	1456.2	BEDROCK/FORMATION	Y	123.0	100	15.0	50.5	0.516	1.000	85.3	0.763	0.671	0.218	N/A	N/A	NO	N/A	Dense/stiff soil	80.3	N/A	N/A	0.000	0.00	N/A
1456.2	1455.2	BEDROCK/FORMATION	Y	123.0	100	15.0	51.5	0.509	1.000	84.1	0.755	0.668	0.218	N/A	N/A	NO	N/A	Dense/stiff soil	79.2	N/A	N/A	0.000	0.00	N/A
1455.2	1454.2	BEDROCK/FORMATION	Y	123.0	100	15.0	52.5	0.502	1.000	82.9	0.747	0.665	0.217	N/A	N/A	NO	N/A	Dense/stiff soil	78.1	N/A	N/A	0.000	0.00	N/A
1454.2	1453.2	BEDROCK/FORMATION	Y	123.0	100	15.0	53.5	0.495	1.000	81.8	0.738	0.662	0.217	N/A	N/A	NO	N/A	Dense/stiff soil	77.0	N/A	N/A	0.000	0.00	N/A
1453.2	1452.2	BEDROCK/FORMATION	Y	123.0	100	15.0	54.5	0.488	1.000	80.8	0.730	0.659	0.216	N/A	N/A	NO	N/A	Dense/stiff soil	76.0	N/A	N/A	0.000	0.00	N/A
1452.2	1451.2	BEDROCK/FORMATION	Y	123.0	100	15.0	55.5	0.482	1.000	79.7	0.722	0.656	0.215	N/A	N/A	NO	N/A	Dense/stiff soil	75.0	N/A	N/A	0.000	0.00	N/A
1451.2	1450.2	BEDROCK/FORMATION	Y	123.0	100	15.0	56.5	0.475	1.000	78.7	0.714	0.654	0.214	N/A	N/A	NO	N/A	Dense/stiff soil	74.0	N/A	N/A	0.000	0.00	N/A
1450.2	1449.2	BEDROCK/FORMATION	Y	123.0	100	15.0	57.5	0.469	1.000	77.7	0.706	0.651	0.213	N/A	N/A	NO	N/A	Dense/stiff soil	73.1	N/A	N/A	0.000	0.00	N/A
1449.2	1448.2	BEDROCK/FORMATION	Y	123.0	100	15.0	58.5	0.463	1.000	76.7	0.698	0.648	0.213	N/A	N/A	NO	N/A	Dense/stiff soil	72.1	N/A	N/A	0.000	0.00	N/A
1448.2	1447.2	BEDROCK/FORMATION	Y	123.0	100	15.0	59.5	0.457	1.000	75.8	0.690	0.646	0.212	N/A	N/A	NO	N/A	Dense/stiff soil	71.2	N/A	N/A	0.000	0.00	N/A
1447.2	1446.2	BEDROCK/FORMATION	Y	123.0	100	15.0	60.5	0.451	1.000	74.8	0.682	0.643	0.210	N/A	N/A	NO	N/A	Dense/stiff soil	70.3	N/A	N/A	0.000	0.00	N/A
1446.2	1445.2	BEDROCK/FORMATION	Y	123.0	100	15.0	61.5	0.446	1.000	73.9	0.673	0.640	0.209	N/A	N/A	NO	N/A	Dense/stiff soil	69.5	N/A	N/A	0.000	0.00	N/A
1445.2	1444.2	BEDROCK/FORMATION	Y	123.0	100	15.0	62.5	0.440	1.000	73.1	0.665	0.638	0.208	N/A	N/A	NO	N/A	Dense/stiff soil	68.6	N/A	N/A	0.000	0.00	N/A
1444.2	1443.2	BEDROCK/FORMATION	Y	123.0	100	15.0	63.5	0.435	1.000	72.2	0.657	0.635	0.207	N/A	N/A	NO	N/A	Dense/stiff soil	67.8	N/A	N/A	0.000	0.00	N/A
1443.2	1442.2	BEDROCK/FORMATION	Y	123.0	100	15.0	64.5	0.430	1.000	71.4	0.649	0.633	0.206	N/A	N/A	NO	N/A	Dense/stiff soil	67.0	N/A	N/A	0.000	0.00	N/A
1442.2	1441.2	BEDROCK/FORMATION	Y	123.0	100	15.0	65.5	0.425	1.000	70.6	0.641	0.630	0.204	N/A	N/A	NO	N/A	Dense/stiff soil	66.3	N/A	N/A	0.000	0.00	N/A
1441.2	1440.2	BEDROCK/FORMATION	Y	123.0	100	15.0	66.5	0.422	1.000	70.1	0.633	0.628	0.203	N/A	N/A	NO	N/A	Dense/stiff soil	65.8	N/A	N/A	0.000	0.00	N/A
1440.2	1439.2	BEDROCK/FORMATION	Y	123.0	100	15.0	67.5	0.419	1.000	69.7	0.625	0.626	0.201	N/A	N/A	NO	N/A	Dense/stiff soil	65.5	N/A	N/A	0.000	0.00	N/A
1439.2	1438.2	BEDROCK/FORMATION	Y	123.0	100	15.0	68.5	0.417	1.000	69.3	0.616	0.623	0.200	N/A	N/A	NO	N/A	Dense/stiff soil	65.1	N/A	N/A	0.000	0.00	N/A
1438.2	1437.2	BEDROCK/FORMATION	Y	123.0	100	15.0	69.5	0.415	1.000	68.9	0.608	0.621	0.198	N/A	N/A	NO	N/A	Dense/stiff soil	64.7	N/A	N/A	0.000	0.00	N/A

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	City of Riverside, California

GENERAL INPUT DATA

Exploration No.	KB-2
Liquefaction Analysis Method	1996+1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1477.70 feet
Proposed Grade Elevation	1477.70 feet
Unit Weight of Proposed Fill on Surface	120.00 pcf
GWT Elevation During Test	1467.80 feet
GWT Elevation For Design	1467.80 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<====	LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet		LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<====	Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.00 inches	<====	Dry or Unsaturated Soils (Above GWT)
	0.00 inches	<====	Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ $CSR = 0.65 A_{max} (\sigma_v/\sigma_v') r_d$
* FS_{liq} = (CRR/CSR), where $CRR = CRR_{7.5} MSF K_\sigma K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_σ =1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma w_i$ x $f(FS_{liq})$ x H_i (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA) / SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio +++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1477.7	1476.7	SM	Y	120.0	30	20.0	0.5	1.700	0.750	66.8	0.999	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	60.2	N/A	0.009	0.000	0.00	0.00
1476.7	1475.7	SM	Y	120.0	30	20.0	1.5	1.700	0.750	66.8	0.997	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	60.2	N/A	0.015	0.000	0.00	0.00
1475.7	1474.7	SM	Y	120.0	30	20.0	2.5	1.630	0.750	64.2	0.994	N/A	0.252	N/A	N/A	NO	N/A	Soil above GWT	57.7	N/A	0.020	0.000	0.00	0.00
1474.7	1473.7	SM	Y	120.0	30	20.0	3.5	1.560	0.750	61.6	0.992	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	55.4	N/A	0.024	0.000	0.00	0.00
1473.7	1472.7	SM	Y	120.0	30	20.0	4.5	1.497	0.750	59.2	0.990	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	53.2	N/A	0.027	0.000	0.00	0.00
1472.7	1471.7	SM	Y	120.0	30	20.0	5.5	1.438	0.750	57.0	0.987	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	51.2	N/A	0.030	0.000	0.00	0.00
1471.7	1470.7	SM	Y	120.0	30	20.0	6.5	1.384	0.750	55.0	0.985	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	49.3	N/A	0.033	0.000	0.00	0.00
1470.7	1469.7	SM	Y	120.0	30	20.0	7.5	1.333	0.750	53.1	0.983	N/A	0.249	N/A	N/A	NO	N/A	Soil above GWT	47.6	N/A	0.036	0.000	0.00	0.00
1469.7	1468.7	SM	Y	120.0	30	20.0	8.5	1.287	0.850	57.8	0.980	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	51.8	N/A	0.037	0.000	0.00	0.00
1468.7	1467.7	SM	Y	120.0	30	20.0	9.5	1.244	0.850	56.0	0.978	N/A	0.249	N/A	N/A	NO	N/A	Soil above GWT	50.2	N/A	0.039	0.000	0.00	0.00
1467.7	1466.7	SM	Y	120.0	30	20.0	10.5	1.215	0.850	54.8	0.976	1.000	0.255	N/A	N/A	NO	N/A	Dense/stiff soil	49.0	N/A	N/A	0.000	0.00	0.00
1466.7	1465.7	SM	Y	120.0	30	20.0	11.5	1.196	0.850	54.0	0.973	1.000	0.266	N/A	N/A	NO	N/A	Dense/stiff soil	48.3	N/A	N/A	0.000	0.00	0.00
1465.7	1464.7	SM	Y	120.0	30	20.0	12.5	1.177	0.850	53.2	0.971	1.000	0.276	N/A	N/A	NO	N/A	Dense/stiff soil	47.6	N/A	N/A	0.000	0.00	0.00
1464.7	1463.7	SM	Y	120.0	30	20.0	13.5	1.159	0.850	52.4	0.969	1.000	0.285	N/A	N/A	NO	N/A	Dense/stiff soil	46.9	N/A	N/A	0.000	0.00	0.00
1463.7	1462.7	SM	Y	120.0	30	20.0	14.5	1.142	0.850	51.7	0.966	1.000	0.293	N/A	N/A	NO	N/A	Dense/stiff soil	46.2	N/A	N/A	0.000	0.00	0.00
1462.7	1461.7	BEDROCK/FORMATION	Y	123.0	100	15.0	15.5	1.125	0.950	173.8	0.964	1.000	0.301	N/A	N/A	NO	N/A	Dense/stiff soil	164.8	N/A	N/A	0.000	0.00	0.00
1461.7	1460.7	BEDROCK/FORMATION	Y	123.0	100	15.0	16.5	1.108	0.950	171.2	0.962	1.000	0.308	N/A	N/A	NO	N/A	Dense/stiff soil	162.3	N/A	N/A	0.000	0.00	0.00
1460.7	1459.7	BEDROCK/FORMATION	Y	123.0	100	15.0	17.5	1.091	0.950	168.6	0.959	1.000	0.314	N/A	N/A	NO	N/A	Dense/stiff soil	159.8	N/A	N/A	0.000	0.00	0.00
1459.7	1458.7	BEDROCK/FORMATION	Y	123.0	100	15.0	18.5	1.075	0.950	166.2	0.957	1.000	0.319	N/A	N/A	NO	N/A	Dense/stiff soil	157.5	N/A	N/A	0.000	0.00	0.00
1458.7	1457.7	BEDROCK/FORMATION	Y	123.0	100	15.0	19.5	1.059	0.950	163.8	0.955	1.000	0.325	N/A	N/A	NO	N/A	Dense/stiff soil	155.2	N/A	N/A	0.000	0.00	0.00
1457.7	1456.7	BEDROCK/FORMATION	Y	123.0	100	15.0	20.5	1.044	0.950	161.5	0.952	1.000	0.329	N/A	N/A	NO	N/A	Dense/stiff soil	153.0	N/A	N/A	0.000	0.00	0.00
1456.7	1455.7	BEDROCK/FORMATION	Y	123.0	100	15.0	21.5	1.029	0.950	159.2	0.950	1.000	0.334	N/A	N/A	NO	N/A	Dense/stiff soil	150.9	N/A	N/A	0.000	0.00	0.00
1455.7	1454.7	BEDROCK/FORMATION	Y	123.0	100	15.0	22.5	1.015	0.950	157.0	0.948	1.000	0.338	N/A	N/A	NO	N/A	Dense/stiff soil	148.8	N/A	N/A	0.000	0.00	0.00
1454.7	1453.7	BEDROCK/FORMATION	Y	123.0	100	15.0	23.5	1.001	0.950	154.9	0.945	1.000	0.341	N/A	N/A	NO	N/A	Dense/stiff soil	146.7	N/A	N/A	0.000	0.00	0.00
1453.7	1452.7	BEDROCK/FORMATION	Y	123.0	100	15.0	24.5	0.987	0.950	152.8	0.943	0.989	0.345	N/A	N/A	NO	N/A	Dense/stiff soil	144.8	N/A	N/A	0.000	0.00	0.00
1452.7	1451.7	BEDROCK/FORMATION	Y	123.0	100	15.0	25.5	0.974	0.950	150.8	0.941	0.977	0.348	N/A	N/A	NO	N/A	Dense/stiff soil	142.8	N/A	N/A	0.000	0.00	0.00
1451.7	1450.7	BEDROCK/FORMATION	Y	123.0	100	15.0	26.5	0.961	0.950	148.8	0.938	0.966	0.351	N/A	N/A	NO	N/A	Dense/stiff soil	141.0	N/A	N/A	0.000	0.00	0.00
1450.7	1449.7	BEDROCK/FORMATION	Y	123.0	100	15.0	27.5	0.948	0.950	146.9	0.936	0.956	0.354	N/A	N/A	NO	N/A	Dense/stiff soil	139.1	N/A	N/A	0.000	0.00	0.00
1449.7	1448.7	BEDROCK/FORMATION	Y	123.0	100	15.0	28.5	0.936	1.000	152.6	0.934	0.946	0.356	N/A	N/A	NO	N/A	Dense/stiff soil	144.5	N/A	N/A	0.000	0.00	0.00
1448.7	1447.7	BEDROCK/FORMATION	Y	123.0	100	15.0	29.5	0.924	1.000	150.7	0.931	0.936	0.358	N/A	N/A	NO	N/A	Dense/stiff soil	142.7	N/A	N/A	0.000	0.00	0.00
1447.7	1446.7	BEDROCK/FORMATION	Y	123.0	100	15.0	30.5	0.913	1.000	148.8	0.926	0.926	0.359	N/A	N/A	NO	N/A	Dense/stiff soil	140.9	N/A	N/A	0.000	0.00	0.00
1446.7	1445.7	BEDROCK/FORMATION	Y	123.0	100	15.0	31.5	0.901	1.000	147.0	0.918	0.917	0.359	N/A	N/A	NO	N/A	Dense/stiff soil	139.2	N/A	N/A	0.000	0.00	0.00
1445.7	1444.7	BEDROCK/FORMATION	Y	123.0	100	15.0	32.5	0.890	1.000	145.2	0.909	0.908	0.358	N/A	N/A	NO	N/A	Dense/stiff soil	137.5	N/A	N/A	0.000	0.00	0.00
1444.7	1443.7	BEDROCK/FORMATION	Y	123.0	100	15.0	33.5	0.879	1.000	143.5	0.901	0.900	0.358	N/A	N/A	NO	N/A	Dense/stiff soil	135.9	N/A	N/A	0.000	0.00	0.00
1443.7	1442.7	BEDROCK/FORMATION	Y	123.0	100	15.0	34.5	0.869	1.000	141.8	0.893	0.892	0.357	N/A	N/A	NO	N/A	Dense/stiff soil	134.2	N/A	N/A	0.000	0.00	0.00
1442.7	1441.7	BEDROCK/FORMATION	Y	123.0	100	15.0	35.5	0.859	1.000	140.2	0.885	0.884	0.356	N/A	N/A	NO	N/A	Dense/stiff soil	132.7	N/A	N/A	0.000	0.00	0.00
1441.7	1440.7	BEDROCK/FORMATION	Y	123.0	100	15.0	36.5	0.849	1.000	138.5	0.877	0.876	0.355	N/A	N/A	NO	N/A	Dense/stiff soil	131.1	N/A	N/A	0.000	0.00	0.00
1440.7	1439.7	BEDROCK/FORMATION	Y	123.0	100	15.0	37.5	0.839	1.000	137.0	0.869	0.868	0.354	N/A	N/A	NO	N/A	Dense/stiff soil	129.6	N/A	N/A	0.000	0.00	0.00
1439.7	1438.7	BEDROCK/FORMATION	Y	123.0	100	15.0	38.5	0.829	1.000	135.4	0.861	0.861	0.352	N/A	N/A	NO	N/A	Dense/stiff soil	128.2	N/A	N/A	0.000	0.00	0.00
1438.7	1437.7	BEDROCK/FORMATION	Y	123.0	100	15.0	39.5	0.820	1.000	133.9	0.852	0.854	0.351	N/A	N/A	NO	N/A	Dense/stiff soil	126.7	N/A	N/A	0.000	0.00	0.00
1437.7	1436.7	BEDROCK/FORMATION	Y	123.0	100	15.0	40.5	0.811	1.000	132.5	0.844	0.847	0.349	N/A	N/A	NO	N/A	Dense/stiff soil	125.3	N/A	N/A	0.000	0.00	0.00
1436.7	1435.7	BEDROCK/FORMATION	Y	123.0	100	15.0	41.5	0.802	1.000	131.0	0.836	0.841	0.347	N/A	N/A	NO	N/A	Dense/stiff soil	124.0	N/A	N/A	0.000	0.00	0.00
1435.7	1434.7	BEDROCK/FORMATION	Y	123.0	100	15.0	42.5	0.793	1.000	129.6	0.828	0.834	0.346	N/A	N/A	NO	N/A	Dense/stiff soil	122.6	N/A	N/A	0.000	0.00	0.00
1434.7	1433.7	BEDROCK/FORMATION	Y	123.0	100	15.0	43.5	0.784	1.000	128.3	0.820	0.828	0.344	N/A	N/A	NO	N/A	Dense/stiff soil	121.3	N/A	N/A	0.000	0.00	0.00
1433.7	1432.7	BEDROCK/FORMATION	Y	123.0	100	15.0	44.5	0.776	1.000	126.9	0.812	0.822	0.342	N/A	N/A	NO	N/A	Dense/stiff soil	120.0	N/A	N/A	0.000	0.00	0.00
1432.7	1431.7	BEDROCK/FORMATION	Y	123.0	100	15.0	45.5	0.768	1.000	125.6	0.804	0.816	0.340	N/A	N/A	NO	N/A	Dense/stiff soil	118.8	N/A	N/A	0.000	0.00	0.00
1431.7	1430.7	BEDROCK/FORMATION	Y	123.0	100	15.0	46.5	0.760	1.000	124.3	0.795	0.810	0.337	N/A	N/A	NO	N/A	Dense/stiff soil	117.6	N/A	N/A	0.000	0.00	0.00
1430.7	1429.7	BEDROCK/FORMATION	Y	123.0	100	15.0	47.5	0.752	1.000	123.0	0.787	0.804	0.335	N/A	N/A	NO	N/A	Dense/stiff soil	116.3	N/A	N/A	0.000	0.00	0.00
1429.7	1428.7	BEDROCK/FORMATION	Y	123.0	100	15.0	48.5	0.744	1.000	121.8	0.779	0.798	0.333	N/A	N/A	NO	N/A	Dense/stiff soil	115.2	N/A	N/A	0.000	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	City of Riverside, California

GENERAL INPUT DATA

Exploration No.	KB-2
Liquefaction Analysis Method	1996+1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1477.70 feet
Proposed Grade Elevation	1477.70 feet
Unit Weight of Proposed Fill on Surface	120.00 pcf
GWT Elevation During Test	1467.80 feet
GWT Elevation For Design	1467.80 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<====	LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet		LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<====	Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.00 inches	<====	Dry or Unsaturated Soils (Above GWT)
	0.00 inches	<====	Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$
* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5}\ MSF\ K_\sigma\ K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_α =1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma\ w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA) / SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1428.7	1427.7	BEDROCK/FORMATION	Y	123.0	100	15.0	49.5	0.737	1.000	120.6	0.771	0.793	0.331	N/A	N/A	NO	N/A	Dense/stiff soil	114.0	N/A	N/A	0.000	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	KB-3
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1477.00 feet
Proposed Grade Elevation	1477.00 feet
Unit Weight of Proposed Fill on Surface	120.00 pcf
GWT Elevation During Test	1467.80 feet
GWT Elevation For Design	1467.80 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<==== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.00 inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.00 inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d
* FS_{liq} = (CRR/CSR), where CRR = $CRR_{7.5}$ MSF K_σ K_α ; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_α =1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. LPI = Σ w_i x f(FS_{liq}) x H_i (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)							SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +											RESIDUAL STRENGTH AND GROUND SETTLEMENT					
Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1477.0	1476.0	SM	Y	120.0	36	20.0	0.5	1.700	0.750	79.4	0.999	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	71.9	N/A	0.008	0.000	0.00	0.00
1476.0	1475.0	SM	Y	120.0	36	20.0	1.5	1.700	0.750	79.4	0.997	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	71.9	N/A	0.014	0.000	0.00	0.00
1475.0	1474.0	SM	Y	120.0	36	20.0	2.5	1.630	0.750	76.3	0.994	N/A	0.252	N/A	N/A	NO	N/A	Soil above GWT	69.0	N/A	0.019	0.000	0.00	0.00
1474.0	1473.0	BEDROCK/FORMATION	Y	120.0	100	20.0	3.5	1.560	0.750	196.8	0.992	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	180.7	N/A	0.016	0.000	0.00	0.00
1473.0	1472.0	BEDROCK/FORMATION	Y	120.0	100	20.0	4.5	1.497	0.750	188.9	0.990	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	173.3	N/A	0.018	0.000	0.00	0.00
1472.0	1471.0	BEDROCK/FORMATION	Y	120.0	100	20.0	5.5	1.438	0.750	181.7	0.987	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	166.6	N/A	0.020	0.000	0.00	0.00
1471.0	1470.0	BEDROCK/FORMATION	Y	120.0	100	20.0	6.5	1.384	0.750	174.9	0.985	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	160.4	N/A	0.022	0.000	0.00	0.00
1470.0	1469.0	BEDROCK/FORMATION	Y	120.0	100	20.0	7.5	1.333	0.750	168.7	0.983	N/A	0.249	N/A	N/A	NO	N/A	Soil above GWT	154.6	N/A	0.024	0.000	0.00	0.00
1469.0	1468.0	BEDROCK/FORMATION	Y	120.0	100	20.0	8.5	1.287	0.850	184.2	0.980	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	168.9	N/A	0.025	0.000	0.00	0.00
1468.0	1467.0	BEDROCK/FORMATION	Y	123.0	100	15.0	9.5	1.251	0.850	173.0	0.978	1.000	0.253	N/A	N/A	NO	N/A	Dense/stiff soil	164.0	N/A	N/A	0.000	0.00	0.00
1467.0	1466.0	BEDROCK/FORMATION	Y	123.0	100	15.0	10.5	1.228	0.850	169.8	0.976	1.000	0.264	N/A	N/A	NO	N/A	Dense/stiff soil	161.0	N/A	N/A	0.000	0.00	0.00
1466.0	1465.0	BEDROCK/FORMATION	Y	123.0	100	15.0	11.5	1.207	0.850	167.0	0.973	1.000	0.275	N/A	N/A	NO	N/A	Dense/stiff soil	158.3	N/A	N/A	0.000	0.00	0.00
1465.0	1464.0	BEDROCK/FORMATION	Y	123.0	100	15.0	12.5	1.188	0.850	164.3	0.971	1.000	0.285	N/A	N/A	NO	N/A	Dense/stiff soil	155.7	N/A	N/A	0.000	0.00	0.00
1464.0	1463.0	BEDROCK/FORMATION	Y	123.0	100	15.0	13.5	1.169	0.850	161.7	0.969	1.000	0.294	N/A	N/A	NO	N/A	Dense/stiff soil	153.3	N/A	N/A	0.000	0.00	0.00
1463.0	1462.0	BEDROCK/FORMATION	Y	123.0	100	15.0	14.5	1.150	0.850	159.2	0.966	1.000	0.302	N/A	N/A	NO	N/A	Dense/stiff soil	150.9	N/A	N/A	0.000	0.00	0.00
1462.0	1461.0	BEDROCK/FORMATION	Y	123.0	100	15.0	15.5	1.132	0.950	174.9	0.964	1.000	0.309	N/A	N/A	NO	N/A	Dense/stiff soil	165.8	N/A	N/A	0.000	0.00	0.00
1461.0	1460.0	BEDROCK/FORMATION	Y	123.0	100	15.0	16.5	1.115	0.950	172.3	0.962	1.000	0.316	N/A	N/A	NO	N/A	Dense/stiff soil	163.3	N/A	N/A	0.000	0.00	0.00
1460.0	1459.0	BEDROCK/FORMATION	Y	123.0	100	15.0	17.5	1.098	0.950	169.7	0.959	1.000	0.321	N/A	N/A	NO	N/A	Dense/stiff soil	160.9	N/A	N/A	0.000	0.00	0.00
1459.0	1458.0	BEDROCK/FORMATION	Y	123.0	100	15.0	18.5	1.082	0.950	167.2	0.957	1.000	0.327	N/A	N/A	NO	N/A	Dense/stiff soil	158.5	N/A	N/A	0.000	0.00	0.00
1458.0	1457.0	BEDROCK/FORMATION	Y	123.0	100	15.0	19.5	1.066	0.950	164.8	0.955	1.000	0.332	N/A	N/A	NO	N/A	Dense/stiff soil	156.2	N/A	N/A	0.000	0.00	0.00
1457.0	1456.0	BEDROCK/FORMATION	Y	123.0	100	15.0	20.5	1.050	0.950	162.4	0.952	1.000	0.336	N/A	N/A	NO	N/A	Dense/stiff soil	153.9	N/A	N/A	0.000	0.00	0.00
1456.0	1455.0	BEDROCK/FORMATION	Y	123.0	100	15.0	21.5	1.035	0.950	160.2	0.950	1.000	0.341	N/A	N/A	NO	N/A	Dense/stiff soil	151.8	N/A	N/A	0.000	0.00	0.00
1455.0	1454.0	BEDROCK/FORMATION	Y	123.0	100	15.0	22.5	1.021	0.950	157.9	0.948	1.000	0.345	N/A	N/A	NO	N/A	Dense/stiff soil	149.7	N/A	N/A	0.000	0.00	0.00
1454.0	1453.0	BEDROCK/FORMATION	Y	123.0	100	15.0	23.5	1.007	0.950	155.8	0.945	1.000	0.348	N/A	N/A	NO	N/A	Dense/stiff soil	147.6	N/A	N/A	0.000	0.00	0.00
1453.0	1452.0	BEDROCK/FORMATION	Y	123.0	100	15.0	24.5	0.993	0.950	153.7	0.943	0.994	0.351	N/A	N/A	NO	N/A	Dense/stiff soil	145.6	N/A	N/A	0.000	0.00	0.00
1452.0	1451.0	BEDROCK/FORMATION	Y	123.0	100	15.0	25.5	0.979	0.950	151.7	0.941	0.982	0.354	N/A	N/A	NO	N/A	Dense/stiff soil	143.6	N/A	N/A	0.000	0.00	0.00
1451.0	1450.0	BEDROCK/FORMATION	Y	123.0	100	15.0	26.5	0.966	0.950	149.7	0.938	0.971	0.357	N/A	N/A	NO	N/A	Dense/stiff soil	141.8	N/A	N/A	0.000	0.00	0.00
1450.0	1449.0	BEDROCK/FORMATION	Y	123.0	100	15.0	27.5	0.954	0.950	147.7	0.936	0.960	0.360	N/A	N/A	NO	N/A	Dense/stiff soil	139.9	N/A	N/A	0.000	0.00	0.00
1449.0	1448.0	BEDROCK/FORMATION	Y	123.0	100	15.0	28.5	0.941	1.000	153.4	0.934	0.950	0.362	N/A	N/A	NO	N/A	Dense/stiff soil	145.3	N/A	N/A	0.000	0.00	0.00
1448.0	1447.0	BEDROCK/FORMATION	Y	123.0	100	15.0	29.5	0.929	1.000	151.5	0.931	0.940	0.364	N/A	N/A	NO	N/A	Dense/stiff soil	143.5	N/A	N/A	0.000	0.00	0.00
1447.0	1446.0	BEDROCK/FORMATION	Y	123.0	100	15.0	30.5	0.918	1.000	149.6	0.926	0.930	0.365	N/A	N/A	NO	N/A	Dense/stiff soil	141.7	N/A	N/A	0.000	0.00	0.00
1446.0	1445.0	BEDROCK/FORMATION	Y	123.0	100	15.0	31.5	0.906	1.000	147.8	0.918	0.921	0.364	N/A	N/A	NO	N/A	Dense/stiff soil	139.9	N/A	N/A	0.000	0.00	0.00
1445.0	1444.0	BEDROCK/FORMATION	Y	123.0	100	15.0	32.5	0.895	1.000	146.0	0.909	0.912	0.364	N/A	N/A	NO	N/A	Dense/stiff soil	138.2	N/A	N/A	0.000	0.00	0.00
1444.0	1443.0	BEDROCK/FORMATION	Y	123.0	100	15.0	33.5	0.884	1.000	144.2	0.901	0.904	0.363	N/A	N/A	NO	N/A	Dense/stiff soil	136.5	N/A	N/A	0.000	0.00	0.00
1443.0	1442.0	BEDROCK/FORMATION	Y	123.0	100	15.0	34.5	0.873	1.000	142.5	0.893	0.895	0.362	N/A	N/A	NO	N/A	Dense/stiff soil	134.9	N/A	N/A	0.000	0.00	0.00
1442.0	1441.0	BEDROCK/FORMATION	Y	123.0	100	15.0	35.5	0.863	1.000	140.8	0.885	0.887	0.361	N/A	N/A	NO	N/A	Dense/stiff soil	133.3	N/A	N/A	0.000	0.00	0.00
1441.0	1440.0	BEDROCK/FORMATION	Y	123.0	100	15.0	36.5	0.853	1.000	139.2	0.877	0.879	0.360	N/A	N/A	NO	N/A	Dense/stiff soil	131.8	N/A	N/A	0.000	0.00	0.00
1440.0	1439.0	BEDROCK/FORMATION	Y	123.0	100	15.0	37.5	0.843	1.000	137.6	0.869	0.872	0.358	N/A	N/A	NO	N/A	Dense/stiff soil	130.3	N/A	N/A	0.000	0.00	0.00
1439.0	1438.0	BEDROCK/FORMATION	Y	123.0	100	15.0	38.5	0.833	1.000	136.1	0.861	0.864	0.357	N/A	N/A	NO	N/A	Dense/stiff soil	128.8	N/A	N/A	0.000	0.00	0.00
1438.0	1437.0	BEDROCK/FORMATION	Y	123.0	100	15.0	39.5	0.824	1.000	134.6	0.852	0.857	0.355	N/A	N/A	NO	N/A	Dense/stiff soil	127.3	N/A	N/A	0.000	0.00	0.00
1437.0	1436.0	BEDROCK/FORMATION	Y	123.0	100	15.0	40.5	0.815	1.000	133.1	0.844	0.850	0.353	N/A	N/A	NO	N/A	Dense/stiff soil	125.9	N/A	N/A	0.000	0.00	0.00
1436.0	1435.0	BEDROCK/FORMATION	Y	123.0	100	15.0	41.5	0.806	1.000	131.6	0.836	0.843	0.351	N/A	N/A	NO	N/A	Dense/stiff soil	124.5	N/A	N/A	0.000	0.00	0.00
1435.0	1434.0	BEDROCK/FORMATION	Y	123.0	100	15.0	42.5	0.797	1.000	130.2	0.828	0.837	0.350	N/A	N/A	NO	N/A	Dense/stiff soil	123.2	N/A	N/A	0.000	0.00	0.00
1434.0	1433.0	BEDROCK/FORMATION	Y	123.0	100	15.0	43.5	0.788	1.000	128.8	0.820	0.830	0.348	N/A	N/A	NO	N/A	Dense/stiff soil	121.9	N/A	N/A	0.000	0.00	0.00
1433.0	1432.0	BEDROCK/FORMATION	Y	123.0	100	15.0	44.5	0.780	1.000	127.5	0.812	0.824	0.346	N/A	N/A	NO	N/A	Dense/stiff soil	120.6	N/A	N/A	0.000	0.00	0.00
1432.0	1431.0	BEDROCK/FORMATION	Y	123.0	100	15.0	45.5	0.771	1.000	126.1	0.804	0.818	0.343	N/A	N/A	NO	N/A	Dense/stiff soil	119.3	N/A	N/A	0.000	0.00	0.00
1431.0	1430.0	BEDROCK/FORMATION	Y	123.0	100	15.0	46.5	0.763	1.000	124.8	0.795	0.812	0.341	N/A	N/A	NO	N/A	Dense/stiff soil	118.1	N/A	N/A	0.000	0.00	0.00
1430.0	1429.0	BEDROCK/FORMATION	Y	123.0	100	15.0	47.5	0.755	1.000	123.6	0.787	0.806	0.339	N/A	N/A	NO	N/A	Dense/stiff soil	116.9	N/A	N/A	0.000	0.00	0.00
1429.0	1428.0	BEDROCK/FORMATION	Y	123.0	100	15.0	48.5	0.748	1.000	122.3	0.779	0.801	0.336	N/A	N/A	NO	N/A	Dense/stiff soil	115.7	N/A	N/A	0.000	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	KB-3
Liquefaction Analysis Method	1996+1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1477.00 feet
Proposed Grade Elevation	1477.00 feet
Unit Weight of Proposed Fill on Surface	120.00 pcf
GWT Elevation During Test	1467.80 feet
GWT Elevation For Design	1467.80 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<====	LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet		LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<====	Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.00 inches	<====	Dry or Unsaturated Soils (Above GWT)
	0.00 inches	<====	Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$
* FS_{liq} = (CRR/CSR), where $CRR = CRR_{7.5}\ MSF\ K_\sigma\ K_o$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_σ =1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma\ w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA) / SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio +++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1428.0	1427.0	BEDROCK/FORMATION	Y	123.0	100	15.0	49.5	0.740	1.000	121.1	0.771	0.795	0.334	N/A	N/A	NO	N/A	Dense/stiff soil	114.5	N/A	N/A	0.000	0.00	0.00

C-2

FOOTING BEARING CAPACITY

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 1 (WSD)
Footing Description	Spread Footing
Footing Width, B	7.43 feet
Footing Length, L	108.24 feet
Min. Footing Embedment Depth, D_f	5.58 feet
Bottom of Footing Elevation	1,495.02 feet
Design GWT Elevation	1,467.80 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Design Method	WSD
Normal Gravity Load, Q	2,909.00 kips
Shear Load (along X-axis), P_x	667.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,500.60 feet
Depth to Design GWT, Z_w	32.80 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	667.00 kips
Effective Footing Width, $B' = B - 2e_x$	7.43 feet
Effective Footing Length, $L' = L - 2e_y$	108.24 feet
Effective Footing Area, $A_f = B' L'$	804.22 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	3.62 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\ c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	6.70 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	669.60 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\ \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.75
Exponent, n	1.06

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.02	1.04	1.04	1.04
s_q	N/A	1.02	1.04	1.04
s_γ	0.80	1.02	0.97	0.97
Depth Factors, d_c	N/A	1.27	1.30	1.30
d_q	N/A	1.14	1.21	1.21
d_γ	N/A	1.14	1.00	1.00
Inclination Factors, i_c	N/A	0.73	0.99	1.00
i_q	N/A	0.73	0.99	1.00
i_γ	N/A	0.36	0.99	0.99
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\ S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	11.1	13.2

Ultimate Gross Bearing Capacity, $q_{ult-ave}$	12.1 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	4.0 ksf (195 kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Pier 2 (LRFD - Strength)
Footing Description	Spread Footing
Footing Width, B	8.88 feet
Footing Length, L	86.06 feet
Min. Footing Embedment Depth, D_f	8.79 feet
Bottom of Footing Elevation	1,467.21 feet
Design GWT Elevation	1,467.80 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Design Method	LRFD (Strength)
Normal Gravity Load, Q	5,793.00 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,476.00 feet
Depth to Design GWT, Z_w	8.20 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	0.00 kips
Effective Footing Width, $B' = B - 2e_x$	8.88 feet
Effective Footing Length, $L' = L - 2e_y$	86.06 feet
Effective Footing Area, $A_f = B' L'$	764.21 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	7.58 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	8.01 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	57.60 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	506.30 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.99
Exponent, n	1.09

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.03	1.07	1.07	1.07
s_q	N/A	1.03	1.05	1.06
s_γ	0.80	1.03	0.96	0.96
Depth Factors, d_c	N/A	1.36	1.40	1.40
d_q	N/A	1.18	1.27	1.27
d_γ	N/A	1.18	1.00	1.00
Inclination Factors, i_c	N/A	1.00	1.00	1.00
i_q	N/A	1.00	1.00	1.00
i_γ	N/A	1.00	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	1.00	1.00
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	28.6	31.4	31.4	33.9

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	31.3 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	14.1 ksf (675 KPa)
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
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ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Pier 2 (LRFD - Extreme Event)
Footing Description	Spread Footing
Footing Width, B	6.69 feet
Footing Length, L	54.38 feet
Min. Footing Embedment Depth, D_f	8.79 feet
Bottom of Footing Elevation	1,467.21 feet
Design GWT Elevation	1,467.80 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Design Method	RFD (Extreme Event)
Normal Gravity Load, Q	3,908.00 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,476.00 feet
Depth to Design GWT, Z_w	8.20 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	0.00 kips
Effective Footing Width, $B' = B - 2e_x$	6.69 feet
Effective Footing Length, $L' = L - 2e_y$	54.38 feet
Effective Footing Area, $A_f = B' L'$	363.80 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	10.74 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\ c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	6.03 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	57.60 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	506.30 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\ \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.92
Exponent, n	1.11

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.04	1.08	1.08	1.08
s_q	N/A	1.04	1.07	1.08
s_γ	0.80	1.04	0.95	0.95
Depth Factors, d_c	N/A	1.47	1.37	1.37
d_q	N/A	1.24	1.25	1.25
d_γ	N/A	1.24	1.00	1.00
Inclination Factors, i_c	N/A	1.00	1.00	1.00
i_q	N/A	1.00	1.00	1.00
i_γ	N/A	1.00	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	1.00	1.00
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\ S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	31.9	30.0	31.9

Ultimate Gross Bearing Capacity, $q_{ult-ave}$	30.9 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	30.9 ksf (1480 kPa)

Notes:
* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Pier 3 (LRFD - Strength)
Footing Description	Spread Footing
Footing Width, B	8.90 feet
Footing Length, L	85.93 feet
Min. Footing Embedment Depth, D_f	7.54 feet
Bottom of Footing Elevation	1,468.46 feet
Design GWT Elevation	1,467.80 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Design Method	LRFD (Strength)
Normal Gravity Load, Q	5,513.00 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,476.00 feet
Depth to Design GWT, Z_w	8.20 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	0.00 kips
Effective Footing Width, $B' = B - 2e_x$	8.90 feet
Effective Footing Length, $L' = L - 2e_y$	85.93 feet
Effective Footing Area, $A_f = B' L'$	764.78 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	7.21 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\ c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45^o+\phi_{eff}/2)$	8.03 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	62.23 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	469.19 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\ \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o+\phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.85
Exponent, n	1.09

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.03	1.07	1.07	1.07
s_q	N/A	1.03	1.05	1.06
s_γ	0.80	1.03	0.96	0.96
Depth Factors, d_c	N/A	1.31	1.34	1.34
d_q	N/A	1.15	1.23	1.23
d_γ	N/A	1.15	1.00	1.00
Inclination Factors, i_c	N/A	1.00	1.00	1.00
i_q	N/A	1.00	1.00	1.00
i_γ	N/A	1.00	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	1.00	1.00
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\ S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	28.1	30.1	29.8	32.5

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	30.1 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	13.6 ksf (650 kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:
* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION	
Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY	
Footing Location	Pier 3 (LRFD - Extreme Event)
Footing Description	Spread Footing
Footing Width, B	6.38 feet
Footing Length, L	50.37 feet
Min. Footing Embedment Depth, D_f	7.54 feet
Bottom of Footing Elevation	1,468.46 feet
Design GWT Elevation	1,467.80 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS	
Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS	
Design Method	LRFD (Extreme Event)
Normal Gravity Load, Q	3,673.00 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS	
LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS	
Min. Ground Surface Elevation	1,476.00 feet
Depth to Design GWT, Z_w	8.20 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	0.00 kips
Effective Footing Width, $B' = B - 2e_x$	6.38 feet
Effective Footing Length, $L' = L - 2e_y$	50.37 feet
Effective Footing Area, $A_f = B' L'$	321.36 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	11.43 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	5.75 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	64.06 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	482.98 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.87
Exponent, n	1.11

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.04	1.08	1.08	1.08
s_q	N/A	1.04	1.07	1.08
s_γ	0.80	1.04	0.95	0.95
Depth Factors, d_c	N/A	1.43	1.35	1.35
d_q	N/A	1.21	1.24	1.24
d_γ	N/A	1.21	1.00	1.00
Inclination Factors, i_c	N/A	1.00	1.00	1.00
i_q	N/A	1.00	1.00	1.00
i_γ	N/A	1.00	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	1.00	1.00
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	30.8	29.2	31.2

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	30.2 ksf*
Allowable Gross Bearing Capacity, WSD q_{all}	N/A ksf*
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf*
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	30.2 ksf* (1470 kPa)

Notes:
* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 4 (WSD)
Footing Description	Spread Footing
Footing Width, B	6.94 feet
Footing Length, L	108.24 feet
Min. Footing Embedment Depth, D_f	7.54 feet
Bottom of Footing Elevation	1,493.06 feet
Design GWT Elevation	1,467.80 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Design Method	WSD
Normal Gravity Load, Q	2,981.00 kips
Shear Load (along X-axis), P_x	617.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,500.60 feet
Depth to Design GWT, Z_w	32.80 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	617.00 kips
Effective Footing Width, $B' = B - 2e_x$	6.94 feet
Effective Footing Length, $L' = L - 2e_y$	108.24 feet
Effective Footing Area, $A_f = B' L'$	751.19 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	3.97 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	6.26 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	904.80 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.83
Exponent, n	1.06

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.02	1.04	1.04	1.04
s_q	N/A	1.02	1.03	1.04
s_γ	0.80	1.02	0.97	0.97
Depth Factors, d_c	N/A	1.39	1.33	1.33
d_q	N/A	1.20	1.23	1.23
d_γ	N/A	1.20	1.00	1.00
Inclination Factors, i_c	N/A	0.76	0.99	1.00
i_q	N/A	0.76	0.99	1.00
i_γ	N/A	0.40	0.99	0.99
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	12.1	14.1

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	13.1 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	4.4 ksf (210 kPa)
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:
* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

C-3

FOOTING SETTLEMENT

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

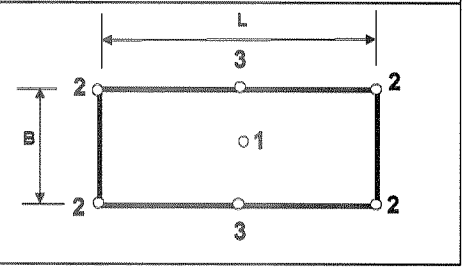
Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abut. 1
Footing Description	Spread Footing
Stress Analysis Method	Boussinesq Method
Footing Width, B	10.00 feet
Footing Length, L	108.24 feet
Applied Net Bearing Pressure, p	6.00 ksf (290 kPa)
Footing Embedment Depth, D_f	4.59 feet
Bottom of Footing Elevation	1,495.02 feet
GWT Elevation for Design	1,467.80 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	1.00	0.26	0.55
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	1.00	0.26	0.55



Performed By: _____ Date: _____
Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,499.61	1,495.02	Cohesionless Soil	120.0					
1,495.02	1,494.60	Cohesionless Soil	120.0	750.0	0.35			1.0
1,494.60	1,489.60	Cohesionless Soil	120.0	417.0	0.35			1.0
1,489.60	1,487.10	Cohesionless Soil	130.0	1,000.0	0.35			1.0
1,487.10	1,484.60	Cohesionless Soil	130.0	1,000.0	0.35			1.0
1,484.60	1,479.60	Cohesionless Soil	130.0	1,000.0	0.35			1.0
1,479.60	1,477.60	Cohesionless Soil	130.0	1,000.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	4.59	0.55	0.28	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
0.21	0.42	0.60	0.58	N/A	6.00	1.50	3.00	0.036	0.007	0.016	0.000	0.000	0.000
2.92	5.00	1.20	0.90	N/A	5.64	1.49	2.97	0.661	0.143	0.312	0.000	0.000	0.000
6.67	2.50	1.53	1.36	N/A	4.29	1.38	2.76	0.093	0.027	0.057	0.000	0.000	0.000
9.17	2.50	1.85	1.69	N/A	3.51	1.27	2.53	0.072	0.024	0.051	0.000	0.000	0.000
12.92	5.00	2.50	2.18	N/A	2.69	1.09	2.18	0.106	0.041	0.085	0.000	0.000	0.000
16.42	2.00	2.76	2.63	N/A	2.19	0.95	1.89	0.034	0.014	0.029	0.000	0.000	0.000

Permissible Net Contact Stress = 290 kPa

* Permissible Gross Contact Stress = 6 ksf + 4.59' x 120/1000 kcf = 6.55 ksf (315 kPa)

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

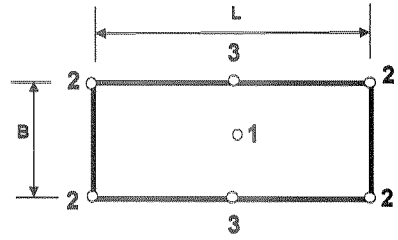
Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Pier 2
Footing Description	Spread Footing
Stress Analysis Method	Boussinesq Method
Footing Width, B	10.00 feet
Footing Length, L	90.04 feet
Applied Net Bearing Pressure, p	9.00 ksf (430 kPa)
Footing Embedment Depth, D_f	8.79 feet
Bottom of Footing Elevation	1,495.02 feet
GWT Elevation for Design	1,467.80 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	1.00	0.33	0.68
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	1.00	0.33	0.68



Performed By: _____ Date: _____
Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,503.81	1,495.02	Cohesionless Soil	120.0					
1,495.02	1,485.00	Cohesionless Soil	130.0	1,150.0	0.35			1.0
1,485.00	1,475.00	Cohesionless Soil	130.0	1,150.0	0.35			1.0
1,475.00	1,467.80	Cohesionless Soil	130.0	1,150.0	0.35			1.0
1,467.80	1,462.80	Cohesionless Soil	130.0	1,150.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	8.79	1.05	0.53	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
5.01	10.02	2.36	1.71	N/A	7.36	2.16	4.32	0.585	0.148	0.317	0.000	0.000	0.000
15.02	10.00	3.66	3.01	N/A	3.54	1.50	2.99	0.242	0.099	0.202	0.000	0.000	0.000
23.62	7.20	4.59	4.13	N/A	2.31	1.09	2.13	0.110	0.051	0.101	0.000	0.000	0.000
29.72	5.00	5.24	4.92	N/A	1.82	0.89	1.72	0.060	0.029	0.056	0.000	0.000	0.000

* Permissible Net Contact Stress = 430 kPa

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

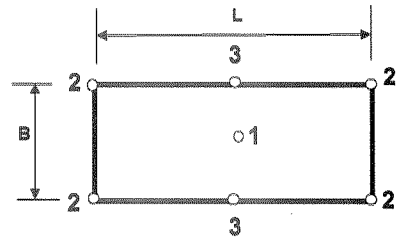
Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Pier 3
Footing Description	Spread Footing
Stress Analysis Method	Boussinesq Method
Footing Width, B	10.00 feet
Footing Length, L	90.04 feet
Applied Net Bearing Pressure, p	6.50 ksf (310 kPa)
Footing Embedment Depth, D_f	7.54 feet
Bottom of Footing Elevation	1,476.00 feet
GWT Elevation for Design	1,467.80 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.99	0.24	0.53
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.99	0.24	0.53



Performed By: _____ Date: _____

Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,483.54	1,476.00	Cohesionless Soil	125.0					
1,476.00	1,485.00	Cohesionless Soil	130.0	1,150.0	0.35			1.0
1,485.00	1,475.00	Cohesionless Soil	130.0	1,150.0	0.35			1.0
1,475.00	1,467.80	Cohesionless Soil	130.0	1,150.0	0.35			1.0
1,467.80	1,462.80	Cohesionless Soil	130.0	1,150.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	7.54	0.94	0.47	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
N/A	-9.00	-0.23	0.36	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
-4.00	10.00	1.07	0.42	N/A	5.73	1.59	3.18	0.571	0.123	0.280	0.000	0.000	0.000
4.60	7.20	2.01	1.54	N/A	5.48	1.57	3.14	0.304	0.076	0.162	0.000	0.000	0.000
10.70	5.00	2.66	2.33	N/A	3.39	1.29	2.58	0.117	0.043	0.088	0.000	0.000	0.000

* Permissible Net Contact Stress = 310 kPa

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

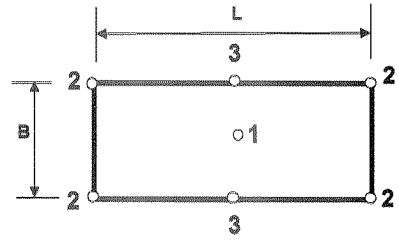
Project Name	Box Springs Road OH (Replace)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abut. 4
Footing Description	Spread Footing
Stress Analysis Method	Boussinesq Method
Footing Width, B	10.00 feet
Footing Length, L	108.24 feet
Applied Net Bearing Pressure, p	6.30 ksf (300 kPa)
Footing Embedment Depth, D_f	7.54 feet
Bottom of Footing Elevation	1,493.06 feet
GWT Elevation for Design	1,467.80 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	1.00	0.25	0.53
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	1.00	0.25	0.53



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,500.60	1,493.06	Cohesionless Soil	120.0					
1,493.06	1,494.60	Cohesionless Soil	120.0	750.0	0.35			1.0
1,494.60	1,489.60	Cohesionless Soil	120.0	490.0	0.35			1.0
1,489.60	1,487.10	Cohesionless Soil	130.0	1,000.0	0.35			1.0
1,487.10	1,484.60	Cohesionless Soil	130.0	1,000.0	0.35			1.0
1,484.60	1,479.60	Cohesionless Soil	130.0	1,000.0	0.35			1.0
1,479.60	1,477.60	Cohesionless Soil	130.0	1,000.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	7.54	0.90	0.45	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
N/A	-1.54	0.72	0.81	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
0.96	5.00	1.32	1.02	N/A	6.28	1.57	3.15	0.624	0.129	0.278	0.000	0.000	0.000
4.71	2.50	1.65	1.48	N/A	5.27	1.52	3.04	0.117	0.030	0.063	0.000	0.000	0.000
7.21	2.50	1.97	1.81	N/A	4.31	1.42	2.85	0.090	0.027	0.057	0.000	0.000	0.000
10.96	5.00	2.62	2.30	N/A	3.23	1.24	2.48	0.128	0.047	0.097	0.000	0.000	0.000
14.46	2.00	2.88	2.75	N/A	2.57	1.08	2.15	0.040	0.016	0.033	0.000	0.000	0.000

Permissible Net Contact Stress = 300 kPa

* Permissible Gross Contact Stress = 6.3 ksf + 7.54' × $\frac{120}{1000}$ ksf = 7.2 ksf (345 kPa)

C-4

SLOPE STABILITY ANALYSES

Box Springs Overhead (Replace)-static I-215/SR-60 Interchange Improvements

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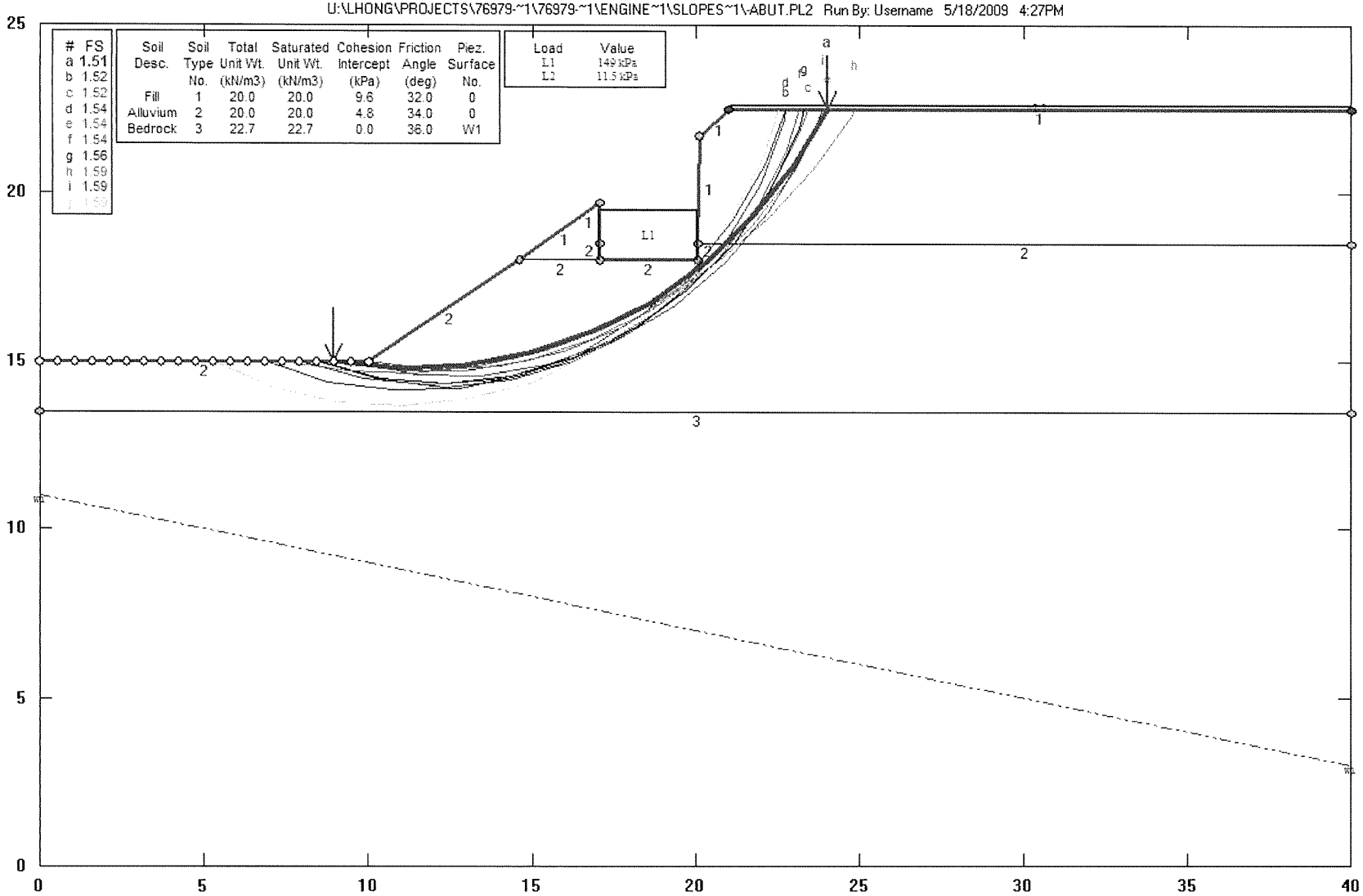

GSTABL7 v.2 FSmin=1.51

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

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*

Analysis Run Date: 5/18/2009
Time of Run: 4:30PM
Run By: Username
Input Data Filename: U:-abut.
Output Filename: U:-abut.OUT
Unit System: SI

Plotted Output Filename: U:-abut.PLT

PROBLEM DESCRIPTION: Box Springs Overhead (Replace)-static
I-215/SR-60 Interchange Improvements

BOUNDARY COORDINATES

10 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	14.99	10.01	14.99	2
2	10.01	14.99	14.60	18.01	2
3	14.60	18.01	17.03	19.68	1
4	17.03	19.68	17.05	18.50	1
5	17.05	18.50	17.07	18.01	2
6	17.07	18.01	20.05	18.01	2
7	20.05	18.01	20.07	18.50	2

8	20.07	18.50	20.09	21.72	1
9	20.09	21.72	21.00	22.50	1
10	21.00	22.50	40.00	22.50	1
11	14.60	18.01	17.07	18.01	2
12	20.07	18.50	40.00	18.50	2
13	0.00	13.52	40.00	13.52	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	20.0	20.0	9.6	32.0	0.00	0.0	0
2	20.0	20.0	4.8	34.0	0.00	0.0	0
3	22.7	22.7	0.0	36.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	0.00	10.99
2	40.00	2.99

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	17.07	20.05	149.0	0.0
2	21.00	39.99	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 10.00(m)

Each Surface Terminates Between X = 21.00(m)
and X = 40.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

2.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 6.504 FS Min = 1.511 FS Ave = 3.310
Standard Deviation = 1.033 Coefficient of Variation = 31.21

%

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.95	14.99
2	10.94	14.79
3	12.94	14.88

4	14.90	15.24
5	16.80	15.88
6	18.59	16.77
7	20.23	17.91
8	21.70	19.27
9	22.97	20.82
10	23.98	22.50

Circle Center At X = 11.3 ; Y = 29.0 and Radius, 14.2

Factor of Safety
*** 1.511 ***

Individual data on the 19 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.9	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2.0	56.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1.7	80.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.3	17.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	1.9	125.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.2	16.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1.5	49.1	0.0	0.0	0.0	0.0	0.0	0.0	226.1
11	1.5	21.4	0.0	0.0	0.0	0.0	0.0	0.0	217.9
12	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.1	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.6	49.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.1	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

17	0.7	49.9	0.0	0.0	0.0	0.0	0.0	0.0
8.1								
18	1.3	62.1	0.0	0.0	0.0	0.0	0.0	0.0
14.5								
19	1.0	17.1	0.0	0.0	0.0	0.0	0.0	0.0
11.7								

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	6.84	14.99
2	8.75	14.40
3	10.73	14.13
4	12.73	14.19
5	14.69	14.59
6	16.56	15.31
7	18.28	16.33
8	19.81	17.62
9	21.10	19.14
10	22.12	20.86
11	22.76	22.50

Circle Center At X = 11.3 ; Y = 26.1 and Radius, 12.0

Factor of Safety
*** 1.520 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	10.00	14.99
2	11.99	14.76
3	13.98	14.86
4	15.93	15.31
5	17.78	16.07
6	19.47	17.14
7	20.96	18.48
8	22.20	20.05
9	23.15	21.81
10	23.38	22.50

Circle Center At X = 12.4 ; Y = 26.4 and Radius, 11.7

Factor of Safety
*** 1.524 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.42	14.99
2	10.34	14.43
3	12.33	14.24
4	14.33	14.43
5	16.25	14.98
6	18.03	15.88
7	19.62	17.10
8	20.95	18.59
9	21.99	20.30
10	22.68	22.18
11	22.74	22.50

Circle Center At X = 12.3 ; Y = 24.9 and Radius, 10.7

Factor of Safety
*** 1.543 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.95	14.99
2	10.93	14.70
3	12.93	14.72
4	14.90	15.03
5	16.81	15.63
6	18.61	16.51
7	20.25	17.65
8	21.70	19.02
9	22.94	20.60
10	23.92	22.34
11	23.99	22.50

Circle Center At X = 11.8 ; Y = 28.0 and Radius, 13.4

Factor of Safety
*** 1.544 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	9.47	14.99
2	11.43	14.59
3	13.43	14.56
4	15.41	14.89
5	17.29	15.57
6	19.01	16.58
7	20.53	17.88
8	21.78	19.44
9	22.73	21.20
10	23.15	22.50

Circle Center At X = 12.6 ; Y = 25.5 and Radius, 10.9

Factor of Safety
*** 1.545 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.42	14.99
2	10.36	14.50
3	12.36	14.36
4	14.35	14.55
5	16.27	15.08
6	18.08	15.94
7	19.72	17.09
8	21.13	18.50
9	22.28	20.14
10	23.14	21.95
11	23.29	22.50

Circle Center At X = 12.2 ; Y = 26.0 and Radius, 11.7

Factor of Safety
*** 1.559 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.37	14.99
2	9.35	14.71
3	11.35	14.67
4	13.34	14.87
5	15.29	15.31
6	17.18	15.97
7	18.97	16.86
8	20.65	17.95
9	22.18	19.23
10	23.55	20.69
11	24.73	22.30
12	24.84	22.50

Circle Center At X = 10.7 ; Y = 31.4 and Radius, 16.7

Factor of Safety
*** 1.587 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.90	14.99
2	9.83	14.50
3	11.82	14.31
4	13.82	14.44
5	15.77	14.88
6	17.63	15.63
7	19.35	16.65
8	20.88	17.93
9	22.20	19.44
10	23.26	21.13
11	23.84	22.50

Circle Center At X = 12.0 ; Y = 27.0 and Radius, 12.7

Factor of Safety
*** 1.589 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	5.26	14.99
2	7.12	14.24
3	9.07	13.80
4	11.06	13.68
5	13.05	13.89
6	14.98	14.41
7	16.80	15.25
8	18.46	16.37
9	19.91	17.74
10	21.12	19.34
11	22.05	21.10
12	22.52	22.50

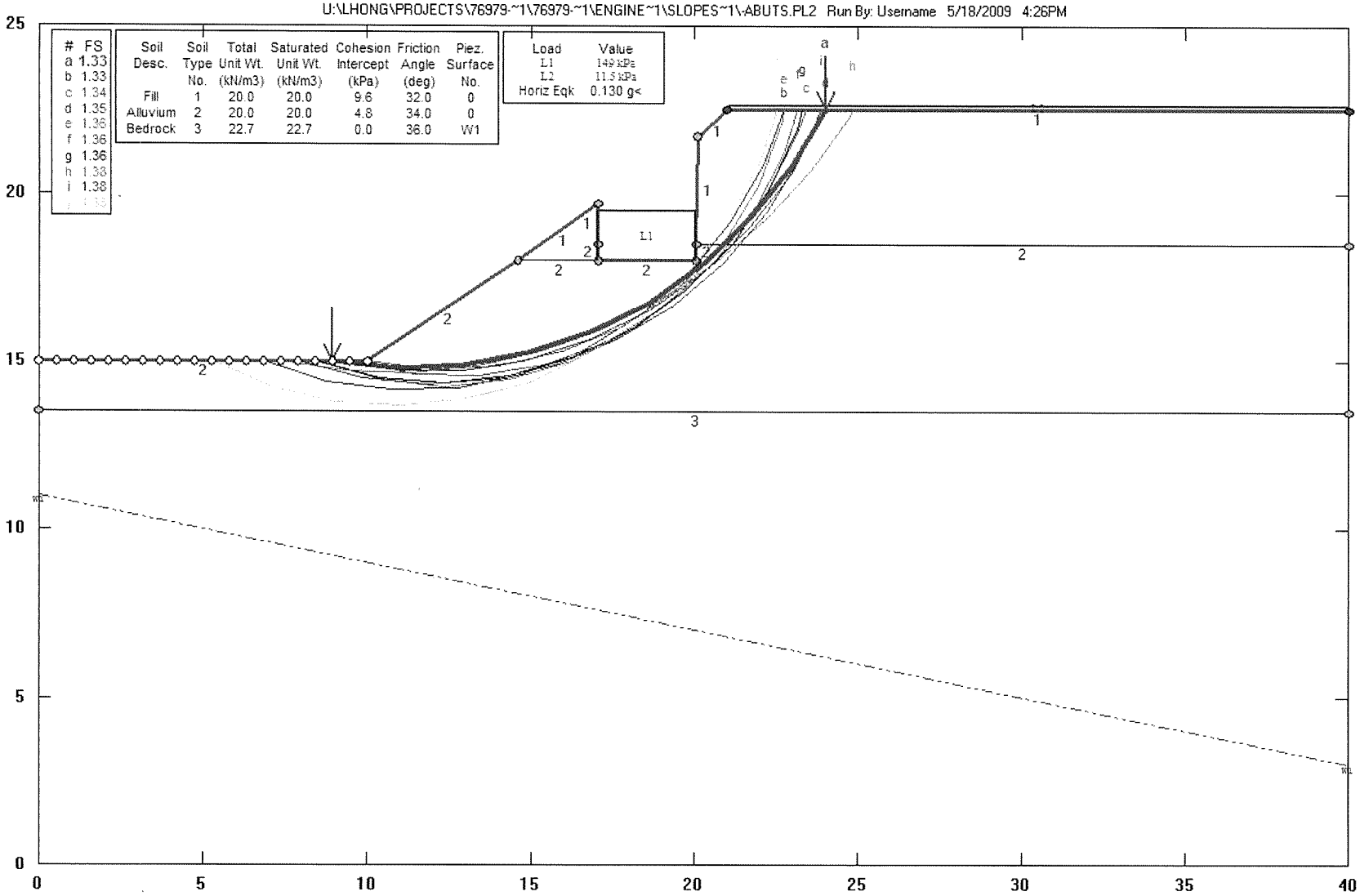
Circle Center At X = 10.8 ; Y = 25.9 and Radius, 12.2

Factor of Safety
*** 1.593 ***

**** END OF GSTABL7 OUTPUT ****

Box Springs Overhead (Replace)-seismic I-215/SR-60 Interchange Improvements

U:\LHONG\PROJECTS\76979-~1\76979-~1\ENGINE~1\SLOPES~1\-ABUTS.PL2 Run By: Username 5/18/2009 4:26PM



GSTABL7 v.2 FSmin=1.33

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
(All Rights Reserved-Unauthorized Use Prohibited)

****
*

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****
*

Analysis Run Date: 5/18/2009
Time of Run: 4:26PM
Run By: Username
Input Data Filename: U:-abuts.
Output Filename: U:-abuts.OUT
Unit System: SI

Plotted Output Filename: U:-abuts.PLT

PROBLEM DESCRIPTION: Box Springs Overhead (Replace)-seismic
I-215/SR-60 Interchange Improvements

BOUNDARY COORDINATES

10 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	14.99	10.01	14.99	2
2	10.01	14.99	14.60	18.01	2
3	14.60	18.01	17.03	19.68	1
4	17.03	19.68	17.05	18.50	1
5	17.05	18.50	17.07	18.01	2
6	17.07	18.01	20.05	18.01	2
7	20.05	18.01	20.07	18.50	2

8	20.07	18.50	20.09	21.72	1
9	20.09	21.72	21.00	22.50	1
10	21.00	22.50	40.00	22.50	1
11	14.60	18.01	17.07	18.01	2
12	20.07	18.50	40.00	18.50	2
13	0.00	13.52	40.00	13.52	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	20.0	20.0	9.6	32.0	0.00	0.0	0
2	20.0	20.0	4.8	34.0	0.00	0.0	0
3	22.7	22.7	0.0	36.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	0.00	10.99
2	40.00	2.99

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	17.07	20.05	149.0	0.0
2	21.00	39.99	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 10.00(m)

Each Surface Terminates Between X = 21.00(m)
and X = 40.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

2.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 4.096 FS Min = 1.327 FS Ave = 2.406
Standard Deviation = 0.595 Coefficient of Variation = 24.74

%

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.95	14.99
2	10.94	14.79
3	12.94	14.88
4	14.90	15.24
5	16.80	15.88
6	18.59	16.77
7	20.23	17.91
8	21.70	19.27
9	22.97	20.82
10	23.98	22.50

Circle Center At X = 11.3 ; Y = 29.0 and Radius, 14.2

Factor of Safety
*** 1.327 ***

Individual data on the 19 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	1.1	1.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0
2	0.9	8.5	0.0	0.0	0.0	0.0	1.1	0.0	0.0
3	2.0	56.9	0.0	0.0	0.0	0.0	7.4	0.0	0.0
4	1.7	80.9	0.0	0.0	0.0	0.0	10.5	0.0	0.0
5	0.3	17.6	0.0	0.0	0.0	0.0	2.3	0.0	0.0
6	1.9	125.5	0.0	0.0	0.0	0.0	16.3	0.0	0.0
7	0.2	16.9	0.0	0.0	0.0	0.0	2.2	0.0	0.0
8	0.0	1.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0
9	0.0	0.9	0.0	0.0	0.0	0.0	0.1	0.0	0.0
10	1.5	49.1	0.0	0.0	0.0	0.0	6.4	0.0	226.1
11	1.5	21.4	0.0	0.0	0.0	0.0	2.8	0.0	217.9

12	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
0.0								
13	0.0	0.9	0.0	0.0	0.0	0.0	0.1	0.0
0.0								
14	0.1	11.2	0.0	0.0	0.0	0.0	1.5	0.0
0.0								
15	0.6	49.9	0.0	0.0	0.0	0.0	6.5	0.0
0.0								
16	0.1	10.1	0.0	0.0	0.0	0.0	1.3	0.0
0.0								
17	0.7	49.9	0.0	0.0	0.0	0.0	6.5	0.0
8.1								
18	1.3	62.1	0.0	0.0	0.0	0.0	8.1	0.0
14.5								
19	1.0	17.1	0.0	0.0	0.0	0.0	2.2	0.0
11.7								

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	6.84	14.99
2	8.75	14.40
3	10.73	14.13
4	12.73	14.19
5	14.69	14.59
6	16.56	15.31
7	18.28	16.33
8	19.81	17.62
9	21.10	19.14
10	22.12	20.86
11	22.76	22.50

Circle Center At X = 11.3 ; Y = 26.1 and Radius, 12.0

Factor of Safety
*** 1.332 ***

1

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	10.00	14.99
2	11.99	14.76
3	13.98	14.86
4	15.93	15.31
5	17.78	16.07
6	19.47	17.14

7	20.96	18.48
8	22.20	20.05
9	23.15	21.81
10	23.38	22.50

Circle Center At X = 12.4 ; Y = 26.4 and Radius, 11.7

Factor of Safety
*** 1.341 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.95	14.99
2	10.93	14.70
3	12.93	14.72
4	14.90	15.03
5	16.81	15.63
6	18.61	16.51
7	20.25	17.65
8	21.70	19.02
9	22.94	20.60
10	23.92	22.34
11	23.99	22.50

Circle Center At X = 11.8 ; Y = 28.0 and Radius, 13.4

Factor of Safety
*** 1.352 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.42	14.99
2	10.34	14.43
3	12.33	14.24
4	14.33	14.43
5	16.25	14.98
6	18.03	15.88
7	19.62	17.10
8	20.95	18.59
9	21.99	20.30

10	22.68	22.18
11	22.74	22.50

Circle Center At X = 12.3 ; Y = 24.9 and Radius, 10.7

Factor of Safety
*** 1.358 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	9.47	14.99
2	11.43	14.59
3	13.43	14.56
4	15.41	14.89
5	17.29	15.57
6	19.01	16.58
7	20.53	17.88
8	21.78	19.44
9	22.73	21.20
10	23.15	22.50

Circle Center At X = 12.6 ; Y = 25.5 and Radius, 10.9

Factor of Safety
*** 1.359 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.42	14.99
2	10.36	14.50
3	12.36	14.36
4	14.35	14.55
5	16.27	15.08
6	18.08	15.94
7	19.72	17.09
8	21.13	18.50
9	22.28	20.14
10	23.14	21.95
11	23.29	22.50

Circle Center At X = 12.2 ; Y = 26.0 and Radius, 11.7

Factor of Safety
*** 1.364 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.37	14.99
2	9.35	14.71
3	11.35	14.67
4	13.34	14.87
5	15.29	15.31
6	17.18	15.97
7	18.97	16.86
8	20.65	17.95
9	22.18	19.23
10	23.55	20.69
11	24.73	22.30
12	24.84	22.50

Circle Center At X = 10.7 ; Y = 31.4 and Radius, 16.7

Factor of Safety
*** 1.375 ***

1

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.90	14.99
2	9.83	14.50
3	11.82	14.31
4	13.82	14.44
5	15.77	14.88
6	17.63	15.63
7	19.35	16.65
8	20.88	17.93
9	22.20	19.44
10	23.26	21.13
11	23.84	22.50

Circle Center At X = 12.0 ; Y = 27.0 and Radius, 12.7

Factor of Safety
*** 1.381 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	5.26	14.99
2	7.12	14.24
3	9.07	13.80
4	11.06	13.68
5	13.05	13.89
6	14.98	14.41
7	16.80	15.25
8	18.46	16.37
9	19.91	17.74
10	21.12	19.34
11	22.05	21.10
12	22.52	22.50

Circle Center At X = 10.8 ; Y = 25.9 and Radius, 12.2

Factor of Safety
*** 1.382 ***

**** END OF GSTABL7 OUTPUT ****

APPENDIX D

RESPONSE TO CALTRANS REVIEW COMMENTS

1220 Research Drive
Suite B
Redlands, CA 92374
p| 909.793.2691
f| 909.792.1704
kleinfelder.com

June 12, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Subject: Response to Caltrans Review Comments (Dated January 30, 2009)
Revised Structure Foundation Report (Dated December 22, 2008)
Box Springs Road Overhead (Replace)
Previously Called Frontage Road Overhead (Replace)
I-215/SR-60 East Junction Improvement Project
Riverside County, California
08-Riv-215/60, KP 60.7/70.6, 22.0/18.5, 32.7/34.7
Caltrans EA No. 449311

Dear Mr. Suydam:

Kleinfelder has prepared this letter in response to comments provided by the California Department of Transportation (Caltrans), Division of Engineering Services, Office of Geotechnical Design South-2, pertaining to their review of our report entitled *Revised Structure Foundation Report, Frontage Road Overhead Replacement, I-215/SR-60 East Junction Improvement Project, Riverside County, California,* dated December 22, 2008. This bridge is currently re-named as Box Springs Road Overhead (Replace). Caltrans has requested responses and resolutions on four comments (Comments 1 through 4). The Caltrans review comments and our responses to these comments are presented below:

Comment No. 1. Foundation Plan (FP) Foundation Report (FR): *The bottom of footing elevation of abutment 1 is not consistent within Foundation Plan and Foundation Report, please revise.*

Response to Comment No. 1. The bottom of footing elevation of Abutment 1 in Table 2, Footing Data Table based on the latest Foundation Plan, which is 455.8 meters.

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Comment No. 2. FR and Appendix C-3: *Please provide the summary of calculations, which were used to calculate the Permissible Gross/Net contact Stresses (i.e., settlements vs loads curves).*

Response to Comment No. 2. Permissible gross and net bearing capacities can be obtained from the footing bearing capacity calculations provided in Appendix C-2 and settlement calculations provided in Appendix C-3.

Comment No. 3. *FR and Appendix C-2: Table 2 (Footing Data Table), shows LRFD Resistance Factor of 0.45 for Strength limit, but in the Engineering Analysis a safety factor of 3.0 was used to calculate the allowable bearing capacities, please clarify.*

Response to Comment No. 3. Table 2, Footing Data Table, has been revised in our final report. Supporting calculations are presented in Appendices C-2 and C-3.

Comment No. 4. LOTB: *The Revised Log of Test Boring (LOTB) for the above project still does NOT meet with Caltrans' Soil & Rock Logging, Classification, and Presentation Manual (June 2007), and the Caltrans' Guidelines for Structures Foundation Reports v. 2.0, March 2006. Please revise according to the following website.*
http://www.dot.ca.gov/hq/esc/geotech/requests/logging_manual/logging_manual.html

Response to Comment No. 4. We agree with Caltrans on the comment. We revised our LOTB sheet based on Caltrans soil and rock logging, classification, and presentation manual (June 2007). Some of the changes made to LOTB sheet include:

- Bore hole ID's.
- Names of nearest cities on plan.
- Vertical scale for profile.
- Soil descriptions.
- Rock descriptions.
- Representation of groundwater surface elevation.
- Hammer energy ratio.
- Note indicating the LOTB sheet is prepared in accordance with Caltrans Manual.

However, Bedding Spacing, Fracture Density, Core Recovery (REC), and Rock Quality Designation (RQD) are not shown on the logs. These descriptions are only possible when rock coring is performed. Rock coring was not performed for the current project. Subsurface exploration only consisted of California (CAL) and Standard Penetration Test (SPT) samples in soil and bedrock.

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CLOSURE

The information contained in this letter/report is subject to the conditions and limitations contained within the preliminary foundation report. We appreciate the opportunity to be of service on this project. If you have any questions, comments or require additional information, please do not hesitate to contact our office at your convenience.

Respectfully submitted,

KLEINFELDER WEST, INC.

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

MC/CVA:lg

Attachments: Comments Resolution Form

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State of California

Business, Transportation and Housing Agency

Flex your power!
Be energy efficient!

Memorandum

To: MR. LAM NGUYEN, CHIEF
DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
OFFICE OF SPECIAL FUNDED PROJECTS MS#9-2/7G

Date: January 30, 2009

File: 08-Riv-91-PM 37.1/43.9
08-449311

Attention: Mr. Robert Zezoff

Frontage Road
Overhead (Replace)
Br. No. 56C-0056

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES - MS #5
OFFICE OF GEOTECHNICAL DESIGN SOUTH-2

Subject: California Department of Transportation (Caltrans) Foundation Report Review Comments.

The submitted Foundation Report by Lim & Nascimento Engineering Corporation and Kleinfelder for the above-proposed project does not satisfy the requirements of Caltrans' Guidelines for Structures Foundation Reports (version 2.0, March 2006).

We are suggesting incorporating the attached comments to the Foundation Report. The attached comments are based on the Foundation Report, General and Foundation Plans, Log of Test Boring and details sheets dated December 22, 2008. for the above-proposed project in Riverside, California.

We are suggesting that all responses to Caltrans' comments should be attached as an addendum to Foundation Report.

Any questions regarding the review comments and recommendations should be directed to the attention of Asef Wardak (916) 227-1219 or Angel Perez-Cobo (916) 227-7167, Office of Geotechnical Design South-2.

Prepared by: Date: 2/5/09

Asef Wardak
Transportation Engineer

REGISTERED PROFESSIONAL ENGINEER
ASEF WARDAK
No. C 61960
Exp. 9/30/09
CIVIL
STATE OF CALIFORNIA

Supervised by: Date:

Angel Perez-Cobo
Senior Transportation Engineer
Office of Geotechnical Design South-2

Attachment: Caltrans' Foundation Report Review Comments

c: Project File

I215/SR 60 East Junction HOV Gap Closure
Frontage Road O.H
Bridge No. 56C-0056

REVIEWER: Asef Wardak
DATE: January 30, 2009

COMMENTS RESOLUTION FORM

RESPONDER:_____
DATE: _____

DOCUMENT NAME AND DATE: Foundation Report, General and Foundation Plans, Log of Test Boring and details sheets dated December 22, 2008.

COMMENT NUMBER	PAGE NO.	CRITERIA / REPORT /DRAWING NO./ SPECIFICATION	COMMENT (Do not address more than one discipline per sheet)	RESPONSE	ACTION CODE
1	Sheet 4 Page 2	Foundation Plan (FP) Foundation Report (FR)	The bottom of footing elevation of abutment 1 is not consistent within Foundation Plan and Foundation Report, please revise.		
2	13	FR and Appendix C-3	Please provide the summary of calculations, which were used to calculate the Permissible Gross/Net contact Stresses (i.e. settlements vs. loads curves).		
3	13	FR and Appendix C-2	Table 2 (Footing Data Table), shows LRFD Resistance Factor of 0.45 for Strength limit, but in the Engineering Analysis a safety factor of 3.00 was used to calculate the allowable bearing capacities, please clarify.		
4	Plates 4a – 4d	LOTB	The Revised Log Of Test Boring (LOTB) for the above project still dose NOT meet with Caltrans' Soil & Rock Logging Classification, and Presentation Manual (June 2007), and The Caltrans' Guidelines For Structures Foundation Reports v. 2.0, March 2006. Please revise according to the following website. http://www.dot.ca.gov/hq/esc/geotech/requests/logging_manual/logging_manual.html		

ACTION CODES: A – Designer agrees and will comply/take action.
B – Designer will investigate and comment.
C – Disagree for reasons noted, discussion may be required.

NOTES: ( ) Indicates paraphrasing of original comment.
.... Indicates unreadable comment

REVISED
STRUCTURE FOUNDATION REPORT
BOX SPRINGS OVERHEAD RIGHT BRIDGE (WIDEN)
BRIDGE NO. 56-0082R
INTERSTATE 215/STATE ROUTE 60 EAST JUNCTION
CITY OF RIVERSIDE, CALIFORNIA
08-RIV-215/60-KP 61.7/62.6, 19.4/21.5
CALTRANS EA NO. 08-449311

Prepared for:

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER WEST, INC.
1220 Research Drive, Suite B
Redlands, CA 92374

Kleinfelder Project No. 76979

Revised June 12, 2009
October 10, 2008

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APPROVAL LETTER

State of California | Business, Transportation and Housing Agency

Flex your power!
Be energy efficient!

Memorandum

To: Mr. Denix D. Anbiah
Department of Transportation
Division of Engineering Services
Office of Special Funded Projects MS #9- 2/7G

Date: September 17, 2009

File: EA 08-449311
08-RIV-56-0082R
(Widen)

Attention: Robert Zezoff

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES - MS #5
OFFICE OF GEOTECHNICAL DESIGN SOUTH-2

Subject: Caltrans OSFP Review Comments

References: Addendum to Structure Foundation Report (dated June 12, 2009), Box Springs Overhead Right Bridge (Widen), Bridge No. 56-0082R, Interstate 215/State Route 60 East Junction Improvements, City of Riverside, California, 08-Riv-215/60, KP 61.7/62.6, 19.4/21.5, Caltrans EA No. 08-449311, dated August 19, 2009, by Kleinfelder West, Inc., Project No. 76979.

The submitted Addendums to the Structure Foundation Report by Kleinfelder West, Inc. for the above-proposed project was found to generally satisfy the requirements of Caltrans' Structure Foundation Report Guidelines, based upon the responses to the review comments (dated July 27, 2009).

Any questions regarding the review comments and recommendations should be directed to the attention of K. Douglas Cook (916) 227-4514 or Angel Perez-Cobo (916) 227-7167, Office of Geotechnical Design South-2 A.

Prepared by:

K. Douglas Cook , CEG date:_____
Engineering Geologist

Reviewed by:

Angel Perez-Cobo, PE date:_____
Senior Transportation Engineer
Office of Geotechnical Design South-2

KDC/AW

Distribution: (2) Addressee

ADDENDUM

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August 19, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

via Electronic Mail
Mohan.Char@lanengineering.com
Kimberly.Gee@lanengineering.com

Subject: Addendum to Revised Structure Foundation Report (Dated June 12, 2009) Box Springs Overhead Right Bridge (Widen) Bridge No. 56-0082R Interstate 215/State Route 60 East Junction City of Riverside, California 08-RIV-215/60-KP 61.7/62.6, 19.4/21.5 Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder has prepared this addendum report in response to comments provided by the California Department of Transportation (Caltrans), Division of Engineering Services, Geotechnical Services- MS #5, Office of Geotechnical Design South-2, pertaining to their review of our report entitled Revised Structure Foundation Report, Box Springs Overhead Right Bridge (Widen), Bridge No. 56-0082R, Interstate 215/State Route 60 East Junction, City of Riverside, California, dated June 12, 2009. The Caltrans review comments and our responses to these comments are attached.

CLOSURE

The information contained in this report/letter is subject to the conditions and limitations contained within the structure foundation report. We appreciate the opportunity to be of service on this project. If you have any questions, comments or require additional information, please do not hesitate to contact our office at your convenience.

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KLEINFELDER
Bright People. Right Solutions.

Respectfully submitted,
KLEINFELDER WEST, INC.

REGISTERED PROFESSIONAL ENGINEER
MADAN CHIRUMALLA, PE
No. 74186
Exp. 6/30/2011
CIVIL
STATE OF CALIFORNIA

Madan Chirumalla, PE
Staff Engineer

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

for: Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

PROFESSIONAL GEOLOGIST
MICHAEL O. COOK
CEG #1716
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

MC/CVA:lg

Attachments: Response to Comments Form
Abutment Details No.4

REGISTERED PROFESSIONAL ENGINEER
CARLOS V. AMANTE
No. 2724
Exp. 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

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Project Name: **I-215/SR-60 East Junction**
08-RIV-215/60 CU08 -EA449311
Review Phase: **Foundation Report Review**
Box Springs OH Right (Widen) Bridge No 56-0082R
Responses by: Carlos Amante/ Madan Chirumalla

RESPONSE TO COMMENTS ON FOUNDATION REPORT REVIEW – BOX SPRINGS OH RIGHT (WIDEN)

Comment No.	Sheet No.	Comments by Douglas Cook & Asef Wardak	Consultant Response	✓
1	Cover Letter and Pg. 1	Please indicate the date of the "latest bridge design plans" for which the report is being issued, and by whom were said plans prepared. Please provide a set of these revised plans for review.	The latest bridge design plans will be provided by LAN Engineering.	
2	Pgs. 1 and 2	Please note that additional borings at the respective abutment and bent locations may be necessary prior to acceptance of subject report.	In our opinion, additional borings are not necessary since the subsurface conditions at the bridge can be adequately evaluated from the previous borings by Caltrans and two nearby borings for the Box Springs OH Left Bridge.	
3	Pgs. 6,7,10 Sec. 4.2	Review of the cited USGS Geologic Map of the San Bernardino and Santa Ana 30'x60' Quadrangles (Morton, 2006) indicated that the site is transected by an inferred fault. Please include a copy of the geological map for the site vicinity, discuss this fault in the text of the report. Provide recommendations to address and mitigate it in the design of the project as necessary.	The inferred fault depicted on the San Bernardino and Santa Ana 30'x60' quadrangle, sheet 1of 4, (USGS Open-File Report OF-2006-1217) is a pre-Pleistocene fault. The fault does not cut Late Pleistocene or Holocene deposits as indicated on Sheet 3 of 4 of OF-2006-1217. As such the fault is not considered a "sufficiently active" or "well-defined" active fault based on the California Geological Survey criterion in CGS Special Publication 42 (2007). In addition, the fault is not identified as an active fault by Caltrans on the Seismic Hazards Map used for bridge seismic design. Bridge design parameters were developed based on current Caltrans seismic design criteria and no additional mitigation recommendations for this subject fault are necessary.	
4	Pg. 8 LOTB	It is mentioned under the "Earth Materials" (Section 5) as well as in the Log of Test Boring (LOTB) that soils consists of scattered gravel, cobbles (≥100 mm) and rock. Therefore, it is essential to explain the mitigation and alleviation in the foundation report for construction of the proposed footings.	The abutments, bents, and retaining wall are all supported on shallow footings. Overexcavation recommendations are provided in Sections 6.2.2, 6.3.2, and 7.1.2 of our report. No separate mitigation and alleviation for the scattered cobbles is necessary.	

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Project Name: **I-215/SR-60 East Junction**
08-RIV-215/60 CU08 -EA449311
Review Phase: **Foundation Report Review**
Box Springs OH Right (Widen) Bridge No 56-0082R
Responses by: Carlos Amante/ Madan Chirumalla

Comment No.	Sheet No.	Comments by Douglas Cook & Asef Wardak	Consultant Response	✓
5	**Pgs. 12, Sec.6.1.4**	Please reference the source cited for the County of Riverside Liquefaction information provided.	Riverside County Land Information System http://www3.tlma.co.riverside.ca.us/pa/rclis/index.html	
6	**Pg. 13**	The bottom of footing elevation (Abut. 4) shown in Table 2 is not consistent with bottom of footing elevation shown on the foundation plan.	It is consistent in both locations with a value of 453.10 meters.	
7	**Pg. 16 Table 3**	Please discuss and present the data for the Abutment 4, similar to that presented for Abutment 1 wall.	In our opinion, this disussion is not necessary since Abutment 4 wall is a wingwall. However, we have attached the plan for Abutment Details No.4 in this addendum report, for your reference.	
8	**Appendix D**	The spread Footing Data Table is not consistent with Index Plans MEMO TO DESIGNERS 4-1. Please follow Caltrans MEMO TO DESIGNERS 4-1.	The plans presented in Appendix D are as-built plans prepared in 2003, and Kleinfelder cannot make any changes on them. Our current spread footing data table for the proposed bridge widening is prepared in general accordance with Caltrans Memo to Designers 4-1, April 2008.	

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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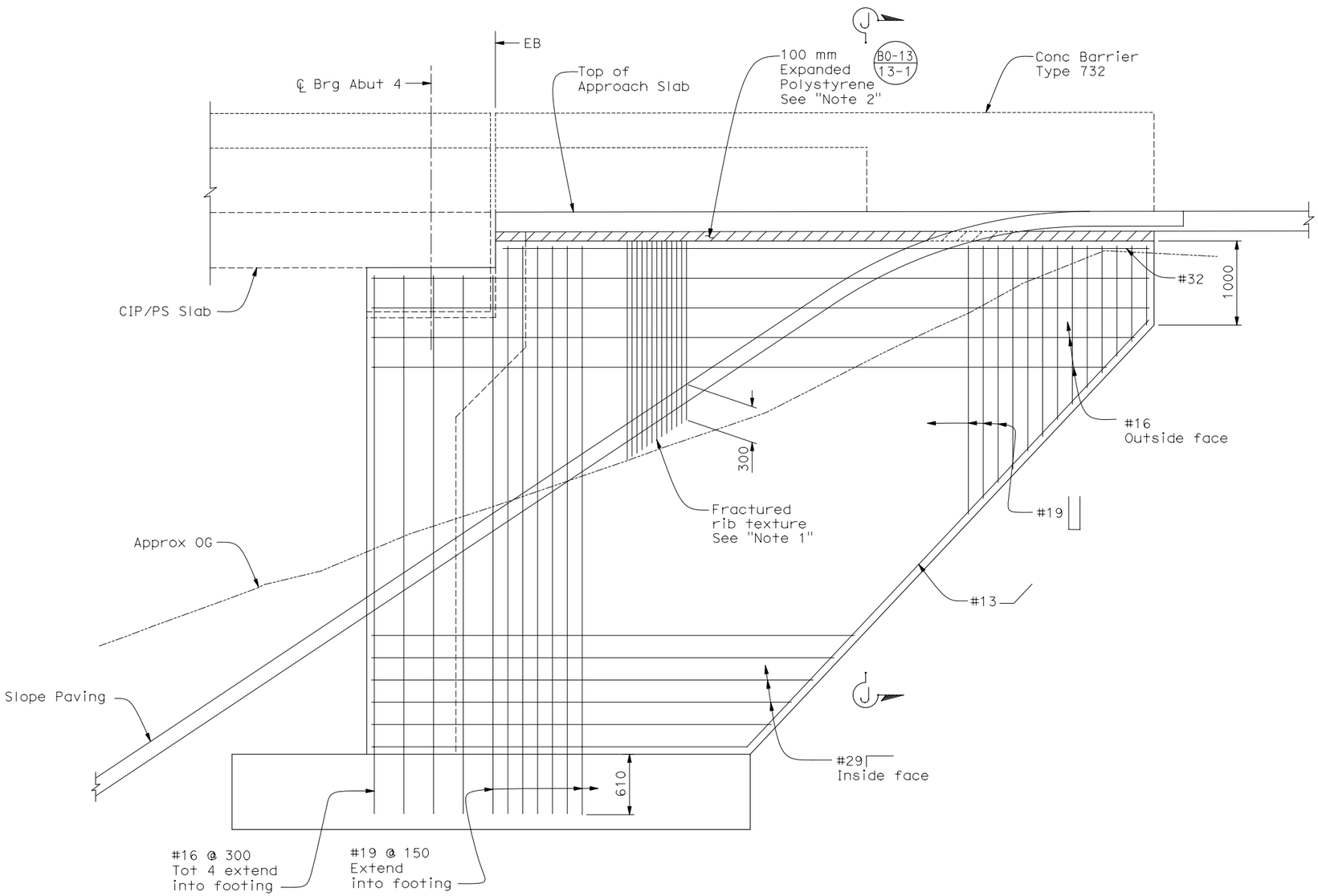
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

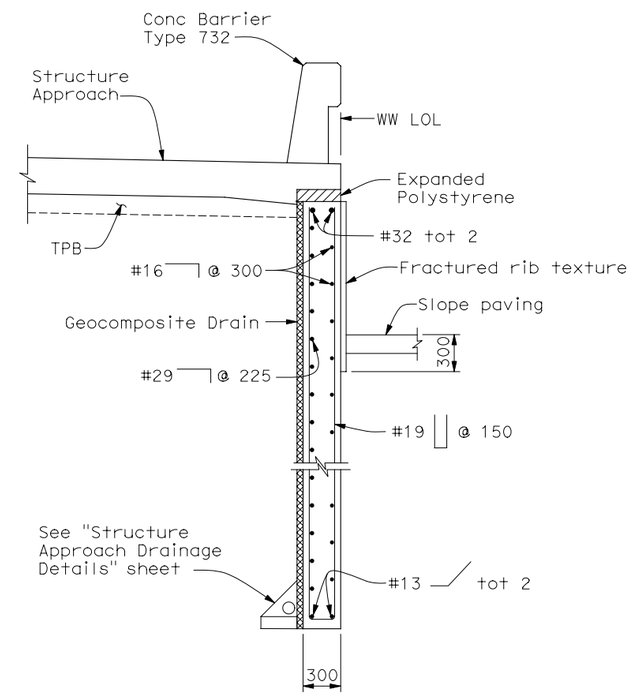
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



WINGWALL MIRROR ELEVATION
ABUTMENT 4 LEFT
1:25

Notes:

1. For fractured rib texture detail, see "Abutment Details No. 2" sheet.
2. Remove all polystyrene after forming



SECTION J-J
1:25

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

	BY	CHECKED
DESIGN	D. KIM/D. SARETSKY	T. DUDLEY/A. SIVATHASAN
DETAILS	R. ANDRASEK/D.SARETSKY	T. DUDLEY/M. CHAR
QUANTITIES	D. SARETSKY	K. GEE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56-0082R
KILOMETER POST

BOX SPRINGS OH (WIDEN)
ABUTMENT DETAILS No. 4

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 9/28/08 12/22/08 6/15/09 8/20/09

SHEET 13 OF 28

DATE PLOTTED → 8/21/2009 TIME PLOTTED → 14:16

REVISED FINAL STRUCTURE FOUNDATION REPORT

REVISED
STRUCTURE FOUNDATION REPORT
BOX SPRINGS OVERHEAD RIGHT BRIDGE (WIDEN)
BRIDGE NO. 56-0082R
INTERSTATE 215/STATE ROUTE 60 EAST JUNCTION
CITY OF RIVERSIDE, CALIFORNIA
08-RIV-215/60-KP 61.7/62.6, 19.4/21.5
CALTRANS EA NO. 08-449311

Prepared for:

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER WEST, INC.
1220 Research Drive, Suite B
Redlands, CA 92374

Kleinfelder Project No. 76979

Revised June 12, 2009
October 10, 2008

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Revised June 12, 2009
October 10, 2008
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

Subject: **Revised Structure Foundation Report**
Box Springs Overhead Right Bridge (Widen)
Bridge No. 56-0082R
Interstate 215/State Route 60 East Junction
City of Riverside, California
08-RIV-215/60-KP 61.7/62.6, 19.4/21.5
Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) is pleased to present this Revised Structure Foundation Report for the proposed Box Springs Overhead Right Bridge Widening, located at the east junction of existing Interstate 215 (I-215) and State Route 60 (SR60) in the City of Riverside, California. The purpose of this report is to provide geotechnical engineering recommendations for design and construction of the proposed project. This report updates the foundation data shown in the latest bridge design plans.

The proposed project is geotechnically feasible provided that our recommendations in this report are properly incorporated into the design and construction of the project. Recommendations provided herein are contingent on the provisions outlined in the Additional Services and Limitations section of this report. The project Owner should become familiar with these provisions in order to assess potential impacts to the proposed project and further involvement by Kleinfelder.

We appreciate the opportunity to be of service on this project. If you have any questions and comments or require additional information, please do not hesitate to contact the undersigned.

Sincerely,
KLEINFELDER WEST, INC.

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
CARLOS V. AMANTE
No. 2724
Exp. 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

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STATE OF CALIFORNIA

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APPENDICES

Appendix A – Field Exploration
Appendix B – Laboratory Testing
Appendix C – Engineering Analyses
Appendix D – Bridge As-built Plans

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1.0 INTRODUCTION

1.1 GENERAL

Kleinfelder West, Inc., (Kleinfelder) was retained by Lim & Nascimento Engineering Corporation (LAN Engineering) to provide geotechnical services for the proposed Box Springs Overhead Right Bridge Widening, located at the Interstate 215/State Route 60 (I-215/SR-60) East Junction, in the City of Riverside, Riverside County, California (see Plate 1, *Site Location Map*). The scope of our services was provided in our proposal entitled *Revised Proposal for Geotechnical Services For Plans, Specifications, and Cost Estimates (PS&E), I-215 East Junction, Riverside, California, dated July 29, 2008.*

This report presents our recommendations relative to the geotechnical aspects of design and construction for the proposed project. Based on our discussions with LAN Engineering, drilling was not performed for the proposed project. Conclusions and recommendations presented in this report are based on the as-built Log of Test Borings (LOTB) sheets for the existing Box Springs Overhead Right Bridge (see Appendix D) and the subsurface data from borings (BS-1 and BS-2) performed by Kleinfelder (2007) for the proposed nearby Box Springs Overhead Left Bridge.

Recommendations presented in this report should not be extrapolated to other areas or be used for other projects without our prior review.

1.2 PROJECT DESCRIPTION

Based on the bridge G*eneral Plan* and *Foundation Plan*, respectively, the existing Box Springs Overhead Right Bridge is a three-span bridge supported on two abutments (Abutments 1 and 4) and two bents (Bents 2 and 3), all founded on spread footings. We understand that the existing Right Bridge was recently constructed to replace an older bridge but was only partially completed and that this project will complete the widening of the bridge. Based on design plans prepared for the proposed Box Springs Overhead, Right Bridge Widening, the proposed widened bridge is a three-span bridge to be constructed with cast-in-place, prestressed slab with a length of 39.55 meters measured along the “H” centerline, and a variable width. The widened bridge is proposed to be founded on shallow foundations similar to the existing bridge.

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As part of our research for this project, Kleinfelder reviewed design plans (including the as-built LOTB sheets) for the recently constructed Box Springs Overhead Right Bridge, Revised Foundation Report prepared by Caltrans for the Box Springs Overhead Right Bridge (Bridge No. 56-0082R) replacement project. The report was presented as a memorandum dated April 10, 2007. We have also reviewed the Preliminary Foundation Report for the proposed Box Springs Overhead Right Bridge Widening prepared by Kleinfelder, dated April 25, 2008.

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2.0 GEOTECHNICAL INVESTIGATION

The purpose of this investigation was to evaluate subsurface conditions at the site and provide geotechnical recommendations for design and construction of the proposed bridge widening. A description of the scope of services performed is presented below.

Task 1 – Literature Review

We began our services by reviewing the as-built plans of the existing structures (see Appendix D, *Bridge As-Built Plans*), as well as the soils and geologic data in our files and from select public agencies (see References). We have completed a computerized search of appropriate seismic and faulting information as it relates to the site.

Task 2 – Field Exploration

Drilling was not performed for the proposed bridge widening. Kleinfelder drilled two borings (BS-1 and BS-2) for the nearby Box Springs Overhead Left Bridge widening on March 7, 2007 to depths ranging from approximately 11.3 to 15.1 meters below the existing ground surface (bgs). These borings were advanced using an L10T track-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer delivery system. The borings were logged and sampled by a staff professional from our office using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Each soil sample was observed and described in general accordance with the Unified Soil Classification System (USCS). Following drilling, sampling and logging, the borings were backfilled with native cuttings. The boring logs are presented in Appendix A, *Field Exploration*.

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Task 3 – Laboratory Soil Testing

Laboratory test data obtained from the Box Springs Overhead Left Bridge widening project is provided in Appendix B, *Laboratory Testing*. Tests performed consisted of moisture content and in-situ dry unit weight (ASTM D2216 and D2937); grain size distribution (ASTM D 422); direct shear test (ASTM D 3080); consolidation test (ASTM D 5333); and corrosivity tests consisting of electrical resistivity test (CTM 532), pH (CTM 643), sulfate content (CTM 417), and chloride content (CTM 422).

Task 4 – Geotechnical Analyses and Report Preparation

Field and laboratory findings were evaluated in conjunction with the proposed use project. This report includes conclusions and recommendations regarding the following:

- Regional geologic setting, geologic features, and geologic hazards including the potential for ground rupture due to surface faulting, liquefaction potential, and other seismically induced hazards;
- Subsurface materials encountered within the exploratory borings, anticipated groundwater levels and excavation characteristics of these materials;
- Corrosion potential of the near-surface soils;
- Acceleration Response Spectra (ARS) curves, including standard Caltrans ARS curve and modified (design) ARS curve;
- Recommendations for design and construction of spread footing foundations including recommended bearing capacities and total and differential settlements
- Recommended active, passive, at-rest and seismically-induced lateral earth pressures for retaining walls and other below grade structures;
- Guidelines for earthwork including recommendations for site preparation, fill placement, and compaction.

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3.0 PERTINENT REPORTS AND INVESTIGATIONS

The following documents were reviewed for this study:

- General Plan for Box Springs Overhead Right (Widen), Bridge Number 56-0082R, prepared for the State of California, Department of Transportation, CU 08, EA 449311, by Lim & Nascimento Engineering, Revision Date December 22, 2008.
- Foundation Plan for Box Springs Overhead Right (Widen), Bridge Number 56-0082R, prepared for the State of California, Department of Transportation, CU 08, EA 449311, by Lim & Nascimento Engineering, Revision Date December 22, 2008.
- Retaining Wall No. 1 Layout for Box Springs Overhead Right (Widen), Bridge Number 56-0082R, prepared for the State of California, Department of Transportation, CU 08, EA 449311, by Lim & Nascimento Engineering, Revision Date September 25, 2008.
- Preliminary Foundation Report, Proposed Box Springs Overhead Right Bridge Widening, I-215/SR60 East Junction, Riverside, Kleinfelder Project No. 76979, dated April 25, 2008.
- Structure Foundation Report, Proposed Box Springs Overhead Left Bridge Widening, Bridge Number 56-0082L, I-215/SR60 East Junction, Riverside, California, California, 08-RIV-215/60, KP R38.6, Caltrans EA No. 449311, Kleinfelder Project No. 76979, dated March 14, 2008.
- United States Geological Survey, 7-1/2 Minute Series, Riverside East Quadrangle, California, 1967, Photorevised 1980.
- United States Geological Survey, Geologic Map of the San Bernardino and Santa Ana 30' X 60' Quadrangle, California, Version 1.0, 2006.

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4.0 GEOLOGY AND SEISMICITY

4.1 REGIONAL AND LOCAL GEOLOGY

The project site is situated within the northern Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are a northwest-southeast oriented complex of blocks separated by similarly trending faults which extend 200 kilometers from the Transverse Ranges, south of the Mexican border and beyond another 1250 kilometers to the tip of Baja California. The province varies in width from 50 to 160 kilometers and is bounded on the east by the Colorado Desert and the Gulf of California and on the west by the Pacific Ocean.

The Peninsular Ranges contain Jurassic-age and Cretaceous-age igneous and metamorphic rocks, as well as a thick sequence of marine and non-marine sedimentary rock. The Peninsular Ranges Province is further described by sub-units, which include the Perris Block, the Santa Ana Mountains, and the San Jacinto Mountains. The Perris Block is characterized as a broad area of intermixed valleys and low mountain ranges situated between the Elsinore and San Jacinto fault zones.

The project site is located in the northern portion of the Perris Block and Perris Valley. Typical lithographic units within this area consist of Quaternary alluvial deposits overlying granitic and metamorphic bedrock. Sporadic outcrops of bedrock dot the valley floor and represent remnants of eroded hills and mountains. Bedrock consists of mostly Cretaceous-age igneous rock (tonalite) forming the bedrock hills north of the site.

4.2 FAULTING AND SEISMICITY

The project site is located in the highly seismic southern California region within the influence of several fault systems that are considered to be active or potentially active. An active fault is a fault that has experienced seismic activity during historic time (since roughly 1800) or exhibits evidence of surface displacement during Holocene time (Bryant and Hart, 2007). The definition of “potentially active” varies. A generally accepted definition of “potentially active” is a fault showing evidence of displacement that is older than 11,000 years (Holocene age) and younger than 1.7 million years (Pleistocene age). However, “potentially active” is no longer used as criteria for zoning

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by the California Geologic Survey (CGS). The terms “sufficiently active” and “well-defined” are now used by the CGS as criteria for zoning faults under the Alquist-Priolo Earthquake Fault Act. A “sufficiently active fault” is a fault that shows evidence of Holocene surface displacement along one or more of its segments and branches, while a “well-defined fault” is a fault whose trace is clearly detectable by a trained geologist as a physical feature at or just below the ground surface. The definition “inactive” generally implies that a fault has not been active since the beginning of the Pleistocene Epoch (older than 1.7 million years old). These sufficiently active and well defined faults are capable of producing seismic shaking at the site that could potentially be damaging to buildings and appurtenant structures. It is anticipated that the project site will periodically experience ground acceleration as the result of moderate to large magnitude earthquakes. Other active faults without surface expression (blind faults) that are capable of generating an earthquake, or other potentially active seismic sources may be present that are not currently zoned.

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5.0 SUBSURFACE CONDITIONS

5.1 EARTH MATERIALS

Based on our review of the Caltrans LOTB sheets, the Revised Foundation Report prepared by Caltrans (dated April 10, 2007), and the results of our previous geotechnical investigation for the Box Springs Overhead Left Bridge widening (see Appendices A and B), the subsurface conditions anticipated at the site of the Right Bridge widening consists of undocumented fill soil, sandy alluvial soil deposits, and granitic bedrock. Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the Boring Logs provided in Appendix A.

5.1.1 Undocumented Fill (Afu)

The fill soils were likely placed as part of the development of the existing bridges. In general, the fill soils consist of loose to very dense silty sand and clayey sand.

5.1.2 Alluvium (Qal)

Alluvial soils were encountered below the fill soils in each of the borings reviewed. The alluvial soils extend to elevations ranging from approximately 454 to 446 meters above Mean Sea Level (MSL). In general, the alluvial soil deposits consist of medium dense to very dense silty sand with some interbedded layers of sand and silt and scattered gravel and cobbles.

5.1.3 Granitic Bedrock (Kgr)

Tonalite granitic bedrock was encountered in all of the borings reviewed for this report. The bedrock was encountered below the alluvial soils at elevations ranging from approximately 454 to 446 meters above MSL and extended to the lowest elevation explored of approximately 441.5 meters above MSL. In general, the tonalite rock is moderately to highly weathered and decomposed near the contact with the alluvial soils and becomes less weathered with depth.

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5.2 GROUNDWATER

Groundwater was not encountered in either of Kleinfelder's borings excavated in March of 2007 for the Box Springs Overhead Left Bridge widening. Groundwater was not encountered in the Caltrans borings excavated for the original Box Springs Overhead bridge in December of 1961 and was not encountered in the Caltrans borings excavated in August of 2002 for the Box Springs Overhead Right Bridge replacement project. However, groundwater was encountered at approximate elevation 449.0 meters in two of the nine additional borings excavated by Caltrans in April of 2007 near the proposed Bents 2 and 3 support locations for the Box Springs Overhead Right Bridge.

Fluctuations of the groundwater level, localized zones of perched water, and variations in soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas on and adjacent to the site can also cause a fluctuation of local groundwater levels.

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6.0 DISCUSSION AND RECOMMENDATIONS

6.1 SEISMIC DESIGN CRITERIA

6.1.1 Ground Surface Rupture and Deformation Potential

The site is not located within a currently delineated State of California Alquist-Priolo Earthquake Fault Zone (Bryant and Hart, 2007). No known active faults have been identified on the site, thus, the potential for future surface fault rupture at the site is considered to be "low." While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

6.1.2 Seismic Shaking

The *1996 California Seismic Hazard Map* prepared by Caltrans (Mualchin, 1996a) indicates that the controlling fault for this project is the San Jacinto Fault (SJO), a strike slip fault with a maximum credible earthquake (MCE) moment magnitude of 7.5. The closest fault distance to the project site is approximately 8.8 km.

The horizontal peak bedrock acceleration (PBA) at the site based on the 1996 Caltrans Seismic Hazard Map is 0.5g. Caltrans *Guidelines for Structures Foundation Reports* (Version 2.0, dated March 2006) requires that the PBA determined above be verified with well-established attenuation relationships such as Sadigh et el. (1997) for controlling faults. The PBA value for the site, estimated using Sadigh et al. (1997) attenuation relationship, is 0.46g. Therefore, a PBA of 0.5g is recommended in accordance with Caltrans design practice.

Based on the results of our previous field exploration, our past experience, and in accordance with Table B.1 of Caltrans *Seismic Design Criteria* (SDC) (Version 1.4, dated June 2006), the site can be classified as Soil Profile Type C. The recommended seismic design parameters are summarized in the following Table 1.

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Table 1
Seismic Design Parameters

Seismic Parameters	Design Recommendation and Reference
Controlling Fault	San Jacinto (SJO), (Mualchin, 1996a)
Type of Fault	Strike-Slip (Mualchin, 1996b)
Site Distance from the Fault	8.8 km (Mualchin, 1996a)
Earthquake Magnitude (MCE)	7.5 (Mualchin, 1996a,b)
Horizontal Peak Bedrock Acceleration (PBA)	0.5g
Soil Profile Type	C (Table B.1, 2006 Caltrans Seismic Design Criteria)
ARS Curve Recommendation	SDC ARS Figure B.5 modified for directivity effects and scaled to design PBA; Damping = 5%

6.1.3 Design ARS Curve

The standard acceleration response spectra (ARS) curve presented in Figure B.5 of Caltrans SDC for PBA of 0.5g, magnitude 7.5 and Soil Profile Type C was selected for seismic design of the proposed bridges. This standard ARS curve was modified to account for near-source fault rupture directivity effect as follows:

- 20% increase in spectral values for periods equal to or greater than 1.0 second;
- No change for periods less than 0.5 seconds; and
- Spectral ordinates for periods between 0.5 and 1 second determined by linear interpolation.

The standard Caltrans SDC ARS curve, modified ARS curve and their ordinate values are presented on Plate 6, *Design ARS Curve*.

6.1.4 Liquefaction Potential

Seismically induced soil liquefaction generally occurs in loose, saturated, cohesionless soil when pore pressures within the soil increase during ground shaking. The increase in pore pressure transforms the soil from a solid to a semi-liquid state. The primary factors affecting the liquefaction potential of a soil deposit are: 1) intensity and duration of earthquake shaking, 2) soil type and relative density, 3) overburden pressures, and 4) depth to groundwater. Soils most susceptible to liquefaction are clean, loose, uniformly

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graded, fine-grained sands, and non-plastic silts that are saturated. Silty sands have also been shown to be susceptible to liquefaction. These soils typically lose a portion or all of their shear strength and regain strength sometime after shaking stops. Soil movements (both vertical and lateral) have been observed under these conditions due to consolidation of the liquefied soils and the reduced shear resistance of slopes.

According to a Liquefaction Hazard Map prepared by the County of Riverside (Generalized Liquefaction Figure S-3, 2002), the site is located in an area designated as having a "low" liquefaction susceptibility. Groundwater was not encountered in either of Kleinfelder's borings excavated for the Box Springs Overhead Left Bridge widening. Groundwater was encountered at approximate elevation of 449.0 meters above MSL in two borings excavated by Caltrans in April of 2007 near the proposed Bents 2 and 3 support locations.

In order to evaluate the liquefaction potential at the proposed bridge site, we used the simplified liquefaction analysis procedure recommended by NCEER (Youd and Idriss, 2001). Based on a groundwater elevation of 449.0 meters, the medium dense to very dense nature of the subsurface alluvial soils, and the presence of weathered bedrock, the site has a "low" liquefaction potential.

6.1.5 Seismically Induced Settlement

Unconsolidated, loose to medium dense sandy soil deposits tend to densify or become more tightly packed during strong ground shaking, thereby causing ground settlement. Using an empirical procedure developed by Tokimatsu and Seed (1987), seismically induced settlements due to seismic compaction of dry or unsaturated soils below the foundations were estimated to be on the order of 13 mm or less.

6.2 BRIDGE FOUNDATION DESIGN RECOMMENDATIONS

6.2.1 Foundation Type Selection

To match the existing foundations, we understand that the proposed bridge widening will also be supported on shallow spread footings at the abutments and bents. Selection of this foundation type was made by the project structural engineer of LAN Engineering in consultation with Kleinfelder.

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6.2.2 Recommended Bearing Limits

The recommended bearing limits for the abutment and pier foundations are presented in the following Table 2 based on Caltrans Memo to Designers 4-1, April 2008.

Table 2
Spread Footing Data Table for Proposed Bridge Foundations
Box Springs Overhead Right Bridge Widening
Bridge No. 56-0082R

Support Location	Footing Size (meters)[1]		Bottom of Footing Elevation[1] (meters)	Minimum Footing Embedment Depth (meters)	WSD[2] (LRFD Service-I Limit State Load Combination)		LRFD[2]		
							Service	Strength $\varphi_b = 0.45$	Extreme Event $\varphi_b = 1.00$
	B	L			Permissible Gross Contact Stress (kPa)	Allowable Gross Bearing Capacity (kPa)	Permissible Net Contact Stress (kPa)	Factored Gross Nominal Bearing Resistance (kPa)	Factored Gross Nominal Bearing Resistance (kPa)
Abut. 1	5.8	36.5	449.10	2.5	320	335	N/A	N/A	N/A
Pier 2	3.6	32.7	449.30	2.5	N/A	N/A	435	1350	1350
Pier 3	3.6	29.5	448.40	2.5	N/A	N/A	435	1350	1350
Abut. 4	4.27	30.3	453.10	2.5	320	245	N/A	N/A	N/A

Notes:
[1] Footing sizes and elevations are obtained from Box Springs OH (Widen) Foundation Plan.
[2] Recommended design parameters are provided in accordance with Caltrans Memo to Designers 4-1, April 2008.

Bearing capacity of spread footings was evaluated based on footing geometry, settlement potential of foundation soils, and slope stability. The calculations for bearing capacity were provided in Appendix C-2.

We recommend that the abutment and pier footings be founded on a minimum of 0.6 meter of structure backfill material compacted to at least 95 percent relative compaction. We anticipate that subsurface materials exposed at the bottom of footing elevation for the bents may consist of bedrock material. In these instances, the bent footings should be founded on undisturbed bedrock material. If undisturbed bedrock material is not exposed at the bottom of bent footing elevations during construction, the existing soils should be overexcavated 0.30 meter beyond the edge of footing with 1:1 slope to the depth elevation until bedrock material is encountered, and the excavation backfilled with lean or Class 3 concrete.

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The project geotechnical engineer or engineering geologist should visually evaluate the soil and/or bedrock conditions exposed at the bottom of the overexcavation in foundation areas for presence of soft, loose, or otherwise unsuitable materials. If the material encountered at the overexcavation bottom is considered to be unsuitable by the project geotechnical engineer or geologist, this material should be additionally overexcavated and replaced with structure backfill material at the abutments or lean or Class 3 concrete at the bents as described previously. Soil placed as engineered fill below foundations should be compacted to at least 95 percent relative compaction per ASTM D1557. Foundation excavations should be performed such that footings are founded entirely in engineered fill or bedrock material or lean/Class 3 concrete to reduce the potential for differential settlement due to dissimilar soil types. At a minimum, we recommend that foundations be embedded at least 2.5 meters below the lowest adjacent final grade.

Footings may experience an overall loss in bearing capacity or an increased potential to settle where located in close proximity to existing or future utility trenches. Furthermore, stresses imposed by the foundations on the utility lines may cause cracking, collapse and/or a loss of serviceability. To reduce this risk, footings should extend below a 1:1 plane projected upward from the closest bottom corner of the trench.

To achieve design grades for the proposed bridge widening, modifications to the existing fill embankments will likely be required. Recommendations for remedial earthwork, if necessary, can be provided by Kleinfelder at a later stage in the design process. All areas to receive fill should be stripped of existing pavements, cleared of any structures, all existing vegetation, debris, and other deleterious materials in accordance with Section 16 of Caltrans *Standard Specifications*.

6.2.3 Foundation Settlements

The total settlements of the foundations will vary depending on the plan dimensions of the foundations and the actual loads supported. The total settlements due to the net allowable footing loads are anticipated to be on the order of 25 mm or less. The differential settlement between adjacent supports is anticipated to be on the order of 13 mm or less.

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Due to the granular nature of the on-site soil materials, the settlement of foundations is expected to occur during construction and should be essentially complete shortly after initial application of the loads.

6.2.4 Slope Stability

Design plans indicate the abutment footings will be constructed on the existing 1:1.5 (V:H) fill slopes. The overall global stability of abutment slopes was analyzed for Abutment 1 and Abutment 4. Slope stability was calculated using the Modified Bishop's Method for circular slip surfaces implemented in the computer program GSTABL7 with STEDWin3.0 (Van Aller and Gregory, 2001). The design criteria utilized are as follows: permanent abutment slopes are required to have a minimum factor of safety of 1.5 for the static condition; and a minimum factor of safety of 1.1 for the pseudostatic condition using the Caltrans recommended horizontal earthquake loading coefficient equal to one-third of the horizontal peak ground acceleration (k_h=0.17 in this case), but not exceeding 0.20. The results of slope stability analyses for both abutments indicate that the required minimum static and pseudostatic factors of safety would be satisfied provided the minimum shear strength parameters for the new compacted fill are equal to or exceed the following values: (1) a friction angle of 32 degrees, and (2) a cohesion of 9.6 kPa.

Although the approach abutment slopes are expected to be grossly stable, erosion and surficial instability may be a concern during periods of heavy or intense rainfall. Erosion control and highway planting should be performed in accordance with Section 20 of Caltrans Standard Specifications. Excessive irrigation of slopes should be avoided. Appropriate drainage devices should be placed at the top of all slopes such that water does not flow over slope faces in an uncontrolled manner.

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6.3 EARTH RETAINING SYSTEMS

6.3.1 General

A Caltrans Type 1 retaining wall is proposed at the northern portion of Abutment 1 and a wing wall is proposed at the northern portion of Abutment 4. The retaining wall configurations are provided in the attached Plate 4. Plans indicate that the retaining walls will be supported on shallow foundations.

6.3.2 Design Bearing Pressures

We understand that Load Factor Design (LFD) will be used for design of proposed standard Type 1 retaining wall footings at Abutment 1. The recommended LFD nominal bearing resistance are presented in Table 3, below.

Table 3
Nominal Bearing Resistance for Proposed Type 1 Retaining Wall Footings

Support Location	Height of Wall (m)	Footing Dimension[1] (m)	Bottom of Footing Elevation[2] (m)	Minimum Footing Embedment Depth[1] (m)	LFD[3] Nominal Bearing Resistance q_n (kPa)
Abutment 1 (North Side)	7.90	2.44 x 4.34	450.69	1.6	720
	6.70	2.44 x 3.68	452.00	1.6	645
	5.50	2.44 x 3.05	453.23	1.6	540
	4.20	2.44 x 2.42	454.50	1.6	420
	3.00	2.44 x 1.89	455.72	1.6	420
	1.80	2.44 x 1.32	456.94	1.6	420

Notes:
[1]Footing dimensions and Minimum Footing Depth were obtained from *Retaining Wall No.1 Layout, Box Springs OH (Widen)* design drawings.
[2]Bottom of Footing Elevations were provided by LAN Engineering.
[3]Load Factor Design (LFD), the Maximum Contact Pressure, q_{max}, divided by the Strength Reduction Factor, Φ, is not to exceed the Nominal Bearing Resistance, q_n.

Our recommendations are based on the assumption that wall foundations will be supported on competent native soils or properly compacted fill.

For wall heights of less than 3 meters, we recommend that 0.3 meters of soil below the bottom of the footing be overexcavated and recompacted to 95% relative compaction

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per ASTM D 1557. For walls equal to or greater than 3 meters, but less than 4.9 meters in height, we recommend a minimum of 0.6 meter of soil below the bottom of the footing be overexcavated and recompacted to 95% relative compaction per ASTM D 1557. For walls equal to or greater than 4.9 meters in height, we recommend a minimum of 0.9 meters of soil below the bottom of the footing be overexcavated and recompacted to 95% relative compaction per ASTM D 1557. Kleinfelder should observe the foundation excavations to verify that competent soils are present at the foundation level. Kleinfelder may waive the overexcavation and recompaction requirement or recommend deeper overexcavation and recompaction in localized areas where loose or weak soils are encountered at the foundation depth.

6.3.3 Foundation Settlements

Total and differential foundation settlements of less than 19 mm and 13 mm, respectively, are anticipated for the proposed retaining walls constructed as recommended above.

6.3.4 Lateral Earth Pressures

The recommended static lateral earth pressures in the following assume backfill is placed and drainage is provided as recommended in the following sections, and that the walls can deflect laterally a sufficient amount to develop active conditions.

Table 4
Static Lateral Earth Pressures for Design

Backfill Slope	Equivalent Fluid Weight (kN/m^3)
Level	5.9
1:1.5 (V:H)	10.3

For level backfill conditions, the resultant of the fluid pressure should be assumed horizontal (ignore wall friction). For sloped backfill condition, the resultant of the fluid pressure may be inclined to maximum slope gradient of 1:1.5 (V:H). For level backfill walls subjected to uniformly distributed surcharge loading, the lateral pressure may be taken as 0.3 times the vertical pressure.

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In general, walls designed for static lateral earth pressures only have performed satisfactorily in past earthquakes. If required, seismic wall pressures may be estimated using the simplified Mononobe-Okabe method for cantilever walls proposed by Seed and Whitman (1970). In this method, the additional loads are estimated by a lateral seismic pressure coefficient of one-half the peak ground acceleration (PGA). Based on this method, we recommend an additional lateral soil pressure equivalent to a fluid unit weight of 2.9 kN/m^3. This inverted triangle dynamic pressure should be added to the static earth pressure, and the resultant of the dynamic component may be applied as a horizontal force at a height of 0.6 times the wall height above the base of the wall.

6.3.5 Lateral Load Resistance of Footing

For footings without a key, we recommend an ultimate sliding friction coefficient of 0.4 between soil and concrete. For footing with a key, an ultimate sliding friction coefficient of 0.55 may be used. An ultimate passive fluid pressure limited to 47.2 kN/m^3 may be used for passive resistance against embedded portions of footings.

Sliding resistance may be calculated using either full passive only or full frictional resistance only, or, 50% of frictional resistance plus 50% of passive resistance behind the footing. In unpaved areas, we recommend neglecting the upper 0.3 meters of soil when computing the passive resistance.

6.3.6 Wall Drainage

Our recommendations for design lateral earth pressures assume that the wall has adequate drainage provisions to prevent the buildup of hydrostatic pressures in the soil backfill. The drainage system may be designed in accordance with Caltrans Standard Plan BO-3, Detail 3-1. Pervious backfill (other than sacked material at wall drain outlets) shall conform to the grading requirements in Section 19-3.065 of the Caltrans Standard Specifications. Sacked pervious backfill at wall drain outlets shall conform to the grading for 37.5-mm by 19-mm primary aggregate size specified in Section 90-3.02 of Caltrans Standard Specifications. As an alternate, approved geocomposite drain board may be used in lieu of the pervious backfill.

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6.3.7 Backfill Placement

Retaining wall backfill should be structure backfill and conform to the Sand Equivalent (SE) and gradation requirements in Section 19-3.06 of Caltrans Standard Specifications. Soils used for engineered fill (either reinforced or retained) should be uniformly moisture-conditioned at optimum to 2 percent above optimum moisture content, placed in horizontal lifts less than 200 mm in loose thickness, and compacted to at least 95 percent relative compaction, as required in the Caltrans Standard Specifications, Section 19-6. Light equipment should be used during backfill compaction to minimize possible overstressing of the wall. Any engineered fill placed beneath the wall should be compacted to at least 95 percent relative compaction.

6.4 CORROSION POTENTIAL

Corrosion potential tests of the on site soils were not performed for the proposed bridge. To evaluate corrosion potential of the on-site soils, one soil sample collected during the our field investigation for the nearby Box Springs Overhead Left Bridge Widening was tested for pH, resistivity, sulfate and chloride concentrations in accordance with Caltrans Standard Test Methods 532, 643, 417, and 422. Testing was performed by AP Engineering and Testing, Inc. in Pomona, California. The test results are presented in Appendix B and Table 5, below.

Table 5
Corrosion Test Results

Boring No.	Depth (m)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
BS-2	2 - 3	3,000	7.7	8	131

In accordance with Section 4.1 of Caltrans *Corrosion Guidelines* (dated September 2003), a corrosive area is defined as an area where the soil and/or water contains more than 500 ppm of chlorides, more than 2,000 ppm of sulfates, or has a pH of less than 5.5. In general, a minimum resistivity for soil and/or water less than 1,000 ohm-cm indicates the presence of high quantities of soluble salts and a higher propensity for corrosion. Based on the laboratory test results and the above guidelines, the project site soils may generally be considered as non-corrosive.

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6.5 EXPANSION POTENTIAL

Expansive soils generally contain clay particles that swell considerably when wetted and shrink when dried. Foundations constructed on these soils are subjected to uplifting forces caused by the swelling. Based on the results of our investigation for the proposed Box Springs Overhead Left Bridge widening, it is our opinion that soils within the upper portion of the project site have a low potential for expansion. Testing of the final subgrade soils after completion of grading should be conducted to evaluate their expansion potential and confirm or modify the recommendations presented herein.

6.6 FLOOD HAZARD AND SCOUR POTENTIAL

The flood hazard potential was evaluated based on Flood Hazard Maps available through the Federal Emergency Management Agency (FEMA) Map Service Center website and Flood Hazard Area Maps available through Riverside County. Based on the maps reviewed (06065CIND1A), the proposed bridge structure is not located within known flood hazard zones.

The proposed bridge widening will cross over the existing BNSF railroad tracks and is not located in a flood/drainage or river channel. Therefore, scour potential is not considered a design issue.

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7.0 CONSTRUCTION CONSIDERATIONS

7.1 SITE PREPARATION

All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations, and other local, state, or federal specifications. All references to maximum unit weight should be established in accordance with the current ASTM Standard Test Method D1557 and may supersede references cited herein.

7.1.1 Stripping and Grubbing

Prior to general site grading, existing pavement, vegetation, organic topsoil, existing fill soils, and debris shall be stripped and disposed of outside the construction limits. Deeper stripping or grubbing may be required where concentrations of fill debris, organic soils, existing trees, or thick root mats are encountered during site grading. Stripped topsoil (less any debris) may be stockpiled and reused for landscape purposes elsewhere on the project; however, this material should not be incorporated into any engineered fill.

In areas where existing trees will be removed, care should be taken to remove the root-ball, roots exceeding 25 mm in diameter, and remaining organics, and to backfill the excavations with compacted engineered fill. We strongly recommend having a representative of Kleinfelder present during tree removal in areas to receive fill or beneath foundations to observe removal of large roots and subsequent scarification and recompaction. Engineered fill should be placed and compacted in accordance with recommendations provided below.

7.1.2 Earthwork and Backfill

After clearing and stripping, the surface should be excavated to a minimum depth of 0.6 meter before placement of new fill. The undocumented fill soils (if encountered) shall be removed during site development and grading and replaced with structural backfill. In addition, any compressible soils encountered shall be removed and replaced with compacted structural backfill in accordance with Caltrans Standard Specifications Section 19-3.06. The exposed surface should be proof-rolled with loaded heavy equipment. Any areas of loose or yielding soils should be over-excavated and re-

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compacted. Any soils that cannot be compacted, or are otherwise unsuitable for the planned use, should be excavated and disposed of from the project site. The exposed surface should then be scarified and compacted to the specified density before placement of new fill. New fill placed on or adjacent to the existing slopes should be properly benched into the existing fill in accordance with Caltrans Standard Specifications.

All earthwork should be performed in accordance with Caltrans Standard Specification Section 19. All materials to be placed as fill should be free of vegetation, organics, debris, and other deleterious materials. All fill placed around foundations and behind walls should be placed in thin loose lifts, moisture-conditioned, and compacted to Caltrans Standard Specification.

Abutment wall backfill shall be structural backfill according to Caltrans standard specifications. In addition, we recommend that abutment backfill be well-graded soil with maximum dimension of 100 mm, essentially non-plastic (liquid limit less than 30, plasticity index less than 12, and with less than 50 percent passing the No. 200) and non-expansive. Expansive soils, defined as soils with Expansion Index (EI) greater than 50 and/or soils with Sand Equivalent (SE) less than 20, should be excluded from the bridge abutments as required by Caltrans guidelines and shown on Plate 7, *Expansive Soil Exclusion Zone in Bridge Embankment*. Expansion Index should be determined in accordance with ASTM D4829. Sand Equivalent should be determined in accordance with California Test Method (CTM) 217.

The limits of bridge approach zone are considered to extend longitudinally 46 meters measured horizontally from the bridge abutment and either parallel or concentric with the roadway centerline, and transversely the full width of embankment except the outer 1.5 meters measured horizontally from the embankment side slopes. Fills placed within 46 meters of abutments should be compacted to 95 percent relative compaction per ASTM D1557.

7.1.3 Temporary Excavations and Shoring

All excavations must comply with the current CAL-OSHA Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We

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are providing the information below solely as a service to our client. Under no circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

A shoring design and safety plan should be required from the contractor and submitted to the Engineer for review and approval. Likewise, measures to control impact of both groundwater and surface water on the stability of temporary excavations and shoring should be employed and should remain the sole responsibility of the contractor.

7.2 FOOTING OBSERVATIONS

Prior to placing steel and concrete, foundation excavations should be cleaned of all debris, loose or soft soil, and water. All foundation excavations should be observed by a qualified engineer or geologist from our firm just prior to placing steel or concrete to verify that the recommendations contained herein are implemented during construction.

7.3 SURFACE WATER CONTROL

Ponding of water adjacent to the structure should be avoided. During and after construction, positive drainage should be provided to direct surface water away from structures and all excavations toward suitable, non-erosive drainage devices.

7.4 ACCESS TO THE SITE

The presence of steep slopes on both sides of the railroad will make the direct access to the project site very difficult for construction crews as well as their equipments. It is recommended that the construction crews and equipments to enter the site through the gate located on River Crest Drive on the south side of SR-60. Moreover, the project site is situated in the proximity of a number of bridges; access to the site may be restricted or made difficult due to limited vertical clearance for construction equipments to pass underneath the existing bridges.

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8.0 ADDITIONAL SERVICES AND LIMITATIONS

8.1 ADDITIONAL SERVICES

The review of plans and specifications, and the observation and testing by Kleinfelder of earthwork and foundation related construction activities, are an integral part of the conclusions and recommendations made in this report. If Kleinfelder is not retained for these services, the client will be assuming our responsibility for any potential claims that may arise during or after construction. The recommended tests, observations, and consultation by Kleinfelder during construction include, but are not limited to:

- A review of preliminary plans and specifications;
- Observation of site clearing, undocumented fill removal, and subgrade preparation;
- Engineered fill placement and compaction;
- Construction observation and density testing of fill material placement, trench backfill, and subgrade preparation;
- Footing excavations; and
- When any unusual conditions are encountered during construction.

These services may be performed in accordance with our current fee schedule.

8.2 LIMITATIONS

The conclusions and recommendations presented in this report are intended to assist the type selection study for the proposed Box Springs Overhead Right Bridge widening to be located at the I-215/SR-60 east junction in the City of Riverside, Riverside County, California. The findings, conclusions and recommendations were prepared in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made. This report was based on the proposed project information provided to Kleinfelder. If any change (i.e., structure type, location, etc.) is implemented which materially alters the project, additional geotechnical services may be required, which could include revisions to the geotechnical recommendations presented herein.

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Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard. They are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

This report may be used only by the project designers and Caltrans and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on-site and off-site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party, and client agrees to defend, indemnify, and hold harmless Kleinfelder from any claim or liability associated with such unauthorized use or non-compliance.

Environmental site assessment for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater or atmosphere, or the presence of wetlands was not included in the scope of our services for this report.

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United States Geological Survey, 1967, 7-1/2 Minute Series, Riverside East, Quadrangle, California, Scale 1:24,000, photo revised 1980.

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Youd, T.L., and Idriss, I.M., et al., October 2001, "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils."

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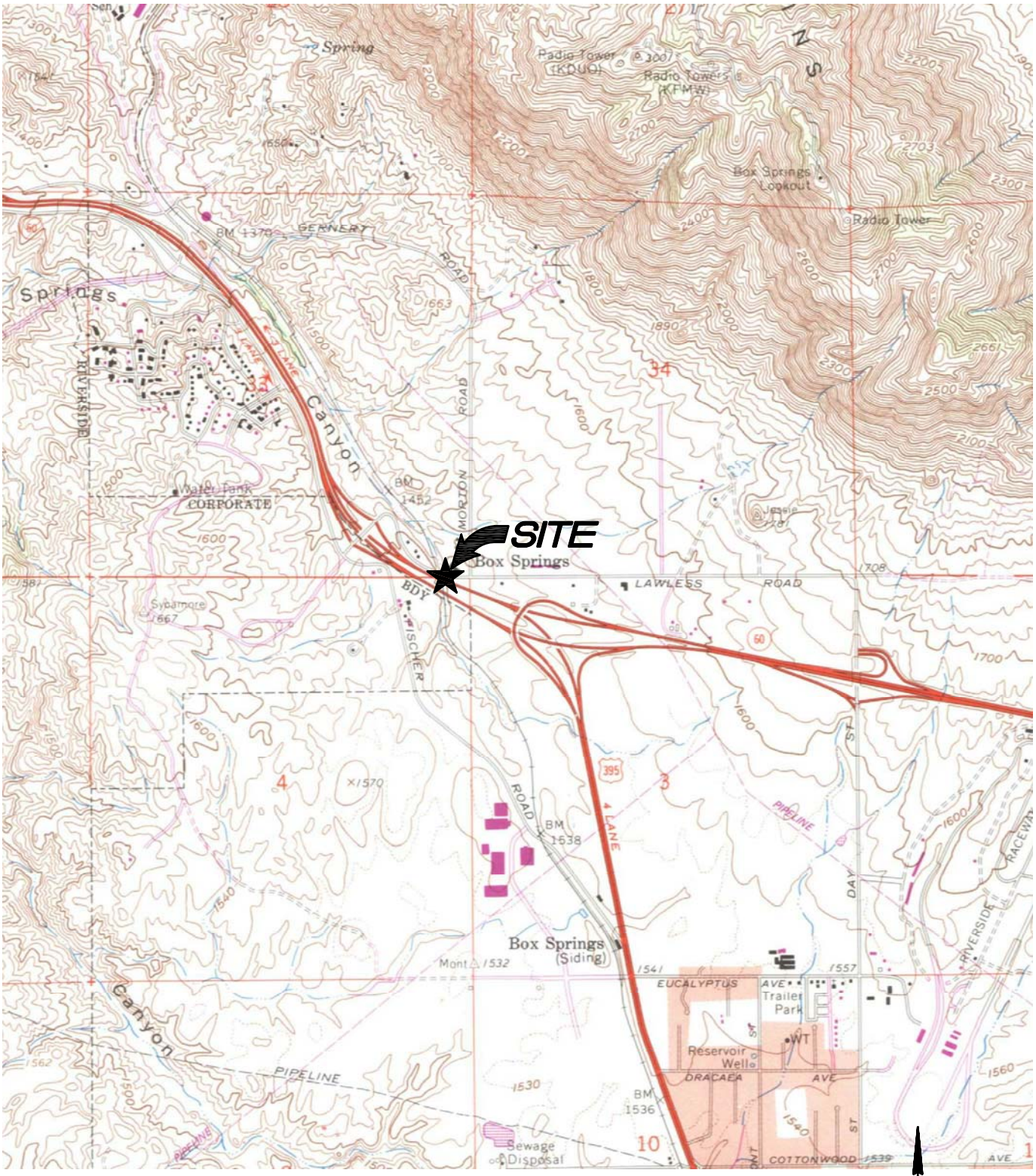
PLATES



SOURCE: U.S.G.S. 7.5' topographic series, Riverside East, California quadrangle dated 1967, photorevised 1980.

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SCALE 1:24,000

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ATTACHED XREFS:
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CAD FILE: U:\MGriffin\CADD\2008\76979\I-215_SR60\081008_Box-Springs_OH_Wid\ LAYOUT: Layout1PLOTTED: 08 Oct 2008, 9:52am, MGriffin

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PROJECT NO.	76979
DRAWN:	10/8/08
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME: 76979p1.dwg	

SITE LOCATION MAP

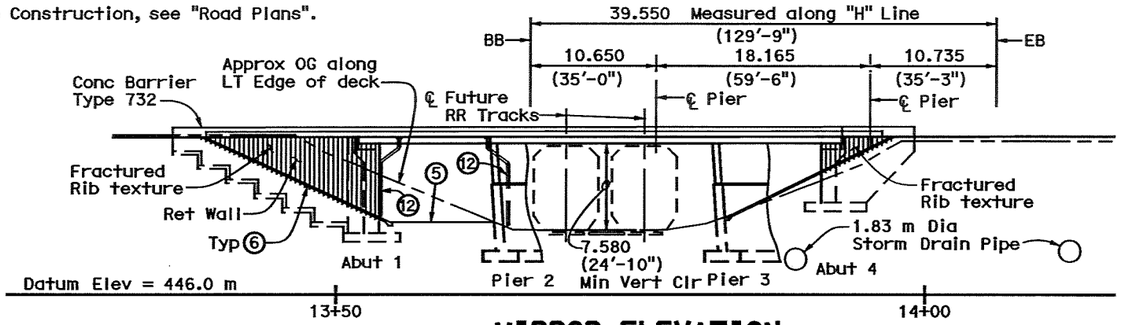
I-215/SR-60 EAST JUNCTION
BOX SPRINGS OVERHEAD WIDENING
RIVERSIDE, CALIFORNIA

PLATE
1

Notes:

1. For "General Notes", "Index to Plans" and "Spread Footing Data Table", see "Index to Plans" sheet.

2. For Stage Construction, see "Road Plans".



MIRROR ELEVATION
1:250

NOTES:

1. Paint "Br. No. 56-0082R & Year Constructed"
2. Paint "Box Springs OH"
3. Structure Approach Type N(9S)
4. MBGR, See "Road Plans"
5. RR Maintenance Rd
6. Slope Paving
7. 1.0 m Closure Pour
8. Conc Barrier Type 60SA, see "Road Plans"
9. Exist Br. No. 56C0056 to be removed
10. Exist Br. No. 56-0082R (Original) to be removed
11. Deck Drain, Type D-2 (Mod)
12. 150 mm Deck Drain Pipe

Point of minimum vertical clearance
Indicates Direction of traffic
Indicates existing structure
Indicates existing bridge removal

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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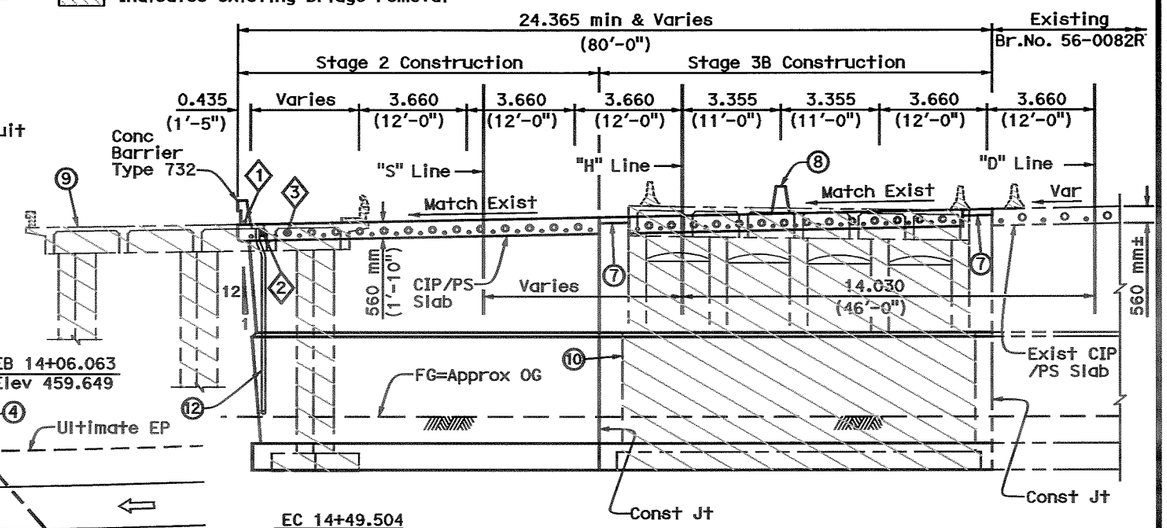
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

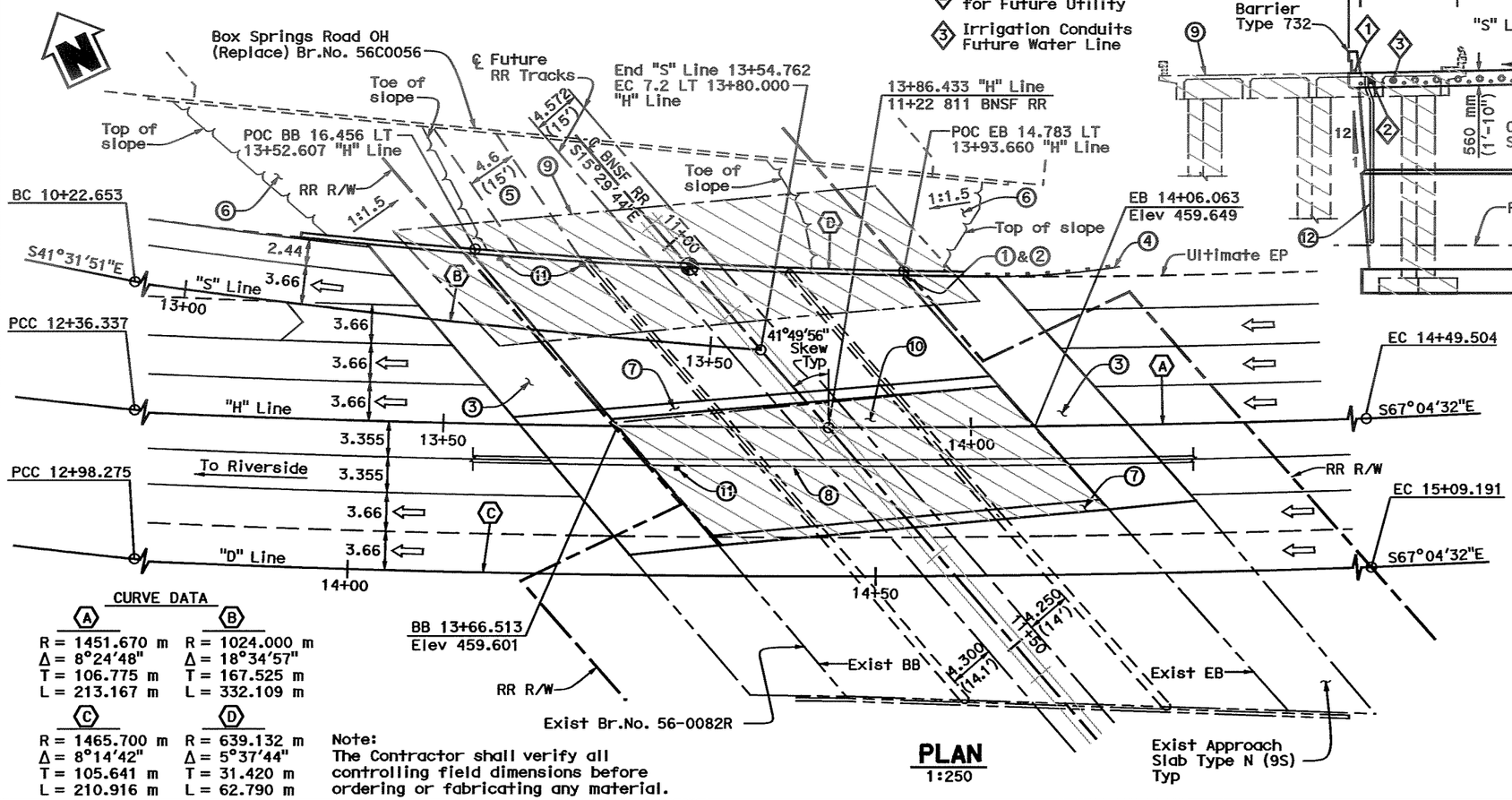
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

UTILITY LEGEND

1. Electrical Conduit for Future Utility
2. Communication Conduit for Future Utility
3. Irrigation Conduits Future Water Line



TYPICAL SECTION
1:100



PLAN
1:250

CURVE DATA

A	B
R = 1451.670 m	R = 1024.000 m
Δ = 8°24'48"	Δ = 18°34'57"
T = 106.775 m	T = 167.525 m
L = 213.167 m	L = 332.109 m

C	D
R = 1465.700 m	R = 639.132 m
Δ = 8°14'42"	Δ = 5°37'44"
T = 105.641 m	T = 31.420 m
L = 210.916 m	L = 62.790 m

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

0 - 1.5

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. KIM / D. SARETSKY	CHECKED T. DUDLEY/A. SIVATHASAN	LOAD AND RESISTANCE FACTOR DESIGN — LIVE LOADING: HL-93 W/ "LOW-BOY" AND PERMIT DESIGN VEHICLE
SIGN OFF DATE	DETAILS	BY R. ANDRASEK	CHECKED M. CHAR	LAYOUT BY R. ANDRASEK CHECKED T. DUDLEY/M. CHAR
	QUANTITIES	BY D. SARETSKY	CHECKED K. GEE	SPECIFICATIONS BY PLANS AND SPECS COMPARED

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56-0082R
KILOMETER POST

BOX SPRINGS OH (WIDEN)
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES (PRELIMINARY STAGE ONLY) 9/28/06 12/28/08 5/15/09

SHEET 1 OF 27

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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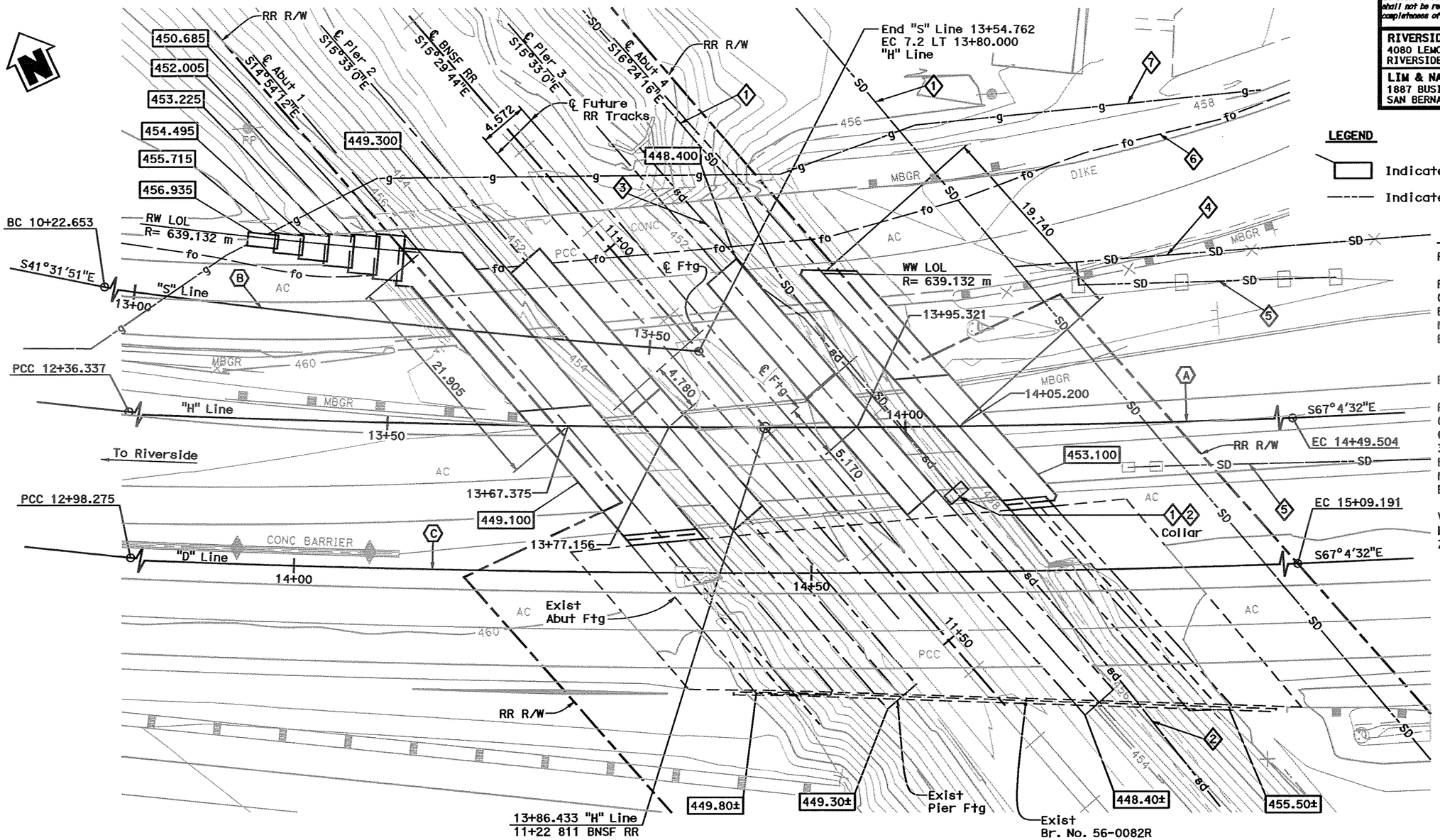
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

Page 2 of 2

CURVE DATA

A	B	C
R = 1451.670 m	R = 1024.000 m	R = 1465.700 m
Δ = 8°24'48"	Δ = 18°34'57"	Δ = 8°14'42"
T = 106.775 m	T = 167.525 m	T = 105.641 m
L = 213.167 m	L = 332.109 m	L = 210.916 m



PLAN
1:200

LEGEND

Indicates bottom of footing elevation

Indicates existing footing

BENCHMARK

PT #865 ELEVATION 460.688 m

Found 25 mm iron pipe with Caltrans North side of Box Springs Road
N=698034.479
E=1903003.479

PT #3030 ELEVATION 472.840 m

Found 50 mm iron pipe with Brass Cap Stamped "Dept of Trans RIV 60-12.7 1990"
34.14 m Southwesterly of bridge. Box Springs Road
N=697603.049
E=1903554.738

Vertical Datum: NGVD-1929
Horizontal Datum: NAD-83, Zone 6 (EPOCH 1984.0)

UTILITY LEGEND

1. 1.83 m Dia Storm Drain Pipe
2. Exist 1.83 m Dia Storm Drain Pipe Protect-in-place
3. Exist 1.83 m Dia Storm Drain Pipe To be removed
4. 1.50 m Dia Storm Drain Pipe
5. 450 mm Dia Storm Drain Pipe
6. Exist 4- 100 mm Conduit (AT&T) To be relocated
7. Exist 50 mm Dia Gas Line (TGC) Abandoned

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

GEOTECHNICAL PROFESSIONAL APPROVAL DATE

DESIGN OVERSIGHT ROBERT ZEZOFF	SCALE: AS SHOWN	VERT.DATUM NGVD-1929	HORZ.DATUM NAD-83, Zone 6 (EPOCH 1984.0)	DESIGN BY D. KIM/D. SARETSKY	CHECKED T. DUDLEY/A. SIVATHASAN
	PHOTOGRAMMETRY AS OF:	ALIGNMENT TIES		DETAILS BY R. ANDRASEK	CHECKED T.DUDLEY/M. CHAR
	SURVEYED BY	DRAFTED BY		QUANTITIES BY D. SARETSKY	CHECKED K. GEE
SIGN OFF DATE	FIELD CHECKED BY	CHECKED BY			

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56-0082R
KILOMETER POST

BOX SPRINGS OH (WIDEN)
FOUNDATION PLAN

FOUNDATION PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/28/08 12/26/08 5/15/09

SHEET 7 OF 27

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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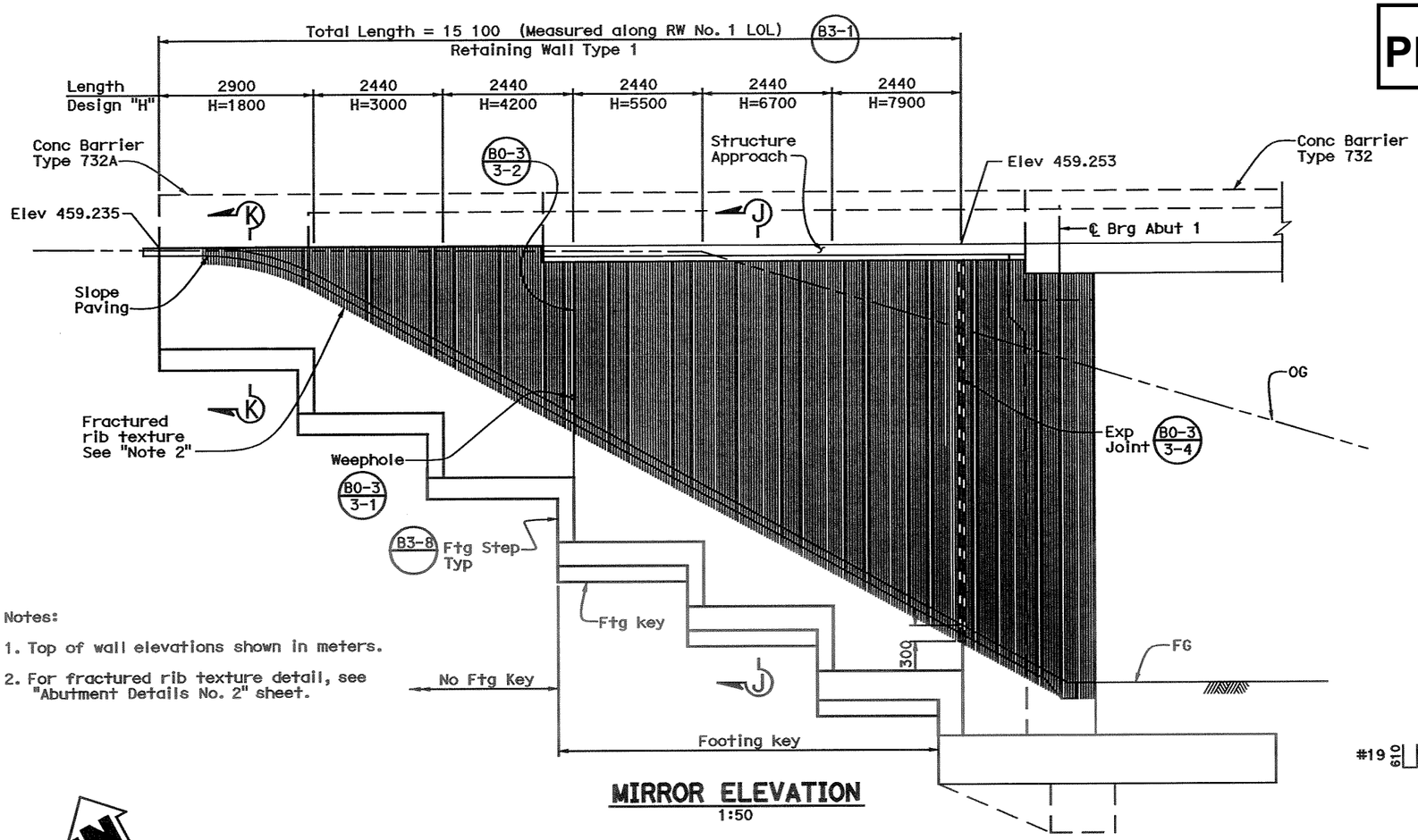
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

PLATE 3b

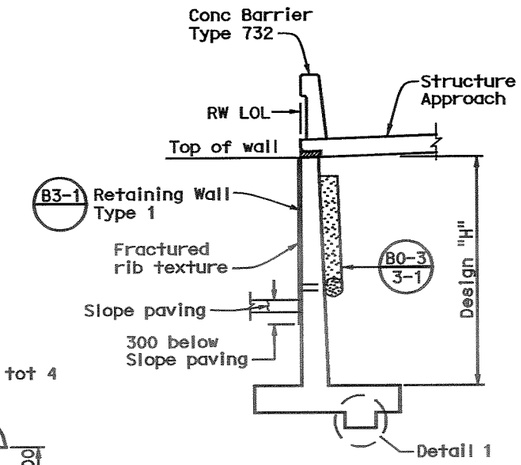
Metric



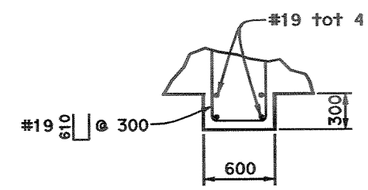
MIRROR ELEVATION
1:50

Notes:

1. Top of wall elevations shown in meters.
2. For fractured rib texture detail, see "Abutment Details No. 2" sheet.

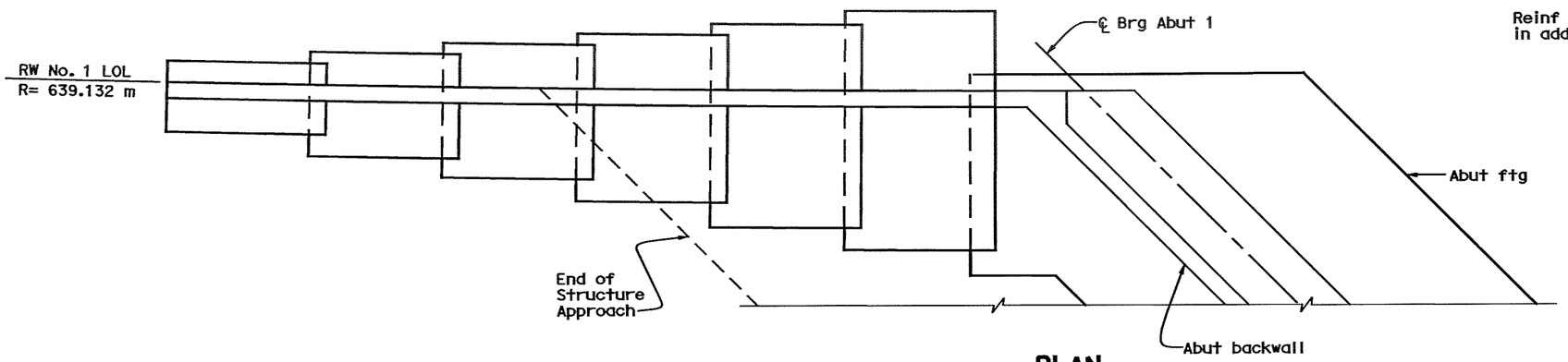


SECTION J-J
No Scale

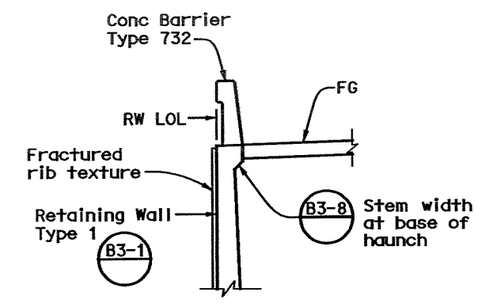


DETAIL 1
No Scale

Reinf shown is in addition to B3-1



PLAN
1:50



SECTION K-K
No Scale

For information not shown, see "Section J-J"

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	D. KIM/D. SARETSKY	T. DUDLEY/A. SIVATHASAN
SIGN OFF DATE	DETAILS	D. SARETSKY/R. ANDRASEK	T. DUDLEY/M. CHAR
	QUANTITIES	D. SARETSKY	K. GEE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56-0082R
KILOMETER POST

BOX SPRINGS OH (WIDEN)
RETAINING WALL No. 1 LAYOUT

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

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REVISION DATES (PRELIMINARY STAGE ONLY) 3/28/08 12/26/08 5/15/09

SHEET 15 OF 27

ATTACHED IMAGES: Images: Fault.tif Images: Fault-legend.tif Images: plate 5.tif
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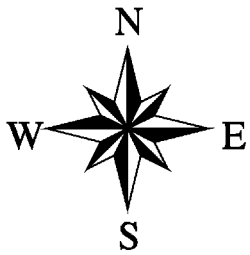

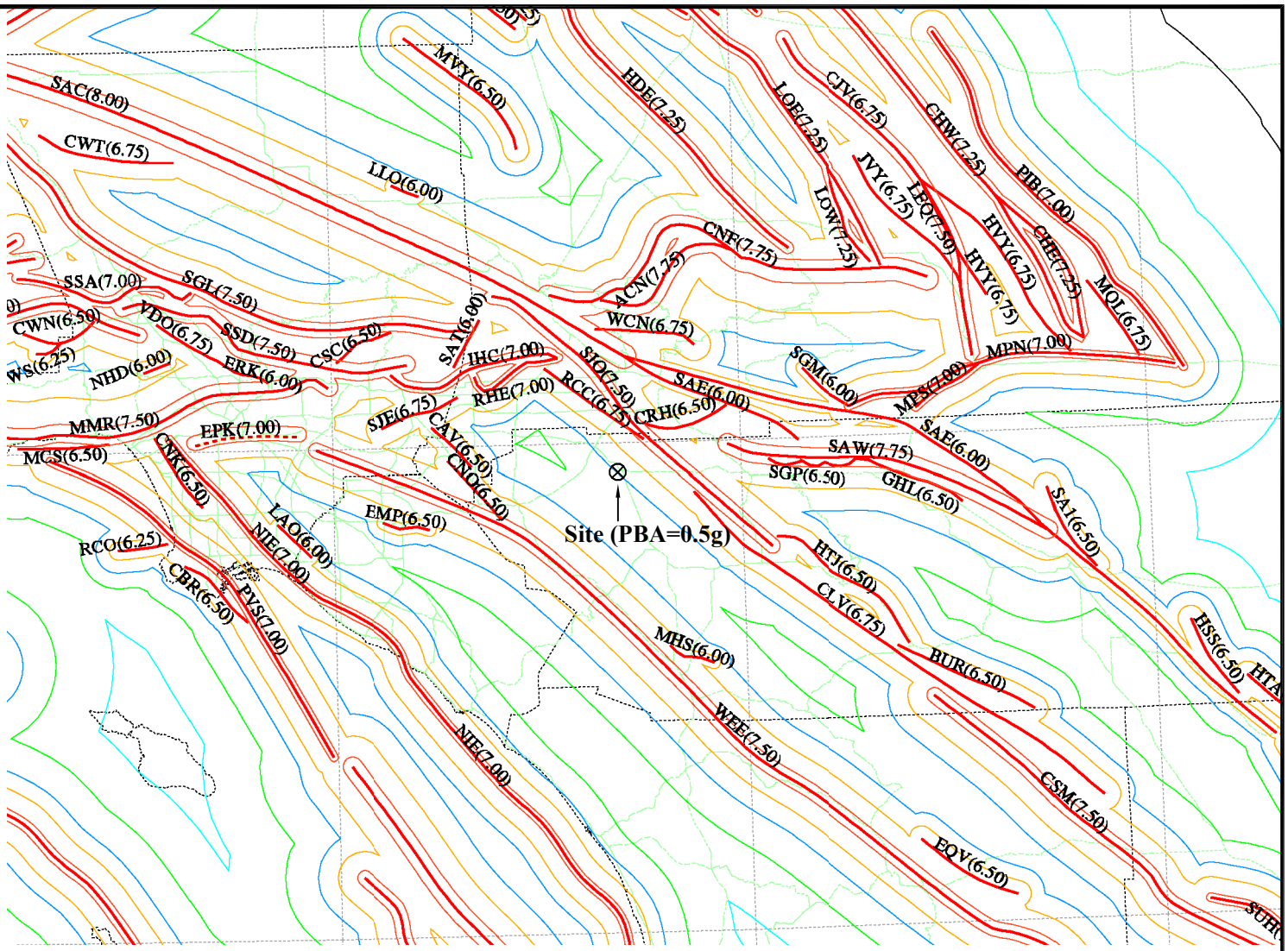

LEGEND:

- 0.7g Peak Acceleration Contour
- 0.6g Peak Acceleration Contour
- 0.5g Peak Acceleration Contour
- 0.4g Peak Acceleration Contour
- 0.3g Peak Acceleration Contour
- 0.2g Peak Acceleration Contour
- 0.1g Peak Acceleration Contour
- Special Seismic Source (SSS)
- Faults with Fault Codes (MCE)
- State Highways
- County Boundary
- Latitude & Longitude

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PROJECT NO.	76979
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DRAWN BY:	DMF
CHECKED BY:	MC
FILE NAME:	76979p5.dwg

FAULT AND PBA MAP

I-215/SR-60 EAST JUNCTION
BOX SPRINGS OVERHEAD WIDENING
RIVERSIDE, CALIFORNIA

PLATE
5

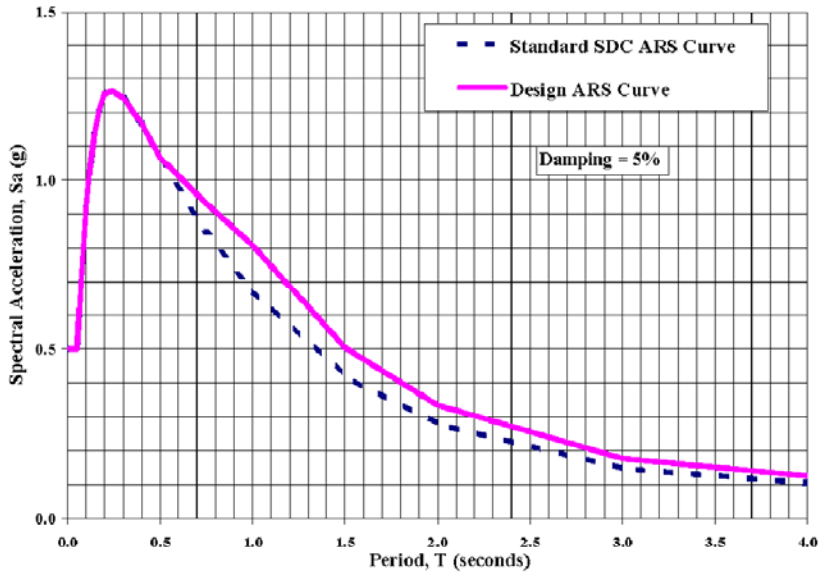
CALTRANS BRIDGE DESIGN ARS CURVE

(Version 4.0, Copyright 2007, Developed By: GeoSoftware Solutions, All Rights Reserved, http://www.geosoftwaresolutions.com)
(Licensed to: Kleinfelder West, Inc. - Redlands, California)

PROJECT INFORMATION	
Project Name	I-215/SR60 East Junction
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS	
Controlling Fault Name	San Jacinto (SJO)
Fault Type	Strike-slip (SS)
MCE Moment Magnitude	7.50
Distance to Fault	8.80 kilometers
Peak Bedrock Acceleration Based on 1996 California Seismic Hazard Map	0.5 g
Soil Profile Type	C

COMPUTED RESULTS	
Peak Bedrock Acceleration Based on Sadigh et al. (1997)[1]	0.46 g
Design Peak Bedrock Acceleration (g)	0.50 g



COMPUTED ARS CURVES

Period T (seconds)	Standard SDC ARS Curve[2] Sa (g)	Design ARS Curve[3] Sa (g)
0.010	0.500	0.500
0.020	0.500	0.500
0.030	0.500	0.500
0.050	0.500	0.500
0.075	0.719	0.719
0.100	0.919	0.919
0.120	1.037	1.037
0.150	1.155	1.155
0.170	1.207	1.207
0.200	1.256	1.256
0.240	1.264	1.264
0.300	1.244	1.244
0.400	1.168	1.168
0.500	1.067	1.067
0.750	0.847	0.932
1.000	0.674	0.808
1.500	0.419	0.503
2.000	0.278	0.334
3.000	0.147	0.177
4.000	0.104	0.125

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

NOTES:

[1]Peak Bedrock Acceleration (PBA):
Estimated using attenuation relationship by Sadigh et al. (1997) for rock site.
Sadigh et al. (1997) recommended no increase for Strike-Slip Fault, 10% increase for Oblique Fault; and 20% increase for Reverse/Thrust Fault. If type of fault is unknown, a 10% increase is assumed.

[2]Standard Seismic Design Criteria (SDC) ARS Curve:
Used Caltrans standard SDC ARS curve for the given PBA, magnitude, and soil profile type.

[3]Design ARS Curve:
When the bridge is located within 15 km of the controlling fault, the standard SDC ARS curve was modified as follows to account for fault rupture directivity effect:
- For Periods < 0.5 sec, no increase in standard SDC spectral acceleration values.
- For Periods > 1.0 sec, the standard SDC spectral acceleration values were increased by 20%.
- For Periods between 0.5 sec and 1.0 sec, spectral acceleration values were linearly interpolated.

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PROJECT NO.	76979
DRAWN:	10/8/08
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p6.dwg

PRELIMINARY DESIGN ARS CURVE

I-215/SR-60 EAST JUNCTION
BOX SPRINGS OVERHEAD WIDENING
RIVERSIDE, CALIFORNIA

PLATE
6

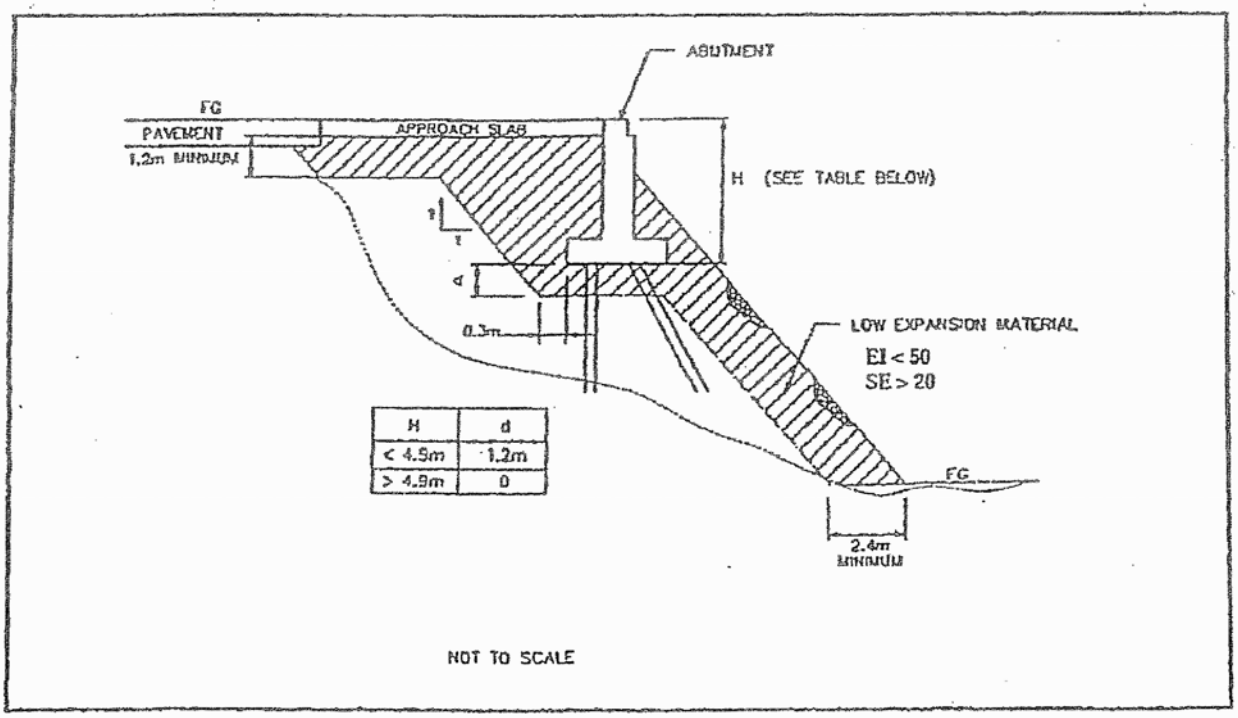
ATTACHED IMAGES: Images: Plate6-ARS Curve_1.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: U:\MGriffin\CADD\2008\76979\I-215_SR60\081008_Box-Springs_OH_Wid\ LAYOUT: 6 PLOTTED: 08 Oct 2008, 9:58am, MGriffin

EXPANSIVE SOIL EXCLUSION ZONE

GUIDELINE FOR DEFINING EXPANSIVE SOIL AND THE ZONE AROUND BRIDGE ABUTMENTS IN WHICH EXPANSIVE SOIL IS TO BE EXCLUDED (ALSO APPLICABLE TO WINGWALLS AND RETAINING WALLS).

Expansive soil materials shall not be placed as part of the embankment within the limits of a bridge abutment as shown in Figure 7 below for the full width of the embankment. Expansive soil materials for this requirement are defined as having either an Expansion Index (EI) greater than 50, (Expansion Index to be determined in accordance with ASTM D 4829) or a Sand Equivalent (SE) less than 20 (Sand Equivalent to be determined in accordance with California Test Method 217). This requirement is exclusive of the structure backfill and pervious backfill material requirements as shown on the plans and set forth in the Standard Specifications under Sections 19-3.06 and 19-3.065 respectively.

TYPICAL SECTION - EXPANSIVE SOIL EXCLUSION ZONE IN BRIDGE EMBANKMENT



H	d
< 4.9m	1.2m
> 4.9m	0

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PROJECT NO.	76979
DRAWN:	5/3/09
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p7.dwg

EXPANSIVE SOIL EXCLUSION ZONE

I-215/SR-60 EAST JUNCTION
BOX SPRINGS OVERHEAD WIDENING
RIVERSIDE, CALIFORNIA

PLATE
7

ATTACHED IMAGES: Images: For Plate 9.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\050309_Box-Spring_OH_Widening\ LAYOUT: 7 PLOTTED: 04 May 2009, 4:40pm, MGriffin

APPENDIX A

FIELD EXPLORATION

APPENDIX A
FIELD EXPLORATION

Borings were not drilled for the proposed widening of Box Springs Overhead Right Bridge. The subsurface exploration program for the Box Springs Overhead Left Bridge Widening consisted of drilling and logging two exploratory soil borings (BS-1 and BS-2) on March 7, 2007. These borings were advanced to depths ranging from approximately 11.3 to 15.1 meters below the existing ground surface (bgs) using a Mobile B-61, truck-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer delivery system. The borings were logged and sampled using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Following drilling, sampling and logging, the borings were backfilled with native cuttings. The boring locations, including stations and offsets were surveyed by LAN Engineering.

The boring logs are presented in Plates A-2 and A-3 in the following section. The logs describe the earth materials encountered and indicate the locations of the samples obtained and infill thickness measured in the bedrock. The excavations were logged by a staff professional from Kleinfelder using methods outlined in the Unified Soil Classification System (USCS) and general procedures established in ASTM D 2488. The boundaries between soil and rock type(s) shown on the logs are approximate because the transition between different soil and rock layer(s) may be gradual.

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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	ID	DESCRIPTION	MAJOR DIVISION		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Well-graded gravels, gravel-sand mixtures	FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands
		GP		Poorly-graded gravels, gravel-sand mixtures			CL		Inorganic clays of low to medium plasticity; gravelly clays silty clays,sandy clays, lean clays
		GM		Silty gravels, gravel-sand-silt mixtures			OL		Organic silts and organic silt-clays of low plasticity
		GC		Clayey gravels, gravel-sand-clay mixtures					
	SAND AND SANDY SOILS	SW		Well-graded sands, gravelly sands		SILTS AND CLAYS LL > 50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		SP		Poorly-graded sands and gravelly sands			CH		Inorganic clays of medium to high plasticity
		SM		Silty sands, sand-silt mixture			OH		Organic clays of medium to high plasticity
		SC		Clayey sands, sand-clay mixture		HIGHLY ORGANIC SOILS	Pt		Peat, muck and other highly organic soils

▼ Approximate water level observed in boring following drilling

SOIL SAMPLE

- Bulk Sample
- Drive Sample - California Sample
- Shelby Tube Sample
- Standard Penetration Test (SPT) Sample

ADDITIONAL TESTS

CN	- Consolidation
COR	- Corrosion
CP	- Collapse Potential
DS	- Direct Shear
EI	- Expansion Potential
MAX	- Maximum Dry Density
OC	- Organic Content
PI	- Plasticity Index
RV	- R-Value
SE	- Sand Equivalent
GS	- Grain Size Distribution

NOTES:

Blow counts represent the number of blows of a 64-kilogram hammer falling 760 mm required to drive a sampler through the last 300 mm of a 460 mm penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

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LEGEND TO LOGS

PLATE A-1

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	461 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
461							**Undocumented Fill**			
	1	1 2	40			SM	**Silty Sand (SM):** brown, dry, medium dense, fine to medium grained sand			
460		3	35				--olive-brown, iron staining	18.7	9.0	
	2	4	31				--slightly moist, medium dense, fine to coarse grained sand	20.4	7.2	DS
459	3	5	15				--brown, some clay			GS
458	4									
457		6	22					18.5	7.9	CN
	5									
456	6	7	22							
455	7						--drilling effort increases			
454							**Alluvium**			
	8	8	98			SM	**Silty Sand (SM):** light brown, dry, very dense, fine to medium grained	19.6	6.3	
453	9									
452		9	30, 50/1[illegible]							

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I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

LOG OF BORING BS-1

PLATE A-2a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08

Elevation (approx.) (meters)	Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
451										
	11	10	50/150				--orange-brown			
450							--auger bit chatter			
	12									
449		11	50							
	13									
448										
	14	12	16, 50/15				--brown to dark gray			
447										
	15		50/25				**Bedrock:** Sampler refusal and practical drill refusal on bedrock			

Boring terminated at 15.1 meters due to practical refusal .
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

LOG OF BORING BS-1

PLATE A-2b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	453 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
							Undocumented Fill			
452	1	1	6			SM	**Silty Sand (SM):** brown, slightly moist, loose, fine to medium grained sand			
							--dark brown			
451	2	2	5				--moist	15.4	9.6	
		3								GS, COR
		4	16				--medium dense, trace clay	18.8	9.9	CN
450	3						**Alluvium**			
		5	53			SM	**Silty Sand (SM):** olive, moist, dense, fine to medium grained sand	18.8	13.5	
449	4						--some clay			
448	5	6	78				--orange-brown, very dense, fine to coarse grained sand, coarse gravel in upper 0.3 meters of sample			
							--trace to some clay			
447	6	7	22, 50/10							
446	7									
							--auger bit chatter			
445	8	8	50/100				**Bedrock**: Tonalite, brown, moderately weathered, recovered as fine to coarse grained sand	16.9	7.5	
444	9									
		9	50/130				--brown, moderately to highly weathered, recovered as fine to medium grained sand			
443										

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PROJECT NO. 76979

I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

LOG OF BORING BS-2

PLATE A-3a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
442 11	10	26, 50/5				--light brown, slightly weathered			
						Practical drill refusal on on bedrock at approximately 11.3 meters			
						Boring terminated at 11.3 meters due to practical refusal. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

LOG OF BORING BS-2

PLATE A-3b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08

APPENDIX B

LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

Laboratory soil testing was not performed for the proposed right bridge widening. Laboratory tests data presented here is from the proposed Box Springs Overhead Left Bridge widening project. Laboratory tests were performed on drive and bulk soil samples to estimate engineering characteristics of the various earth materials encountered. Testing was performed in general accordance with procedures outlined by the American Society for Testing and Materials, the California Department of Transportation, or other accepted procedures.

IN-SITU MOISTURE CONTENT AND DRY UNIT WEIGHT

In-situ moisture content and dry unit weight tests were performed on samples that could be recovered in a relatively undisturbed condition. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937. The results are presented on the Logs of Borings.

GRAIN SIZE DISTRIBUTION

Two sieve analyses were performed on selected samples of the materials encountered at the site to evaluate the grain size distribution characteristics of the soils and to aid in their classification. The tests were performed in general accordance with ASTM Standard Test Method D 422. The test results are presented on Plate B-1.

CONSOLIDATION TEST

Two consolidation tests were performed on representative drive soil samples to evaluate the settlement characteristics of the in-situ soils when subjected to typical foundation loads and wetting. The tests were performed in accordance with ASTM Standard Test Method D 5333. The test results are presented on Plates B-2 and B-3.

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DIRECT SHEAR TEST

One direct shear test was performed on a selected sample to evaluate the drained shear strength of the soils. The sample was soaked and tested in a near-saturated condition in general accordance with ASTM Test Method D3080 (consolidated, drained). The results of this test is presented on Plate B-4 and summarized in Table B-1, below.

Table B-1
Direct Shear Test Results

Boring No.	Depth (m)	USCS Soil Type	Dry Unit Weight (kN/m^3)	Angle of Internal Friction (degrees)	Cohesion (kPa)
BS-1	2.3	SM	20.4	33	44

CORROSIVITY TESTS

Chemical analyses were performed on a selected sample of the sub-surface soil to estimate pH, resistivity, soluble sulfate, and chloride contents in general accordance with Caltrans Standard Test Methods 532 (pH), 643 (resistivity), 417 (sulfates), and 422 (chlorides). The test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to the construction materials. The results of the tests are presented in Table B-2, below.

Table B-2
Corrosion Test Results

Boring No.	Depth (m)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
BS-2	2 - 3	3,000	7.7	8	131

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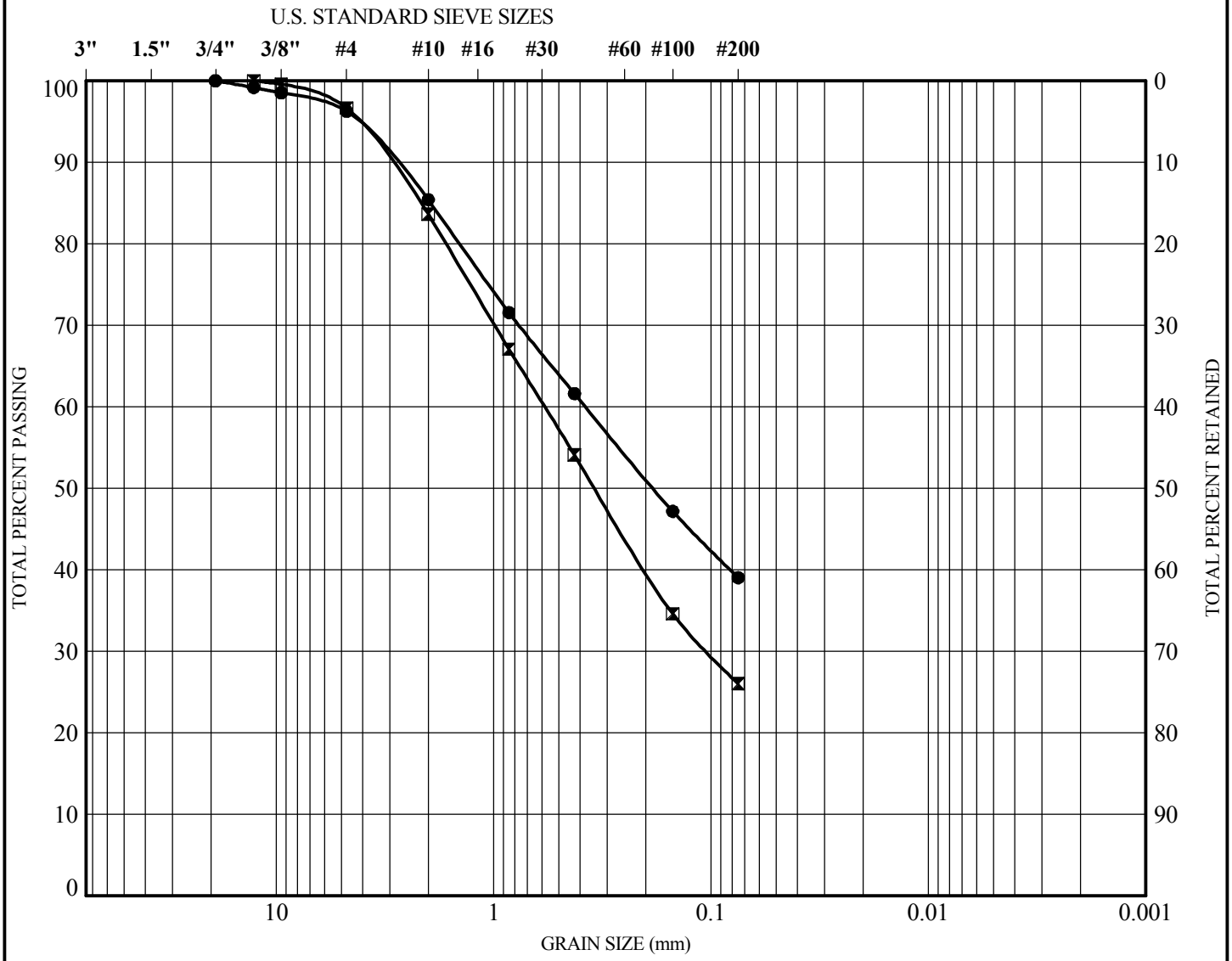
SIEVE ANALYSIS	HYDROMETER



GRAVEL	SAND					SILT	CLAY
	Very Coarse	Coarse	Medium	Fine	Very Fine		

Symbol	Test Pit	Depth (m)	USDA Description	USCS Classification
●	BS-1	1	Silty Sand	SM
⧗	BS-2	1	Silty Sand	SM

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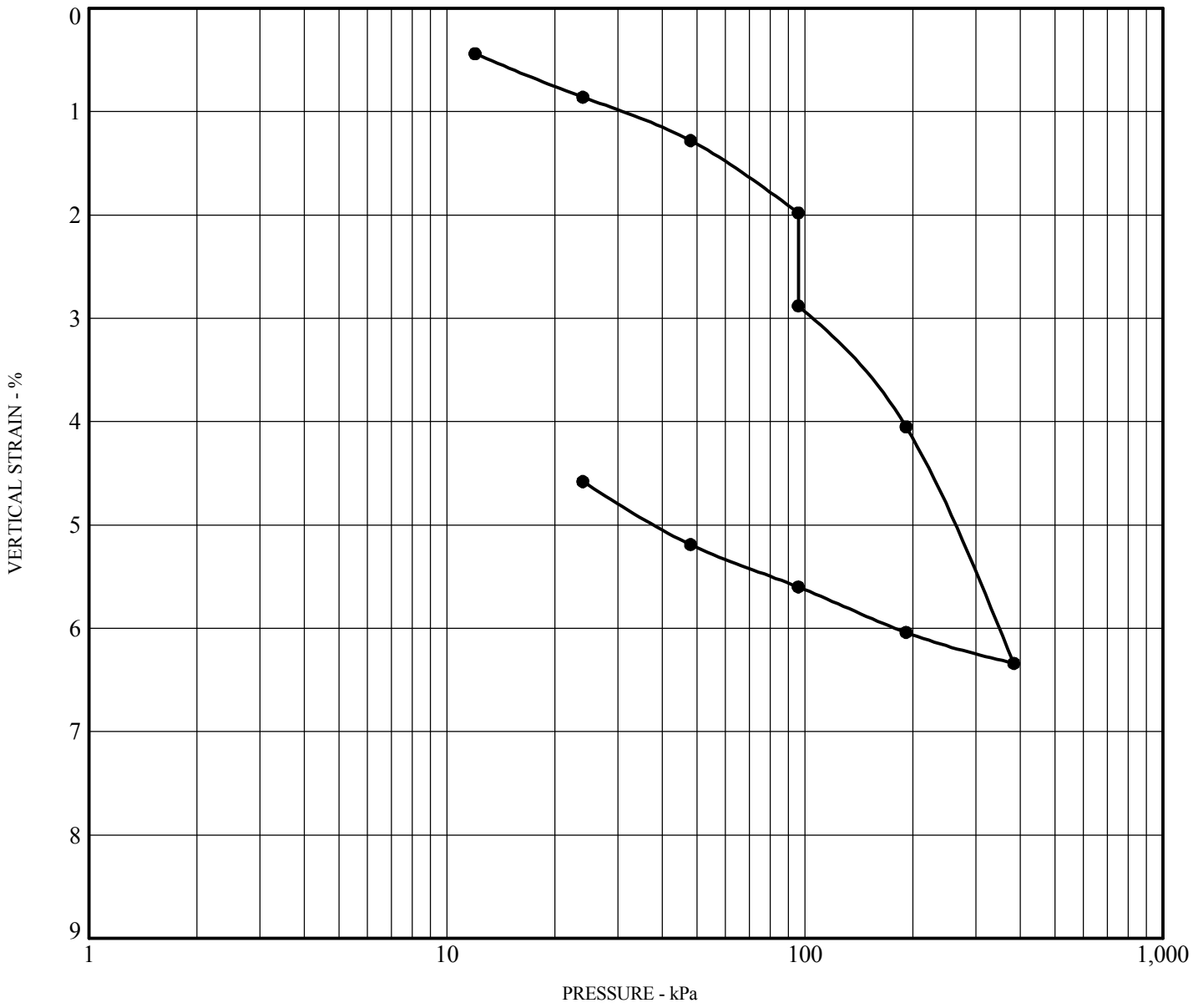
I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

GRAIN SIZE DISTRIBUTION

PLATE

B-1

GRAIN SIZE USDA 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08



Boring	**BS-1**			
Depth (meters)	**5**			
Moisture Content (%)	**7.9**	**Before**	**16.4**	**After**
Dry Density (kN/m^3)	**18.5**			
Description	**Silty Sand**			
Classification	**SM**			

NOTE : 1 kPa = 21 psf
SPECIMEN FLOODED
AT 2000 psf

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PROJECT NO. 76979

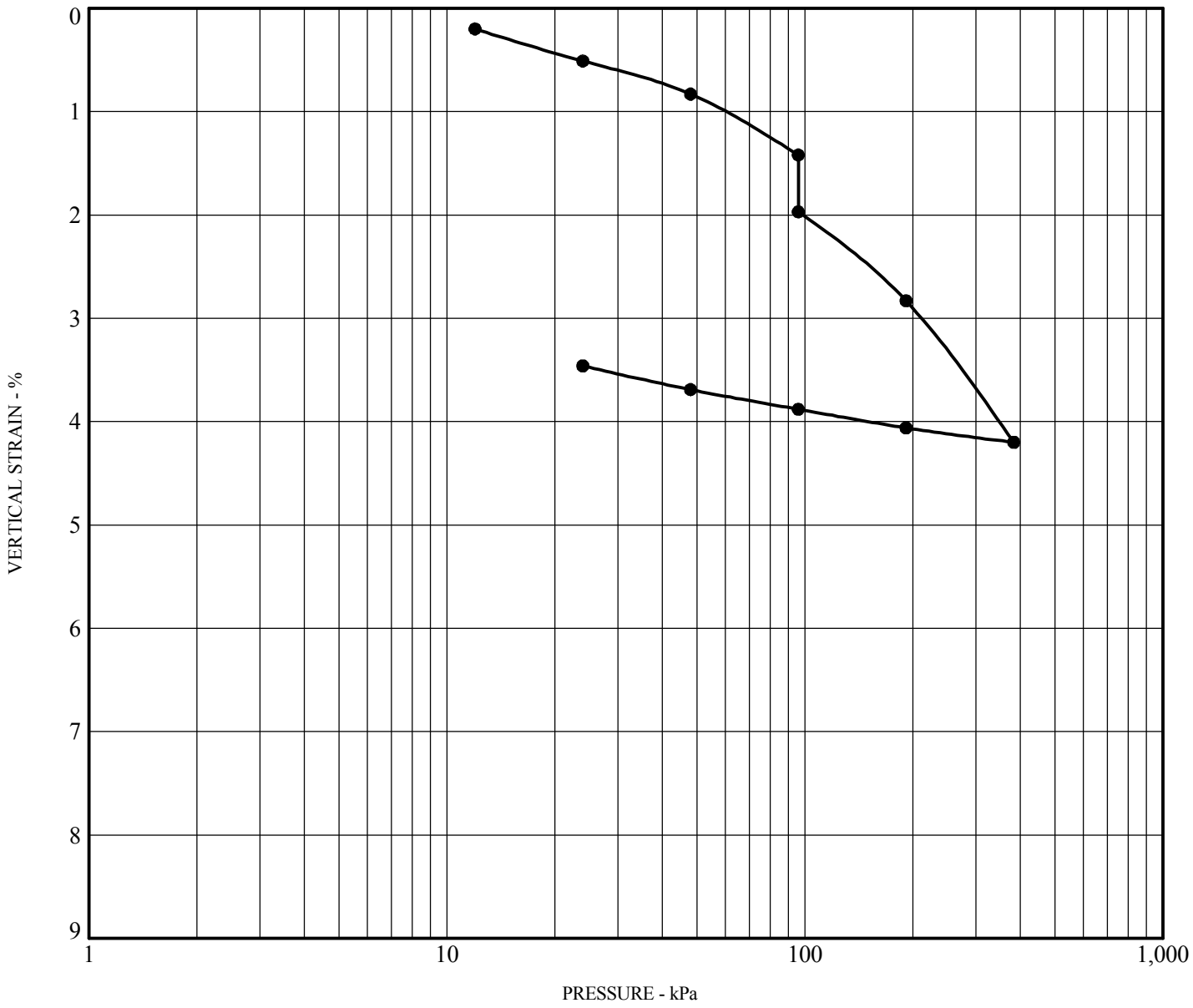
I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

CONSOLIDATION/COLLAPSE POTENTIAL TEST

PLATE

B-2

CONSOL NO INDICIES 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08



Boring	**BS-2**			
Depth (meters)	**2**			
Moisture Content (%)	**9.9**	**Before**	**12.9**	**After**
Dry Density (kN/m^3)	**18.8**			
Description	**Silty Sand**			
Classification	**SM**			

NOTE : 1 kPa = 21 psf
SPECIMEN FLOODED
AT 2000 psf

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I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

PLATE

B-3

PROJECT NO. 76979

CONSOLIDATION/COLLAPSE POTENTIAL TEST

CONSOL NO INDICIES 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08

APPENDIX C

ENGINEERING ANALYSES

C-1

LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	I-215/SR-60 East Junction, Box Springs Overhead
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA	
Exploration No.	BS-1
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1514.0 feet
Proposed Grade Elevation	1505.0 feet
Unit Weight of Proposed Fill on Surface	0.0 pcf
GWT Elevation During Test	1414.0 feet
GWT Elevation For Design	1414.0 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1514.0	1509.0	5.0	SM	Y	119.0	28.00	20.0
1509.0	1505.0	9.0	SM	Y	130.0	25.00	20.0
1505.0	1504.0	10.0	SM	Y	130.0	25.00	20.0
1504.0	1499.0	15.0	SM	Y	118.0	15.00	20.0
1499.0	1494.0	20.0	SM	Y	118.0	20.00	20.0
1494.0	1489.0	25.0	SM	Y	118.0	20.00	20.0
1489.0	1484.0	30.0	SM	Y	125.0	68.00	20.0
1484.0	1479.0	35.0	SM	Y	125.0	60.00	20.0
1479.0	1474.0	40.0	SM	Y	125.0	65.00	20.0
1474.0	1469.0	45.0	SM	Y	125.0	35.00	15.0
1469.0	1464.0	50.0	BEDROCK/FORMATION	N	125.0	65.00	0.0

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction, Box Springs Overhead
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	BS-1
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1514.00 feet
Proposed Grade Elevation	1505.00 feet
Unit Weight of Proposed Fill on Surface	0.00 pcf
GWT Elevation During Test	1414.00 feet
GWT Elevation For Design	1414.00 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<=== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<=== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.15 inches	<=== Dry or Unsaturated Soils (Above GWT)
	0.15 inches	<=== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d
* FS_{liq} = (CRR/CSR), where CRR = $CRR_{7.5}$ MSF K_σ K_α ; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_σ=1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. LPI = $\sum(1-FS_{liq})$ x H_i (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)							SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +												RESIDUAL STRENGTH AND GROUND SETTLEMENT					
Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_T (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1514.0	1513.0	SM	Y	119.0	28	20.0	0.5																	
1513.0	1512.0	SM	Y	119.0	28	20.0	1.5																	
1512.0	1511.0	SM	Y	119.0	28	20.0	2.5																	
1511.0	1510.0	SM	Y	119.0	28	20.0	3.5																	
1510.0	1509.0	SM	Y	119.0	28	20.0	4.5																	
1509.0	1508.0	SM	Y	130.0	25	20.0	5.5																	
1508.0	1507.0	SM	Y	130.0	25	20.0	6.5																	
1507.0	1506.0	SM	Y	130.0	25	20.0	7.5																	
1506.0	1505.0	SM	Y	130.0	25	20.0	8.5																	
1505.0	1504.0	SM	Y	130.0	25	20.0	9.5	1.229	0.850	46.7	0.999	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	41.6	N/A	0.010	0.000	0.00	0.15
1504.0	1503.0	SM	Y	118.0	15	20.0	10.5	1.188	0.850	28.6	0.997	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	24.8	N/A	0.022	0.028	0.00	0.14
1503.0	1502.0	SM	Y	118.0	15	20.0	11.5	1.151	0.850	27.8	0.994	N/A	0.252	N/A	N/A	NO	N/A	Soil above GWT	24.1	N/A	0.028	0.038	0.00	0.14
1502.0	1501.0	SM	Y	118.0	15	20.0	12.5	1.117	0.850	27.1	0.992	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	23.4	N/A	0.033	0.046	0.01	0.13
1501.0	1500.0	SM	Y	118.0	15	20.0	13.5	1.084	0.850	26.4	0.990	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	22.8	N/A	0.038	0.054	0.01	0.13
1500.0	1499.0	SM	Y	118.0	15	20.0	14.5	1.054	0.850	25.8	0.987	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	22.2	N/A	0.042	0.062	0.01	0.12
1499.0	1498.0	SM	Y	118.0	20	20.0	15.5	1.025	0.950	35.8	0.985	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	31.4	N/A	0.040	0.039	0.00	0.12
1498.0	1497.0	SM	Y	118.0	20	20.0	16.5	0.997	0.950	34.9	0.983	N/A	0.249	N/A	N/A	NO	N/A	Soil above GWT	30.6	N/A	0.043	0.044	0.01	0.11
1497.0	1496.0	SM	Y	118.0	20	20.0	17.5	0.971	0.950	34.1	0.980	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	29.9	N/A	0.046	0.048	0.01	0.11
1496.0	1495.0	SM	Y	118.0	20	20.0	18.5	0.947	0.950	33.3	0.978	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	29.2	N/A	0.049	0.053	0.01	0.10
1495.0	1494.0	SM	Y	118.0	20	20.0	19.5	0.923	0.950	32.6	0.976	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	28.5	N/A	0.051	0.057	0.01	0.09
1494.0	1493.0	SM	Y	118.0	20	20.0	20.5	0.901	0.950	31.9	0.973	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	27.8	N/A	0.054	0.062	0.01	0.08
1493.0	1492.0	SM	Y	118.0	20	20.0	21.5	0.880	0.950	31.2	0.971	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	27.2	N/A	0.057	0.067	0.01	0.08
1492.0	1491.0	SM	Y	118.0	20	20.0	22.5	0.859	0.950	30.6	0.969	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	26.6	N/A	0.059	0.071	0.01	0.07
1491.0	1490.0	SM	Y	118.0	20	20.0	23.5	0.840	0.950	30.0	0.966	N/A	0.245	N/A	N/A	NO	N/A	Soil above GWT	26.1	N/A	0.062	0.076	0.01	0.06
1490.0	1489.0	SM	Y	118.0	20	20.0	24.5	0.822	0.950	29.4	0.964	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	25.5	N/A	0.064	0.081	0.01	0.05
1489.0	1488.0	SM	Y	125.0	68	20.0	25.5	0.803	0.950	89.3	0.962	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	81.0	N/A	0.043	0.000	0.00	0.05
1488.0	1487.0	SM	Y	125.0	68	20.0	26.5	0.785	0.950	87.4	0.959	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	79.3	N/A	0.045	0.000	0.00	0.05
1487.0	1486.0	SM	Y	125.0	68	20.0	27.5	0.768	0.950	85.5	0.957	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	77.6	N/A	0.046	0.000	0.00	0.05
1486.0	1485.0	SM	Y	125.0	68	20.0	28.5	0.752	1.000	88.0	0.955	N/A	0.242	N/A	N/A	NO	N/A	Soil above GWT	79.9	N/A	0.047	0.000	0.00	0.05
1485.0	1484.0	SM	Y	125.0	68	20.0	29.5	0.736	1.000	86.3	0.952	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	78.2	N/A	0.048	0.000	0.00	0.05
1484.0	1483.0	SM	Y	125.0	60	20.0	30.5	0.721	1.000	75.0	0.950	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	67.8	N/A	0.051	0.000	0.00	0.05
1483.0	1482.0	SM	Y	125.0	60	20.0	31.5	0.707	1.000	73.6	0.948	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	66.5	N/A	0.053	0.000	0.00	0.05
1482.0	1481.0	SM	Y	125.0	60	20.0	32.5	0.693	1.000	72.2	0.945	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	65.2	N/A	0.054	0.000	0.00	0.05
1481.0	1480.0	SM	Y	125.0	60	20.0	33.5	0.679	1.000	70.9	0.943	N/A	0.239	N/A	N/A	NO	N/A	Soil above GWT	64.0	N/A	0.055	0.000	0.00	0.05
1480.0	1479.0	SM	Y	125.0	60	20.0	34.5	0.666	1.000	69.6	0.941	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	62.8	N/A	0.057	0.000	0.00	0.05
1479.0	1478.0	SM	Y	125.0	65	20.0	35.5	0.654	1.000	73.8	0.938	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	66.7	N/A	0.057	0.000	0.00	0.05
1478.0	1477.0	SM	Y	125.0	65	20.0	36.5	0.642	1.000	72.5	0.936	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	65.5	N/A	0.058	0.000	0.00	0.05
1477.0	1476.0	SM	Y	125.0	65	20.0	37.5	0.631	1.000	71.3	0.934	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	64.4	N/A	0.059	0.000	0.00	0.05
1476.0	1475.0	SM	Y	125.0	65	20.0	38.5	0.620	1.000	70.1	0.931	N/A	0.236	N/A	N/A	NO	N/A	Soil above GWT	63.3	N/A	0.060	0.000	0.00	0.05
1475.0	1474.0	SM	Y	125.0	65	20.0	39.5	0.609	1.000	68.9	0.926	N/A	0.235	N/A	N/A	NO	N/A	Soil above GWT	62.2	N/A	0.061	0.000	0.00	0.05
1474.0	1473.0	SM	Y	125.0	35	15.0	40.5	0.598	1.000	36.1	0.918	N/A	0.233	N/A	N/A	NO	N/A	Soil above GWT	33.4	N/A	0.079	0.078	0.01	0.04
1473.0	1472.0	SM	Y	125.0	35	15.0	41.5	0.588	1.000	35.5	0.909	N/A	0.231	N/A	N/A	NO	N/A	Soil above GWT	32.8	N/A	0.079	0.080	0.01	0.03
1472.0	1471.0	SM	Y	125.0	35	15.0	42.5	0.579	1.000	35.0	0.900	N/A	0.228	N/A	N/A	NO	N/A	Soil above GWT	32.3	N/A	0.080	0.082	0.01	0.02
1471.0	1470.0	SM	Y	125.0	35	15.0	43.5	0.569	1.000	34.4	0.893	N/A	0.226	N/A	N/A	NO	N/A	Soil above GWT	31.8	N/A	0.081	0.084	0.01	0.01
1470.0	1469.0	SM	Y	125.0	35	15.0	44.5	0.560	1.000	33.9	0.885	N/A	0.224	N/A	N/A	NO	N/A	Soil above GWT	31.3	N/A	0.081	0.086	0.01	0.00
1469.0	1468.0	BEDROCK/FORMATION	N	125.0	65	0.0	45.5	0.552	1.000	N/A	0.877	N/A	0.222	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1468.0	1467.0	BEDROCK/FORMATION	N	125.0	65	0.0	46.5	0.543	1.000	N/A	0.869	N/A	0.220	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1467.0	1466.0	BEDROCK/FORMATION	N	125.0	65	0.0	47.5	0.535	1.000	N/A	0.861	N/A	0.218	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1466.0	1465.0	BEDROCK/FORMATION	N	125.0	65	0.0	48.5	0.527	1.000	N/A	0.852	N/A	0.216	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction, Box Springs Overhead
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	BS-1
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1514.00 feet
Proposed Grade Elevation	1505.00 feet
Unit Weight of Proposed Fill on Surface	0.00 pcf
GWT Elevation During Test	1414.00 feet
GWT Elevation For Design	1414.00 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<=== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<=== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.15 inches	<=== Dry or Unsaturated Soils (Above GWT)
	0.15 inches	<=== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count $(N_1)_{60cs}$ = $N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%; Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d
* FS_{liq} = (CRR/CSR), where CRR = $CRR_{7.5}$ MSF K_σ K_α; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K=1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. LPI = $\Sigma w(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA) / SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (Inches)
1465.0	1464.0	BEDROCK/FORMATION	N	125.0	65	0.0	49.5	0.519	1.000	N/A	0.844	N/A	0.214	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	I-215/SR-60 East Junction, Box Springs Overhead
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA	
Exploration No.	BS-2
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1485.0 feet
Proposed Grade Elevation	1476.0 feet
Unit Weight of Proposed Fill on Surface	0.0 pcf
GWT Elevation During Test	1385.0 feet
GWT Elevation For Design	1385.0 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1485.0	1480.0	5.0	SM	Y	98.0	6.00	20.0
1480.0	1476.0	9.0	SM	Y	120.0	7.00	20.0
1476.0	1475.0	10.0	SM	Y	120.0	7.00	20.0
1475.0	1470.0	15.0	SM	Y	120.0	37.00	20.0
1470.0	1465.0	20.0	SM	Y	120.0	55.00	20.0
1465.0	1460.0	25.0	SM	Y	122.0	70.00	20.0
1460.0	1455.0	30.0	BEDROCK/FORMATION	N	125.0	70.00	0.0
1455.0	1450.0	35.0	BEDROCK/FORMATION	N	125.0	70.00	0.0
1450.0	1445.0	40.0	BEDROCK/FORMATION	N	125.0	70.00	0.0

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction, Box Springs Overhead
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	BS-2
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1485.00 feet
Proposed Grade Elevation	1476.00 feet
Unit Weight of Proposed Fill on Surface	0.00 pcf
GWT Elevation During Test	1385.00 feet
GWT Elevation For Design	1385.00 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<===	LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet		LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sand boils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<===	Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.00 inches	<===	Dry or Unsaturated Soils (Above GWT)
	0.00 inches	<===	Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count ($(N_1)_{60cs}$= N_m C_N C_E C_B C_R C_S x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d
* FS_{liq} = (CRR/CSR), where CRR = $CRR_{7.5}$ MSF K_σ K_α ; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K=1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. LPI = $\sum F(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)							SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +												RESIDUAL STRENGTH AND GROUND SETTLEMENT					
Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1485.0	1484.0	SM	Y	98.0	6	20.0	0.5																	
1484.0	1483.0	SM	Y	98.0	6	20.0	1.5																	
1483.0	1482.0	SM	Y	98.0	6	20.0	2.5																	
1482.0	1481.0	SM	Y	98.0	6	20.0	3.5																	
1481.0	1480.0	SM	Y	98.0	6	20.0	4.5																	
1480.0	1479.0	SM	Y	120.0	7	20.0	5.5																	
1479.0	1478.0	SM	Y	120.0	7	20.0	6.5																	
1478.0	1477.0	SM	Y	120.0	7	20.0	7.5																	
1477.0	1476.0	SM	Y	120.0	7	20.0	8.5																	
1476.0	1475.0	SM	Y	120.0	7	20.0	9.5	1.283	0.850	16.2	0.999	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	13.3	N/A	0.016	0.040	0.00	0.00
1475.0	1474.0	SM	Y	120.0	37	20.0	10.5	1.239	0.850	68.0	0.997	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	61.3	N/A	0.015	0.000	0.00	0.00
1474.0	1473.0	SM	Y	120.0	37	20.0	11.5	1.199	0.850	65.9	0.994	N/A	0.252	N/A	N/A	NO	N/A	Soil above GWT	59.3	N/A	0.020	0.000	0.00	0.00
1473.0	1472.0	SM	Y	120.0	37	20.0	12.5	1.161	0.850	63.9	0.992	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	57.5	N/A	0.023	0.000	0.00	0.00
1472.0	1471.0	SM	Y	120.0	37	20.0	13.5	1.125	0.850	62.0	0.990	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	55.8	N/A	0.027	0.000	0.00	0.00
1471.0	1470.0	SM	Y	120.0	37	20.0	14.5	1.092	0.850	60.3	0.987	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	54.2	N/A	0.030	0.000	0.00	0.00
1470.0	1469.0	SM	Y	120.0	55	20.0	15.5	1.060	0.950	95.1	0.985	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	86.4	N/A	0.027	0.000	0.00	0.00
1469.0	1468.0	SM	Y	120.0	55	20.0	16.5	1.030	0.950	92.5	0.983	N/A	0.249	N/A	N/A	NO	N/A	Soil above GWT	84.0	N/A	0.030	0.000	0.00	0.00
1468.0	1467.0	SM	Y	120.0	55	20.0	17.5	1.002	0.950	90.1	0.980	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	81.8	N/A	0.032	0.000	0.00	0.00
1467.0	1466.0	SM	Y	120.0	55	20.0	18.5	0.976	0.950	87.8	0.978	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	79.6	N/A	0.034	0.000	0.00	0.00
1466.0	1465.0	SM	Y	120.0	55	20.0	19.5	0.950	0.950	85.6	0.976	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	77.6	N/A	0.036	0.000	0.00	0.00
1465.0	1464.0	SM	Y	122.0	70	20.0	20.5	0.926	0.950	105.3	0.973	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	95.9	N/A	0.035	0.000	0.00	0.00
1464.0	1463.0	SM	Y	122.0	70	20.0	21.5	0.903	0.950	102.7	0.971	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	93.5	N/A	0.036	0.000	0.00	0.00
1463.0	1462.0	SM	Y	122.0	70	20.0	22.5	0.881	0.950	100.3	0.969	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	91.3	N/A	0.038	0.000	0.00	0.00
1462.0	1461.0	SM	Y	122.0	70	20.0	23.5	0.860	0.950	98.0	0.966	N/A	0.245	N/A	N/A	NO	N/A	Soil above GWT	89.1	N/A	0.040	0.000	0.00	0.00
1461.0	1460.0	SM	Y	122.0	70	20.0	24.5	0.840	0.950	95.8	0.964	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	87.1	N/A	0.041	0.000	0.00	0.00
1460.0	1459.0	BEDROCK/FORMATION	N	125.0	70	0.0	25.5	0.821	0.950	N/A	0.962	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1459.0	1458.0	BEDROCK/FORMATION	N	125.0	70	0.0	26.5	0.802	0.950	N/A	0.959	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1458.0	1457.0	BEDROCK/FORMATION	N	125.0	70	0.0	27.5	0.784	0.950	N/A	0.957	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1457.0	1456.0	BEDROCK/FORMATION	N	125.0	70	0.0	28.5	0.767	1.000	N/A	0.955	N/A	0.242	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1456.0	1455.0	BEDROCK/FORMATION	N	125.0	70	0.0	29.5	0.751	1.000	N/A	0.952	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1455.0	1454.0	BEDROCK/FORMATION	N	125.0	70	0.0	30.5	0.735	1.000	N/A	0.950	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1454.0	1453.0	BEDROCK/FORMATION	N	125.0	70	0.0	31.5	0.720	1.000	N/A	0.948	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1453.0	1452.0	BEDROCK/FORMATION	N	125.0	70	0.0	32.5	0.705	1.000	N/A	0.945	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1452.0	1451.0	BEDROCK/FORMATION	N	125.0	70	0.0	33.5	0.692	1.000	N/A	0.943	N/A	0.239	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1451.0	1450.0	BEDROCK/FORMATION	N	125.0	70	0.0	34.5	0.678	1.000	N/A	0.941	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1450.0	1449.0	BEDROCK/FORMATION	N	125.0	70	0.0	35.5	0.665	1.000	N/A	0.938	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1449.0	1448.0	BEDROCK/FORMATION	N	125.0	70	0.0	36.5	0.653	1.000	N/A	0.936	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1448.0	1447.0	BEDROCK/FORMATION	N	125.0	70	0.0	37.5	0.641	1.000	N/A	0.934	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1447.0	1446.0	BEDROCK/FORMATION	N	125.0	70	0.0	38.5	0.630	1.000	N/A	0.931	N/A	0.236	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1446.0	1445.0	BEDROCK/FORMATION	N	125.0	70	0.0	39.5	0.619	1.000	N/A	0.926	N/A	0.235	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00

C-2

FOOTING BEARING CAPACITY

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs OH (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 1
Footing Description	19' x 112.5' footing
Footing Width, B	19.00 feet
Footing Length, L	112.50 feet
Min. Footing Embedment Depth, D_f	8.20 feet
Bottom of Footing Elevation	1,473.05 feet
Design GWT Elevation	1,420.00 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	0.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Normal Gravity Load, Q	14,321.25 kips
Shear Load (along X-axis), P_x	1,359.94 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY

Factor of Safety for Sliding Failure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Failure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,481.25 feet
Depth to Design GWT, Z_w	61.25 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	1,359.94 kips
Effective Footing Width, $B' = B - 2e_x$	19.00 feet
Effective Footing Length, $L' = L - 2e_y$	112.50 feet
Effective Footing Area, $A_f = B'L'$	2,137.50 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(BL)$	6.70 ksf
Effective Cohesion, c_{eff}	0.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	0.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	17.14 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	125.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	1,025.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.43
Exponent, n	1.14

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.05	1.11	1.11	1.11
s_q	N/A	1.05	1.09	1.11
s_γ	0.80	1.05	0.93	0.93
Depth Factors, d_c	N/A	1.16	1.17	1.17
d_q	N/A	1.08	1.12	1.12
d_γ	N/A	1.08	1.00	1.00
Inclination Factors, i_c	N/A	0.88	0.86	0.88
i_q	N/A	0.88	0.86	0.89
i_γ	N/A	0.69	0.81	0.81
Ground Factors (base on slope), g_c	N/A	N/A	1.00	0.86
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	61.1	56.8	43.8	53.2

Average Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	53.7 ksf
Average Allowable Gross Bearing Capacity, $q_{all} = q_{ult\text{-}ave}/FS_{bearing}$	17.9 ksf *
Maximum Shear Resistance: $P_{max} = Q \tan\delta + C_a B L$	5,593.2 kips
Check Sliding Failure: $(P_{max}/P) \geq FS_{sliding}$?	N/A
Check Load Eccentricity (along X-axis): $e_x \leq B/6$	N/A
Check Load Eccentricity (along Y-axis): $e_y \leq L/6$	N/A
Check Bearing Failure: $(q_{ult\text{-}ave}/q_{app}) \geq FS_{bearing}$?	Yes

Notes:

* The footing should be checked for tolerable settlement.
Allowable gross bearing capacity may be limited to 10 ksf due to settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs OH (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 4
Footing Description	14' x 95.8' footing
Footing Width, B	14.00 feet
Footing Length, L	95.80 feet
Min. Footing Embedment Depth, D_f	8.20 feet
Bottom of Footing Elevation	1,486.17 feet
Design GWT Elevation	1,420.00 feet
Ground Slope Angle, β	26.57 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Normal Gravity Load, Q	6,800.00 kips
Shear Load (along X-axis), P_x	490.11 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY

Factor of Safety for Sliding Failure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Failure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,494.37 feet
Depth to Design GWT, Z_w	74.37 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	490.11 kips
Effective Footing Width, $B' = B - 2e_x$	14.00 feet
Effective Footing Length, $L' = L - 2e_y$	95.80 feet
Effective Footing Area, $A_f = B' L'$	1,341.20 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(BL)$	5.07 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\ c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	12.63 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	125.00 pcf
Effective Soil Pressure at Footing Base, $q_h = \gamma_{eff} D_f$	1,025.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\ \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.59
Exponent, n	1.13

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.04	1.10	1.10	1.10
s_q	N/A	1.05	1.08	1.09
s_γ	0.80	1.05	0.94	0.94
Depth Factors, d_c	N/A	1.21	1.23	1.23
d_q	N/A	1.11	1.16	1.16
d_γ	N/A	1.11	1.00	1.00
Inclination Factors, i_c	N/A	0.91	1.00	1.00
i_q	N/A	0.91	1.00	1.00
i_γ	N/A	0.76	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.82	1.00
g_q	N/A	N/A	0.24	0.25
g_γ	N/A	N/A	0.24	0.25
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_h N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\ S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_h$	N/A	N/A	18.9	23.3

Average Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	21.1 ksf
Average Allowable Gross Bearing Capacity, $q_{all} = q_{ult\text{-}ave}/FS_{bearing}$	7.0 ksf *
Maximum Shear Resistance: $P_{max} = Q \tan\delta + C_a B L$	150,187.8 kips
Check Sliding Failure: $(P_{max}/P) \geq FS_{sliding}$?	N/A
Check Load Eccentricity (along X-axis): $e_x \leq B/6$	N/A
Check Load Eccentricity (along Y-axis): $e_y \leq L/6$	N/A
Check Bearing Failure: $(q_{ult\text{-}ave}/q_{app}) \geq FS_{bearing}$?	Yes

Notes:

* The footing should be checked for tolerable settlement.
Allowable gross bearing capacity may be limited to 10 ksf due to settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs OH (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Pier 2
Footing Description	11.8' x 107.26' footing
Footing Width, B	11.80 feet
Footing Length, L	107.26 feet
Min. Footing Embedment Depth, D_f	8.20 feet
Bottom of Footing Elevation	1,473.70 feet
Design GWT Elevation	1,420.00 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	0.00 psf
Soil Friction Angle, ϕ	34.00 degrees

FOOTING LOADS

Normal Gravity Load, Q	22,971.87 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY

Factor of Safety for Sliding Failure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Failure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,481.90 feet
Depth to Design GWT, Z_w	61.90 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	0.00 kips
Effective Footing Width, $B' = B - 2e_x$	11.80 feet
Effective Footing Length, $L' = L - 2e_y$	107.26 feet
Effective Footing Area, $A_f = B'L'$	1,265.67 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(BL)$	18.15 ksf
Effective Cohesion, c_{eff}	0.00 psf
Effective Friction Angle, ϕ_{eff}	34.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	0.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	11.10 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	125.00 pcf
Effective Soil Pressure at Footing Base, $q_{fb} = \gamma_{eff} D_f$	1,025.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	22.67 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.54
Depth Factor Parameter, k	0.69
Exponent, n	1.10

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	42.16	42.16	42.16	42.16
N_q	36.50	29.44	29.44	29.44
N_γ	37.98	31.15	28.77	41.06
Shape Factors, s_c	1.03	1.08	1.08	1.08
s_q	N/A	1.04	1.06	1.07
s_γ	0.80	1.04	0.96	0.96
Depth Factors, d_c	N/A	1.26	1.28	1.28
d_q	N/A	1.13	1.18	1.18
d_γ	N/A	1.13	1.00	1.00
Inclination Factors, i_c	N/A	1.00	1.00	1.00
i_q	N/A	1.00	1.00	1.00
i_γ	N/A	1.00	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	1.00	1.00
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	65.4	62.4	58.2	67.3

Average Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	63.3 ksf
Average Allowable Gross Bearing Capacity, $q_{all} = q_{ult\text{-}ave}/FS_{bearing}$	21.1 ksf *
Maximum Shear Resistance: $P_{max} = Q \tan\delta + C_a B L$	9,593.6 kips
Check Sliding Failure: $(P_{max}/P) \geq FS_{sliding}$?	N/A
Check Load Eccentricity (along X-axis): $e_x \leq B/6$	N/A
Check Load Eccentricity (along Y-axis): $e_y \leq L/6$	N/A
Check Bearing Failure: $(q_{ult\text{-}ave}/q_{app}) \geq FS_{bearing}$?	Yes

Notes:

* The footing should be checked for tolerable settlement.
Allowable gross bearing capacity may be limited to 10 ksf due to settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs OH (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Pier 3
Footing Description	11.8' x 96.76' footing
Footing Width, B	11.80 feet
Footing Length, L	96.76 feet
Min. Footing Embedment Depth, D_f	8.20 feet
Bottom of Footing Elevation	1,470.80 feet
Design GWT Elevation	1,420.00 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	0.00 psf
Soil Friction Angle, ϕ	34.00 degrees

FOOTING LOADS

Normal Gravity Load, Q	19,649.80 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY

Factor of Safety for Sliding Failure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Failure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,479.00 feet
Depth to Design GWT, Z_w	59.00 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	0.00 kips
Effective Footing Width, $B' = B - 2e_x$	11.80 feet
Effective Footing Length, $L' = L - 2e_y$	96.76 feet
Effective Footing Area, $A_f = B'L'$	1,141.77 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(BL)$	17.21 ksf
Effective Cohesion, c_{eff}	0.00 psf
Effective Friction Angle, ϕ_{eff}	34.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	0.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	11.10 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	125.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	1,025.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	22.67 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.54
Depth Factor Parameter, k	0.69
Exponent, n	1.11

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	42.16	42.16	42.16	42.16
N_q	36.50	29.44	29.44	29.44
N_γ	37.98	31.15	28.77	41.06
Shape Factors, s_c	1.04	1.09	1.09	1.09
s_q	N/A	1.04	1.07	1.08
s_γ	0.80	1.04	0.95	0.95
Depth Factors, d_c	N/A	1.26	1.28	1.28
d_q	N/A	1.13	1.18	1.18
d_γ	N/A	1.13	1.00	1.00
Inclination Factors, i_c	N/A	1.00	1.00	1.00
i_q	N/A	1.00	1.00	1.00
i_γ	N/A	1.00	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	1.00	1.00
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	65.4	62.7	58.3	67.4

Average Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	63.5 ksf
Average Allowable Gross Bearing Capacity, $q_{all} = q_{ult\text{-}ave}/FS_{bearing}$	21.2 ksf *
Maximum Shear Resistance: $P_{max} = Q \tan\delta + C_a B L$	8,206.3 kips
Check Sliding Failure: $(P_{max}/P) \geq FS_{sliding}$?	N/A
Check Load Eccentricity (along X-axis): $e_x \leq B/6$	N/A
Check Load Eccentricity (along Y-axis): $e_y \leq L/6$	N/A
Check Bearing Failure: $(q_{ult\text{-}ave}/q_{app}) \geq FS_{bearing}$?	Yes

Notes:

* The footing should be checked for tolerable settlement.
Allowable gross bearing capacity may be limited to 10 ksf due to settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

C-3

FOOTING SETTLEMENT

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

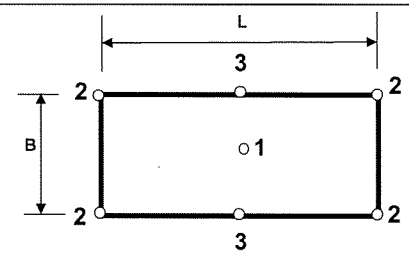
Project Name	Box Springs Overhead Widening (Right)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	19.00 feet
Footing Length, L	112.50 feet
Applied Net Bearing Pressure, p	5.70 ksf
Footing Embedment Depth, D	8.20 feet
Bottom of Footing Elevation	1,473.05 feet
GWT Elevation for Design	1,420.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.72	0.17	0.39
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.72	0.17	0.39



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Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,481.25	1,473.05	Cohesionless Soil	120.0					
1,473.05	1,471.00	Cohesionless Soil	120.0	600.0	0.35			2.0
1,471.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,465.00	1,460.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,460.00	1,455.00	Incompressible Soil	125.0	1,250.0	0.35			1.0
1,455.00	1,450.00	Incompressible Soil	140.0	1,250.0	0.35			1.0
1,450.00	1,445.00	Incompressible Soil	140.0	1,250.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vnb}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vnm}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	8.20	0.98	0.49	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.02	2.05	1.23	1.11	N/A	5.70	1.42	2.85	0.130	0.027	0.082	0.000	0.000	0.000
5.05	6.00	1.95	1.59	N/A	5.43	1.41	2.83	0.358	0.082	0.172	0.000	0.000	0.000
10.55	5.00	2.55	2.25	N/A	4.46	1.35	2.70	0.229	0.064	0.132	0.000	0.000	0.000
15.55	5.00	3.18	2.86	N/A	3.60	1.25	2.49	0.000	0.000	0.000	0.000	0.000	0.000
20.55	5.00	3.88	3.53	N/A	2.94	1.13	2.24	0.000	0.000	0.000	0.000	0.000	0.000
25.55	5.00	4.58	4.23	N/A	2.45	1.01	2.00	0.000	0.000	0.000	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

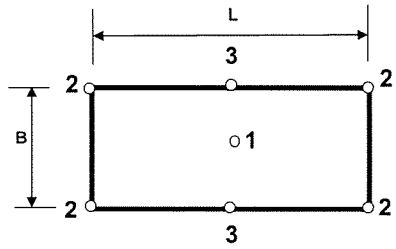
Project Name	Box Springs Overhead Widening (Right)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1-for 1-inch settlement
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	19.00 feet
Footing Length, L	112.50 feet
Applied Net Bearing Pressure, p	7.60 ksf
Footing Embedment Depth, D_f	8.20 feet
Bottom of Footing Elevation	1,473.05 feet
GWT Elevation for Design	1,420.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	1.00	0.23	0.53
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	1.00	0.23	0.53



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,481.25	1,473.05	Cohesionless Soil	120.0					
1,473.05	1,471.00	Cohesionless Soil	120.0	600.0	0.35			2.0
1,471.00	1,465.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,465.00	1,460.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,460.00	1,455.00	Incompressible Soil	125.0	1,250.0	0.35			1.0
1,455.00	1,450.00	Incompressible Soil	140.0	1,250.0	0.35			1.0
1,450.00	1,445.00	Incompressible Soil	140.0	1,250.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{voh}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	8.20	0.98	0.49	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.02	2.05	1.23	1.11	N/A	7.60	1.90	3.80	0.182	0.037	0.114	0.000	0.000	0.000
5.05	6.00	1.95	1.59	N/A	7.24	1.89	3.77	0.500	0.111	0.237	0.000	0.000	0.000
10.55	5.00	2.55	2.25	N/A	5.95	1.80	3.60	0.315	0.086	0.180	0.000	0.000	0.000
15.55	5.00	3.18	2.86	N/A	4.79	1.66	3.32	0.000	0.000	0.000	0.000	0.000	0.000
20.55	5.00	3.88	3.53	N/A	3.91	1.50	2.99	0.000	0.000	0.000	0.000	0.000	0.000
25.55	5.00	4.58	4.23	N/A	3.26	1.35	2.67	0.000	0.000	0.000	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

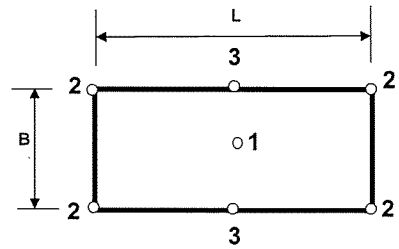
Project Name	Box Springs Overhead Widening (Right)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 4
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	14.00 feet
Footing Length, L	95.80 feet
Applied Net Bearing Pressure, p	4.07 ksf
Footing Embedment Depth, D_f	8.20 feet
Bottom of Footing Elevation	1,488.50 feet
GWT Elevation for Design	1,420.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.61	0.19	0.40
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.61	0.19	0.40



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,496.70	1,488.50	Cohesionless Soil	120.0					
1,488.50	1,486.50	Cohesionless Soil	120.0	600.0	0.35			2.0
1,486.50	1,479.00	Cohesionless Soil	120.0	900.0	0.35			1.0
1,479.00	1,474.00	Cohesionless Soil	120.0	900.0	0.35			1.0
1,474.00	1,469.00	Cohesionless Soil	125.0	1,000.0	0.35			1.0
1,469.00	1,464.00	Cohesionless Soil	125.0	1,000.0	0.35			1.0
1,464.00	1,460.00	Cohesionless Soil	125.0	1,000.0	0.35			1.0
1,460.00	1,455.00	Incompressible Soil	140.0	1,250.0	0.35			1.0
1,455.00	1,450.00	Incompressible Soil	140.0	1,250.0	0.35			1.0
1,450.00	1,445.00	Incompressible Soil	140.0	1,250.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	8.20	0.98	0.49	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.00	2.00	1.22	1.10	N/A	4.07	1.02	2.03	0.085	0.019	0.055	0.000	0.000	0.000
5.75	7.50	2.12	1.67	N/A	3.56	0.99	1.98	0.245	0.063	0.130	0.000	0.000	0.000
12.00	5.00	2.72	2.42	N/A	2.49	0.88	1.75	0.108	0.037	0.075	0.000	0.000	0.000
17.00	5.00	3.35	3.04	N/A	1.91	0.76	1.52	0.073	0.029	0.057	0.000	0.000	0.000
22.00	5.00	3.97	3.66	N/A	1.53	0.66	1.30	0.058	0.025	0.049	0.000	0.000	0.000
26.50	4.00	4.47	4.22	N/A	1.28	0.58	1.14	0.038	0.017	0.034	0.000	0.000	0.000
31.00	5.00	5.17	4.82	N/A	1.09	0.52	0.99	0.000	0.000	0.000	0.000	0.000	0.000
36.00	5.00	5.87	5.52	N/A	0.93	0.46	0.86	0.000	0.000	0.000	0.000	0.000	0.000
41.00	5.00	6.57	6.22	N/A	0.80	0.41	0.75	0.000	0.000	0.000	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

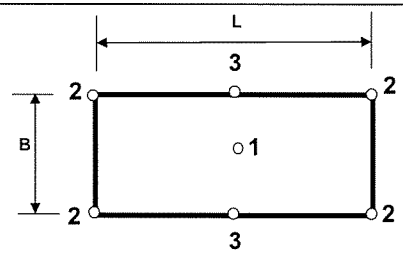
Project Name	Box Springs Overhead Widening (Right)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 4- for 1-inch settlement
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	14.00 feet
Footing Length, L	95.80 feet
Applied Net Bearing Pressure, p	5.85 ksf
Footing Embedment Depth, D_f	8.20 feet
Bottom of Footing Elevation	1,488.50 feet
GWT Elevation for Design	1,420.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	1.00	0.30	0.65
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	1.00	0.30	0.65



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,496.70	1,488.50	Cohesionless Soil	120.0					
1,488.50	1,486.50	Cohesionless Soil	120.0	600.0	0.35			2.0
1,486.50	1,479.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,479.00	1,474.00	Cohesionless Soil	120.0	800.0	0.35			1.0
1,474.00	1,469.00	Cohesionless Soil	125.0	900.0	0.35			1.0
1,469.00	1,464.00	Cohesionless Soil	125.0	900.0	0.35			1.0
1,464.00	1,460.00	Cohesionless Soil	125.0	900.0	0.35			1.0
1,460.00	1,455.00	Incompressible Soil	140.0	1,250.0	0.35			1.0
1,455.00	1,450.00	Incompressible Soil	140.0	1,250.0	0.35			1.0
1,450.00	1,445.00	Incompressible Soil	140.0	1,250.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	8.20	0.98	0.49	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.00	2.00	1.22	1.10	N/A	5.84	1.46	2.92	0.130	0.027	0.083	0.000	0.000	0.000
5.75	7.50	2.12	1.67	N/A	5.11	1.43	2.85	0.415	0.103	0.216	0.000	0.000	0.000
12.00	5.00	2.72	2.42	N/A	3.58	1.26	2.52	0.179	0.060	0.123	0.000	0.000	0.000
17.00	5.00	3.35	3.04	N/A	2.75	1.10	2.18	0.118	0.046	0.093	0.000	0.000	0.000
22.00	5.00	3.97	3.66	N/A	2.19	0.95	1.87	0.093	0.040	0.079	0.000	0.000	0.000
26.50	4.00	4.47	4.22	N/A	1.84	0.84	1.63	0.062	0.028	0.055	0.000	0.000	0.000
31.00	5.00	5.17	4.82	N/A	1.57	0.74	1.43	0.000	0.000	0.000	0.000	0.000	0.000
36.00	5.00	5.87	5.52	N/A	1.33	0.66	1.24	0.000	0.000	0.000	0.000	0.000	0.000
41.00	5.00	6.57	6.22	N/A	1.15	0.59	1.08	0.000	0.000	0.000	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

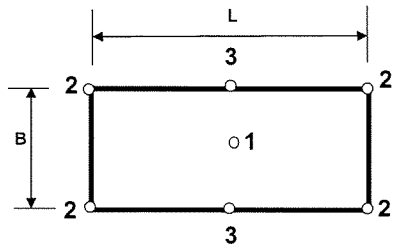
Project Name	Box Springs Overhead Widening (Right)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Pier 2
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	11.80 feet
Footing Length, L	107.26 feet
Applied Net Bearing Pressure, p	7.72 ksf
Footing Embedment Depth, D_f	8.20 feet
Bottom of Footing Elevation	1,473.70 feet
GWT Elevation for Design	1,420.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.82	0.21	0.49
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.82	0.21	0.49



Performed By: _____ Date: _____

Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,481.90	1,473.70	Cohesionless Soil	120.0					
1,473.70	1,471.70	Cohesionless Soil	120.0	600.0	0.35			2.0
1,471.70	1,465.00	Cohesionless Soil	120.0	900.0	0.35			1.0
1,465.00	1,460.00	Cohesionless Soil	120.0	900.0	0.35			1.0
1,460.00	1,455.00	Incompressible Soil	125.0	1,250.0	0.35			1.0
1,455.00	1,450.00	Incompressible Soil	125.0	1,250.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	8.20	0.98	0.49	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.00	2.00	1.22	1.10	N/A	7.70	1.93	3.86	0.181	0.037	0.114	0.000	0.000	0.000
5.35	6.70	2.03	1.63	N/A	6.55	1.87	3.74	0.440	0.109	0.232	0.000	0.000	0.000
11.20	5.00	2.63	2.33	N/A	4.41	1.61	3.22	0.200	0.068	0.142	0.000	0.000	0.000
16.20	5.00	3.25	2.94	N/A	3.29	1.36	2.71	0.000	0.000	0.000	0.000	0.000	0.000
21.20	5.00	3.88	3.57	N/A	2.58	1.15	2.27	0.000	0.000	0.000	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

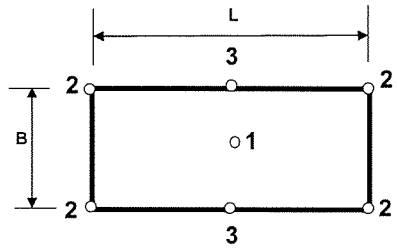
Project Name	Box Springs Overhead Widening (Right)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Pier 2- 1-inch settlement
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	11.80 feet
Footing Length, L	107.26 feet
Applied Net Bearing Pressure, p	9.15 ksf
Footing Embedment Depth, D_f	8.20 feet
Bottom of Footing Elevation	1,473.70 feet
GWT Elevation for Design	1,420.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	1.00	0.26	0.59
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	1.00	0.26	0.59



Performed By: _____ Date: _____

Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,481.90	1,473.70	Cohesionless Soil	120.0					
1,473.70	1,471.70	Cohesionless Soil	120.0	600.0	0.35			2.0
1,471.70	1,465.00	Cohesionless Soil	120.0	900.0	0.35			1.0
1,465.00	1,460.00	Cohesionless Soil	120.0	900.0	0.35			1.0
1,460.00	1,455.00	Incompressible Soil	125.0	1,250.0	0.35			1.0
1,455.00	1,450.00	Incompressible Soil	125.0	1,250.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vnb}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vnm}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	8.20	0.98	0.49	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.00	2.00	1.22	1.10	N/A	9.13	2.29	4.57	0.222	0.044	0.138	0.000	0.000	0.000
5.35	6.70	2.03	1.63	N/A	7.76	2.22	4.43	0.536	0.131	0.281	0.000	0.000	0.000
11.20	5.00	2.63	2.33	N/A	5.22	1.91	3.81	0.241	0.082	0.170	0.000	0.000	0.000
16.20	5.00	3.25	2.94	N/A	3.90	1.61	3.21	0.000	0.000	0.000	0.000	0.000	0.000
21.20	5.00	3.88	3.57	N/A	3.06	1.36	2.69	0.000	0.000	0.000	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

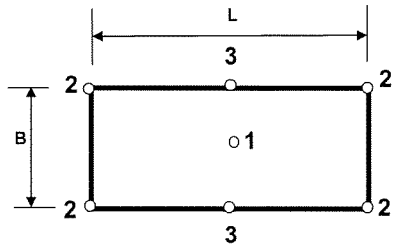
Project Name	Box Springs Overhead Widening
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Pier 3
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	11.80 feet
Footing Length, L	96.76 feet
Applied Net Bearing Pressure, p	7.29 ksf
Footing Embedment Depth, D_f	8.20 feet
Bottom of Footing Elevation	1,470.75 feet
GWT Elevation for Design	1,414.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.67	0.16	0.38
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.67	0.16	0.38



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3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,478.95	1,470.75	Cohesionless Soil	120.0					
1,470.75	1,468.75	Cohesionless Soil	120.0	600.0	0.35			2.0
1,468.75	1,465.00	Cohesionless Soil	120.0	900.0	0.35			1.0
1,465.00	1,460.00	Cohesionless Soil	120.0	900.0	0.35			1.0
1,460.00	1,455.00	Incompressible Soil	125.0	1,250.0	0.35			1.0
1,455.00	1,450.00	Incompressible Soil	125.0	1,250.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	8.20	0.98	0.49	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.00	2.00	1.22	1.10	N/A	7.28	1.82	3.64	0.169	0.035	0.106	0.000	0.000	0.000
3.88	3.75	1.67	1.45	N/A	6.72	1.80	3.60	0.259	0.059	0.126	0.000	0.000	0.000
8.25	5.00	2.27	1.97	N/A	5.08	1.66	3.32	0.238	0.071	0.149	0.000	0.000	0.000
13.25	5.00	2.90	2.59	N/A	3.66	1.42	2.83	0.000	0.000	0.000	0.000	0.000	0.000
18.25	5.00	3.52	3.21	N/A	2.79	1.19	2.37	0.000	0.000	0.000	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

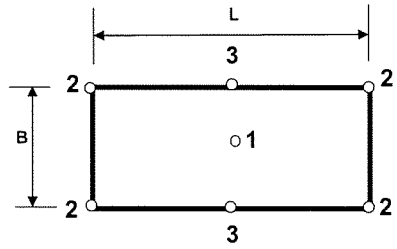
Project Name	Box Springs Overhead Widening
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Pier 3- for 1-inch settlement
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	11.80 feet
Footing Length, L	96.76 feet
Applied Net Bearing Pressure, p	10.30 ksf
Footing Embedment Depth, D_f	8.20 feet
Bottom of Footing Elevation	1,470.75 feet
GWT Elevation for Design	1,414.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	1.00	0.24	0.56
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	1.00	0.24	0.56



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3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,478.95	1,470.75	Cohesionless Soil	120.0					
1,470.75	1,468.75	Cohesionless Soil	120.0	600.0	0.35			2.0
1,468.75	1,465.00	Cohesionless Soil	120.0	900.0	0.35			1.0
1,465.00	1,460.00	Cohesionless Soil	120.0	900.0	0.35			1.0
1,460.00	1,455.00	Incompressible Soil	125.0	1,250.0	0.35			1.0
1,455.00	1,450.00	Incompressible Soil	125.0	1,250.0	0.35			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	8.20	0.98	0.49	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.00	2.00	1.22	1.10	N/A	10.28	2.57	5.15	0.256	0.051	0.159	0.000	0.000	0.000
3.88	3.75	1.67	1.45	N/A	9.50	2.54	5.08	0.390	0.086	0.187	0.000	0.000	0.000
8.25	5.00	2.27	1.97	N/A	7.17	2.34	4.69	0.354	0.102	0.218	0.000	0.000	0.000
13.25	5.00	2.90	2.59	N/A	5.17	2.01	4.00	0.000	0.000	0.000	0.000	0.000	0.000
18.25	5.00	3.52	3.21	N/A	3.94	1.69	3.35	0.000	0.000	0.000	0.000	0.000	0.000

C-4

SLOPE STABILITY ANALYSES

Box springs OH-Right Bridge Abut 1 Static

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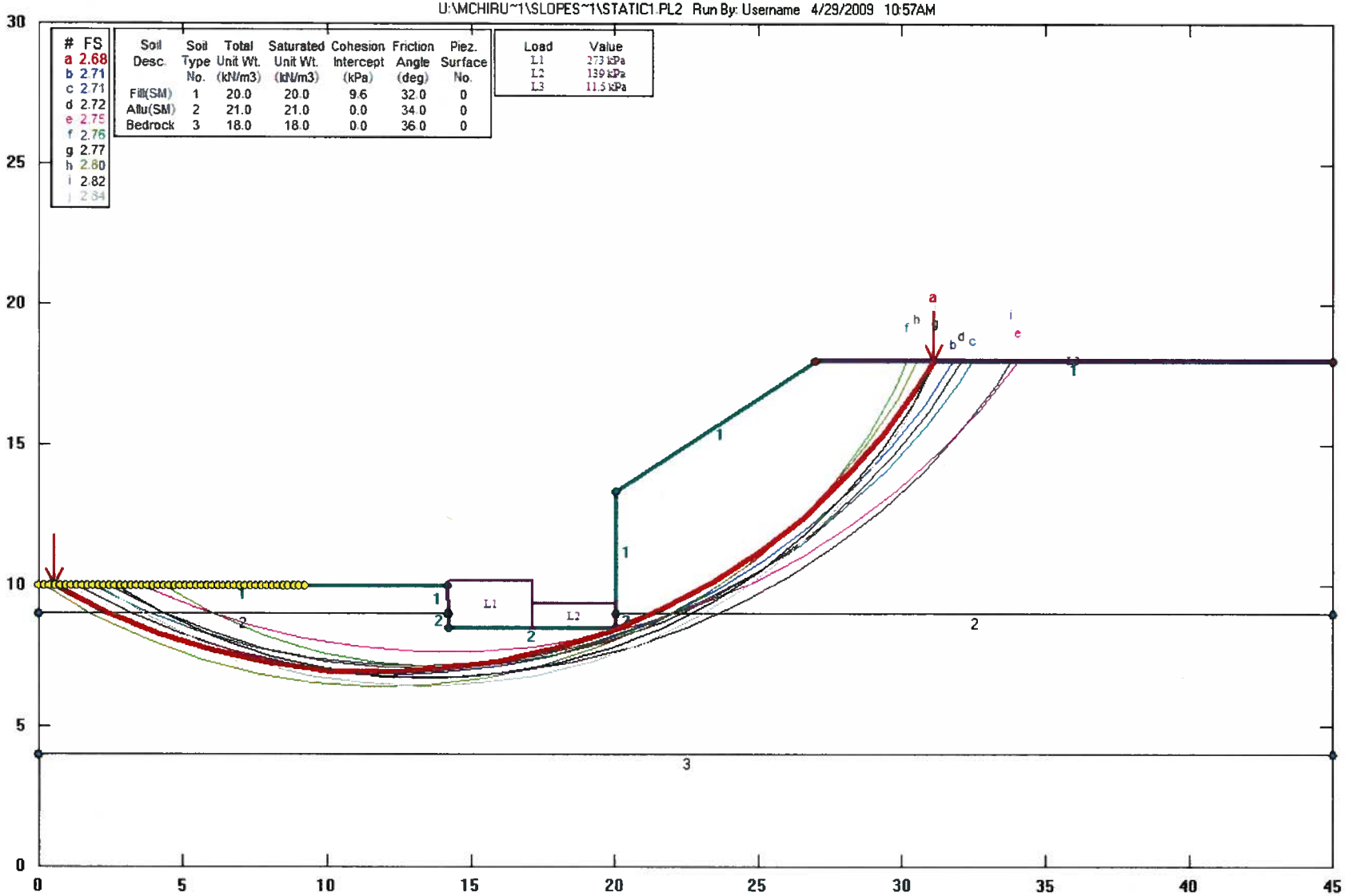

GSTABL7 v.2 FSmin=2.68

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

STATIC1
*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **

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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 4/29/2009
Time of Run: 10:57AM
Run By: Username
Input Data Filename: U:STATIC1.SI
Output Filename: U:STATIC1.OUT
Unit System: SI

Plotted Output Filename: U:STATIC1.PLT

PROBLEM DESCRIPTION: Box springs OH-Right Bridge Abut 1
Static

BOUNDARY COORDINATES

8 Top Boundaries
11 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	10.00	14.20	10.01	1
2	14.20	10.01	14.22	9.00	1
3	14.22	9.00	14.24	8.50	2
4	14.24	8.50	20.00	8.50	2
5	20.00	8.50	20.02	9.00	2
6	20.02	9.00	20.04	13.35	1
7	20.04	13.35	27.00	18.00	1
8	27.00	18.00	45.00	18.00	1
9	0.00	9.00	14.20	9.00	2
10	20.00	9.00	45.00	9.00	2
11	0.00	4.00	45.00	4.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	20.0	20.0	9.6	32.0	0.00	0.0	0
2	21.0	21.0	0.0	34.0	0.00	0.0	0
3	18.0	18.0	0.0	36.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

3 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	14.24	17.14	273.0	0.0
2	17.15	20.00	139.0	0.0
3	27.00	45.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

250 Trial Surfaces Have Been Generated.

5 Surfaces Initiate From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 9.20(m)

Each Surface Terminates Between X = 27.00(m)
and X = 45.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

2.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

STATIC1

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 250

Statistical Data On All Valid FS Values:
FS Max = 6.063 FS Min = 2.682 FS Ave = 3.798
Standard Deviation = 0.659 Coefficient of Variation = 17.35 %

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	0.56	10.00
2	2.33	9.06
3	4.17	8.29
4	6.08	7.68
5	8.03	7.25
6	10.02	6.99
7	12.02	6.92
8	14.01	7.02
9	15.99	7.30
10	17.94	7.76
11	19.84	8.39
12	21.67	9.18
13	23.43	10.14
14	25.09	11.26
15	26.65	12.51
16	28.08	13.90
17	29.39	15.42
18	30.56	17.04
19	31.12	18.00

Circle Center At X = 11.9 ; Y = 29.2 and Radius, 22.3

Factor of Safety
*** 2.682 ***

Individual data on the 29 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	1.8	16.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.2	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1.7	46.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1.9	78.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	2.0	102.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	2.0	118.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	2.0	126.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

8	2.0	125.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.2	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1.8	48.8	0.0	0.0	0.0	0.0	0.0	0.0	478.6
13	1.1	25.7	0.0	0.0	0.0	0.0	0.0	0.0	313.1
14	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.8	13.9	0.0	0.0	0.0	0.0	0.0	0.0	109.8
16	1.9	17.1	0.0	0.0	0.0	0.0	0.0	0.0	263.9
17	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	22.5
18	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	1.2	121.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.4	44.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1.8	188.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	1.7	181.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	1.6	166.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.4	36.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	1.1	100.1	0.0	0.0	0.0	0.0	0.0	0.0	12.5
27	1.3	87.3	0.0	0.0	0.0	0.0	0.0	0.0	15.0
28	1.2	41.3	0.0	0.0	0.0	0.0	0.0	0.0	13.4
29	0.6	5.4	0.0	0.0	0.0	0.0	0.0	0.0	6.5

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	0.56	10.00
2	2.33	9.06
3	4.17	8.27
4	6.07	7.65
5	8.02	7.20
6	10.00	6.93
7	12.00	6.82
8	13.99	6.89
9	15.98	7.14
10	17.93	7.56
11	19.85	8.15
12	21.70	8.90
13	23.48	9.82
14	25.17	10.88
15	26.76	12.09
16	28.24	13.44
17	29.60	14.90
18	30.82	16.49
19	31.79	18.00

Circle Center At X = 12.2 ; Y = 29.6 and Radius, 22.8

Factor of Safety
*** 2.715 ***

1

Failure Surface Specified By 19 Coordinate Points

Point X-Surf Y-Surf

STATIC1

No.	(m)	(m)
1	1.88	10.00
2	3.67	9.11
3	5.53	8.37
4	7.45	7.81
5	9.41	7.41
6	11.39	7.18
7	13.39	7.13
8	15.39	7.25
9	17.37	7.54
10	19.31	8.01
11	21.21	8.64
12	23.04	9.44
13	24.80	10.40
14	26.47	11.50
15	28.03	12.74
16	29.48	14.12
17	30.81	15.62
18	32.00	17.23
19	32.47	18.00

Circle Center At X = 13.0 ; Y = 30.0 and Radius, 22.9

Factor of Safety
*** 2.715 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.44	10.00
2	4.21	9.07
3	6.06	8.31
4	7.97	7.72
5	9.93	7.31
6	11.92	7.09
7	13.92	7.05
8	15.91	7.20
9	17.88	7.53
10	19.82	8.05
11	21.69	8.74
12	23.50	9.60
13	25.21	10.63
14	26.82	11.81
15	28.32	13.14
16	29.69	14.60
17	30.91	16.18
18	31.98	17.87
19	32.05	18.00

Circle Center At X = 13.3 ; Y = 28.5 and Radius, 21.5

Factor of Safety
*** 2.717 ***

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	3.57	10.00
2	5.41	9.22
3	7.30	8.59
4	9.25	8.11
5	11.22	7.80
6	13.22	7.65
7	15.22	7.66
8	17.21	7.83
9	19.18	8.17
10	21.12	8.67
11	23.01	9.33
12	24.84	10.14
13	26.59	11.09
14	28.27	12.19
15	29.84	13.42
16	31.32	14.77
17	32.67	16.24
18	33.90	17.82
19	34.02	18.00

Circle Center At X = 14.1 ; Y = 32.0 and Radius, 24.4

Factor of Safety
*** 2.751 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	4.32	10.00
2	6.05	9.00
3	7.88	8.19
4	9.79	7.60
5	11.75	7.23
6	13.75	7.09
7	15.75	7.18
8	17.72	7.50
9	19.65	8.04
10	21.50	8.79
11	23.25	9.76
12	24.88	10.91
13	26.37	12.25
14	27.70	13.75
15	28.85	15.39
16	29.80	17.14
17	30.14	18.00

Circle Center At X = 14.0 ; Y = 24.6 and Radius, 17.5

Factor of Safety
*** 2.757 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.63	10.00
2	4.35	8.97
3	6.16	8.13
4	8.05	7.47
5	9.99	7.01
6	11.98	6.76
7	13.98	6.70
8	15.97	6.86
9	17.94	7.21
10	19.86	7.77
11	21.71	8.52
12	23.48	9.46
13	25.14	10.57
14	26.68	11.85
15	28.08	13.27
16	29.33	14.84
17	30.41	16.52
18	31.16	18.00

Circle Center At X = 13.5 ; Y = 26.2 and Radius, 19.5

Factor of Safety
*** 2.773 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	0.19	10.00
2	1.89	8.95
3	3.69	8.08
4	5.56	7.38
5	7.50	6.86
6	9.47	6.53
7	11.46	6.39
8	13.46	6.44
9	15.45	6.69
10	17.40	7.12
11	19.30	7.74
12	21.13	8.54
13	22.88	9.51

14	24.53	10.65
15	26.06	11.94
16	27.46	13.37
17	28.71	14.92
18	29.81	16.59
19	30.56	18.00

Circle Center At X = 11.9 ; Y = 27.2 and Radius, 20.8

Factor of Safety
*** 2.795 ***

1

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.31	10.00
2	3.08	9.07
3	4.93	8.29
4	6.82	7.66
5	8.77	7.19
6	10.75	6.89
7	12.74	6.75
8	14.74	6.78
9	16.73	6.97
10	18.70	7.33
11	20.63	7.84
12	22.51	8.52
13	24.33	9.35
14	26.08	10.33
15	27.73	11.45
16	29.29	12.70
17	30.74	14.08
18	32.07	15.58
19	33.27	17.17
20	33.79	18.00

Circle Center At X = 13.4 ; Y = 30.8 and Radius, 24.1

Factor of Safety
*** 2.819 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.07	10.00
2	3.75	8.93
3	5.54	8.04
4	7.41	7.33

		STATIC1
5	9.35	6.82
6	11.32	6.51
7	13.32	6.40
8	15.32	6.50
9	17.30	6.81
10	19.23	7.31
11	21.11	8.01
12	22.90	8.90
13	24.59	9.96
14	26.16	11.20
15	27.60	12.59
16	28.89	14.12
17	30.02	15.77
18	30.97	17.53
19	31.16	18.00

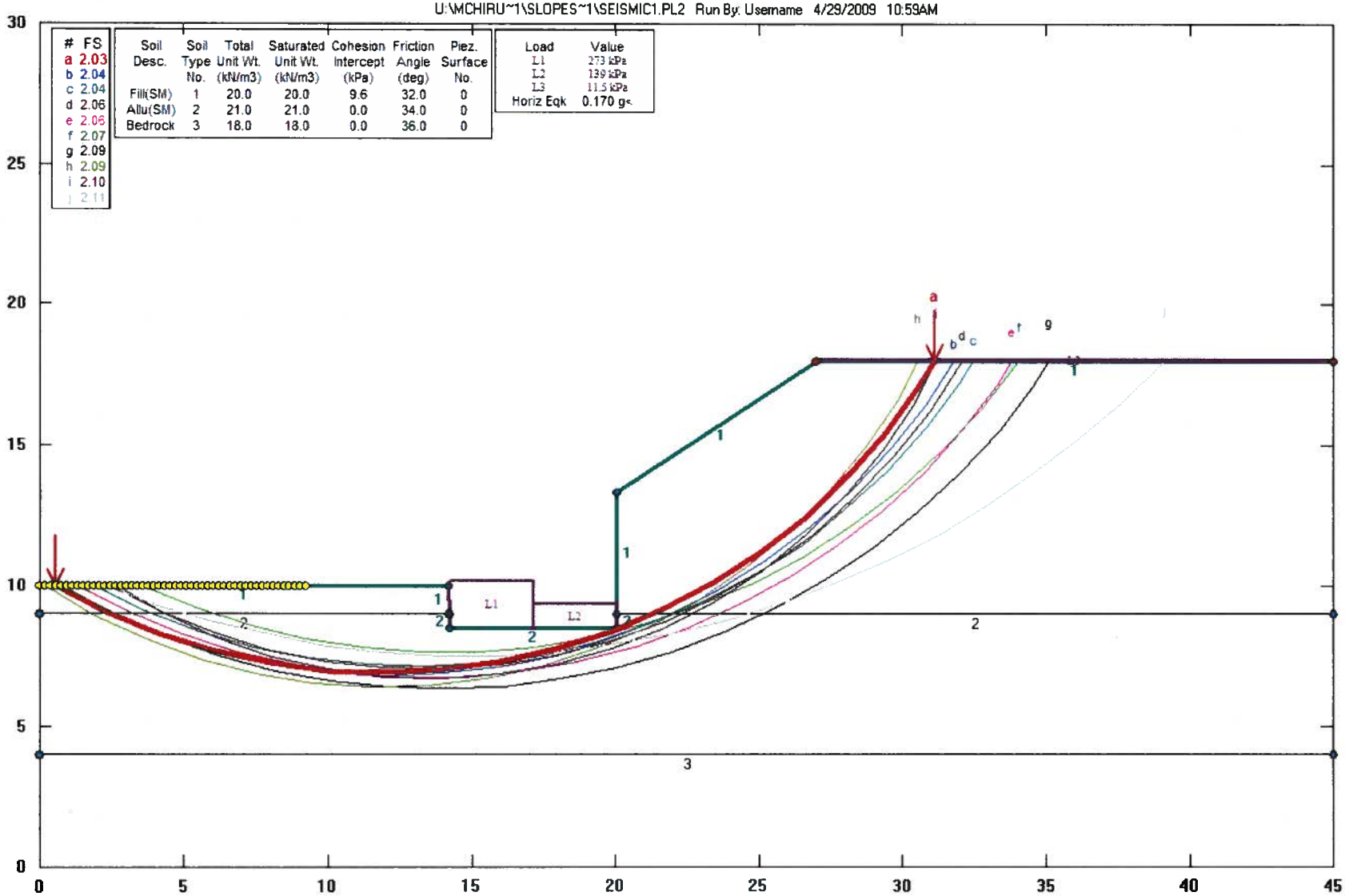
Circle Center At X = 13.4 ; Y = 25.9 and Radius, 19.5

Factor of Safety
*** 2.841 ***

**** END OF GSTABL7 OUTPUT ****

Box springs OH-Right Bridge Abut 1 Pseudostatic

U:\MCHIRU~1\SLOPES~1\SEISMIC1.PL2 Run By: Username 4/29/2009 10:59AM



GSTABL7 v.2 FSmin=2.03

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

SEISMIC1
*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **

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****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 4/29/2009
Time of Run: 10:59AM
Run By: Username
Input Data Filename: U:SEISMIC1.SI
Output Filename: U:SEISMIC1.OUT
Unit System: SI

Plotted Output Filename: U:SEISMIC1.PLT

PROBLEM DESCRIPTION: Box springs OH-Right Bridge Abut 1
Pseudostatic

BOUNDARY COORDINATES

8 Top Boundaries
11 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	10.00	14.20	10.01	1
2	14.20	10.01	14.22	9.00	1
3	14.22	9.00	14.24	8.50	2
4	14.24	8.50	20.00	8.50	2
5	20.00	8.50	20.02	9.00	2
6	20.02	9.00	20.04	13.35	1
7	20.04	13.35	27.00	18.00	1
8	27.00	18.00	45.00	18.00	1
9	0.00	9.00	14.20	9.00	2
10	20.00	9.00	45.00	9.00	2
11	0.00	4.00	45.00	4.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	20.0	20.0	9.6	32.0	0.00	0.0	0
2	21.0	21.0	0.0	34.0	0.00	0.0	0
3	18.0	18.0	0.0	36.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

3 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	14.24	17.14	273.0	0.0
2	17.15	20.00	139.0	0.0
3	27.00	45.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.170 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

250 Trial Surfaces Have Been Generated.

5 Surfaces Initiate From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 9.20(m)

Each Surface Terminates Between X = 27.00(m)
and X = 45.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

SEISMIC1

2.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 250

Statistical Data On All Valid FS Values:
FS Max = 3.507 FS Min = 2.033 FS Ave = 2.541
Standard Deviation = 0.318 Coefficient of Variation = 12.52 %

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	0.56	10.00
2	2.33	9.06
3	4.17	8.29
4	6.08	7.68
5	8.03	7.25
6	10.02	6.99
7	12.02	6.92
8	14.01	7.02
9	15.99	7.30
10	17.94	7.76
11	19.84	8.39
12	21.67	9.18
13	23.43	10.14
14	25.09	11.26
15	26.65	12.51
16	28.08	13.90
17	29.39	15.42
18	30.56	17.04
19	31.12	18.00

Circle Center At X = 11.9 ; Y = 29.2 and Radius, 22.3

Factor of Safety
*** 2.033 ***

Individual data on the 29 slices

Water Force	Water Force	Tie Force	Tie Force	Earthquake Force	Surcharge

SEISMIC1

Slice No.	Width (m)	Weight (kN)	Top (kN)	Bot (kN)	Norm (kN)	Tan (kN)	Hor (kN)	Ver (kN)	Load (kN)
1	1.8	16.6	0.0	0.0	0.0	0.0	2.8	0.0	0.0
2	0.2	2.9	0.0	0.0	0.0	0.0	0.5	0.0	0.0
3	1.7	46.6	0.0	0.0	0.0	0.0	7.9	0.0	0.0
4	1.9	78.8	0.0	0.0	0.0	0.0	13.4	0.0	0.0
5	2.0	102.1	0.0	0.0	0.0	0.0	17.4	0.0	0.0
6	2.0	118.1	0.0	0.0	0.0	0.0	20.1	0.0	0.0
7	2.0	126.1	0.0	0.0	0.0	0.0	21.4	0.0	0.0
8	2.0	125.5	0.0	0.0	0.0	0.0	21.3	0.0	0.0
9	0.2	11.5	0.0	0.0	0.0	0.0	2.0	0.0	0.0
10	0.0	1.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
11	0.0	0.7	0.0	0.0	0.0	0.0	0.1	0.0	0.0
12	1.8	48.8	0.0	0.0	0.0	0.0	8.3	0.0	478.6
13	1.1	25.7	0.0	0.0	0.0	0.0	4.4	0.0	313.1
14	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.8	13.9	0.0	0.0	0.0	0.0	2.4	0.0	109.8
16	1.9	17.1	0.0	0.0	0.0	0.0	2.9	0.0	263.9
17	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	22.5
18	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	1.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0
20	1.2	121.5	0.0	0.0	0.0	0.0	20.7	0.0	0.0
21	0.4	44.2	0.0	0.0	0.0	0.0	7.5	0.0	0.0
22	1.8	188.3	0.0	0.0	0.0	0.0	32.0	0.0	0.0
23	1.7	181.8	0.0	0.0	0.0	0.0	30.9	0.0	0.0
24	1.6	166.8	0.0	0.0	0.0	0.0	28.4	0.0	0.0
25	0.4	36.8	0.0	0.0	0.0	0.0	6.3	0.0	0.0
26	1.1	100.1	0.0	0.0	0.0	0.0	17.0	0.0	12.5
27	1.3	87.3	0.0	0.0	0.0	0.0	14.8	0.0	15.0
28	1.2	41.3	0.0	0.0	0.0	0.0	7.0	0.0	13.4
29	0.6	5.4	0.0	0.0	0.0	0.0	0.9	0.0	6.5

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	0.56	10.00
2	2.33	9.06
3	4.17	8.27
4	6.07	7.65
5	8.02	7.20
6	10.00	6.93
7	12.00	6.82
8	13.99	6.89
9	15.98	7.14
10	17.93	7.56
11	19.85	8.15
12	21.70	8.90
13	23.48	9.82
14	25.17	10.88
15	26.76	12.09
16	28.24	13.44
17	29.60	14.90
18	30.82	16.49
19	31.79	18.00

Circle Center At X = 12.2 ; Y = 29.6 and Radius, 22.8

Factor of Safety

*** 2.035 ***

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.88	10.00
2	3.67	9.11
3	5.53	8.37
4	7.45	7.81
5	9.41	7.41
6	11.39	7.18
7	13.39	7.13
8	15.39	7.25
9	17.37	7.54
10	19.31	8.01
11	21.21	8.64
12	23.04	9.44
13	24.80	10.40
14	26.47	11.50
15	28.03	12.74
16	29.48	14.12
17	30.81	15.62
18	32.00	17.23
19	32.47	18.00

Circle Center At X = 13.0 ; Y = 30.0 and Radius, 22.9

Factor of Safety
*** 2.043 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.44	10.00
2	4.21	9.07
3	6.06	8.31
4	7.97	7.72
5	9.93	7.31
6	11.92	7.09
7	13.92	7.05
8	15.91	7.20
9	17.88	7.53
10	19.82	8.05
11	21.69	8.74
12	23.50	9.60
13	25.21	10.63
14	26.82	11.81
15	28.32	13.14
16	29.69	14.60

17	30.91	16.18
18	31.98	17.87
19	32.05	18.00

Circle Center At X = 13.3 ; Y = 28.5 and Radius, 21.5

Factor of Safety
*** 2.056 ***

1

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.31	10.00
2	3.08	9.07
3	4.93	8.29
4	6.82	7.66
5	8.77	7.19
6	10.75	6.89
7	12.74	6.75
8	14.74	6.78
9	16.73	6.97
10	18.70	7.33
11	20.63	7.84
12	22.51	8.52
13	24.33	9.35
14	26.08	10.33
15	27.73	11.45
16	29.29	12.70
17	30.74	14.08
18	32.07	15.58
19	33.27	17.17
20	33.79	18.00

Circle Center At X = 13.4 ; Y = 30.8 and Radius, 24.1

Factor of Safety
*** 2.059 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	3.57	10.00
2	5.41	9.22
3	7.30	8.59
4	9.25	8.11
5	11.22	7.80
6	13.22	7.65
7	15.22	7.66

8	17.21	7.83
9	19.18	8.17
10	21.12	8.67
11	23.01	9.33
12	24.84	10.14
13	26.59	11.09
14	28.27	12.19
15	29.84	13.42
16	31.32	14.77
17	32.67	16.24
18	33.90	17.82
19	34.02	18.00

Circle Center At X = 14.1 ; Y = 32.0 and Radius, 24.4

Factor of Safety
*** 2.066 ***

1

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	0.75	10.00
2	2.50	9.03
3	4.32	8.20
4	6.20	7.52
5	8.13	6.99
6	10.10	6.62
7	12.08	6.40
8	14.08	6.34
9	16.08	6.43
10	18.06	6.69
11	20.02	7.10
12	21.94	7.66
13	23.81	8.38
14	25.61	9.24
15	27.35	10.24
16	28.99	11.37
17	30.55	12.63
18	31.99	14.01
19	33.33	15.50
20	34.54	17.09
21	35.13	18.00

Circle Center At X = 13.9 ; Y = 31.6 and Radius, 25.3

Factor of Safety
*** 2.086 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	0.19	10.00
2	1.89	8.95
3	3.69	8.08
4	5.56	7.38
5	7.50	6.86
6	9.47	6.53
7	11.46	6.39
8	13.46	6.44
9	15.45	6.69
10	17.40	7.12
11	19.30	7.74
12	21.13	8.54
13	22.88	9.51
14	24.53	10.65
15	26.06	11.94
16	27.46	13.37
17	28.71	14.92
18	29.81	16.59
19	30.56	18.00

Circle Center At X = 11.9 ; Y = 27.2 and Radius, 20.8

Factor of Safety
*** 2.088 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.63	10.00
2	4.35	8.97
3	6.16	8.13
4	8.05	7.47
5	9.99	7.01
6	11.98	6.76
7	13.98	6.70
8	15.97	6.86
9	17.94	7.21
10	19.86	7.77
11	21.71	8.52
12	23.48	9.46
13	25.14	10.57
14	26.68	11.85
15	28.08	13.27
16	29.33	14.84
17	30.41	16.52
18	31.16	18.00

Circle Center At X = 13.5 ; Y = 26.2 and Radius, 19.5

Factor of Safety
*** 2.100 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.25	10.00
2	4.13	9.30
3	6.04	8.72
4	7.98	8.24
5	9.95	7.89
6	11.94	7.66
7	13.93	7.54
8	15.93	7.55
9	17.93	7.68
10	19.92	7.92
11	21.88	8.28
12	23.82	8.77
13	25.73	9.36
14	27.60	10.07
15	29.42	10.90
16	31.20	11.83
17	32.91	12.86
18	34.55	14.00
19	36.13	15.23
20	37.63	16.55
21	39.04	17.96
22	39.08	18.00

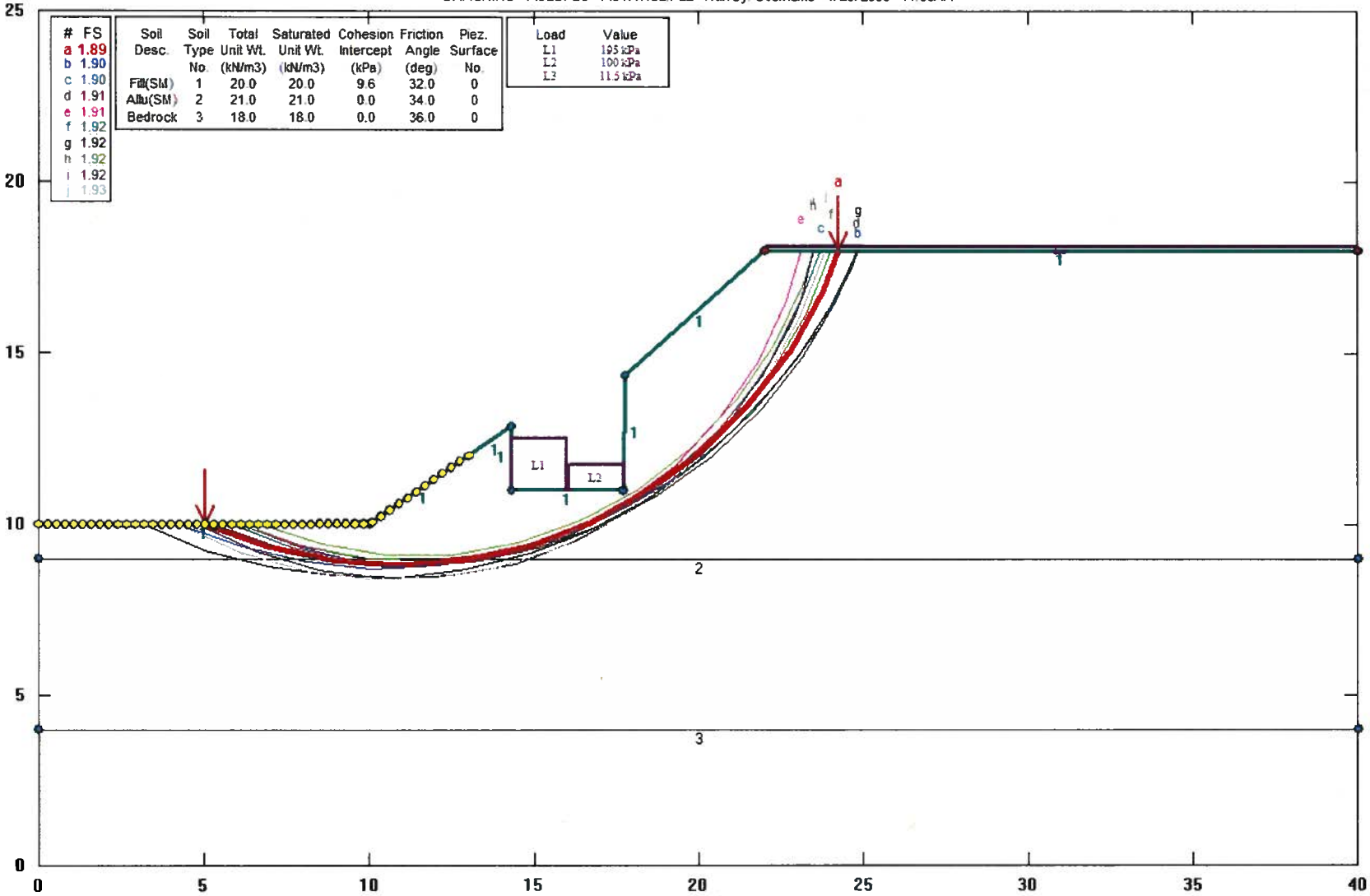
Circle Center At X = 14.8 ; Y = 40.8 and Radius, 33.3

Factor of Safety
*** 2.111 ***

**** END OF GSTABL7 OUTPUT ****

Box springs OH-Right Bridge Abut 4 Static

U:\MCHIRU~1\SLOPES~1\STATIC2.PL2 Run By: Username 4/29/2009 11:05AM



GSTABL7 v.2 FSmin=1.89

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

STATIC2
*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **

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****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 4/29/2009
Time of Run: 11:05AM
Run By: Username
Input Data Filename: U:STATIC2.SI
Output Filename: U:STATIC2.OUT
Unit System: SI

Plotted Output Filename: U:STATIC2.PLT

PROBLEM DESCRIPTION: Box springs OH-Right Bridge Abut 4
Static

BOUNDARY COORDINATES

8 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	10.00	10.00	10.01	1
2	10.00	10.01	13.00	12.00	1
3	13.00	12.00	14.31	12.87	1
4	14.31	12.87	14.32	11.00	1
5	14.32	11.00	17.71	11.00	1
6	17.71	11.00	17.73	14.34	1
7	17.73	14.34	22.00	18.00	1
8	22.00	18.00	40.00	18.00	1
9	0.00	9.00	40.00	9.00	2
10	0.00	4.00	40.00	4.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	20.0	20.0	9.6	32.0	0.00	0.0	0
2	21.0	21.0	0.0	34.0	0.00	0.0	0
3	18.0	18.0	0.0	36.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

3 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	14.32	16.02	195.0	0.0
2	16.03	17.71	100.0	0.0
3	22.00	40.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

2500 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 13.00(m)

Each Surface Terminates Between X = 22.00(m)
and X = 40.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

2.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

STATIC2

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 2500

Statistical Data On All Valid FS Values:
FS Max = 9.067 FS Min = 1.886 FS Ave = 3.644
Standard Deviation = 1.333 Coefficient of Variation = 36.58 %

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	5.04	10.01
2	6.93	9.33
3	8.88	8.93
4	10.88	8.80
5	12.87	8.94
6	14.83	9.36
7	16.71	10.05
8	18.48	10.98
9	20.10	12.15
10	21.54	13.54
11	22.78	15.11
12	23.79	16.83
13	24.27	18.00

Circle Center At X = 10.8 ; Y = 23.3 and Radius, 14.5

Factor of Safety
*** 1.886 ***

Individual data on the 23 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	1.9	12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	1.6	27.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.3	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1.1	25.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.9	26.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	2.0	95.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.1	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.1	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1.2	78.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.5	17.3	0.0	0.0	0.0	0.0	0.0	0.0	99.4
12	1.2	33.9	0.0	0.0	0.0	0.0	0.0	0.0	232.1
13	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.7	14.6	0.0	0.0	0.0	0.0	0.0	0.0	67.9

15	1.0	13.8	0.0	0.0	0.0	0.0	0.0	0.0	100.1
16	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.7	57.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	1.6	133.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	1.4	119.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.5	36.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.8	52.8	0.0	0.0	0.0	0.0	0.0	0.0	9.0
22	1.0	41.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6
23	0.5	5.6	0.0	0.0	0.0	0.0	0.0	0.0	5.5

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	4.25	10.00
2	6.13	9.33
3	8.08	8.89
4	10.07	8.71
5	12.07	8.78
6	14.04	9.10
7	15.96	9.67
8	17.79	10.48
9	19.50	11.51
10	21.07	12.75
11	22.47	14.18
12	23.68	15.78
13	24.67	17.51
14	24.87	18.00

Circle Center At X = 10.5 ; Y = 24.4 and Radius, 15.7

Factor of Safety
*** 1.902 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	5.84	10.01
2	7.71	9.31
3	9.67	8.90
4	11.67	8.81
5	13.66	9.02
6	15.59	9.54
7	17.42	10.34
8	19.10	11.42
9	20.60	12.74
10	21.88	14.28
11	22.91	16.00
12	23.66	17.85
13	23.69	18.00

Circle Center At X = 11.3 ; Y = 21.8 and Radius, 13.0

Factor of Safety
*** 1.904 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	5.31	10.01
2	7.19	9.33
3	9.14	8.91
4	11.14	8.76
5	13.13	8.89
6	15.10	9.29
7	16.98	9.94
8	18.76	10.85
9	20.41	12.00
10	21.88	13.35
11	23.15	14.90
12	24.20	16.60
13	24.82	18.00

Circle Center At X = 11.2 ; Y = 23.4 and Radius, 14.7

Factor of Safety
*** 1.912 ***

1

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	6.10	10.01
2	7.97	9.28
3	9.92	8.87
4	11.92	8.79
5	13.91	9.05
6	15.82	9.62
7	17.62	10.51
8	19.24	11.67
9	20.65	13.09
10	21.80	14.73
11	22.67	16.53
12	23.10	18.00

Circle Center At X = 11.4 ; Y = 20.8 and Radius, 12.0

Factor of Safety
*** 1.915 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	6.10	10.01
2	7.99	9.36
3	9.96	9.00
4	11.96	8.93
5	13.95	9.17
6	15.87	9.70
7	17.70	10.52
8	19.39	11.59
9	20.89	12.91
10	22.18	14.44
11	23.23	16.14
12	24.01	17.98
13	24.02	18.00

Circle Center At X = 11.4 ; Y = 22.3 and Radius, 13.3

Factor of Safety
*** 1.917 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	3.18	10.00
2	5.04	9.26
3	6.97	8.75
4	8.96	8.48
5	10.96	8.46
6	12.94	8.69
7	14.89	9.16
8	16.76	9.87
9	18.53	10.80
10	20.16	11.94
11	21.65	13.28
12	22.96	14.80
13	24.07	16.46
14	24.84	18.00

Circle Center At X = 10.1 ; Y = 24.6 and Radius, 16.1

Factor of Safety
*** 1.918 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	6.63	10.01
2	8.54	9.40
3	10.52	9.10
4	12.52	9.12
5	14.49	9.45
6	16.39	10.08
7	18.16	11.01
8	19.76	12.20
9	21.16	13.63
10	22.31	15.27
11	23.20	17.06
12	23.49	18.00

Circle Center At X = 11.4 ; Y = 21.7 and Radius, 12.6

Factor of Safety
*** 1.922 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	4.78	10.00
2	6.60	9.18
3	8.52	8.64
4	10.51	8.41
5	12.51	8.48
6	14.47	8.86
7	16.35	9.54
8	18.11	10.50
9	19.69	11.72
10	21.07	13.16
11	22.21	14.81
12	23.09	16.61
13	23.52	18.00

Circle Center At X = 11.0 ; Y = 21.4 and Radius, 13.0

Factor of Safety
*** 1.924 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)

		STATIC2
1	4.25	10.00
2	6.07	9.19
3	8.00	8.65
4	9.98	8.39
5	11.98	8.43
6	13.95	8.75
7	15.86	9.36
8	17.66	10.23
9	19.31	11.36
10	20.78	12.72
11	22.03	14.28
12	23.05	16.00
13	23.81	17.85
14	23.85	18.00

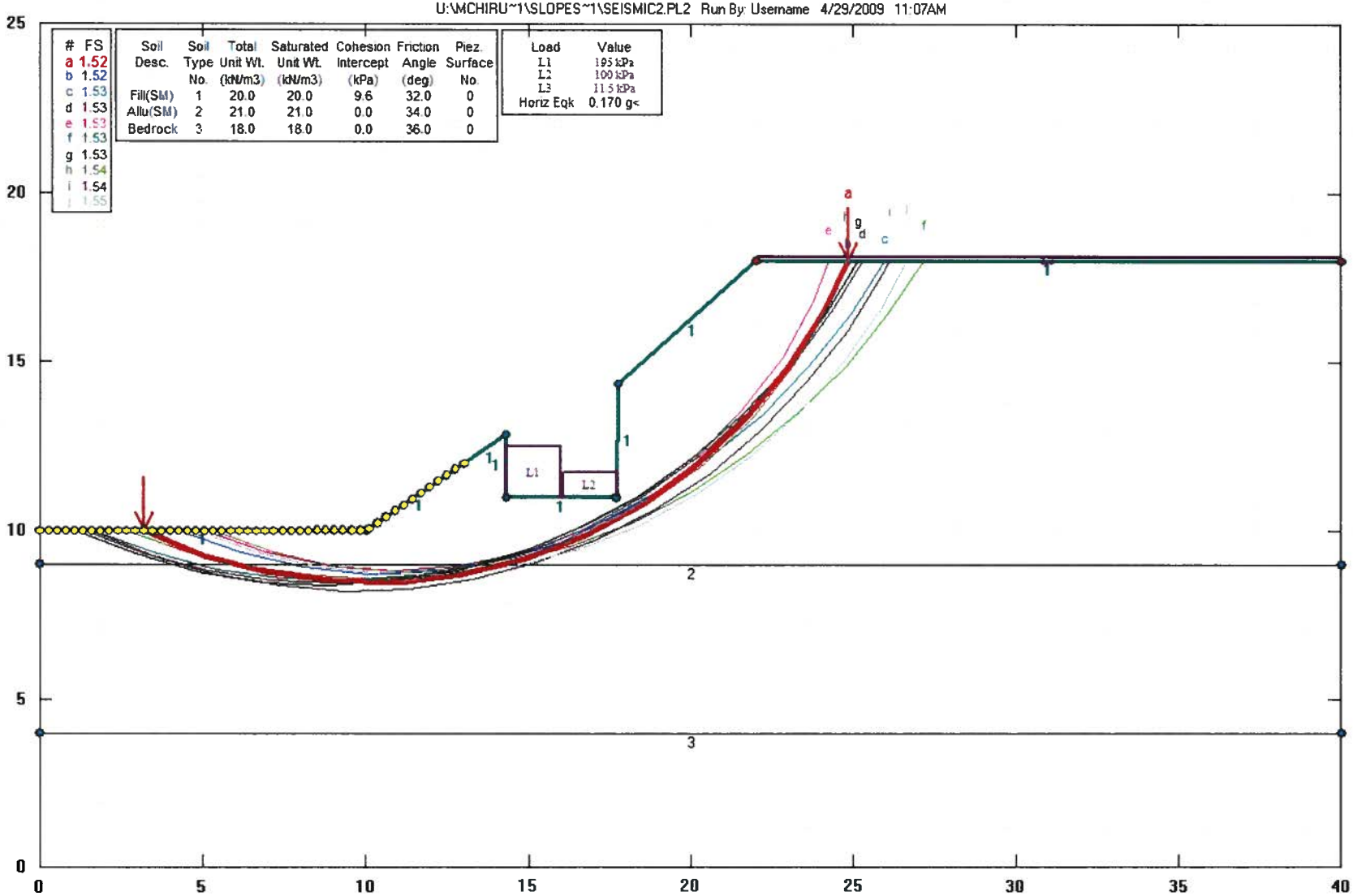
Circle Center At X = 10.7 ; Y = 22.1 and Radius, 13.7

Factor of Safety
*** 1.931 ***

**** END OF GSTABL7 OUTPUT ****

Box springs OH-Right Bridge Abut 4 Pseudostatic

U:\MCHIRU~1\SLOPES~1\SEISMIC2.PL2 Run By: Username 4/29/2009 11:07AM



GSTABL7 v.2 FSmin=1.52

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

SEISMIC2
*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **

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****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 4/29/2009
Time of Run: 11:07AM
Run By: Username
Input Data Filename: U:SEISMIC2.SI
Output Filename: U:SEISMIC2.OUT
Unit System: SI

Plotted Output Filename: U:SEISMIC2.PLT

PROBLEM DESCRIPTION: Box springs OH-Right Bridge Abut 4
Pseudostatic

BOUNDARY COORDINATES

8 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	10.00	10.00	10.01	1
2	10.00	10.01	13.00	12.00	1
3	13.00	12.00	14.31	12.87	1
4	14.31	12.87	14.32	11.00	1
5	14.32	11.00	17.71	11.00	1
6	17.71	11.00	17.73	14.34	1
7	17.73	14.34	22.00	18.00	1
8	22.00	18.00	40.00	18.00	1
9	0.00	9.00	40.00	9.00	2
10	0.00	4.00	40.00	4.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	20.0	20.0	9.6	32.0	0.00	0.0	0
2	21.0	21.0	0.0	34.0	0.00	0.0	0
3	18.0	18.0	0.0	36.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

3 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	14.32	16.02	195.0	0.0
2	16.03	17.71	100.0	0.0
3	22.00	40.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.170 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

2500 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 13.00(m)

Each Surface Terminates Between X = 22.00(m)
and X = 40.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

SEISMIC2

2.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 2500

Statistical Data On All Valid FS Values:
FS Max = 4.473 FS Min = 1.522 FS Ave = 2.397
Standard Deviation = 0.647 Coefficient of Variation = 26.97 %

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	3.18	10.00
2	5.04	9.26
3	6.97	8.75
4	8.96	8.48
5	10.96	8.46
6	12.94	8.69
7	14.89	9.16
8	16.76	9.87
9	18.53	10.80
10	20.16	11.94
11	21.65	13.28
12	22.96	14.80
13	24.07	16.46
14	24.84	18.00

Circle Center At X = 10.1 ; Y = 24.6 and Radius, 16.1

Factor of Safety
*** 1.522 ***

Individual data on the 24 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	1.9	13.9	0.0	0.0	0.0	0.0	2.4	0.0	0.0
2	1.0	17.1	0.0	0.0	0.0	0.0	2.9	0.0	0.0
3	1.0	21.9	0.0	0.0	0.0	0.0	3.7	0.0	0.0

4	2.0	56.1	0.0	0.0	0.0	0.0	9.5	0.0	0.0
5	1.0	32.6	0.0	0.0	0.0	0.0	5.5	0.0	0.0
6	1.0	36.1	0.0	0.0	0.0	0.0	6.1	0.0	0.0
7	2.0	109.4	0.0	0.0	0.0	0.0	18.6	0.0	0.0
8	0.1	3.8	0.0	0.0	0.0	0.0	0.6	0.0	0.0
9	1.2	88.3	0.0	0.0	0.0	0.0	15.0	0.0	0.0
10	0.1	5.5	0.0	0.0	0.0	0.0	0.9	0.0	0.0
11	0.0	0.6	0.0	0.0	0.0	0.0	0.1	0.0	0.0
12	0.6	21.6	0.0	0.0	0.0	0.0	3.7	0.0	110.4
13	1.1	36.9	0.0	0.0	0.0	0.0	6.3	0.0	221.1
14	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.7	18.5	0.0	0.0	0.0	0.0	3.1	0.0	72.7
16	1.0	16.8	0.0	0.0	0.0	0.0	2.9	0.0	95.3
17	0.0	0.9	0.0	0.0	0.0	0.0	0.2	0.0	0.0
18	0.8	65.1	0.0	0.0	0.0	0.0	11.1	0.0	0.0
19	1.6	142.7	0.0	0.0	0.0	0.0	24.3	0.0	0.0
20	1.5	132.2	0.0	0.0	0.0	0.0	22.5	0.0	0.0
21	0.3	30.5	0.0	0.0	0.0	0.0	5.2	0.0	0.0
22	1.0	72.0	0.0	0.0	0.0	0.0	12.2	0.0	11.0
23	1.1	52.7	0.0	0.0	0.0	0.0	9.0	0.0	12.8
24	0.8	11.9	0.0	0.0	0.0	0.0	2.0	0.0	8.9

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	4.25	10.00
2	6.13	9.33
3	8.08	8.89
4	10.07	8.71
5	12.07	8.78
6	14.04	9.10
7	15.96	9.67
8	17.79	10.48
9	19.50	11.51
10	21.07	12.75
11	22.47	14.18
12	23.68	15.78
13	24.67	17.51
14	24.87	18.00

Circle Center At X = 10.5 ; Y = 24.4 and Radius, 15.7

Factor of Safety
*** 1.525 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.59	10.00
2	3.48	9.33
3	5.42	8.85
4	7.40	8.58

5	9.40	8.50
6	11.39	8.63
7	13.37	8.96
8	15.29	9.49
9	17.16	10.22
10	18.94	11.13
11	20.62	12.21
12	22.18	13.47
13	23.60	14.87
14	24.88	16.41
15	25.94	18.00

Circle Center At X = 9.1 ; Y = 28.1 and Radius, 19.6

Factor of Safety
*** 1.529 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.33	10.00
2	3.20	9.30
3	5.14	8.80
4	7.12	8.51
5	9.12	8.43
6	11.11	8.57
7	13.08	8.91
8	15.00	9.46
9	16.86	10.20
10	18.63	11.14
11	20.28	12.27
12	21.81	13.55
13	23.19	15.00
14	24.42	16.58
15	25.29	18.00

Circle Center At X = 8.9 ; Y = 27.3 and Radius, 18.9

Factor of Safety
*** 1.532 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	5.04	10.01
2	6.93	9.33
3	8.88	8.93
4	10.88	8.80

5	12.87	8.94
6	14.83	9.36
7	16.71	10.05
8	18.48	10.98
9	20.10	12.15
10	21.54	13.54
11	22.78	15.11
12	23.79	16.83
13	24.27	18.00

Circle Center At X = 10.8 ; Y = 23.3 and Radius, 14.5

Factor of Safety
*** 1.534 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.65	10.00
2	4.54	9.35
3	6.49	8.89
4	8.47	8.63
5	10.47	8.56
6	12.47	8.70
7	14.44	9.03
8	16.37	9.56
9	18.24	10.27
10	20.02	11.17
11	21.71	12.24
12	23.29	13.48
13	24.73	14.86
14	26.03	16.38
15	27.15	18.00

Circle Center At X = 10.1 ; Y = 28.6 and Radius, 20.1

Factor of Safety
*** 1.535 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.06	10.00
2	2.93	9.28
3	4.86	8.77
4	6.84	8.46
5	8.83	8.36
6	10.83	8.48

7	12.80	8.81
8	14.73	9.34
9	16.59	10.08
10	18.36	11.01
11	20.02	12.13
12	21.55	13.41
13	22.94	14.85
14	24.17	16.43
15	25.13	18.00

Circle Center At X = 8.7 ; Y = 27.1 and Radius, 18.8

Factor of Safety
*** 1.535 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	5.31	10.01
2	7.19	9.33
3	9.14	8.91
4	11.14	8.76
5	13.13	8.89
6	15.10	9.29
7	16.98	9.94
8	18.76	10.85
9	20.41	12.00
10	21.88	13.35
11	23.15	14.90
12	24.20	16.60
13	24.82	18.00

Circle Center At X = 11.2 ; Y = 23.4 and Radius, 14.7

Factor of Safety
*** 1.541 ***

1

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.59	10.00
2	3.44	9.24
3	5.36	8.68
4	7.33	8.33
5	9.33	8.19
6	11.33	8.27
7	13.31	8.55
8	15.24	9.05

9	17.12	9.75
10	18.91	10.64
11	20.59	11.72
12	22.15	12.97
13	23.57	14.38
14	24.83	15.93
15	25.92	17.61
16	26.12	18.00

Circle Center At X = 9.6 ; Y = 26.9 and Radius, 18.7

Factor of Safety
*** 1.545 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	4.78	10.00
2	6.66	9.34
3	8.61	8.90
4	10.60	8.69
5	12.60	8.71
6	14.59	8.97
7	16.53	9.45
8	18.40	10.16
9	20.17	11.08
10	21.83	12.20
11	23.34	13.51
12	24.69	14.98
13	25.86	16.60
14	26.64	18.00

Circle Center At X = 11.4 ; Y = 25.8 and Radius, 17.1

Factor of Safety
*** 1.547 ***

**** END OF GSTABL7 OUTPUT ****

C- 5

RETAINING WALL BEARING CAPACITY

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs OH (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 1; Segment 1; H=7900
Footing Description	8' x 14.2' footing
Footing Width, B	8.00 feet
Footing Length, L	14.20 feet
Min. Footing Embedment Depth, D_f	5.25 feet
Bottom of Footing Elevation	1,478.00 feet
Design GWT Elevation	1,420.00 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	0.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Normal Gravity Load, Q	602.10 kips
Shear Load (along X-axis), P_x	13.94 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY

Factor of Safety for Sliding Falure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Falure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,483.25 feet
Depth to Design GWT, Z_w	63.25 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	13.94 kips
Effective Footing Width, $B' = B - 2\,e_x$	8.00 feet
Effective Footing Length, $L' = L - 2\,e_y$	14.20 feet
Effective Footing Area, $A_f = B'\,L'$	113.60 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(BL)$	5.30 ksf
Effective Cohesion, c_{eff}	0.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\,c_{eff}$	0.00 psf
Depth of Wedge Zone, $D = 0.5B\tan(45^o+\phi_{eff}/2)$	7.22 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	125.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	656.25 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\,\phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o+\phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.66
Exponent, n	1.36

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.17	1.37	1.37	1.37
s_q	N/A	1.18	1.30	1.35
s_γ	0.80	1.18	0.77	0.77
Depth Factors, d_c	N/A	1.24	1.26	1.26
d_q	N/A	1.12	1.18	1.18
d_γ	N/A	1.12	1.00	1.00
Inclination Factors, i_c	N/A	0.97	0.96	0.97
i_q	N/A	0.97	0.97	0.97
i_γ	N/A	0.92	0.95	0.95
Ground Factors (base on slope), g_c	N/A	N/A	1.00	0.96
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_cs_cd_ci_cg_cb_c + q_bN_qs_qd_qi_qg_qb_q + 0.5\gamma_{eff}N_\gamma s_\gamma d_\gamma\, i_\gamma\, g_\gamma\, b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\,S_u\,(1 + s_c + d_c - i_c - b_c - g_c) + q_b$	32.2	34.7	30.2	34.6

Average Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	32.9 ksf
Average Allowable Gross Bearing Capacity, $q_{all} = q_{ult\text{-}ave}/FS_{bearing}$	11.0 ksf *
Maximum Shear Resistance: $P_{max} = Q\tan\delta + C_a B L$	235.2 kips
Check Sliding Failure: $(P_{max}/P) \geq FS_{sliding}$?	N/A
Check Load Eccentricity (along X-axis): $e_x \leq B/6$	N/A
Check Load Eccentricity (along Y-axis): $e_y \leq L/6$	N/A
Check Bearing Failure: $(q_{ult\text{-}ave}/q_{app}) \geq FS_{bearing}$?	Yes

Notes:

* The footing should be checked for tolerable settlement.
Allowable gross bearing capacity may be limited to 10 ksf due to settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs OH (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 1, Segment 2; H=6700
Footing Description	8' x 12.1' footing
Footing Width, B	8.00 feet
Footing Length, L	12.10 feet
Min. Footing Embedment Depth, D_f	5.25 feet
Bottom of Footing Elevation	1,482.92 feet
Design GWT Elevation	1,420.00 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Normal Gravity Load, Q	425.90 kips
Shear Load (along X-axis), P_x	9.89 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY

Factor of Safety for Sliding Failure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Failure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,488.17 feet
Depth to Design GWT, Z_w	68.17 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	9.89 kips
Effective Footing Width, $B' = B - 2e_x$	8.00 feet
Effective Footing Length, $L' = L - 2e_y$	12.10 feet
Effective Footing Area, $A_f = B' L'$	96.80 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(BL)$	4.40 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45^o + \phi_{eff}/2)$	7.22 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	125.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	656.25 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.66
Exponent, n	1.40

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.20	1.43	1.43	1.43
s_q	N/A	1.22	1.35	1.41
s_γ	0.80	1.22	0.74	0.74
Depth Factors, d_c	N/A	1.24	1.26	1.26
d_q	N/A	1.12	1.18	1.18
d_γ	N/A	1.12	1.00	1.00
Inclination Factors, i_c	N/A	0.97	1.00	1.00
i_q	N/A	0.97	1.00	1.00
i_γ	N/A	0.92	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	14.1	16.9

Average Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	15.5 ksf
Average Allowable Gross Bearing Capacity, $q_{all} = q_{ult\text{-}ave}/FS_{bearing}$	5.2 ksf *
Maximum Shear Resistance: $P_{max} = Q \tan\delta + C_a B L$	10,814.3 kips
Check Sliding Failure: $(P_{max}/P) \geq FS_{sliding}$?	N/A
Check Load Eccentricity (along X-axis): $e_x \leq B/6$	N/A
Check Load Eccentricity (along Y-axis): $e_y \leq L/6$	N/A
Check Bearing Failure: $(q_{ult\text{-}ave}/q_{app}) \geq FS_{bearing}$?	Yes

Notes:

* The footing should be checked for tolerable settlement.
Allowable gross bearing capacity may be limited to 10 ksf due to settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs OH (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 1, Segment 3; H=4800
Footing Description	8' x 10.0' footing
Footing Width, B	8.00 feet
Footing Length, L	10.00 feet
Min. Footing Embedment Depth, D_f	5.25 feet
Bottom of Footing Elevation	1,486.59 feet
Design GWT Elevation	1,420.00 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Normal Gravity Load, Q	312.80 kips
Shear Load (along X-axis), P_x	6.97 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY

Factor of Safety for Sliding Failure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Failure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,491.84 feet
Depth to Design GWT, Z_w	71.84 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	6.97 kips
Effective Footing Width, $B' = B - 2\,e_x$	8.00 feet
Effective Footing Length, $L' = L - 2\,e_y$	10.00 feet
Effective Footing Area, $A_f = B'\,L'$	80.00 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(BL)$	3.91 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\,c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45^o+\phi_{eff}/2)$	7.22 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	125.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	656.25 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\,\phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o+\phi_{eff}/2)$	3.25
Depth Factor Parameter, κ	0.66
Exponent, n	1.44

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.24	1.52	1.52	1.52
s_q	N/A	1.26	1.42	1.50
s_γ	0.80	1.26	0.68	0.68
Depth Factors, d_c	N/A	1.24	1.26	1.26
d_q	N/A	1.12	1.18	1.18
d_γ	N/A	1.12	1.00	1.00
Inclination Factors, i_c	N/A	0.97	1.00	1.00
i_q	N/A	0.97	1.00	1.00
i_γ	N/A	0.92	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma\, i_\gamma\, g_\gamma\, b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u\,(1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	14.8	17.8

Average Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	16.3 ksf
Average Allowable Gross Bearing Capacity, $q_{all} = q_{ult\text{-}ave}/FS_{bearing}$	5.4 ksf *
Maximum Shear Resistance: $P_{max} = Q \tan\delta + C_a\,B\,L$	8,922.2 kips
Check Sliding Failure: $(P_{max}/P) \geq FS_{sliding}$?	N/A
Check Load Eccentricity (along X-axis): $e_x \leq B/6$	N/A
Check Load Eccentricity (along Y-axis): $e_y \leq L/6$	N/A
Check Bearing Failure: $(q_{ult\text{-}ave}/q_{app}) \geq FS_{bearing}$?	Yes

Notes:

* The footing should be checked for tolerable settlement.
Allowable gross bearing capacity may be limited to 10 ksf due to settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs OH (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 1, Segment 4; H=4200
Footing Description	8' x 7.9' footing
Footing Width, B	7.90 feet
Footing Length, L	8.00 feet
Min. Footing Embedment Depth, D_f	5.25 feet
Bottom of Footing Elevation	1,490.60 feet
Design GWT Elevation	1,420.00 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Normal Gravity Load, Q	229.40 kips
Shear Load (along X-axis), P_x	6.97 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY

Factor of Safety for Sliding Falure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Falure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,495.85 feet
Depth to Design GWT, Z_w	75.85 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	6.97 kips
Effective Footing Width, $B' = B - 2\,e_x$	7.90 feet
Effective Footing Length, $L' = L - 2\,e_y$	8.00 feet
Effective Footing Area, $A_f = B'\,L'$	63.20 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(BL)$	3.63 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\,c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B\tan(45^o+\phi_{eff}/2)$	7.13 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	125.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	656.25 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\,\phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o+\phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.66
Exponent, n	1.50

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.30	1.64	1.64	1.64
s_q	N/A	1.32	1.52	1.62
s_γ	0.80	1.32	0.61	0.61
Depth Factors, d_c	N/A	1.24	1.27	1.27
d_q	N/A	1.12	1.18	1.18
d_γ	N/A	1.12	1.00	1.00
Inclination Factors, i_c	N/A	0.96	1.00	1.00
i_q	N/A	0.96	1.00	1.00
i_γ	N/A	0.89	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\,S_u\,(1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	15.8	19.0

Average Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	17.4 ksf
Average Allowable Gross Bearing Capacity, $q_{all} = q_{ult\text{-}ave}/FS_{bearing}$	5.8 ksf *
Maximum Shear Resistance: $P_{max} = Q\tan\delta + C_a B L$	7,041.6 kips
Check Sliding Failure: $(P_{max}/P) \geq FS_{sliding}$?	N/A
Check Load Eccentricity (along X-axis): $e_x \leq B/6$	N/A
Check Load Eccentricity (along Y-axis): $e_y \leq L/6$	N/A
Check Bearing Failure: $(q_{ult\text{-}ave}/q_{app}) \geq FS_{bearing}$?	Yes

Notes:

* The footing should be checked for tolerable settlement.
Allowable gross bearing capacity may be limited to 10 ksf due to settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs OH (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 1, Segment 5; H=3000
Footing Description	8' x 6.2' footing
Footing Width, B	6.20 feet
Footing Length, L	8.00 feet
Min. Footing Embedment Depth, D_f	5.25 feet
Bottom of Footing Elevation	1,494.79 feet
Design GWT Elevation	1,420.00 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Normal Gravity Load, Q	138.88 kips
Shear Load (along X-axis), P_x	4.27 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY

Factor of Safety for Sliding Falure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Falure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,500.04 feet
Depth to Design GWT, Z_w	80.04 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	4.27 kips
Effective Footing Width, $B' = B - 2\,e_x$	6.20 feet
Effective Footing Length, $L' = L - 2\,e_y$	8.00 feet
Effective Footing Area, $A_f = B'\,L'$	49.60 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(BL)$	2.80 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\,c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B\tan(45^o+\phi_{eff}/2)$	5.59 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	125.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	656.25 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\,\phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o+\phi_{eff}/2)$	3.25
Depth Factor Parameter, κ	0.85
Exponent, n	1.44

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.23	1.50	1.51	1.51
s_q	N/A	1.25	1.41	1.48
s_γ	0.80	1.25	0.69	0.69
Depth Factors, d_c	N/A	1.31	1.34	1.34
d_q	N/A	1.15	1.23	1.23
d_γ	N/A	1.15	1.00	1.00
Inclination Factors, i_c	N/A	0.96	1.00	1.00
i_q	N/A	0.96	1.00	1.00
i_γ	N/A	0.89	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma\, i_\gamma\, g_\gamma\, b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\,S_u\,(1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	15.2	18.3

Average Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	16.8 ksf
Average Allowable Gross Bearing Capacity, $q_{all} = q_{ult\text{-}ave}/FS_{bearing}$	5.6 ksf *
Maximum Shear Resistance: $P_{max} = Q\tan\delta + C_a B L$	5,510.2 kips
Check Sliding Failure: $(P_{max}/P) \geq FS_{sliding}$?	N/A
Check Load Eccentricity (along X-axis): $e_x \leq B/6$	N/A
Check Load Eccentricity (along Y-axis): $e_y \leq L/6$	N/A
Check Bearing Failure: $(q_{ult\text{-}ave}/q_{app}) \geq FS_{bearing}$?	Yes

Notes:

* The footing should be checked for tolerable settlement.
Allowable gross bearing capacity may be limited to 10 ksf due to settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	Box Springs OH (Widen)
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Abutment 1, Segment 6; H=1800
Footing Description	8' x 4.33' footing
Footing Width, B	4.33 feet
Footing Length, L	8.00 feet
Min. Footing Embedment Depth, D_f	5.25 feet
Bottom of Footing Elevation	1,498.80 feet
Design GWT Elevation	1,420.00 feet
Ground Slope Angle, β	33.69 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Normal Gravity Load, Q	60.62 kips
Shear Load (along X-axis), P_x	2.25 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY

Factor of Safety for Sliding Falure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Falure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,504.05 feet
Depth to Design GWT, Z_w	84.05 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	2.25 kips
Effective Footing Width, $B' = B - 2e_x$	4.33 feet
Effective Footing Length, $L' = L - 2e_y$	8.00 feet
Effective Footing Area, $A_f = B' L'$	34.64 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(BL)$	1.75 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\ c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45^o + \phi_{eff}/2)$	3.91 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	125.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	656.25 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\ \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45^o + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.88
Exponent, n	1.35

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.16	1.35	1.35	1.35
s_q	N/A	1.18	1.29	1.34
s_γ	0.80	1.18	0.78	0.78
Depth Factors, d_c	N/A	1.44	1.35	1.35
d_q	N/A	1.22	1.24	1.24
d_γ	N/A	1.22	1.00	1.00
Inclination Factors, i_c	N/A	0.95	1.00	1.00
i_q	N/A	0.95	1.00	1.00
i_γ	N/A	0.87	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.77	1.00
g_q	N/A	N/A	0.13	0.11
g_γ	N/A	N/A	0.13	0.11
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\ S_u\ (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	13.8	16.5

Average Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	15.1 ksf
Average Allowable Gross Bearing Capacity, $q_{all} = q_{ult\text{-}ave}/FS_{bearing}$	5.0 ksf *
Maximum Shear Resistance: $P_{max} = Q \tan\delta + C_a B L$	3,834.1 kips
Check Sliding Failure: $(P_{max}/P) \geq FS_{sliding}$?	N/A
Check Load Eccentricity (along X-axis): $e_x \leq B/6$	N/A
Check Load Eccentricity (along Y-axis): $e_y \leq L/6$	N/A
Check Bearing Failure: $(q_{ult\text{-}ave}/q_{app}) \geq FS_{bearing}$?	Yes

Notes:

* The footing should be checked for tolerable settlement.
Allowable gross bearing capacity may be limited to 10 ksf due to settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

C-6

RETAINING WALL SETTLEMENT

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

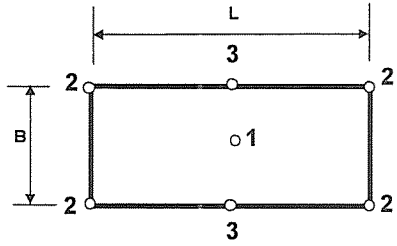
Project Name	Box Springs Overhead Widening (Right)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1, Segment 1; H=7900
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	8.00 feet
Footing Length, L	14.20 feet
Applied Net Bearing Pressure, p	5.30 ksf
Footing Embedment Depth, D_f	5.25 feet
Bottom of Footing Elevation	1,478.00 feet
GWT Elevation for Design	1,420.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.61	0.23	0.39
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.61	0.23	0.39



Performed By: _____ Date: _____

Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,483.25	1,478.00	Cohesionless Soil	120.0					
1,478.00	1,475.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	650.0	0.30			1.0
1,465.00	1,460.00	Cohesionless Soil	120.0	750.0	0.30			1.0
1,460.00	1,455.00	Cohesionless Soil	125.0	1,300.0	0.35			1.0
1,455.00	1,450.00	Cohesionless Soil	140.0	1,250.0	0.40			1.0
1,450.00	1,445.00	Cohesionless Soil	140.0	1,250.0	0.40			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.25	0.63	0.32	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.50	3.00	0.99	0.81	N/A	5.19	1.32	2.63	0.202	0.042	0.091	0.000	0.000	0.000
5.50	5.00	1.59	1.29	N/A	3.46	1.20	2.21	0.194	0.061	0.118	0.000	0.000	0.000
10.50	5.00	2.19	1.89	N/A	1.75	0.89	1.39	0.124	0.062	0.097	0.000	0.000	0.000
15.50	5.00	2.79	2.49	N/A	0.97	0.63	0.85	0.058	0.038	0.051	0.000	0.000	0.000
20.50	5.00	3.42	3.10	N/A	0.60	0.45	0.56	0.017	0.013	0.016	0.000	0.000	0.000
25.50	5.00	4.12	3.77	N/A	0.41	0.33	0.39	0.009	0.007	0.009	0.000	0.000	0.000
30.50	5.00	4.82	4.47	N/A	0.29	0.25	0.28	0.007	0.006	0.006	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

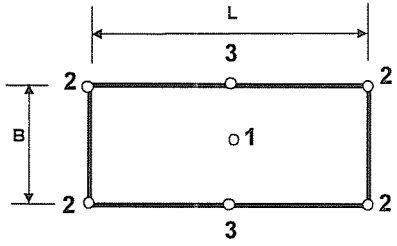
Project Name	Box Springs Overhead Widening (Right)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1, Segment 2; H=6700
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	8.00 feet
Footing Length, L	12.10 feet
Applied Net Bearing Pressure, p	4.40 ksf
Footing Embedment Depth, D_f	5.25 feet
Bottom of Footing Elevation	1,482.92 feet
GWT Elevation for Design	1,420.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.47	0.19	0.30
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.47	0.19	0.30



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,488.17	1,482.92	Cohesionless Soil	120.0					
1,482.92	1,480.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,480.00	1,475.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	650.0	0.30			1.0
1,465.00	1,460.00	Cohesionless Soil	120.0	750.0	0.30			1.0
1,460.00	1,455.00	Cohesionless Soil	125.0	1,300.0	0.35			1.0
1,455.00	1,450.00	Cohesionless Soil	140.0	1,250.0	0.40			1.0
1,450.00	1,445.00	Cohesionless Soil	140.0	1,250.0	0.40			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.25	0.63	0.32	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.46	2.92	0.98	0.81	N/A	4.31	1.10	2.18	0.158	0.034	0.072	0.000	0.000	0.000
5.42	5.00	1.58	1.28	N/A	2.79	0.99	1.76	0.153	0.050	0.093	0.000	0.000	0.000
10.42	5.00	2.18	1.88	N/A	1.34	0.72	1.05	0.068	0.036	0.053	0.000	0.000	0.000
15.42	5.00	2.78	2.48	N/A	0.72	0.49	0.63	0.050	0.034	0.043	0.000	0.000	0.000
20.42	5.00	3.38	3.08	N/A	0.44	0.34	0.41	0.026	0.020	0.024	0.000	0.000	0.000
25.42	5.00	4.01	3.69	N/A	0.29	0.25	0.28	0.008	0.007	0.008	0.000	0.000	0.000
30.42	5.00	4.71	4.36	N/A	0.21	0.18	0.20	0.005	0.004	0.005	0.000	0.000	0.000
35.42	5.00	5.41	5.06	N/A	0.16	0.14	0.15	0.004	0.003	0.003	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

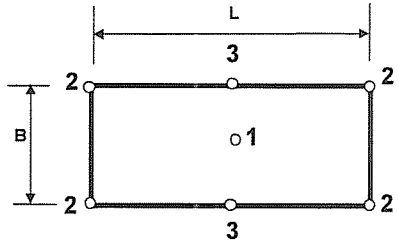
Project Name	Box Springs Overhead Widening (Right)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1, Segment 3; H=4800
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	8.00 feet
Footing Length, L	10.00 feet
Applied Net Bearing Pressure, p	3.91 ksf
Footing Embedment Depth, D_f	5.25 feet
Bottom of Footing Elevation	1,486.59 feet
GWT Elevation for Design	1,420.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.39	0.16	0.25
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.39	0.16	0.25



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,491.84	1,486.59	Cohesionless Soil	120.0					
1,486.59	1,480.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,480.00	1,475.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	650.0	0.30			1.0
1,465.00	1,460.00	Cohesionless Soil	120.0	750.0	0.30			1.0
1,460.00	1,455.00	Cohesionless Soil	125.0	1,300.0	0.35			1.0
1,455.00	1,450.00	Cohesionless Soil	140.0	1,250.0	0.40			1.0
1,450.00	1,445.00	Cohesionless Soil	140.0	1,250.0	0.40			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.25	0.63	0.32	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
3.29	6.59	1.42	1.03	N/A	3.23	0.94	1.77	0.245	0.064	0.125	0.000	0.000	0.000
9.09	5.00	2.02	1.72	N/A	1.28	0.67	0.96	0.065	0.034	0.048	0.000	0.000	0.000
14.09	5.00	2.62	2.32	N/A	0.64	0.44	0.55	0.032	0.022	0.027	0.000	0.000	0.000
19.09	5.00	3.22	2.92	N/A	0.37	0.30	0.34	0.026	0.020	0.023	0.000	0.000	0.000
24.09	5.00	3.82	3.52	N/A	0.24	0.21	0.23	0.014	0.012	0.014	0.000	0.000	0.000
29.09	5.00	4.45	4.13	N/A	0.17	0.15	0.16	0.005	0.004	0.005	0.000	0.000	0.000
34.09	5.00	5.15	4.80	N/A	0.12	0.11	0.12	0.003	0.003	0.003	0.000	0.000	0.000
39.09	5.00	5.85	5.50	N/A	0.10	0.09	0.09	0.002	0.002	0.002	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

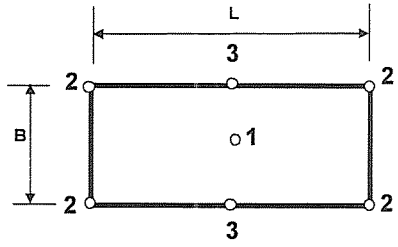
Project Name	Box Springs Overhead Widening (Right)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1, Segment 4; H=4200
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	7.90 feet
Footing Length, L	8.00 feet
Applied Net Bearing Pressure, p	3.63 ksf
Footing Embedment Depth, D_f	5.25 feet
Bottom of Footing Elevation	1,490.60 feet
GWT Elevation for Design	1,420.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.33	0.14	0.20
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.33	0.14	0.20



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,495.85	1,490.60	Cohesionless Soil	120.0					
1,490.60	1,485.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,485.00	1,480.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,480.00	1,475.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	650.0	0.30			1.0
1,465.00	1,460.00	Cohesionless Soil	120.0	750.0	0.30			1.0
1,460.00	1,455.00	Cohesionless Soil	125.0	1,300.0	0.35			1.0
1,455.00	1,450.00	Cohesionless Soil	140.0	1,250.0	0.40			1.0
1,450.00	1,445.00	Cohesionless Soil	140.0	1,250.0	0.40			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.25	0.63	0.32	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
2.80	5.60	1.30	0.97	N/A	3.07	0.88	1.64	0.198	0.051	0.098	0.000	0.000	0.000
8.10	5.00	1.90	1.60	N/A	1.19	0.63	0.86	0.060	0.031	0.043	0.000	0.000	0.000
13.10	5.00	2.50	2.20	N/A	0.55	0.39	0.47	0.027	0.020	0.023	0.000	0.000	0.000
18.10	5.00	3.10	2.80	N/A	0.31	0.25	0.28	0.015	0.013	0.014	0.000	0.000	0.000
23.10	5.00	3.70	3.40	N/A	0.20	0.17	0.18	0.013	0.012	0.013	0.000	0.000	0.000
28.10	5.00	4.30	4.00	N/A	0.13	0.12	0.13	0.008	0.007	0.008	0.000	0.000	0.000
33.10	5.00	4.93	4.61	N/A	0.10	0.09	0.09	0.003	0.003	0.003	0.000	0.000	0.000
38.10	5.00	5.63	5.28	N/A	0.07	0.07	0.07	0.002	0.002	0.002	0.000	0.000	0.000
43.10	5.00	6.33	5.98	N/A	0.06	0.06	0.06	0.001	0.001	0.001	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

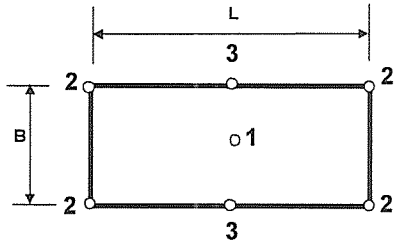
Project Name	Box Springs Overhead Widening (Right)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1, Segment 5; H=3000
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	6.20 feet
Footing Length, L	8.00 feet
Applied Net Bearing Pressure, p	2.80 ksf
Footing Embedment Depth, D_f	5.25 feet
Bottom of Footing Elevation	1,494.79 feet
GWT Elevation for Design	1,420.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.22	0.10	0.14
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.22	0.10	0.14



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,500.04	1,494.79	Cohesionless Soil	120.0					
1,494.79	1,490.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,485.00	1,480.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,480.00	1,475.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	650.0	0.30			1.0
1,465.00	1,460.00	Cohesionless Soil	120.0	750.0	0.30			1.0
1,460.00	1,455.00	Cohesionless Soil	125.0	1,300.0	0.35			1.0
1,455.00	1,450.00	Cohesionless Soil	140.0	1,250.0	0.40			1.0
1,450.00	1,445.00	Cohesionless Soil	140.0	1,250.0	0.40			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.25	0.63	0.32	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
2.39	4.79	1.20	0.92	N/A	2.38	0.68	1.30	0.128	0.033	0.065	0.000	0.000	0.000
7.29	5.00	1.80	1.50	N/A	0.89	0.47	0.68	0.045	0.024	0.034	0.000	0.000	0.000
12.29	5.00	2.40	2.10	N/A	0.38	0.28	0.34	0.019	0.014	0.017	0.000	0.000	0.000
17.29	5.00	3.00	2.70	N/A	0.21	0.17	0.19	0.010	0.009	0.010	0.000	0.000	0.000
22.29	5.00	3.60	3.30	N/A	0.13	0.11	0.12	0.006	0.006	0.006	0.000	0.000	0.000
27.29	5.00	4.20	3.90	N/A	0.09	0.08	0.08	0.006	0.005	0.006	0.000	0.000	0.000
32.29	5.00	4.80	4.50	N/A	0.06	0.06	0.06	0.004	0.003	0.004	0.000	0.000	0.000
37.29	5.00	5.43	5.12	N/A	0.05	0.04	0.05	0.001	0.001	0.001	0.000	0.000	0.000
42.29	5.00	6.13	5.78	N/A	0.04	0.04	0.04	0.001	0.001	0.001	0.000	0.000	0.000
47.29	5.00	6.83	6.48	N/A	0.03	0.03	0.03	0.001	0.001	0.001	0.000	0.000	0.000

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

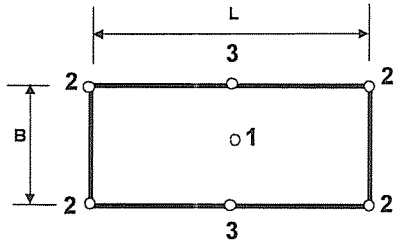
Project Name	Box Springs Overhead Widening (Right)
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Footing Location	Abutment 1, Segment 6; H=1800
Footing Description	Spread Footings
Stress Analysis Method	Boussinesq Method
Footing Width, B	4.33 feet
Footing Length, L	8.00 feet
Applied Net Bearing Pressure, p	1.75 ksf
Footing Embedment Depth, D_f	5.25 feet
Bottom of Footing Elevation	1,498.80 feet
GWT Elevation for Design	1,420.00 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.11	0.05	0.08
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.11	0.05	0.08



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REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,504.05	1,498.80	Cohesionless Soil	120.0					
1,498.80	1,495.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,495.00	1,490.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,485.00	1,480.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,480.00	1,475.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	900.0	0.30			1.0
1,470.00	1,465.00	Cohesionless Soil	120.0	650.0	0.30			1.0
1,465.00	1,460.00	Cohesionless Soil	120.0	750.0	0.30			1.0
1,460.00	1,455.00	Cohesionless Soil	125.0	1,300.0	0.35			1.0
1,455.00	1,450.00	Cohesionless Soil	140.0	1,250.0	0.40			1.0
1,450.00	1,445.00	Cohesionless Soil	140.0	1,250.0	0.40			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	5.25	0.63	0.32	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.90	3.80	1.09	0.86	N/A	1.47	0.42	0.83	0.060	0.016	0.032	0.000	0.000	0.000
6.30	5.00	1.69	1.39	N/A	0.51	0.28	0.42	0.026	0.014	0.021	0.000	0.000	0.000
11.30	5.00	2.29	1.99	N/A	0.20	0.15	0.18	0.010	0.007	0.009	0.000	0.000	0.000
16.30	5.00	2.89	2.59	N/A	0.10	0.09	0.10	0.005	0.004	0.005	0.000	0.000	0.000
21.30	5.00	3.49	3.19	N/A	0.06	0.06	0.06	0.003	0.003	0.003	0.000	0.000	0.000
26.30	5.00	4.09	3.79	N/A	0.04	0.04	0.04	0.002	0.002	0.002	0.000	0.000	0.000
31.30	5.00	4.69	4.39	N/A	0.03	0.03	0.03	0.002	0.002	0.002	0.000	0.000	0.000
36.30	5.00	5.29	4.99	N/A	0.02	0.02	0.02	0.001	0.001	0.001	0.000	0.000	0.000
41.30	5.00	5.91	5.60	N/A	0.02	0.02	0.02	0.000	0.000	0.000	0.000	0.000	0.000
46.30	5.00	6.61	6.26	N/A	0.01	0.01	0.01	0.000	0.000	0.000	0.000	0.000	0.000
51.30	5.00	7.31	6.96	N/A	0.01	0.01	0.01	0.000	0.000	0.000	0.000	0.000	0.000

APPENDIX D

BRIDGE AS-BUILT PLANS

Note:
For "Index to Plans", "General Notes", and "Standard Plans List", see "INDEX TO PLANS" sheet.

MARK	DATE	DESCRIPTIONS	BY	CH'D
4	9-27-04	Future access road	BF	KS
3	9-27-04	Extended concrete barrier	BF	KS
2	9-27-04	Delete slope paving @ Abut 1	BF	KS
1	9-27-04	Revised Abutment 1	BF	KS

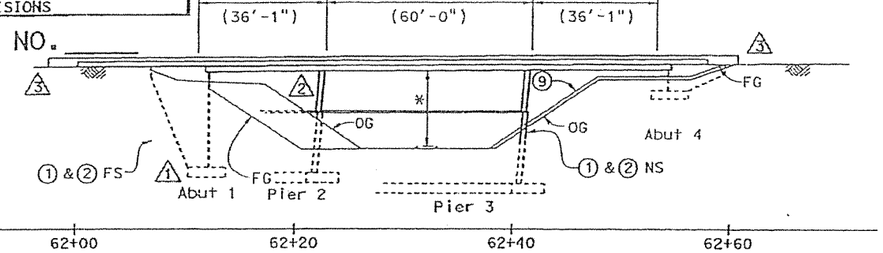
REVISIONS

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51662 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA 11-2-04

CONTRACT CHANGE ORDER NO. ____
SHEET ____ OF ____

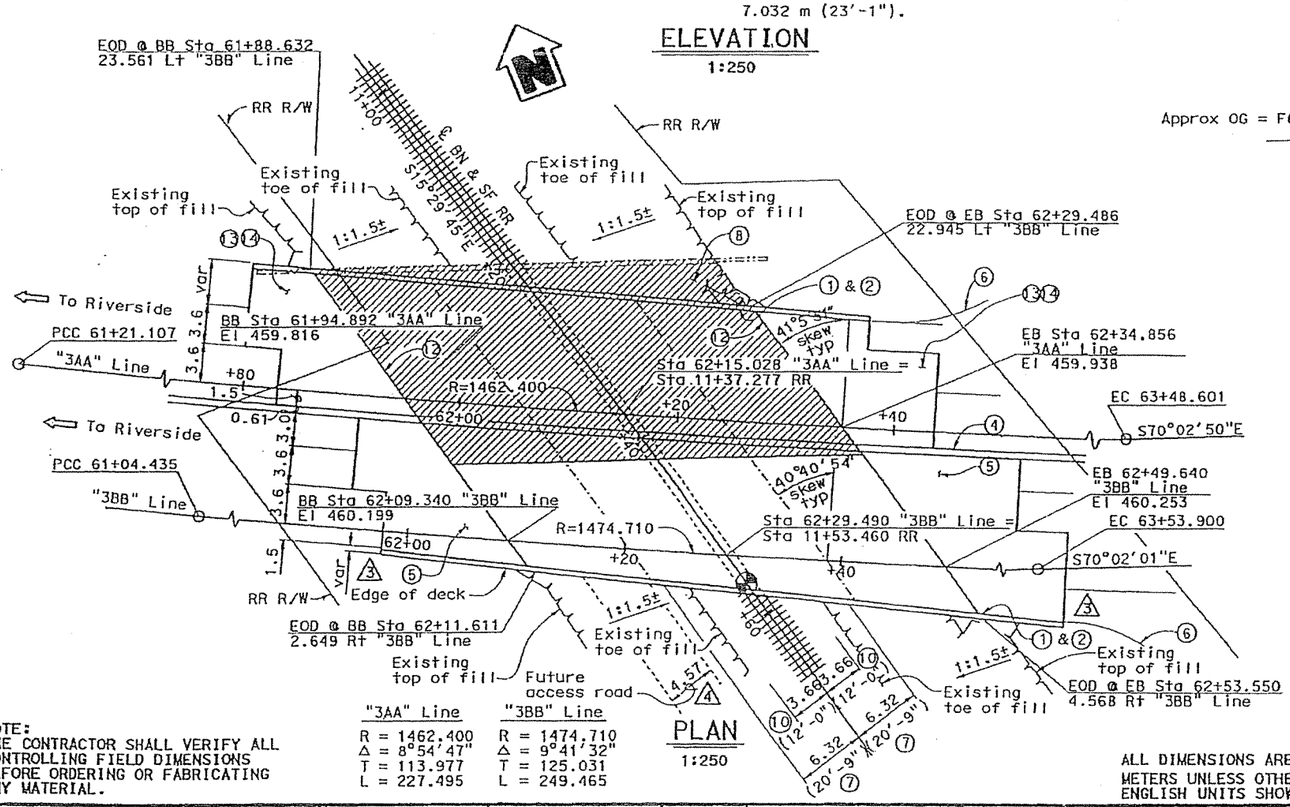
Sta 61+40.000 Elev 459.650 — +0.303% "3AA" — Sta 62+40.000 Elev 459.953
Sta 61+80.000 Elev 460.160 — +0.134% "3BB" — Sta 62+80.000 Elev 460.294

PROFILE GRADES
No Scale



* Minimum vertical clearance over widening = 7.032 m (23'-1").

ELEVATION
1:250



"3AA" Line	"3BB" Line
R = 1462.400	R = 1474.710
Δ = 8°54'47"	Δ = 9°41'32"
T = 113.977	T = 125.031
L = 227.495	L = 249.465

PLAN
1:250

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

QUANTITIES

BRIDGE REMOVAL	LUMP SUM	
STRUCTURE EXCAVATION (BRIDGE)	3 585	m^3
STRUCTURE BACKFILL (BRIDGE)	2 580	m^3
PRESTRESSING CAST-IN-PLACE CONCRETE	LUMP SUM	
STRUCTURAL CONCRETE, BRIDGE FOOTING	414	m^3
STRUCTURAL CONCRETE, BRIDGE	1 240	m^3
STRUCTURAL CONCRETE, APPROACH SLAB (TYPE N)	175	m^3
FRACTURED RIB TEXTURE	23	m^2
JOINT SEAL (MR 30 MM)	70	m
BAR REINFORCING STEEL (BRIDGE)	236 400	kg
SLOPE PAVING (CONCRETE)	55	m^3
CONCRETE BARRIER (TYPE 60SA)	69	m
CONCRETE BARRIER (TYPE 732)	119	m

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215, 60, 91	60.7/70.5, 22.0/18.5, 32.7/34.7	1748R1	2838

David Soon 6-2-04
REGISTERED CIVIL ENGINEER

8-4-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51662 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA

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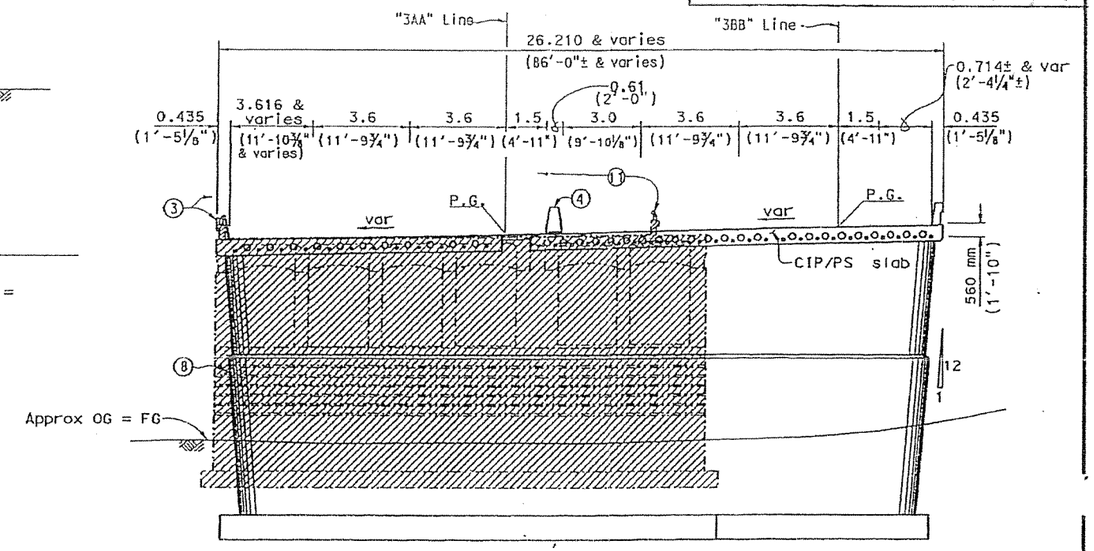

TYPICAL SECTION
1:100

Note:
"Typical Section" dimensions measured perpendicular to "3AA" & "3BB" Lines.

Notes:

1. Paint "Box Springs OH Right Bridge".
2. Paint "Br. No. 56-0082R".
3. Concrete Barrier Type 732.
4. Concrete Barrier Type 60SA Mod.
5. Structure Approach Type N(9S).
6. MBGR, see "Road Plans".
7. Minimum horizontal clearance measured from ℄ RR tracks to face of column.
8. Remove existing bridge.
9. Slope Paving (concrete).
10. Mininimum horizontal clearance to footing excavation measured from ℄ RR tracks.
11. Remove concrete barriers. Salvage metal railing and parts.
12. Remove existing sacked concrete slope protection.
13. Remove existing AC approach.
14. Structure Approach Type N Mod (9S).

See "STAGE CONSTRUCTION" sheet for Traffic & Construction staging.

Indicates existing structure.
Indicates limits of removal.
Point of minimum vertical clearance.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN
ENGLISH UNITS SHOWN IN PARENTHESIS

DESIGN SEQUENCE 2

DESIGN	BY David Soon	CHECKED Keith Stillmunkes	LOAD FACTOR DESIGN	LIVE LOADING: HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD
DETAILS	BY Sandra McHealy	CHECKED Keith Stillmunkes	LAYOUT	BY David Soon / CHECKED Keith Stillmunkes
QUANTITIES	BY Keith Stillmunkes	CHECKED JP/BJ	SPECIFICATIONS	BY Mary Kopsa / PLANS AND SPECS COMPARED Mary Kopsa

Kelly Ann Holder
DESIGN ENGINEER

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

BRIDGE NO. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACE)
GENERAL PLAN

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES (PRELIMINARY STAGE ONLY)
SHEET 1 OF 21

STRUCTURES DESIGN GENERAL PLAN SHEET (METRIC) (REV.4/20/00)
ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100
FILE => 56-0082r-a-gp.cco
USERNAME => sm
DATE PLOTTED => 26-JAN-2005
TIME PLOTTED => 09:45

No.	R	Δ	T	L
1	1474.710	-9°41'32"	125.031	249.465
2	1462.400	-8°54'47"	113.977	227.495

MARK	DATE	DESCRIPTIONS	BY	CH'D
2	9-13-04	Revised footing size	BF	KS
1	9-13-04	Revised elevation	BF	KS

REVISIONS

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL
08	Riv	215, 60, 91	60.7/10.6, 22.0/18.5, 32.1/34.7	1752R	2838

David Scan 6-2-04
REGISTERED CIVIL ENGINEER

8-4-03
PLANS APPROVAL DATE

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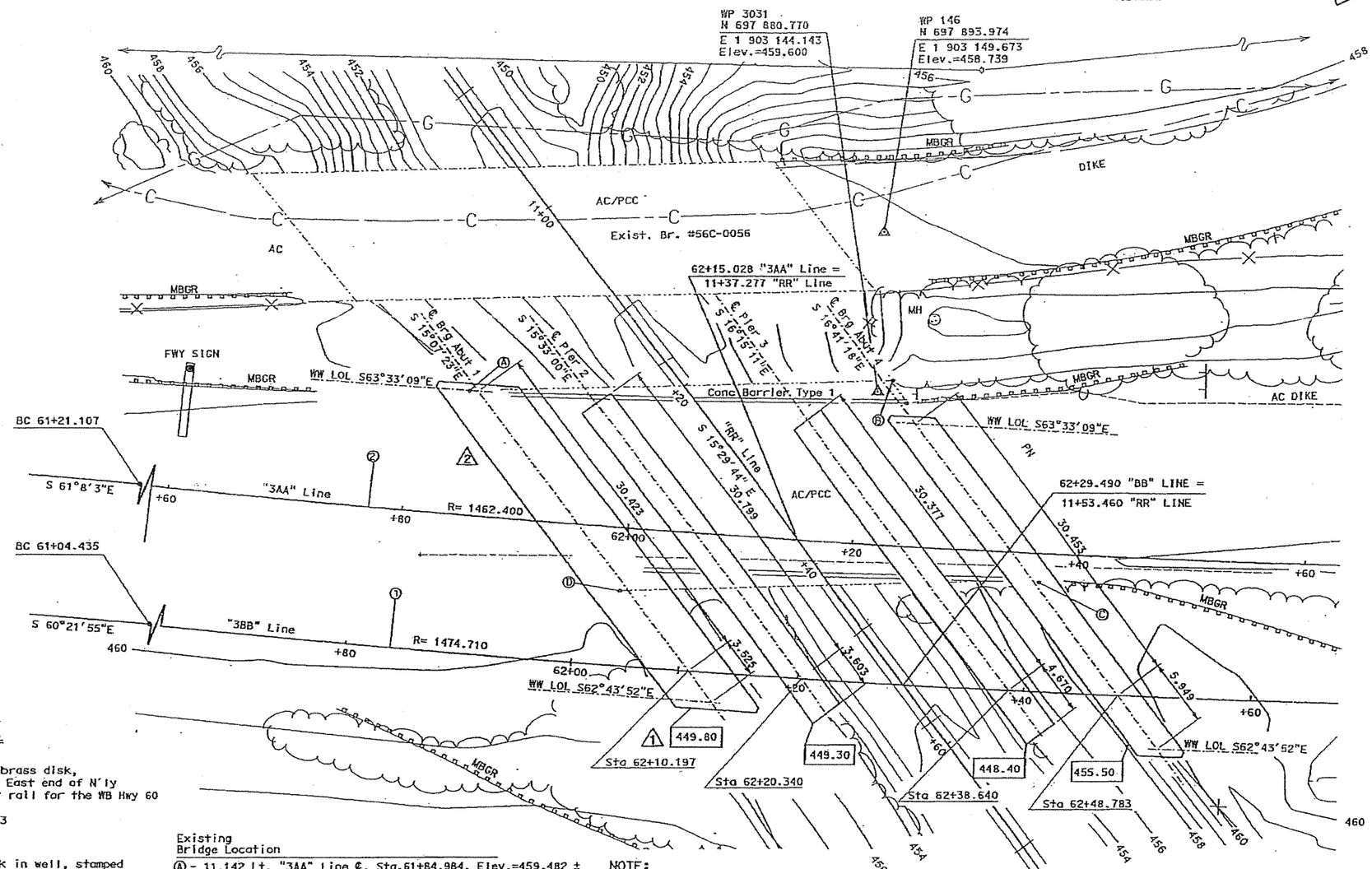
CONTRACT CHANGE ORDER NO. ____ SHEET ___ OF ___



SURVEY CONTROL

WP 3031
Fnd 5cm CDOT brass disk,
1m E'ly of the East end of N'ly
bridge barrier rail for the WB Hwy 60
N 697 880.770
E 1 903 144.143
Elev. = 459.60

WP 146
Fnd std br dsk in well, stamped
"26+89.16 BC C.L. N. FR. RD."
N 697 893.974
E 1 903 149.673
Elev. = 458.739

Existing
Bridge Location

Ⓐ - 11.142 Lt. "3AA" Line ℄, Sta.61+84.984, Elev.=459.482 ±
Ⓑ - 14.790 Lt. "3AA" Line ℄, Sta.62+22.402, Elev.=459.604 ±
Ⓒ - 2.587 Rt. "3AA" Line ℄, Sta.62+36.610, Elev.=459.920 ±
Ⓓ - 5.629 Rt. "3AA" Line ℄, Sta.61+99.805, Elev.=459.697 ±

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

NOTES:

+ Denotes spot elevation.
* Denotes spot elevation on structure on PCC.
Indicates bottom of footing elevation.
Underground utilities as shown are approximate.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN SEQUENCE 2

PRELIMINARY INVESTIGATION SECTION

SCALE 1:200	VERT. DATUM NGVD '29	PHOTOGRAMMETRY AS OF:	
	HORZ. DATUM NAD '83	SURVEYED	DRAFTED H AZARI 2/01
ALIGNMENT TIES DIST TRAVERSE SHEET		FIELD CHECKED L MANABO 2/01	CHECKED L MANABO 3/01

DESIGN	Keith Stillmunkes	CHECKED Benjamin Fontes
DETAILS	Bruno Jenko	CHECKED Benjamin Fontes
QUANTITIES	Keith Stillmunkes	CHECKED JPEU

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

CU 08
EA 334841

FILE => 56-0082r-e-fp.cco

BRIDGE No. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACE)

FOUNDATION PLAN

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)
11-8-01 1-14-02 12-26-02 4-16-04

SHEET 5 OF 21

STRUCTURES FOUNDATION PLAN SHEET (METRIC) (REV. 4/20/00)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

DATE PLOTTED => 26-JAN-2005 TIME PLOTTED => 09:45

USERNAME => BF

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215, 60, 91	60.7/10.6, 22.0/18.5, 32.7/34.7	1749R1	2838

David Soon 6-2-04
REGISTERED CIVIL ENGINEER DATE

B-4-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51862 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA

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Caltrans Metric

INDEX TO PLANS

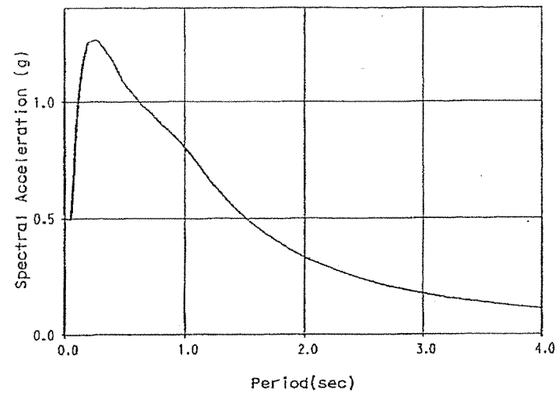
SHEET NO	TITLE
1	GENERAL PLAN
2	INDEX TO PANS
3	STAGE CONSTRUCTION
4	DECK CONTOURS
5	FOUNDATION PLAN
6	ABUTMENT 1 LAYOUT
7	ABUTMENT 4 LAYOUT
8	ABUTMENT DETAILS NO. 1
9	ABUTMENT DETAILS NO. 2
10	ABUTMENT DETAILS NO. 3
10A △3	ABUTMENT DETAILS NO. 4
11	PIER LAYOUT
12	PIER DETAILS
13	TYPICAL SECTION
14	VOID LAYOUT
15	LONGITUDINAL SECTION
15A	CONCRETE BARRIER TYPE 60SA MODIFIED
16	STRUCTURE APPROACH TYPE N(9S) AND N MOD (9S)
17	STRUCTURE APPROACH DRAINAGE DETAILS
18	SLOPE PAVING - FULL SLOPE
18A △3	MISCELLANEOUS DETAILS
19	LOG OF TEST BORINGS 1 OF 3
20	LOG OF TEST BORINGS 2 OF 3
21	LOG OF TEST BORINGS 3 OF 3

STANDARD PLANS DATED JULY 1999

A10A	ABBREVIATIONS
A10B	SYMBOLS
A62C	LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL - BRIDGE
A76G	CONCRETE BARRIER TYPE 60S
A76H	CONCRETE BARRIER TYPE 60S
B0-1	BRIDGE DETAILS
B0-3	BRIDGE DETAILS
B0-5	BRIDGE DETAILS
B0-13	BRIDGE DETAILS
B6-21	JOINT SEALS (MAXIMUM MOVEMENT RATING = 50 mm)
B8-5	CAST-IN-PLACE PRESTRESSED GIRDER DETAILS
B11-55	CONCRETE BARRIER TYPE 732
B11-47	CABLE RAILING

STANDARD PLAN SHEET NO.

DETAIL NO.



SITE SPECIFIC ACCELERATION RESPONSE SPECTRA CURVE

Modified SDC (ARS) Curve for Soil Profile C (M=7.25 ± .25)
(Peak Bedrock Acceleration = 0.5g)

SPREAD FOOTING DATA TABLE

SUPPORT LOCATION	RECOMMENDED BEARING PRESSURE		MAXIMUM CONTACT PRESSURE		STRENGTH REDUCTION FACTOR Ø or FACTOR OF SAFETY (FS) (Note 1)
	WSD	LFD	WSD	LFD	
	Gross Allowable Bearing pressure (q_{all})	Ultimate Bearing pressure (q_u)	q_{max}	$q_{max}/Ø$	
Abut 1	△1 290 kPa	N/A	△1 287 kPa	N/A	FS = 3
Pier 2	N/A	1436 kPa	N/A	1080 kPa	Ø = 0.5
Pier 3	N/A	1436 kPa	N/A	1090 kPa	Ø = 0.5
Abut 4	192 kPa	N/A	115 kPa	N/A	FS = 3

Notes:
1. Ø = 1.0 for seismic loads, otherwise Ø = 0.5.

GENERAL NOTES
LOAD FACTOR DESIGN

DESIGN: Bridge Design Specifications-April 2000 (LFD) (1996 AASHTO with Interims and Revisions by Caltrans)

SEISMIC DESIGN: Seismic Design Criteria (SDC) by Caltrans Version 1.2 December 2001

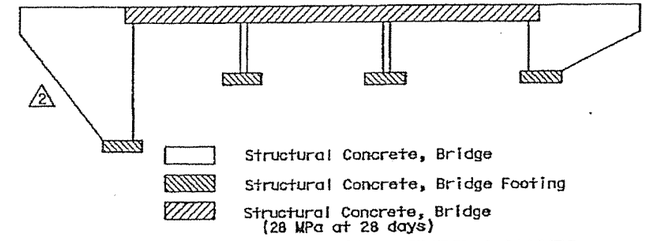
DEAD LOAD: Includes 1675 Pa for future wearing surface.

LIVE LOADING: HS20-44 and alternative and permit design load.

SEISMIC LOADING: Site Specific Acceleration Response Spectra Curve

REINFORCED CONCRETE: f_y=420 MPa
f'_c= 25 MPa
n = 8

PRESTRESSED CONCRETE: See "Prestressing Notes" on "LONGITUDINAL SECTION" sheet.



CONCRETE STRENGTH AND TYPE LIMITS

No Scale

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51862 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA 11-2-04

MARK	DATE	DESCRIPTIONS	BY	CH'D
△3	9-13-04	Revised note	BF	KS
△2	9-13-04	Modified detail	BF	KS
△1	9-13-04	Revised value	BF	KS

REVISIONS

CONTRACT CHANGE ORDER NO. ____
SHEET ___ OF ___

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN SEQUENCE 2

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

	BY	CHECKED
DESIGN	Keith Stillmunkes	Benjamin Fontes
DETAILS	Bruno Jenko	Benjamin Fontes
QUANTITIES	Keith Stillmunkes	JP/BJ

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

BRIDGE NO. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACE)
INDEX TO PLANS

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 1-1-01 2-1-01 3-2-01 4-16-01 5-1-01

SHEET 2 OF 21

STRUCTURES DESIGN DETAIL SHEET (METRIC) (REV.12-1-01)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

FILE => 56-0082r-a-iip.cco

DATE PLOTTED => 26-JAN-2005 TIME PLOTTED => 09:45

USERNAME => sm

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215, 60, 91	60.7/70.6, 22.0/18.5, 32.7/34.1	1753R1	2838

REGISTERED CIVIL ENGINEER — DATE 6-2-04

8-4-03
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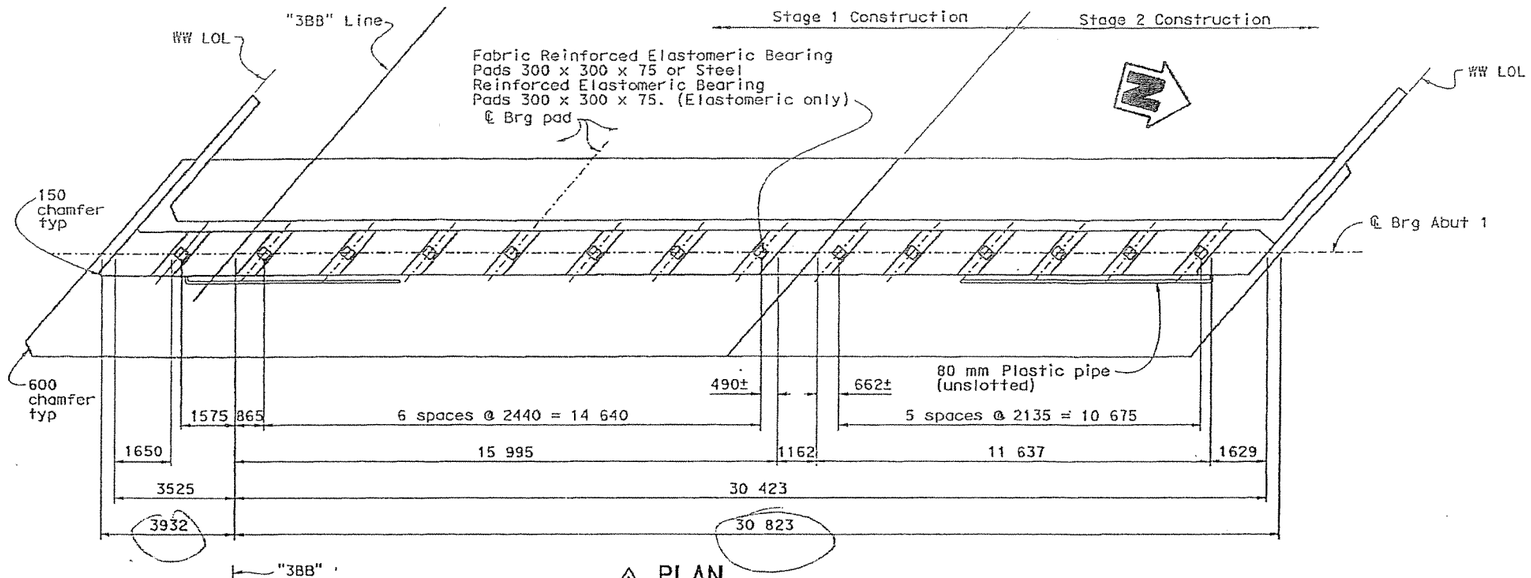
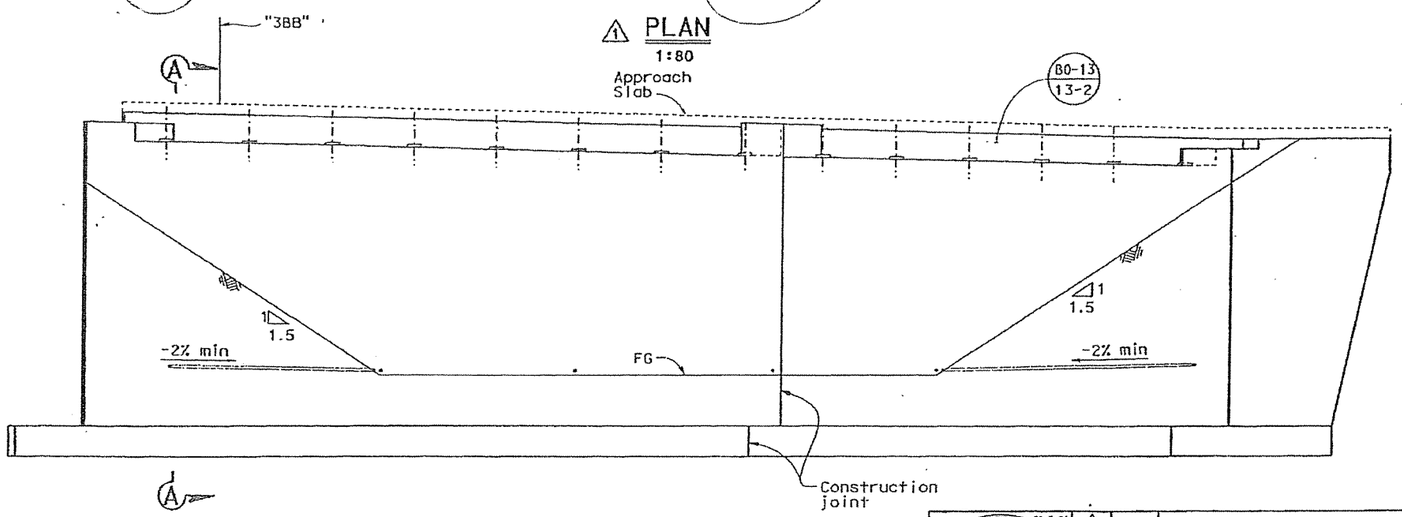
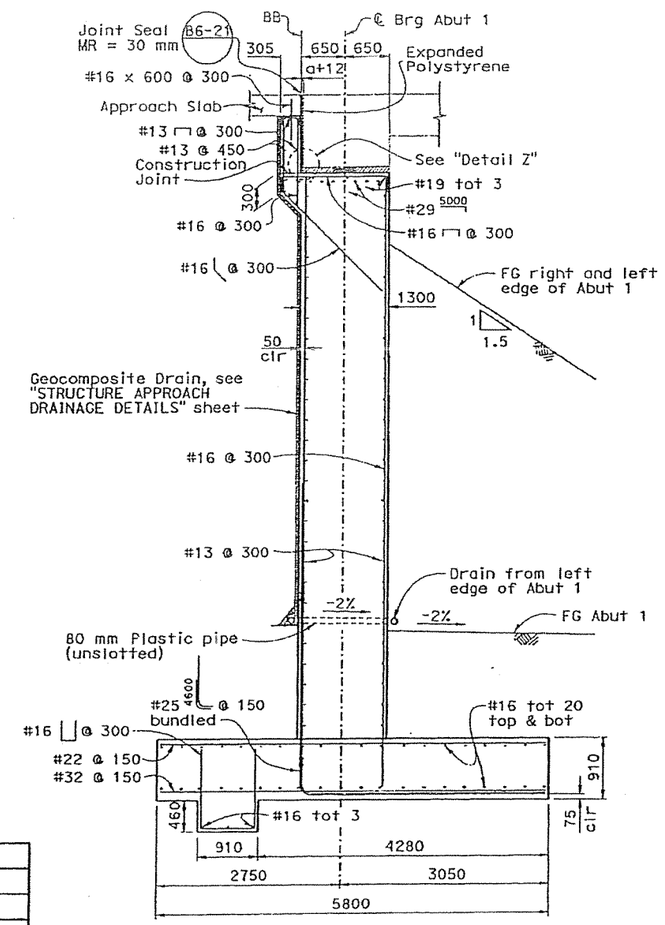


1 PLAN
1:80



1 ELEVATION
1:80



Note:
For "Detail Z", see ABUTMENT DETAILS NO. 1 sheet.

1 SECTION A-A
1:40

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

REGISTERED PROFESSIONAL ENGINEER — David Soon — No. 51862 — Exp. 6-30-06 — CIVIL — STATE OF CALIFORNIA — 11-2-04

MARK	DATE	DESCRIPTIONS	BY	CH'D
1	9-13-04	Revised detail	BF	KS

REVISIONS

CONTRACT CHANGE ORDER NO. ____
SHEET ___ OF ___

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN SEQUENCE 2

	BY	CHECKED
DESIGN	Keith Stillmunkes	Benjamin Fontes
DETAILS	Bruno Jenko	Benjamin Fontes
QUANTITIES	Keith Stillmunkes	JP/BJ

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

CU 08
EA 334841

BRIDGE NO. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACE)
ABUTMENT 1 LAYOUT

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 1-14 1-14 1-14 4-11-14

SHEET 6 OF 21

STRUCTURES DESIGN DETAIL SHEET (METRIC) (REV.12-1-01)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

FILE => 56-0082r-h-01-1a.cco

USERNAME => SI
DATE PLOTTED => 26-JAN-2005
TIME PLOTTED => 09:46

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO	TOTAL SHEETS
08	Riv	215,60, 91	60.7/10.6, 22.0/18.5, 32.7/34.1	1754R1	2838

David Soon 6-2-04
REGISTERED CIVIL ENGINEER DATE

8-4-03
PLANS APPROVAL DATE

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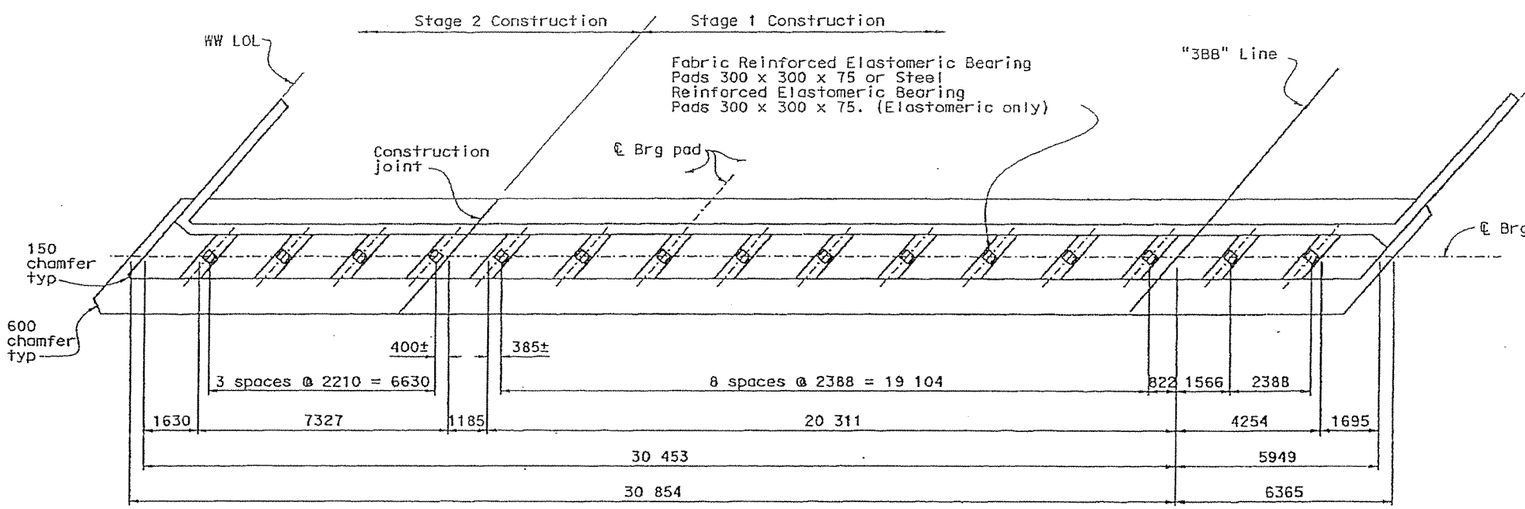
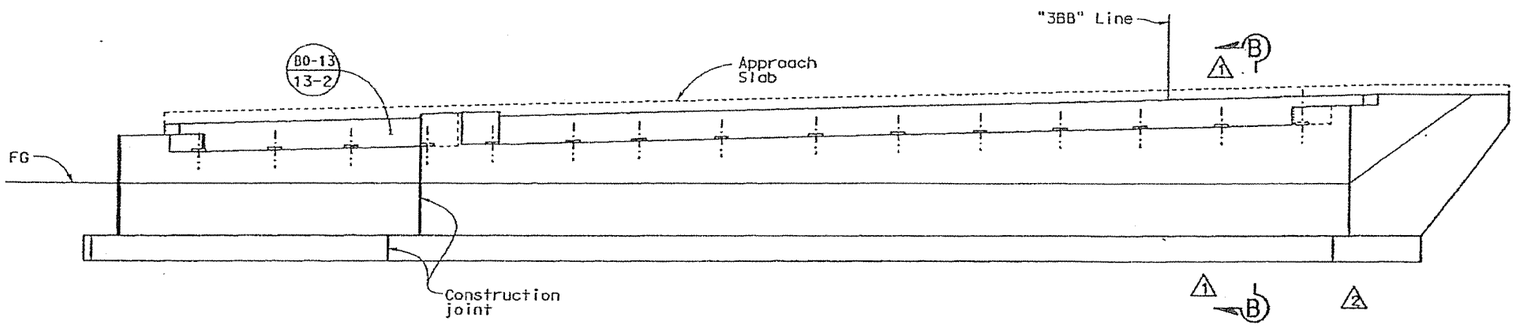
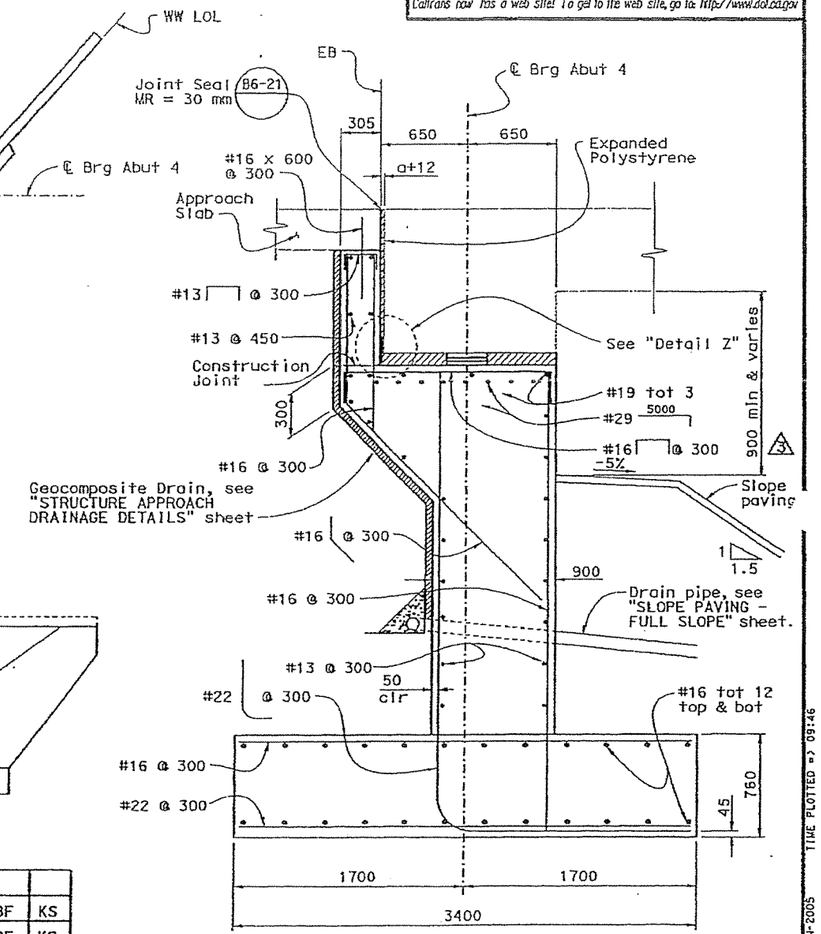


PLAN
1:80



ELEVATION
1:80



1 SECTION B-B
1:20

Note:
For "Detail Z", see ABUTMENT DETAILS NO. 1 sheet.

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

PROFESSIONAL ENGINEER David Soon No. 51862 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA 11-2-04

MARK	DATE	DESCRIPTIONS	BY	CH'D
3	9-13-04	Revised dimension	BF	KS
2	9-13-04	Deleted note	BF	KS
1	9-13-04	Added detail	BF	KS

REVISIONS

CONTRACT CHANGE ORDER NO. ____
SHEET ___ OF ___

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN SEQUENCE 2

DESIGN	BY Keith Stillmunkes	CHECKED Benjamin Fontes	
DETAILS	BY Bruno Janko	CHECKED Benjamin Fontes	
QUANTITIES	BY Keith Stillmunkes	CHECKED JP/BJ	

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

BRIDGE NO. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACE)
ABUTMENT 4 LAYOUT

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 7 OF 21

STRUCTURES DESIGN DETAIL SHEET (METRIC) (REV.12-1-01)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

FILE => 56-0082r-h-a4-lo.cco

DATE PLOTTED => 26-JAN-2005 TIME PLOTTED => 09:46

USERNAME => sti

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215, 60, 91	60.7/70.6, 22.0/18.5, 32.7/34.7	1755R1	2838

David Soon 6-2-04
REGISTERED CIVIL ENGINEER DATE

8-4-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51862 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA

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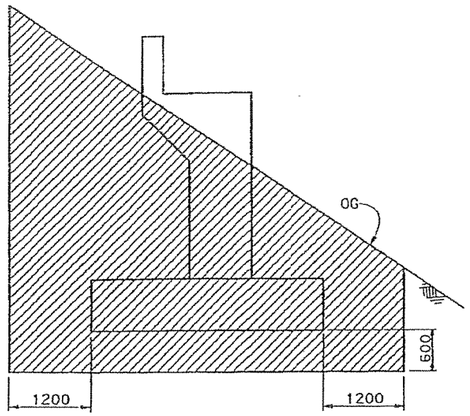
Caltrans Metric

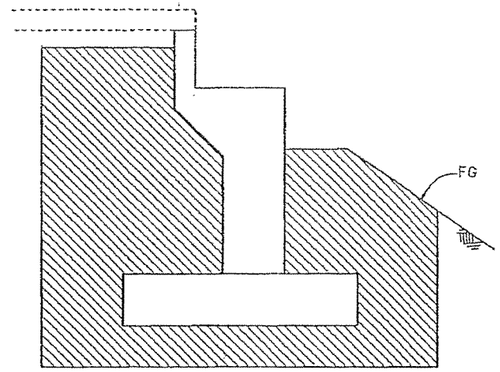
MARK	DATE	DESCRIPTIONS	BY	CH'D
3				
2				
2	9-13-04	Added note	BF	KS
1	9-13-04	Modified title	BF	KS

REVISIONS

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51862 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA 11-2-04

CONTRACT CHANGE ORDER NO. ____
SHEET ___ OF ___





Notes:

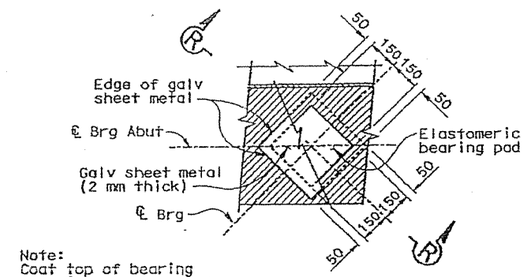
Indicates limits of excavation.

Indicates limits of backfill.

LIMITS OF PAYMENT FOR EXCAVATION & BACKFILL AT ABUTMENT 4 △1

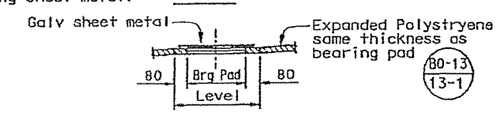
No Scale

△2 Note: Detail does not apply to Abutment 1



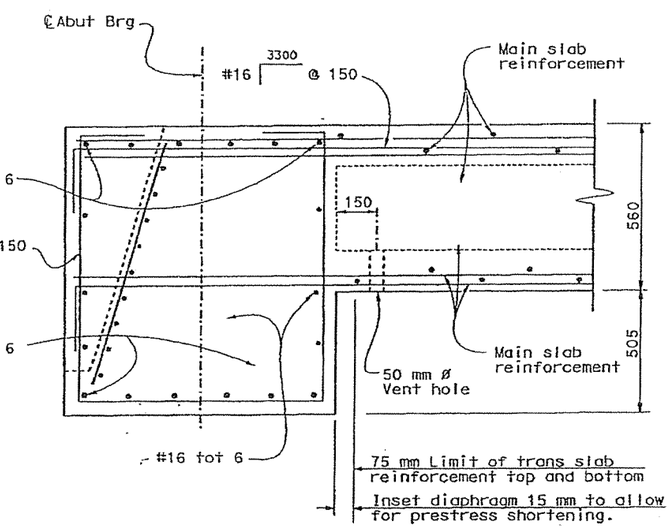
Note:
Coat top of bearing pad with grease prior to placing sheet metal.

PLAN



SECTION R-R
BEARING PAD DETAIL

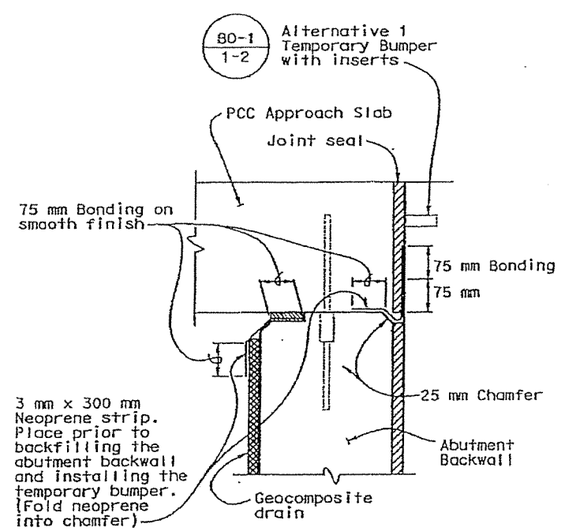
No Scale
Details typical at all bearing pads



NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

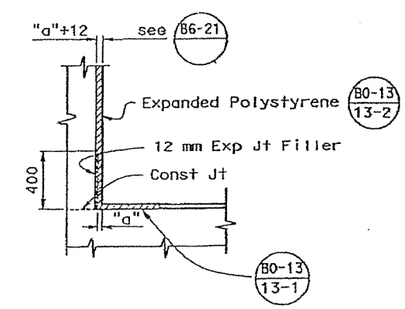
END DIAPHRAGM (B8-5)

1:10



JOINT PROTECTION DETAIL

No Scale



DETAIL Z

No scale

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN SEQUENCE 2

DESIGN	BY Keith Stillmunkes	CHECKED Benjamin Fontes	
DETAILS	BY Bruno Jenko	CHECKED Benjamin Fontes	
QUANTITIES	BY Keith Stillmunkes	CHECKED JP/BJ	

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

BRIDGE NO. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACE)
ABUTMENT DETAILS NO. 1

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 8 OF 21

STRUCTURES DESIGN DETAIL SHEET (METRIC) (REV.12-1-01)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

FILE => 56-0082r-h-ab-d01.cce

USERNAME => si DATE PLOTTED => 26-JAN-2005 TIME PLOTTED => 09:47

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215, 60, 91	60.7/70.6, 22.0/18.5, 32.7/34.7	1766	2838

Mark A. Richards 10-1-02
REGISTERED GEOLOGIST

8-4-03
PLANS APPROVAL DATE

REGISTERED GEOLOGIST Mark A. Richards No. 5240 Exp. 7-31-04 REGISTERED GEOLOGIST STATE OF CALIFORNIA

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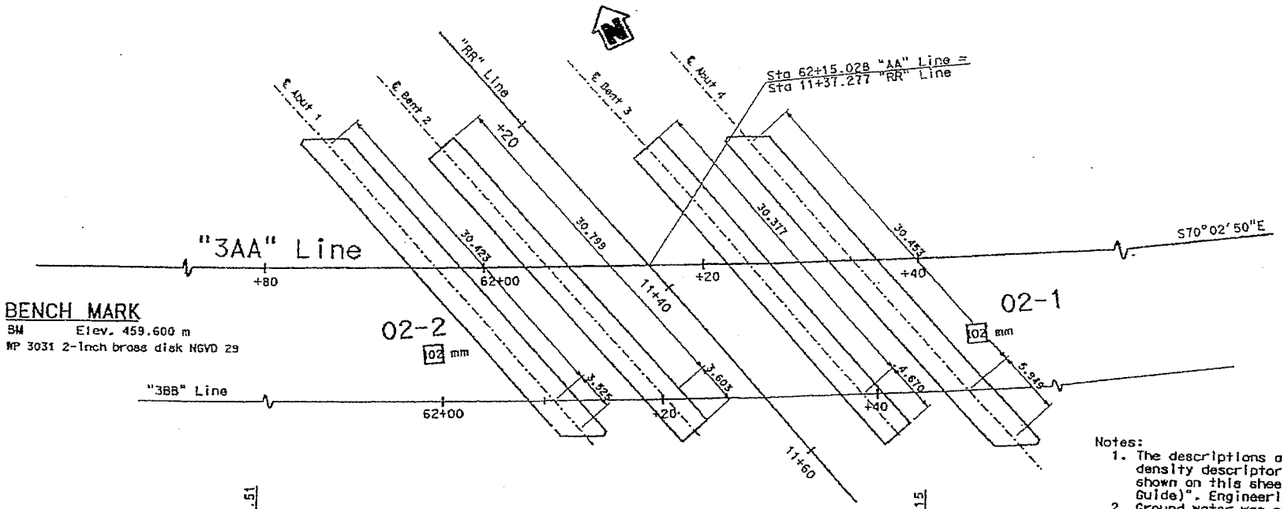
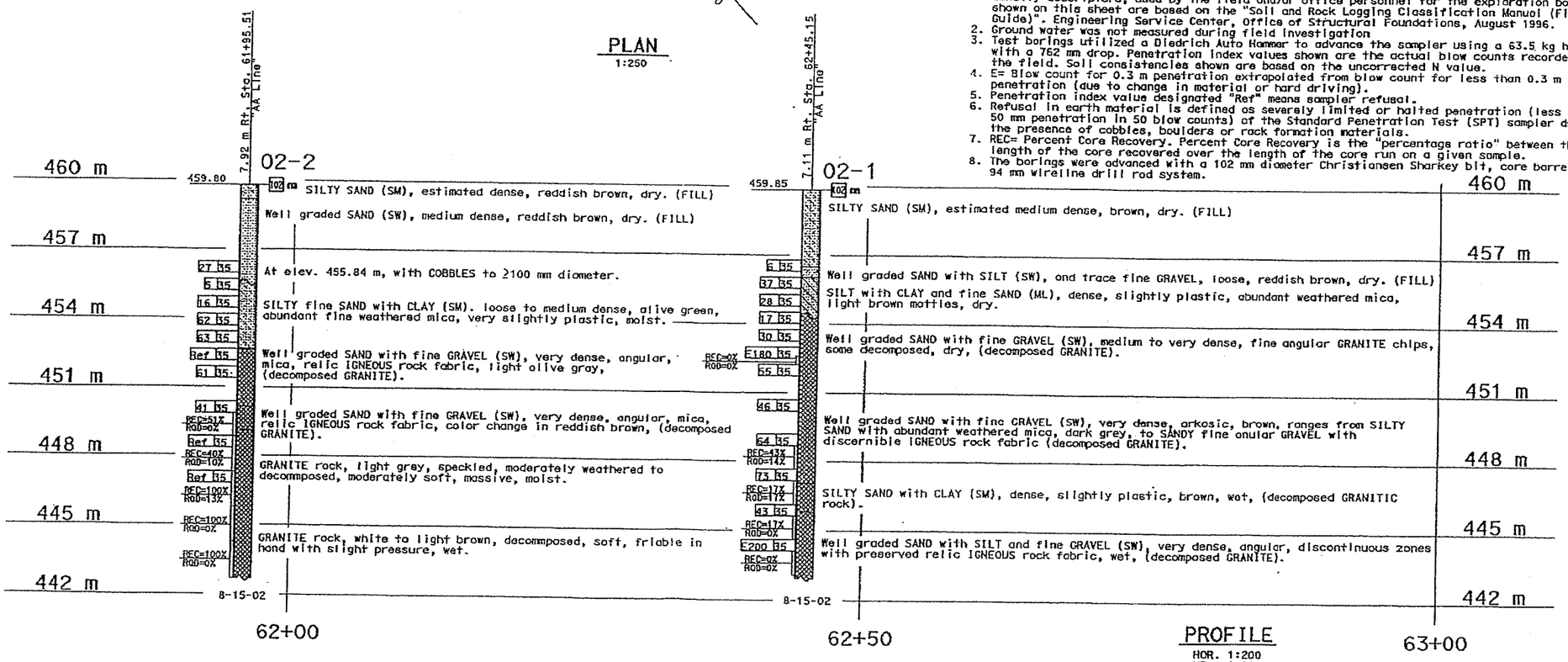


BENCH MARK
BM Elev. 459.600 m
MP 3031 2-inch brass disk NGVD 29

PLAN
1:250

Notes:
1. The descriptions and classifications of rock and/or soil, including consistency and relative density descriptors, used by the field and/or office personnel for the exploration boreholes shown on this sheet are based on the "Soil and Rock Logging Classification Manual (Field Guide)", Engineering Service Center, Office of Structural Foundations, August 1996.
2. Ground water was not measured during field investigation.
3. Test borings utilized a Diedrich Auto Hammer to advance the sampler using a 63.5 kg hammer with a 762 mm drop. Penetration index values shown are the actual blow counts recorded in the field. Soil consistencies shown are based on the uncorrected N value.
4. E= Blow count for 0.3 m penetration extrapolated from blow count for less than 0.3 m penetration (due to change in material or hard driving).
5. Penetration index value designated "Ref" means sampler refusal.
6. Refusal in earth material is defined as severely limited or halted penetration (less than 50 mm penetration in 50 blow counts) of the Standard Penetration Test (SPT) sampler due to the presence of cobbles, boulders or rock formation materials.
7. REC= Percent Core Recovery. Percent Core Recovery is the "percentage ratio" between the length of the core recovered over the length of the core run on a given sample.
8. The borings were advanced with a 102 mm diameter Christiansen Sharkey bit, core barrel, and 94 mm wireline drill rod system.



PROFILE
HOR. 1:200
VER. 1:100

DESIGN SEQUENCE 2

LEGEND OF BORING OPERATIONS

LEGEND OF EARTH MATERIALS

CONSISTENCY CLASSIFICATION FOR SOILS

NOTE: Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply extensive analysis.

ENGINEERING SERVICES	GEOTECHNICAL SERVICES
DRAWN BY F. Nguyen 9/02	
CHECKED BY M. Richards 9/02	

FIELD INVESTIGATION BY: M. Richards

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES STRUCTURE DESIGN 7

BRIDGE No. 56-0082R
KILOMETER POST 60.13

BOX SPRINGS OH RIGHT BRIDGE (REPLACEMENT)
LOG OF TEST BORINGS 1 OF 3

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 7-15-02 11-1-02 12-12-02 4-15-03

SHEET 20 OF 22

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

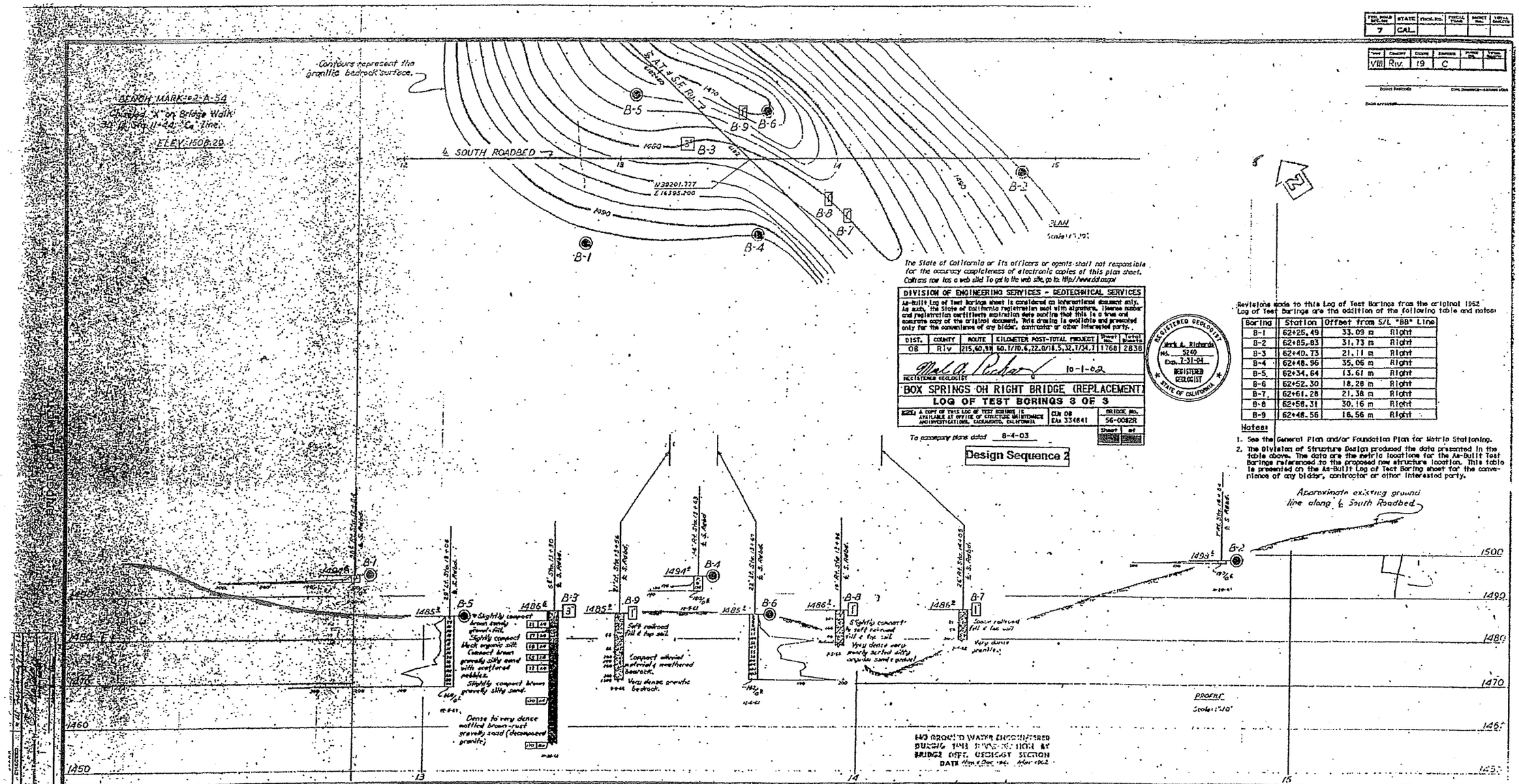
DGS GEOLOGIST LOG OF TEST BORINGS SHEET (METRIC) (REV. 2/02)

FILE => 56-0082r-z-1tb1.dgn

USERNAME => dpoto DATE PLOTTED => 04-JUN-2004 TIME PLOTTED => 14:45

FED. ROAD DIST. NO.	STATE	FISCAL YEAR	PROJ. NO.	SHEET NO.	TOTAL SHEETS
7	CAL.				

ROUTE	COUNTY	PREFIX	SUFFIX	PROJECT NO.	TOTAL SHEETS
VIII	Riv.	19	C		



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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	KILOMETER POST-TOTAL PROJECT	Sheet No.	Total Sheets
08	Riv	215,60,91	60.1/70.6,72.0/18.5,32.1/34.7	11768	2838

Mark A. Richard 10-1-02
REGISTERED GEOLOGIST

BOX SPRINGS OH RIGHT BRIDGE (REPLACEMENT)

LOG OF TEST BORINGS 3 OF 3

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE INVESTIGATIONS, SACRAMENTO, CALIFORNIA

CUN 08 EAA 334641

BRIDGE NO. 56-0082R

Sheet 1 of

To accompany plans dated 8-4-03

Design Sequence 2

REGISTERED GEOLOGIST Mark A. Richard No. 5240 Exp. 1-31-04 REGISTERED GEOLOGIST STATE OF CALIFORNIA

Revisions made to this Log of Test Borings from the original 1962 Log of Test Borings are the addition of the following table and notes:

Boring	Station	Offset from S/L "BB" Line	
B-1	62+25.49	33.09 m	Right
B-2	62+85.83	31.73 m	Right
B-3	62+40.73	21.11 m	Right
B-4	62+48.96	35.06 m	Right
B-5	62+34.64	13.67 m	Right
B-6	62+52.30	18.28 m	Right
B-7	62+61.28	21.38 m	Right
B-8	62+58.31	30.16 m	Right
B-9	62+48.56	16.56 m	Right

Notes:

1. See the General Plan and/or Foundation Plan for Metric Stationing.
2. The Division of Structure Design produced the data presented in the table above. The data are the metric locations for the As-Built Test Borings referenced to the proposed new structure location. This table is presented on the As-Built Log of Test Boring sheet for the convenience of any bidder, contractor or other interested party.

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

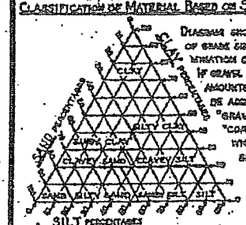


DIAGRAM SHOWS THE BASIS FOR ESTIMATES OF GRADE SIZE DISTRIBUTION USED IN DETERMINATION OF CLASS NAMES.

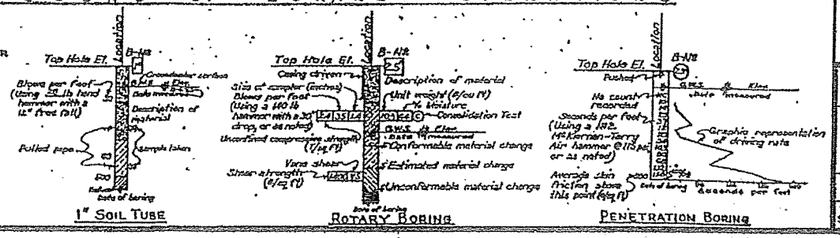
IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIZ; "GRAVELLY SAND." THE TERMS "COARSE", "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE SAND, SILT AND GRAVEL REFER TO STANDARD GRADE SIZE LIMITS.

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/OR ORGANIC MATTER
- FILL MATERIAL
- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

LEGEND OF BORING OPERATIONS

- PENETROMETER
- 2¼" CONE PENETROMETER
- SAMPLER BORING (DRY)
- ROTARY BORING (WET)
- AUGER BORING (DRY)
- JET BORING
- CORE BORING
- TEST PIT



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

BOX SPRINGS - OVERHEAD
W/ Contours

LOG OF TEST BORINGS

SCALE: 1" = 10' | BRIDGE EA 334641 | FILE - | DRAWING

56-0082r-z-1tb3.tif

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	Riv	215.60	R6.1-8/66.3, R19.5/23.0	237	281

REGISTERED ENGINEER - CIVIL 5-4-99

4-13-00
PLANS APPROVAL DATE

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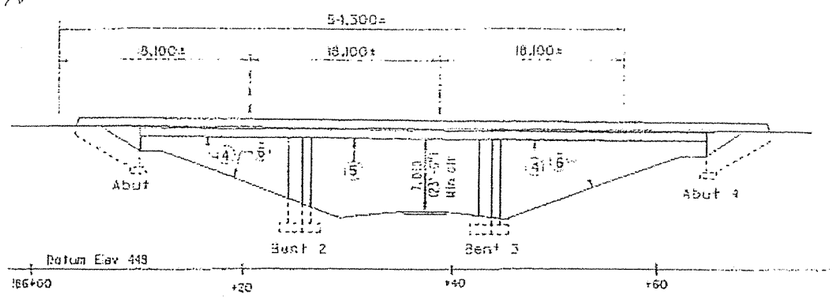


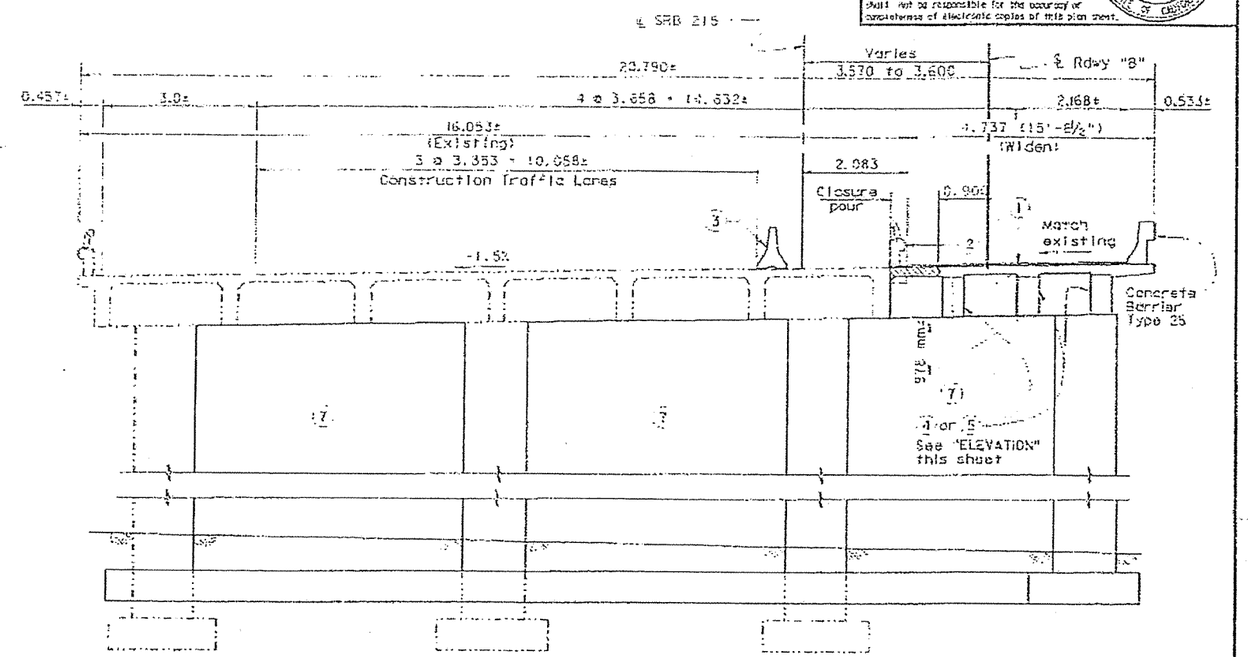
ELEVATION

1:250

Notes:

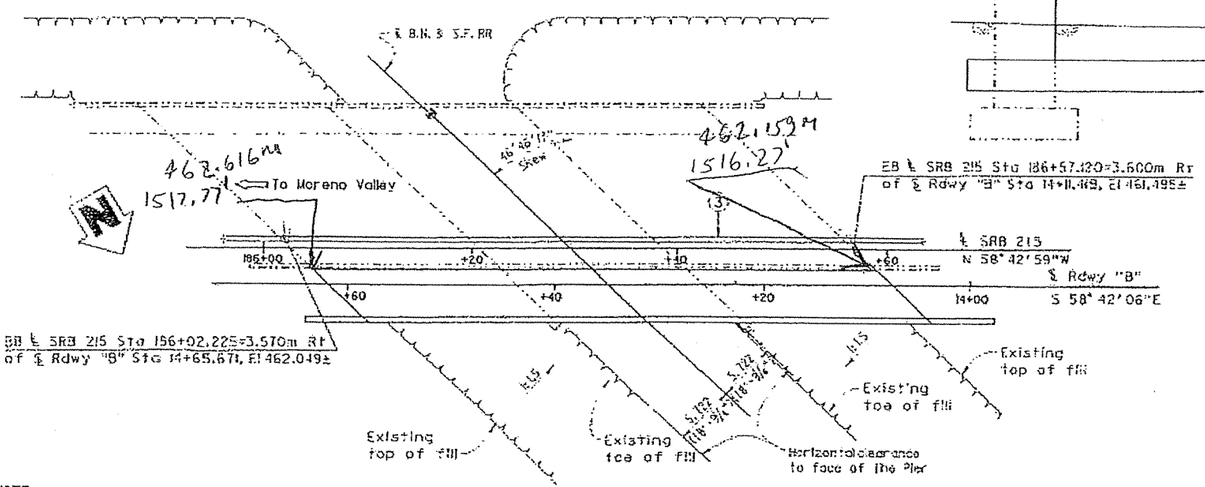
1. 30 mm overlay to match existing. (See Road Plans)
2. Remove existing type 1 railing and deck overhang.
3. Temporary railing type K. (See Road Plans)
4. CIP concrete T girder.
5. Precast/prestressed rectangular girder
6. Slope paving.
7. In-fillwall.

⊘ Point of minimum vertical clearance
— — Indicates existing structure
——— Indicates new construction



TYPICAL SECTION

1:50



NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

PLAN

1: 250

QUANTITIES

BRIDGE REMOVAL (PORTION), LOCATION B	LUMP	SUM
STRUCTURE EXCAVATION (BRIDGE)	713	m^3
STRUCTURE BACKFILL (BRIDGE)	480	m^3
STRUCTURAL CONCRETE, BRIDGE FOOTING	160	m^3
STRUCTURAL CONCRETE, BRIDGE	445	m^3
DRILL AND BOND DOWEL	150	m^3
FURNISH PRECAST PRESTRESSED CONCRETE GIRDER 115 M - 20 M	3	EA
ERECT PRECAST PRESTRESSED CONCRETE GIRDER	3	EA
BAR REINFORCING STEEL (BRIDGE)	54,840	kg
STRUCTURE DRAINAGE SYSTEM	LUMP	SUM
SLOPE PAVING (CONCRETE)	42	m^3
CONCRETE BARRIER (TYPE 25)	86	m

Note:

For General Notes and Standard Plans, see "Index to Plans" sheet

English unit is to be used for AR information only

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN	Ariel Reyes	CHECKED Lawrence Okoye	LOAD FACTOR DESIGN	LIVE LOADING: HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD
DETAILS	A. Lovato/Ed Tapanta	CHECKED Lawrence Okoye	LAYOUT	Ariel Reyes — CHECKED Lawrence Okoye
QUANTITIES	Tim Grouteert	CHECKED Lawrence Okoye	SPECIFICATIONS	Ruth Fernandez — CLASS 1 SPEC CHANGES

DESIGN ENGINEER

STRUCTURES DESIGN GENERAL PLAN SHEET (REVISED 10-1-97)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 10

CU 08
EA 452001

BRIDGE NO. 56-0082L
KILOMETER POST R62.135

BOX SPRINGS OVERHEAD (WIDEN)

GENERAL PLAN

DISREGARD PRINTS BEARING EARLIER REVISION DATES

SHEET 1 OF 14

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	Riv	215.60	R61.8/66.8, R15.5/23.0	238	261

REGISTERED ENGINEER - CIVIL 5-8-99

4-17-00

PLANS APPROVAL DATE

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INDEX TO PLANS

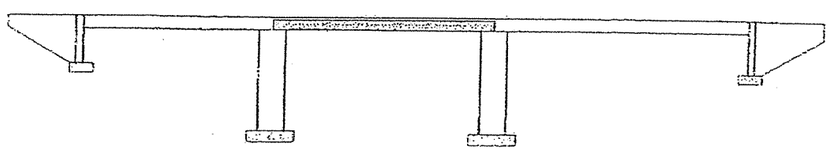
SHEET NO.	TITLE
1	GENERAL PLAN
2	INDEX TO PLANS
3	FOUNDATION PLAN
4	ABUTMENT LAYOUT
5	ABUTMENT DETAILS
6	BENT LAYOUT
7	BENT DETAILS
8	TYPICAL SECTION
9	GIRDER LAYOUT
10	GIRDER REINFORCEMENT
11	PRESTRESSED GIRDER
12	SLOPE PAVING-FULL SLOPE
13	STRUCTURE DRAINAGE DETAILS
14	LOG OF TEST BORING

STANDARD PLANS DATED JULY 1997

A62-C	LIMITS OF PAYMENT FOR EXCAVATION AND BACKFILL-BRIDGE
B0-1	BRIDGE DETAILS
B0-5	BRIDGE DETAILS
B6-1	T-BEAM DETAILS
B6-21	JOINT SEALS (MAX. MOVEMENT RATING=50)
B8-53	CONCRETE BARRIER TYPE 25

STANDARD PLAN SHEET NO.

DETAIL NO.



Structural concrete, Bridge footing (25 MPa @ 28 days)

Structural concrete, Bridge (28 MPa @ 28 days)

indicates PC/PS concrete

CONCRETE STRENGTH AND TYPE LIMITS

GENERAL NOTES
LOAD FACTOR DESIGN

DESIGN: BRIDGE DESIGN SPECIFICATIONS (1983) AASHTO with Interims and Revisions by CALTRANS)

DEAD LOAD: Includes 1675 Pc for future wearing surface.

LIVE LOADING: HS20-44 and alternative and permit design load.

SEISMIC LOADING: Peak Rock Acceleration=0.5 g
ATC-32 ARS Curve (R3=5, Soil Profile C)

REINFORCED CONCRETE: fy = 414 MPa
f'c = 28 MPa
n = 6
Transverse Deck Slabs (Working Stress Design)
fs = 138 MPa
fc = 8 MPa
n = 10

PRESTRESSED CONCRETE: See "Prestressing Notes"

STRUCTURAL STEEL: fy = 250 MPa

FOOTING PRESSURE:	ALLOWABLE	DESIGN
ABUTMENTS:	195 kPa	145 kPa
BENTS:	479 kPa	450 kPa

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN	Arlai Reyes	Lawrence Okoye
DETAILS	Ed D. Tapale 9/98	Lawrence Okoye
QUANTITIES	Jim Greuterl	Lawrence Okoye

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 10

CU 08
EA 453001

BRIDGE NO. 56-0082L
ALIGNMENT POST R62.135

BOX SPRINGS OVERHEAD (WIDEN)

INDEX TO PLANS

DISCARD PRINTS BEARING EARLIER REVISION DATES

SHEET 2 OF 261

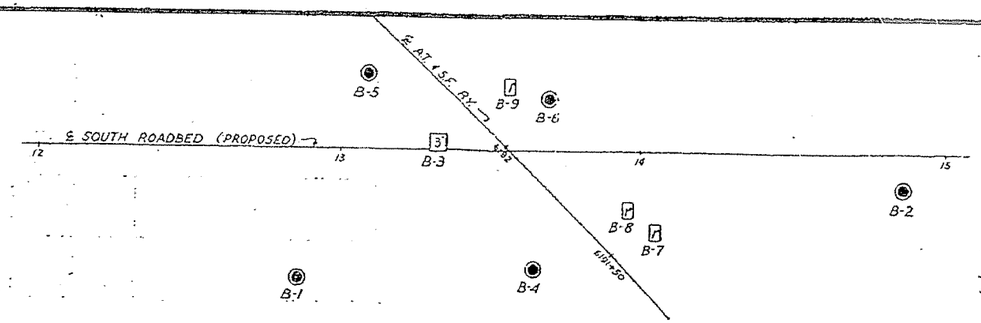
STRUCTURES DESIGN DETAIL SHEET (REVISED REV. 1/29/97)

STATE	FEDERAL AID PROJECT NO.	FISCAL YEARS	SHEET NO.	TOTAL SHEETS
CAL.				

DIST.	COUNTY	ROUTE	POST MILE	SHEET NO.	TOTAL SHEETS
VIII	RIV.	395	21.7/21.71	B3	205

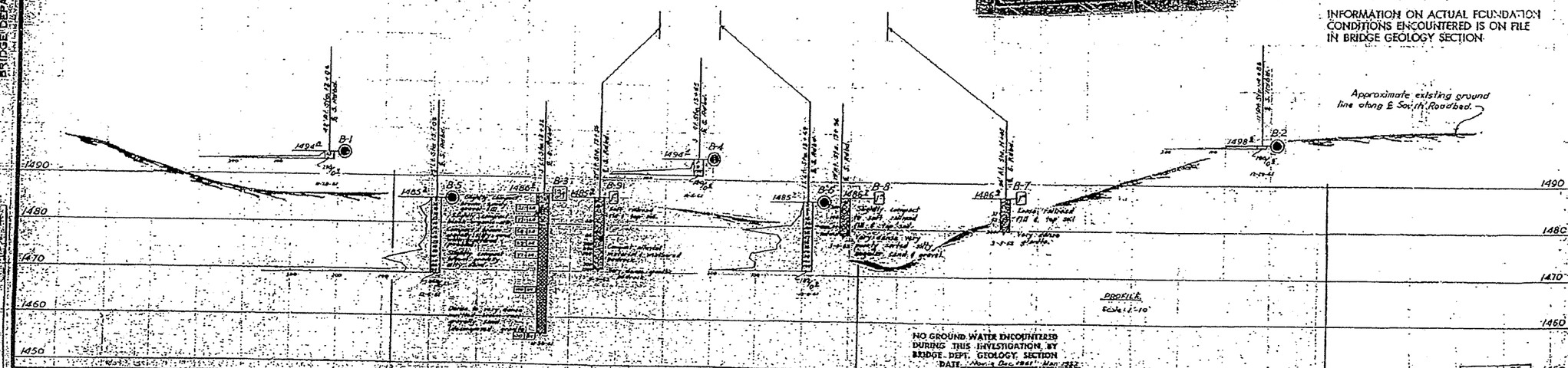
August 2 1962

BENCH MARK # 2-A-54
Chiseled "X" on Bridge Walk 30' Lt Sta. 11+44 "C" Line.
ELEV. 1508.29



AS BUILT PLANS

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 Nov. & Dec. 1961 - Mar. 1962

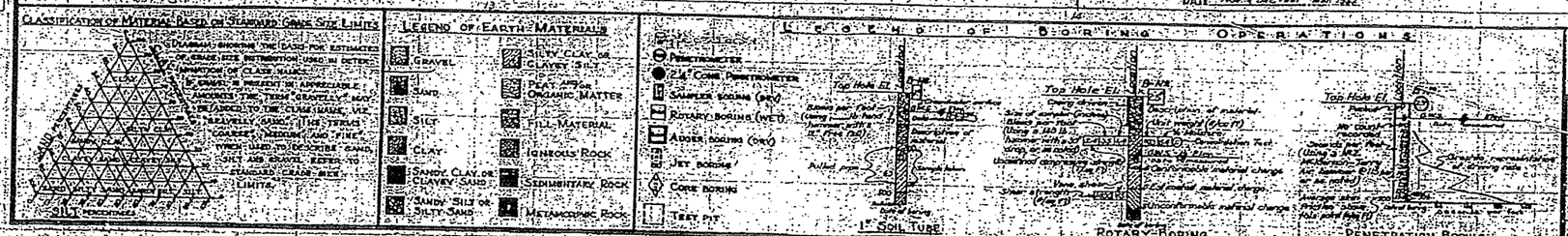
BRIDGE DEPARTMENT

SHEET	OF
8	8

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRAIN SIZE LIMITS

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

LEGEND OF BORING OPERATIONS: PENETROMETER, 2½" CORE PENETROMETER, SAMPLER BORING (PRV), ROTARY BORING (WET), AUGER BORING (DRY), JET BORING, CORE BORING, TEST PIT



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.

BOX SPRINGS OVERHEAD

LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 56-82 R. | FILE | DRAWING 5682-10

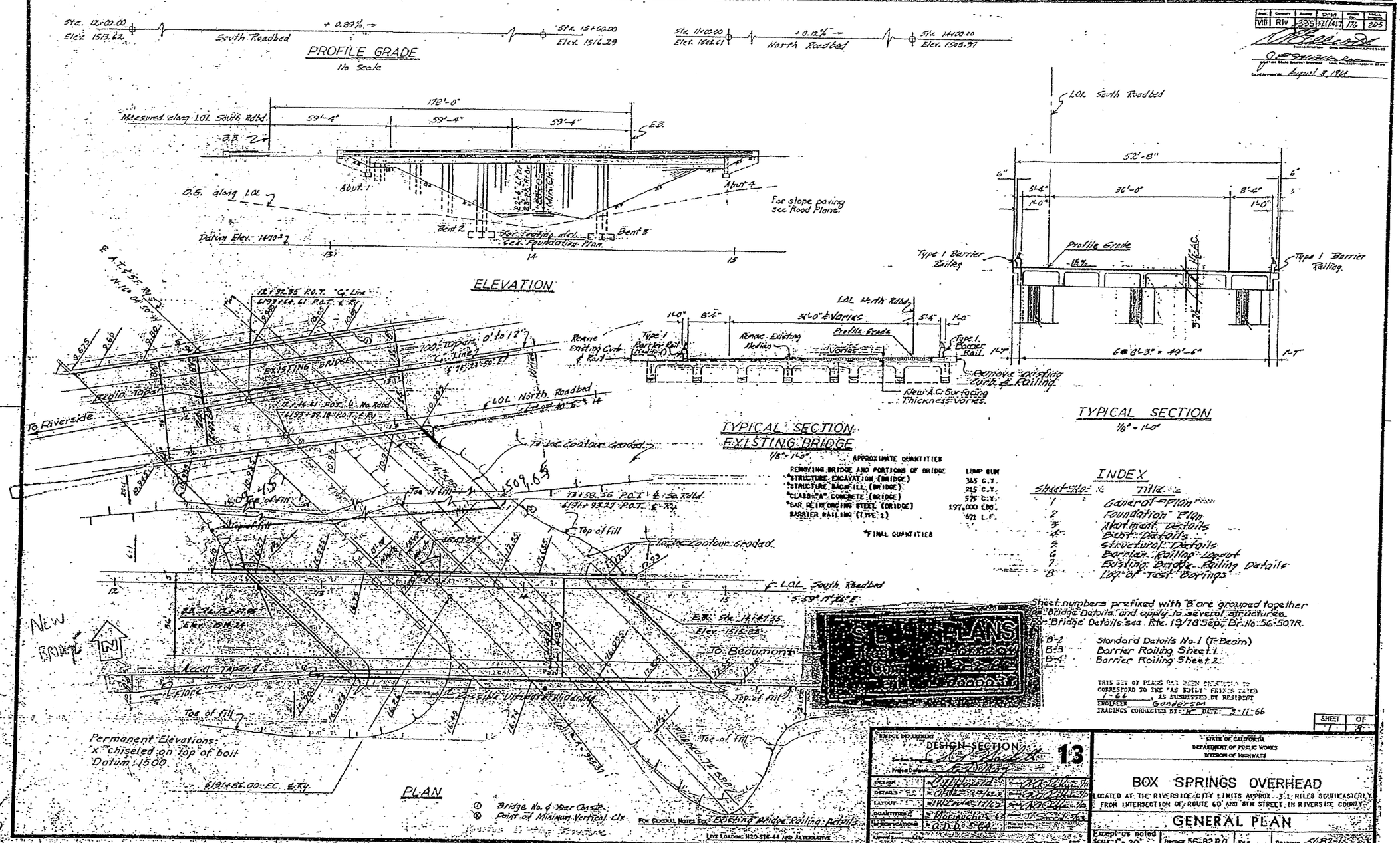
PREL. DRAWING NO. P-5442-8

183

FED. ROAD DIST. NO.	STATE	F.A. PROJECT NO.	REGIST. NO.	CONTRACT NO.
7	CALIF.			

DIST.	COUNTY	ROUTE	POST MILE	SHEET NO.	TOTAL SHEETS
VIII	Riv	395	27.6/41.7	176	205

11-057-2(3) E-057-2(4)



APPROXIMATE QUANTITIES

REMOVING BRIDGE AND PORTIONS OF BRIDGE	LUMP SUM
*STRUCTURE EXCAVATION (BRIDGE)	345 C.Y.
*STRUCTURE BACKFILL (BRIDGE)	215 C.Y.
*CLASS "A" CONCRETE (BRIDGE)	575 C.Y.
*BAR REINFORCING STEEL (BRIDGE)	197,000 LBS.
BARRIER RAILING (TYPE 2)	671 L.F.

*FINAL QUANTITIES

INDEX

Sheet No.	Title
1	General Plan
2	Foundation Plan
3	Abutment Details
4	Bent Details
5	Structural Details
6	Barrier Railing Layout
7	Existing Bridge Railing Details
8	Log of Test Borings

Sheet numbers prefixed with "B" are grouped together as "Bridge Details" and apply to several structures.
"Bridge Details" see Rte. 19/78 Sep. Br. No. 56-507R.

B-2	Standard Details No. 1 (T-Beam)
B-3	Barrier Railing Sheet 1
B-4	Barrier Railing Sheet 2

AS BUILT PLANS
Contract No. 56-82R
Contractor
Date

THIS SET OF PLANS HAS BEEN CHANGED TO CORRESPOND TO THE "AS BUILT" PRINTS DATED 1-66, AS SUBMITTED BY RESIDENT ENGINEER Gunderson
TRACINGS CORRECTED BY: W DATE: 3-11-66

SHEET 1 OF 8

BRIDGE DEPARTMENT
DESIGN SECTION 13
Chief Bridge Engineer
Project Engineer
DESIGN
DETAILS
LAYOUT
QUANTITIES
SPECIFICATIONS

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

BOX SPRINGS OVERHEAD

LOCATED AT THE RIVERSIDE CITY LIMITS APPROX. 3.1 MILES SOUTHEASTERLY FROM INTERSECTION OF ROUTE 60 AND 8TH STREET IN RIVERSIDE COUNTY

GENERAL PLAN

Except as noted SCALE 1" = 20'
BRIDGE 56-82 R/L
FILE
DRAWING 5682-1

P-3682-1

176

12.15

23

County	Route	Section	P.M.	Sheet	Total Sheets
VIII RIV.	395	31/40	17.7	2/4	

August 5, 1966

12+32.35 P.O.T. 'C4' Line
6193+64.61 POT ℄ Ry
N 39,366.417
E 16,347.741

11+15.30 E.C. 'C4' Line
N 39,405.687
E 16,237.473

EXIST BRIDGE NO. 5682

'C4' LINE
S 70° 23' 50" E

LOL NORTH ROADBED

S 67° 37' 40" E

LOL. SOUTH ROADBED

S 59° 17' 26" E

Wood Guard Rail
Exist Edge Shld.
Exist 9" Drains
Exist Curb
PMS Shld.
P.C.C. Rdwy.
Dirt
Concrete

N 39,203.074
E 16,206.348
10+86.09 EC ℄ No Rdbd

N 39,341.977
E 16,354.785
12+46.61 POT ℄ No Rdbd
6193+39.18 POT ℄ Ry

N 39,201.777
E 16,395.200
13+58.56 POT ℄ So Rdbd
6191+93.27 POT ℄ Ry

N 39,194.957
E 16,397.213
6191+86.00 EC ℄ Ry

A.T.E. SF Ry
R = 955.37
Δ = 16° 01' 00"
N 38,930.168
E 15,479.224

AS BUILT PLANS
Contract No. 08-0K520
Date Completed 2-12-66
Document No. RIV 395 P.M. 31.4

UTILITIES

① TP 10 Wires @ Elev. 1502 N-S
② TP 10 Wires @ Elev. 1507 N-S
③ TP 10 Wires @ Elev. 1509 N-W
④ TP# 496249
1 Cable @ Elev. 1526
1 Wire @ Elev. 1529 N-S

Note: indicate bottom of footing elevations

EXIST RAIL GRADES

Station	Elevation Rt. Rail	Elevation Lt. Rail
6191+00	1488.85	1488.67
+25	1488.32	1488.15
+50	1487.79	1487.61
+75	1487.20	1487.06
6192+00	1486.58	1486.53
+25	1485.99	1485.97
+50	1485.42	1485.41
+75	1484.89	1484.89
6193+00	1484.30	1484.31
+25	1483.76	1483.77
+50	1483.25	1483.23

BENCH MARKS

B.M. 2-A-54 Elev. 1508.29
Chisled X on Bridge Walk 30' Lt. Sta. 16+44 C4 Line

B.M. 2-B Elev. 1501.16
Pin in R/W Mon. 135' Lt. Sta. 13+52 C4 Line

THIS SET OF PLANS HAS BEEN CORRECTED TO REFLECT "AS BUILT" CONDITIONS AS SUPERVISED BY CSSY CPI

ENGINEER
TRACINGS CORRECTED BY: DATE:

CUSTOMS CHECKED & VERIFIED IN FIELD
DATE: 6-6-66
BY: J. S. B.

DESIGN SECTION

DESIGN: R. Lundquist
DETAILS: R. Lubic
QUANTITIES: N. Nuzzo

DRAWN BY: H. Hurtado
CHECKED BY: F. J. Hyder

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

BOX SPRINGS OVERHEAD

FOUNDATION PLAN

SCALE: 1" = 20'
STRUCTURE: 56-62 R/L
FILE:
DRAWING: 5282

SHEET 1 OF 8

	NORTH	EAST
A 187 + 94.390 B.C. ℄ SRB 215	697918.9492	1903004.3649
B 186 + 29.671 P.O.T. ℄ SRB 215 11 + 83.535 P.O.T. ℄ AT&SF RR	697826.4440	1903145.320
C 184 + 46.326 P.O.T. ℄ SRB 215 And. 3.657m Rt. 184 + 46.126 P.O.T. ℄ WRB 215 Bk.	697734.2075	1903301.8995

	NORTH	EAST
A 12 + 49.041 E.C. ℄ Rdwy "B"	697927.9574	1902985.0504
B 14 + 34.734 P.O.T. ℄ Rdwy "B" 11 + 78.200 P.O.T. ℄ BNSF RR	697831.4883	1903143.1248
C 14 + 77.474 B.C. ℄ Rdwy "B"	697809.2878	1903150.2403
D 17 + 09.181 E.C. ℄ Rdwy "B"	697693.5469	1903380.9460
E 11 + 39.122 P.O.T. ℄ BNSF RR	697865.4474	1903133.2844
F 11 + 86.339 B.C. ℄ BNSF RR	697823.5465	1903145.8993
G 12 + 55.436 E.C. ℄ BNSF RR	697755.4941	1903156.2359

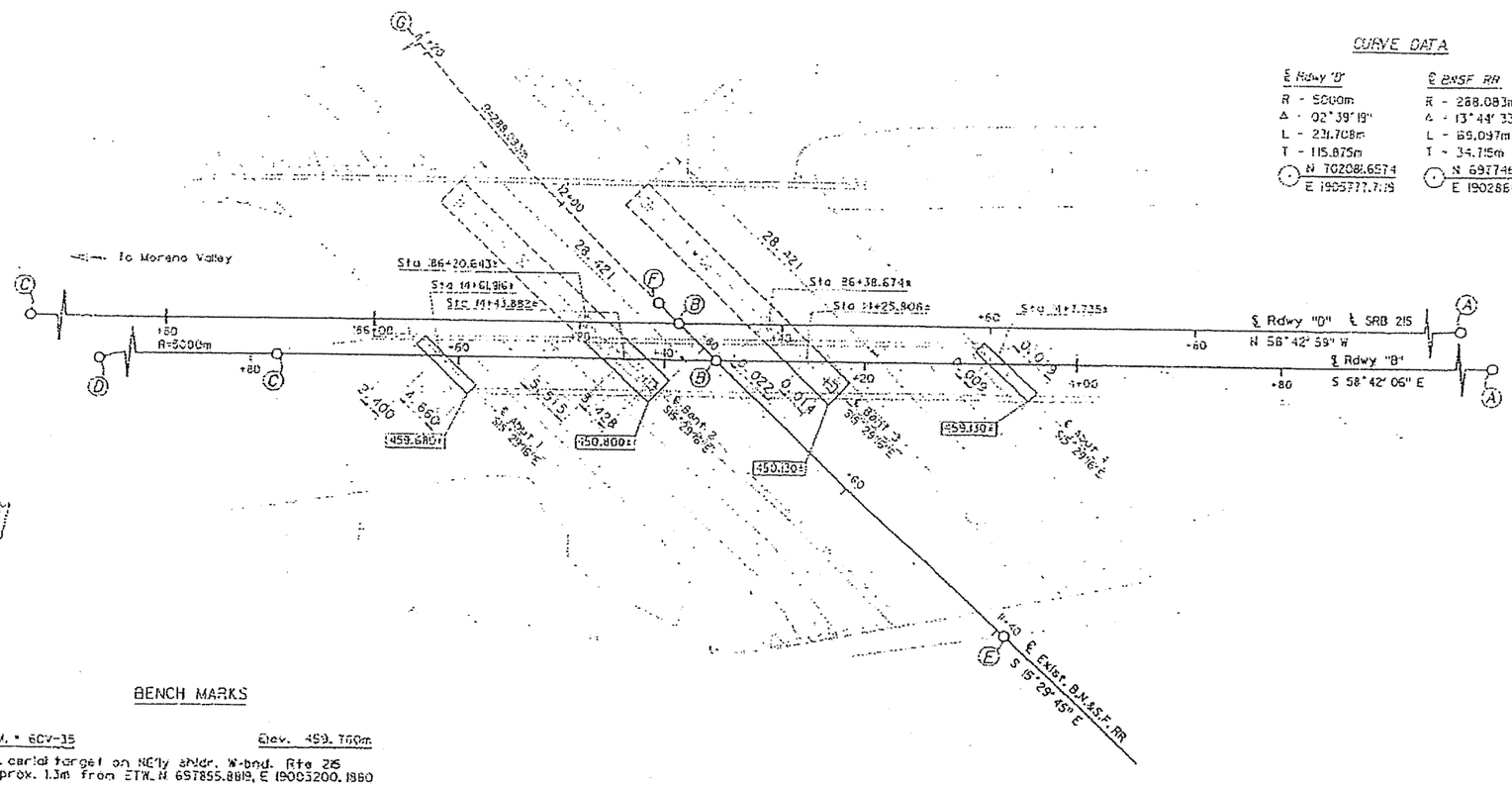
Caltrans Metric

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	Riv	215.60	R61.8/R66.8, R79.5/R83.8	238	281

REGISTERED ENGINEER - CIVIL 5-4-99

4-17-00
PLANS APPROVAL DATE

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



CURVE DATA

℄ Rdwy "B"	℄ BNSF RR
R - 5000m	R - 288.083m
Δ - 02° 39' 19"	Δ - 13° 44' 33"
L - 231.708m	L - 69.097m
T - 115.875m	T - 34.715m
N 702088.6574 E 1905777.7119	N 697746.7882 E 1902868.2771

BENCH MARKS

B.M. * 6CV-35 — Elev. 459.760m

Fd. cardal target on NE'ly shldr. W-bnd. Rte 215 approx. 1.3m from ETW. N 697855.8819, E 1900320.1860

B.M. * 303! — Elev. 459.599m

Fd. 51mm brass disk in 51mm stamped "Calif. Dept of Transportation" IBV 215-38.67 1990", NE cor. W-bnd Rte 215 bridge over AT&SF RR track. N 697880.7696, E 1903144.1431

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

NOTES

+ denotes spot elevation.
* denotes top of rail grade elevation below structure.
indicates bottom of footing elevation. plus/minus indicates adjustments to achieve minimum 0.90m ground cover.

Datum: NGVD 29, Adj. 1960.
Underground utilities as shown are approx.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

PRELIMINARY INVESTIGATION SECTION

SCALE	HORZ. DATUM	PHOTOGRAMMETRY AS OF:	DRAWN	W. HEDBLUM 2/90
1:250	VERT. DATUM	SURVEYED	TRACED	
ALIGNMENT DATE		FIELD CHECKED L. MANARO 1/98	CHECKED L. MANARO 3/98	

STRUCTURES FOUNDATION PLAN SHEET (DETAIL) (REV. 5/5/97)

DESIGN	Jalal Rayes	Lawrence Okaya
DETAILS	Ed D. Tepoa 9/98	Lawrence Okaya
QUANTITIES	Tim Greutert	Lawrence Okaya

ORIGINAL SCALE IN MILLIMETERS FOR MODIFIED TRACE 0 10 20 30 40 50 60 70 80 90 100

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

CU 08
EA 453001

UNIT NO. 56-0062L
KILOMETER POST R62.145

BOX SPRINGS OVERHEAD (WIDEN)
FOUNDATION PLAN

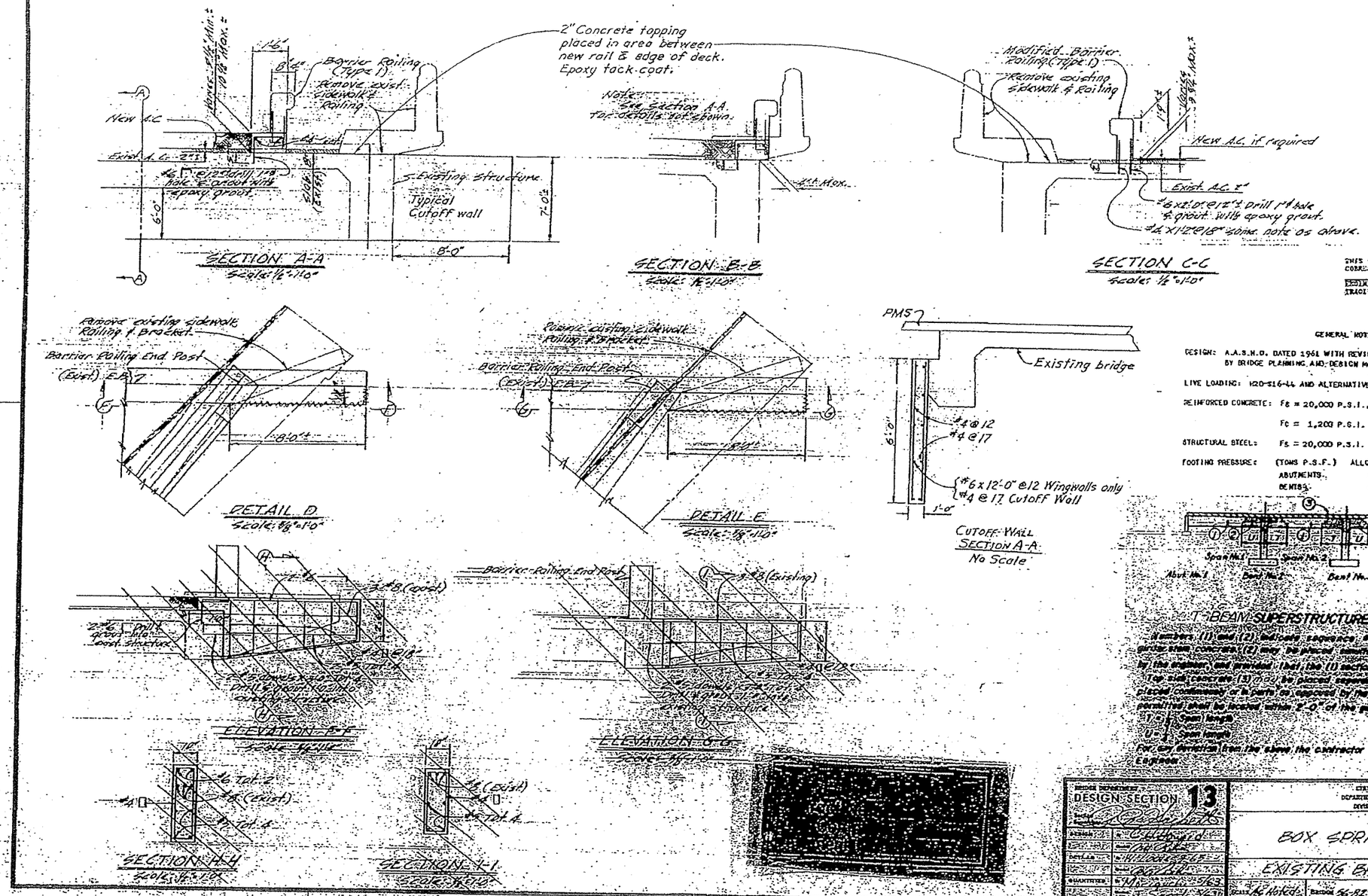
DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRE-PRIMARY STAGE ONLY) | SHEET 3 OF 34

FED. ROAD DIST. NO.	STATE	F.A. PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CALIF.			

Bridge	Structure	Sheet	P.M.	Project No.	Sheet No.
12/14	14-A	395	32.1/41.7	182	205

August 3, 1964



THIS SET OF PLANS DO NOT CORRESPOND TO THE AS SUBMITTED BY RESIDENT ENGINEER
DRAWINGS CORRECTED BY: DATE:

GENERAL NOTES

DESIGN: A.A.S.H.O. DATED 1961 WITH REVISIONS AND AS SUPPLEMENTED BY BRIDGE PLANNING AND DESIGN MANUAL.

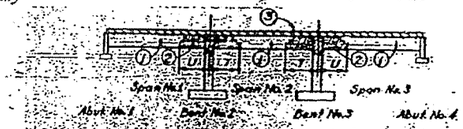
LIVE LOADING: H20-S16-44 AND ALTERNATIVE

REINFORCED CONCRETE: Fs = 20,000 P.S.I., N = 10

Fc = 1,200 P.S.I.

STRUCTURAL STEEL: Fs = 20,000 P.S.I.

FOOTING PRESSURE:	(TONS P.S.F.)	ALLOWABLE	DESIGN
	ABUTMENTS	2	1 1/2
	BENTS	6	4 1/2



T-BEAM SUPERSTRUCTURE PLACING DIAGRAM

Numbers (1) and (2) indicate sequence of placing girder stem concrete. (2) may be placed simultaneously with (1) when approved by the engineer, and provided that the (1) sections are placed in adjacent spans. Top slab concrete (3) may be placed separately from (1) and (2). (3) may be placed continuously or in parts as approved by the engineer, however the only joints permitted shall be located within 2'-0" of the center joints between (1) and (2)

T - ¼ Span length
U - ¼ Span length

For any deviation from the above the contractor shall submit a diagram to the Engineer.

SHEET	OF
7	8

BRIDGE DEPARTMENT
DESIGN SECTION 13

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

BOX SPRINGS OVERHEAD

EXISTING BRIDGE RAILING DETAILS

SCALE As Noted | BRIDGE 56-82 TL | TITLE: | DRAWING SLBR-1

182

FINAL
STRUCTURE FOUNDATION REPORT
BOX SPRINGS OVERHEAD (TIEBACK)
BRIDGE NO. 56E0036
INTERSTATE 215/STATE ROUTE 60 EAST JUNCTION
CITY OF RIVERSIDE, CALIFORNIA
08-RIV-215/60, KP 60.7/70.6, 22.0/18.5
CALTRANS EA NO. 449311

Prepared for:

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER WEST, INC.
1220 Research Drive, Suite B
Redlands, CA 92374

Kleinfelder Project No. 76979

Revised June 12, 2009
February 9, 2009

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APPROVAL LETTER

Flex your power!
Be energy efficient!

Memorandum

To: Mr. Denix D. Anbiah
Department of Transportation
Division of Structural Engineering
Office of Special Funded Projects MS #9- 2/7G

Date: October 13, 2009

File: 08-RIV-56E0036
EA 08-449311
Box Springs OH,
Tieback Wall

Attention: Robert Zezoff
Kookjoon Ahn

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES - MS #5
OFFICE OF GEOTECHNICAL DESIGN SOUTH-2

Subject: California Department of Transportation (Caltrans) Foundation Report Review Comments.

Reference: Addendum to Final Structural Foundation Report, Box Springs Overhead (TieBack), Bridge No. 56E0036, Interstate 215 / State Route 60 East Junction, City of Riverside, California, 08-Riv-215/60, KP 60.7/70.6, 22.0/18.5, Caltrans EA No. 449311, dated October 2, 2009, by Kleinfelder West, Inc., Project No. 76979.

(Half Size) General Plans No.1, Box Springs OH (Tieback), 13 sheets , dated 10/2/09, by LAN Engineering Corp.

The submitted Foundation Report by Kleinfelder West, Inc. and Revised Plans for the referenced project generally satisfy the requirements of Caltrans' Foundation/Geotechnical Design Report Guidelines and is accepted.

Any questions regarding the review comments and recommendations should be directed to attention of Doug Cook (916) 227-4514 or Angel Perez-Cobo (916) 227-7167, Office of Geotechnical Design South-2.

Prepared by:

K. Douglas Cook

K. Douglas Cook, CEG date: 10-13-09
Engineering Geologist

KDC

Reviewed by:

Angel Perez-Cobo, PE date: 10-13-09
Senior Transportation Engineer
Office of Geotechnical Design South-2

Distribution: (2) Addressee

ADDENDUM

1220 Research Drive
Suite B
Redlands, CA 92374
p| 909.793.2691
f| 909.792.1704
kleinfelder.com

October 2, 2009
Project No. 76979

Mr. Norman Suydam, PE
AECOM LAN
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

via Electronic Mail
Mohan.Char@aecom.com
Kimberly.Gee@aecom.com

Subject: Addendum to Final Structure Foundation Report
Box Springs Overhead (Tieback)
Bridge No. 56E0036
Interstate 215/State Route 60 East Junction Improvements
City of Riverside, California
08-RIV-215/60, KP 60.7/70.6, 22.0/18.5
Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder has prepared this addendum report in response to comments provided by the California Department of Transportation (Caltrans) Office of Geotechnical Design South-2, dated July 28, 2009, pertaining to their review of our Final Structure Foundation Report for Box Springs Overhead (Tieback), dated June 12, 2009. The Caltrans review comments and our responses to these comments are attached.

CLOSURE

The information contained in this report/letter is subject to the conditions and limitations contained within the structure foundation report. We appreciate the opportunity to be of service on this project. If you have any questions, comments or require additional information, please do not hesitate to contact our office at your convenience.

Copyright 2009 Kleinfelder

Respectfully submitted,
KLEINFELDER WEST, INC.

Madan Chirumalla, PE
Staff Engineer

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

MC/CVA:lg

Attachments: Caltrans Review Comments Matrix

Copyright 2009 Kleinfelder

Project Name: **I-215/SR-60 East Junction**
08-Riv-215/60 CU08 -EA449311
Review Phase: **Foundation Report Review**
Box Springs OH (Tieback) Bridge No. 56E0036
Responses by: **Carlos Amante & Madan Chirumalla**

This document contains the response to Caltrans comments dated September 17, 2009 on Addendum to Structure Foundation Report.

RESPONSE TO COMMENTS ON FOUNDATION REPORT REVIEW – RETAINING WALLS FOR WB AND EB SR60 HOV CONNECTORS

Comment No.	Page, Section	Review Comments by Douglas Cook and Asef Wardak	Responses	✓
1	Appendix E	The response to Comment 1 has not addressed the comment: "Please discuss what effects the proposed tieback wall may have on the existing and new foundation elements at the abutment and if necessary provide recommendations to mitigate". The response discussed intent of the design and global factor of safety against slope failure	The tieback wall will be constructed to provide containment and support for the existing abutment slope and foundations after proposed excavation and roadway widening under the existing bridge.	
2	Appendix E	The response to Comment 3 indicated an action and reply submittal from LAN Engineering. Such a reply and submittal by LAN not been received as of this date.	AECOM LAN (formerly, LAN Engineering) will submit the required details.	
3	Pg.10 Sec 6.1	Review of the cited USGS Geologic Map of the San Bernardino and Santa Ana 30'x60' Quadrangles (2006) indicated that the site is transected by an inferred fault. Please include a copy of the geologic map for the site vicinity, discuss this fault in the text of the report. Provide recommendations to address and mitigate it in the design of the project as necessary.	The inferred fault depicted on the San Bernardino and Santa Ana 30'x60' quadrangle, sheet 1of 4, (USGS Open-File Report OF-2006-1217) is a pre-Pleistocene fault. The fault does not cut Late Pleistocene or Holocene deposits as indicated on Sheet 3 of 4 of OF-2006-1217. As such the fault is not considered a "sufficiently active" or "well-defined" active fault based on the California Geological Survey criterion in CGS Special Publication 42 (2007). In addition, the fault is not identified as an active fault by Caltrans on the Seismic Hazards Map used for bridge seismic design. Bridge design parameters were developed based on current Caltrans seismic design criteria and no additional mitigation recommendations for this subject fault are necessary.	

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Project Name: **I-215/SR-60 East Junction**
08-Riv-215/60 CU08 -EA449311
Review Phase: **Foundation Report Review**
Box Springs OH (Tieback) Bridge No. 56E0036
Responses by: **Carlos Amante & Madan Chirumalla**

Comment No.	Page, Section	Review Comments by Douglas Cook and Asef Wardak	Responses	✓
4	Pg 13, Appendices B and C	The lab results (Appendix B) reports a shear value Friction Angle of 33 degrees, yet a friction angle value of 34 degrees is reported in the text and used in the stability analysis for the fill (Appendix C). Please review and justify the use of the higher value or revise the analysis using the lower value accordingly.	The friction angle of 34 degrees was obtained from Caltrans memorandum for the Tieback Wall for Box Springs OH Left Bridge, dated February 24, 2005, prepared by Mark A. Richards, Engineering Geologist, and Angel V. Perez-Cobo, Senior Transportation Engineer. (File: 08-Riv-Rte 60-KP 62.10, EA 08-334841, Box Springs OH Left Bridge, RW 215-3M-14, Bridge Number 56-0082L)	
5	Pg. 14, Plate 7	A Peak Bedrock Acceleration (PBA) of 0.5g is reported for the site on pages 10 and 11 of the report, yet a peak ground acceleration (PGA) of 0.39g was is reported on Plate 7. For a Type C site the PBA and PGA should be the same. It appears that the reported PGA value of 0.39g was used in determining the horizontal peak ground acceleration (HPGA) of 0.13g as reported on page 14 and used in the analysis. If 0.5g were to be used then a HPGA of 0.17g should be used. Please review and justify the use of the lower value or revise the analysis using the larger value.	Based on Sadigh et al. (1997) attenuation relationship for soil site, the peak ground acceleration (PGA) for this bridge site is 0.39g. In our opinion, the use of PBA of 0.5g is not appropriate since the bridge site is founded on soil. New Generation Attenuation (NGA) relationships also indicate that peak bedrock acceleration and peak ground acceleration for Soil Profile Type C are not the same.	

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60.215	R19.7/21.9. R61.3/62.7		

Caltrans Metric

Carlos Amante 10/02/09
CERTIFIED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

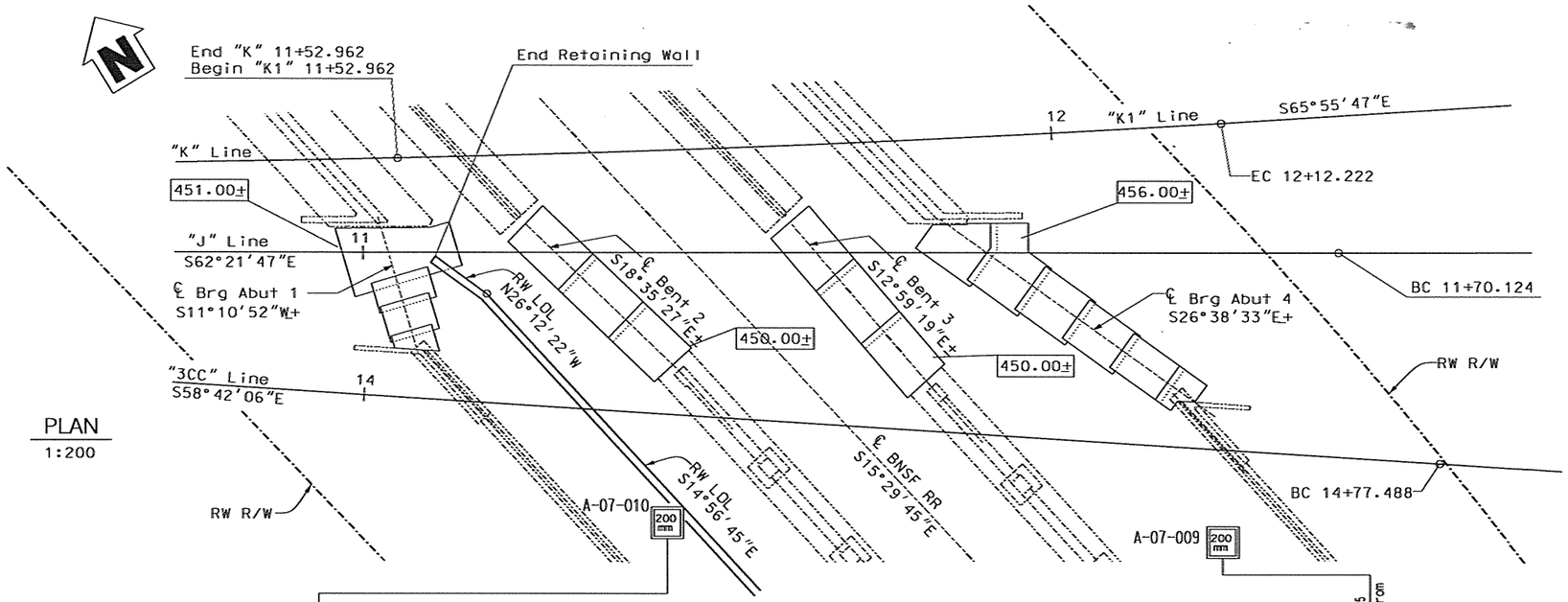
PLANS APPROVALDATE

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.

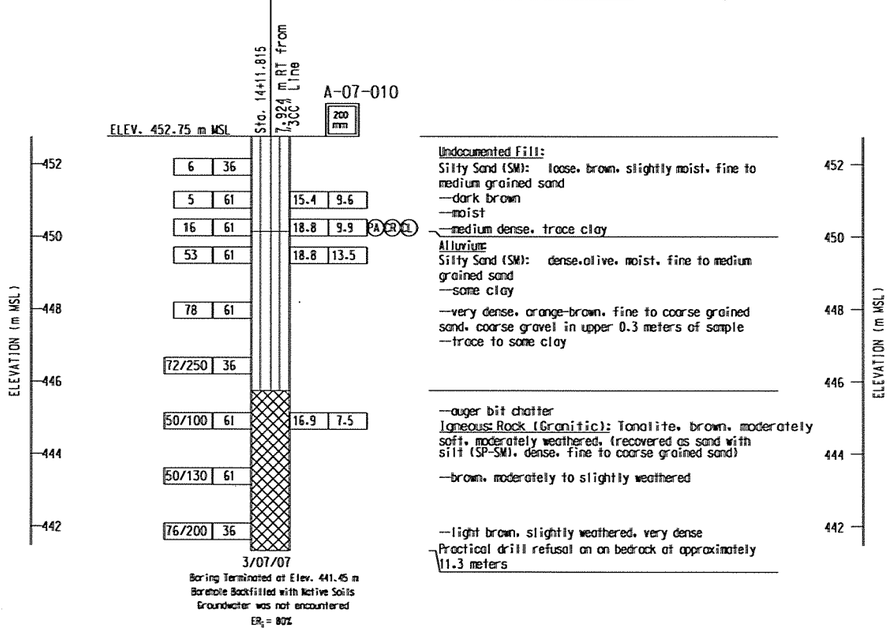
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

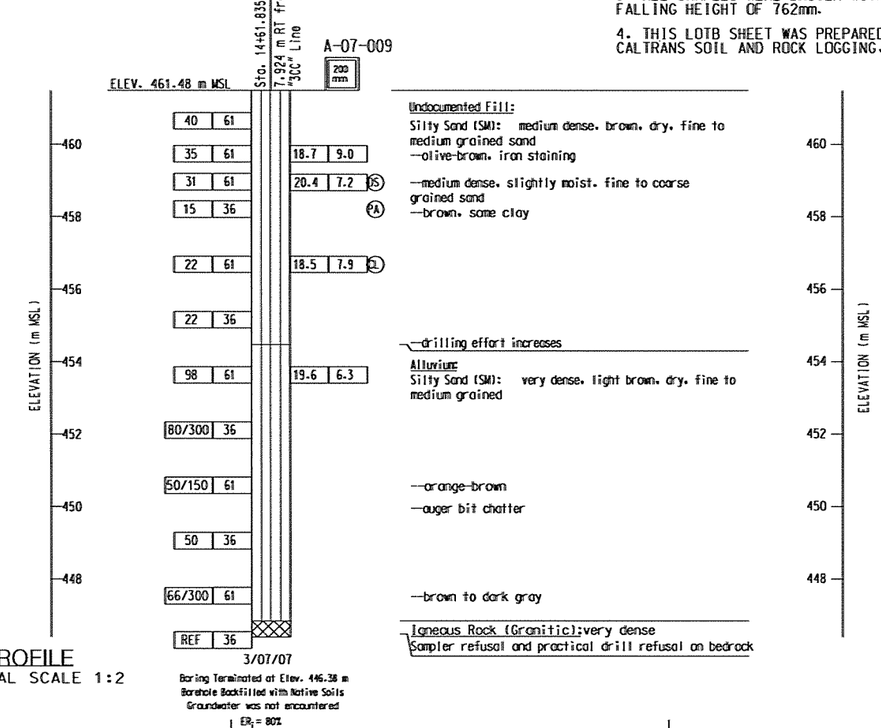
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374



PLAN
1:200





PROFILE
VERTICAL SCALE 1:2

14+00 15+00

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

BENCH MARK

BM Elev. 459.600 m
NP 3031 51mm Brass disk NGVD29

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.
2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.
3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.
4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56E0036
KILOMETER POST R62.2

BOX SPRINGS OH (TIEBACK)
LOG OF TEST BORINGS

OGS CIVIL LOG OF TEST BORINGS SHEET

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

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REVISED FINAL STRUCTURE FOUNDATION REPORT

FINAL
STRUCTURE FOUNDATION REPORT
BOX SPRINGS OVERHEAD (TIEBACK)
BRIDGE NO. 56E0036
INTERSTATE 215/STATE ROUTE 60 EAST JUNCTION
CITY OF RIVERSIDE, CALIFORNIA
08-RIV-215/60, KP 60.7/70.6, 22.0/18.5
CALTRANS EA NO. 449311

Prepared for:

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Kleinfelder Project No. 76979

Revised June 12, 2009
February 9, 2009

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Revised June 12, 2009
February 9, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

Subject: **Final Structure Foundation Report**
Box Springs Overhead (Tieback)
Bridge No. 56E0036
Interstate 215/State Route 60 East Junction
City of Riverside, California
08-RIV-215/60, KP 60.7/70.6, 22.0/18.5
EA No. 449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) is pleased to present this Final Structure Foundation Report for the proposed tieback retaining wall for Box Springs Overhead Left Bridge widening, to be located at the east junction of existing Interstate 215 and State Route 60 in the City of Riverside, California. The purpose of this report is to provide geotechnical engineering recommendations for design and construction of the proposed project. This report incorporates our responses to Caltrans review comments dated March 25, 2009 (see Appendix E).

The proposed project is geotechnically feasible provided that our recommendations in this report are properly incorporated into the design and construction of the project. Recommendations provided herein are contingent on the provisions outlined in the Additional Services and Limitations section of this report. The project Owner should become familiar with these provisions in order to assess potential impacts to the proposed project and further involvement by Kleinfelder.

We appreciate the opportunity to be of service on this project. If you have any questions and comments or require additional information, please do not hesitate to contact the undersigned.

Sincerely,
KLEINFELDER WEST, INC.

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1.0 INTRODUCTION

1.1 GENERAL

Kleinfelder West, Inc., (Kleinfelder) was retained by Lim & Nascimento Engineering Corporation (LAN Engineering) to provide geotechnical services for the proposed Box Springs Overhead Bridge Widening, located at the Interstate 215/State Route 60 (I-215/SR-60) East Junction in the City of Riverside, Riverside County, California (see Plate 1, *Site Location Map*). The scope of our services was provided in our proposal entitled *Revised Proposal for Geotechnical Services For Plans, Specifications, and Cost Estimates (PS&E), I-215 East Junction, Riverside, California, dated July 29, 2008.*

This report presents our recommendations relative to the geotechnical aspects of design and construction of the proposed tieback retaining walls for the proposed Box Springs Overhead bridge widening project. Conclusions and recommendations presented in this report are based on the subsurface conditions encountered at the locations of our field excavations, and the provisions and requirements outlined in the Additional Services and Limitations sections of this report. Recommendations presented in this report should not be extrapolated to other areas or be used for other projects without our prior review.

1.2 PROJECT DESCRIPTION

The project consists of construction of a new tieback retaining wall under the existing Box Springs Overhead Left Bridge (Bridge No. 56-0082L) and Box Springs Overhead Truck Connector (Bridge No. 56-0805G), near the east junction of I-215 and SR-60 (see Plates 2a, 2b and 3a, *General Plan No. 1 and 2, and Foundation Plan, respectively).*

We understand that the tieback wall will be constructed along the western abutment slopes of the existing structures to provide for the construction of access road along the west side of existing BNSF railroad tracks. The proposed tieback wall will consist of two to four levels of tieback anchors with height ranging from 2.4 to 6.8 meters and backfill slopes of 1:1.5 and 1:2 (Vertical:Horizontal, V:H)

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Based on the as-built plans (see Appendix D) for Box Springs Overhead Left Bridge structure, the existing structure consists of three-span, precast, prestressed rectangular concrete girder and cast-in-place concrete T-girder, supported on shallow spread footings at the abutments and bents with a total length of 54.3 meters and width of 20.79 meters (including the widened portion).

The existing Box Springs Overhead Truck Connector lies on the south side of Box Springs Overhead Left Bridge and consists of a three-span cast-in-place, prestressed concrete slab, supported on shallow foundations. This bridge has a length of 59.46 meters and width of 15.95 meters.

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2.0 GEOTECHNICAL INVESTIGATION

The purpose of this investigation was to evaluate subsurface conditions at the site and provide geotechnical recommendations for design and construction of the proposed tieback retaining wall. A description of the scope of services performed is presented below.

Task 1 – Literature Review

We began our services by reviewing the as-built plans of the existing structures (see Appendix D), as well as the soils and geologic data in our files and from select public agencies (see References). We have completed a computerized search of appropriate seismic and faulting information as it relates to the site.

Task 2 – Field Exploration

Our subsurface exploration program for the Box Springs Overhead Left Bridge widening consisted of drilling and logging two exploratory soil borings A-07-009 and A-07-010 (BS-1 and BS-2) on March 7, 2007. Locations of our borings are shown on Plate 4D, *Log of Test Borings.* These borings were advanced to depths ranging from approximately 11.3 to 15.1 meters below the existing ground surface (bgs).

The borings were advanced using an L10T track-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer delivery system. The borings were logged and sampled by a staff professional from our office using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Each soil sample was observed and described in general accordance with the Unified Soil Classification System (USCS). Following drilling, sampling and logging, the borings were backfilled with native cuttings. The boring logs are presented in Appendix A, *Field Exploration*.

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Task 3 – Laboratory Soil Testing

A laboratory testing program was developed and performed to characterize and evaluate the engineering properties of the subsurface soils. Tests performed consisted of moisture content and in situ dry unit weight (ASTM D2216 and D2937); grain size distribution (ASTM D 422); direct shear test (ASTM D 3080); consolidation test (ASTM D 5333); and corrosivity tests consisting of electrical resistivity test (CTM 532), pH (CTM 643), sulfate content (CTM 417), and chloride content (CTM 422). The laboratory test procedures and results are presented in Appendix B, *Laboratory Testing*.

Task 4 – Geotechnical Analyses and Report Preparation

Field and laboratory findings were evaluated in conjunction with the proposed use project. This report includes conclusions and recommendations regarding the following:

- Regional geologic setting, geologic features, and geologic hazards including the potential for ground rupture due to surface faulting, liquefaction potential, and other seismically induced hazards;
- Subsurface materials encountered within the exploratory borings, anticipated groundwater levels and excavation characteristics of these materials;
- Corrosion potential of the near-surface soils;
- Acceleration Response Spectra (ARS) curves, including standard Caltrans ARS curve and modified (design) ARS curve;
- Lateral earth pressures and soil bearing capacity for tieback wall design;
- Global slope stability analysis of the tieback wall and retained soil mass; and
- Guidelines for earthwork including recommendations for site preparation, fill placement, and compaction.

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3.0 PERTINENT REPORTS AND INVESTIGATIONS

The following documents were reviewed for this study:

- General Plan No. 1 and 2, Foundation Plan and Wall Layout for Box Springs OH (Tieback), I-215/SR60 East Junction, Prepared for the State of California, Department of Transportation, CU 08, EA 449311, by LAN Engineering, Revision Date June 12, 2009.
- As-Built General Plan, Foundation Plan and Log of Test Borings, Box Springs OH Truck Connector, Bridge No. 56-0805G, Prepared by the State of California, Department of Transportation, CU 08, EA 334841, Dated 8-4-03.
- As-Built General Plan, Foundation Plan and Log of Test Borings for Box Springs Overhead (Widen), Bridge No. 56-0082L, Prepared by the State of California, Department of Transportation, CU 08, EA 4493111, Dated 4-17-00.
- As-Built General Plan, Foundation Plan and Log of Test Borings for Box Springs Overhead (Widen), Bridge No. 56-0082R/L, Prepared by the State of California, Department of Transportation, Dated 8-3-64.
- Structure Foundation Report, Proposed Box Springs Overhead Left Bridge Widening, Bridge Number 56-0082L, I-215/SR60 East Junction, Riverside, California, California, 08-RIV-215/60, KP R38.6, Caltrans EA No. 449311, Kleinfelder Project No. 76979, dated March 14, 2008.
- Preliminary Foundation Report, Proposed Box Springs Overhead Bridge Widening, I-215/SR60 East Junction, Riverside, California, Kleinfelder Project No. 76979, dated June 14, 2007.
- United States Geological Survey, 7-1/2 Minute Series, Riverside East Quadrangle, California, 1967, Photorevised 1980.
- United States Geological Survey, Geologic Map of the San Bernardino and Santa Ana 30’ X 60’ Quadrangle, California, Version 1.0, 2006.

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4.0 GEOLOGY AND SEISMICITY

4.1 REGIONAL AND LOCAL GEOLOGY

The project site is situated within the northern Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are a northwest-southeast oriented complex of blocks separated by similarly trending faults which extend 200 kilometers from the Transverse Ranges south to the Mexican border and beyond another 1250 kilometers to the tip of Baja California. The province varies in width from 50 to 160 kilometers and is bounded on the east by the Colorado Desert and the Gulf of California and on the west by the Pacific Ocean.

The Peninsular Ranges contain Jurassic-age and Cretaceous-age igneous and metamorphic rocks, as well as a thick sequence of marine and non-marine sedimentary rock. The Peninsular Ranges Province is further described by sub-units, which include the Perris Block, the Santa Ana Mountains, and the San Jacinto Mountains. The Perris Block is characterized as a broad area of intermixed valleys and low mountain ranges situated between the Elsinore and San Jacinto fault zones.

The project site is located in the northern portion of the Perris Block and Perris Valley. Typical lithographic units within this area consist of Quaternary alluvial deposits overlying granitic and metamorphic bedrock. Sporadic outcrops of bedrock dot the valley floor and represent remnants of eroded hills and mountains. Bedrock consists of mostly Cretaceous-age igneous rock (tonalite) forming the bedrock hills north of the site.

4.2 FAULTING AND SEISMICITY

The project site is located in the highly seismic southern California region within the influence of several fault systems that are considered to be active or potentially active. An active fault is defined by the State of California as “a sufficiently active and well defined fault, which has exhibited surface displacement within the Holocene time (the last 11,000 years).” The definition of “potentially active” varies. A generally accepted definition of “potentially active” is a fault showing evidence of displacement that is older than 11,000 years (Holocene age) and younger than 1.7 million years (Pleistocene age). However, “potentially active” is no longer used as criteria for zoning

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by the California Geologic Survey (CGS). The terms “sufficiently active” and “well-defined” are now used by the CGS as criteria for zoning faults under the Alquist-Priolo Earthquake Fault Act. A “sufficiently active fault” is a fault that shows evidence of Holocene surface displacement along one of more of its segments and branches, while a “well-defined fault” is a fault whose trace is clearly detectable by a trained geologist as a physical feature at or just below the ground surface. The definition “inactive” generally implies that a fault has not been active since the beginning of the Pleistocene Epoch (older than 1.7 million years old). These sufficiently active and well defined faults are capable of producing seismic shaking at the site that could potentially be damaging to structures. It is anticipated that the study area will periodically experience ground acceleration as a result of moderate to large magnitude earthquakes.

The San Jacinto fault zone is the nearest major active fault to the site. Numerous other faults may also represent significant hazards. However, this fault is considered to have the greatest impact to the site due to anticipated high peak ground accelerations resulting from a maximum credible earthquake.

The most significant geologic hazard to this project is the potential for moderate to severe seismic shaking that is likely to occur during the design life of the proposed bridge structure. The recommended seismic design parameters will be provided in a separate Geotechnical Design Report prepared by Kleinfelder.

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5.0 SUBSURFACE CONDITIONS

5.1 EARTH MATERIALS

5.1.1 Undocumented Fill (Afu)

Embankment fill soil was encountered in boring A-07-009 (BS-1) near the proposed location of Abutment 4 to a depth of approximately 7 meters below the existing grade at the top of the existing east embankment. Undocumented fill soil was also encountered in boring A-07-010 (BS-2) near the proposed location of Bent 2 to a depth of approximately 2.8 meters below the existing grade, near the toe of the existing west embankment. The fill soils were likely placed as part of the development of the existing bridges. In general, the fill soils consist of loose to medium dense silty sand (SM). Additional areas of undocumented fill soils may be encountered during earthwork operations that were not identified during this investigation.

5.1.2 Alluvium (Qal)

Alluvial soils were encountered below the fill soils in both borings. The alluvial soils extend to elevations ranging from approximately 446.6 to 445.6 meters above MSL. In general, the alluvial soil deposits encountered during our investigation consist of dense to very dense silty sand (SM).

5.1.3 Granitic Bedrock (Kgr)

Tonalite granitic bedrock was encountered in both of our borings A-07-009 and A-07-010 (BS-1 and BS-2) excavated for the proposed project. The bedrock was encountered below the alluvial soils at elevations ranging from approximately 446.6 to 454.6 meters above MSL and extended to the lowest elevation explored of approximately 441.5 meters above MSL. In general, the tonalite rock is moderately to highly weathered and decomposed near the contact with the alluvial soils and becomes less weathered with depth.

The locations of our exploratory borings are shown on the attached Plate 1A, *Boring Location Map* and Plate 4d, *Log of Test Borings*. Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the boring logs provided in Appendix A.

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5.2 GROUNDWATER

Groundwater was not encountered in either of the two borings excavated for the Box Springs Overhead Left Bridge widening. Boring A-07-010 (BS-2) was advanced to a depth of approximately 11.3 meters below the existing grade, which corresponds to the lowest elevation explored of approximately 441.5 meters above Mean Sea Level (MSL). According to As-Built Log of Test Borings prepared for the original bridge in 1965, groundwater was not encountered at that time to the lowest elevation explored of approximately 443.5 meters above MSL.

Fluctuations of the groundwater level, localized zones of perched water, and soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas on or immediately adjacent to the site can also cause a fluctuation of local groundwater levels.

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6.0 DISCUSSION AND RECOMMENDATIONS

6.1 SEISMIC DESIGN CRITERIA

6.1.1 Ground Surface Rupture and Deformation Potential

The site is not located within a currently delineated State of California Alquist-Priolo Earthquake Fault Zone (Hart and Bryant, 1997). No known active faults have been identified on the site, thus, the potential for future surface fault rupture at the site is considered to be "low." While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

6.1.2 Seismic Shaking

The 1996 California Seismic Hazard Map prepared by Caltrans (Mualchin, 1996a) indicates that the controlling fault for this project is the San Jacinto Fault (SJO), a strike slip fault with a maximum credible earthquake (MCE) moment magnitude of 7.5. The closest fault distance to the project site is approximately 8.8 km.

The horizontal peak bedrock acceleration (PBA) at the site based on the 1996 Caltrans Seismic Hazard Map is 0.5g, as shown on Plate 5, *Fault and PBA Map*. Caltrans Guidelines for Structures Foundation Reports (Version 2.0, dated March 2006) requires that the PBA determined above be verified with well-established attenuation relationships such as Sadigh et al. (1997) for controlling faults. The PBA value for the site, estimated using Sadigh et al. (1997) attenuation relationship, is 0.46g. Therefore, a PBA of 0.5g is recommended in accordance with Caltrans design practice.

Based on the results of our field exploration, our past experience, and in accordance with Table B.1 of Caltrans Seismic Design Criteria (SDC) (Version 1.4, dated June 2006), the site can be classified as Soil Profile Type C. The recommended seismic design parameters are summarized in the following Table 1.

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Table 1
Seismic Design Parameters

Seismic Parameters	Design Recommendation and Reference
Controlling Fault	San Jacinto (SJO), (Mualchin, 1996a)
Type of Fault	Strike-Slip (Mualchin, 1996b)
Closest Distance to the Fault	8.8 km (Mualchin, 1996a)
Earthquake Magnitude (MCE)	7.5 (Mualchin, 1996a,b)
Horizontal Peak Bedrock Acceleration (PBA)	0.5g
Soil Profile Type	C (Table B.1, 2006 Caltrans Seismic Design Criteria)

6.1.3 Design ARS Curve

The standard acceleration response spectra (ARS) curve presented in Figure B.5 of Caltrans SDC for PBA of 0.5g, magnitude 7.5 and Soil Profile Type C was selected for seismic design of the proposed bridges. This standard ARS curve was modified to account for near-source fault rupture directivity effect as follows:

- 20% increase in spectral values for periods equal to or greater than 1.0 second;
- No change for periods less than 0.5 seconds; and
- Spectral ordinates for periods between 0.5 and 1 second determined by linear interpolation.

The standard Caltrans SDC ARS curve, modified ARS curve and their ordinate values are presented on Plate 6, *Preliminary Design ARS Curve*.

6.1.4 Liquefaction Potential

Seismically induced soil liquefaction generally occurs in loose, saturated, cohesionless soil when pore pressures within the soil increase during ground shaking. The increase in pore pressure transforms the soil from a solid to a semi-liquid state. The primary factors affecting the liquefaction potential of a soil deposit are: 1) intensity and duration of earthquake shaking, 2) soil type and relative density, 3) overburden pressures, and 4) depth to groundwater. Soils most susceptible to liquefaction are clean, loose, uniformly

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graded, fine-grained sands, and non-plastic silts that are saturated. Silty sands have also been shown to be susceptible to liquefaction. These soils typically lose a portion or all of their shear strength and regain strength sometime after shaking stops. Soil movements (both vertical and lateral) have been observed under these conditions due to consolidation of the liquefied soils and the reduced shear resistance of slopes.

According to a Liquefaction Hazard Map prepared by the County of Riverside (Generalized Liquefaction Figure S-3, 2002), the site is located in an area designated as having a "low" liquefaction susceptibility. Groundwater was not encountered in any of the borings drilled for this project. Based on the simplified liquefaction analysis approach (Youd and Idriss, 2001), it is our professional opinion that due to the dense nature of subsurface soils encountered on-site and the observed depth to groundwater, the site has a "low" liquefaction potential.

6.1.5 Seismically Induced Settlement

Unconsolidated, loose to medium dense sandy soil deposits tend to densify or become more tightly packed during strong ground shaking, thereby causing ground settlement. Using an empirical procedure developed by Tokimatsu and Seed (1987), seismically induced settlements due to seismic compaction of dry or unsaturated soils below the foundations were estimated to be on the order of less than 13 mm.

6.2 EARTH RETAINING SYSTEMS

To provide for the construction of access road along the west side of existing BNSF railroad, we understand that a tieback wall with two to four levels of tieback anchors will be constructed at Abutment 1 slope (see Plates 2a and 2b). The tieback wall will have a height ranging from 2.4 meters to 6.8 meters and backfill slope gradient of 1:1.5 and 1:2 (V:H). Geotechnical design recommendations for the proposed tieback wall are presented in the following sections.

6.2.1 Lateral Earth Pressures

We recommend that the static lateral active earth pressure be calculated using the trapezoidal pressure diagram shown in Figure 5.5.5.7.1-1(b) in Section 5 of Caltrans Bridge Design Specifications (dated July 2004) for anchored walls.

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Seismic earth pressure is computed using the method by Yong (1985) for rigid walls or walls unable to yield sufficiently to develop active earth pressure conditions. According to Yong (1985), the seismic earth pressure for rigid wall is approximately two to three times than those predicted by the Mononobe-Okabe method for cantilever walls (Seed and Whitman, 1970). The seismic earth pressure values presented in our report are based on the premise that the tieback walls will not yield sufficiently to develop active earth pressure conditions.

Static and seismic lateral earth pressures acting on the tieback walls were graphically presented in Plate 7. Calculations for specific conditions using the above methods are provided in Appendix C-4.

6.2.2 Tieback Anchors

Tieback design should follow procedures described in Chapter 5 of Caltrans Bridge Design Specifications (2004) for anchored walls. The tiebacks should be vertically spaced a minimum of 1.2 meters and horizontally spaced a minimum of 2.5 meters.

Due to potential for collapse or caving of drilled anchor holes in granular alluvial materials, specialized installation methods such as casing or injection anchors will likely be required. Soil-to-grout bond stresses are highly dependent on installation technique, drilling and grouting method, grouting pressure and anchor diameter. In consideration of these factors and required load capacity, the design typically optimizes tieback anchor diameter, bonded length and installation methods. For purposes of estimating anchor lengths for preliminary design and cost estimating, the bonded length may be estimated using a maximum transfer load of 50 kN/m between pressurized concrete/grout and in-situ soil materials.

The unbonded length of the proposed tiebacks should extend a minimum of 1.5 meters beyond the passive wedge failure plane of the retained soil. In accordance with Rankine lateral earth pressure theory, a passive wedge failure plane is mobilized as the wall is pulled into the retained soil by the tieback anchors. The passive failure plane is inclined at an angle of (45 - Φ/2) degrees = (45 - 34/2) = 28 degrees from the horizontal, passing through the bottom of the wall. For preliminary design purposes, we recommend a minimum unbonded length of 8.5 meters.

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Proper drainage should be designed behind the walls in accordance with Caltrans Standard Plans to prevent buildup of hydrostatic pressure in the backfill. Due to collapse or caving potential for drilled anchor holes in granular alluvial materials, specialized installation methods such as casing or injection anchors will likely be required.

Caltrans requires testing of all anchors. Permanent anchors are to be tested to either 150% of the design load exclusive of seismic, or 110% including seismic, whichever is greater. Tieback testing should be performed in accordance with current Caltrans specifications. We recommend that tieback construction, including tieback anchor testing, be monitored by Kleinfelder. Based on the design criteria and testing of all anchors, movement of the wall after construction should be limited to approximately 6 mm. This amount of movement is typical for these types of walls. The geotechnical engineer should observe and record the installation of the anchors to verify the assumed soil and geologic conditions and record the testing and lock-off of the anchors.

6.2.3 Slope Stability

The overall global stability of the abutment slope and the tieback wall was analyzed assuming a bearing pressure of 195 kPa for the existing abutment footing. Slope stability was calculated using the Modified Bishop's Method for circular slip surfaces implemented in the computer program GSTABL7 with STEDWin3.0 (Van Aller and Gregory, 2001). The design criteria utilized are as follows: permanent abutment slopes are required to have a minimum factor of safety of 1.5 for the static condition; and a minimum factor of safety of 1.1 for the pseudostatic condition using the Caltrans recommended horizontal earthquake loading coefficient equal to one-third (1/3) of the horizontal peak ground acceleration or 0.13g. The results of slope stability analysis indicate that the required minimum static and pseudostatic factors of safety would be satisfied for the proposed tieback wall. The slope stability analysis results are presented in Appendix C-2.

6.2.4 Soil Bearing Capacity

The tieback anchor loads will induce a bearing pressure on the foundation soils at the bottom of the wall. Assuming a depth of embedment of at least 760 mm and wall thickness of 560 mm, a gross allowable bearing pressure of 195 kPa may be used for the underlying native soils (see Appendix C-3 for calculations).

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6.3 CORROSION POTENTIAL

To evaluate corrosion potential of the on-site soils, one soil sample collected during our field investigation was tested for pH, resistivity, sulfate and chloride concentrations in accordance with Caltrans Standard Test Methods 532, 643, 417, and 422. Testing was performed by AP Engineering and Testing, Inc. in Pomona, California. The test results are presented in Appendix B.

To evaluate corrosion potential of the on-site soils, one soil sample collected from boring A-07-010 (BS-2) was tested for pH, resistivity, sulfate and chloride concentrations in accordance with Caltrans Standard Test Methods 532, 643, 417, and 422, respectively. Testing was performed by AP Engineering and Testing, Inc. in Pomona, California. The test results are presented below in Table 2, below.

Table 2
Corrosion Test Results

Boring No.	Depth (m)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
A-07-010 (BS-2)	2 - 3	3,000	7.7	8	131

In accordance with Section 4.1 of Caltrans *Corrosion Guidelines* (dated September 2003), a corrosive area is defined as an area where the soil and/or water contains more than 500 ppm of chlorides, more than 2,000 ppm of sulfates, or has a pH of less than 5.5. In general, a minimum resistivity for soil and/or water less than 1,000 ohm-cm indicates the presence of high quantities of soluble salts and a higher propensity for corrosion. Based on the laboratory test results and the above guidelines, the project site soils may generally be considered as non-corrosive.

6.4 EXPANSION POTENTIAL

Expansive soils generally contain clay particles that swell considerably when wetted and shrink when dried. Foundations constructed on these soils are subjected to uplifting forces caused by the swelling. Based on our field exploration and the results of our laboratory testing, it is our opinion that soils within the upper portion of the project site have a low potential for expansion. Testing of the final subgrade soils after completion

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of grading should be conducted to evaluate their expansion potential and confirm or modify the recommendations presented herein.

6.5 SCOUR POTENTIAL

The proposed bridge widening will cross over the existing BNSF railroad tracks and is not located in a flood/drainage or river channel. Therefore, scour potential is not considered a design issue.

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7.0 CONSTRUCTION CONSIDERATIONS

7.1 SITE PREPARATION

All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations, and other local, state, or federal specifications. All references to maximum unit weight should be established in accordance with the current ASTM Standard Test Method D1557 and may supersede references cited herein.

7.1.1 Stripping and Grubbing

Prior to general site grading, existing pavement, vegetation, organic topsoil, existing fill soils, and debris shall be stripped and disposed of outside the construction limits. Deeper stripping or grubbing may be required where concentrations of fill debris, organic soils, existing trees, or thick root mats are encountered during site grading. Stripped topsoil (less any debris) may be stockpiled and reused for landscape purposes elsewhere on the project; however, this material should not be incorporated into any engineered fill.

In areas where existing trees will be removed, care should be taken to remove the root-ball, roots exceeding 25.4 mm in diameter, and remaining organics, and to backfill the excavations with compacted engineered fill. We strongly recommend having a representative of Kleinfelder present during tree removal in areas to receive fill or beneath foundations to observe removal of large roots and subsequent scarification and recompaction. Engineered fill should be placed and compacted in accordance with recommendations provided below.

7.1.2 Earthwork and Backfill

After clearing and stripping, the surface should be excavated to a minimum depth of 600 mm before placement of new fill. The undocumented fill soils (if encountered) shall be removed during site development and grading and replaced with structural backfill. In addition, any compressible soils encountered shall be removed and replaced with compacted structural backfill in accordance with Caltrans Standard Specifications Section 19-3.06. The exposed surface should be proof-rolled with loaded heavy equipment. Any areas of loose or yielding soils should be over-excavated and re-

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compacted. Any soils that cannot be compacted, or are otherwise unsuitable for the planned use, should be excavated and disposed of from the project site. The exposed surface should then be scarified and compacted to the specified density before placement of new fill. New fill placed on or adjacent to the existing slopes should be properly benched into the existing fill in accordance with Caltrans Standard Specifications.

All earthwork should be performed in accordance with Caltrans Standard Specification Section 19. All materials to be placed as fill should be free of vegetation, organics, debris, and other deleterious materials. All fill placed around foundations and behind walls should be placed in thin loose lifts, moisture-conditioned, and compacted to Caltrans Standard Specification.

Abutment wall backfill shall be structural backfill according to Caltrans standard specifications. In addition, we recommend that abutment backfill be well-graded soil with maximum dimension of 100 mm, essentially non-plastic (liquid limit less than 30, plasticity index less than 12, and with less than 50 percent passing the No. 200) and non-expansive. Expansive soils, defined as soils with Expansion Index (EI) greater than 50 and/or soils with Sand Equivalent (SE) less than 20, should be excluded from the bridge abutments as required by Caltrans guidelines. Expansion Index should be determined in accordance with ASTM D4829. Sand Equivalent should be determined in accordance with California Test Method (CTM) 217.

The limits of bridge approach zone are considered to extend longitudinally 46 meters measured horizontally from the bridge abutment and either parallel or concentric with the roadway centerline, and transversely the full width of embankment except the outer 1.5 meters measured horizontally from the embankment side slopes. Fills placed within 46 meters of abutments should be compacted to 95 percent relative compaction per ASTM D1557.

7.1.3 Temporary Excavations and Shoring

All excavations must comply with the current CAL-OSHA Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing the information below solely as a service to our client. Under no

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circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

A shoring design and safety plan should be required from the contractor and submitted to the Engineer for review and approval. Likewise, measures to control impact of both groundwater and surface water on the stability of temporary excavations and shoring should be employed and should remain the sole responsibility of the contractor.

7.2 SURFACE WATER CONTROL

Ponding of water adjacent to the structure should be avoided. During and after construction, positive drainage should be provided to direct surface water away from structures and all excavations toward suitable, non-erosive drainage devices.

7.3 ACCESS TO THE SITE

The presence of steep slopes on both sides of the railroad will make the direct access to the project site very difficult for construction crews as well as their equipments. It is recommended that the construction crews and equipments to enter the site through the gate located on River Crest Drive on the south side of Interstate 60. Moreover, the project site is situated in the proximity of a number of bridges; access to the site may be restricted or made difficult due to limited vertical clearance for construction equipments to pass underneath the existing bridges.

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8.0 ADDITIONAL SERVICES AND LIMITATIONS

8.1 ADDITIONAL SERVICES

The review of plans and specifications, and the observation and testing by Kleinfelder of earthwork and foundation related construction activities, are an integral part of the conclusions and recommendations made in this report. If Kleinfelder is not retained for these services, the client will be assuming our responsibility for any potential claims that may arise during or after construction. The recommended tests, observations, and consultation by Kleinfelder during construction include, but are not limited to:

- A review of preliminary plans and specifications;
- Observation of site clearing, undocumented fill removal, and subgrade preparation;
- Engineered fill placement and compaction;
- Construction observation and density testing of fill material placement, trench backfill, and subgrade preparation;
- Tieback anchor testing; and
- When any unusual conditions are encountered during construction.

These services may be performed in accordance with our current fee schedule.

8.2 LIMITATIONS

The conclusions and recommendations presented in this report are intended to assist in the design study for the proposed tieback retaining wall associated with the Box Springs Overhead Left Bridge widening to be located at the I-215/SR-60 east junction in the City of Riverside, California. The findings, conclusions and recommendations were prepared in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made. This report was based on the proposed project information provided to Kleinfelder. If any change (i.e., structure type, location, etc.) is implemented which materially alters the project, additional geotechnical services may be required, which could include revisions to the geotechnical recommendations presented herein.

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Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard. They are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

This report may be used only by the project designers and Caltrans and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on-site and off-site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party, and client agrees to defend, indemnify, and hold harmless Kleinfelder from any claim or liability associated with such unauthorized use or non-compliance.

Environmental site assessment for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater or atmosphere, or the presence of wetlands was not included in the scope of our services for this report.

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9.0 REFERENCES

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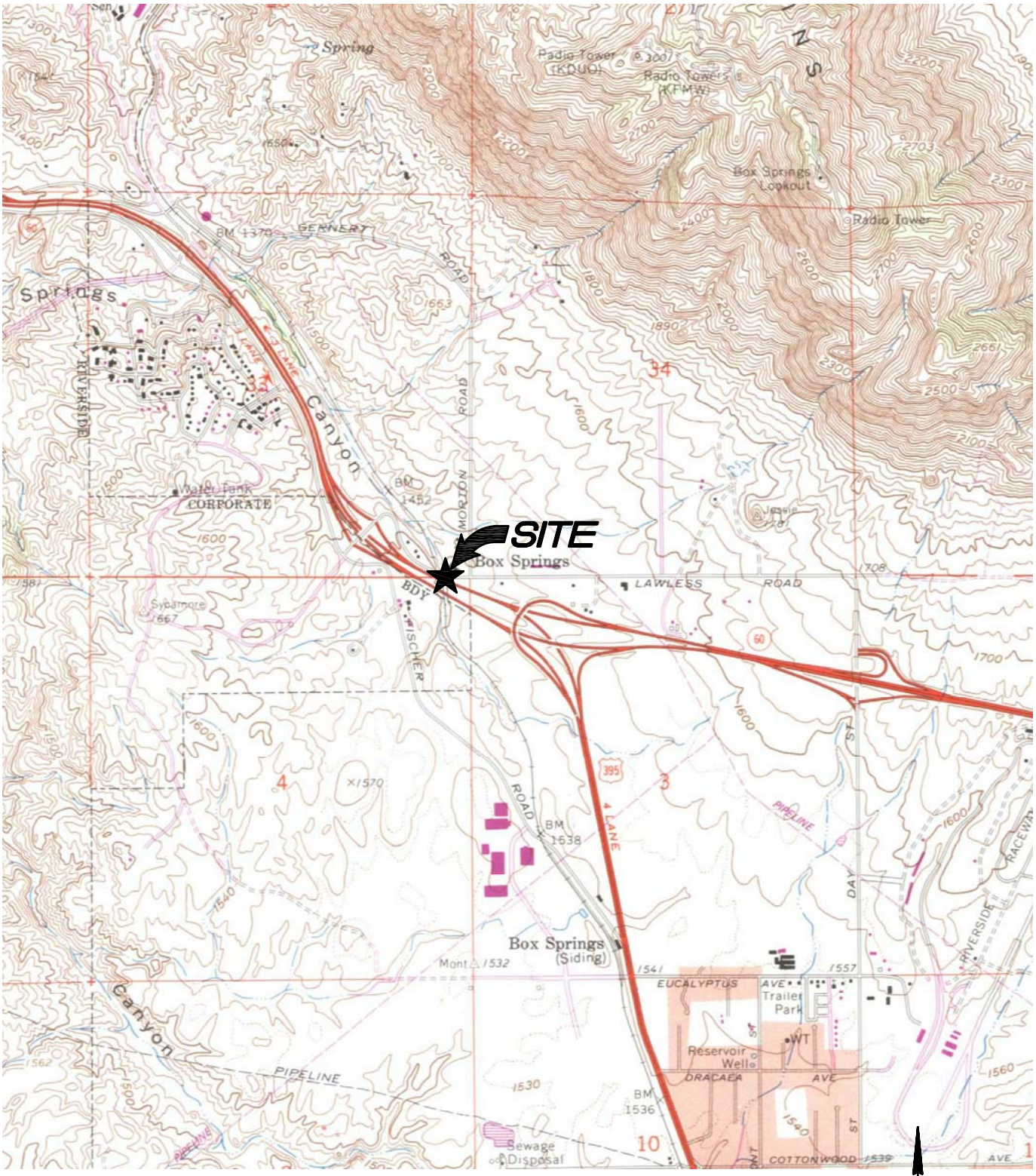
PLATES



SOURCE: U.S.G.S. 7.5' topographic series, Riverside East, California quadrangle dated 1967, photorevised 1980.

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PROJECT NO.	76979
DRAWN:	01/09/09
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME: 76979p1.dwg	

SITE LOCATION MAP

I-215/SR-60 EAST JUNCTION
BOX SPRINGS OVERHEAD (TIEBACK)
RIVERSIDE, CALIFORNIA

PLATE
1

ATTACHED IMAGES: Images: 76979p1.jpg
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\010909_Box-Springs_OH_TB\ LAYOUT: Layout1 PLOTTED: 09 Jan 2009, 12:11pm, MGriffin

ATTACHED IMAGES:
ATTACHED XREFS:
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CAD FILE: L:\2009\CADD\76979\TIEBACK-LOTB\ LAYOUT: Layout1

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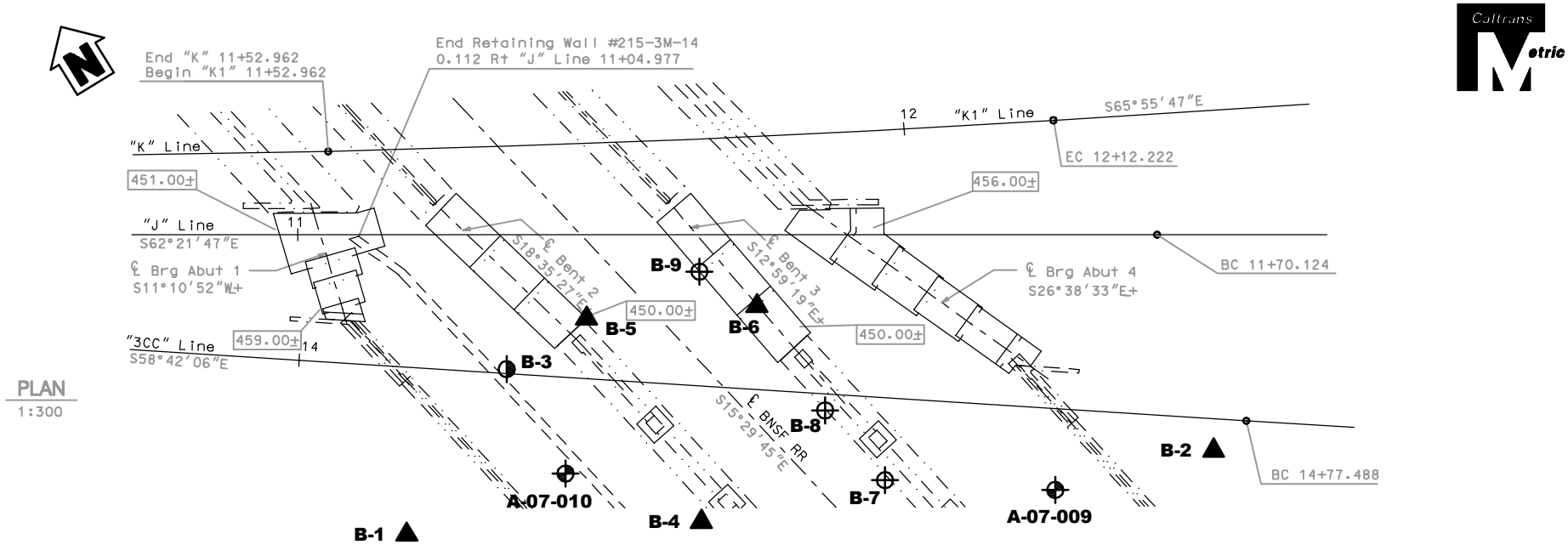

EXPLANATION

A-07-010	APPROXIMATE SOIL BORING LOCATION (KLEINFELDER, 2007)
B-9	APPROXIMATE 1" ROTARY BORING LOCATION (PREVIOUS CALTRANS BORING)
B-3	APPROXIMATE 3" ROTARY BORING LOCATION
B-6	2-1/4" PENETROMETER BORING (PREVIOUS CALTRANS BORING)

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PROJECT NO.	76979
DRAWN:	05/19/09
DRAWN BY:	DMF
CHECKED BY:	LH
FILE NAME:	76979p1A.dwg

BORING LOCATION MAP

BOX SPRINGS OVERHEAD (TIEBACK WALL)
RIVERSIDE COUNTY, CALIFORNIA

PLATE
1A

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

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PLANS APPROVAL DATE

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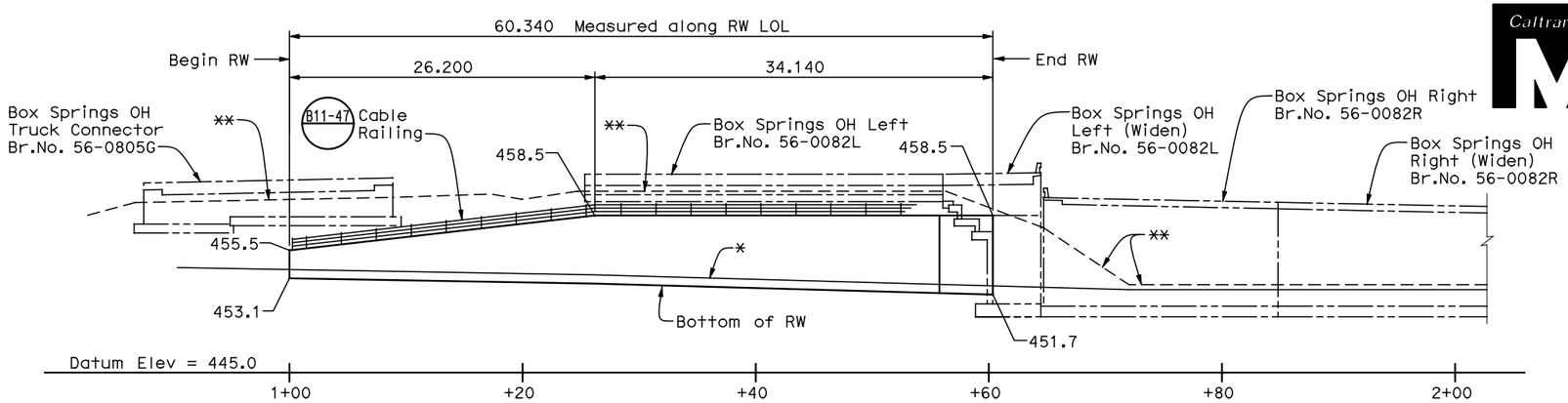
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



DEVELOPED ELEVATION
1:250

* FG at face of Ret Wall

** Approx OG at face of Abutment (beyond)

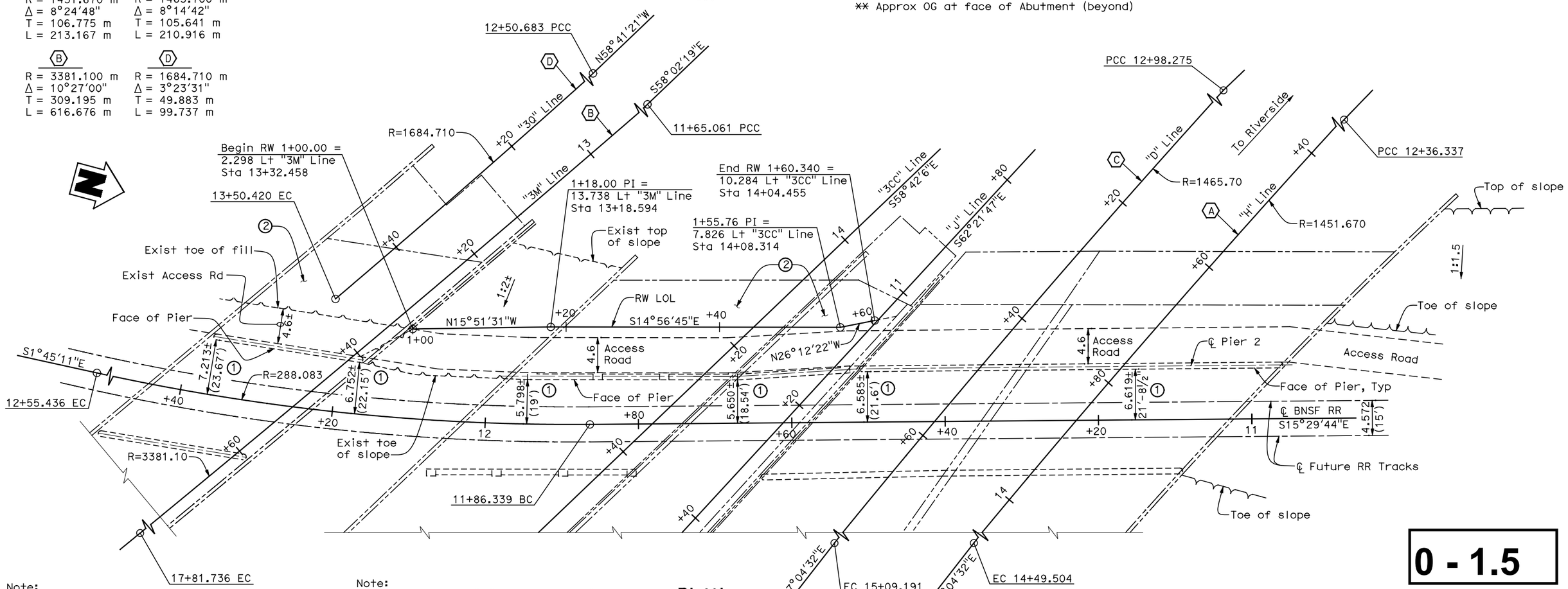
NOTES:

1. Clearance to face of Pier from ℄ RR Tracks
2. Existing Concrete Slope Paving

CURVE DATA

A	C
R = 1451.670 m	R = 1465.700 m
Δ = 8°24′48"	Δ = 8°14′42"
T = 106.775 m	T = 105.641 m
L = 213.167 m	L = 210.916 m

B	D
R = 3381.100 m	R = 1684.710 m
Δ = 10°27′00"	Δ = 3°23′31"
T = 309.195 m	T = 49.883 m
L = 616.676 m	L = 99.737 m



PLAN
1:250

0 - 1.5

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

Note:
For "General Notes", "Standard Plans", "Index To Plans" & list of Quantities see "Index To Plans" sheet.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. KIM	CHECKED R. LAWRENCE	LOAD FACTOR DESIGN	LIVE LOADING: HS20-44 AND PERMIT DESIGN LOAD	
	DETAILS	BY R. ANDRASEK	CHECKED D. KIM/M. CHAR	LAYOUT	BY R. ANDRASEK	CHECKED D. KIM/M. CHAR
SIGN OFF DATE	QUANTITIES	BY D. KIM	CHECKED G. CHOI	SPECIFICATIONS	BY M. CHAR	PLANS AND SPECS COMPARED

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN CHAR
PROJECT ENGINEER

BRIDGE NO. 56E0036
KILOMETER POST R62.2

BOX SPRINGS OH (TIEBACK)
GENERAL PLAN No. 1

DESIGN GENERAL PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

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SHEET 1 OF 13

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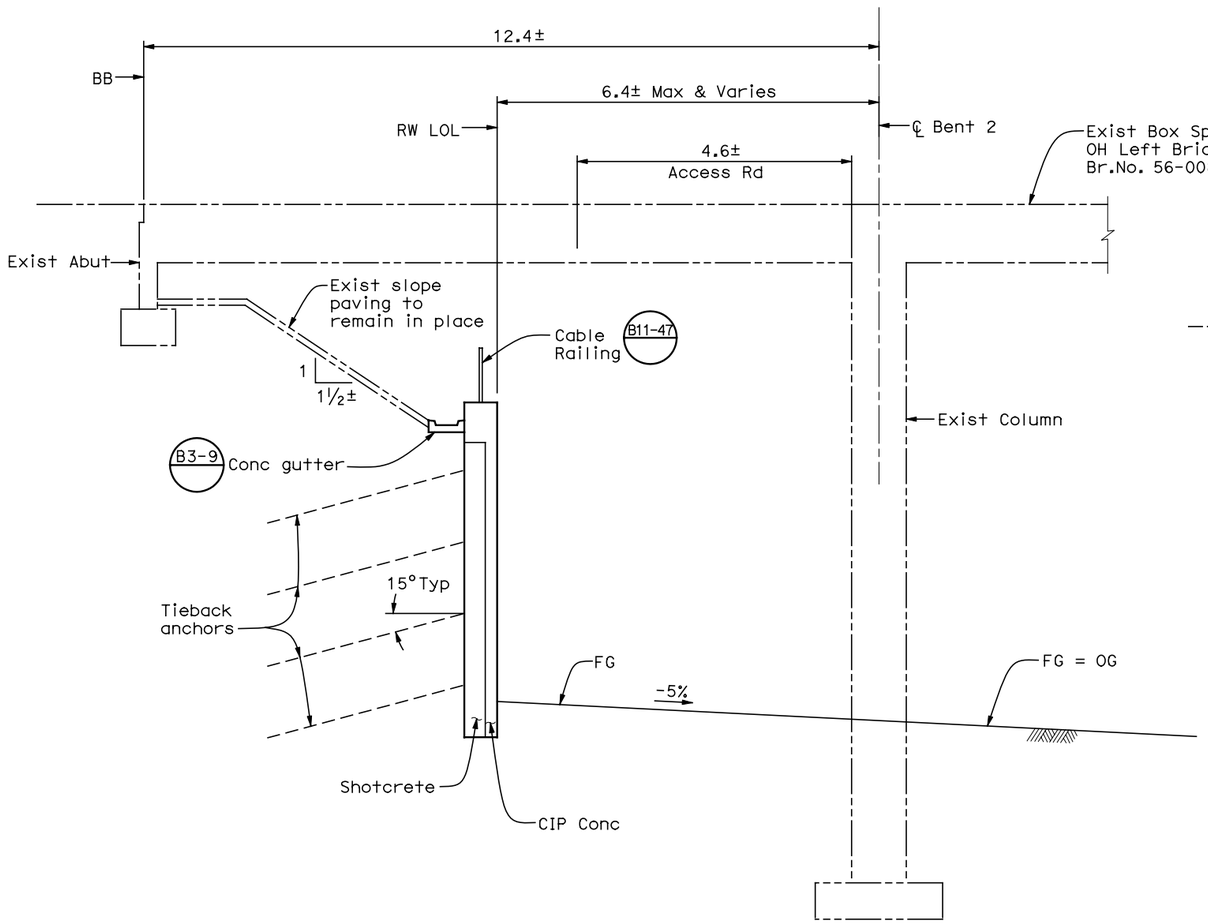
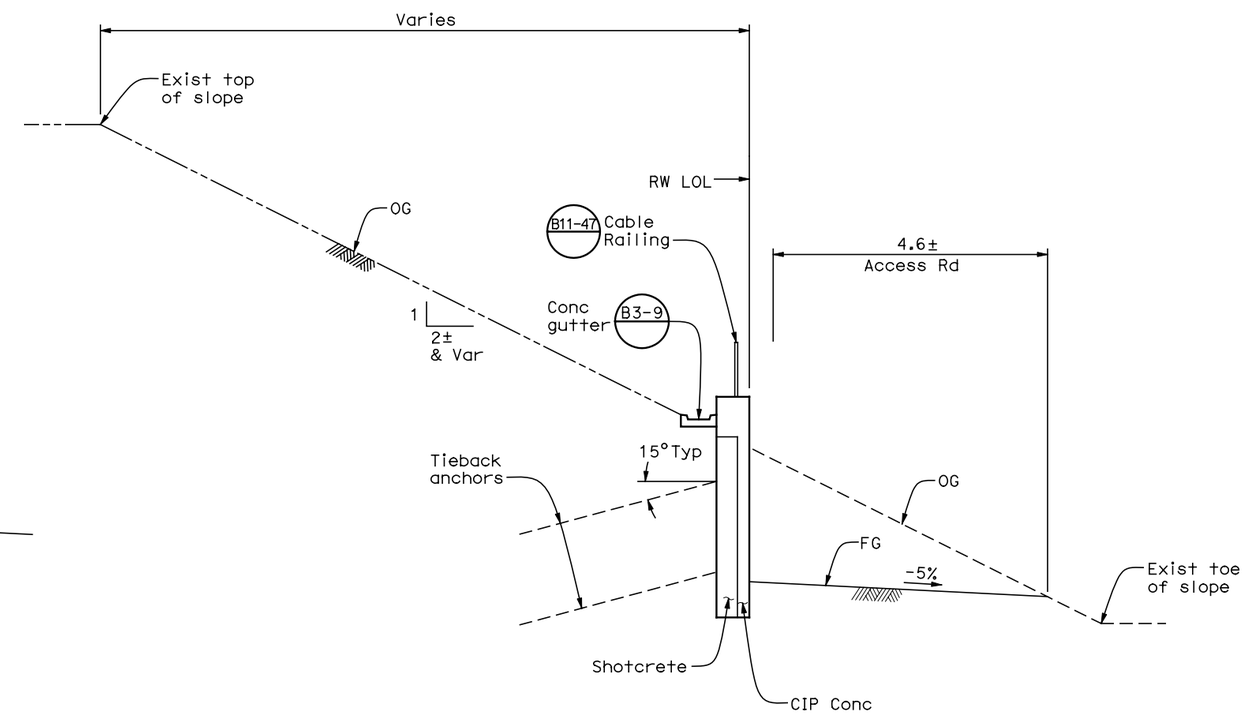
LEGEND

---- Indicates existing structure



UNDER EXISTING BRIDGE
1:50



OUTSIDE EXISTING BRIDGE
1:50

TYPICAL SECTIONS
TIEBACK RETAINING WALL

Page 2 of 2

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. KIM	CHECKED R. LAWRENCE	LOAD FACTOR DESIGN	LIVE LOADING: HS20-44 AND PERMIT DESIGN LOAD
SIGN OFF DATE	DETAILS	BY R. ANDRASEK	CHECKED D. KIM/M. CHAR	LAYOUT BY R. ANDRASEK	CHECKED D. KIM/M. CHAR
	QUANTITIES	BY D. KIM	CHECKED G. CHOI	SPECIFICATIONS BY M. CHAR	PLANS AND SPECS COMPARED

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

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PROJECT ENGINEER

BRIDGE NO. 56E0036
KILOMETER POST R62.2

BOX SPRINGS OH (TIEBACK)
GENERAL PLAN No. 2

DESIGN GENERAL PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

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USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

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LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

CURVE DATA

A	C
R = 1451.670 m	R = 1465.700 m
Δ = 8°24′48"	Δ = 8°14′42"
T = 106.775 m	T = 105.641 m
L = 213.167 m	L = 210.916 m

B	D
R = 3381.100 m	R = 1684.710 m
Δ = 10°27′00"	Δ = 3°23′31"
T = 309.195 m	T = 49.883 m
L = 616.676 m	L = 99.737 m

WALL LAYOUT DATA

1. Begin RW 1+00.00 = 2.298 Lt "3M" Line Sta 13+32.458
2. 1+18.00 PI = 13.738 Lt "3M" Line Sta 13+18.594
3. 1+55.76 PI = 7.826 Lt "3CC" Line Sta 14+08.314
4. End RW 1+60.340 = 10.284 Lt "3CC" Line Sta 14+04.455

BENCHMARKS

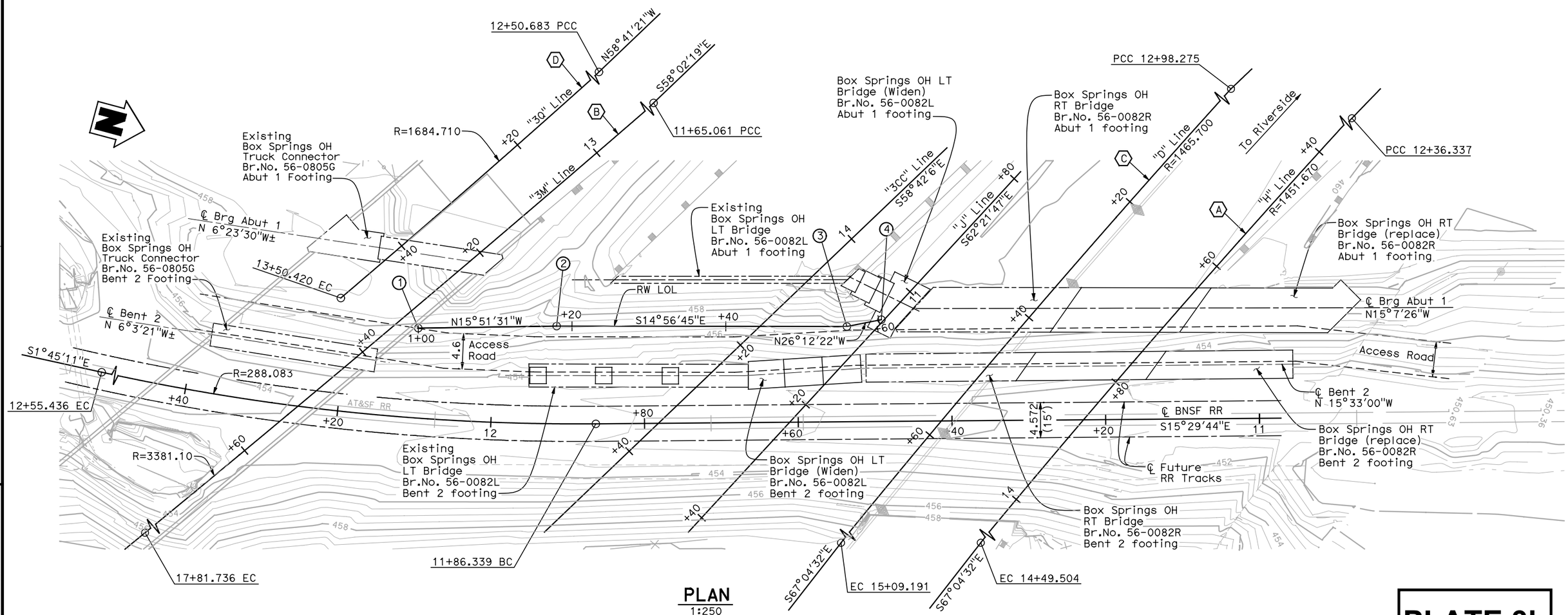
PT #865 Elevation 460.668 m

Found 25 mm iron pipe with Caltrans RP plug
North side of Box Springs Road.
N = 698034.479
E = 1903003.479

PT #3030 Elevation 472.840 m

Found 50 mm iron pipe with Brass Cap Stamped
"Dept of Trans RIV 60-12.7 1990"
34.14 m Southwesterly of bridge.
N = 697603.049
E = 1903554.738

Vertical Datum: NGVD-1929
Horizontal Datum: NAD-83, Zone 6 (EPOCH 1984.0)



PLAN
1:250

PLATE 3b

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	SCALE: AS SHOWN	VERT.DATUM NGVD-1929	HORZ.DATUM NAD-83, Zone 6 (EPOCH 1984.0)	DESIGN BY D. KIM	CHECKED R. LAWRENCE	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	MOHAN S. CHAR PROJECT ENGINEER
	PHOTOGRAMMETRY AS OF:	ALIGNMENT TIES		DETAILS BY R. ANDRASEK	CHECKED D. KIM/M. CHAR		
	SURVEYED BY	DRAFTED BY		QUANTITIES BY D. KIM	CHECKED G. CHOI		
SIGN OFF DATE	FIELD CHECKED BY	CHECKED BY					

BRIDGE NO. 56E0036
KILOMETER POST R62.2

BOX SPRINGS OH (TIEBACK)
FOUNDATION PLAN

FOUNDATION PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN WILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

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SHEET 4 OF 13

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GEOTECHNICAL PROFESSIONAL APPROVAL DATE

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

Notes:

1. For wall section, see "Wall Details No. 1" sheet.
2. For wall drainage, see "Drainage Details" sheet.
3. Use #32 @ 150 for vertical reinforcing in backface of shotcrete facing for this portion of wall.

LEGEND

* FG at RW LOL

** FG at face of Abutment

① Location ID

Ⓐ Column ID starting at top row

TIEBACK TENDON FORCE TABLE								
T(kN)								
Location	Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ	Ⓕ	Ⓖ	Ⓗ
①	300	250	325	275	275	300	300	300
②		200	250	200	225	200	250	250
③				225	250	275	300	275
④						275	275	250

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

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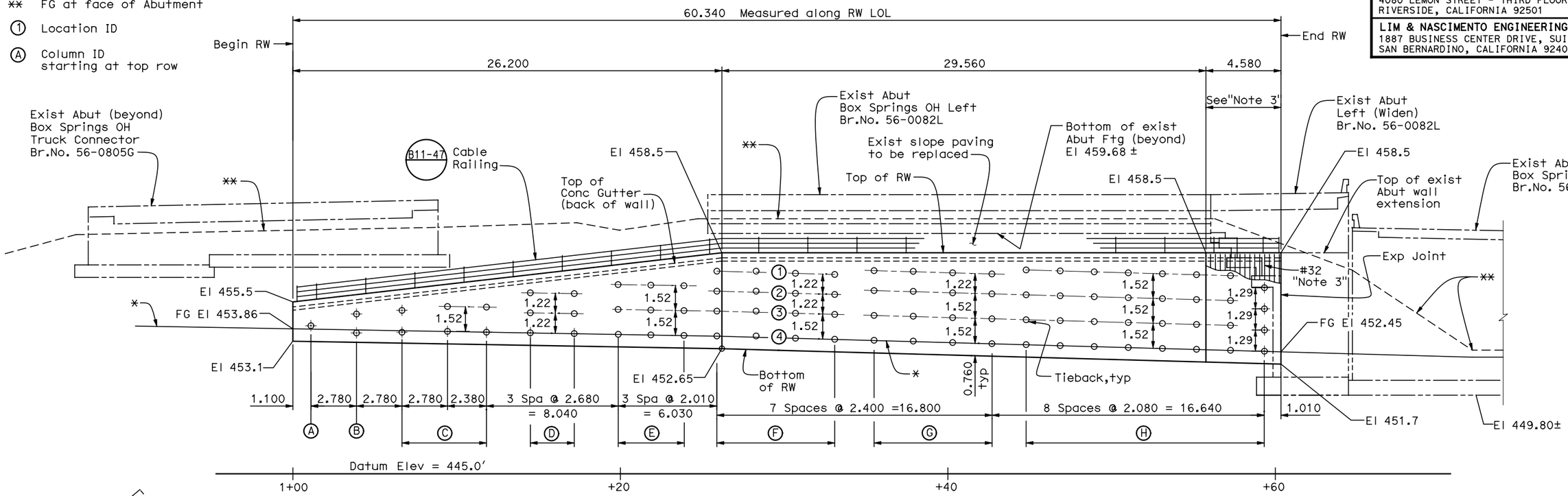
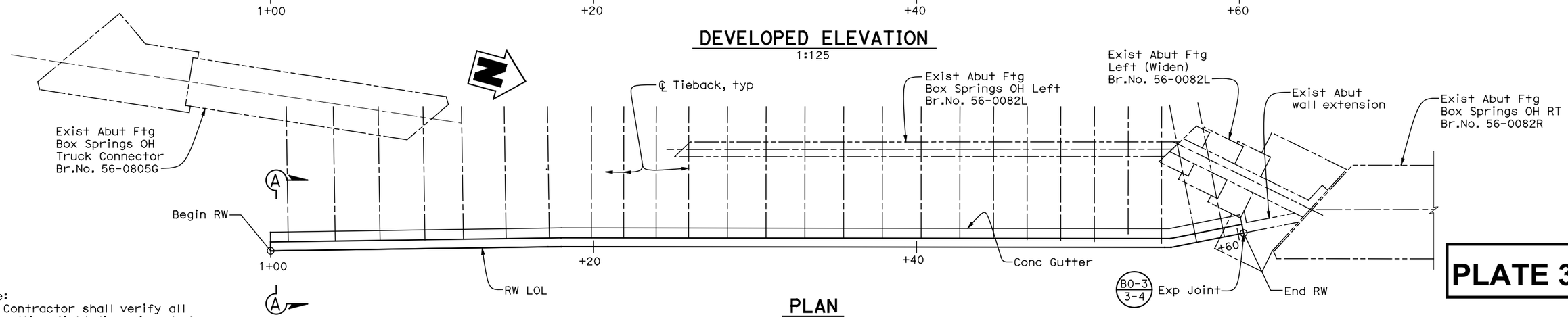
SAN BERNARDINO, CALIFORNIA 92408



DEVELOPED ELEVATION
1:125



PLAN
1:125

PLATE 3c

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN BY D. KIM	CHECKED R. LAWRENCE	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	DETAILS BY R. ANDRASEK	CHECKED D. KIM/M. CHAR	MOHAN S. CHAR PROJECT ENGINEER
	QUANTITIES BY D. KIM	CHECKED G. CHOI	

BRIDGE NO. 56E0036 — KILOMETER POST R62.2

BOX SPRINGS OH (TIEBACK)

WALL LAYOUT

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 9/28/08 1/08/09 2/18/09 5/18/09 6/12/09

SHEET 5 OF 13

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

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

PLATE 3d

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVALDATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

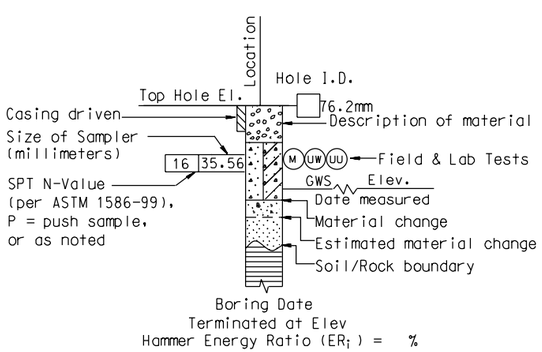
BOREHOLE IDENTIFICATION

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 (25.4mm soil tube) Hand Auger
	D	Dynamic Cone Penetration Boring
	CPT	Cone Penetration Test (ASTM D 5778-95)
	O	Other

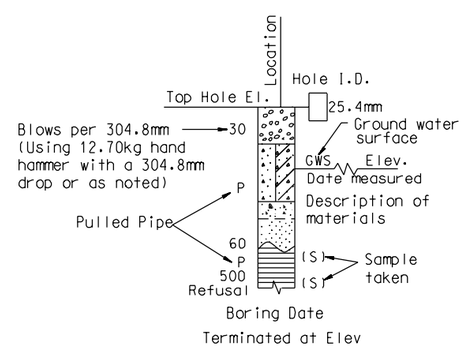
Note: Size in millimeters.

PLASTICITY OF FINE-GRAINED SOILS

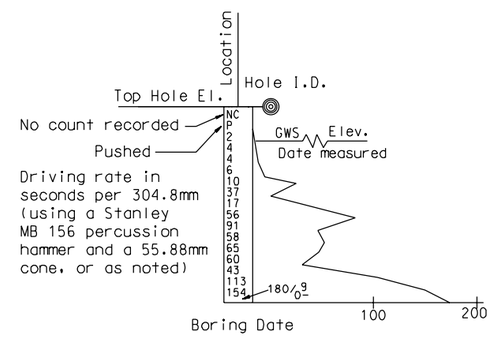
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



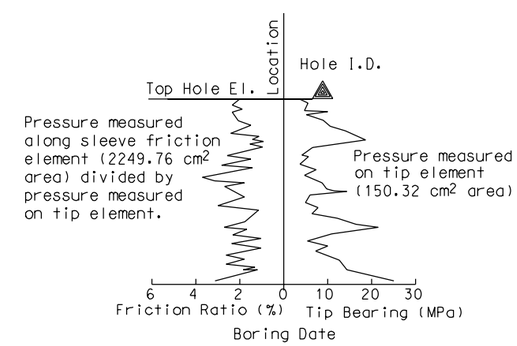
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

C. AMANTE DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
11/17/08 SIGN OFF DATE	CHECKED BY	C. AMANTE	C. AMANTE PROJECT ENGINEER

BRIDGE NO. 56-E0036
KILOMETER POST R62.2

BOX SPRINGS OH (TIEBACK)

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/14/08 1/08/09 5/20/09

REVISION DATES | SHEET 10 | OF 13

FILE -) $REQUEST

USERNAME -$USER DATE PLOTTED -) $DATE TIME PLOTTED -) $TIME

PLATE 4a

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8mm)
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		> 304.8mm
Cobble		76.2mm to 304.8mm
Gravel	Coarse	19.05mm to 76.2mm
	Fine	No. 4 to 19.05mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

C. AMANTE
DESIGN OVERSIGHT
11/17/08
SIGN OFF DATE

DRAWN BY: D. FAHRNEY
CHECKED BY: C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-E0036
KILOMETER POST R62.2

BOX SPRINGS OH (TIEBACK)
SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 3/12/08 7/21/08 11/14/08 1/05/09 5/20/09

SHEET 11 OF 13

FILE => $REQUEST

USERNAME -$USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

PLATE 4b

Caltrans Metric

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVALDATE

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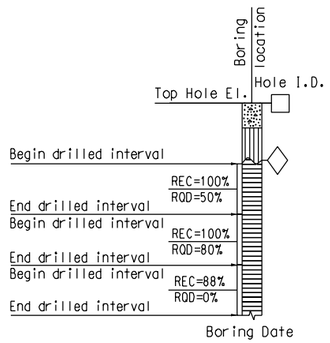
KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\ \text{mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

C. AMANTE
DESIGN OVERSIGHT
11/17/08
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE
STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-E0036
KILOMETER POST R62.2

BOX SPRINGS OH (TIEBACK)

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/4/08 1/06/09 5/20/09

REVISION DATES

SHEET 12 OF 13

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

PLATE 4c

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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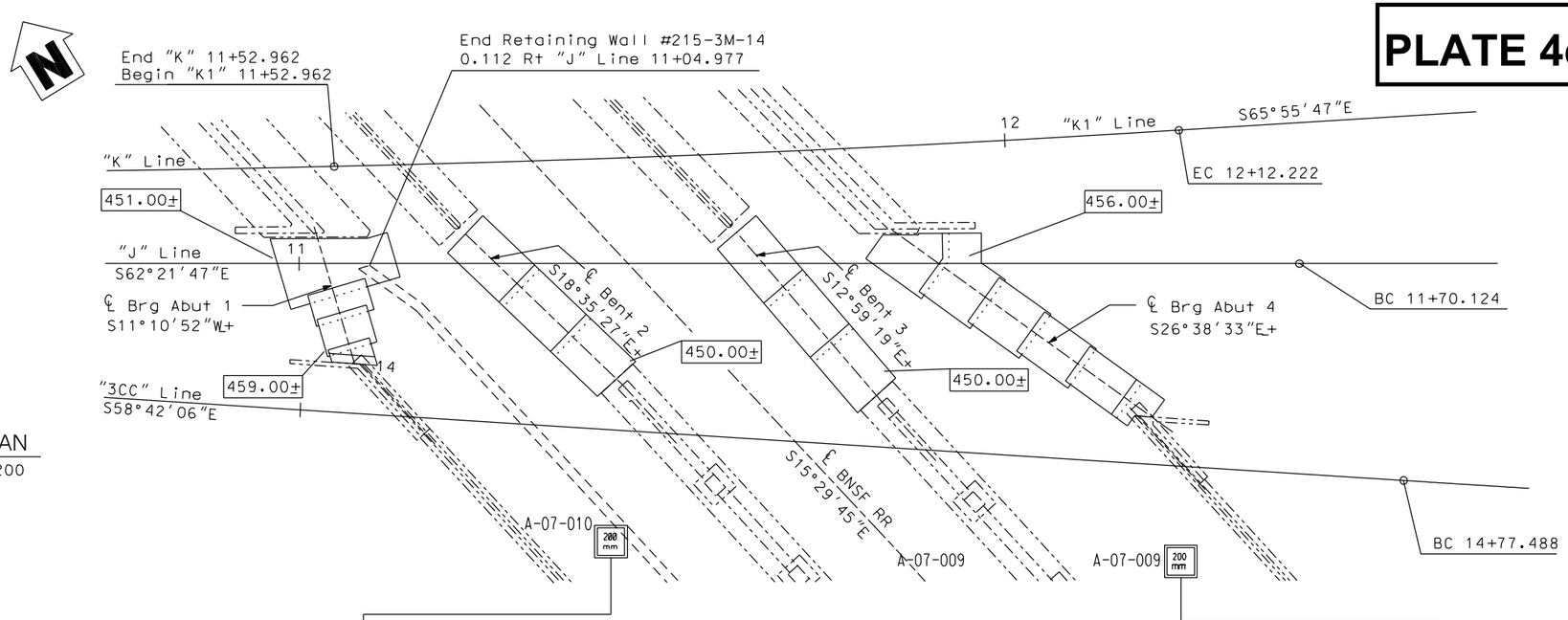
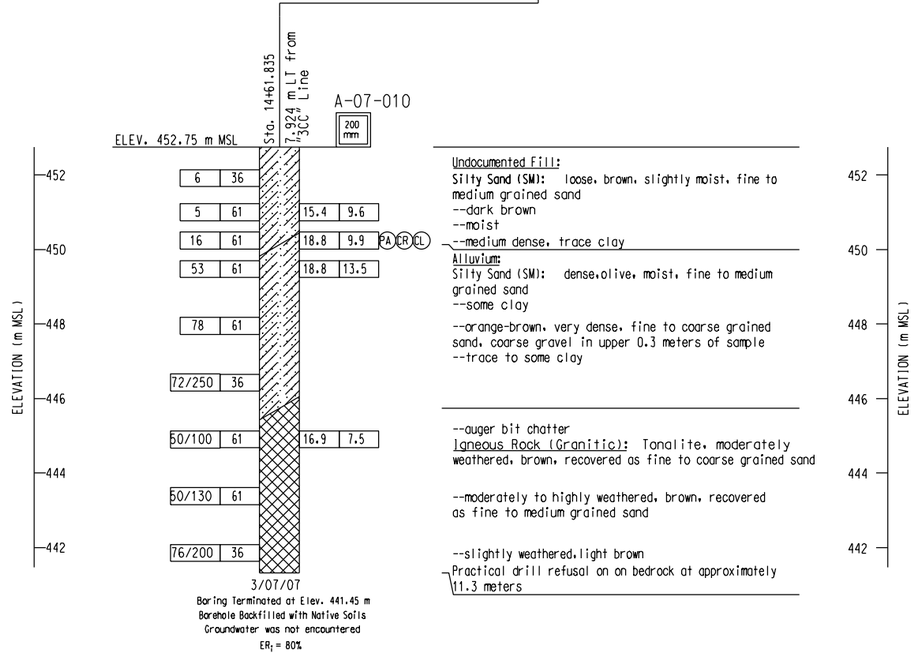
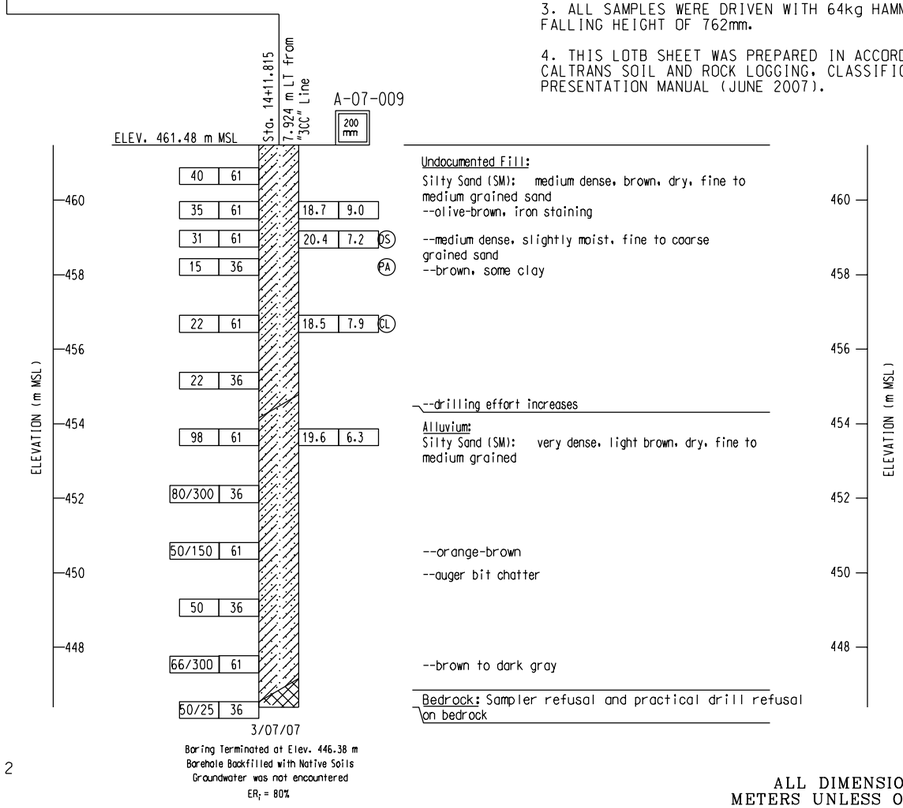
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:200







PROFILE
VERTICAL SCALE 1:2

BENCH MARK

BM Elev. 459.600 m
NP 3031 51mm Brass disk NGVD29

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

C. AMANTE
DESIGN OVERSIGHT
11/17/08
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-E0036
KILOMETER POST R62.2

BOX SPRINGS OH (TIEBACK)
LOG OF TEST BORINGS

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

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EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 1/06/09 5/20/09

SHEET 13 OF 13

FILE -> $REQUEST

USERNAME ->$USER DATE PLOTTED ->$DATE TIME PLOTTED ->$TIME

ATTACHED IMAGES: Images: Fault.tif Images: Fault-legend.tif
ATTACHED XREFS:
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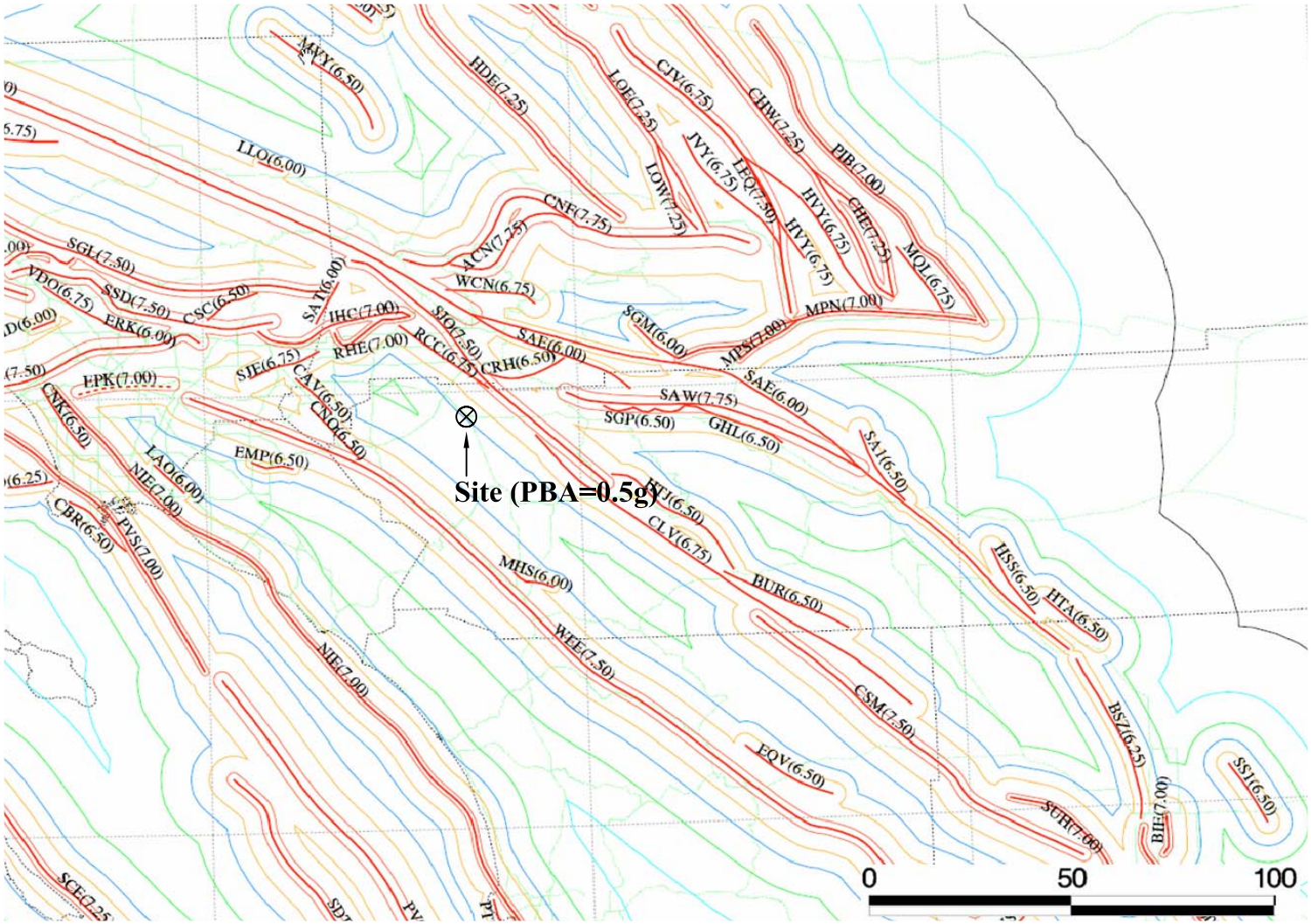

LEGEND:

- 0.7g Peak Acceleration Contour
- 0.6g Peak Acceleration Contour
- 0.5g Peak Acceleration Contour
- 0.4g Peak Acceleration Contour
- 0.3g Peak Acceleration Contour
- 0.2g Peak Acceleration Contour
- 0.1g Peak Acceleration Contour
- Special Seismic Source (SSS)
- Faults with Fault Codes (MCE)
- State Highways
- County Boundary
- Latitude & Longitude

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PROJECT NO.	76979
DRAWN:	01/09/09
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p5.dwg

FAULT AND PBA MAP

I-215/SR-60 EAST JUNCTION
BOX SPRINGS OVERHEAD (TIEBACK)
RIVERSIDE, CALIFORNIA

PLATE
5

CALTRANS BRIDGE DESIGN ARS CURVE

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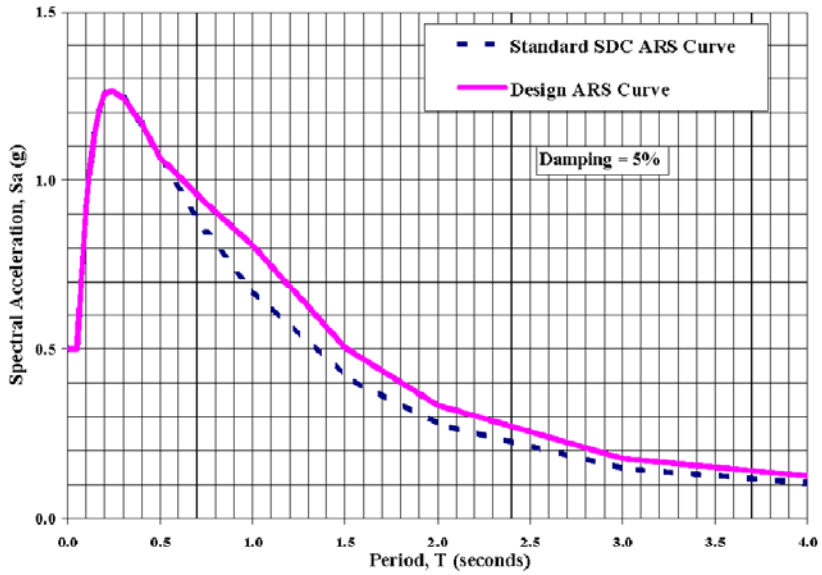
PROJECT INFORMATION	
Project Name	I-215/SR60 East Junction
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS	
Controlling Fault Name	San Jacinto (SJO)
Fault Type	Strike-slip (SS)
MCE Moment Magnitude	7.50
Distance to Fault	8.80 kilometers
Peak Bedrock Acceleration Based on 1996 California Seismic Hazard Map	0.5 g
Soil Profile Type	C

COMPUTED RESULTS	
Peak Bedrock Acceleration Based on Sadigh et al. (1997)[1]	0.46 g
Design Peak Bedrock Acceleration (g)	0.50 g



COMPUTED ARS CURVES

Period T (seconds)	Standard SDC ARS Curve[2] Sa (g)	Design ARS Curve[3] Sa (g)
0.010	0.500	0.500
0.020	0.500	0.500
0.030	0.500	0.500
0.050	0.500	0.500
0.075	0.719	0.719
0.100	0.919	0.919
0.120	1.037	1.037
0.150	1.155	1.155
0.170	1.207	1.207
0.200	1.256	1.256
0.240	1.264	1.264
0.300	1.244	1.244
0.400	1.168	1.168
0.500	1.067	1.067
0.750	0.847	0.932
1.000	0.674	0.808
1.500	0.419	0.503
2.000	0.278	0.334
3.000	0.147	0.177
4.000	0.104	0.125

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

NOTES:

[1]Peak Bedrock Acceleration (PBA):
Estimated using attenuation relationship by Sadigh et al. (1997) for rock site.
Sadigh et al. (1997) recommended no increase for Strike-Slip Fault, 10% increase for Oblique Fault; and 20% increase for Reverse/Thrust Fault. If type of fault is unknown, a 10% increase is assumed.

[2]Standard Seismic Design Criteria (SDC) ARS Curve:
Used Caltrans standard SDC ARS curve for the given PBA, magnitude, and soil profile type.

[3]Design ARS Curve:
When the bridge is located within 15 km of the controlling fault, the standard SDC ARS curve was modified as follows to account for fault rupture directivity effect:
- For Periods < 0.5 sec, no increase in standard SDC spectral acceleration values.
- For Periods > 1.0 sec, the standard SDC spectral acceleration values were increased by 20%.
- For Periods between 0.5 sec and 1.0 sec, spectral acceleration values were linearly interpolated.

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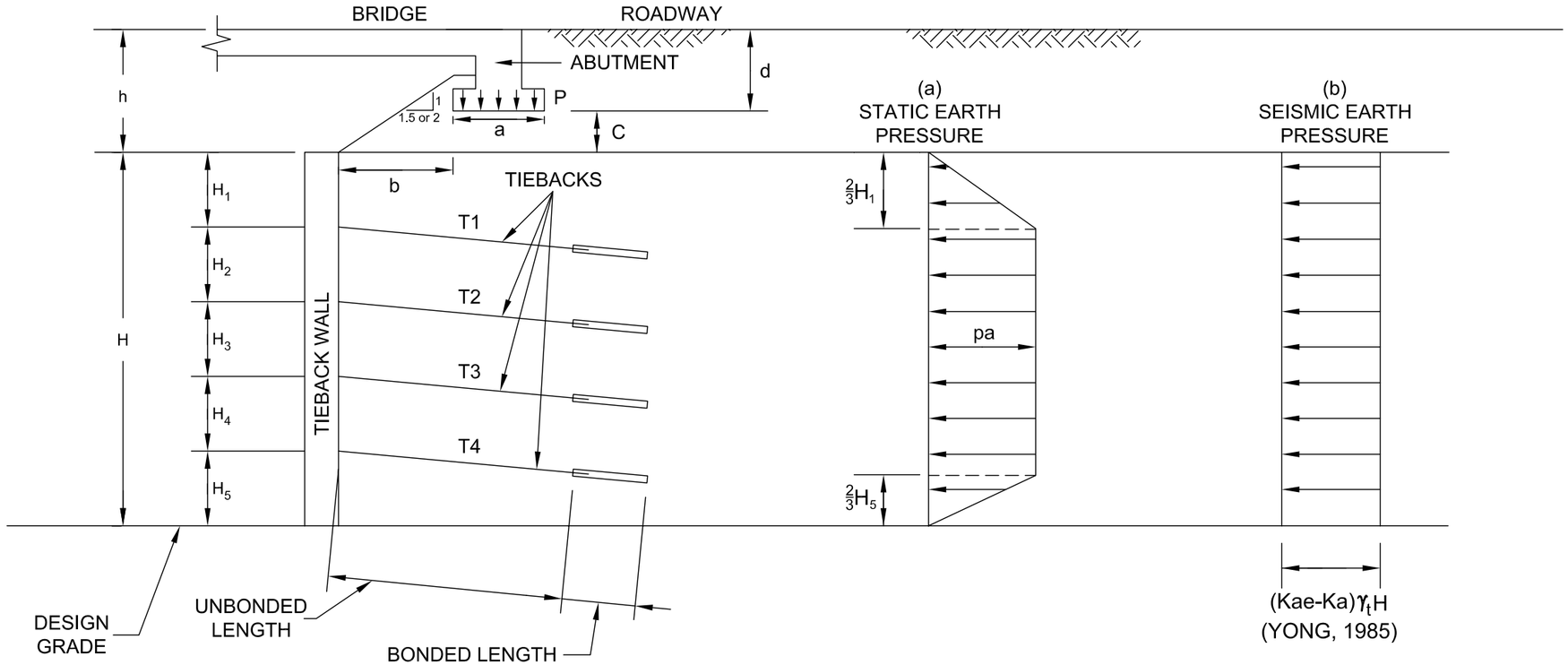
FILE NAME:	76979p6.dwg

PRELIMINARY DESIGN ARS CURVE

I-215/SR-60 EAST JUNCTION
BOX SPRINGS OVERHEAD (TIEBACK)
RIVERSIDE, CALIFORNIA

PLATE
6

ATTACHED IMAGES: Images: Plate6-ARS Curve_1.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\010909_Box-Springs_OH_TB\ LAYOUT: 6 PLOTTED: 09 Jan 2009, 12:15pm, MGriffin



BASED ON EQUATION 5.5.5.7.1-2 OF CALTRANS BDS (2004):

$$p_a = \frac{P_{TOTAL}}{(H - \frac{1}{3}H_1 - \frac{1}{3}H_{n+1})}$$

WHERE P_{TOTAL} = REQUIRED TOTAL LATERAL LOAD TO PROVIDE A FACTOR OF SAFETY (FS) EQUAL TO 1.5 FOR THE RETAINED SOIL MASS

$$P_{TOTAL} \geq \frac{1.44}{2} K_a \gamma H^2 = 0.72 K_a \gamma H^2$$

n = LEVELS OF THE TIEBACKS

H = HEIGHT OF THE WALL

FOR THE BOX SPRINGS OVERHEAD (TIEBACK):

γ = SOIL UNIT WEIGHT,
= 18.85 KN / m^3

ϕ = FRICTION ANGLE = 34°

PGA = PEAK GROUND ACCERATION = 0.39g

K_h = SEISMIC COEFFICIENT = 0.5 x PGA = 0.195

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PROJECT NO.	76979
DRAWN:	6/09/09
DRAWN BY:	MRG
CHECKED BY:	CA
FILE NAME:	76979p7.dwg

LATERAL EARTH PRESSURES ON TIEBACK WALL

BOX SPRINGS OVERHEAD (TIEBACK)
I-215 / SR-60 EAST JUNCTION PROJECT
RIVERSIDE, CALIFORNIA

PLATE
7

CAD FILE: L:\2009\CADD\76979\I-215_SR60\010909_Box-Springs_OH_TB\06-09-09\ LAYOUT: 7 PLOTTED: 09 Jun 2009, 10:00pm, MGriffin
ATTACHED IMAGES:
ATTACHED XREFS:
DIAMOND BAR, CA

APPENDIX A

FIELD EXPLORATION

APPENDIX A
FIELD EXPLORATION

The subsurface exploration program for the Box Springs Overhead Bridge Widening consisted of drilling and logging two exploratory soil borings BS-1 and BS-2 (LOTB Nos. A-07-009 and A-07-010) on March 7, 2007. These borings were advanced to depths ranging from approximately 11.3 to 15.1 meters below the existing ground surface (bgs) using a Mobile B-61, truck-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer delivery system. The borings were logged and sampled using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Following drilling, sampling and logging, the borings were backfilled with native cuttings.

Plates 1A and 4d show the locations of the exploratory borings. The boring locations, including stations and offsets were surveyed by LAN Engineering.

The boring logs are presented in Plates A-2 and A-3 in the following section. The logs describe the earth materials encountered and indicate the locations of the samples obtained and infill thickness measured in the bedrock. The excavations were logged by a staff professional from Kleinfelder using methods outlined in the Unified Soil Classification System (USCS) and general procedures established in ASTM D 2488. The boundaries between soil and rock type(s) shown on the logs are approximate because the transition between different soil and rock layer(s) may be gradual.

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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	ID	DESCRIPTION	MAJOR DIVISION		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Well-graded gravels, gravel-sand mixtures	FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands
		GP		Poorly-graded gravels, gravel-sand mixtures			CL		Inorganic clays of low to medium plasticity; gravelly clays silty clays,sandy clays, lean clays
		GM		Silty gravels, gravel-sand-silt mixtures			OL		Organic silts and organic silt-clays of low plasticity
		GC		Clayey gravels, gravel-sand-clay mixtures					
	SAND AND SANDY SOILS	SW		Well-graded sands, gravelly sands		SILTS AND CLAYS LL > 50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		SP		Poorly-graded sands and gravelly sands			CH		Inorganic clays of medium to high plasticity
		SM		Silty sands, sand-silt mixture			OH		Organic clays of medium to high plasticity
		SC		Clayey sands, sand-clay mixture		HIGHLY ORGANIC SOILS	Pt		Peat, muck and other highly organic soils

▼ Approximate water level observed in boring following drilling

SOIL SAMPLE

- Bulk Sample
- Drive Sample - California Sample
- Shelby Tube Sample
- Standard Penetration Test (SPT) Sample

ADDITIONAL TESTS

CN	- Consolidation
COR	- Corrosion
CP	- Collapse Potential
DS	- Direct Shear
EI	- Expansion Potential
MAX	- Maximum Dry Density
OC	- Organic Content
PI	- Plasticity Index
RV	- R-Value
SE	- Sand Equivalent
GS	- Grain Size Distribution

NOTES:

Blow counts represent the number of blows of a 64-kilogram hammer falling 760 mm required to drive a sampler through the last 300 mm of a 460 mm penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

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LEGEND TO LOGS

PLATE A-1

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	461 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
461							**Undocumented Fill**			
	1	1 2	40			SM	**Silty Sand (SM):** brown, dry, medium dense, fine to medium grained sand			
460		3	35				--olive-brown, iron staining	18.7	9.0	
	2	4	31				--slightly moist, medium dense, fine to coarse grained sand	20.4	7.2	DS
459	3	5	15				--brown, some clay			GS
458	4									
457		6	22					18.5	7.9	CN
	5									
456	6	7	22							
455	7						--drilling effort increases			
454							**Alluvium**			
	8	8	98			SM	**Silty Sand (SM):** light brown, dry, very dense, fine to medium grained	19.6	6.3	
453	9									
452		9	30, 50/1[illegible]							

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PROJECT NO. 76979

I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

LOG OF BORING BS-1

PLATE A-2a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08

Elevation (approx.) (meters)	Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
451										
	11	10	50/150				--orange-brown			
450							--auger bit chatter			
	12									
449		11	50							
	13									
448										
	14	12	16, 50/15				--brown to dark gray			
447										
	15		50/25				**Bedrock:** Sampler refusal and practical drill refusal on bedrock			

Boring terminated at 15.1 meters due to practical refusal .
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

LOG OF BORING BS-1

PLATE A-2b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08

Date Drilled	3/7/07	Water Depth:	Not Encountered
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	453 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
							Undocumented Fill			
452	1	1	6			SM	**Silty Sand (SM):** brown, slightly moist, loose, fine to medium grained sand			
							--dark brown			
451	2	2	5				--moist	15.4	9.6	
		3								GS, COR
		4	16				--medium dense, trace clay	18.8	9.9	CN
450	3						**Alluvium**			
		5	53			SM	**Silty Sand (SM):** olive, moist, dense, fine to medium grained sand	18.8	13.5	
449	4						--some clay			
448	5	6	78				--orange-brown, very dense, fine to coarse grained sand, coarse gravel in upper 0.3 meters of sample			
							--trace to some clay			
447	6	7	22, 50/10							
446	7									
							--auger bit chatter			
445	8	8	50/100				**Bedrock**: Tonalite, brown, moderately weathered, recovered as fine to coarse grained sand	16.9	7.5	
444	9									
		9	50/130				--brown, moderately to highly weathered, recovered as fine to medium grained sand			
443										

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I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

LOG OF BORING BS-2

PLATE A-3a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
442 11	10	26, 50/5				--light brown, slightly weathered			
						Practical drill refusal on on bedrock at approximately 11.3 meters			
						Boring terminated at 11.3 meters due to practical refusal. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

LOG OF BORING BS-2

PLATE A-3b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08

APPENDIX B

LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

Laboratory tests were performed on drive and bulk soil samples to estimate engineering characteristics of the various earth materials encountered. Testing was performed in general accordance with procedures outlined by the American Society for Testing and Materials, the California Department of Transportation, or other accepted procedures.

IN-SITU MOISTURE CONTENT AND DRY UNIT WEIGHT

In-situ moisture content and dry unit weight tests were performed on samples that could be recovered in a relatively undisturbed condition. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937. The results are presented on the Logs of Borings.

GRAIN SIZE DISTRIBUTION

Two sieve analyses were performed on selected samples of the materials encountered at the site to evaluate the grain size distribution characteristics of the soils and to aid in their classification. The tests were performed in general accordance with ASTM Standard Test Method D 422. The test results are presented on Plate B-1, *Grain Size Distribution*.

CONSOLIDATION TEST

Two consolidation tests were performed on representative drive soil samples to evaluate the settlement characteristics of the in-situ soils when subjected to typical foundation loads and wetting. The tests were performed in accordance with ASTM Standard Test Method D 5333. The test results are presented on Plates B-2 and B-3, *Consolidation/Collapse Potential Test*.

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DIRECT SHEAR TEST

One direct shear test was performed on a selected sample to evaluate the drained shear strength of the soils. The sample was soaked and tested in a near-saturated condition in general accordance with ASTM Test Method D3080 (consolidated, drained). The results of this test is presented on Plate B-4, *Direct Shear Test*, and summarized in Table B-1, below.

Table B-1
Direct Shear Test Results

Boring No.	Depth (m)	USCS Soil Type	Dry Unit Weight (kN/m^3)	Angle of Internal Friction (degrees)	Cohesion (kPa)
BS-1	2.3	SM	20.4	33	44

CORROSIVITY TESTS

Chemical analyses were performed on a selected sample of the sub-surface soil to estimate pH, resistivity, soluble sulfate, and chloride contents in general accordance with Caltrans Standard Test Methods 532 (pH), 643 (resistivity), 417 (sulfates), and 422 (chlorides). The test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to the construction materials. The results of the tests are presented in Table B-2, below.

Table B-2
Corrosion Test Results

Boring No.	Depth (m)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
BS-2	2 - 3	3,000	7.7	8	131

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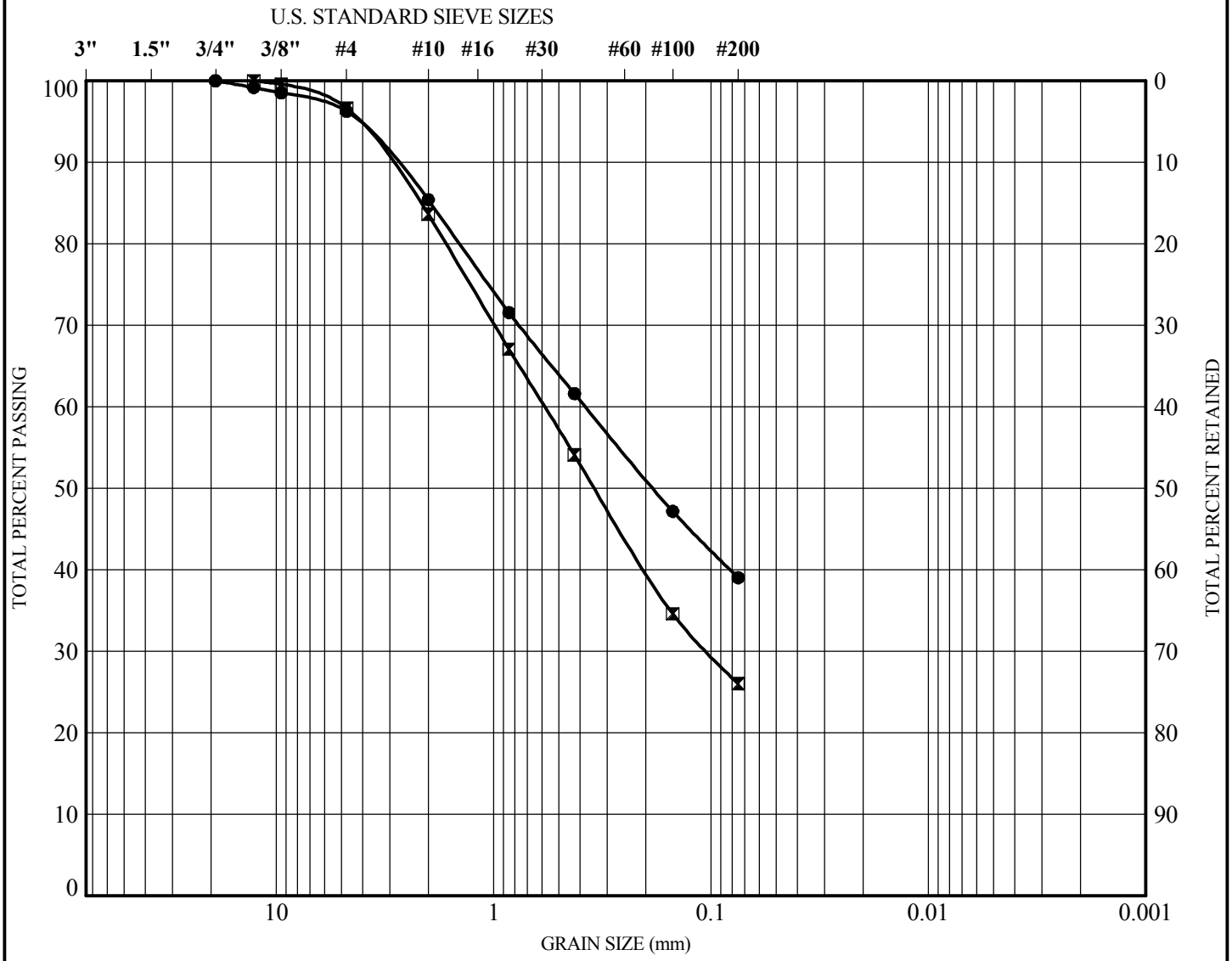
SIEVE ANALYSIS	HYDROMETER



GRAVEL	SAND					SILT	CLAY
	Very Coarse	Coarse	Medium	Fine	Very Fine		

Symbol	Test Pit	Depth (m)	USDA Description	USCS Classification
●	BS-1	1	Silty Sand	SM
⧗	BS-2	1	Silty Sand	SM

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PROJECT NO. 76979

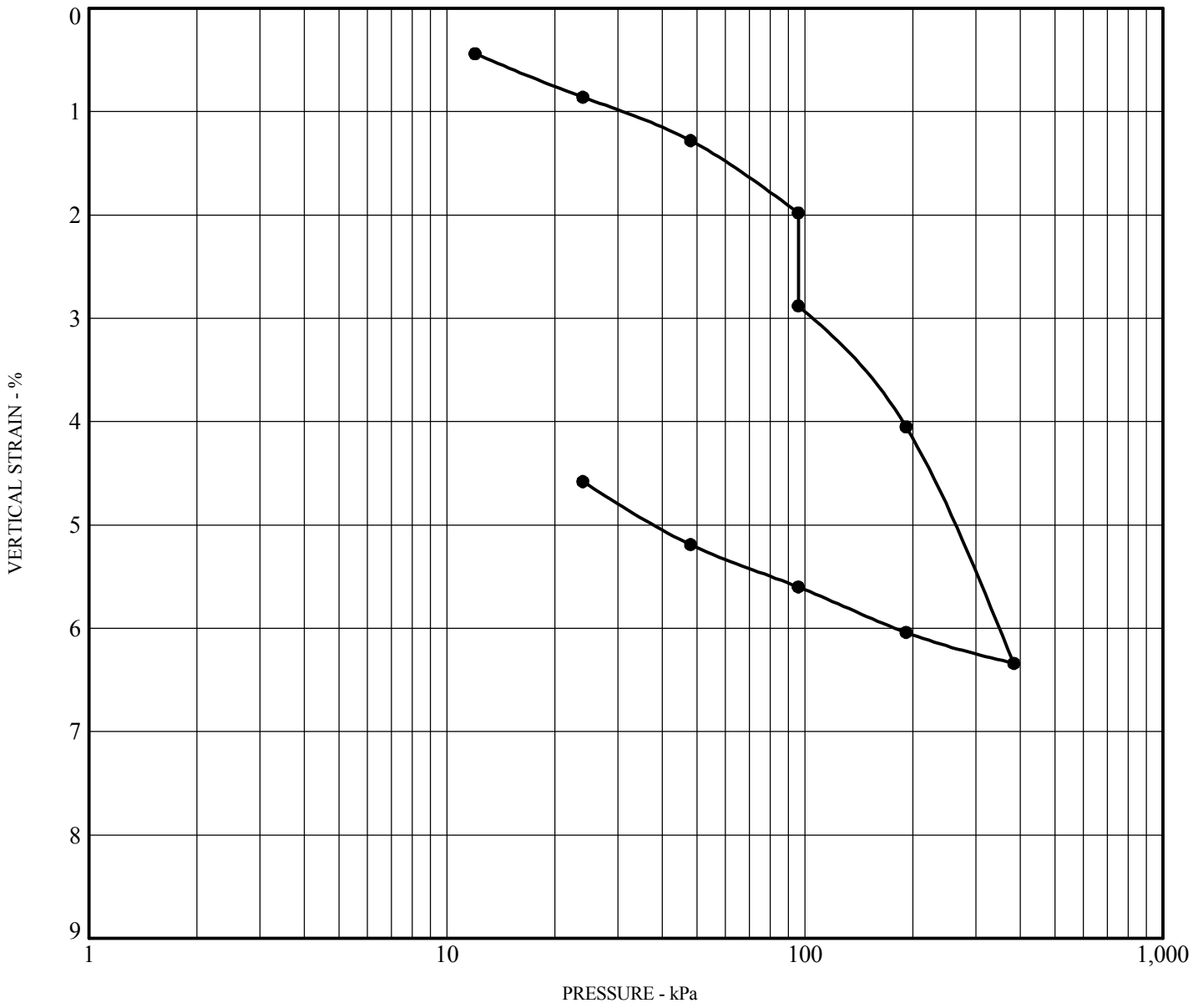
I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

GRAIN SIZE DISTRIBUTION

PLATE

B-1

GRAIN SIZE USDA 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08



Boring	**BS-1**			
Depth (meters)	**5**			
Moisture Content (%)	**7.9**	**Before**	**16.4**	**After**
Dry Density (kN/m^3)	**18.5**			
Description	**Silty Sand**			
Classification	**SM**			

NOTE : 1 kPa = 21 psf
SPECIMEN FLOODED
AT 2000 psf

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PROJECT NO. 76979

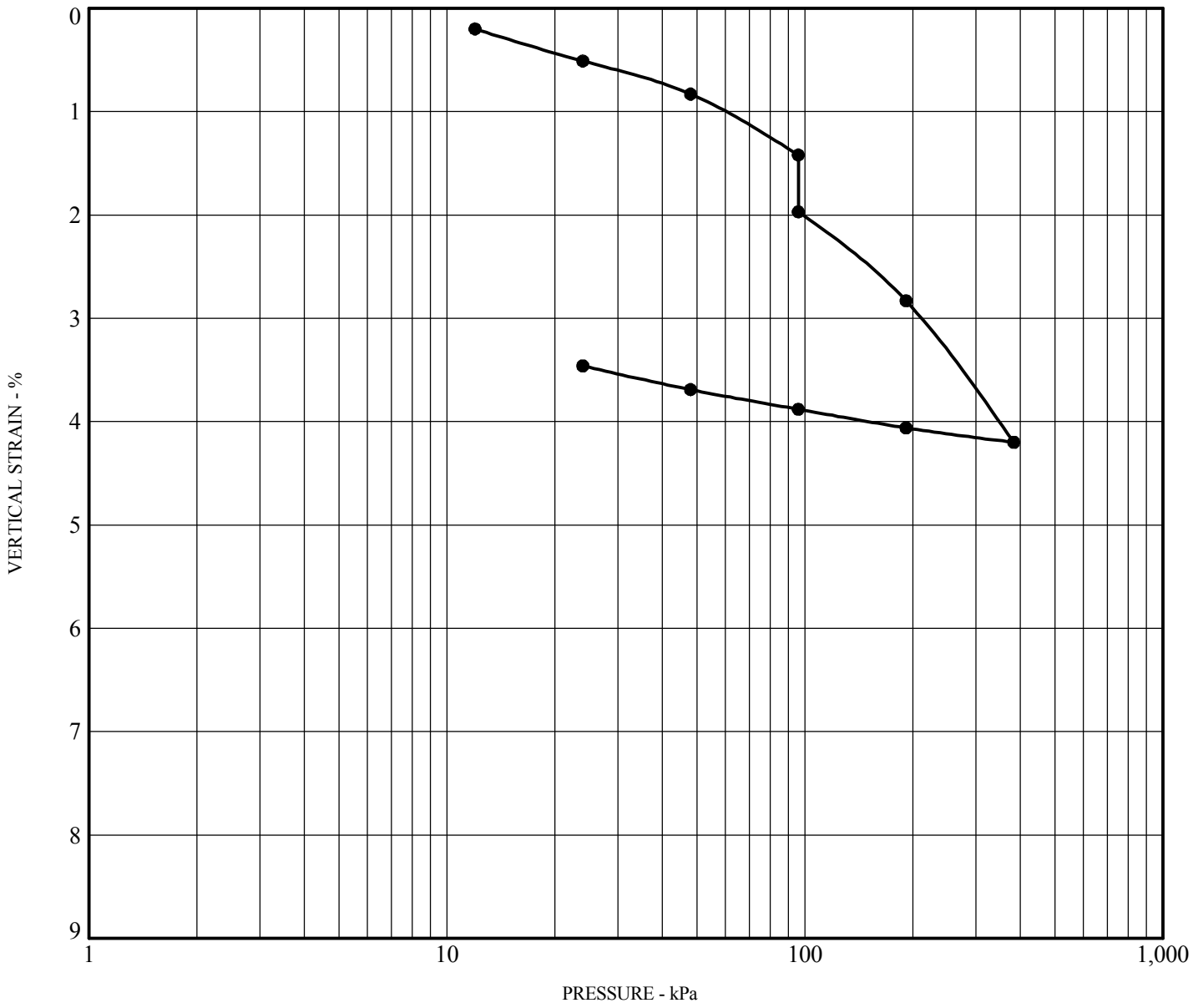
I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

CONSOLIDATION/COLLAPSE POTENTIAL TEST

PLATE

B-2

CONSOL NO INDICIES 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08



Boring	**BS-2**			
Depth (meters)	**2**			
Moisture Content (%)	**9.9**	**Before**	**12.9**	**After**
Dry Density (kN/m^3)	**18.8**			
Description	**Silty Sand**			
Classification	**SM**			

NOTE : 1 kPa = 21 psf
SPECIMEN FLOODED
AT 2000 psf

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I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

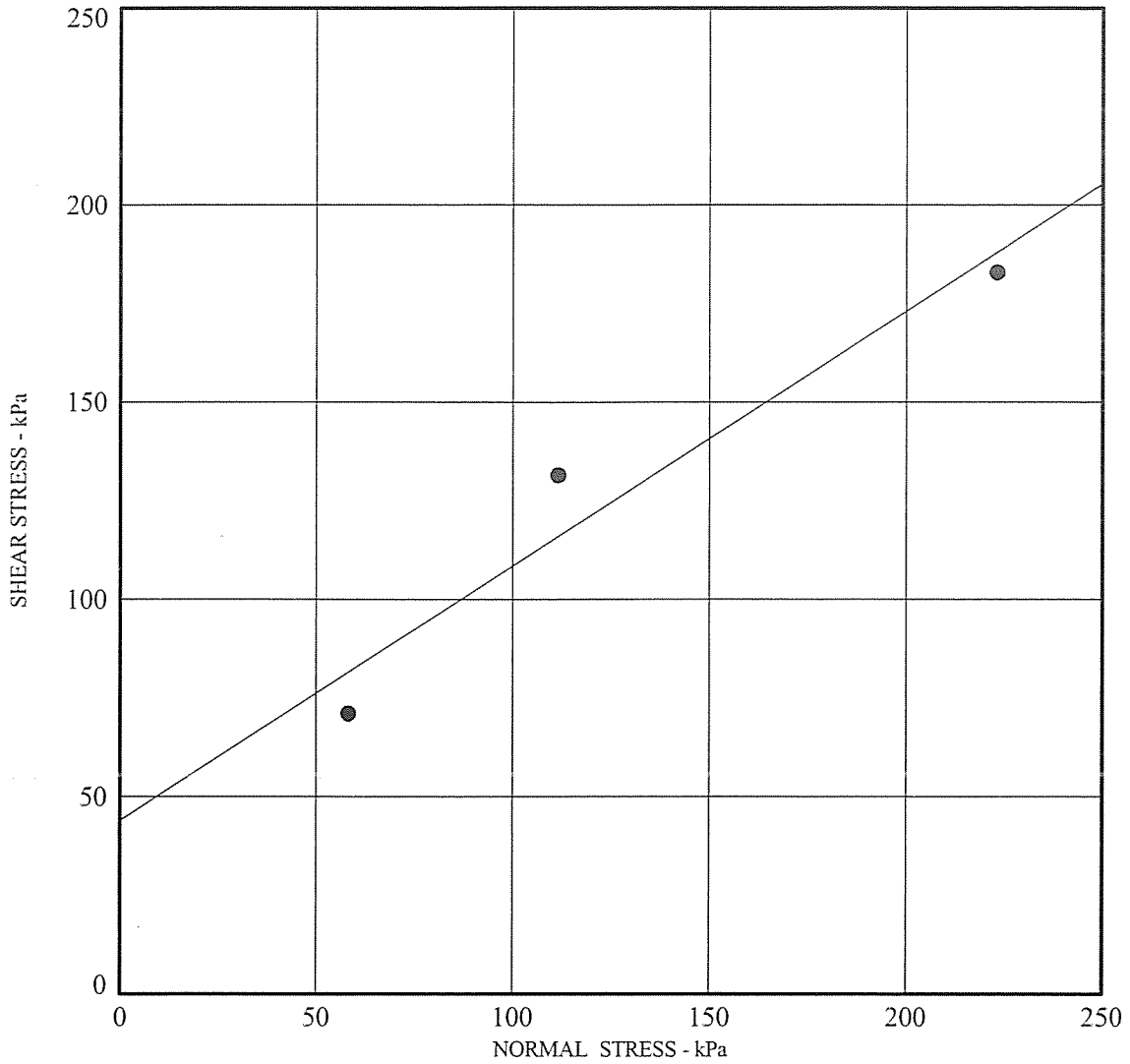
PLATE

B-3

PROJECT NO. 76979

CONSOLIDATION/COLLAPSE POTENTIAL TEST

CONSOL NO INDICIES 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 10/7/08



Test Type: Strain Controlled

Saturated Specimen

Boring	**BS-1**
Depth (m)	**2.3**
Friction Angle - deg	**33**
Cohesion (kPa)	**44.0**
Dry Density (kN/m^3)	**20.4**
Moisture Content (%)*	**7.2**
Description	**Silty Sand**
Classification	**SM**

*** In-Situ**

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I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

DIRECT SHEAR TEST

PLATE

B-4

DIRECT SHEAR 76979 I-215_SR60 EAST JUNCTION CALTRANS FORMAT.GPJ KA_RDLND.GDT 3/12/08

APPENDIX C

ENGINEERING ANALYSES

C-1

LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	I-215/SR-60 East Junction, Box Springs Overhead
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA	
Exploration No.	BS-1
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1514.0 feet
Proposed Grade Elevation	1484.0 feet
Unit Weight of Proposed Fill on Surface	0.0 pcf
GWT Elevation During Test	1448.0 feet
GWT Elevation For Design	1448.0 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1514.0	1509.0	5.0	SM	Y	119.0	28.00	20.0
1509.0	1505.0	9.0	SM	Y	130.0	25.00	20.0
1505.0	1504.0	10.0	SM	Y	130.0	25.00	20.0
1504.0	1499.0	15.0	SM	Y	118.0	15.00	20.0
1499.0	1494.0	20.0	SM	Y	118.0	20.00	20.0
1494.0	1489.0	25.0	SM	Y	118.0	20.00	20.0
1489.0	1484.0	30.0	SM	Y	125.0	68.00	20.0
1484.0	1479.0	35.0	SM	Y	125.0	60.00	20.0
1479.0	1474.0	40.0	SM	Y	125.0	65.00	20.0
1474.0	1469.0	45.0	SM	Y	125.0	35.00	15.0
1469.0	1464.0	50.0	BEDROCK/FORMATION	N	125.0	65.00	0.0

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR-60 Fast Junction, Box Springs Overhead
Project No.	76079
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	BR-1
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1514.00 feet
Proposed Grade Elevation	1484.00 feet
Unit Weight of Proposed Fill on Surface	0.00 pcf
GWT Elevation During Test	1448.00 feet
GWT Elevation For Design	1448.00 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00	****	<==== LPI < 5 ; "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0	feet	LPI = 5 - 15 ; "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 ; "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00	inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.03	inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.03	inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$
* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5}\ MSF\ K_\sigma\ K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_σ = 1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma\ w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA) / SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1514.0	1513.0	SM	Y	119.0	28	20.0	0.5																	
1513.0	1512.0	SM	Y	119.0	28	20.0	1.5																	
1512.0	1511.0	SM	Y	119.0	28	20.0	2.5																	
1511.0	1510.0	SM	Y	119.0	28	20.0	3.5																	
1510.0	1509.0	SM	Y	119.0	28	20.0	4.5																	
1509.0	1508.0	SM	Y	130.0	25	20.0	5.5																	
1508.0	1507.0	SM	Y	130.0	25	20.0	6.5																	
1507.0	1506.0	SM	Y	130.0	25	20.0	7.5																	
1506.0	1505.0	SM	Y	130.0	25	20.0	8.5																	
1505.0	1504.0	SM	Y	130.0	25	20.0	9.5																	
1504.0	1503.0	SM	Y	118.0	15	20.0	10.5																	
1503.0	1502.0	SM	Y	118.0	15	20.0	11.5																	
1502.0	1501.0	SM	Y	118.0	15	20.0	12.5																	
1501.0	1500.0	SM	Y	118.0	15	20.0	13.5																	
1500.0	1499.0	SM	Y	118.0	15	20.0	14.5																	
1499.0	1498.0	SM	Y	118.0	20	20.0	15.5																	
1498.0	1497.0	SM	Y	118.0	20	20.0	16.5																	
1497.0	1496.0	SM	Y	118.0	20	20.0	17.5																	
1496.0	1495.0	SM	Y	118.0	20	20.0	18.5																	
1495.0	1494.0	SM	Y	118.0	20	20.0	19.5																	
1494.0	1493.0	SM	Y	118.0	20	20.0	20.5																	
1493.0	1492.0	SM	Y	118.0	20	20.0	21.5																	
1492.0	1491.0	SM	Y	118.0	20	20.0	22.5																	
1491.0	1490.0	SM	Y	118.0	20	20.0	23.5																	
1490.0	1489.0	SM	Y	118.0	20	20.0	24.5																	
1489.0	1488.0	SM	Y	125.0	68	20.0	25.5																	
1488.0	1487.0	SM	Y	125.0	68	20.0	26.5																	
1487.0	1486.0	SM	Y	125.0	68	20.0	27.5																	
1486.0	1485.0	SM	Y	125.0	68	20.0	28.5																	
1485.0	1484.0	SM	Y	125.0	68	20.0	29.5																	
1484.0	1483.0	SM	Y	125.0	60	20.0	30.5	0.721	1.000	75.0	0.999	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	67.8	N/A	0.009	0.000	0.00	0.03
1483.0	1482.0	SM	Y	125.0	60	20.0	31.5	0.707	1.000	73.6	0.997	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	66.5	N/A	0.015	0.000	0.00	0.03
1482.0	1481.0	SM	Y	125.0	60	20.0	32.5	0.693	1.000	72.2	0.994	N/A	0.252	N/A	N/A	NO	N/A	Soil above GWT	65.2	N/A	0.019	0.000	0.00	0.03
1481.0	1480.0	SM	Y	125.0	60	20.0	33.5	0.679	1.000	70.9	0.992	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	64.0	N/A	0.023	0.000	0.00	0.03
1480.0	1479.0	SM	Y	125.0	60	20.0	34.5	0.666	1.000	69.6	0.990	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	62.8	N/A	0.026	0.000	0.00	0.03
1479.0	1478.0	SM	Y	125.0	65	20.0	35.5	0.654	1.000	73.8	0.987	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	66.7	N/A	0.028	0.000	0.00	0.03
1478.0	1477.0	SM	Y	125.0	65	20.0	36.5	0.642	1.000	72.5	0.985	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	65.5	N/A	0.031	0.000	0.00	0.03
1477.0	1476.0	SM	Y	125.0	65	20.0	37.5	0.631	1.000	71.3	0.983	N/A	0.249	N/A	N/A	NO	N/A	Soil above GWT	64.4	N/A	0.033	0.000	0.00	0.03
1476.0	1475.0	SM	Y	125.0	65	20.0	38.5	0.620	1.000	70.1	0.980	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	63.3	N/A	0.035	0.000	0.00	0.03
1475.0	1474.0	SM	Y	125.0	65	20.0	39.5	0.609	1.000	68.9	0.978	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	62.2	N/A	0.037	0.000	0.00	0.03
1474.0	1473.0	SM	Y	125.0	35	15.0	40.5	0.598	1.000	36.1	0.976	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	33.4	N/A	0.050	0.050	0.01	0.03
1473.0	1472.0	SM	Y	125.0	35	15.0	41.5	0.588	1.000	35.5	0.973	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	32.8	N/A	0.053	0.053	0.01	0.02
1472.0	1471.0	SM	Y	125.0	35	15.0	42.5	0.578	1.000	35.0	0.971	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	32.3	N/A	0.055	0.057	0.01	0.01
1471.0	1470.0	SM	Y	125.0	35	15.0	43.5	0.569	1.000	34.4	0.969	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	31.8	N/A	0.058	0.060	0.01	0.01
1470.0	1469.0	SM	Y	125.0	35	15.0	44.5	0.560	1.000	33.9	0.966	N/A	0.245	N/A	N/A	NO	N/A	Soil above GWT	31.3	N/A	0.060	0.064	0.01	0.00
1469.0	1468.0	BEDROCK/FORMATION	N	125.0	65	0.0	45.5	0.552	1.000	N/A	0.964	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1468.0	1467.0	BEDROCK/FORMATION	N	125.0	65	0.0	46.5	0.543	1.000	N/A	0.962	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1467.0	1466.0	BEDROCK/FORMATION	N	125.0	65	0.0	47.5	0.535	1.000	N/A	0.959	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1466.0	1465.0	BEDROCK/FORMATION	N	125.0	65	0.0	48.5	0.527	1.000	N/A	0.957	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction, Box Springs Overleg
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	BS-1
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1514.00 feet
Proposed Grade Elevation	1484.00 feet
Unit Weight of Proposed Fill on Surface	0.00 pcf
GWT Elevation During Test	1448.00 feet
GWT Elevation For Design	1448.00 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.00

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<====	LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet		LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<====	Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.03 inches	<====	Dry or Unsaturated Soils (Above GWT)
	0.03 inches	<====	Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$
* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5}\ MSF\ K_\sigma\ K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_σ =1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma\ w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_{m} (blows/ft)	Fines Content FC (%)
1465.0	1464.0	BEDROCK/FORMATION	N	125.0	65	0.0

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
49.5	0.519	1.000	N/A	0.955	N/A	0.242	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	I-215/SR-60 East Junction, Box Springs Overhead
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA	
Exploration No.	BS-2
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1485.0 feet
Proposed Grade Elevation	1484.0 feet
Unit Weight of Proposed Fill on Surface	0.0 pcf
GWT Elevation During Test	1448.0 feet
GWT Elevation For Design	1448.0 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1485.0	1480.0	5.0	SM	Y	98.0	6.00	20.0
1480.0	1476.0	9.0	SM	Y	120.0	7.00	20.0
1476.0	1475.0	10.0	SM	Y	120.0	7.00	20.0
1475.0	1470.0	15.0	SM	Y	120.0	37.00	20.0
1470.0	1465.0	20.0	SM	Y	120.0	55.00	20.0
1465.0	1460.0	25.0	SM	Y	122.0	70.00	20.0
1460.0	1455.0	30.0	BEDROCK/FORMATION	N	125.0	70.00	0.0
1455.0	1450.0	35.0	BEDROCK/FORMATION	N	125.0	70.00	0.0
1450.0	1445.0	40.0	BEDROCK/FORMATION	N	125.0	70.00	0.0

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction, Box Springs Overhead
Project No.	76079
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	DS-2
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1485.00 feet
Proposed Grade Elevation	1484.00 feet
Unit Weight of Proposed Fill on Surface	0.00 pcf
GWT Elevation During Test	1448.00 feet
GWT Elevation For Design	1448.00 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<==== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 - 15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.11 inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.11 inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ $CSR = 0.65\ A_{max}\ (\sigma_v/\sigma_v')\ r_d$
* FS_{liq} = (CRR/CSR), where $CRR = CRR_{7.5}\ MSF\ K_\sigma\ K_\alpha$ ($CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_σ =1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site, $LPI = \Sigma\ w_i\ x\ f(FS_{liq})\ x\ H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA) / SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

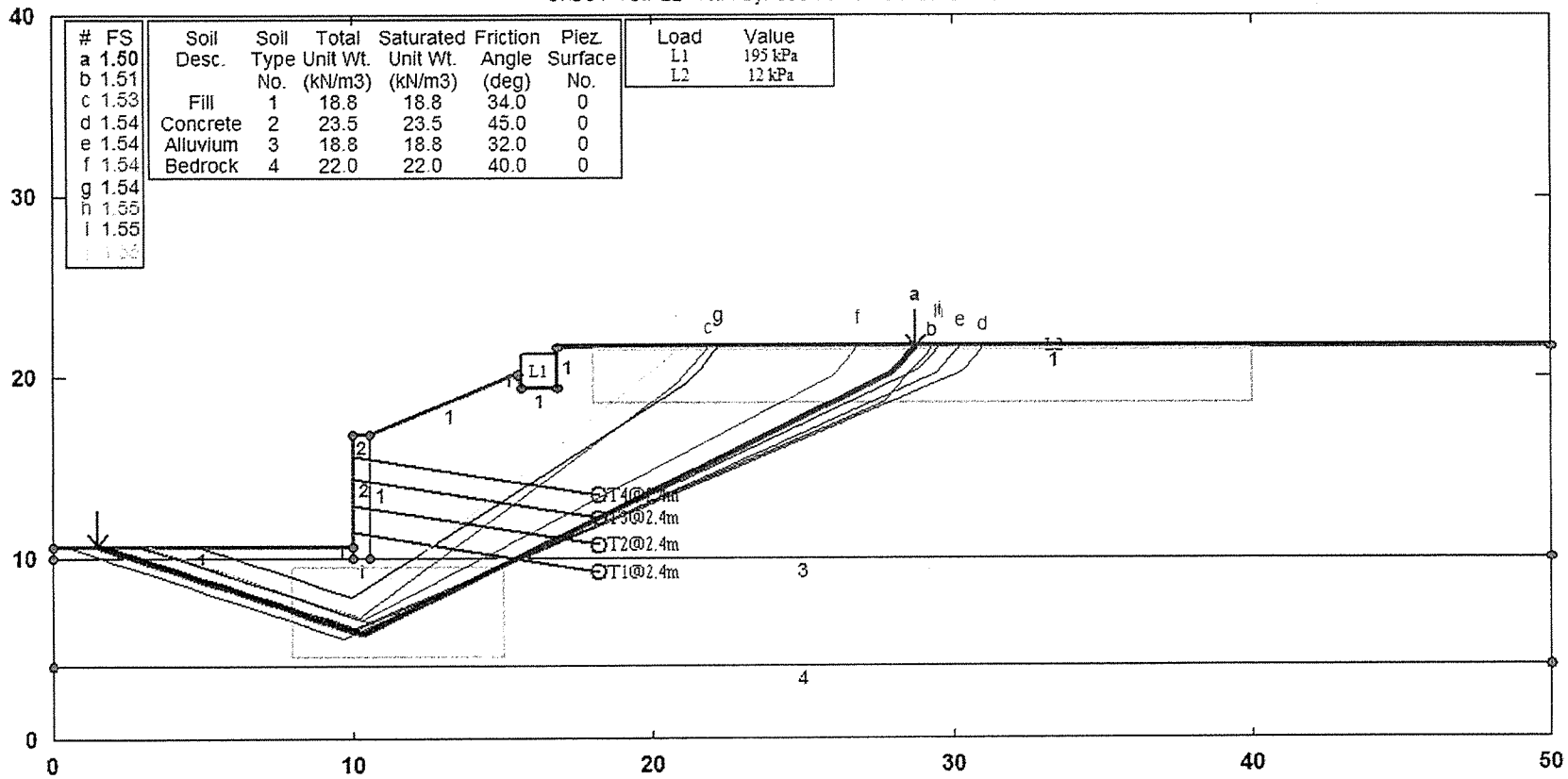
Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1485.0	1484.0	SM	Y	98.0	6	20.0	0.5																	
1484.0	1483.0	SM	Y	98.0	6	20.0	1.5	1.709	0.750	16.2	0.999	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	13.4	N/A	0.014	0.036	0.00	0.11
1483.0	1482.0	SM	Y	98.0	6	20.0	2.5	1.664	0.750	16.0	0.997	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	13.1	N/A	0.024	0.064	0.01	0.11
1482.0	1481.0	SM	Y	98.0	6	20.0	3.5	1.604	0.750	15.5	0.994	N/A	0.252	N/A	N/A	NO	N/A	Soil above GWT	12.7	N/A	0.032	0.086	0.01	0.10
1481.0	1480.0	SM	Y	98.0	6	20.0	4.5	1.549	0.750	15.1	0.992	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	12.3	N/A	0.038	0.106	0.01	0.08
1480.0	1479.0	SM	Y	120.0	7	20.0	5.5	1.492	0.750	16.5	0.990	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	13.6	N/A	0.042	0.115	0.01	0.07
1479.0	1478.0	SM	Y	120.0	7	20.0	6.5	1.433	0.750	16.0	0.987	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	13.2	N/A	0.047	0.124	0.01	0.06
1478.0	1477.0	SM	Y	120.0	7	20.0	7.5	1.379	0.750	15.6	0.985	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	12.7	N/A	0.053	0.142	0.02	0.04
1477.0	1476.0	SM	Y	120.0	7	20.0	8.5	1.329	0.850	16.7	0.983	N/A	0.249	N/A	N/A	NO	N/A	Soil above GWT	13.8	N/A	0.055	0.137	0.02	0.02
1476.0	1475.0	SM	Y	120.0	7	20.0	9.5	1.283	0.850	16.2	0.980	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	13.3	N/A	0.060	0.153	0.02	0.00
1475.0	1474.0	SM	Y	120.0	37	20.0	10.5	1.239	0.850	68.0	0.978	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	61.3	N/A	0.005	0.000	0.00	0.00
1474.0	1473.0	SM	Y	120.0	37	20.0	11.5	1.199	0.850	65.9	0.976	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	59.3	N/A	0.038	0.000	0.00	0.00
1473.0	1472.0	SM	Y	120.0	37	20.0	12.5	1.161	0.850	63.9	0.973	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	57.5	N/A	0.040	0.000	0.00	0.00
1472.0	1471.0	SM	Y	120.0	37	20.0	13.5	1.125	0.850	62.0	0.971	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	55.8	N/A	0.042	0.000	0.00	0.00
1471.0	1470.0	SM	Y	120.0	37	20.0	14.5	1.092	0.850	60.3	0.969	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	54.2	N/A	0.044	0.000	0.00	0.00
1470.0	1469.0	SM	Y	120.0	55	20.0	15.5	1.060	0.950	95.1	0.966	N/A	0.245	N/A	N/A	NO	N/A	Soil above GWT	86.4	N/A	0.039	0.000	0.00	0.00
1469.0	1468.0	SM	Y	120.0	55	20.0	16.5	1.030	0.950	92.5	0.964	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	84.0	N/A	0.041	0.000	0.00	0.00
1468.0	1467.0	SM	Y	120.0	55	20.0	17.5	1.002	0.950	90.1	0.962	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	81.8	N/A	0.042	0.000	0.00	0.00
1467.0	1466.0	SM	Y	120.0	55	20.0	18.5	0.976	0.950	87.8	0.959	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	79.6	N/A	0.044	0.000	0.00	0.00
1466.0	1465.0	SM	Y	120.0	55	20.0	19.5	0.950	0.950	85.6	0.957	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	77.6	N/A	0.045	0.000	0.00	0.00
1465.0	1464.0	SM	Y	122.0	70	20.0	20.5	0.926	0.950	105.3	0.955	N/A	0.242	N/A	N/A	NO	N/A	Soil above GWT	95.9	N/A	0.043	0.000	0.00	0.00
1464.0	1463.0	SM	Y	122.0	70	20.0	21.5	0.903	0.950	102.7	0.952	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	93.5	N/A	0.045	0.000	0.00	0.00
1463.0	1462.0	SM	Y	122.0	70	20.0	22.5	0.881	0.950	100.3	0.950	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	91.3	N/A	0.046	0.000	0.00	0.00
1462.0	1461.0	SM	Y	122.0	70	20.0	23.5	0.860	0.950	98.0	0.948	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	89.1	N/A	0.047	0.000	0.00	0.00
1461.0	1460.0	SM	Y	122.0	70	20.0	24.5	0.840	0.950	95.8	0.945	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	87.1	N/A	0.048	0.000	0.00	0.00
1460.0	1459.0	BEDROCK/FORMATION	N	125.0	70	0.0	25.5	0.821	0.950	N/A	0.943	N/A	0.239	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1459.0	1458.0	BEDROCK/FORMATION	N	125.0	70	0.0	26.5	0.802	0.950	N/A	0.941	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1458.0	1457.0	BEDROCK/FORMATION	N	125.0	70	0.0	27.5	0.784	0.950	N/A	0.938	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1457.0	1456.0	BEDROCK/FORMATION	N	125.0	70	0.0	28.5	0.767	1.000	N/A	0.936	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1456.0	1455.0	BEDROCK/FORMATION	N	125.0	70	0.0	29.5	0.751	1.000	N/A	0.934	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1455.0	1454.0	BEDROCK/FORMATION	N	125.0	70	0.0	30.5	0.735	1.000	N/A	0.931	N/A	0.236	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1454.0	1453.0	BEDROCK/FORMATION	N	125.0	70	0.0	31.5	0.720	1.000	N/A	0.929	N/A	0.235	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1453.0	1452.0	BEDROCK/FORMATION	N	125.0	70	0.0	32.5	0.705	1.000	N/A	0.918	N/A	0.233	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1452.0	1451.0	BEDROCK/FORMATION	N	125.0	70	0.0	33.5	0.692	1.000	N/A	0.909	N/A	0.231	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1451.0	1450.0	BEDROCK/FORMATION	N	125.0	70	0.0	34.5	0.678	1.000	N/A	0.901	N/A	0.228	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1450.0	1449.0	BEDROCK/FORMATION	N	125.0	70	0.0	35.5	0.665	1.000	N/A	0.893	N/A	0.226	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1449.0	1448.0	BEDROCK/FORMATION	N	125.0	70	0.0	36.5	0.653	1.000	N/A	0.885	N/A	0.224	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.00
1448.0	1447.0	BEDROCK/FORMATION	N	125.0	70	0.0	37.5	0.644	1.000	N/A	0.877	N/A	0.224	N/A	N/A	NO	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.00
1447.0	1446.0	BEDROCK/FORMATION	N	125.0	70	0.0	38.5	0.638	1.000	N/A	0.869	N/A	0.225	N/A	N/A	NO	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.00
1446.0	1445.0	BEDROCK/FORMATION	N	125.0	70	0.0	39.5	0.633	1.000	N/A	0.861	N/A	0.226	N/A	N/A	NO	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.00

C-2

SLOPE STABILITY

Box Springs OH (Tieback), Static Case

C:\BST-1C.PL2 Run By: Username 6/9/2009 10:18AM



#	FS
a	1.50
b	1.51
c	1.53
d	1.54
e	1.54
f	1.54
g	1.54
h	1.55
i	1.55

Soil Desc.	Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Friction Angle (deg)	Piez. Surface No.
Fill	1	18.8	18.8	34.0	0
Concrete	2	23.5	23.5	45.0	0
Alluvium	3	18.8	18.8	32.0	0
Bedrock	4	22.0	22.0	40.0	0

Load	Value
L1	195 kPa
L2	12 kPa

GSTABL7 v.2 FSmin=1.50

Safety Factors Are Calculated By The Simplified Janbu Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 6/9/2009
Time of Run: 2:37PM
Run By: Username
Input Data Filename: C:bst-1c.si
Output Filename: C:bst-1c.OUT
Unit System: SI

Plotted Output Filename: C:bst-1c.PLT

PROBLEM DESCRIPTION: Box Springs OH (Tieback),
Static Case

BOUNDARY COORDINATES

8 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	10.60	10.00	10.60	1
2	10.00	10.60	10.01	16.80	2
3	10.01	16.80	10.57	16.80	2
4	10.57	16.80	15.50	20.13	1
5	15.50	20.13	15.60	19.35	1
6	15.60	19.35	16.80	19.35	1
7	16.80	19.35	16.81	21.61	1
8	16.81	21.61	50.00	21.61	1
9	10.00	10.60	10.01	10.00	1
10	10.01	10.00	10.56	10.00	1
11	10.56	10.00	10.57	16.80	1
12	0.00	10.00	50.00	10.00	3
13	0.00	4.00	50.00	4.00	4

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	18.8	18.8	0.0	34.0	0.00	0.0	0
2	23.5	23.5	0.0	45.0	0.00	0.0	0

3	18.8	18.8	0.0	32.0	0.00	0.0	0
4	22.0	22.0	0.0	40.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	15.60	16.80	195.0	0.0
2	16.81	50.00	12.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

1

TIEBACK LOAD(S)

4 Tieback Load(s) Specified

Tieback No.	X-Pos (m)	Y-Pos (m)	Load (kN)	Spacing (m)	Inclination (deg)	Length (m)	Force Method
1	10.00	11.36	275.0	2.4	15.00	8.5	2
2	10.00	12.88	300.0	2.4	15.00	8.5	2
3	10.01	14.40	250.0	2.4	15.00	8.5	2
4	10.01	15.62	300.0	2.4	15.00	8.5	2

NOTE - An Equivalent Line Load Is Calculated For Each Row Of Tiebacks Assuming A Uniform Distribution Of Load Horizontally Between Individual Tiebacks. Force Method 1 Considers Only Tangential Tieback Forces. Force Method 2 Considers Both Tangential and Normal Tieback Forces.

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

The Active And Passive Portions Of The Sliding Surfaces Are Generated According To The Rankine Theory.

1000 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 1.0

Box No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Height (m)
1	8.00	7.00	15.00	7.00	5.00
2	18.00	20.00	40.00	20.00	3.00

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Evaluated. They Are

Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Simplified Janbu Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 4.010 FS Min = 1.502 FS Ave = 1.817
Standard Deviation = 0.363 Coefficient of Variation = 19.97 %

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.50	10.60
2	1.74	10.47
3	2.63	10.00
4	3.33	9.61
5	4.20	9.13
6	5.08	8.64
7	5.95	8.16
8	6.83	7.67
9	7.70	7.19
10	8.58	6.70
11	9.45	6.22
12	10.33	5.73
13	27.96	20.15
14	28.43	21.03
15	28.74	21.61

Factor of Safety
*** 1.502 ***

Individual data on the 23 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.9	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.7	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.9	20.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.9	28.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.9	36.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.9	44.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.9	52.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.9	60.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.9	68.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.5	46.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	1.6	0.0	0.0	0.1	0.0	0.0	0.0	0.0
13	0.3	75.3	0.0	0.0	1.8	1.0	0.0	0.0	0.0
14	0.2	55.9	0.0	0.0	1.6	-1.1	0.0	0.0	0.0
15	0.0	2.2	0.0	0.0	0.1	-0.1	0.0	0.0	0.0
16	4.9	977.4	0.0	0.0	120.2	-4.8	0.0	0.0	0.0
17	0.0	8.8	0.0	0.0	1.1	0.6	0.0	0.0	0.0
18	0.1	9.5	0.0	0.0	1.2	0.7	0.0	0.0	0.0
19	1.2	199.4	0.0	0.0	24.1	17.5	0.0	0.0	234.0
20	0.0	1.8	0.0	0.0	0.2	0.2	0.0	0.0	0.0
21	11.2	1265.7	0.0	0.0	49.7	110.6	0.0	0.0	133.8
22	0.5	9.0	0.0	0.0	2.9	3.8	0.0	0.0	5.6
23	0.3	1.7	0.0	0.0	1.8	2.4	0.0	0.0	3.7

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.80	10.60
2	2.04	10.47
3	2.93	10.00
4	3.03	9.94
5	3.90	9.46
6	4.78	8.97
7	5.65	8.49
8	6.53	8.00
9	7.40	7.52
10	8.28	7.03
11	9.15	6.55
12	10.02	6.06
13	27.70	18.56
14	28.17	19.45
15	28.64	20.33
16	29.11	21.21
17	29.32	21.61

Factor of Safety
*** 1.519 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.93	10.60
2	3.18	10.47
3	4.06	10.00
4	4.87	9.55
5	5.75	9.06
6	6.62	8.58
7	7.50	8.10
8	8.37	7.61
9	9.25	7.13
10	10.12	6.64
11	20.79	19.61
12	21.26	20.50
13	21.73	21.38
14	21.85	21.61

Factor of Safety
*** 1.530 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	3.11	10.60
2	3.36	10.47
3	4.24	10.00
4	5.11	9.52
5	5.98	9.04
6	6.85	8.55
7	7.73	8.07

8	8.60	7.58
9	9.48	7.10
10	10.35	6.61
11	25.99	20.02
12	26.45	20.90
13	26.83	21.61

Factor of Safety
*** 1.531 ***

1

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	4.93	10.60
2	5.18	10.47
3	6.06	10.00
4	6.46	9.78
5	7.34	9.29
6	8.21	8.81
7	9.09	8.32
8	9.96	7.84
9	21.15	19.60
10	21.62	20.49
11	22.09	21.37
12	22.22	21.61

Factor of Safety
*** 1.541 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.89	10.60
2	2.13	10.47
3	3.01	10.00
4	3.14	9.93
5	4.02	9.44
6	4.89	8.96
7	5.77	8.47
8	6.64	7.99
9	7.52	7.50
10	8.39	7.02
11	9.27	6.53
12	10.14	6.05
13	30.30	20.27
14	30.77	21.15
15	31.02	21.61

Factor of Safety
*** 1.547 ***

1

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	3.23	10.60
2	3.48	10.47
3	4.36	10.00
4	4.57	9.88
5	5.45	9.40
6	6.32	8.91
7	7.20	8.43
8	8.07	7.94
9	8.95	7.46
10	9.82	6.97
11	20.53	21.03
12	20.84	21.61

Factor of Safety
*** 1.549 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	0.48	10.60
2	0.73	10.47
3	1.61	10.00
4	1.83	9.88
5	2.70	9.40
6	3.57	8.91
7	4.45	8.43
8	5.32	7.94
9	6.20	7.46
10	7.07	6.97
11	7.95	6.49
12	8.82	6.00
13	9.70	5.52
14	29.42	20.11
15	29.89	20.99
16	30.22	21.61

Factor of Safety
*** 1.550 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.23	10.60
2	1.47	10.47
3	2.36	10.00
4	2.98	9.66
5	3.85	9.17
6	4.73	8.69
7	5.60	8.20
8	6.48	7.72
9	7.35	7.23
10	8.23	6.75
11	9.10	6.26
12	9.98	5.78
13	20.16	21.04
14	20.47	21.61

Factor of Safety
*** 1.551 ***

Failure Surface Specified By 10 Coordinate Points

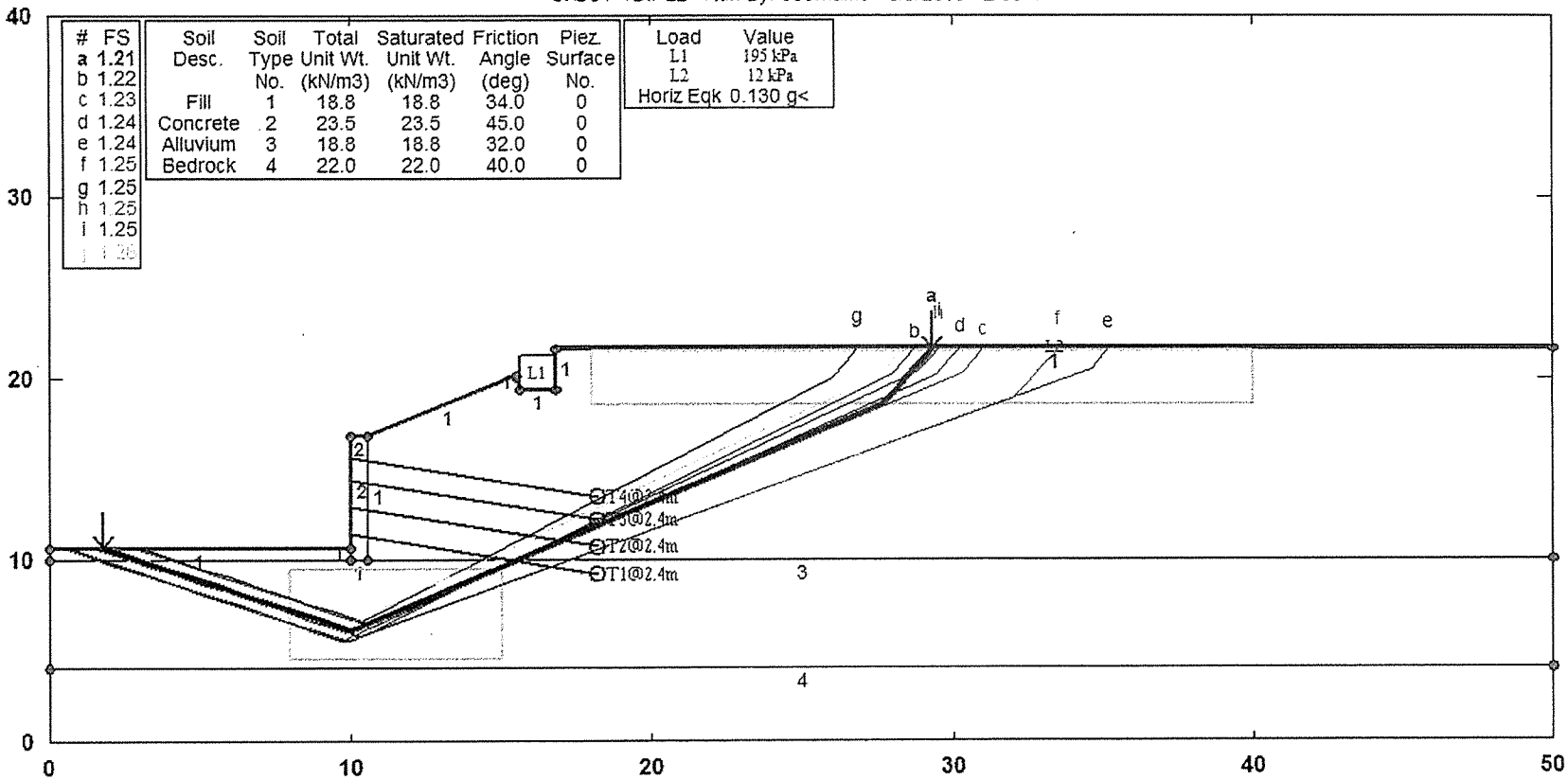
Point No.	X-Surf (m)	Y-Surf (m)
1	5.02	10.60
2	5.27	10.47
3	6.15	10.00
4	6.58	9.76
5	7.46	9.28
6	8.33	8.79
7	9.20	8.31
8	10.08	7.82
9	23.75	21.31
10	23.91	21.61

Factor of Safety
*** 1.554 ***

**** END OF GSTABL7 OUTPUT ****

Box Springs OH (Tieback), Seismic Case

C:\BST-1D.PL2 Run By: Username 6/9/2009 2:38PM



GSTABL7 v.2 FSmin=1.21

Safety Factors Are Calculated By The Simplified Janbu Method

GSTABL7

bst-1d.OUT
*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 6/9/2009
Time of Run: 2:38PM
Run By: Username
Input Data Filename: C:bst-1d.si
Output Filename: C:bst-1d.OUT
Unit System: SI

Plotted Output Filename: C:bst-1d.PLT

PROBLEM DESCRIPTION: Box Springs OH (Tieback),
Seismic Case

BOUNDARY COORDINATES

8 Top Boundaries
13 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	10.60	10.00	10.60	1
2	10.00	10.60	10.01	16.80	2
3	10.01	16.80	10.57	16.80	2
4	10.57	16.80	15.50	20.13	1
5	15.50	20.13	15.60	19.35	1
6	15.60	19.35	16.80	19.35	1
7	16.80	19.35	16.81	21.61	1
8	16.81	21.61	50.00	21.61	1
9	10.00	10.60	10.01	10.00	1
10	10.01	10.00	10.56	10.00	1
11	10.56	10.00	10.57	16.80	1
12	0.00	10.00	50.00	10.00	3
13	0.00	4.00	50.00	4.00	4

1

ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	18.8	18.8	0.0	34.0	0.00	0.0	0
2	23.5	23.5	0.0	45.0	0.00	0.0	0

3	18.8	18.8	0.0	32.0	0.00	0.0	0
4	22.0	22.0	0.0	40.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	15.60	16.80	195.0	0.0
2	16.81	50.00	12.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

TIEBACK LOAD(S)

4 Tieback Load(s) Specified

Tieback No.	X-Pos (m)	Y-Pos (m)	Load (kN)	Spacing (m)	Inclination (deg)	Length (m)	Force Method
1	10.00	11.36	275.0	2.4	15.00	8.5	2
2	10.00	12.88	300.0	2.4	15.00	8.5	2
3	10.01	14.40	250.0	2.4	15.00	8.5	2
4	10.01	15.62	300.0	2.4	15.00	8.5	2

NOTE - An Equivalent Line Load Is Calculated For Each Row Of Tiebacks
Assuming A Uniform Distribution Of Load Horizontally Between Individual
Tiebacks. Force Method 1 Considers Only Tangential Tieback Forces.
Force Method 2 Considers Both Tangential and Normal Tieback Forces.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.

The Active And Passive Portions Of The Sliding Surfaces
Are Generated According To The Rankine Theory.

1000 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 1.0

Box No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Height (m)
1	8.00	7.00	15.00	7.00	5.00
2	18.00	20.00	40.00	20.00	3.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Simplified Janbu Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 3.096 FS Min = 1.211 FS Ave = 1.416
Standard Deviation = 0.265 Coefficient of Variation = 18.74 %

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.80	10.60
2	2.04	10.47
3	2.93	10.00
4	3.03	9.94
5	3.90	9.46
6	4.78	8.97
7	5.65	8.49
8	6.53	8.00
9	7.40	7.52
10	8.28	7.03
11	9.15	6.55
12	10.02	6.06
13	27.70	18.56
14	28.17	19.45
15	28.64	20.33
16	29.11	21.21
17	29.32	21.61

Factor of Safety
*** 1.211 ***

Individual data on the 25 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.9	6.1	0.0	0.0	0.0	0.0	0.8	0.0	0.0
3	0.1	1.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0
4	0.9	14.8	0.0	0.0	0.0	0.0	1.9	0.0	0.0
5	0.9	22.8	0.0	0.0	0.0	0.0	3.0	0.0	0.0
6	0.9	30.8	0.0	0.0	0.0	0.0	4.0	0.0	0.0
7	0.9	38.8	0.0	0.0	0.0	0.0	5.0	0.0	0.0
8	0.9	46.8	0.0	0.0	0.0	0.0	6.1	0.0	0.0
9	0.9	54.8	0.0	0.0	0.0	0.0	7.1	0.0	0.0
10	0.9	62.8	0.0	0.0	0.0	0.0	8.2	0.0	0.0
11	0.8	68.7	0.0	0.0	0.0	0.0	8.9	0.0	0.0

12	0.0	1.6	0.0	0.0	0.1	0.0	0.2	0.0	0.0
13	0.0	3.4	0.0	0.0	0.1	0.0	0.4	0.0	0.0
14	0.5	123.3	0.0	0.0	3.5	-2.2	16.0	0.0	0.0
15	0.0	2.1	0.0	0.0	0.1	0.0	0.3	0.0	0.0
16	4.9	954.6	0.0	0.0	115.7	7.0	124.1	0.0	0.0
17	0.1	16.8	0.0	0.0	1.8	1.2	2.2	0.0	0.0
18	0.0	1.6	0.0	0.0	0.2	0.1	0.2	0.0	0.0
19	1.2	201.8	0.0	0.0	20.9	17.0	26.2	0.0	234.0
20	0.0	1.8	0.0	0.0	0.2	0.1	0.2	0.0	0.0
21	10.9	1416.3	0.0	0.0	46.3	104.5	184.1	0.0	130.7
22	0.5	23.0	0.0	0.0	3.4	3.8	3.0	0.0	5.6
23	0.5	15.2	0.0	0.0	3.0	3.7	2.0	0.0	5.6
24	0.5	7.4	0.0	0.0	2.7	3.5	1.0	0.0	5.6
25	0.2	0.8	0.0	0.0	1.1	1.5	0.1	0.0	2.5

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.50	10.60
2	1.74	10.47
3	2.63	10.00
4	3.33	9.61
5	4.20	9.13
6	5.08	8.64
7	5.95	8.16
8	6.83	7.67
9	7.70	7.19
10	8.58	6.70
11	9.45	6.22
12	10.33	5.73
13	27.96	20.15
14	28.43	21.03
15	28.74	21.61

Factor of Safety
*** 1.216 ***

1

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	1.89	10.60
2	2.13	10.47
3	3.01	10.00
4	3.14	9.93
5	4.02	9.44
6	4.89	8.96
7	5.77	8.47
8	6.64	7.99
9	7.52	7.50
10	8.39	7.02
11	9.27	6.53
12	10.14	6.05
13	30.30	20.27
14	30.77	21.15
15	31.02	21.61

Factor of Safety
*** 1.231 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	0.48	10.60
2	0.73	10.47
3	1.61	10.00
4	1.83	9.88
5	2.70	9.40
6	3.57	8.91
7	4.45	8.43
8	5.32	7.94
9	6.20	7.46
10	7.07	6.97
11	7.95	6.49
12	8.82	6.00
13	9.70	5.52
14	29.42	20.11
15	29.89	20.99
16	30.22	21.61

Factor of Safety
*** 1.240 ***

1

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	0.66	10.60
2	0.91	10.47
3	1.79	10.00
4	2.06	9.85
5	2.93	9.37
6	3.81	8.88
7	4.68	8.40
8	5.56	7.91
9	6.43	7.43
10	7.31	6.94
11	8.18	6.46
12	9.05	5.97
13	9.93	5.49
14	34.62	20.52
15	35.09	21.40
16	35.20	21.61

Factor of Safety
*** 1.242 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	0.57	10.60
2	0.82	10.47
3	1.70	10.00
4	1.94	9.87
5	2.82	9.38
6	3.69	8.90
7	4.57	8.41

8	5.44	7.93
9	6.31	7.44
10	7.19	6.96
11	8.06	6.47
12	8.94	5.99
13	9.81	5.50
14	32.02	18.81
15	32.49	19.70
16	32.96	20.58
17	33.43	21.46
18	33.51	21.61

Factor of Safety
*** 1.246 ***

1

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	3.11	10.60
2	3.36	10.47
3	4.24	10.00
4	5.11	9.52
5	5.98	9.04
6	6.85	8.55
7	7.73	8.07
8	8.60	7.58
9	9.48	7.10
10	10.35	6.61
11	25.99	20.02
12	26.45	20.90
13	26.83	21.61

Factor of Safety
*** 1.246 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.90	10.60
2	3.15	10.47
3	4.03	10.00
4	4.65	9.66
5	5.52	9.17
6	6.40	8.69
7	7.27	8.20
8	8.15	7.72
9	9.02	7.23
10	9.90	6.75
11	10.77	6.26
12	28.84	20.30
13	29.31	21.18
14	29.54	21.61

Factor of Safety
*** 1.254 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.90	10.60
2	3.15	10.47
3	4.03	10.00
4	4.65	9.66
5	5.52	9.17
6	6.40	8.69
7	7.27	8.20
8	8.15	7.72
9	9.02	7.23
10	9.90	6.75
11	10.77	6.26
12	28.84	20.30
13	29.31	21.18
14	29.54	21.61

Factor of Safety
*** 1.254 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.09	10.60
2	2.34	10.47
3	3.22	10.00
4	3.60	9.79
5	4.48	9.31
6	5.35	8.82
7	6.23	8.34
8	7.10	7.85
9	7.97	7.37
10	8.85	6.88
11	9.72	6.40
12	27.45	19.98
13	27.92	20.87
14	28.31	21.61

Factor of Safety
*** 1.257 ***

**** END OF GSTABL7 OUTPUT ****

C-3

SOIL BEARING CAPACITY

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

(Version 3.0, Copyright 2005, Developed By: GeoSoftware Solutions, All Rights Reserved)
(Licensed to: Kleinfelder West, Inc. - Redlands, California)

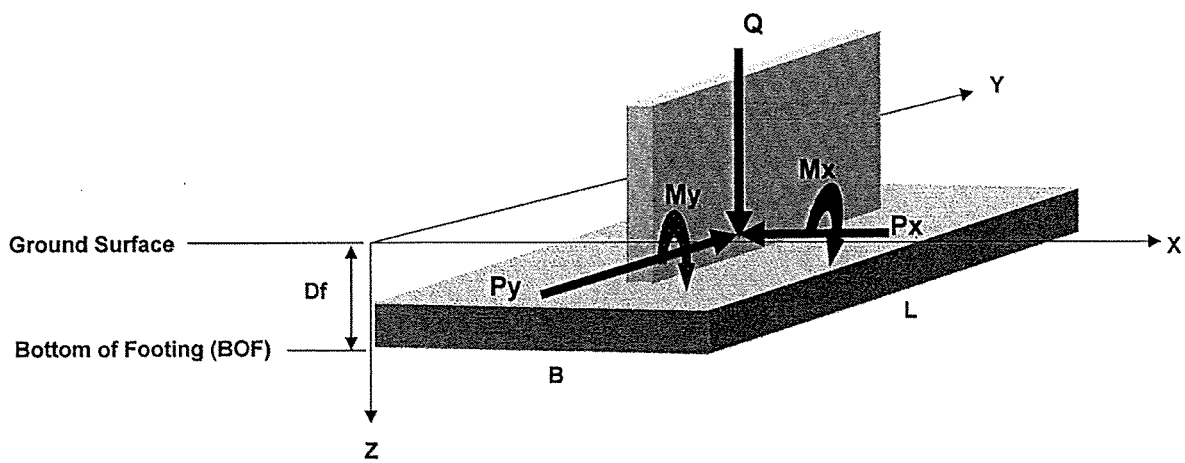
PROJECT INFORMATION	
Project Name	I-215/SR-60 East Junction, Proposed "D" Line Walls
Project No.	76979
Location	Riverside, California

FOOTING GEOMETRY	
Footing Location	Box Springs OH (Tieback)
Footing Description	Wall Footing
Footing Width, B	1.84 feet
Footing Length, L	20.00 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,484.00 feet
Design GWT Elevation	1,448.00 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

SOIL PARAMETERS	
Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS	
Design Method	WSD
Normal Load, Q	65.43 kips
Shear Load (along X-axis), P_x	244.19 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	275.68 kip-foot

RESISTANCE FACTORS	
LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear



ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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(Licensed to: Kleinfelder West, Inc. - Redlands, California)

PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction, Proposed "D" Line Walls
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	Box Springs OH (Tieback)
Footing Description	Wall Footing
Footing Width, B	1.84 feet
Footing Length, L	20.00 feet
Min. Footing Embedment Depth, D_f	5.00 feet
Bottom of Footing Elevation	1,484.00 feet
Design GWT Elevation	1,448.00 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Design Method	WSD
Normal Gravity Load, Q	65.43 kips
Shear Load (along X-axis), P_x	244.19 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	275.68 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,489.00 feet
Depth to Design GWT, Z_w	41.00 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	4.21 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	244.19 kips
Effective Footing Width, $B' = B - 2\,e_x$	-6.59 feet
Effective Footing Length, $L' = L - 2\,e_y$	20.00 feet
Effective Footing Area, $A_f = B'\,L'$	-131.73 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	1.78 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\,c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	1.66 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	600.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\,\phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	1.22
Exponent, n	0.51

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.03	1.06	0.78	0.78
s_q	N/A	1.03	0.83	0.79
s_γ	0.80	1.03	1.13	1.13
Depth Factors, d_c	N/A	1.98	1.49	1.49
d_q	N/A	1.49	1.34	1.34
d_γ	N/A	1.49	1.00	1.00
Inclination Factors, i_c	N/A	0.03	1.02	1.00
i_q	N/A	0.03	1.02	1.00
i_γ	N/A	1.81	1.02	1.01
Ground Factors (base on slope), g_c	N/A	N/A	1.00	1.00
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\,S_u\,(1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	22.9	14.5	9.5

Ultimate Gross Bearing Capacity, $q_{ult-ave}$	12.0 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	4.0 ksf
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:
* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

APPENDIX D

BRIDGE AS-BUILT PLANS

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	Riv	215.60	R6.8/R6.8 R9.5/23.0	237	281

REG. STERED ENGINEER - CIVIL 5-4-99

4-17-00
PLANS APPROVAL DATE

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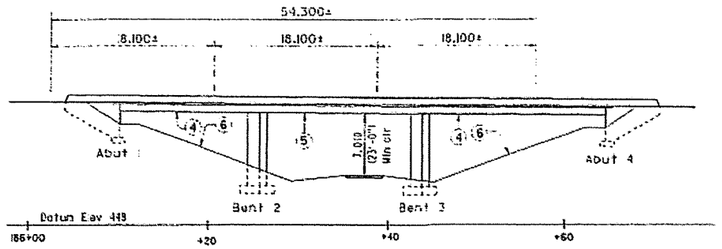
REGISTERED PROFESSIONAL ENGINEER — YUSUF SAKI — No. 54166 — Exp. 12-31-99 — CIVIL — STATE OF CALIFORNIA

Caltrans Metric



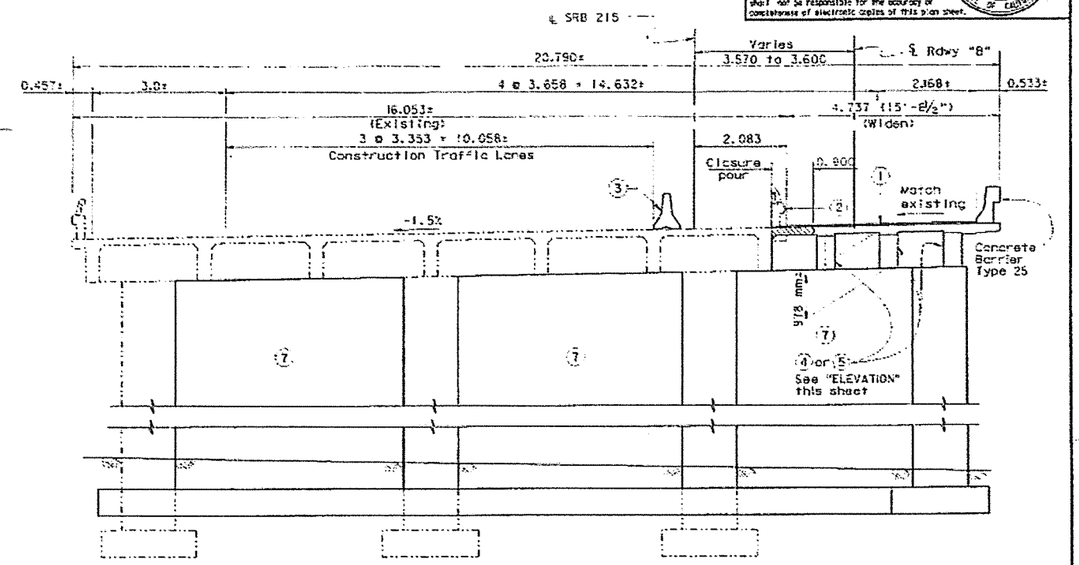
ELEVATION

1:250

Notes:

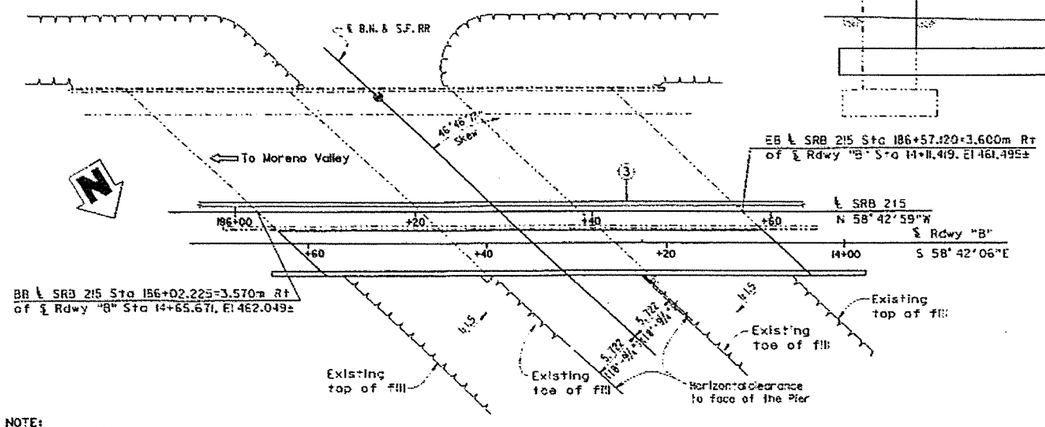
1. 30 mm overlay to match existing. (See Road Plans)
2. Remove existing type 1 railing and deck overhang.
3. Temporary railing type K. (See Road Plans)
4. CIP concrete T-girder.
5. Precast/prestressed rectangular girder
6. Slope paving.
7. Infill wall.

Point of minimum vertical clearance
— — Indicates existing structure
—— Indicates new construction



TYPICAL SECTION

1:50



PLAN

1: 250

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

QUANTITIES

BRIDGE REMOVAL (PORTION), LOCATION B	LUMP	SUM
STRUCTURE EXCAVATION (BRIDGE)	713	m^3
STRUCTURE BACKFILL (BRIDGE)	480	m^3
STRUCTURAL CONCRETE, BRIDGE FOOTING	160	m^3
STRUCTURAL CONCRETE, BRIDGE	445	m^3
DRILL AND BOND DOWEL	150	m
FURNISH PRECAST PRESTRESSED CONCRETE GIRDER 115 M - 20 M	3	EA
ERECT PRECAST PRESTRESSED CONCRETE GIRDER	3	EA
BAR REINFORCING STEEL (BRIDGE)	54,840	kg
STRUCTURE DRAINAGE SYSTEM	LUMP	SUM
SLOPE PAVING (CONCRETE)	42	m^3
CONCRETE BARRIER (TYPE 25)	66	m

Note:
For General Notes and Standard Plans, see "Index to Plans" sheet

English unit is to be used for AR information only

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN ENGINEER	DESIGN	BY Ariel Reyes	CHECKED Lawrence Okoye	LOAD FACTOR DESIGN
	DETAILS	BY A. Lovato/Ed Todd	CHECKED Lawrence Okoye	LAYOUT
	QUANTITIES	BY Tim Crouter	CHECKED Lawrence Okoye	SPECIFICATIONS

LIVE LOADING: HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD

BY Ariel Reyes — CHECKED Lawrence Okoye

BY Ruth Fernandes — CLEAR-ANCE SPECS

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 10

BRIDGE NO. 56-0082L
EXCEPTION POST R62.135

BOX SPRINGS OVERHEAD (WIDEN)
GENERAL PLAN

CU 08
EA 453001

DISREGARD PRINTS BEARING EARLIER REVISION DATES

SHEET 1 OF 14

STRUCTURES DESIGN GENERAL PLAN SHEET

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

		NORTH	EAST
A	187 + 94.390 B.C. ℄ SRB 215	697911.9492	1903064.3618
B	186 + 29.671 P.O.T. ℄ SRB 215 14 + 83.535 P.O.T. ℄ AT&SF RR	697826.4140	1903145.1320
C	194 + 46.326 P.O.T. ℄ SRB 215 And + 3.657m Rt. 184 + 46.326 P.O.T. ℄ WRB 215 Bk.	697734.2078	1903301.8195

		NORTH	EAST
A	12 + 49.041 E.C. ℄ Rdwy "B"	697921.9574	1902985.0504
B	14 + 34.734 P.O.T. ℄ Rdwy "B" 11 + 76.200 P.O.T. ℄ BNSF RR	697931.4883	1903143.7249
C	14 + 77.474 B.C. ℄ Rdwy "B"	697869.2678	1903180.2403
D	17 + 09.181 E.C. ℄ Rdwy "B"	697693.5469	1903380.9460
E	11 + 39.122 P.O.T. ℄ BNSF RR	697869.1474	1903133.2844
F	11 + 86.339 B.C. ℄ BNSF RR	697923.5465	1903145.8993
G	12 + 55.436 E.C. ℄ BNSF RR	697755.4941	1903156.2359

Caltrans Metric

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	Riv	215.60	R61.8/66.8 R19.6/29.0	238	281

REGISTERED ENGINEER - CIVIL
5-4-99
4-17-00
PLANS APPROVAL DATE
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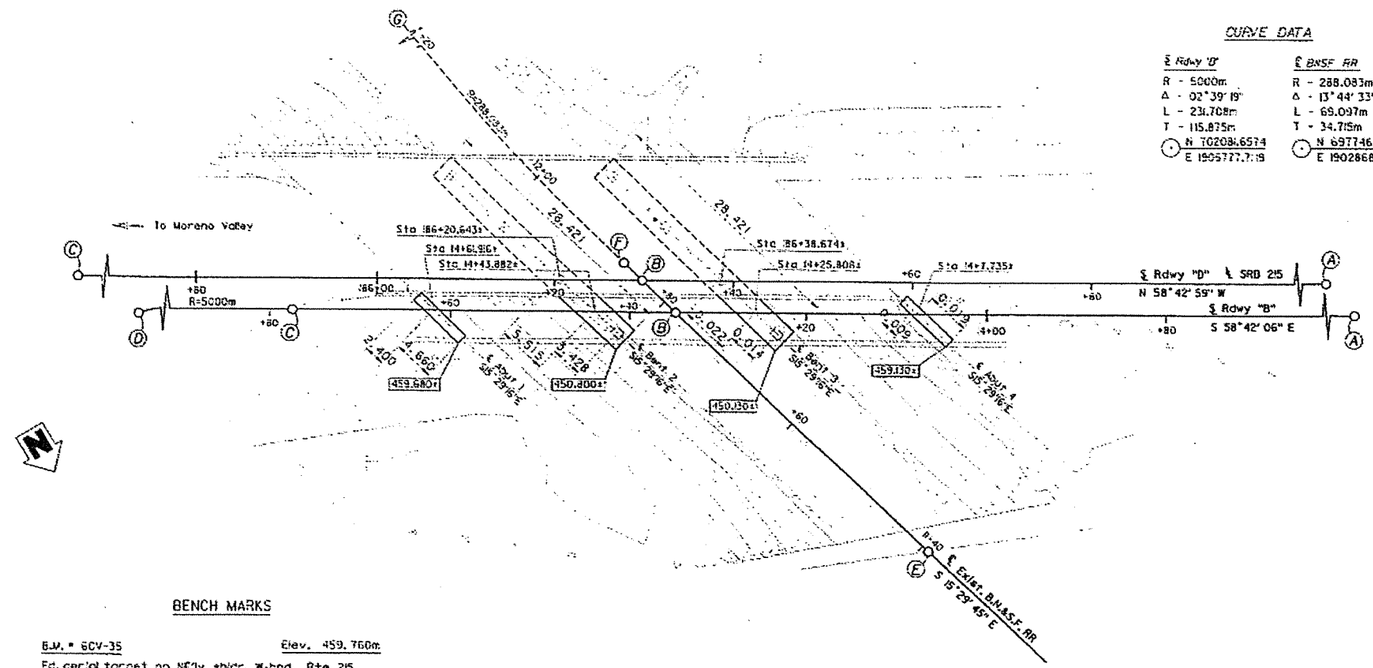

CURVE DATA

℄ Rdwy "B"	℄ BNSF RR
R - 5000m	R - 288.083m
Δ - 02° 39' 19"	Δ - 13° 44' 33"
L - 231.708m	L - 69.097m
T - 115.875m	T - 34.715m
N 702084.6574	N 697746.7187
E 1905777.7119	E 1902868.2271

BENCH MARKS

B.M. * 6CV-35 — Elev. 459.760m

Fd. cerial target on NE'ly shldr. W-bnd. Rte 215 approx. 1.3m from ETW. N 697855.5819, E 1900320.0180

B.M. * 303! — Elev. 459.599m

Fd. 51mm brass disk in 51mm stamped "Calif. Dept of Transportation" RIV 215-38.67 1990", NE cor. W-bnd Rte 215 bridge over AT&SF RR track. N 697880.7696, E 1903144.1431

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

NOTES

+ denotes spot elevation.
* denotes top of rail grade elevation below structure.
Indicates bottom of footing elevation. plus/minus indicates adjustments to achieve minimum 0.90m ground cover.

Datum: NGVD 29, Adj. 1980.
Underground utilities as shown are approx.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

PRELIMINARY INVESTIGATION SECTION

SCALE 1:250	VERT. DATUM / HORZ. DATUM	PHOTOGRAMMETRY AS OF:	DRAWN W. HENNING 2/99
		SURVEYED	TRACED
ALIGNMENT FILES		FIELD CHECKED L. MANARD 1/98	CHECKED L. MANARD 3/98

STRUCTURES FOUNDATION PLAN SHEET (METRIC) (REV. 5/3/97)

DESIGN	Arlet Reyes	CHECKED	Lawrence Okoye
DETAILS	Ed O. Tapaio 9/98	CHECKED	Lawrence Okoye
QUANTITIES	Tim Greutert	CHECKED	Lawrence Okoye

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

CU 08
EA 453001

DR. DGN. NO. 56-0082
KILOMETER POST R62.135

BOX SPRINGS OVERHEAD (WIDEN)
FOUNDATION PLAN

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 3 OF 14

BENCH MARK # 2-A-54

Chiseled "X" on Bridge Wall
90' Lt Sta 11+44 "℄" Line
ELEV 1508.26

BRIDGE DEPARTMENT

℄ SOUTH ROADBED (PROPOSED)

Bottom of Pier Footing Elevations

Approximate existing ground line along E South Roadbed

Bottom of As Built Footing Elevations

PROFILE

NO GROUND WATER ENCOUNTERED DURING THIS INVESTIGATION BY BRIDGE DEPT. GEOLOGY SECTION
DATE Mar 1967

PLANS APPROVAL DATE 4-17-00

STRUCTURAL FOUNDATIONS BRANCH - ENGINEERING SERVICE CENTER

DIST	COUNTY	ROUTE	KILOCITRAPOST - TOTAL PROJECT	Total Sheets	Sheet Number
08	Riv	215, 60	R61.8/66.8, R19.5/23.0	250	261

9-2-99

BOX SPRINGS OVERHEAD

LOG OF TEST BORINGS

CO: 06235 EA: 453067 PROJECT NO. 8X-0001R

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REGISTERED DESIGN ENGINEER
J.D. CRAWFORD
No. 54
Exp. 12-31-00
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

AS BUILT
CORRECTIONS BY
CONTRACT NO. 08-019204
DATE 10/05

SHEET 8 OF 8

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 AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIZ. "GRAVELLY SAND." THE TERMS "COARSE," "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE SAND, SILT AND GRAVEL REFER TO STANDARD GRADE SIZE LIMITS.

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/OR ORGANIC MATTER
- FILL MATERIAL
- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

LEGEND OF BORING OPERATIONS

- PENETROMETER
- 2½" CONE PENETROMETER
- SAMPLER BORING (DRY)
- ROTARY BORING (WET)
- AUGER BORING (DRY)
- JET BORING
- CORE BORING
- TEST PIT

1" SOIL TUBE — ROTARY BORING — PENETRATION BORING

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

BOX SPRINGS OVERHEAD

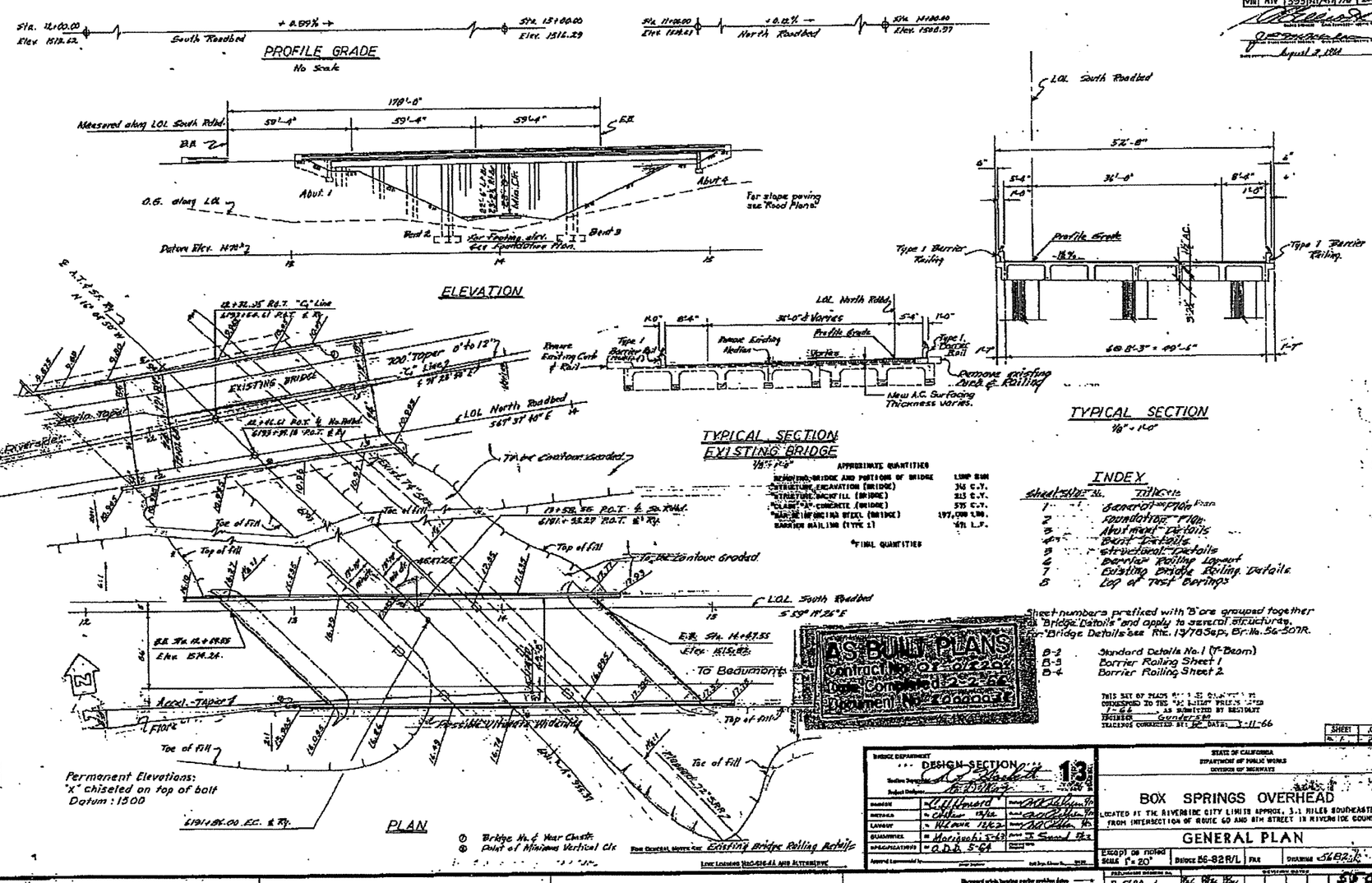
LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 56-82R | FILE | DRAWING 56B210

11-057-7(6) F-057-2(1)

District	County	Route	Post Mile	Sheet	Total Sheets
VIII	Riv	395	11.1/11.7	176	225

August 3, 1966



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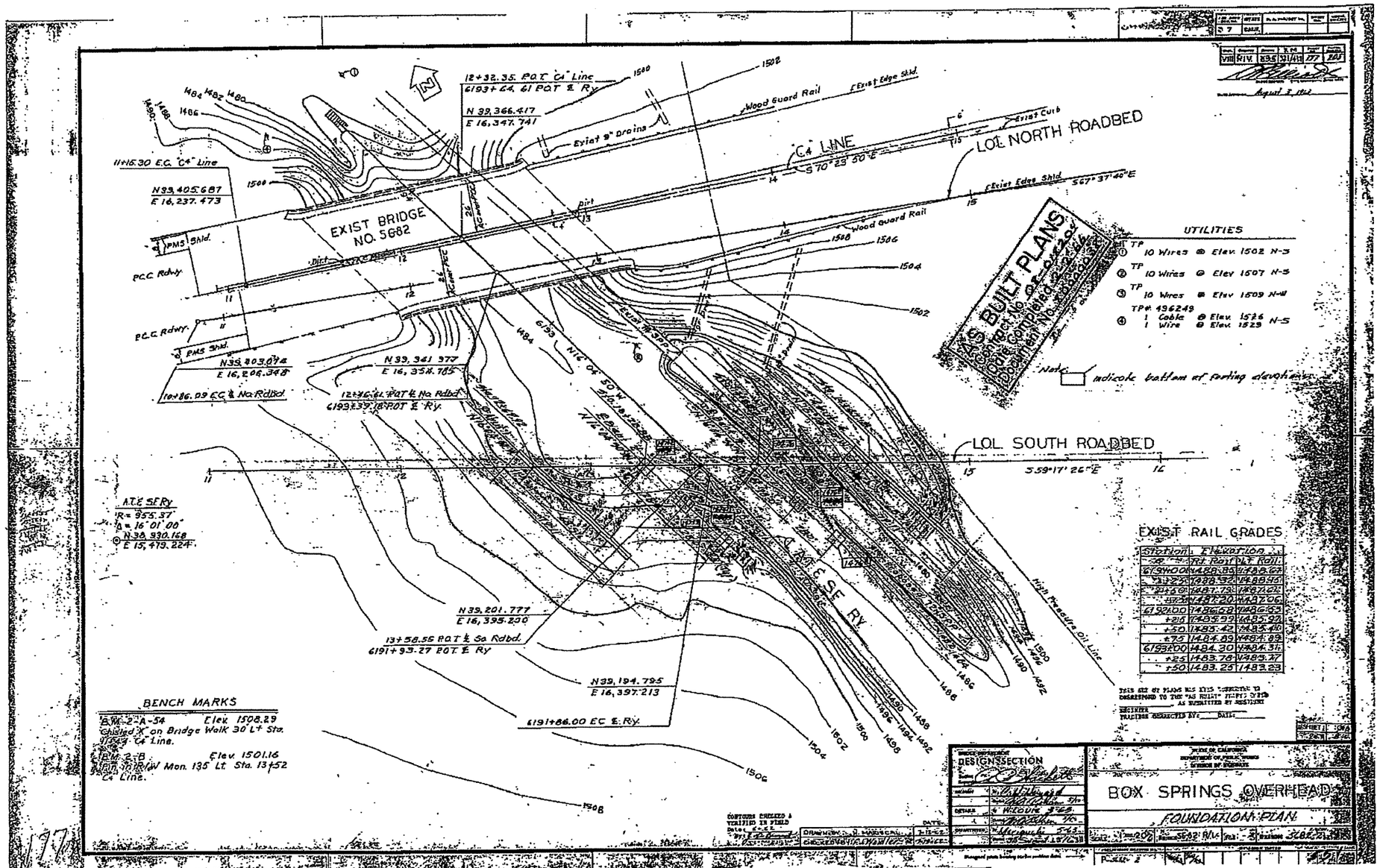


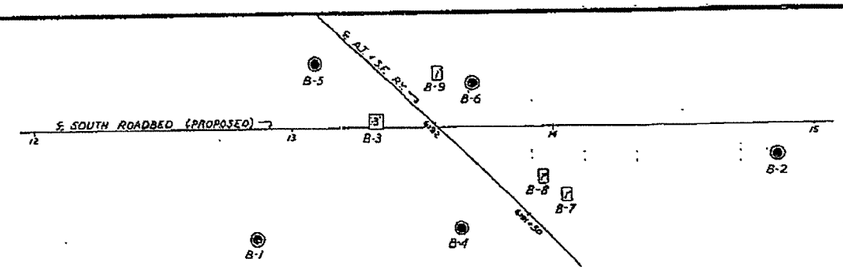
www.fasso.com

FED. ROAD DIST. NO.	STATE	FUNCT. SYSTEM	PROJECT NO.	SHEET NO.	TOTAL SHEETS
7	CAL.				

DESIGN	CHECKED	DRAWN	PLAN	SHEET NO.	TOTAL SHEETS
VM	RH	SBS	31	183	205

August 3 1964

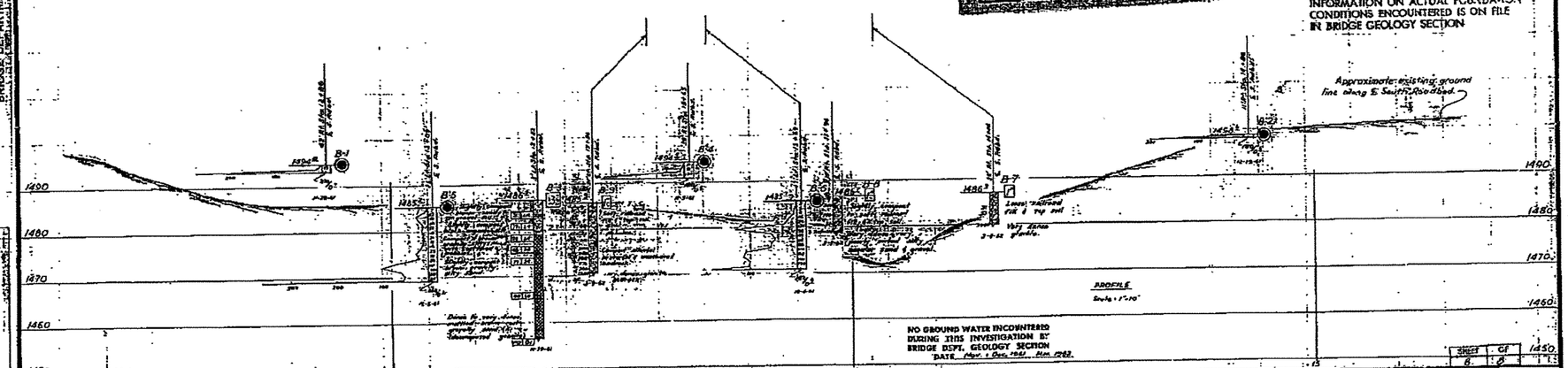
BENCH MARK = 2-A-54
Chiseled "X" on Bridge Walk
30' Lt. Sta. 11+44 "℄" Line.
ELEV. 1508.29



PLAN
Scale: 1"=20'

AS BUILT PLANS
Contract No. 07-0F404
Date Completed 2-25-66
Document No. 7000007

INFORMATION ON ACTUAL FOUNDATION CONDITIONS ENCOUNTERED IS ON FILE IN BRIDGE GEOLOGY SECTION



PROFILE
Scale: 1"=10'

SHEET	OF
8	8

BRIDGE DEPARTMENT

DESIGN BY	CHECKED BY	DRAWN BY	PLAN

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRAIN SIZE LIMITS

"GRAVELLY SAND." THE TERMS "COARSE," "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE SAND, SILT AND GRAVEL REFER TO STANDARD GRADE SIZE LIMITS.

SILT PERCENTAGES

LEGEND OF EARTH MATERIALS

- GRAVEL
- SAND
- SILT
- CLAY
- SANDY CLAY OR CLAYEY SAND
- SANDY SILT OR SILTY SAND
- SILTY CLAY OR CLAYEY SILT
- PEAT OR ORGANIC MATTER
- FILL MATERIAL
- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

LEGEND OF BORING OPERATIONS

- PENETROMETER
- 2½" CORE PENETROMETER
- SAMPLER BORING (CORE)
- ROTARY BORING (WET)
- AUGER BORING (DRY)
- JET BORING
- CORE BORING
- TEST PIT

1" SOIL TUBE — Top Hole El. — Pulled pipe — Sample taken — Sample of boring

ROTARY BORING — Top Hole El. — Unconfined compressive strength (lb/sq ft) — Unconfined compressive strength (lb/sq ft) — Vane shear (lb/sq ft) — Consolidation Test — Compressible material change — Unconsolidated material change — Uncompacted material change

PENETRATION BORING — Top Hole El. — Blows per foot (using a 140 lb. hammer falling 30 inches or as noted) — Average blows per foot (for penetration of 12 inches or as noted) — Blows per foot — Generally representative of driving rate

NOTE

Classification of earth material as shown on this sheet is based upon field inspection and laboratory examination of samples.

BOX SPRINGS OVERHEAD

LOG OF TEST BORINGS

SCALE	BRIDGE	FILE	DRAWING
As Noted	56-52 R		54B2-10

PREL. DRAWING NO. P-54B2-8

183

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215, 60, 91	60.7/70.6, 22.0/18.5, 32.7/34.7	2187	2838

REGISTERED CIVIL ENGINEER

8-4-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — David Soon, No. 51862, Exp. 6-30-06, CIVIL, STATE OF CALIFORNIA

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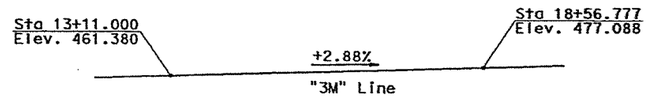
Caltrans Metric

Notes:

1. Paint "Box Springs OH Truck Connector".
2. Paint "Br. No. 56-0805G".
3. Concrete Barrier Type 736.
4. Structure Approach Type N(9S).
5. MBGR, see "Road Plans".
6. Min Horizontal clearance measured from
7. ℄ RR tracks to face of column.
8. Slope paving (concrete), for 200 mm CSP down draining see "Road Plans".

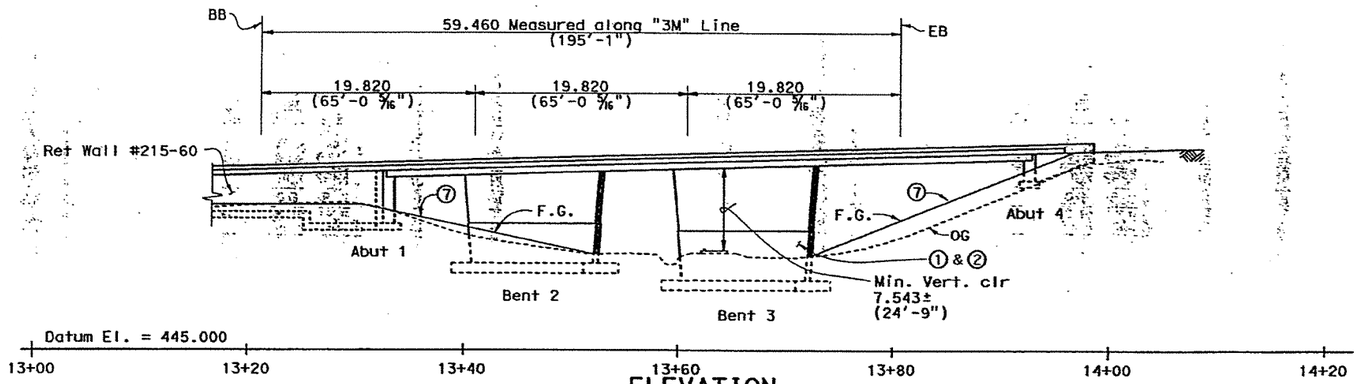
◐ Point of minimum vertical clearance.

------ Indicates original ground.



PROFILE GRADE

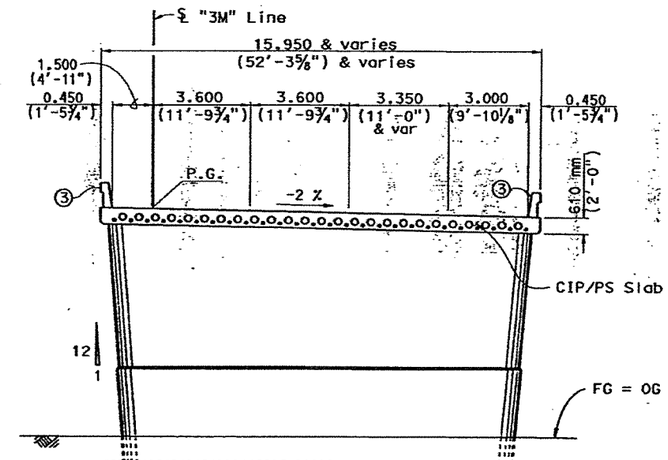
No Scale



ELEVATION

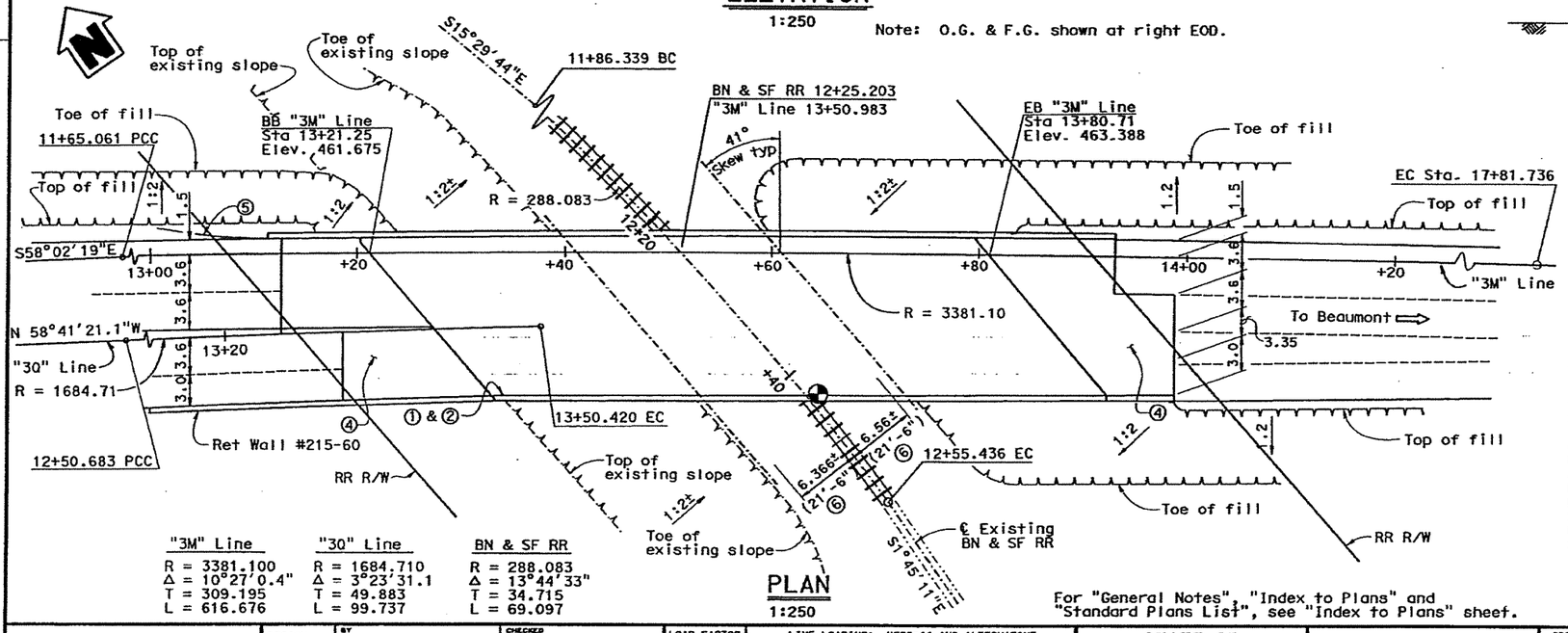
1:250

Note: O.G. & F.G. shown at right EOD.



TYPICAL SECTION

1:100



"3M" Line	"30" Line	BN & SF RR
R = 3381.100	R = 1684.710	R = 288.083
Δ = 10°27'0.4"	Δ = 3°23'31.1	Δ = 13°44'33"
T = 309.195	T = 49.883	T = 34.715
L = 616.676	L = 99.737	L = 69.097

PLAN

1:250

For "General Notes", "Index to Plans" and "Standard Plans List", see "Index to Plans" sheet.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

QUANTITIES

STRUCTURE EXCAVATION (BRIDGE)	960	m³
STRUCTURE EXCAVATION (RETAINING WALL)	110	m³
STRUCTURE BACKFILL (BRIDGE)	670	m³
STRUCTURE BACKFILL (RETAINING WALL)	155	m³
PRESTRESSING CAST-IN-PLACE CONCRETE	LUMP	SUM
STRUCTURAL CONCRETE, BRIDGE FOOTING	226	m³
STRUCTURAL CONCRETE, BRIDGE	840	m³
STRUCTURAL CONCRETE, RETAINING WALL	60	m³
STRUCTURAL CONCRETE, APPROACH SLAB (TYPE N)	108	m³
CLASS 3 CONCRETE (BACKFILL)	400	m³
FRACTURED RIB TEXTURE	115	m²
JOINT SEAL (MR 50 MM)	42	m
BAR REINFORCING STEEL (BRIDGE)	155 200	kg
BAR REINFORCING STEEL (RETAINING WALL)	4 200	kg
SLOPE PAVING (CONCRETE)	62	m³
CONCRETE BARRIER (TYPE 736)	119	m
CONCRETE BARRIER (TYPE 736A)	61	m

PRELIMINARY FOR BIDDING PURPOSES ONLY

DESIGN	BY David Soon	CHECKED Samir Ead	
DETAILS	BY Sandra McNealy	CHECKED Samir Ead	
QUANTITIES	BY N.Yempati	CHECKED T. Nedwick/D.Soon	
LOAD FACTOR DESIGN	LIVE LOADING: HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD		
LAYOUT	BY David Soon	CHECKED Samir Ead	
SPECIFICATIONS	BY Mary Kopsa	PLANS AND SPECS COMPARED Mary Kopsa	

DESIGN ENGINEER

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

BRIDGE NO. 56-0805G
KILOMETER POST 62.19

BOX SPRINGS OH TRUCK CONNECTOR
GENERAL PLAN

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY): 1-24-03

SHEET 1 OF 25

STRUCTURES DESIGN GENERAL PLAN SHEET (METRIC) (REV.-4/20/00)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

FILE => 56-0805g-a-gp.dgn

USERNAME => YTRINGUYE DATE PLOTTED => 11-AUG-2003 TIME PLOTTED => 14:04

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL
08	Riv	215, 60, 91	60.7/70.5, 22.0/18.5, 32.1/34.7	2190	2838

Caltrans Metric

REGISTERED CIVIL ENGINEER

8-4-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER David Soon No. 51862 Exp. 6-30-06 CIVIL STATE OF CALIFORNIA

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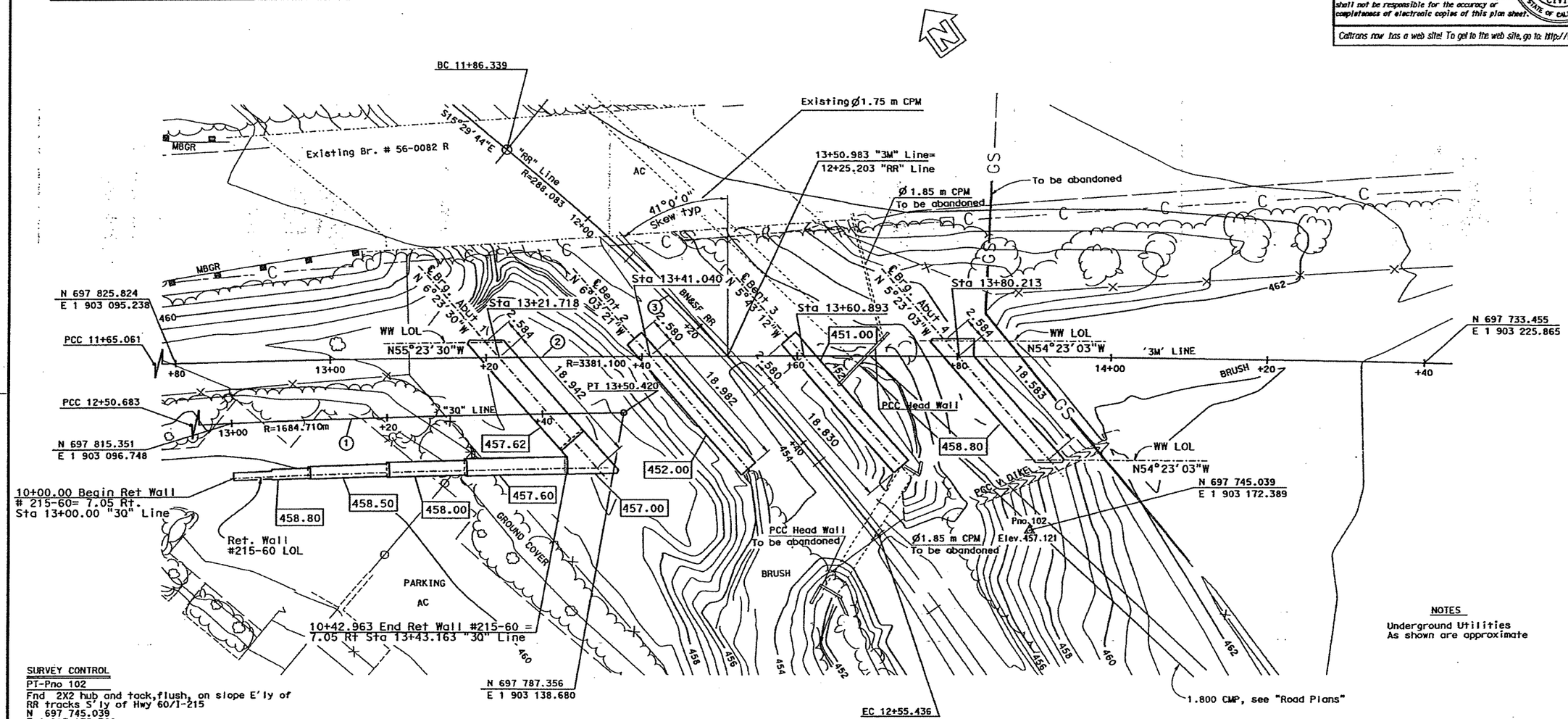
No.	R	Δ	T	L
1	1684.710m	03°23'31"	49.883m	99.737m
2	3381.100m	10°27'00"	309.195m	616.676m
3	288.083m	13°44'33"	34.715m	69.097m



NOTES

Underground Utilities
As shown are approximate

SURVEY CONTROL

PT-Pno 102
Fnd 2X2 hub and tack,flush, on slope E'ly of
RR tracks S'ly of Hwy 60/I-215
N 697 745.039
E 1 903 172.389
Elev. = 457.121

PT-3031 (Not shown on map)
Fnd 5 cm CDOT br dsk, 1 m E'ly of the East end of
N'ly bridge barrier rail for the WB Hwy 60, flush in conc.
N 697 880.770
E 1 903 144.143
Elev. = 459.600

Notes:

[ ] - denotes bottom of footing elevation.

ALL DIMENSIONS ARE IN
METERS UNLESS OTHERWISE SHOWN

PRELIMINARY
FOR BIDDING PURPOSES ONLY

PRELIMINARY INVESTIGATION SECTION

SCALE 1:250	VERT.DATUM NGVD 29	PHOTOGRAMMETRY AS OF:			
	HORZ.DATUM NAD 83	SURVEYED BY		DRAFTED BY M.Sadaghiani 4/26/01	
	ALIGNMENT TIES Dist. Trav. Sheets	FIELD CHECKED BY P. Manabo 4/23/01		CHECKED BY P. Manabo 4/26/01	

DESIGN	BY Samir Ead	CHECKED Reza Erfanian
DETAILS	BY Bruno Jenko	CHECKED Reza Erfanian
QUANTITIES	BY N. Vempati	CHECKED T. Nedwick / D. Soon

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 7

BRIDGE NO. 56-0805G
KILOMETER POST 62.19

BOX SPRINGS OH TRUCK CONNECTOR
FOUNDATION PLAN

STRUCTURES FOUNDATION PLAN SHEET (METRIC) (REV. 4/20/00)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 1-24-03

SHEET 4 OF 25

FILE => 56-0805g-e-fp.dgn

USERNAME => tranguye DATE PLOTTED => 11-AUG-2003 TIME PLOTTED => 14:05

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215,60, 91	60.7/70.6, 22.0/18.5, 32.7/34.7	2208	2838

Mark A. Richards 11-18-02
REGISTERED GEOLOGIST

8-4-03
PLANS APPROVAL DATE

REGISTERED GEOLOGIST MARK A. RICHARDS No. 5240 Exp. 7-31-04 STATE OF CALIFORNIA

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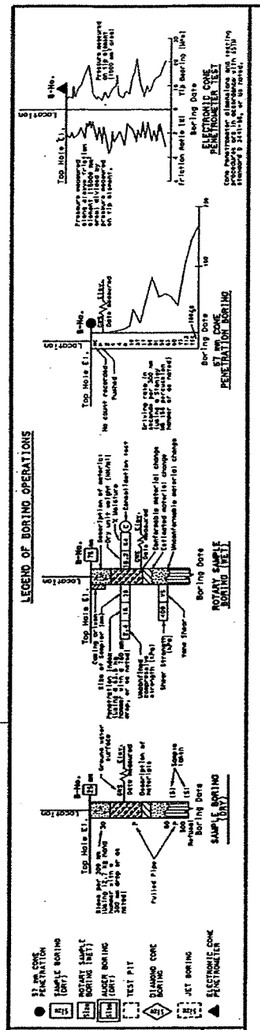
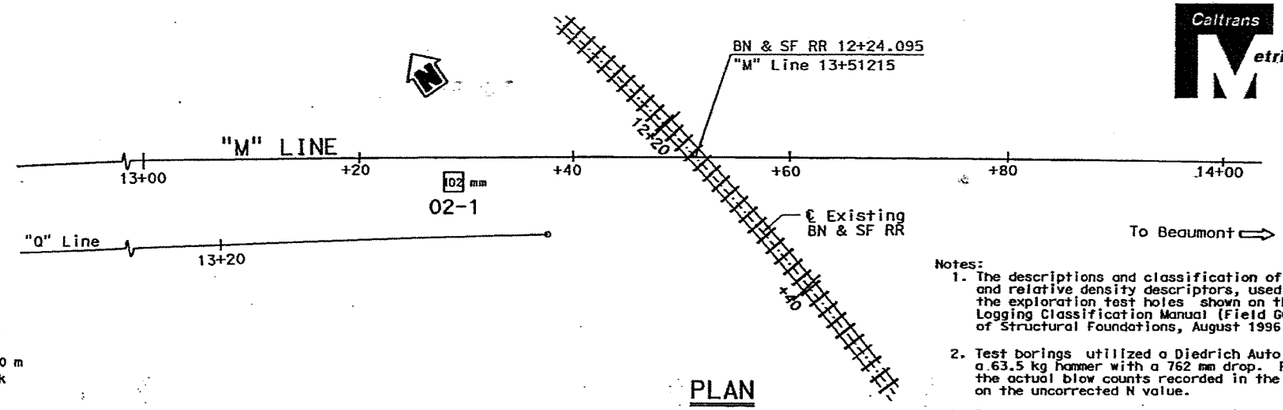
Caltrans Metric





BENCH MARK

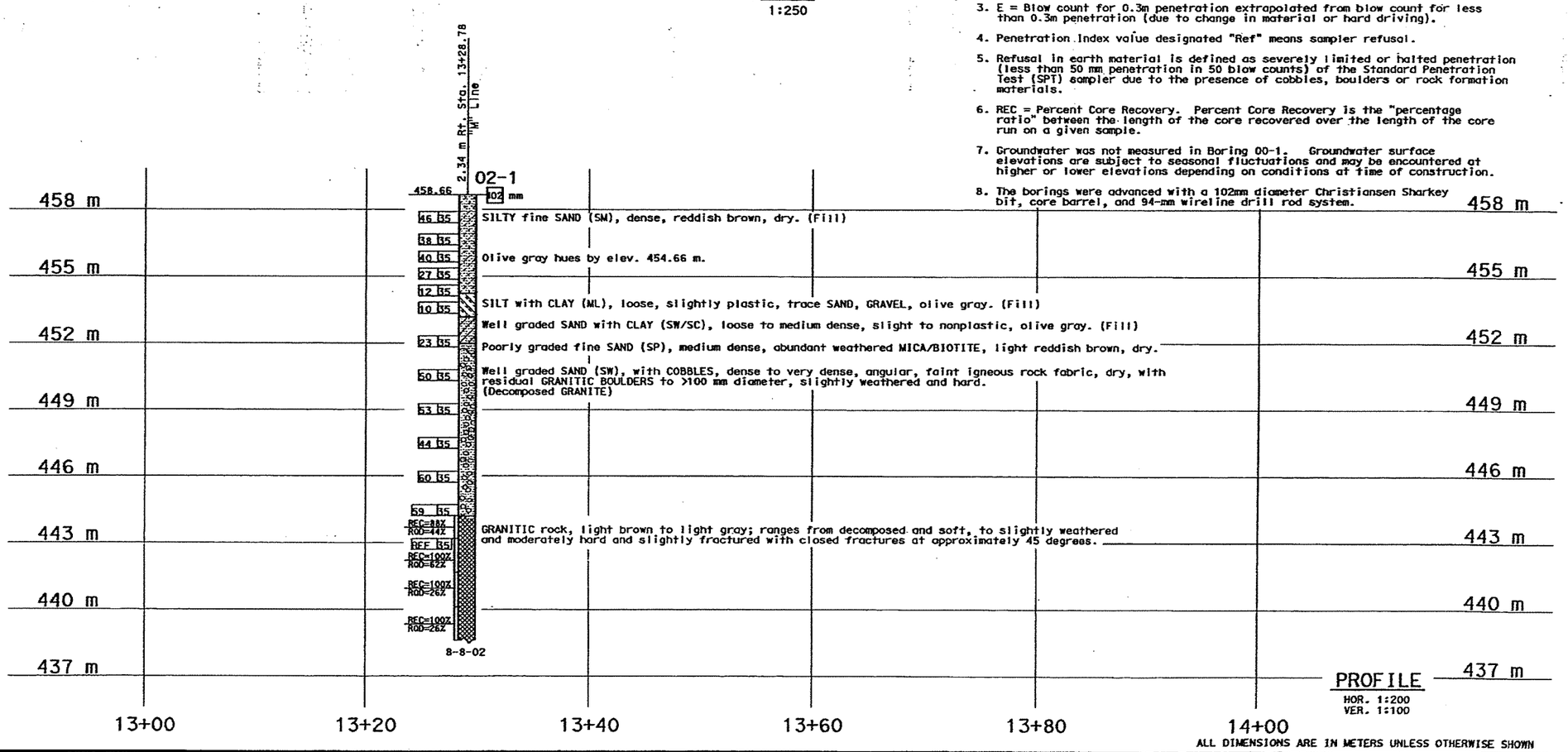
WP 3031 Elev. 459.60 m
2-Inch G brass disk
NGVD 29

PLAN

1:250

Notes:

1. The descriptions and classification of rock and/or soil, including consistency and relative density descriptors, used by the field and/or office personnel for the exploration test holes shown on this sheet are based on the "Soil and Rock Logging Classification Manual (Field Guide)". Engineering Service Center, Office of Structural Foundations, August 1996.
2. Test borings utilized a Diedrich Auto Hammer to advance the sampler using a 63.5 kg hammer with a 762 mm drop. Penetration index values shown are the actual blow counts recorded in the field. Soil consistencies shown are based on the uncorrected N value.
3. E = Blow count for 0.3m penetration extrapolated from blow count for less than 0.3m penetration (due to change in material or hard driving).
4. Penetration Index value designated "Ref" means sampler refusal.
5. Refusal in earth material is defined as severely limited or halted penetration (less than 50 mm penetration in 50 blow counts) of the Standard Penetration Test (SPT) sampler due to the presence of cobbles, boulders or rock formation materials.
6. REC = Percent Core Recovery. Percent Core Recovery is the "percentage ratio" between the length of the core recovered over the length of the core run on a given sample.
7. Groundwater was not measured in Boring 00-1. Groundwater surface elevations are subject to seasonal fluctuations and may be encountered at higher or lower elevations depending on conditions at time of construction.
8. The borings were advanced with a 102mm diameter Christiansen Sharkey bit, core barrel, and 94-mm wireline drill rod system.



PROFILE

HOR. 1:200
VER. 1:100

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

ENGINEERING SERVICES	GEOTECHNICAL SERVICES
DRAWN BY: Irma G-Remmen 9/02	
CHECKED BY: M. Richards 9/02	

FIELD INVESTIGATION BY: M. Richards

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

BRIDGE NO. 56-805G
KILOMETER POST 62.19

BOX SPRINGS OH TRUCK CONNECTOR
LOG OF TEST BORINGS 1 OF 4

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 7-24-02 7-14-03 11-24-03 1-27-03

SHEET 22 OF 25

OGS GEOLOGIST LOG OF TEST BORINGS SHEET (METRIC) (REV. 3/02)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

FILE => 56-0805g-z-1ot01of1.dgn

USERNAME => tkathy DATE PLOTTED => 11-AUG-2003 TIME PLOTTED => 14:51

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215,60, 91	60.7/70.6, 22.0/18.5, 32.7/34.7	2209	2838

REGISTERED CIVIL ENGINEER 11-18-02

8-4-03
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER Yusheng Wei No. 56262 Exp. 12-31-02 CIVIL STATE OF CALIFORNIA

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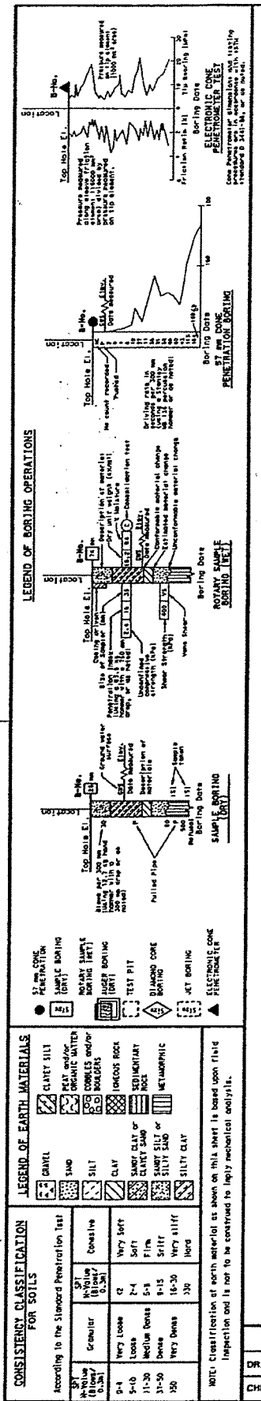
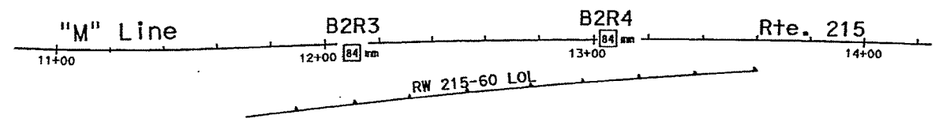
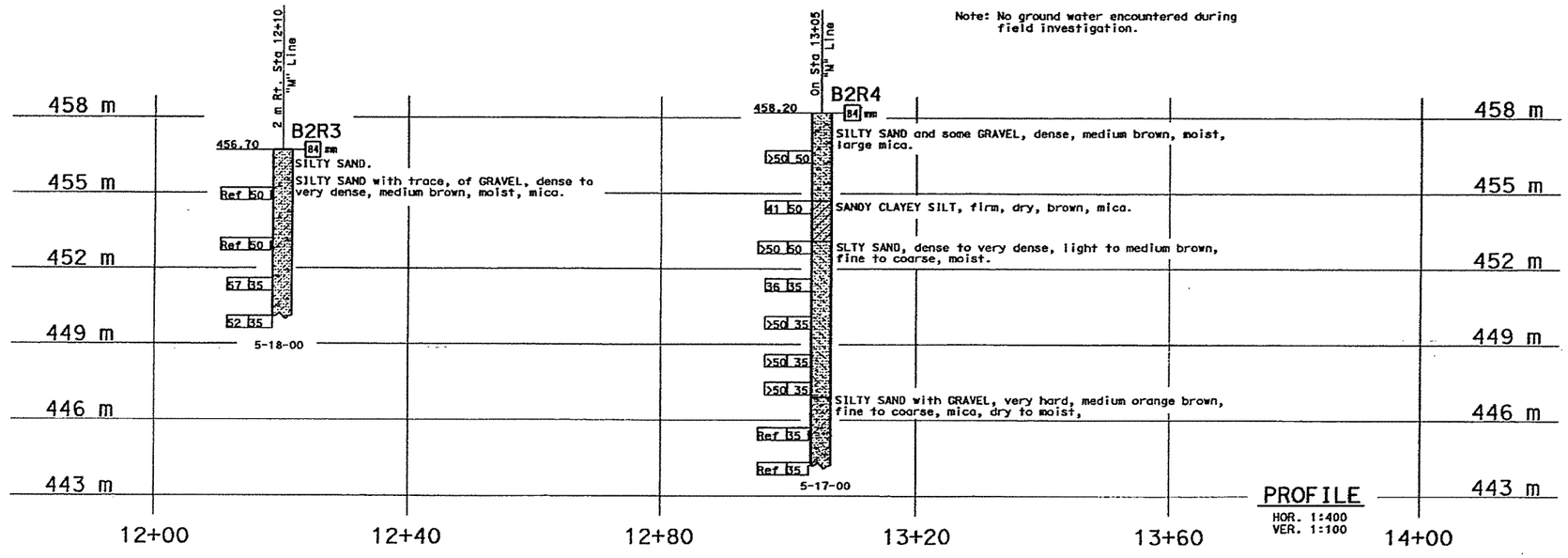




PLAN
1:1000

BENCH MARK
BM 3033 Elev. 447.908 m
N 698607
E1902553.331
RIV-215-38.99



Note: No ground water encountered during field investigation.

PROFILE
HOR. 1:400
VER. 1:100

ENGINEERING SERVICES	GEOTECHNICAL SERVICES
DRAWN BY F. Nguyen 6/02	
CHECKED BY S. Wei 7/02	

FIELD INVESTIGATION BY: C. Hoadley

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES STRUCTURE DESIGN

BRIDGE NO. 56-805G
KILOMETER POST 62.19

BOX SPRINGS OH TRUCK CONNECTOR
RETAINING WALL 215-60
LOG OF TEST BORINGS 2 OF 4

CU 08
EA 334841

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 1-17-02 11-18-02 1-21-03

SHEET 23 OF 25

FILE => 56-0805g-z-iotb2of4.dgn

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

OGS CIVIL LOG OF TEST BORINGS SHEET (METRIC) (REV. 3/02

USERNAME => trkathy DATE PLOTTED => 11-AUG-2003 TIME PLOTTED => 14:51

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215,60, 91	50.7/70.6, 22.0/18.5, 32.7/34.7	2210	2838

Caltrans Metric

Mark A. Richards 11-18-02
REGISTERED GEOLOGIST

8-4-03
PLANS APPROVAL DATE

REGISTERED GEOLOGIST MARK A. RICHARDS No. 5240 Exp. 7-31-04 REGISTERED GEOLOGIST STATE OF CALIFORNIA

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WEATHERING DESCRIPTORS

Modified from United States Bureau of Reclamation, Engineering Geology Field Manual.

Descriptors		Diagnostic features					
		Chemical weathering-Discoloration and/or oxidation		Mechanical weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and solutioning		General characteristics (strength, excavation, etc.)§
Alphanumeric descriptor	Descriptive term	Body of rock	Fracture surfaces†		Texture	Solutioning	
W1	Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck. Almost always rock excavation except for naturally weak or weakly cemented rocks such as siltstones or shales.
W2	Slightly weathered to fresh°						
W3	Slightly weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened. With few exceptions, such as siltstones or shales, classified as rock excavation.
W4	Moderately to slightly weathered°						
W5	Moderately weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened. Depending on fracturing, usually is rock excavation except in naturally weak rocks such as siltstones or shales.
W6	Intensely to moderately weathered°						
W7	Intensely weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened. Usually common excavation.
W8	Very intensely weathered						
W9	Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Always common excavation. Resistant minerals such as quartz may be present as "stringers" or "dikes."

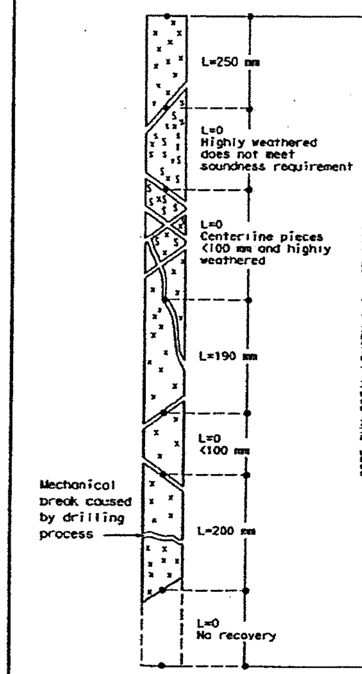
Note: This chart and its horizontal categories are more readily applied to rocks with feldspars and mafic minerals. Weathering in various sedimentary rocks, particularly limestones and poorly indurated sediments, will not always fit the categories established. This chart and weathering categories may have to be modified for particular site conditions or alteration such as hydrothermal effects; however, the basic framework and similar descriptors are to be used.

°Combination descriptors are permissible where equal distribution of both weathering characteristics are present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, dual descriptors should not be used where significant, identifiable zones can be delineated. When given as a range only two adjacent terms may be combined. "Decomposed to slightly weathered," or "moderately weathered to fresh" are not acceptable.

†Does not include directional weathering along shears or faults and their associated features. For example, a shear zone that carried weathering to great depths into a fresh rock mass would not require the rock mass to be classified as weathered.

§These are generalizations and should not be used as diagnostic features for weathering or excavation classification. These characteristics vary to a large extent based on naturally weak materials or cementation and type of excavation.

ROCK QUALITY DESIGNATION (RQD) & PERCENT RECOVERY (REC) LOGGING



RQD (ROCK QUALITY DESIGNATION)	DESCRIPTION OF ROCK QUALITY
0 - 25%	VERY POOR
25 - 50%	POOR
50 - 75%	FAIR
75 - 90%	GOOD
90 - 100%	EXCELLENT

$$RQD = \frac{\sum \text{Length of sound core pieces } \geq 100 \text{ mm}}{\text{Total core run length}}$$

$$RQD = \frac{250+190+200}{1200} \times 100\%$$

RQD = 53% (fair)

REC = Percent Core Recovery

$$REC = \frac{\sum \text{Length of all core pieces}}{\text{Total core run length}}$$

(No Scale)
After Deere & Deere, 1989

FRACTURE DENSITY

Modified from United States Bureau of Reclamation, Engineering Geology Field Manual.

FRACTURE DENSITY- Based on the spacing of all natural fractures in an exposure or core recovery lengths in boreholes; excludes mechanical breaks, shears, and shear zones; however, shear-disturbed zones (fracturing outside the shear) are included. Descriptors for fracture density apply to all rock exposures such as tunnel walls, dozer trenches, outcrops, or foundation cut slopes and inverts, as well as boreholes. Descriptive criteria presented below are based on borehole cores where lengths are measured along the core axis, for other exposures the criteria is distance measured between fractures (size of blocks).

UNFRACTURED (FD0): No fractures.

VERY SLIGHTLY FRACTURED (FD1): Core recovered mostly in lengths greater than 1 m.

SLIGHTLY TO VERY SLIGHTLY FRACTURED (FD2)*

SLIGHTLY FRACTURED (FD3): Core recovered mostly in lengths from 300 to 1000 mm, with few scattered lengths less than 300 mm or greater than 1000 mm.

MODERATELY TO SLIGHTLY FRACTURED (FD4)*

MODERATELY FRACTURED (FD5): Core recovered mostly in 100 to 300 mm lengths with most lengths about 200 mm.

INTENSELY TO MODERATELY FRACTURED (FD6)*

INTENSELY FRACTURED (FD7): Lengths average from 30 to 100 mm with scattered fragmented intervals. Core recovered mostly in lengths less than 100 mm.

VERY INTENSELY TO INTENSELY FRACTURED (FD8)*

VERY INTENSELY FRACTURED (FD9): Core recovered mostly as chips and fragments with a few scattered short core lengths.

* Combinations of fracture densities (e.g. very intensely to intensely fractured, or moderately to slightly fractured) are used where equal distribution of both fracture density characteristics are present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions.

ROCK HARDNESS DESCRIPTORS

Alphanumeric Descriptor	Descriptor	Criteria
H1	Extremely hard	Core, fragment, or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows.
H2	Very hard	Cannot be scratched with knife of sharp pick. Core or fragment breaks with repeated heavy hammer blows.
H3	Hard	Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
H4	Moderately hard	Can be scratched with knife or sharp pick with light or moderate pressure. Core or fragment breaks with moderate hammer blow.
H5	Moderately soft	Can be grooved 2 mm deep by knife or sharp pick with moderate or heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
H6	Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
H7	Very soft	Can be readily indented, grooved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

Any bedrock unit softer than H7, very soft, is to be described using ASTM D-2488 consistency descriptors.

Note: Although "sharp pick" is included in these definitions, descriptions of ability to be scratched, grooved or gouged by a knife is the preferred criteria.

Modified from United States Bureau of Reclamation, Engineering Geology Field Manual.

BEDDING, FOLIATION, OR FLOW TEXTURE DESCRIPTORS

Descriptors	Thickness / Spacing
Massive	Greater than 3 m
Very thickly (bedded, foliated, or banded)	1 to 3 m
Thickly	300 mm to 1 m
Moderately	100 to 300 mm
Thinly	30 to 100 mm
Very thinly	10 to 30 mm
Laminated (intensely foliated or banded)	Less than 10 mm

Modified from United States Bureau of Reclamation, Engineering Geology Field Manual.

DIVISION OF ENGINEERING SERVICES		GEOTECHNICAL SERVICES	FIELD INVESTIGATION BY:
DRAWN BY	I.G-Remmen 9/02		
CHECKED BY	M. Richards 9/02		M. Richards

OGS GEOLOGIST LOG OF TEST BORINGS SHEET (METRIC) (REV. 7/2001)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN

CU 08
EA 334841

FILE => 56-0805g-z-lotb3of4.dgn

BRIDGE NO. 56-805G
KILOMETER POST 62.19

BOX SPRINGS OH TRUCK CONNECTOR

LOG OF TEST BORINGS 3 OF 4

DISREGARD PRINTS BEARING EARLIER REVISION DATES → REVISION DATES (PRELIMINARY STAGE ONLY): 9-26-02, 10-4-02, 11-26-02, 1-27-03

SHEET 24 OF 25

USERNAME => trkathy DATE PLOTTED => 11-AUG-2003 TIME PLOTTED => 14:51

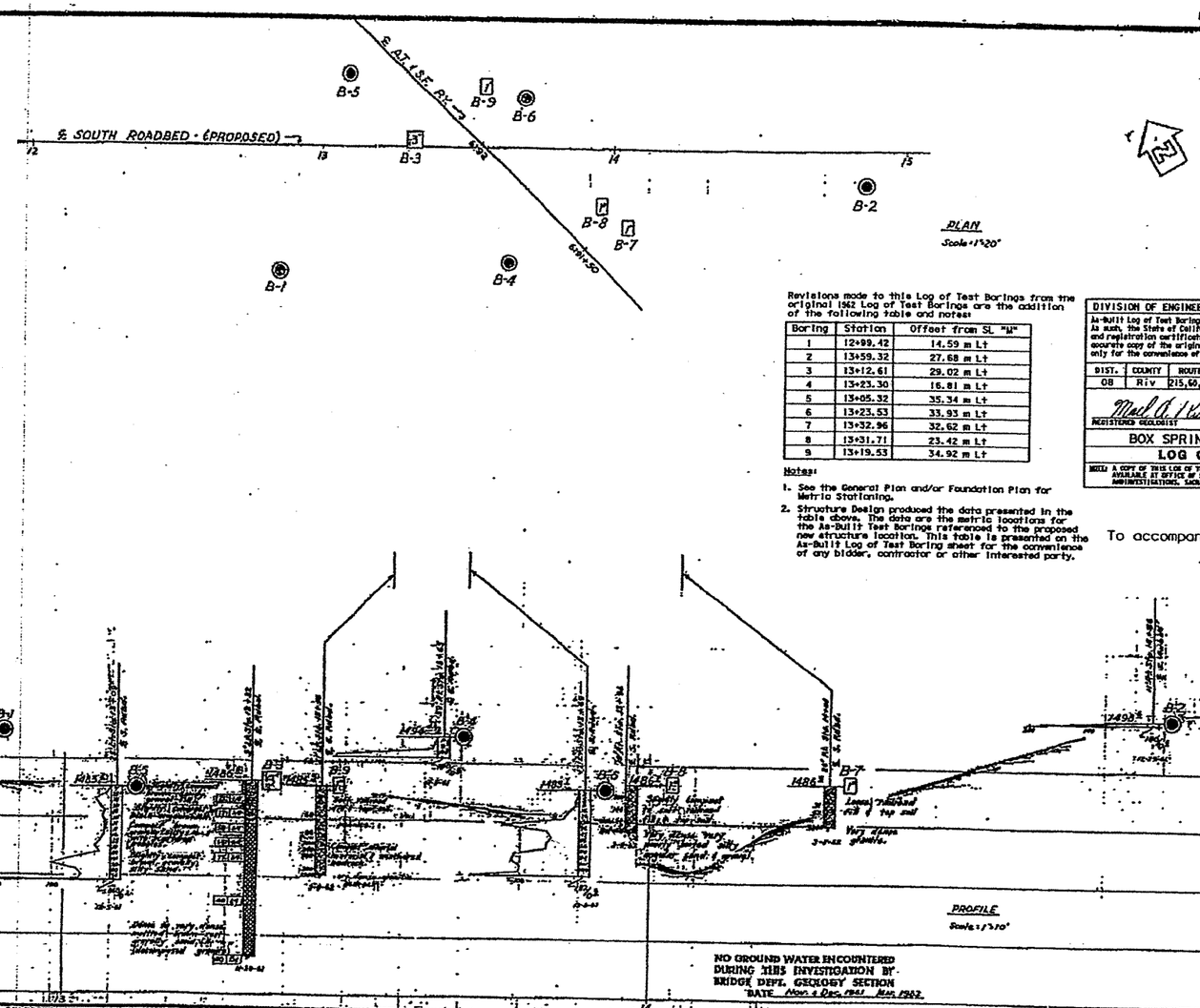
DIST.	COUNTY	ROUTE	POST MILE PREFIX	POST MILE	SHEET NO.	TOTAL SHEETS
7	CAL.					

DIST.	COUNTY	ROUTE	POST MILE	SHEET NO.	TOTAL SHEETS
VIII	Riv	395	50.1/51.1	83	205

August 3, 1964

BENCH MARK # 2-A-54

Chiseled "X" on Bridge Walk
30' Lt. Sta. 11+44 "℄" Line.
ELEV. 1508.29



Revisions made to this Log of Test Borings from the original 1962 Log of Test Borings are the addition of the following table and notes:

Boring	Station	Offset from SL "U"
1	12+99.42	14.59 m Lt
2	13+59.32	27.68 m Lt
3	13+12.61	29.02 m Lt
4	13+23.30	16.81 m Lt
5	13+05.32	35.34 m Lt
6	13+23.53	33.93 m Lt
7	13+32.96	32.62 m Lt
8	13+31.71	23.42 m Lt
9	13+19.53	34.92 m Lt

Notes:

1. See the General Plan and/or Foundation Plan for Metric Stationing.
2. Structure Design produced the data presented in the table above. The data are the metric locations for the As-Built Test Borings referenced to the proposed new structure location. This table is presented on the As-Built Log of Test Boring sheet for the convenience of any bidder, contractor or other interested party.

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	KILOMETER POST-TOTAL PROJECT	Sheet No.	Total Sheets
08	Riv	215,60,91	60.7/70.6,72.0/18.5,32.7/34.7	2211	2838

Mark A. Richards 11/14/02
REGISTERED GEOLOGIST

REGISTERED GEOLOGIST
MARK A. RICHARDS
No. 5240
Exp. 7-31-04
REGISTERED GEOLOGIST
STATE OF CALIFORNIA

BOX SPRINGS OH TRUCK CONNECTOR

LOG OF TEST BORINGS 4 OF 4

NOTE: A COPY OF THIS LOG OF TEST BORINGS IS AVAILABLE AT OFFICE OF STRUCTURE MAINTENANCE AND INVESTIGATIONS, SACRAMENTO, CALIFORNIA

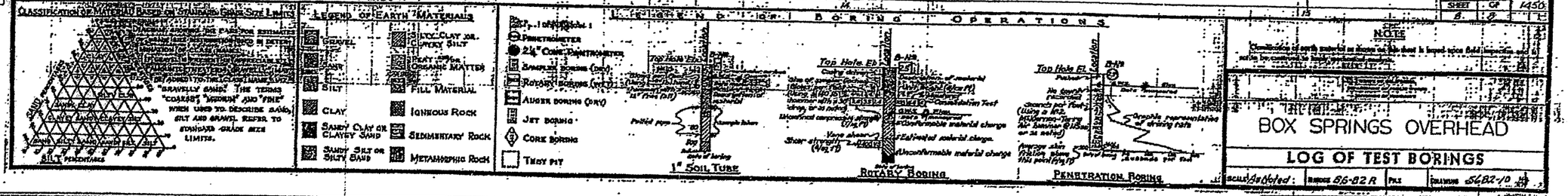
CIN 08
EA: 334841

BRIDGE No. 56-805G

Sheet 25 of 25

To accompany plans dated 8-4-03

INFORMATION ON ACTUAL FOUNDATION CONDITIONS ENCOUNTERED IS ON FILE IN BRIDGE GEOLOGY SECTION



NOTE

Classification of earth material as shown on this sheet is based upon field inspection and laboratory test data.

BOX SPRINGS OVERHEAD

LOG OF TEST BORINGS

SCALE: As Noted | BRIDGE 56-82 R | FILE | DRAWING 56B2-10

PREL. DRAWING NO. P-5682-8

183'

56-0805g-z-1of4of4.tif

APPENDIX E

RESPONSE TO CALTRANS REVIEW COMMENTS

1220 Research Drive
Suite B
Redlands, CA 92374
p| 909.793.2691
f| 909.792.1704
kleinfelder.com

June 12, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Subject: Response to Caltrans Review Comments (Dated March 25, 2009)
Structure Foundation Report (Dated February 9, 2009)
Box Springs Overhead (Tieback)
I-215/SR-60 East Junction Improvements
Riverside, California
08-Riv-215/60-KP 61.7/62.6, 19.4/21.5
Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) has prepared this letter in response to comments provided by the California Department of Transportation (Caltrans), Division of Engineering Services, Geotechnical Services-MS #5, Office of Geotechnical Design South-2, pertaining to their review of our report entitled *Structure Foundation Report, Box Springs Overhead (Tieback), I-215/SR-60 East Junction Improvement Project, Riverside County, California,* dated February 9, 2009. Caltrans has requested responses and resolutions on eleven comments (Comments 1 through 7). The Caltrans review comments and our responses to these comments are presented below:

Comment No. 1. *Please discuss what effects the proposed tieback wall may have on the existing and new foundation elements at the abutment and if necessary provide recommendations to mitigate.*

Response to Comment No. 1. The tieback is designed to retain the existing slope and abutment foundations and provide adequate global factor of safety against slope failure.

Comment No. 2, Plates and Appendices. *Please show the locations (on a single plan) for ALL borings (past and present) utilized in this investigation.*

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Response to Comment No. 2. The requested boring location map is presented on new Plate 1A (see final report).

Comment No. 3. *Please include a table on the detail sheet indicating the "Unbonded, Bonded and Total" lengths and diameter. Along with design stress loads for each tieback group. The unbonded length is recommended to be a minimum of 8.5 m.*

Response to Comment No. 3. LAN Engineering will reply.

Comment No. 4. *Please provide the unbonded stress between the soil and bonded surfaces.*

Response to Comment No. 4. Soil-to-grout bond stresses are highly dependent on installation technique, drilling and grouting method, grouting pressure and anchor diameter. In consideration of these factors and required load capacity, the design typically optimizes tieback anchor diameter, bonded length and installation methods. For purposes of estimating anchor lengths for preliminary design and cost estimating, the bonded length may be estimated using a maximum transfer load of 50 kN/m between pressurized concrete/grout and in-situ soil materials.

Comment No. 5. *Please provide the calculations of the unbonded failure plane using the soil parameters given.*

Response to Comment No. 5. In accordance with Rankine lateral earth pressure theory, a passive soil failure wedge is mobilized as the wall is pulled into the retained soil by the tieback anchors. The passive failure plane is inclined at an angle of (45 - Φ/2) degrees = (45 - 34/2) = 28 degrees from the horizontal, passing through the bottom of the wall.

Comment No. 6. *Please provide calculations to conform the engineering parameter and the different loads apply on the tieback wall on the Plate 7.*

Response to Comment No. 6. The calculations and soil parameters used for the evaluation of lateral earth pressures are provided in Appendix C-4 of our final report.

Comment No. 7. *The proposed project site is located between near structures; we recommend that the foundation report must address the adequate access for excavation sloping, shoring and adequate access for construction equipment.*

Response to Comment No. 7. The presence of steep slopes on both sides of the railroad will make the direct access to the project site very difficult for construction crews as well as their equipments. It is recommended that the construction crews and

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equipments to enter the site through the gate located on River Crest Drive on the south side of SR-60. Moreover, the project site is situated in the proximity of a number of bridges; access to the site may be restricted or made difficult due to limited vertical clearance for construction equipments to pass underneath the existing bridges. This recommendation is provided in Section 7.3 of our final report.

CLOSURE

The information contained in this letter/report is subject to the conditions and limitations contained within the preliminary foundation report. We appreciate the opportunity to be of service on this project. If you have any questions, comments or require additional information, please do not hesitate to contact our office at your convenience.

Respectfully submitted,

KLEINFELDER WEST, INC.

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

MC/CVA:lg

Attachments: Comments Resolution Form

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State of California

Business, Transportation and Housing Agency

Flex your power!
Be energy efficient!

Memorandum

To: Mr. Denix D. Anbiah
Department of Transportation
Division of Structural Engineering
Office of Special Funded Projects MS #9- 2/7G

Date: March 25, 2009

File: 08-RIV-56E0036
EA 08-449311

Box Springs OH,
Tieback Wall

Attention: Kookjoon Ahn

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES - MS #5
OFFICE OF GEOTECHNICAL DESIGN SOUTH-2

RECEIVED
MAR 27 2009
OFFICE OF SPECIAL
FUNDED PROJECTS

Subject: California Department of Transportation (Caltrans) Foundation Report Review Comments.

Reference: Structural Foundation Report, Box Springs Overhead (TieBack), Bridge No. 56E0036, Interstate 215 / State Route 60 East Junction, City of Riverside, California, 08-Riv-215/60, KP 60.7/70.6, 22.0/18.5, Caltrans EA No. 449311, dated February 9, 2009, by Kleinfelder West, Inc., Project No. 76979.

General Plans, Box Springs OH (TieBack), 56E0036, 13 Sheets, Revised dated 2-16-09, by Lim & Nascimento Engineering

The submitted Foundation Report by Kleinfelder West, Inc. and Plans by Lim & Nascimento Engineering for the referenced project **DO NOT** satisfy the requirements of Caltrans' Foundation/Geotechnical Design Report Guidelines. It is suggested to incorporate the attached comments and revisions into the report and plans for the proposed project and resubmit for review.
Any questions regarding the review comments and recommendations should be directed to attention of Doug Cook (916) 227-4514 or Angel Perez-Cobo (916) 227-7167, Office of Geotechnical Design South-2.

Prepared by:

K. Douglas Cook, CEG date: 3/25/09
Engineering Geologist

Reviewed by:

Angel Perez-Cobo, PE date: 3/25/09
Senior Transportation Engineer
Office of Geotechnical Design South-2

KDC/AW/APC
Attachment: Caltrans' Foundation Report Review Comments
Distribution
(2) Addressee

Structureal Foundation Report Box Springs Overhead (Tieback)
08-Riv-215/60, Bridge No. 56E0036

REVIEWER: Asef Wardak
K. Douglas Cook
DATE: March 25, 2009

COMMENTS RESOLUTION FORM

RESPONDER:_____
DATE: _____

DOCUMENT NAME AND DATE:

1. Structural Foundation Report, Box Springs Overhead (TieBack), Bridge No. 56E0036, Interstate 215 / State Route 60 East Junction, City of Riverside, California, 08-Riv-215/60, KP 60.7/70.6, 22.0/18.5, Caltrans EA No. 449311, dated February 9, 2009, by Kleinfelder West, Inc., Project No. 76979.

2. "General Plan No. 1", Box Springs OH (Tieback), 56E0036, 13 Sheets, revised dated 2-16-09, by Lim & Nascimento Engineering

Comment Number	PAGE Number	CRITERIA/REPORT/ DRAWING NO./ SPECIFICATION	COMMENT (Do not address more than one discipline per sheet)	RESPONSE	ACTION CODE
1			Please discuss what effects the proposed tieback wall may have on the existing and new foundation elements at the abutment and if necessary provide recommendations to mitigate.		
2		Plates and Appendices	Please show the locations (on a single plan) for ALL borings (past and present) utilized in this investigation.		
3	8/13	Tieback Details	Please include a table on the detail sheet indicating the "Unbonded, Bonded, and Total" lengths and diameter, along with design stress loads for each tieback group. The unbonded length is recommended to be a minimum of 8.5 m.		

ACTION CODES: A – Designer agrees and will comply/take action.
B – Designer will investigate and comment.
C – Disagree for reasons noted, discussion may be required.

NOTES: ( ) Indicates paraphrasing of original comment.
.... Indicates unreadable comment

REVIEWER: Asef Wardak
K. Douglas Cook
DATE: March 25, 2009

COMMENTS RESOLUTION FORM

RESPONDER:_____
DATE: _____

DOCUMENT NAME AND DATE:

1. Structural Foundation Report, Box Springs Overhead (TieBack), Bridge No. 56E0036, Interstate 215 / State Route 60 East Junction, City of Riverside, California, 08-Riv-215/60, KP 60.7/70.6, 22.0/18.5, Caltrans EA No. 449311, dated February 9, 2009, by Kleinfelder West, Inc., Project No. 76979.

2. "General Plan No. 1", Box Springs OH (Tieback), 56E0036, 13 Sheets, revised dated 2-16-09, by Lim & Nascimento Engineering

4			Please provide the unbonded stress between the soil and bonded surfaces.		
5			Please provide the calculations of the unbonded failure plane using the soil parameters given.		
6		Section 6.2.2 and Plate 7	Please provide calculations to conform the engineering parameter and the different loads apply on the tieback wall on the Plate 7.		
7		Section 6.2.2 and Plate 7	The proposed project site is located between near structures; we recommend that the foundation report must address the adequate access for excavation sloping, shoring and adequate access for construction equipment.		

ACTION CODES: A – Designer agrees and will comply/take action.
B – Designer will investigate and comment.
C – Disagree for reasons noted, discussion may be required.

NOTES: ( ) Indicates paraphrasing of original comment.
.... Indicates unreadable comment

EXCEPTION REQUEST TO CONTINUE THE USE OF METRIC UNITS

Date: 11/29/06
District Co. Rte. 08/RIV/215, PM (38.3 / 38.9), **EA**: 44931
Program Code: HE11
Program Document and Year : PSR signed 6/12/1997, PE/ED Sept 2001
Location: ON RTE 215 FR N/O EUCALYPTUS AVE IC TO S/O BOX SPRINGS RD IC & ON RTE 60 FR 60/215 JCT TO W/O DAY ST. IC
Work Description: Construction of HOV connectors to close the gap between the existing HOV lanes and the ones built as part of the design sequence project (EA 33484).
PA&ED Complete? Yes
PS&E _20_% Compete
Scheduled PS&E Delivery to HQ OE: RCTC may perform AAA **
Proposed Advertisement Date : 01/2008
Construction. Cost Estimate: $30.5 Million
Project Manager: Nader Naguib **Phone**: (909) 388-7180
Project Engineer: Tuan A Truong **Phone**: (909) 383- 4006

Current Project Status / Progress to Date on Project:
On 10/01/2006 RCTC hired LAN engineering to prepare FINAL DESIGN.
Project 33484 (STIP Design Sequence) Segmented off this project (449311) during its final design due to funding constraints. Funding for the segmented work is now available from RCTC. We are currently using the same Metric topo map from project 33484 which is under construction. This project which is under design must be compatible with: 1) existing pavement. 2) the project currently under construction. 3) Ultimate configuration for interchange. Two metric GAD's prepared by Caltrans are being used for the current design. These 2 GAD's cover the current project and the Ultimate design at this interchange.

Reason for Request:
This project is being designed while project 33484 (A design Sequencing project) is being constructed. Numerous changes in the design are happening during construction. This project (449311) will start construction right after 33484 is completed with construction. There are no "As-Builts" which show what "exists". It was agreed that the 33484 Bid Documents will be used to show conditions which will exist when completed. In order for that to happen we must use the original topo modified with the roadway features currently being constructed. If a new English topo were flown today, it would not reflect what will be constructed over the next year. Because the design of the HOV lanes here are tightly woven through this interchange, keeping its design in metric will allow us to use the same station lines being used for the current project, facilitate faster reviews to ensure an accurate fit with the other project improvements, eliminate errors and schedule delays, reduce cost and provide a higher quality project.

Justification for Extension Request:
Cost to Convert to USCU: $250,000.00
Schedule Delay to convert to USCU: 5 Months

Requested By: Approved By:

Patricia Romo 12/1/06 — 1-17-07

Patricia Romo — Date
Deputy District Director
Design/Engineering Services

Kevin Herritt
Chief, Office of Geometric Design Standards
Division of Design

REVISED
STRUCTURE FOUNDATION REPORT
RETAINING WALLS RW-19 AND RW-20
ROUTE 60/215 SEPARATION (BRIDGE NO. 56-0507R)
INTERSTATE 215/STATE ROUTE 60
EAST JUNCTION IMPROVEMENTS
CITY OF MORENO VALLEY, CALIFORNIA
08-RIV-60/215-KP 19.4/21.56, 61.7/62.6
CALTRANS EA NO. 08-449311

Prepared for:

LIM & NASCIMENTO
ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER WEST, INC.
1220 Research Drive, Suite B
Redlands, CA 92374

Project No. 76979

Revised June 15, 2009
February 19, 2009

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APPROVAL LETTER

DIVISION OF ENGINEERING SERVICES
OFFICE OF GEOTECHNICAL DESIGN – SOUTH 2

TO: **Robert Zezoff**
Office of Special Funded Projects
MS # 9 2/7G

DATE: **September 21, 2009**
FILE: **08 – RIV – 60, 215 –KP 61.7/62.6**
DIST – CO – RTE - KP/PM

FROM: **DIVISION OF ENGINEERING SERVICES**
Geotechnical Services – MS-5
Geotechnical Design – South 2, Branch C

STRUCTURE FOUNDATION REPORTS	**Prepared by Kleinfelder West, Inc for Lim & Nascimento Engr Corp**	DTD:	**Aug 19, 2009 (Br)** **Aug 19, 2009 (RW)**	**Various Structures for the 215/60 East Junction**	
				STRUCTURE NAME	
GENERAL PLAN DATED:	**8/20/09 (Br)** **8/20/09 (RWs)**	FDN PLAN DATED:	**8/20/09 (Br)** **8/20/09 (RWs)**	**08-449311**	**56-0841, 56-0842** **Various RWs**
				EA NUMBER	BR NUMBER

Submittal (Check One):
[ ] 1st [X] 2nd [ ] 3rd [ ] Other: _____

The following comments are based on the submitted:
1. Revised Final Structure Foundation Report addition for Proposed Westbound and Eastbound State Route 60 HOV Connectors, dated August 19, 2009.
2. Revised Structure Foundation Report addition for Proposed Retaining Walls RW-19 and RW-20, dated August 19, 2009.
3. PS&E plans for the Proposed Westbound and Eastbound State Route 60 HOV Connectors, dated August 20, 2009
4. PS&E plans for the Proposed Retaining Walls RW-19 and RW-20, dated August 20, 2009

Revised Final Structure Foundation Report for Proposed Westbound and Eastbound State Route 60 HOV Connectors
No further comments from our office.

Revised Structure Foundation Report for Retaining Walls RW-19 and RW-20
No further comments from our office.

PS&E plans for the Proposed Westbound and Eastbound State Route 60 HOV Connectors
Please add this Note to the following sheets: "For Bottom of Footing elevations, please see WB SR60 HOV CONNECTOR, FOUNDATION PLAN"
WB SR60 HOV CONNECTOR, RETAINING WALL #2 LAYOUT
WB SR60 HOV CONNECTOR, RETAINING WALL #3 LAYOUT
WB SR60 HOV CONNECTOR, RETAINING WALL #4 LAYOUT

Please add this Note to the following sheets: "For Bottom of Footing elevations, please see EB SR60 HOV CONNECTOR, FOUNDATION PLAN"
EB SR60 HOV CONNECTOR, RETAINING WALL #1 LAYOUT
EB SR60 HOV CONNECTOR, RETAINING WALL #2 LAYOUT
EB SR60 HOV CONNECTOR, RETAINING WALL #3 and #4 LAYOUT

PS&E plans for the Proposed Retaining Walls RW-19 and RW-20
No further comments from our office.

To: **Robert Zezoff**
Office of Special Funded Projects
MS # 9 2/7G

DATE: **September 21, 2009**

STRUCTURE FOUNDATION REPORTS	**Prepared by Kleinfelder West, Inc for Lim & Nascimento Engr Corp**	DTD:	**Aug 19, 2009 (Br) Aug 19, 2009 (RW)**	**Various Structures for the 215/60 East Junction**	
				STRUCTURE NAME	
GENERAL PLAN DATED:	**8/20/09 (Br) 8/20/09 (RWs)**	FND PLAN DATED:	**8/20/09 (Br) 8/20/09 (RWs)**	**08-449311**	**56-0841, 56-0842 Various RWs**
				EA NUMBER	BR NUMBER

Conclusion

The submitted Revised Final Structure Foundation Report additions for the Proposed Westbound and Eastbound State Route 60 HOV Connectors, and the PS&E plans are approved from the perspective of our office, The Office of Geotechnical Design, South 2, subject to verification of the changes outlined above.

The submitted Revised Structure Foundation Report additions for Retaining Walls RW-19 and RW-20 and the PS&E plans are approved from the perspective of our Office. If you have any questions, you may contact me at (916-227-4539).

NAME: Gina Pursell, R.C.E. #54512 9/21/2009
Structure Foundations Branch - C

c: SWei

REVISED LOTB SHEETS

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

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Carlos V Amante 10/02/09
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

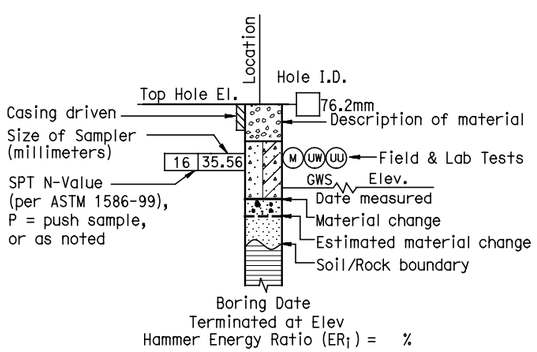
BOREHOLE IDENTIFICATION

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 (25.4mm soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

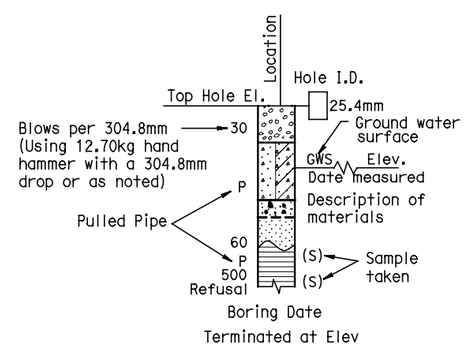
Note: Size in millimeters.

PLASTICITY OF FINE-GRAINED SOILS

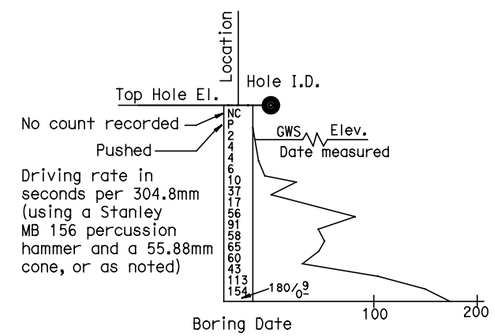
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



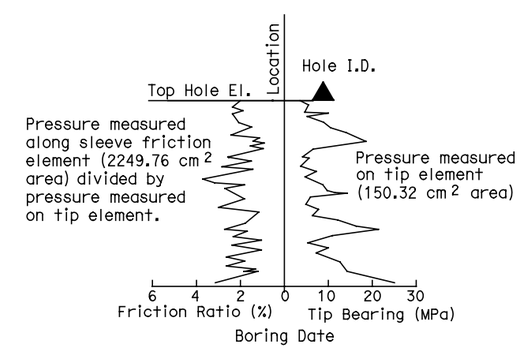
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	
SIGN OFF DATE	CHECKED BY	C. AMANTE	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56E0060
KILOMETER POST R61.82

RETAINING WALL NO. RW-19

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 6/18/09 8/20/09 10/2/09

SHEET 7 OF 12

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V Amante 10/02/09
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

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1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56E0060

KILOMETER POST R61.82

RETAINING WALL NO. RW-19

SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 6/18/09 8/28/09 10/2/09

REVISION DATES

SHEET 8 OF 12

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V Amante 10/02/09
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

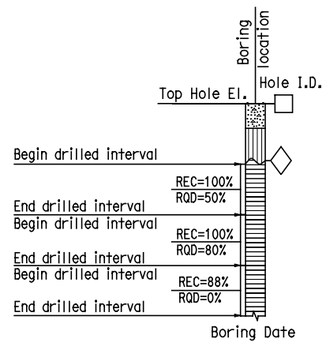
KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56E0060
KILOMETER POST R61.82

RETAINING WALL NO. RW-19
ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 6/18/09 8/28/09 10/2/09

REVISION DATES

SHEET 9 OF 12

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V Amante 10/02/09
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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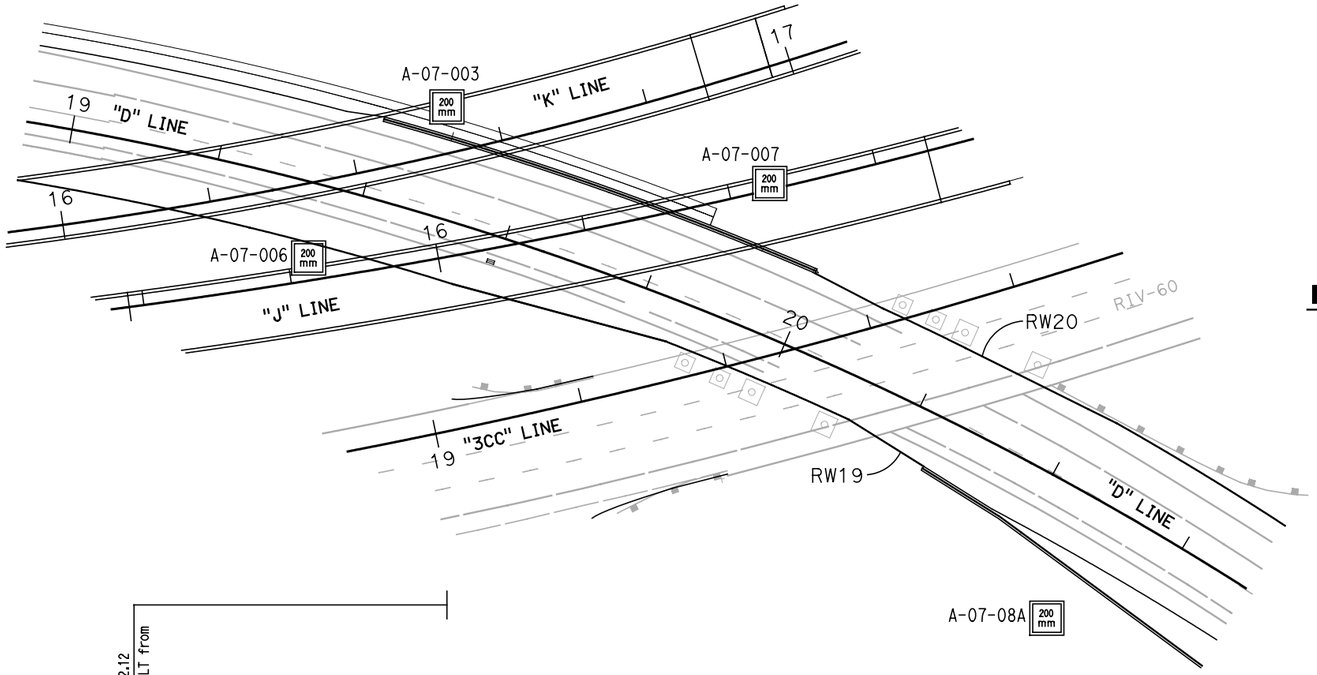
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374



PLAN
1:400

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

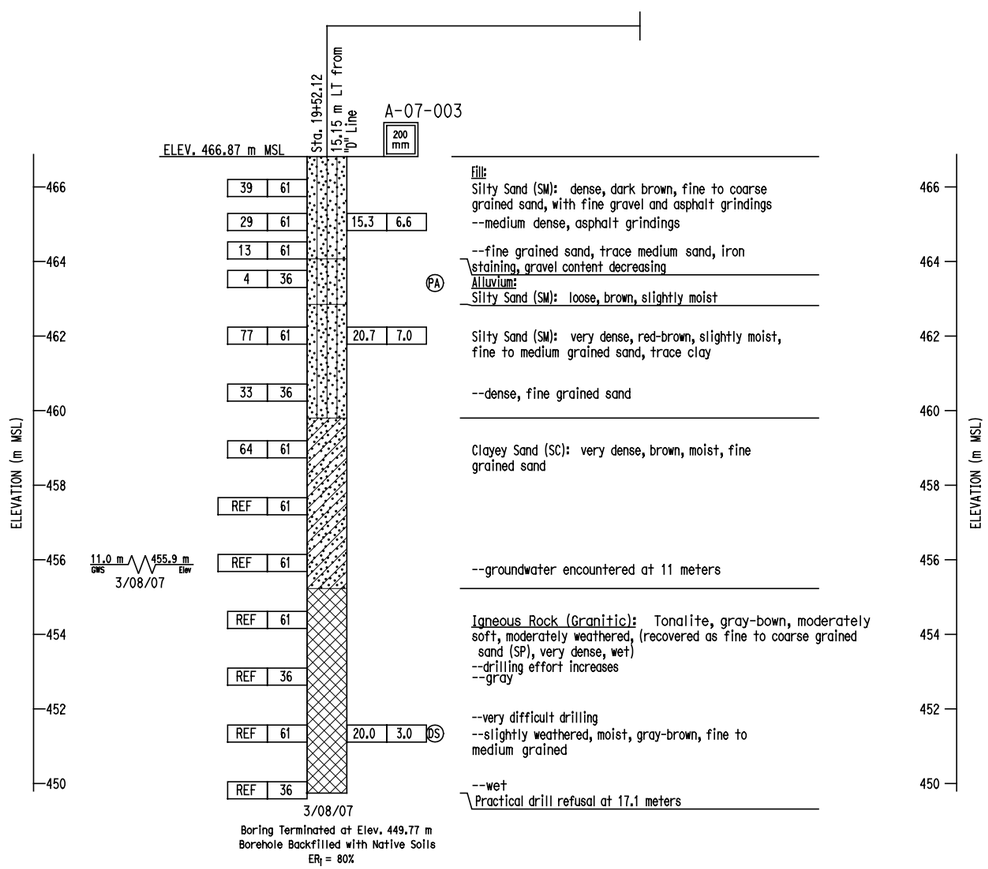
NOTES:

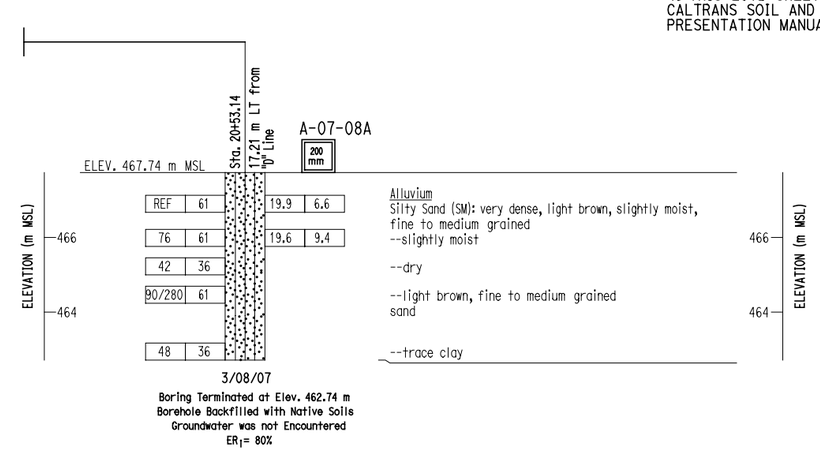
1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).





PROFILE
VERTICAL SCALE 1:2

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	
SIGN OFF DATE	CHECKED BY	C. AMANTE	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56E0060
KILOMETER POST R61.82

RETAINING WALL NO. RW-19
LOG OF TEST BORINGS 1 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 6/18/09 8/28/09 10/2/09

REVISION DATES

SHEET 10 OF 12

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V. Amante 10/02/09
CERTIFIED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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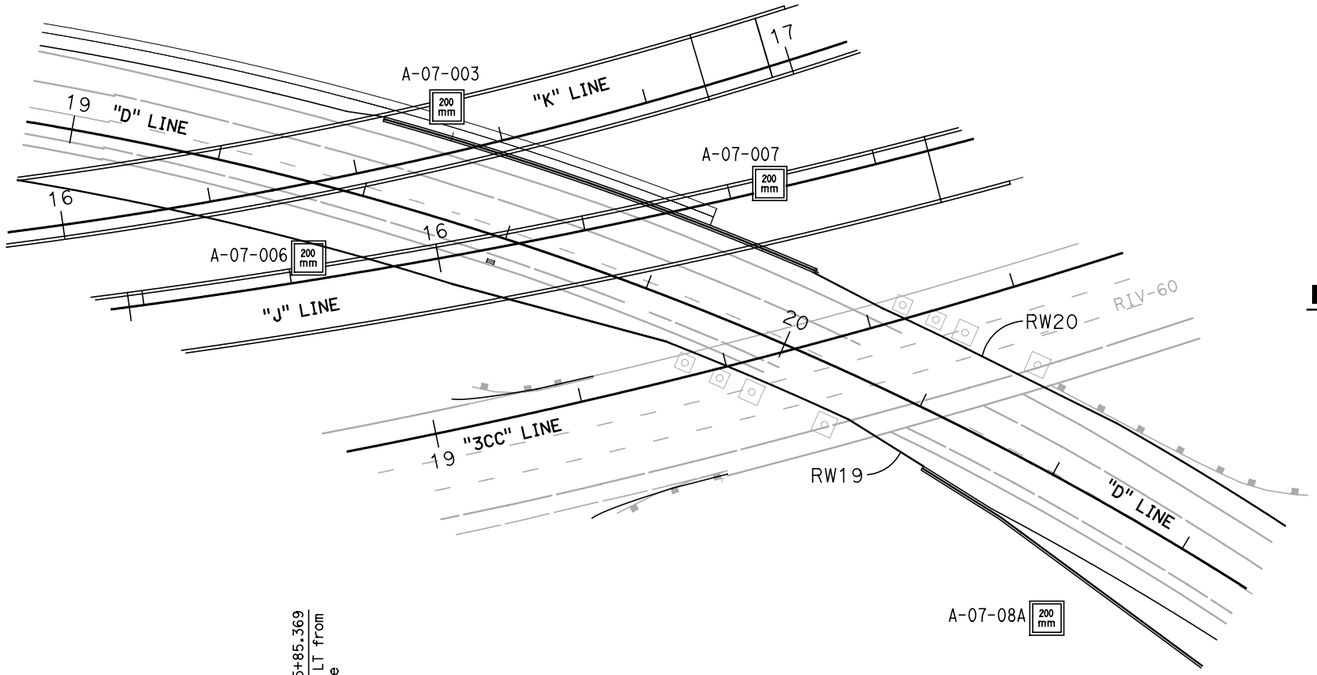

PLAN
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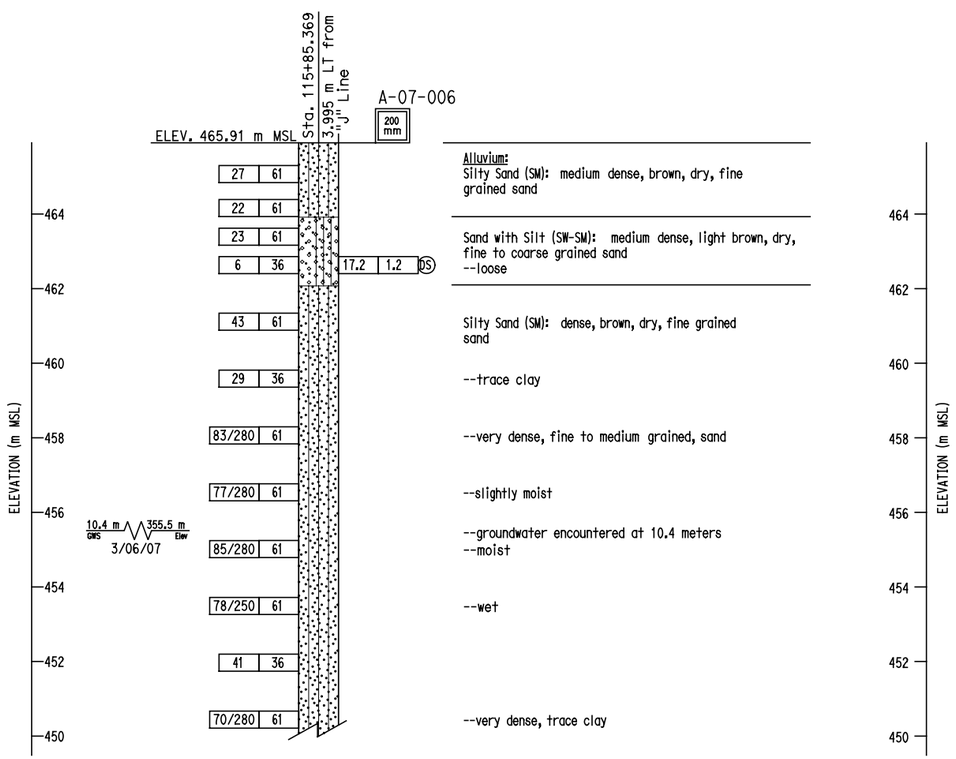

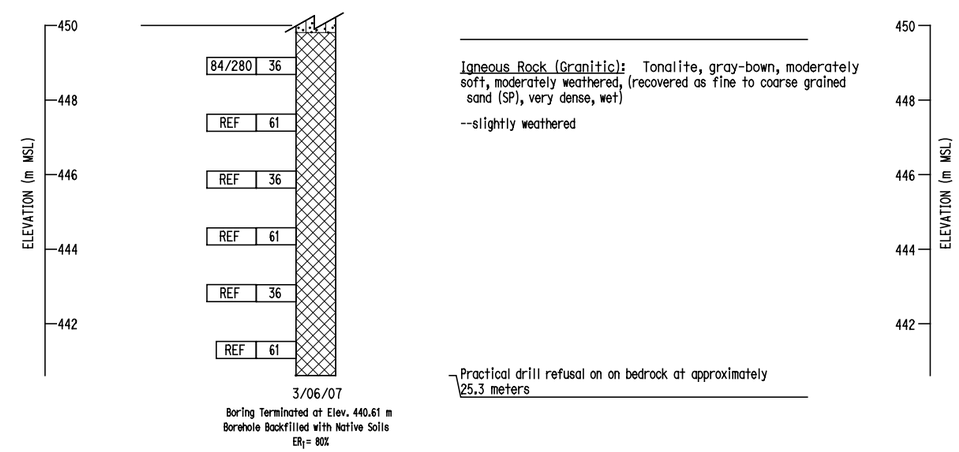

PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
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E = 1903554.738

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ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56E0060
KILOMETER POST R61.82

RETAINING WALL NO. RW-19
LOG OF TEST BORINGS 2 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES 6/18/09 8/28/09 10/2/09

SHEET 11 OF 12

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

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CERTIFIED GEOTECHNICAL ENGINEER

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SAN BERNARDINO, CALIFORNIA 92408

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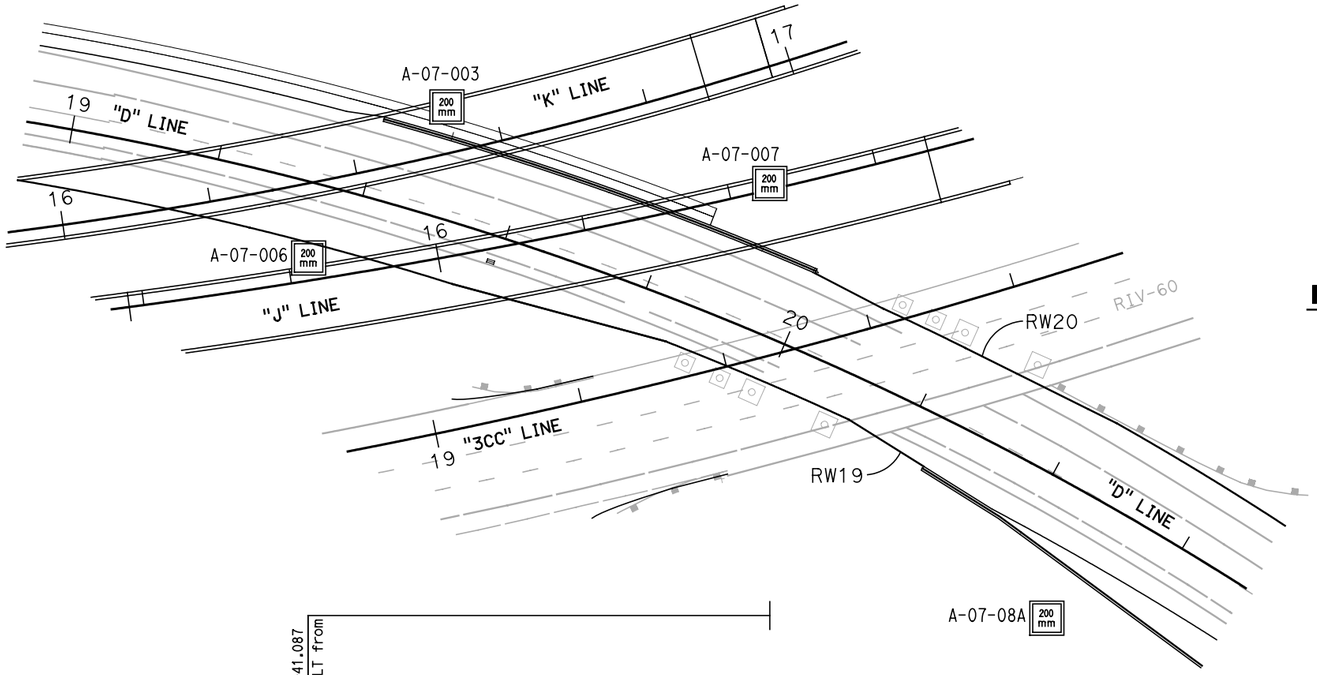

PLAN
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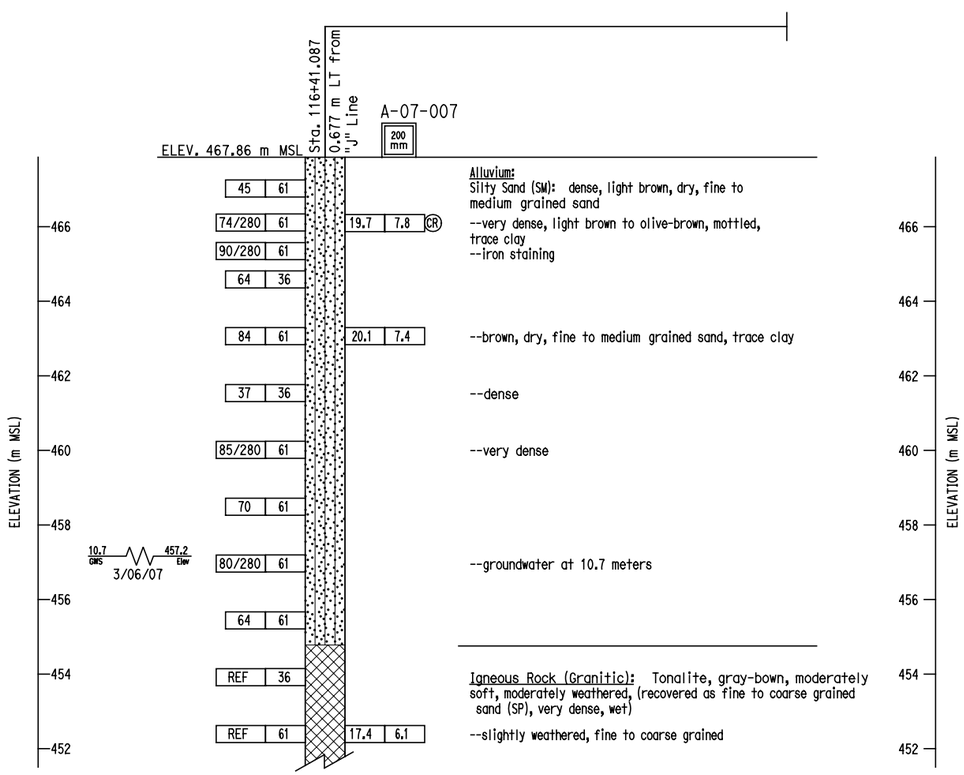

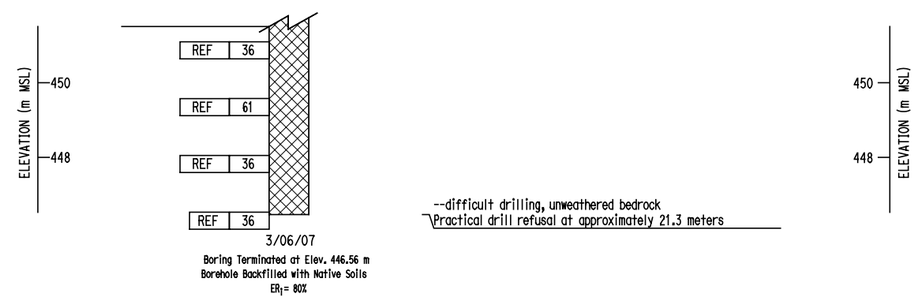

PROFILE
VERTICAL SCALE 1:2

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY	C. AMANTE	C. AMANTE, PROJECT ENGINEER

BRIDGE NO. 56E0060
KILOMETER POST R61.82

RETAINING WALL NO. RW-19
LOG OF TEST BORINGS 3 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 6/18/09 8/28/09 10/2/09

SHEET 12 OF 12

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

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Carlos V Amante 10/02/09
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

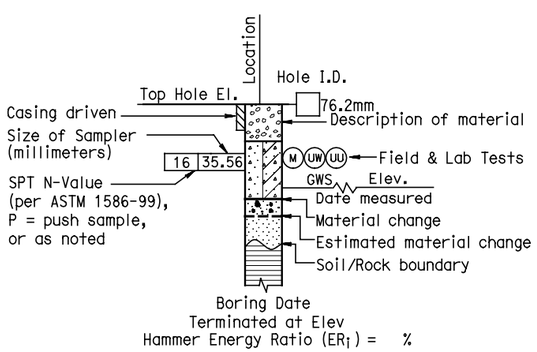
BOREHOLE IDENTIFICATION

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 (25.4mm soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

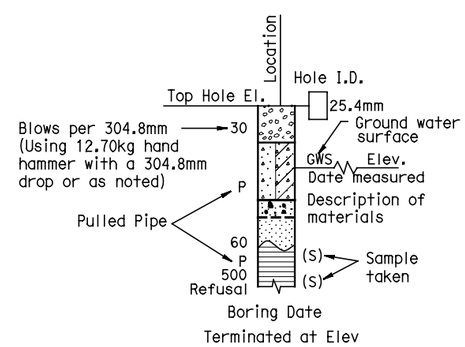
Note: Size in millimeters.

PLASTICITY OF FINE-GRAINED SOILS

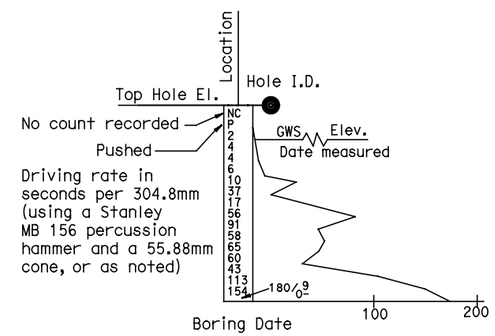
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



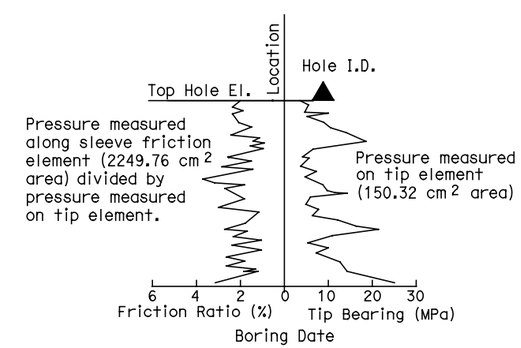
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY	C. AMANTE	C. AMANTE, PROJECT ENGINEER

BRIDGE NO. 56E0061
KILOMETER POST R61.78

RETAINING WALL NO. RW-20

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 6/18/09 8/28/09 10/2/09

REVISION DATES

SHEET 8 OF 13

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V. Amante 10/02/09
CERTIFIED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

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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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56E0061
KILOMETER POST R61.78

RETAINING WALL NO. RW-20
SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 6/18/09 8/20/09 10/2/09

REVISION DATES

SHEET 9 OF 13

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V Amante 10/02/09
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

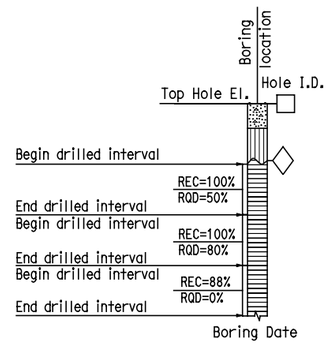
KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56E0061
KILOMETER POST R61.78

RETAINING WALL NO. RW-20
ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 6/18/09 8/28/09 10/2/09

REVISION DATES

SHEET 10 OF 13

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V Amante 10/02/09
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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KLEINFELDER
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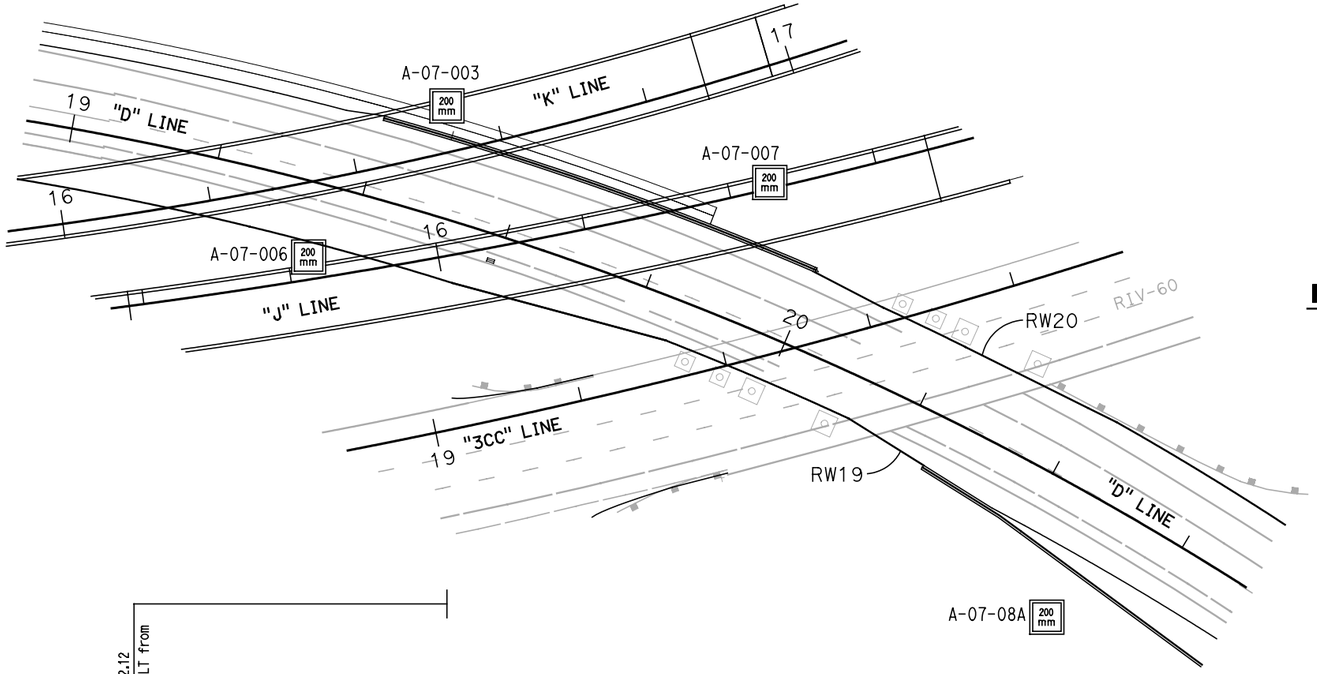

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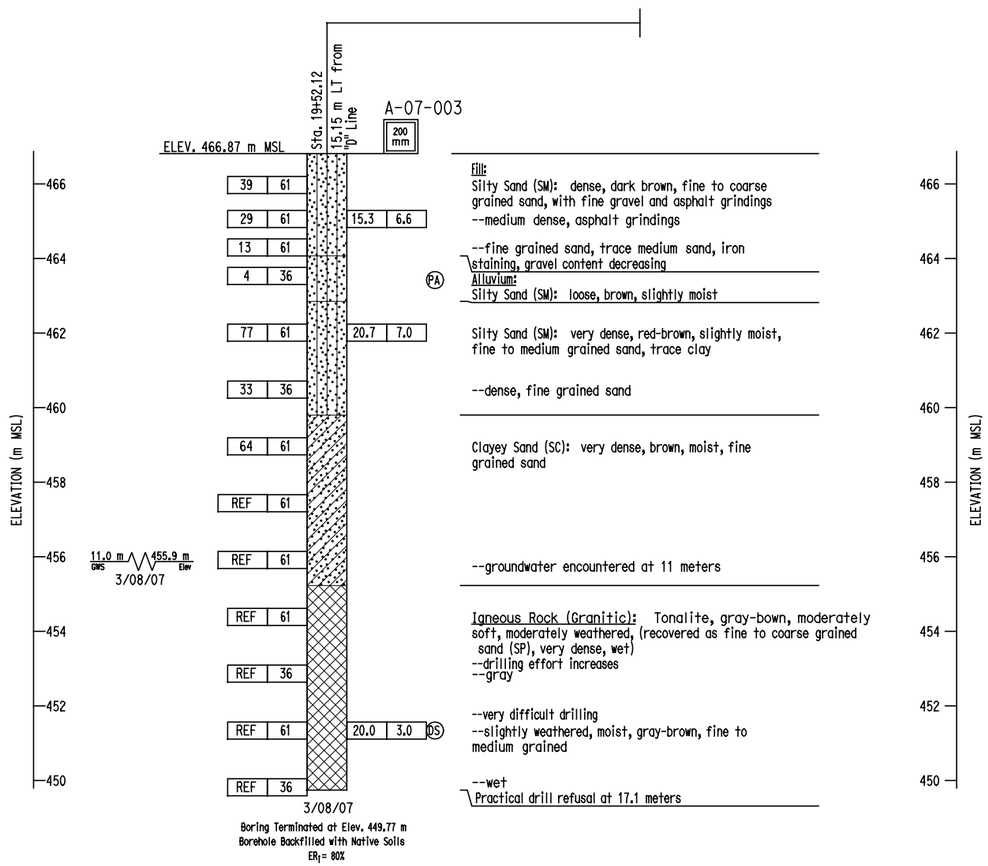

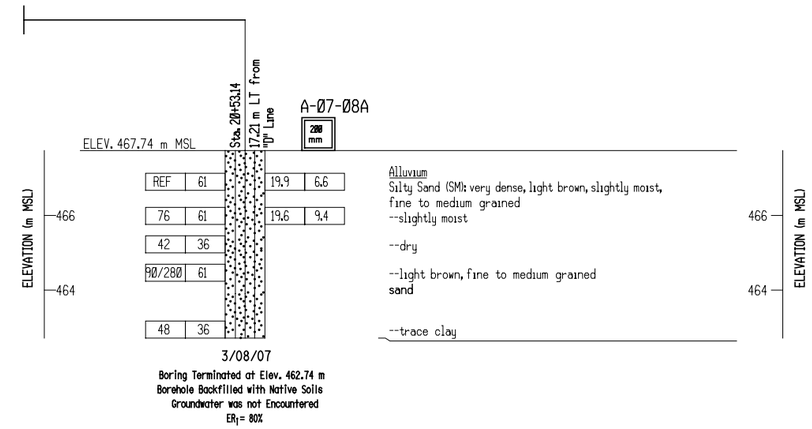

PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT
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CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56E0061
KILOMETER POST R61.78

RETAINING WALL NO. RW-20
LOG OF TEST BORINGS 1 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES 6/18/09 8/28/09 10/2/09

SHEET 11 OF 13

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08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V. Amante 10/02/09
CERTIFIED GEOTECHNICAL ENGINEER

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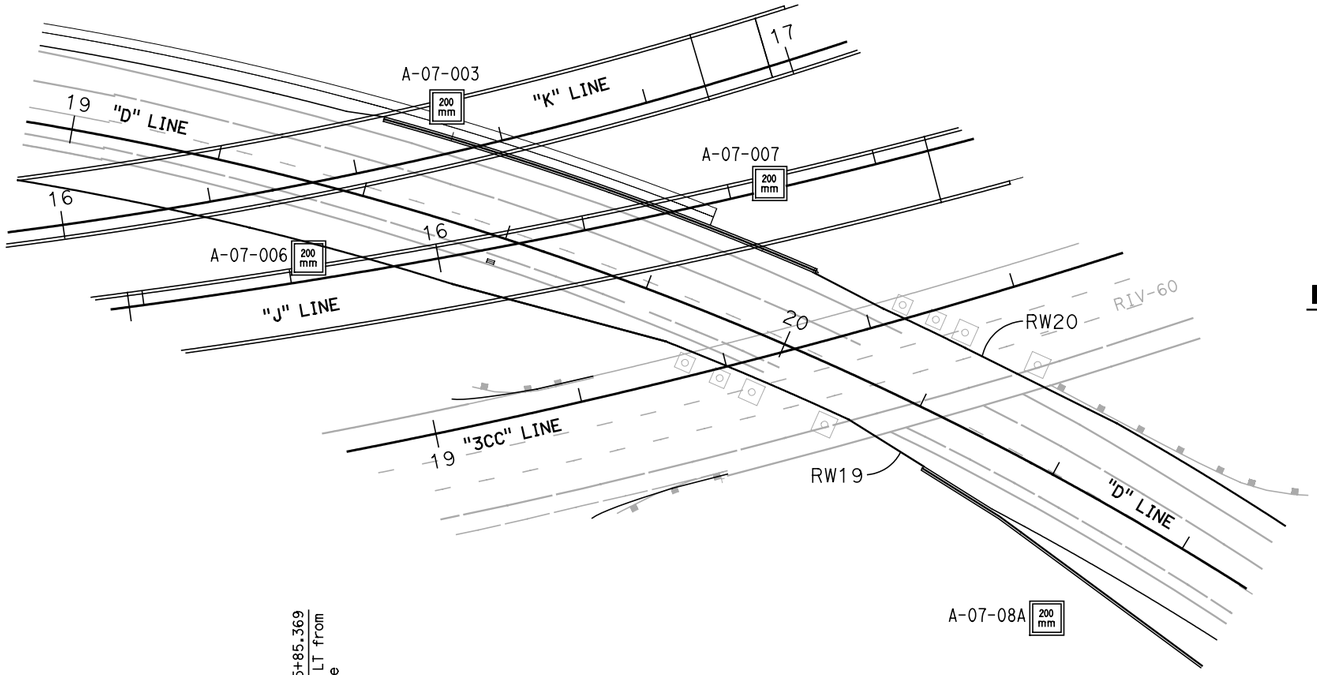

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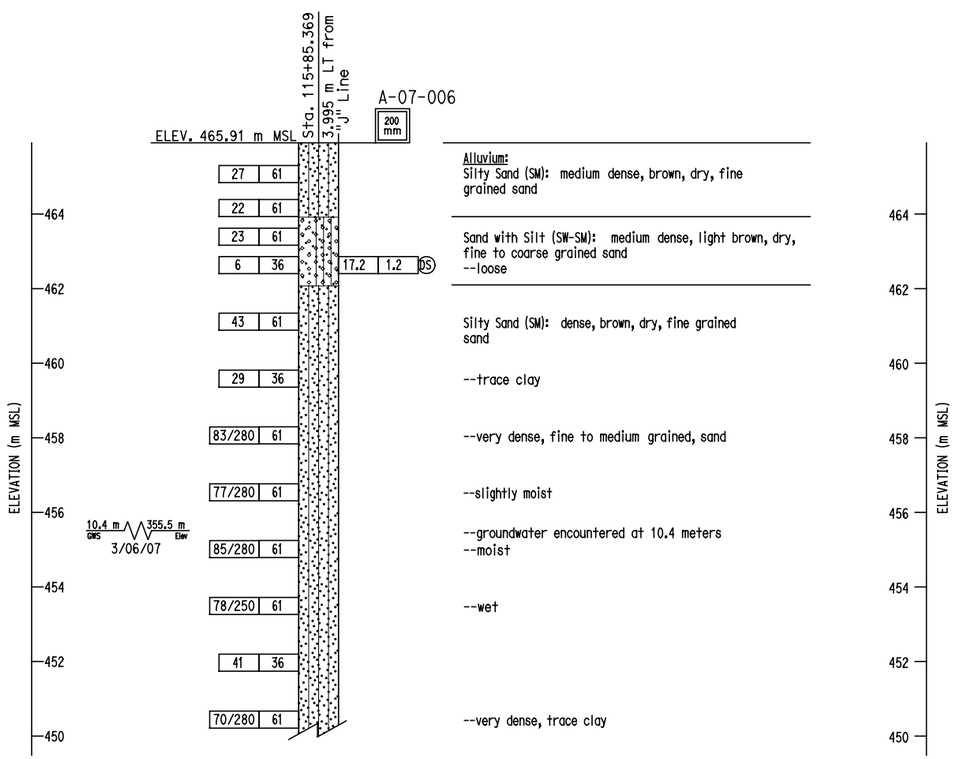

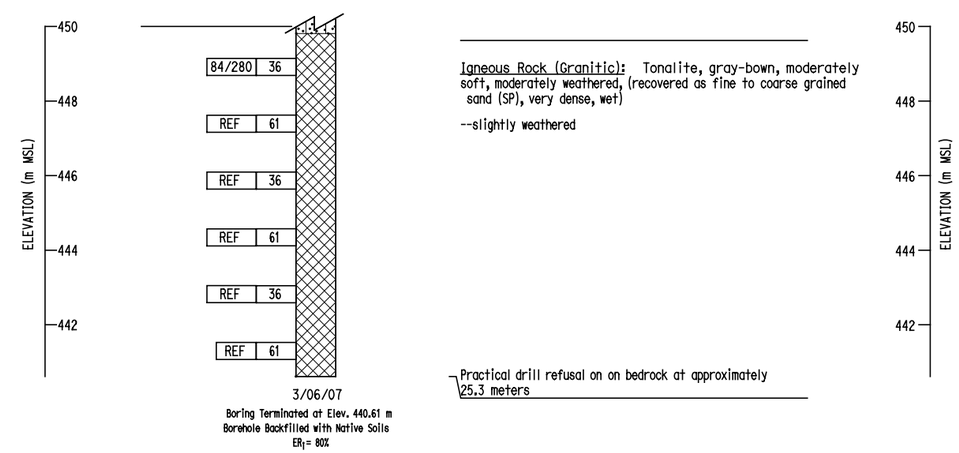

PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
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C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56E0061
KILOMETER POST R61.78

RETAINING WALL NO. RW-20
LOG OF TEST BORINGS 2 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 6/18/09 8/28/09 10/2/09

SHEET 12 OF 13

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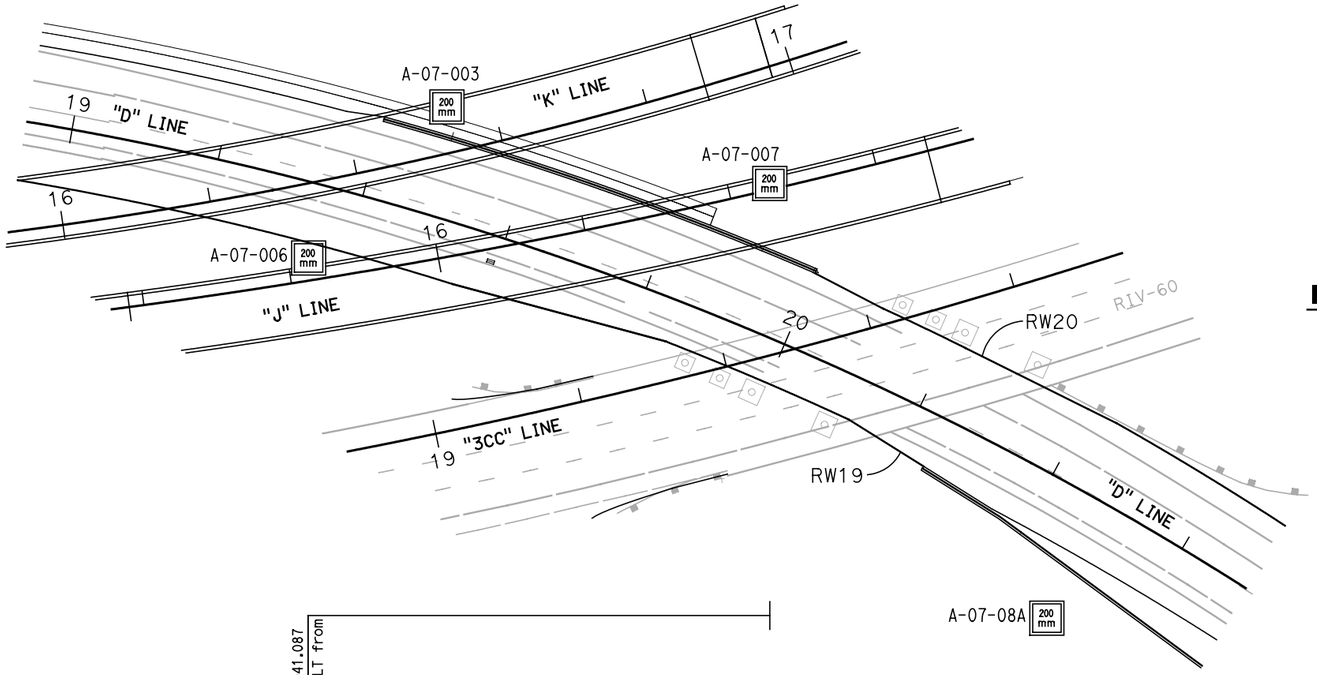

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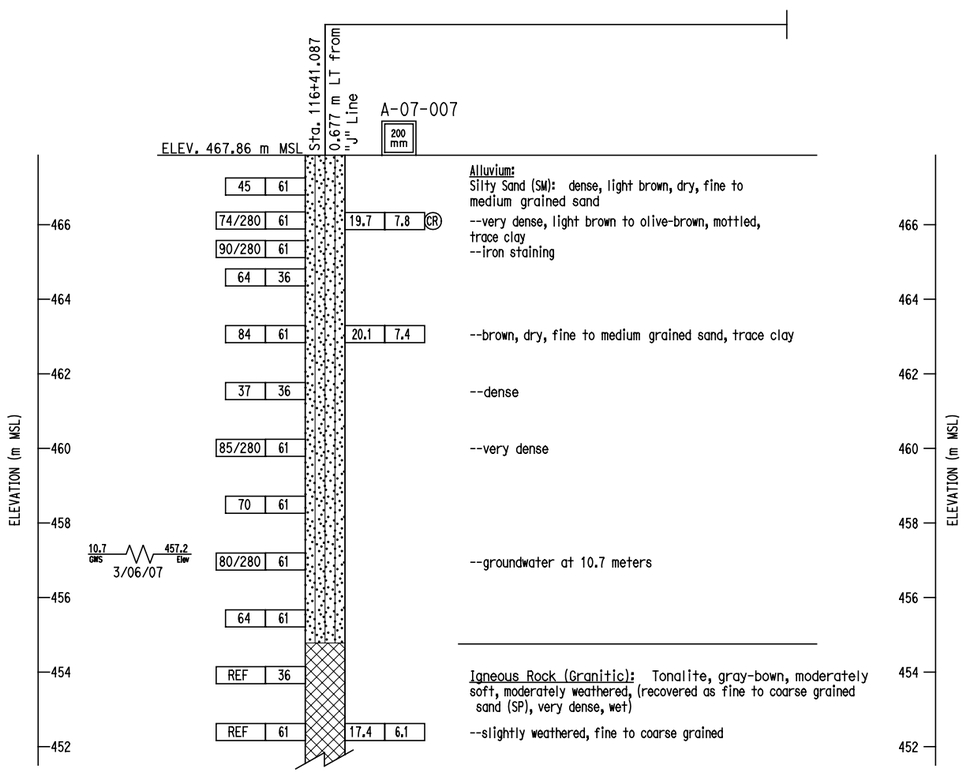

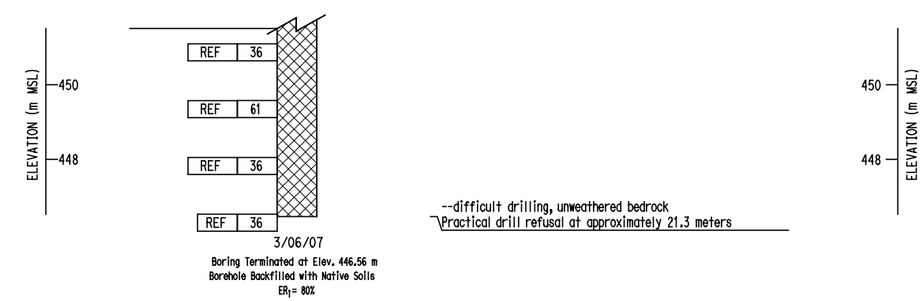

PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

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DRAWN BY: D. FAHRNEY
CHECKED BY: C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56E0061
KILOMETER POST R61.78

RETAINING WALL NO. RW-20
LOG OF TEST BORINGS 3 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 6/18/09 8/28/09 10/2/09

SHEET 13 OF 13

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ADDENDUM

1220 Research Drive
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Redlands, CA 92374
p| 909.793.2691
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kleinfelder.com

August 19, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

via Electronic Mail
Mohan.Char@lanengineering.com
Kimberly.Gee@lanengineering.com

Subject: Addendum to Revised Structure Foundation Report (Dated June 15, 2009) Retaining Walls RW-19 and RW-20 Route 60/215 Separation (Bridge No. 56-0507R) Interstate 215/State Route 60 East Junction Improvements City of Moreno Valley, California 08-RIV-60/215-KP 19.4/21.56, 61.7/62.6 Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder has prepared this addendum report in response to comments provided by the California Department of Transportation (Caltrans), Division of Engineering Services, Geotechnical Services- MS #5, Office of Geotechnical Design South-2, pertaining to their review of our report entitled Revised Structure Foundation Report, Retaining Walls RW-19 and RW-20, Route 60/215 Separation (Bridge No. 56-0507R), Interstate 215/State Route 60 East Junction Improvements, City of Moreno Valley, California, dated June 15, 2009. The Caltrans review comments and our responses to these comments are attached.

CLOSURE

The information contained in this report/letter is subject to the conditions and limitations contained within the structure foundation report. We appreciate the opportunity to be of service on this project. If you have any questions, comments or require additional information, please do not hesitate to contact our office at your convenience.

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Respectfully submitted,

KLEINFELDER WEST, INC.

Madan Chirumalla, PE
Staff Engineer

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

for Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

MC/CVA:lg

Attachments: Response to Comments Form
Revised Table 2, Seismic Design Parameters
Revised Log of Test Boring (LOTB) Sheets

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Project Name: **I-215/SR-60 East Junction**
08-SBd-215/60 CU08 -EA449311
Review Phase: **Foundation Report Review**
Retaining Wall RW-19 and RW-20
Responses by: Carlos Amante/ Madan Chirumalla

RESPONSE TO COMMENTS ON FOUNDATION REPORT REVIEW –Retaining Wall RW-19 and RW-20

Comment No.	Sheet No.	Plan Comments by Gina Pursell	Response	✓
1	**Pg 12 of 22 Section 6.1**	Seismic Design Considerations: Please include direction of controlling fault in Table 2.	The direction of controlling fault is provided in the revised Table 2 attached in this addendum report..	

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Table 2 (Revised 8-19-09)
Seismic Design Parameters

Seismic Parameters	Design Recommendation and Reference
Controlling Fault	San Jacinto (SJO), (Mualchin, 1996a)
Direction of Controlling Fault	Right-Lateral
Type of Fault	Strike-Slip (Mualchin, 1996b)
Closest Distance to the Fault	8.8 km (northeast) (Mualchin, 1996a)
Earthquake Magnitude (MCE)	7.5 (Mualchin, 1996a,b)
Horizontal Peak Bedrock Acceleration (PBA)	0.5g
Soil Profile Type	C (Table B.1, 2006 Caltrans Seismic Design Criteria)

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

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	60.7/70.6,22.0/18.5 32.7/34.7		

Carlos V Amante
CERTIFIED GEOTECHNICAL ENGINEER

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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.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

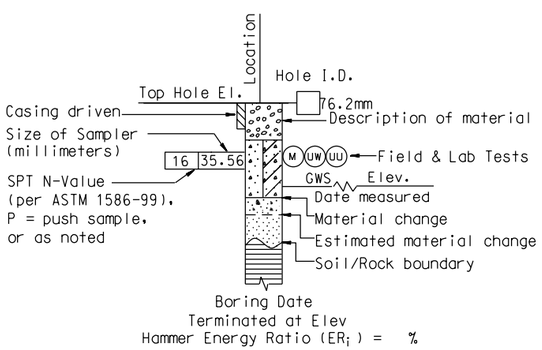
BOREHOLE IDENTIFICATION

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 (25.4mm soil tube) Hand Auger
	D	Dynamic Cone Penetration Boring
	CPT	Cone Penetration Test (ASTM D 5778-95)
	O	Other

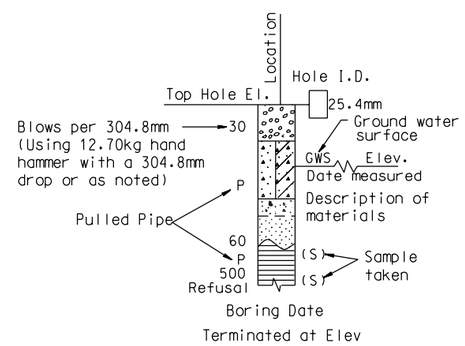
Note: Size in millimeters.

PLASTICITY OF FINE-GRAINED SOILS

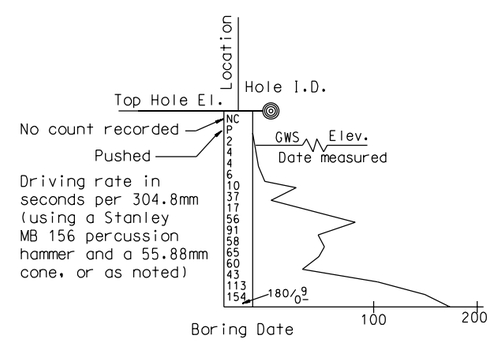
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



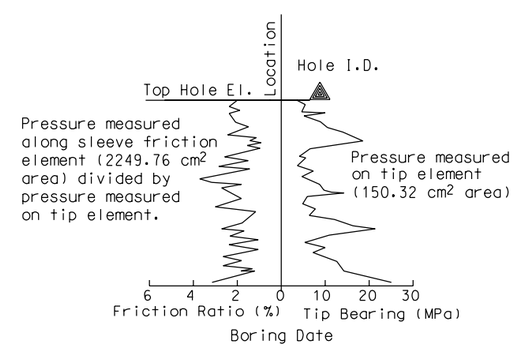
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

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06/03/09 SIGN OFF DATE	CHECKED BY	C. AMANTE

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C. AMANTE
PROJECT ENGINEER

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KILOMETER POST R62.2

RETAINING WALLS RW-19 AND RW-20

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 6/12/09

REVISION DATES

SHEET 1 OF 6

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REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

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06/03/09
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CHECKED BY C. AMANTE

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PROJECT ENGINEER

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RETAINING WALLS RW-19 AND RW-20

SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 6/12/09

REVISION DATES | SHEET 2 | OF 6

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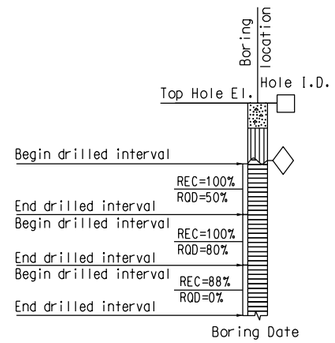
REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

C. AMANTE
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CHECKED BY C. AMANTE

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STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0082R
KILOMETER POST R62.2

RETAINING WALLS RW-19 AND RW-20

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

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REVISION DATES

SHEET 3 OF 6

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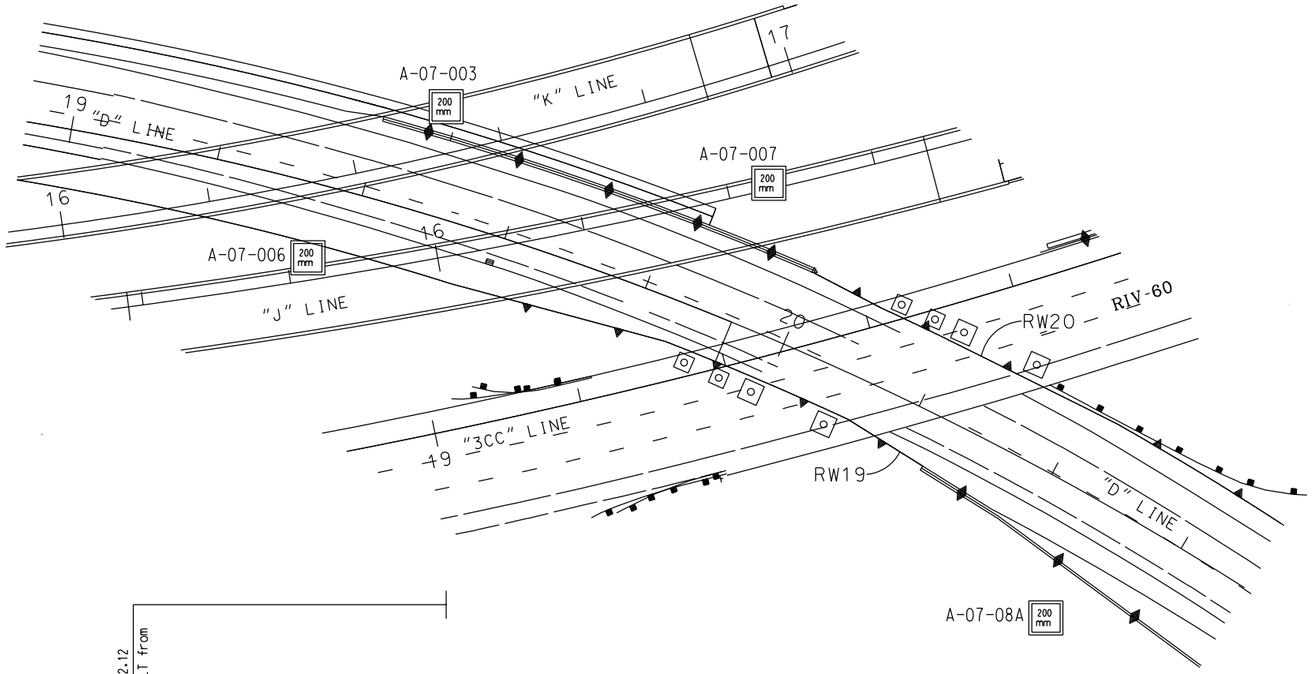


PLAN
1:400

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

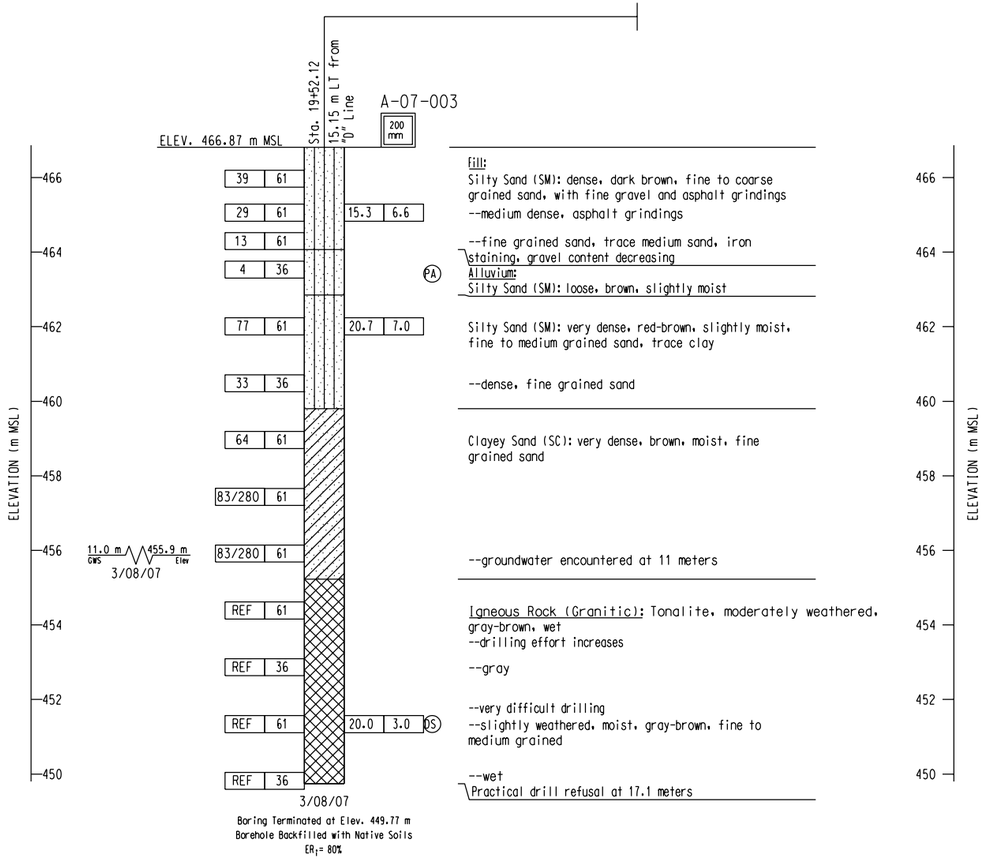
NOTES:

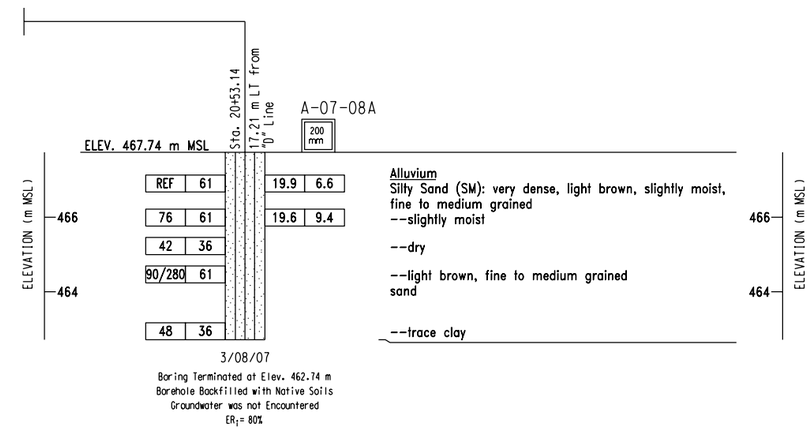
1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).





PROFILE
VERTICAL SCALE 1:2

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

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06/03/09 SIGN OFF DATE	CHECKED BY	C. AMANTE	C. AMANTE PROJECT ENGINEER

BRIDGE NO. 56-0082R
KILOMETER POST R62.2

RETAINING WALLS RW-19 AND RW-20
LOG OF TEST BORINGS

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 6/12/09

REVISION DATES | SHEET 4 | OF 6

FILE -) $REQUEST

USERNAME -$USER DATE PLOTTED -) $DATE TIME PLOTTED -) $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	60.7/70.6,22.0/18.5 32.7/34.7		

Caltrans Metric

Carlos V Amante
CERTIFIED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER CARLOS AMANTE No. GE2724 Exp. 6-30-10 GEOTECHNICAL STATE OF CALIFORNIA

PLANS APPROVALDATE

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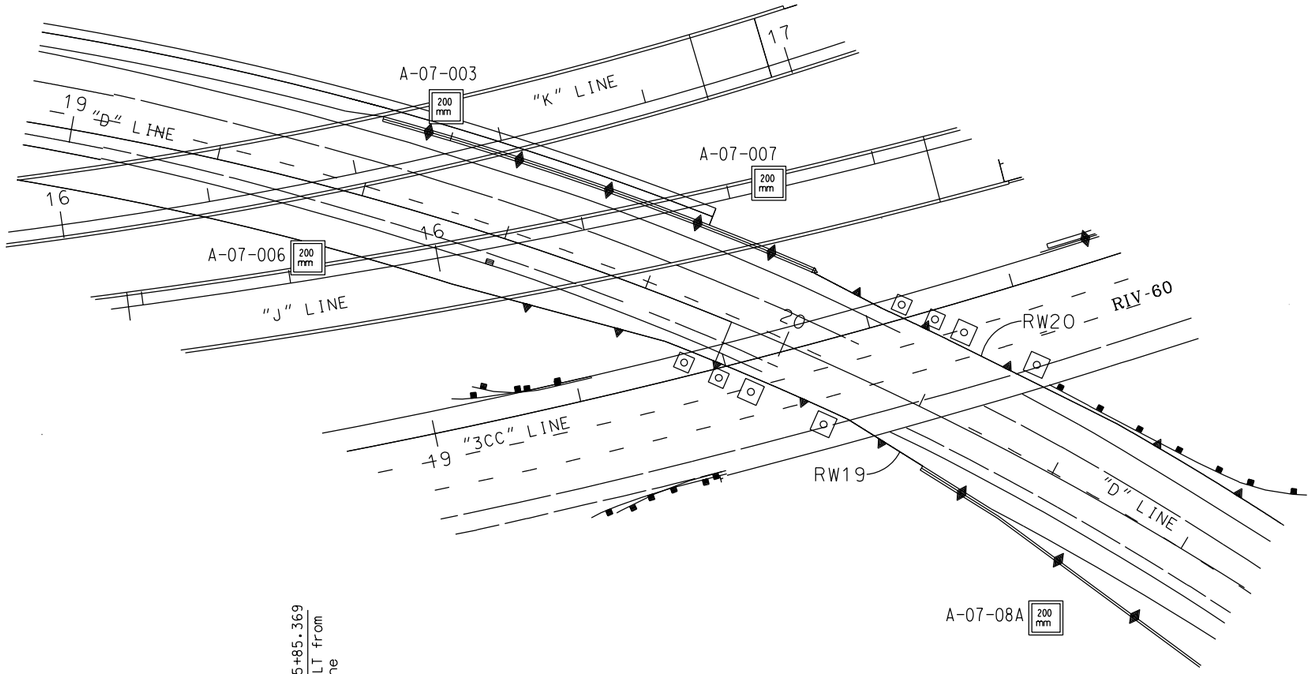
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374



PLAN
1:400

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

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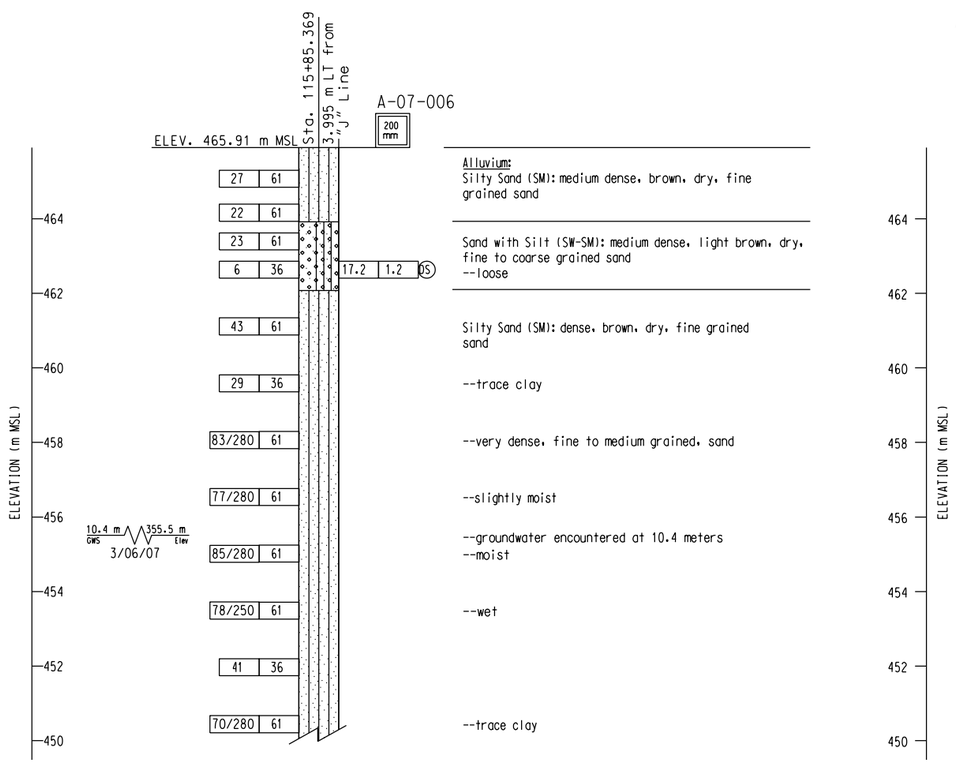

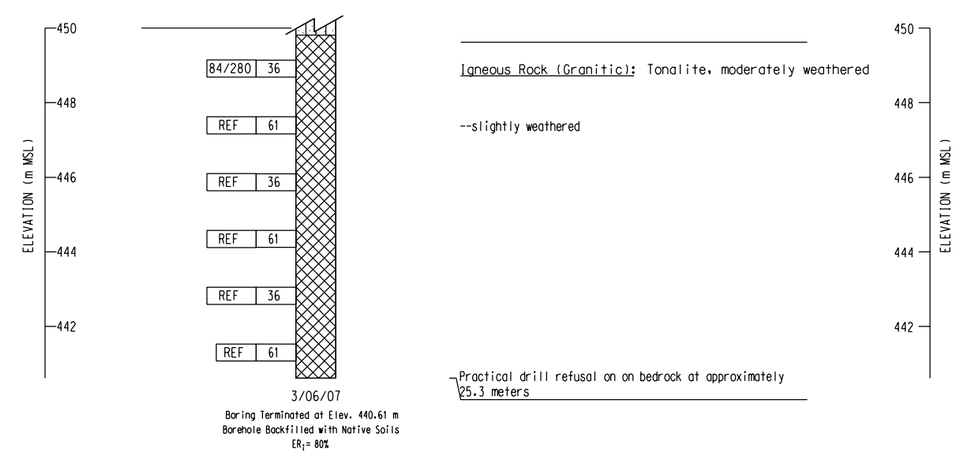

PROFILE
VERTICAL SCALE 1:2

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BRIDGE NO. 56-0082R
KILOMETER POST R62.2

RETAINING WALLS RW-19 AND RW-20

LOG OF TEST BORINGS

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	60.7/70.6,22.0/18.5 32.7/34.7		

Caltrans Metric

Carlos V Amante
CERTIFIED GEOTECHNICAL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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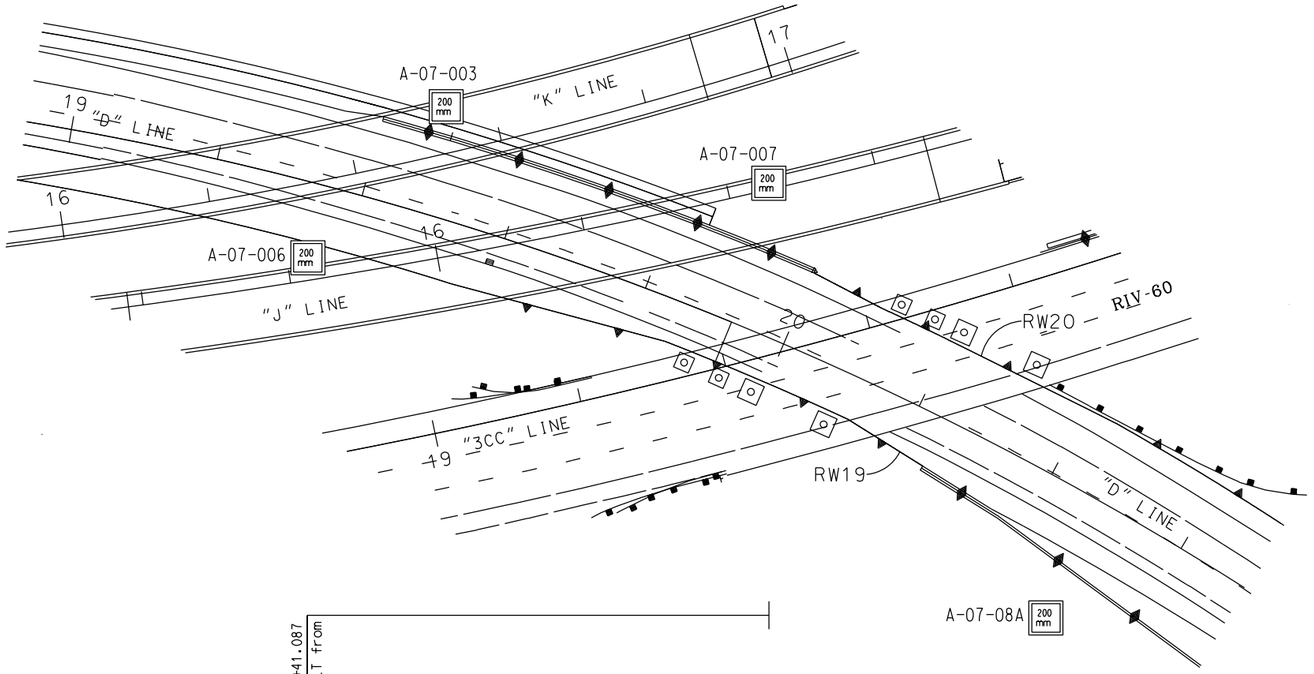

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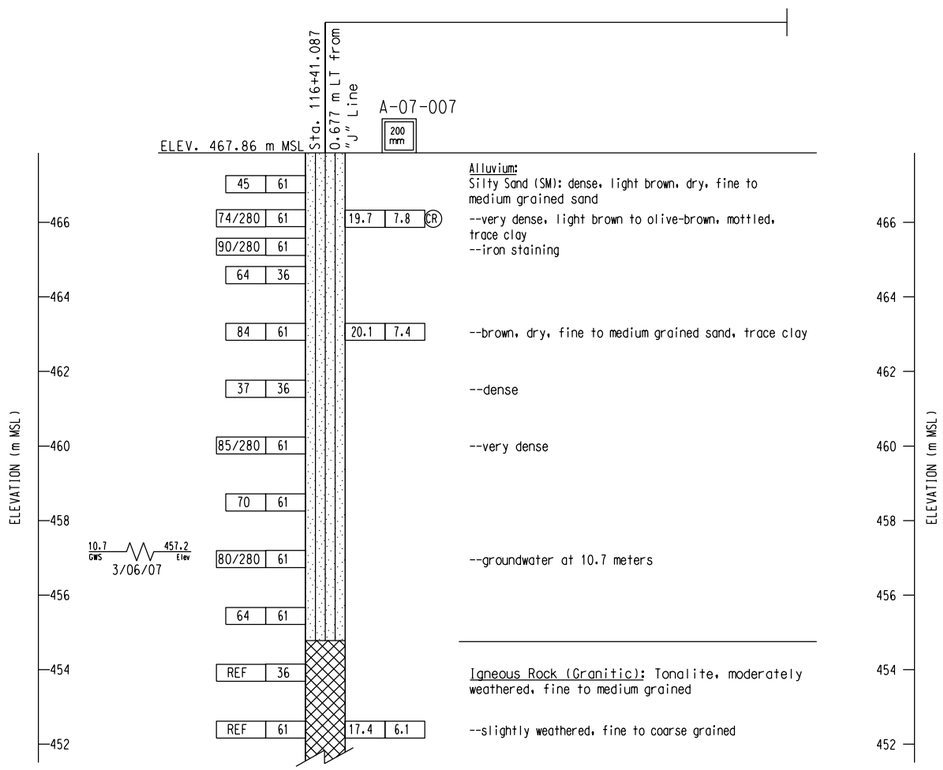

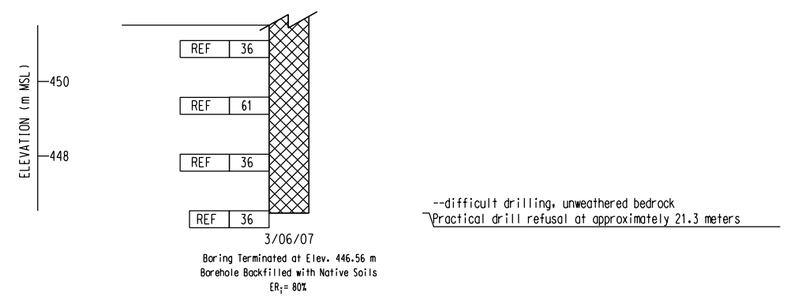

PROFILE
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06/03/09 SIGN OFF DATE	CHECKED BY	C. AMANTE	

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0082R
KILOMETER POST R62.2

RETAINING WALLS RW-19 AND RW-20
LOG OF TEST BORINGS

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
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REVISED FINAL STRUCTURE FOUNDATION REPORT

REVISED
STRUCTURE FOUNDATION REPORT
RETAINING WALLS RW-19 AND RW-20
ROUTE 60/215 SEPARATION (BRIDGE NO. 56-0507R)
INTERSTATE 215/STATE ROUTE 60
EAST JUNCTION IMPROVEMENTS
CITY OF MORENO VALLEY, CALIFORNIA
08-RIV-60/215-KP 19.4/21.56, 61.7/62.6
CALTRANS EA NO. 08-449311

Prepared for:

LIM & NASCIMENTO
ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER WEST, INC.
1220 Research Drive, Suite B
Redlands, CA 92374

Project No. 76979

Revised June 15, 2009
February 19, 2009

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Revised June 15, 2009
February 19, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

Subject: Revised Structure Foundation Report
Retaining Walls RW-19 and RW-20
Route 60/215 Separation (Bridge No. 56-0507R)
Interstate 215/State Route 60 East Junction Improvements
City of Moreno Valley, California
08-RIV-60/215-KP 19.4/21.56, 61.7/62.6
Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) is pleased to present this Revised Structure Foundation Report for the proposed retaining walls RW-19 and RW-20 as part of the proposed improvements at the east junction of existing Interstate 215 and State Route 60, in the City of Moreno Valley, California.

This report presents the geotechnical conditions as evaluated from the results of our investigation and review of as-built Log of Test Borings (LOTB) data of the existing bridge. It also provides recommendations and specifications for the proposed retaining wall foundation design and construction.

We appreciate the opportunity to provide geotechnical services to Lim & Nascimento Engineering Corporation and trust the information in this report meets the current project needs. If you have any questions, please contact the undersigned at your convenience.

Respectfully submitted,
KLEINFELDER WEST, INC.

REGISTERED PROFESSIONAL ENGINEER
CARLOS V. AMANTE
No. 2724
Exp. 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST
RICHARD F. ESCANDON
No. 1213
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

MC/CVA:lg

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1.0 INTRODUCTION

1.1 General

This report presents the results of our geotechnical investigation for design and construction of proposed retaining walls underneath the existing Route 60/215 Separation (Bridge No. 56-0507R), associated with the widening and lowering of the existing northbound Interstate 215 (I-215) freeway. The project site is located in the City of Moreno Valley, California. The approximate limit of the project area is shown on Plate 1, *Site Location Map.* The proposed retaining walls are part of the proposed improvements at the east junction of I-215 and State Route 60.

1.2 Purpose and Scope of Work

The purpose of our investigation was to explore the site subsurface conditions, provide analysis of anticipated site conditions as they pertain to the project as described herein, and provide geotechnical recommendations and specifications for design and construction of proposed retaining walls. This report also establishes a geotechnical baseline to be used in assessing the existence and scope of changed site conditions.

The scope of services performed for this project includes the following:

- Review of proposed retaining wall plans.
- Review of plans for the existing Route 60/215 Separation (Widen).
- Review of as-built plans for Route 60/395 Separation (currently Route 60/215 Separation).
- Review of regional and local geology pertinent to the site.
- Engineering analysis.
- Report preparation.

The following items are addressed in this report:

- Site geology and subsurface conditions.

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- Site preparation and earthwork recommendations.
- Earth retaining system recommendations.
- Corrosion characteristics of the on-site soils.
- Construction considerations.

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2.0 EXISTING FACILITIES AND PROPOSED IMPROVEMENTS

2.1 Existing Facilities

The study area includes the existing I-215 freeway (Escondido Expressway), SR-60 freeway (Moreno Valley Freeway), and Route 60/215 Separation Bridge (Bridge No. 56-0507R).

I-215 freeway in the subject area is a one-way road with two traffic lanes carrying northbound traffic. SR-60 freeway in the subject area is a one-way road with three traffic lanes carrying eastbound traffic.

The existing Route 60/215 Separation Bridge (previously called Route 60/395 Separation) was originally built in 1964 as a two-lane structure and widened to three lanes in 2000. The bridge was constructed as a three span structure with a combination of cast-in-place, prestressed concrete box girders, precast, prestressed I-girders and cast-in-place, reinforced concrete T-beams. The bridge consists of two abutments and two bents. Each bent is supported on four columns, all supported on spread footings. The bridge abutments are also supported on spread footings. The bridge is approximately 59.4 meters long and 17.866 meters wide. The existing bridge carries three lanes of traffic in eastbound direction on State Route 60. The embankments for the bridge consists of fill slopes having a gradient of 1:1.5 (Vertical:Horizontal, V:H) below the bridge and 1:2 (V:H) on the sides. The existing embankment slopes below the bridge are paved. The bridge as-built plans are presented in Appendix D.

2.2 Proposed Improvements

The proposed improvements for I-215/SR-60 East Junction project will include lowering and widening of the existing northbound I-215 freeway ("D" Line), beneath the existing Route 60/215 separation bridge. Two tieback retaining walls (RW-19 and RW-20) are proposed underneath the bridge, located on the west and east sides of northbound I-215, respectively. The retaining wall plans are shown on Plates 3a and through 3d. A summary of retaining wall data is presented in Table 1, below.

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Table 1
Summary of Retaining Wall Data

Wall Number	Beginning Station	Ending Station	Length (m)	Wall Height (m)	Bottom of Footing Elevation (m, MSL)	Wall Type
RW-19	10+00.00	10+29.61	29.61	3.60	463.54 - 463.69, 463.95	Type 1A (Mod.)
	10+29.61	10+58.43	28.82	2.44	464.24 - 467.72	Tieback Wall
	10+58.43	10+68.16	10.29	3.00	464.55	Type 1A (Mod.)
RW-20	10+00.00	10+08.45	8.45	2.40	465.53	Type 1A (Mod.)
	10+08.45	10+36.17	27.72	2.44	465.34 - 465.96	Tieback Wall
	10+36.17	10+71.61	35.45	2.40 – 3.00	466.05 - 466.70	Type 1A (Mod.)

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3.0 PERTINENT REPORTS

For this study, the following documents were used:

- General Plan and Tieback Wall Layout, Retaining Wall No. RW-19, Prepared by LAN Engineering, Latest Revision dated June 12, 2009, EA 0449311.

- General Plan and Tieback Wall Layout, Retaining Wall No. RW-20, Prepared by LAN Engineering, Latest Revision dated June 12, 2009, EA 0449311.

- Kleinfelder West, Inc., Structure Foundation Report, Proposed "D" Line Retaining Walls, Route 60/215 Separation (Bridge No. 56-0507R), Interstate 215/State Route 60 East Junction Improvements, Moreno Valley, California, 08-RIV-60/215, KP 19.4/21.56, 61.7/62.6, Caltrans EA No. 08-449311, Kleinfelder Project No. 76979, dated February 19, 2009.

- Kleinfelder West, Inc., Geotechnical Design Report, Interstate 215/ State Route 60 East Junction Improvements, Riverside and Moreno Valley, California, 08-RIV-215/60, KP 60.7/70.6, 22.0/18.5, Caltrans EA No. 449311, Kleinfelder Project No. 76979, dated January 9, 2009.

- Kleinfelder West, Inc., Materials Report, Interstate 215/ State Route 60 East Junction Improvements, Riverside and Moreno Valley, California, 08-RIV-215/60, KP 60.7/70.6, 22.0/18.5, Caltrans EA No. 449311, Kleinfelder Project No. 76979, dated January 16, 2009.

- Structure Foundation Report, Proposed Box Springs Overhead Right Bridge Widening, Bridge Number 56-0082R, I-215/SR60 East Junction, Riverside, California, 08-RIV-215/60, KP 60.7/70.6, 22.0/18.5, Caltrans EA No. 449311, Kleinfelder Project No. 76979, dated October 10, 2008.

- Structure Foundation Report, Proposed Frontage Road Overhead Replacement, Bridge Number 56C-0056, I-215/SR60 East Junction, Riverside, California, 08-RIV-215/60, KP 60.7/70.6, 22.0/18.5, Caltrans EA No. 449311, Kleinfelder Project No. 76979, dated October 13, 2008.

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- Structure Foundation Report, Proposed Eastbound and Westbound SR60 HOV Connectors, I-215/SR60 East Junction, Riverside, California, 08-RIV-215/60, Caltrans EA No. 449311**,** Kleinfelder Project No. 76979, dated July 18, 2008.

- Structure Foundation Report, Proposed Box Springs Overhead Left Bridge Widening, Bridge Number 56-0082L, I-215/SR60 East Junction, Riverside, California, 08-RIV-215/60, KP R38.6, Caltrans EA No. 449311**,** Kleinfelder Project No. 76979, dated March 14, 2008.

Geologic data compiled and reviewed for this study were obtained from the Geologic Map of the Riverside East 7.5' Quadrangle, scale 1:24,000 (Morton, D.M. and Cox, D.F., 2001), and the Geologic Map of the Riverside East/South ½ of the San Bernardino South Quadrangles, map scale 1:24,000 (Dibblee, 2003). Other maps and publications we reviewed addressing regional geology include the *Geologic Map of the San Bernardino and Santa Ana 30' x 60' Quadrangles*, California, map scale 1 :100,000 (Morton, D.M., and Miller, F.K., 2006).

Maps, reports, and other studies reviewed addressing faulting and seismicity included "*Fault Rupture Hazard Zones in California*," (Bryant, W.A., and Hart, E.W., 2007); "*Fault Activity Map of California and Adjacent Areas, California*," Jennings, C.W. (1994); and *Map showing Quaternary Faults and 1978-84 Seismicity of the Los Angeles Region, California*, Ziony, J.I., and Jones, L. (1989).

Groundwater information from wells within the study area was researched based on records available through the Cooperative Well Measuring Program covering the Upper Santa Ana River, San Jacinto, and Upper Santa Margarita Watersheds (Western Municipal Water District (WMWD)).

Additional references used are listed in Section 8.0 of this report.

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4.0 GEOTECHNICAL INVESTIGATION PROGRAM

4.1 Field Exploration

Prior to conducting the field exploration, our proposed exploration locations were cleared of known existing utility lines through Underground Service Alert (USA). Our subsurface exploration program for the proposed retaining walls consisted of drilling and logging four exploratory soil borings A-07-003, A-07-006, A-07-007, A-07-009 (HV-3, HV-6, HV-7, and HV-9) during the period from March 6 through 8, 2007. These borings were advanced to depths ranging from approximately 5 to 25.3 meters below the existing ground surface (bgs). Locations of our borings are shown on Plates 2a and 2b, *Exploration Location Map*. The borings were advanced using a Mobile B-61, truck-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer delivery system for sample collection.

The borings were logged and sampled by a staff engineer/geologist from our office using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Each soil sample was observed and described in general accordance with the Unified Soil Classification System (USCS). Following drilling, sampling and logging, the borings were backfilled with native cuttings. The boring logs are presented in Appendix A, *Field Exploration*.

4.2 Laboratory Testing

Laboratory testing was performed on soil samples collected during our field exploration to substantiate field classifications and to evaluate the physical characteristics of the subsurface soils. Testing consisted of in-situ moisture content and unit weight, grain size distribution, and corrosion analyses. In addition to these tests we also presented the results obtained from shear strength and the laboratory maximum dry unit weight and optimum moisture content test performed for the project. The laboratory tests performed for this geotechnical study are described and the test results are presented in Appendix B.

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5.0 GEOTECHNICAL CONDITIONS

5.1 Regional and Local Geology

The project site is situated within the northern Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are a northwest-southeast oriented complex of blocks separated by similarly trending faults which extend 200 kilometers from the Transverse Ranges, south of the Mexican border and beyond another 1250 kilometers to the tip of Baja California. The province varies in width from 50 to 160 kilometers and is bounded on the east by the Colorado Desert and the Gulf of California and on the west by the Pacific Ocean.

The Peninsular Ranges contain Jurassic-age and Cretaceous-age igneous and metamorphic rocks, as well as a thick sequence of marine and non-marine sedimentary rock. The Peninsular Ranges Province is further described by sub-units, which include the Perris Block, the Santa Ana Mountains, and the San Jacinto Mountains. The Perris Block is characterized as a broad area of intermixed valleys and low mountain ranges situated between the Elsinore and San Jacinto fault zones.

The project site is located in the northern portion of the Perris Block and Perris Valley. Typical lithographic units within this area consist of Quaternary alluvial deposits overlying granitic and metamorphic bedrock. Sporadic outcrops of bedrock dot the valley floor and represent remnants of eroded hills and mountains. Bedrock consists of mostly Cretaceous-age igneous rock (tonalite) forming the bedrock hills north of the site.

5.2 Site Geology

Based on the results of our geotechnical exploration and testing and review of pertinent geologic literature, maps, and as-built plans of the existing bridge, the subsurface conditions anticipated at the project site consists of undocumented fill soil, alluvial sandy soil deposits, and granitic bedrock. Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the Boring Logs provided in Appendix A.

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5.3 Earth Materials

Earth materials encountered during this investigation include artificial fill, alluvium, and bedrock as described below. The locations of our exploratory borings are shown on Plates 2a and 2b, *Exploration Location Map*. Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the Logs of Borings provided in Appendix A, *Field Exploration* and the Log of Test Borings (LOTB) sheets, presented as Plates 4d through 4f. We recommend that all individuals utilizing this report review these logs for greater detail.

5.3.1 Artificial Fill

Up to approximately three meters of fill was observed in boring A-07-003 (HV-3) during our field investigation. The fill consists of silty sand (SM) with trace gravel. The contact between fill and alluvial fan deposits is poorly defined due to the similarity in composition.

5.3.2 Alluvium

Alluvial soils were encountered in all the borings excavated for the proposed project. The alluvial soils extend to a depth ranging from approximately 0 to 16 meters below the ground surface based on available boring data. In general, the alluvial soil deposits encountered during our investigation consisted of silty sand (SM), well graded sand with silt (SW-SM), and clayey sand (SC). The alluvial soils encountered are generally loose to very dense. As-built LOTB sheet of the existing bridge indicates that similar materials were encountered at the project site.

5.3.3 Bedrock

Tonalite granitic bedrock was encountered in all the borings drilled for the proposed project, except boring A-07-009 (HV-9) which was drilled to a depth of 5 meters below ground surface. The bedrock was encountered at depths ranging from approximately 12 to 16 meters below existing grades and extended to the maximum depth explored of 25.3 meters below the existing grade. In general, the tonalite rock is moderately to highly weathered and decomposed near the contact with the alluvial soils and becomes less weathered with depth. As-built LOTB sheet of the existing bridge indicates that bedrock was not encountered in the borings drilled to a maximum depth of approximately 13.5 meters.

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Detailed descriptions of the subsurface conditions encountered during our field investigation are presented on the Boring Logs provided in Appendix A.

5.4 Water

5.4.1 Surface Water

Surface drainage flows primarily by surficial sheet flow over the existing contour of the land. Proposed roadway improvements should be designed to provide positive surface drainage to prevent ponding and/or saturation of the soils in the vicinity of foundations or pavements. The site is not located within a Federal Emergency Management Agency (FEMA) flood hazard zone based on the latest Flood Insurance Rate Maps (FIRM) for the region.

5.4.2 Groundwater

Groundwater was encountered in three of our four borings excavated for the proposed project at depths ranging from approximately 10.4 to 11 meters below existing grades. These depths to groundwater correspond to groundwater elevations of approximately 455.6 to 457.8 meters, above Mean Sea Level (MSL). As-built LOTB sheet of the existing bridge (dated 1965) indicates that groundwater was not encountered in the borings drilled to a maximum depth of approximately 13.5 meters.

Fluctuations of the groundwater level, localized zones of perched water, and soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas on or immediately adjacent to the site can also cause a fluctuation of local groundwater levels.

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6.0 GEOTECHNICAL ANALYSIS AND DESIGN RECOMMENDATIONS

6.1 Seismic Design Considerations

6.1.1 Fault Rupture Potential

The site is not located within a currently delineated State of California Alquist-Priolo Earthquake Fault Zone (Bryant and Hart, 2007). No known active faults have been identified on the site, thus, the potential for future surface fault rupture at the site is considered to be "low." While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

6.1.2 Seismic Shaking

The 1996 California Seismic Hazard Map prepared by Caltrans (Mualchin, 1996a) indicates that the controlling fault for this project is the San Jacinto Fault (SJO), a strike slip fault with a maximum credible earthquake (MCE) moment magnitude of 7.5. The closest fault distance to the project site is approximately 8.8 km.

The horizontal peak bedrock acceleration (PBA) at the site based on the 1996 Caltrans Seismic Hazard Map is 0.5g. Caltrans Guidelines for Structures Foundation Reports (CGSFR), Version 2.0, dated March 2006, requires that the PBA determined above be verified with well-established attenuation relationships such as Sadigh et al. (1997) for controlling faults. The PBA value for the site, estimated using Sadigh et al. (1997) attenuation relationship, is 0.46g. Therefore, a PBA of 0.5g is recommended in accordance with Caltrans design practice.

Based on the results of our field exploration, our past experience, and in accordance with Table B.1 of Caltrans Seismic Design Criteria (SDC) (Version 1.4, dated June 2006), the site can be classified as Soil Profile Type C. The recommended seismic design parameters and ARS curve are presented in Table 2 and Plate 4, respectively.

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Table 2
Seismic Design Parameters

Seismic Parameters	Design Recommendation and Reference
Controlling Fault	San Jacinto (SJO), (Mualchin, 1996a)
Type of Fault	Strike-Slip (Mualchin, 1996b)
Closest Distance to the Fault	8.8 km (Mualchin, 1996a)
Earthquake Magnitude (MCE)	7.5 (Mualchin, 1996a,b)
Horizontal Peak Bedrock Acceleration (PBA)	0.5g
Soil Profile Type	C (Table B.1, 2006 Caltrans Seismic Design Criteria)

6.1.3 Liquefaction

Seismically induced soil liquefaction generally occurs in loose, saturated, cohesionless soil when pore pressures within the soil increase during ground shaking. The increase in pore pressure transforms the soil from a solid to a semi-liquid state. The primary factors affecting the liquefaction potential of a soil deposit are: 1) intensity and duration of earthquake shaking, 2) soil type and relative density, 3) overburden pressures, and 4) depth to groundwater. Soils most susceptible to liquefaction are clean, loose, uniformly graded, fine-grained sands, and non-plastic silts that are saturated. Silty sands have also been shown to be susceptible to liquefaction. These soils typically lose a portion or all of their shear strength and regain strength sometime after shaking stops. Soil movements (both vertical and lateral) have been observed under these conditions due to consolidation of the liquefied soils and the reduced shear resistance of slopes.

The potential for liquefaction at the site was evaluated using subsurface data obtained from our exploratory borings using the computer program SPTLIQ Version 4.0 (Geosoftware Solutions, 2007c). Due to the relative density of the soils our liquefaction analysis indicates that the site has a “low” liquefaction potential. The results of liquefaction analyses are presented in Appendix C-1.

6.1.4 Seismically Induced Settlement

During a strong seismic event, seismically induced settlement can occur within loose to moderately dense, dry or saturated granular soils. Settlement caused by ground shaking is often non-uniformly distributed, which can result in differential settlement.

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Using an empirical procedure developed by Tokimatsu and Seed (1987), seismically induced settlements due to seismic compaction of dry or unsaturated soils were estimated to be on the order of less than 10 mm. Seismically induced settlement calculations are presented in Appendix C-1.

6.2 Geotechnical Recommendations

The proposed tieback retaining walls RW-19 and RW-20 (see Plates 3a through 3d) are feasible provided the geotechnical recommendations given in the following sections are implemented for design and construction.

6.2.1 Lateral Earth Pressures

We recommend that the static lateral active earth pressure be calculated using the trapezoidal pressure diagram shown in Figure 5.5.5.7.1-1(b) in Section 5 of Caltrans Bridge Design Specifications (dated July 2004) for anchored walls.

Seismic earth pressure is computed using the method by Yong (1985) for rigid walls or walls unable to yield sufficiently to develop active earth pressure conditions. According to Yong (1985), the seismic earth pressure for rigid wall is approximately two to three times than those predicted by the Mononobe-Okabe method for cantilever walls (Seed and Whitman, 1970). The seismic earth pressure values presented in our report are based on the premise that the tieback walls will not yield sufficiently to develop active earth pressure conditions.

Static and seismic lateral earth pressures acting on the tieback walls were estimated using the above methods and presented in Appendix C-2.

6.2.2 Tieback Anchors

Tieback design should follow procedures described in Chapter 5 of Caltrans Bridge Design Specifications (2004) for anchored walls. The tiebacks should be vertically spaced a minimum of 1.2 meters and horizontally spaced a minimum of 2 meters.

Due to potential for collapse or caving of drilled anchor holes in granular alluvial materials, specialized installation methods such as casing or injection anchors will likely be required. Soil-to-grout bond stresses are highly dependent on installation technique,

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drilling and grouting method, grouting pressure and anchor diameter. In consideration of these factors and required load capacity, the design typically optimizes tieback anchor diameter, bonded length and installation methods. For purposes of estimating anchor lengths for preliminary design and cost estimating, the bonded length may be estimated using a maximum transfer load of 50 kN/m between pressurized concrete/grout and in-situ soil materials.

The unbonded length of the proposed tiebacks should extend a minimum of 1.5 meters beyond the passive wedge failure plane of the retained soil. In accordance with Rankine lateral earth pressure theory, a passive wedge failure plane is mobilized as the wall is pulled into the retained soil by the tieback anchors. The passive failure plane is inclined at an angle of (45 - Φ/2) degrees = (45 - 34/2) = 28 degrees from the horizontal, passing through the bottom of the wall. For preliminary design purposes, we recommend a minimum unbonded length of 6.5 meters.

Proper drainage should be designed behind the walls in accordance with Caltrans Standard Plans to prevent buildup of hydrostatic pressure in the backfill. Due to collapse or caving potential for drilled anchor holes in granular alluvial materials, specialized installation methods such as casing or injection anchors will likely be required.

Caltrans requires testing of all anchors. Permanent anchors are to be tested to either 150% of the design load exclusive of seismic, or 110% including seismic, whichever is greater. Tieback testing should be performed in accordance with current Caltrans specifications. We recommend that tieback construction, including tieback anchor testing, be monitored by Kleinfelder. Based on the design criteria and testing of all anchors, movement of the wall after construction should be limited to approximately 6 mm. This amount of movement is typical for these types of walls. The geotechnical engineer should observe and record the installation of the anchors to verify the assumed soil and geologic conditions and record the testing and lock-off of the anchors.

6.2.3 Slope Stability

The overall global stability of the abutment slope and the tieback wall was analyzed assuming bearing pressures of 195 kPa and 383 kPa for the existing abutment footing

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and bent column footing, respectively, for static condition. For seismic condition, we assumed a bearing pressure of 430 kPa for bent column footing,

Slope stability was calculated using the Modified Bishop's Method for circular slip surfaces implemented in the computer program GSTABL7 with STEDWin3.0 (Van Aller and Gregory, 2001). The design criteria utilized are as follows: permanent abutment slopes are required to have a minimum factor of safety of 1.5 for the static condition; and a minimum factor of safety of 1.1 for the pseudostatic condition using the Caltrans recommended horizontal earthquake loading coefficient equal to one-third (1/3) of the horizontal peak ground acceleration or 0.13g. The results of slope stability analysis indicate that the required minimum static and pseudostatic factors of safety would be satisfied for the proposed tieback walls. The slope stability analysis results are presented in Appendix C-3.

6.2.4 Soil Bearing Capacity

The tieback anchor loads will induce a bearing pressure on the foundation soils at the bottom of the wall. Assuming a minimum depth of embedment of 1.2 m and assumed wall thickness of 483 mm, a gross allowable bearing capacity of 195 kPa may be used for the underlying native alluvial soil deposits (see Appendix C-4 for calculations).

6.3 Corrosion Potential

A Corrosion test was performed on a sample obtained from boring A-07-007 (HV-7) at the location of the proposed retaining wall. The sample was tested for pH, resistivity, sulfate and chloride concentrations. These tests were performed by AP Engineering & Testing, Inc. The test results are presented in Table 4, below.

Table 4
Corrosion Test Results

Boring No.	Depth (m)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
A-07-007 (HV-7)	0.9 - 2.4	3,200	7.9	5	126

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According to Section 5.5 of Caltrans Corrosion Guidelines, Version 1.1 (2003), a site is considered corrosive to foundation elements if an area where the soil and/or water contains more than 500 ppm of chlorides, more than 2,000 ppm of sulfates, and/or has a pH of less than 5.5. Minimum resistivity is used by Caltrans to screen samples to determine if further analytical testing is required.

The test results from boring A-07-007 (HV-7) indicate the on-site soils may generally be considered as non-corrosive in accordance with Caltrans Corrosion Guidelines.

Concrete in contact with the ground should be batched using a cement in accordance with the Caltrans Standard Specifications and Table 854.1A of the Highway Design Manual. In general, "Type IP (MS) Modified" or "Type II Modified" cement are acceptable for use along the project alignment. Adequate concrete cover over reinforcing steel should be provided in accordance with good construction practices and Caltrans design standards.

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7.0 CONSTRUCTION CONSIDERATIONS

7.1 General

The borings advanced along the project alignment was advanced with moderate effort using a Mobile B-61, truck-mounted drill rig. Conventional construction and earth-moving equipment should be capable of performing the excavations proposed for the retaining wall. Prior to any excavation and earthwork operations, the contractor should notify the Underground Service Alert (USA) to locate and clear the site of conflict with any existing utility lines during construction.

7.2 Site Preparation and Earthwork

Site preparation and earthwork shall be performed in general accordance with Sections 16 and 19 of Caltrans Standard Specifications. It is recommended that the field geotechnical engineer or engineering geologist visually evaluate the soil conditions within footing excavations for the presence of soft or otherwise unsuitable soil deposits. If the soil encountered within footing excavations is considered to be soft by the field geotechnical engineer or engineering geologist, this material should be overexcavated and replace with soil compacted to 95 percent relative compaction.

7.3 Differing Site Conditions

Differing site conditions are those not encountered during our previous exploration, latent physical conditions that may arise, or unknown conditions that exist but were not observed and included in our report. If such differing conditions are observed during site operations, it is imperative that the designers, resident engineer, contractor, and/or geotechnical engineer be notified as soon as possible.

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8.0 LIMITATIONS

This report has been prepared for the exclusive use of LAN Engineering and its consultants for specific application to the proposed retaining walls at the existing Route 60/215 Separation Bridge, located in Moreno Valley, California. The findings, conclusions, and recommendations presented in this report were prepared in a manner consistent with the standards of care and skill ordinarily exercised by members of its profession practicing under similar conditions in the geographic vicinity and at the time the services will be performed. No warranty or guarantee, express or implied, is made.

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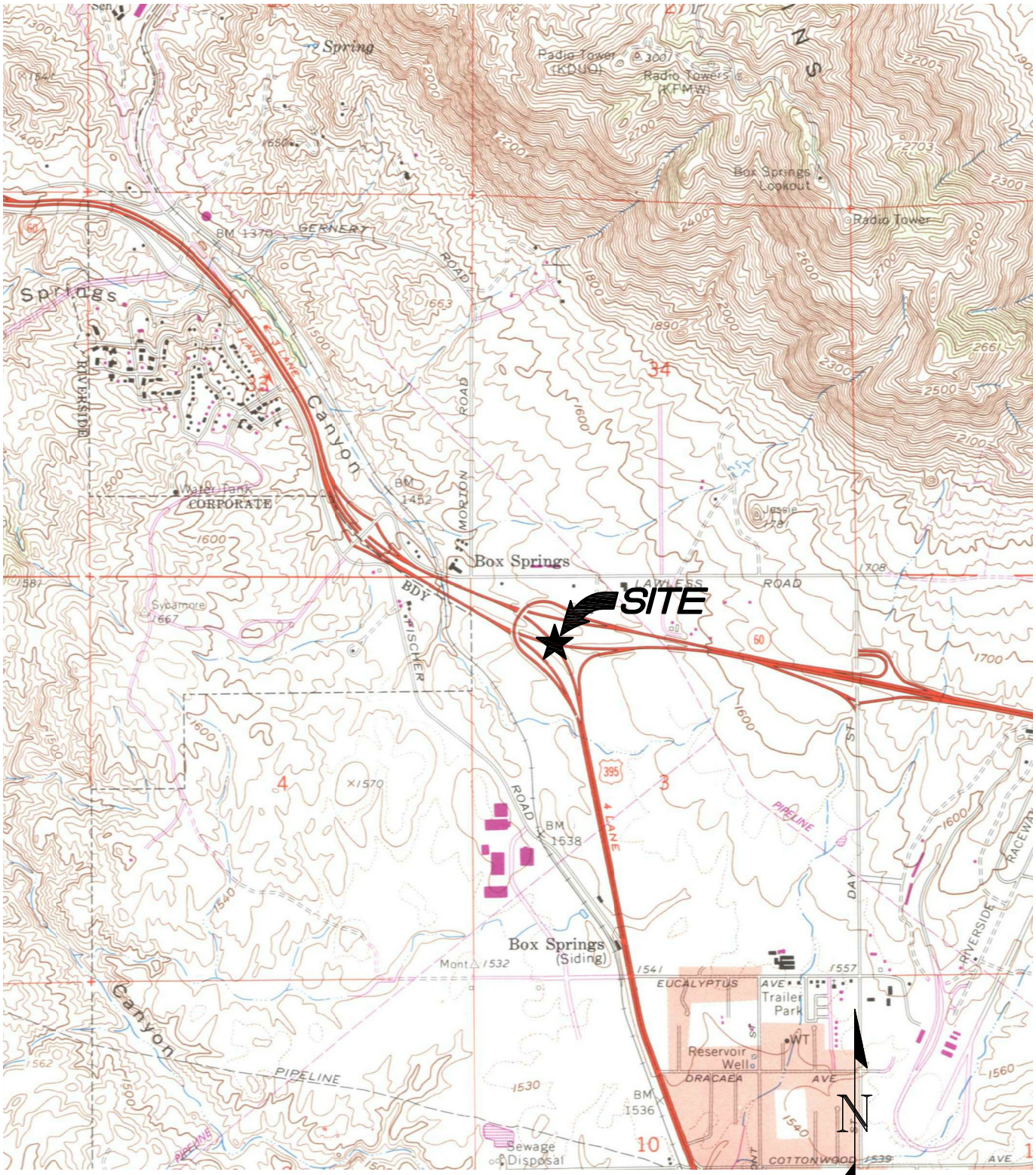
PLATES



SOURCE: U.S.G.S. 7.5' topographic series, Riverside East, California quadrangle dated 1967, photorevised 1980.

2,000 1,000 0 2,000

APPROXIMATE SCALE (feet)

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CAD FILE: L:\2009\CADD\76979\I-215_SR60\052209_Retain-D-Wall_Bridge-56-0507R\ LAYOUT: 1 PLOTTED: 11 Jun 2009, 6:49pm, dfahrney

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DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME: 76979p1.dwg	

SITE LOCATION MAP

RETAINING WALLS RW-19 AND RW-20
ROUTE 60/215 SEPARATION (BRIDGE NO. 56-0507R)
I-215 / SR-60 EAST JUNCTION PROJECT
RIVERSIDE COUNTY, CALIFORNIA

PLATE

1

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

REGISTERED CIVIL ENGINEER

DATE APPROVED

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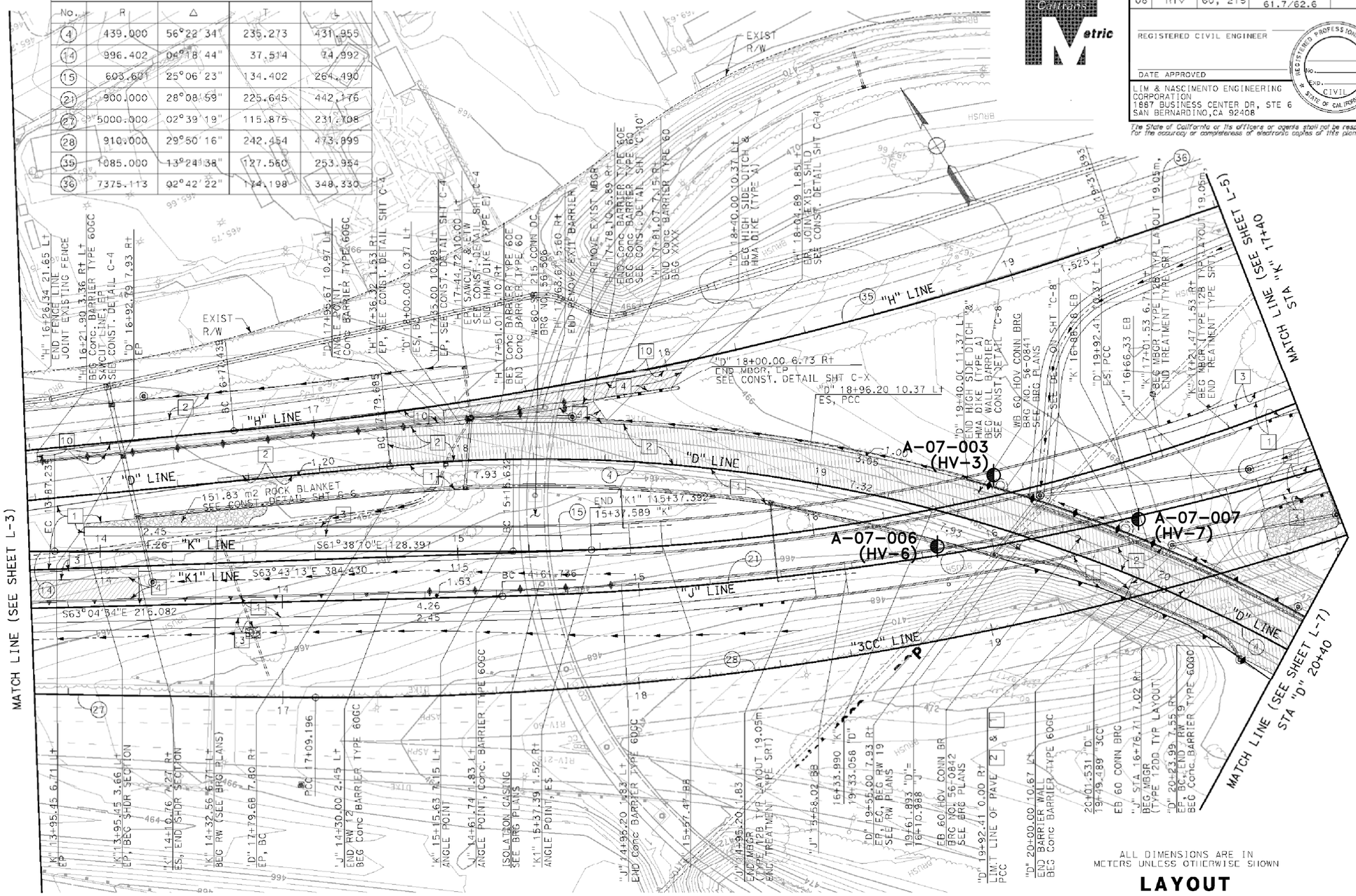
CURVE DATA

No.	R	Δ	T	L
4	439.000	56°22'34"	235.273	431.955
14	996.402	04°18'44"	37.514	74.992
15	603.601	25°06'23"	134.402	264.490
21	900.000	28°08'59"	225.645	442.176
27	5000.000	02°39'19"	115.875	231.708
28	910.000	29°50'16"	242.454	473.999
35	1085.000	13°24'38"	127.560	253.954
36	7375.113	02°42'22"	174.198	348.330



LAYOUT

SCALE: 1:500

L-4

EXPLANATION

A-07-007 (HV-7) — APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

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EXPLORATION LOCATION MAP

RETAINING WALLS RW-19 AND RW-20
ROUTE 60/215 SEPARATION (BRIDGE NO. 56-0507R)
I-215 / SR-60 EAST JUNCTION PROJECT
RIVERSIDE COUNTY, CALIFORNIA

PLATE **2a**

ATTACHED IMAGES: Images: For plate 2b.tif
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DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\052209_Retain-D-Wall_Bridge-56-0507R\ LAYOUT: 2aPLOTTED: 11 Jun 2009, 6:50pm, dfahrney

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

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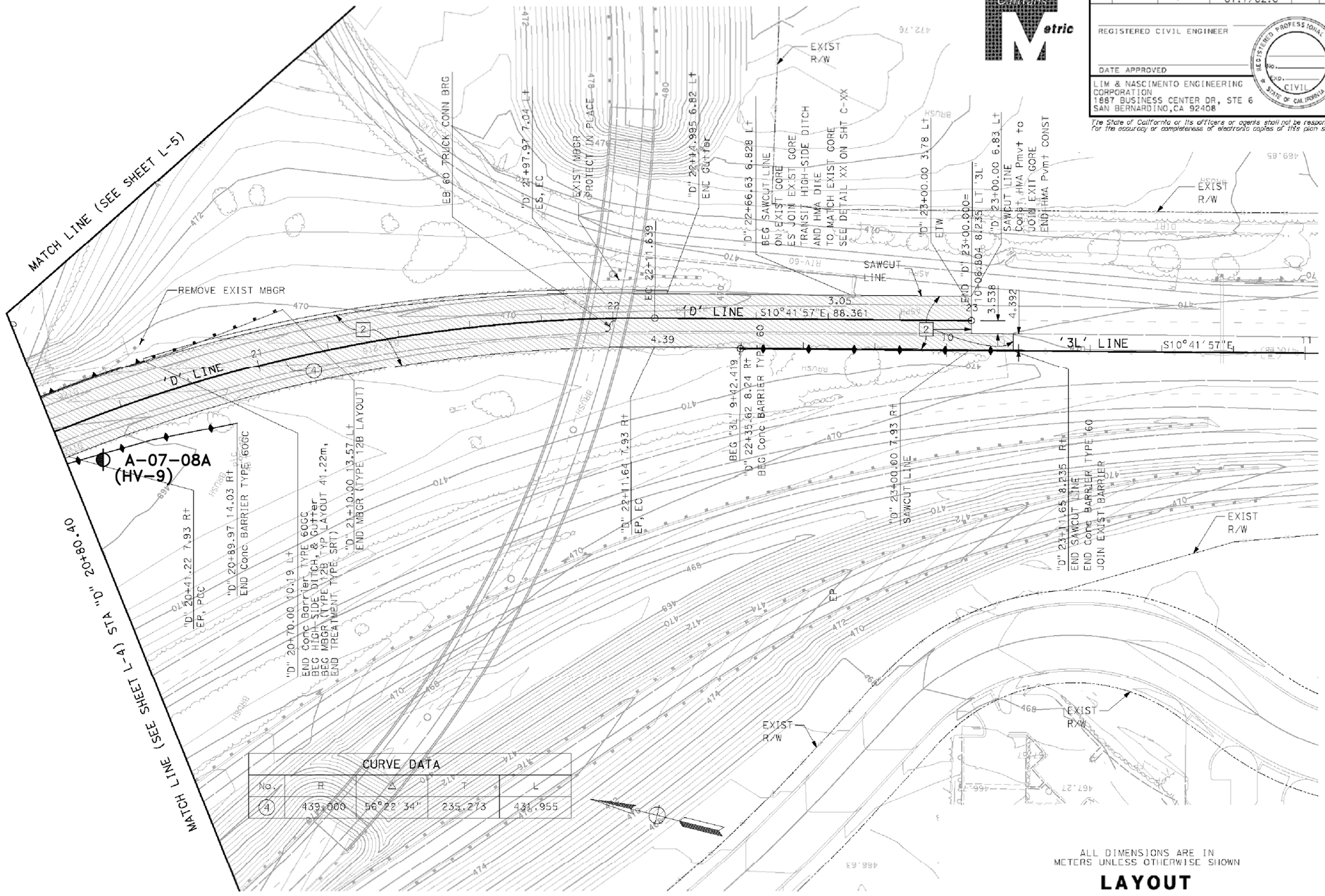

CURVE DATA				
No.	R	Δ	T	L
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ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

LAYOUT

SCALE: 1:500

L-7

EXPLANATION

A-07-08A (HV-9) — APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

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EXPLORATION LOCATION MAP

RETAINING WALLS RW-19 AND RW-20
ROUTE 60/215 SEPARATION (BRIDGE NO. 56-0507R)
I-215 / SR-60 EAST JUNCTION PROJECT
RIVERSIDE COUNTY, CALIFORNIA

PLATE **2b**

ATTACHED IMAGES: Images: For Plate 2d.tif
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CAD FILE: L:\2009\CADD\76979\I-215_SR60\052209_Retain-D-Wall_Bridge-56-0507R\ LAYOUT: 2bPLOTTED: 11 Jun 2009, 6:50pm, dfahrney

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

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SAN BERNARDINO, CALIFORNIA 92408

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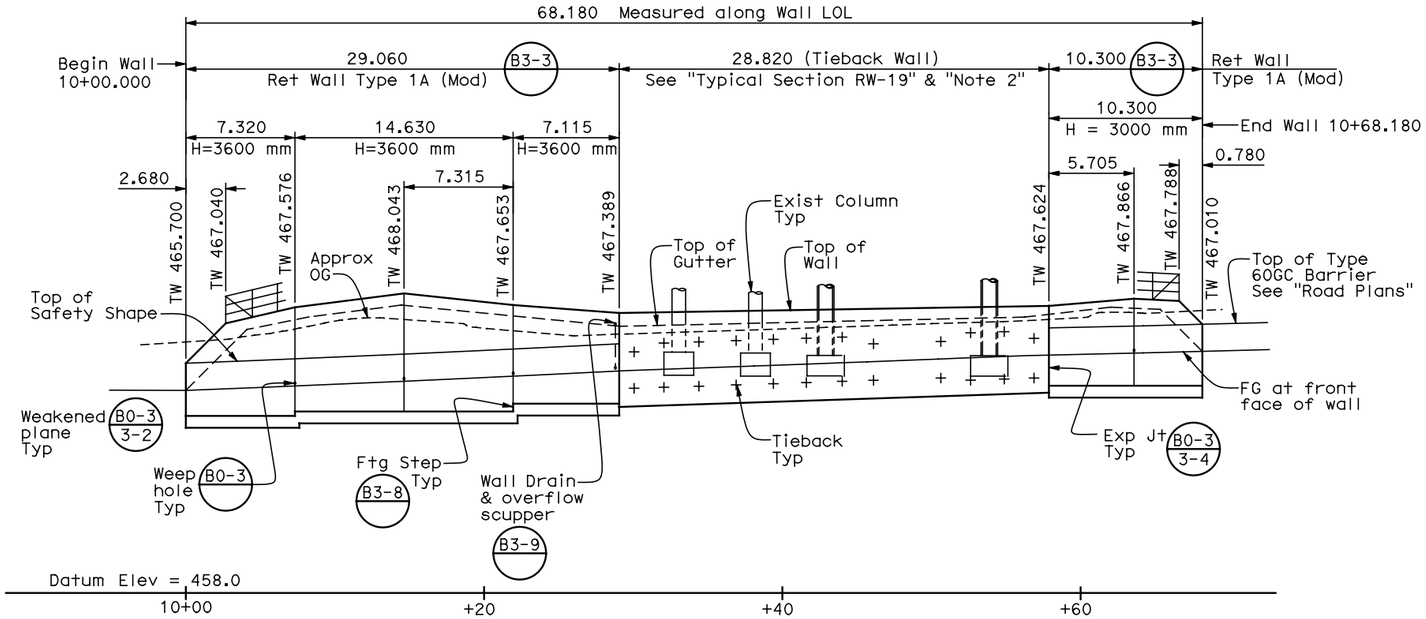
0 - 1.5



DEVELOPED MIRROR ELEVATION

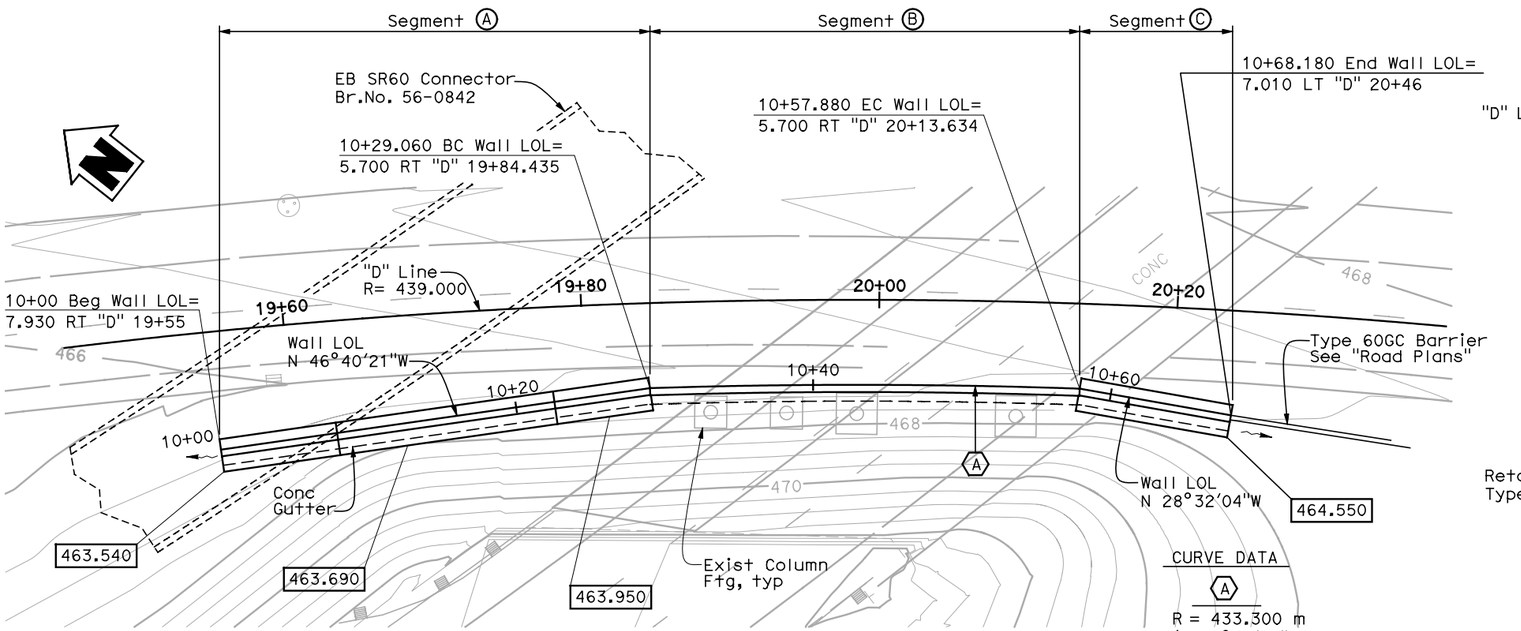
Horiz: 1:200
Vert: 1:100

Notes:

1. For RW-19 wall reinforcement, see "Wall Details No. 1" sheet.
2. For RW-19 details, see "Wall Details No. 1" sheet.
3. For Type 1A wall modification, see "Wall Details No. 2" sheet.
4. For limits of existing slope paving, see "Excavation and Backfill Pay Limits" on "Index To Plans" sheet.

LEGEND

Bottom of footing elevation (m)



CURVE DATA

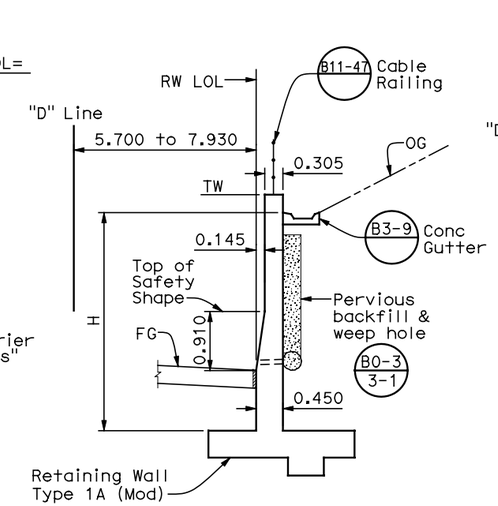
A

R = 433.300 m
Δ = 3°48'39"
T = 14.415 m
L = 28.820 m

PLAN

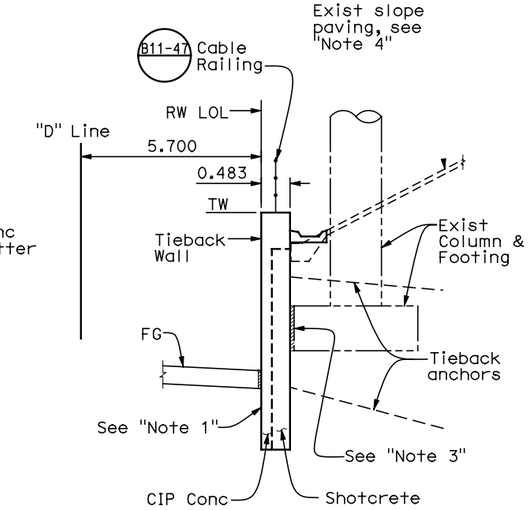
1:200

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.



TYPICAL SECTION B3-3

No Scale
(Station 10+00 to 10+29.060 & Sta 10+57.880 to 10+68.180)
Segements A & C



TYPICAL SECTION RW-19

No Scale
(Station 10+29.060 to 10+57.880)
Segement B

Note: This plan accurate for Retaining Wall work only.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. KIM	CHECKED R. PRICE	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: HL-93 AND PERMIT DESIGN VEHICLE
	DETAILS	BY R. ANDRASEK	CHECKED M. CHAR	LAYOUT BY R. ANDRASEK	CHECKED M. CHAR
SIGN OFF DATE	QUANTITIES	BY D. KIM	CHECKED A. SIVATHASAN	SPECIFICATIONS BY M. CHAR	PLANS AND SPECS COMPARED M. CHAR

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO.
KILOMETER POST

RETAINING WALL NO. RW-19 & RW-20

GENERAL PLAN RW-19

DESIGN GENERAL PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 9/26/08 4/27/09 6/15/09

SHEET 1 OF 15

FILE => u:\BRIDGE\RCTC0601-EAST J2\95% Ret Walls\56-0507r-a-gp01.dgn

USERNAME => LAN DATE PLOTTED => 6/17/2009 TIME PLOTTED => 5:10:16 PM

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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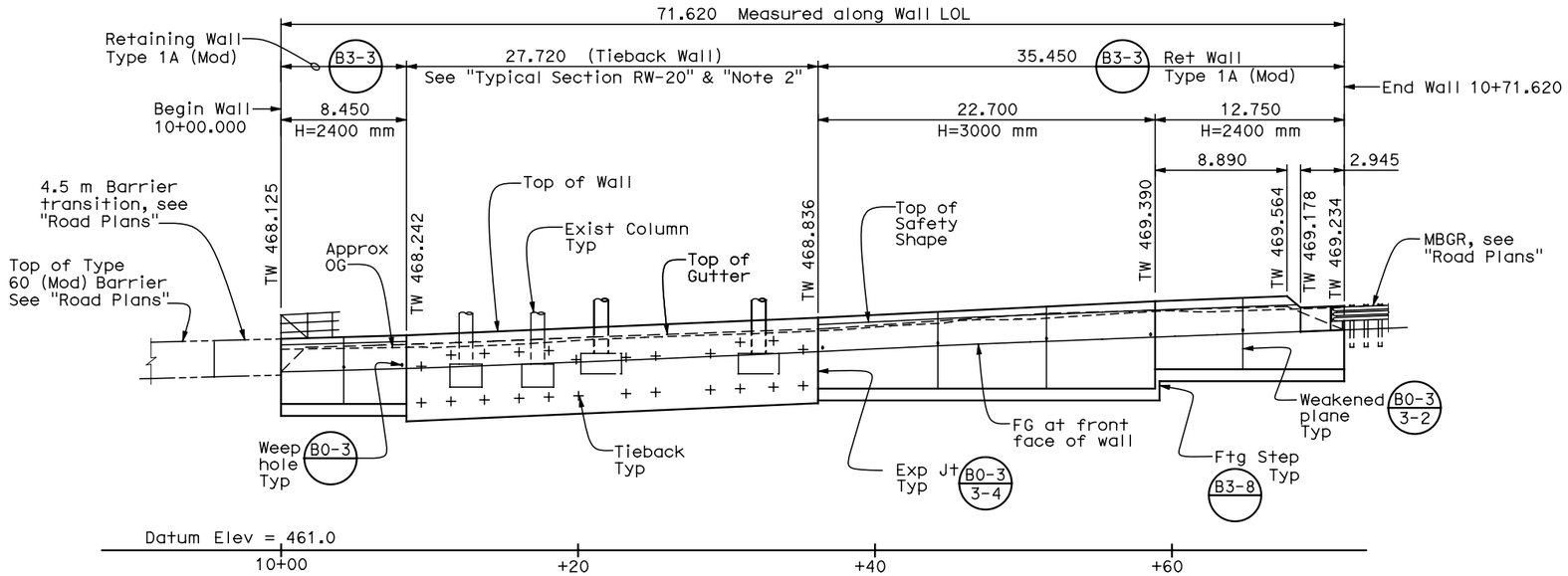
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

Caltrans Metric

PLATE 3b



DEVELOPED MIRROR ELEVATION

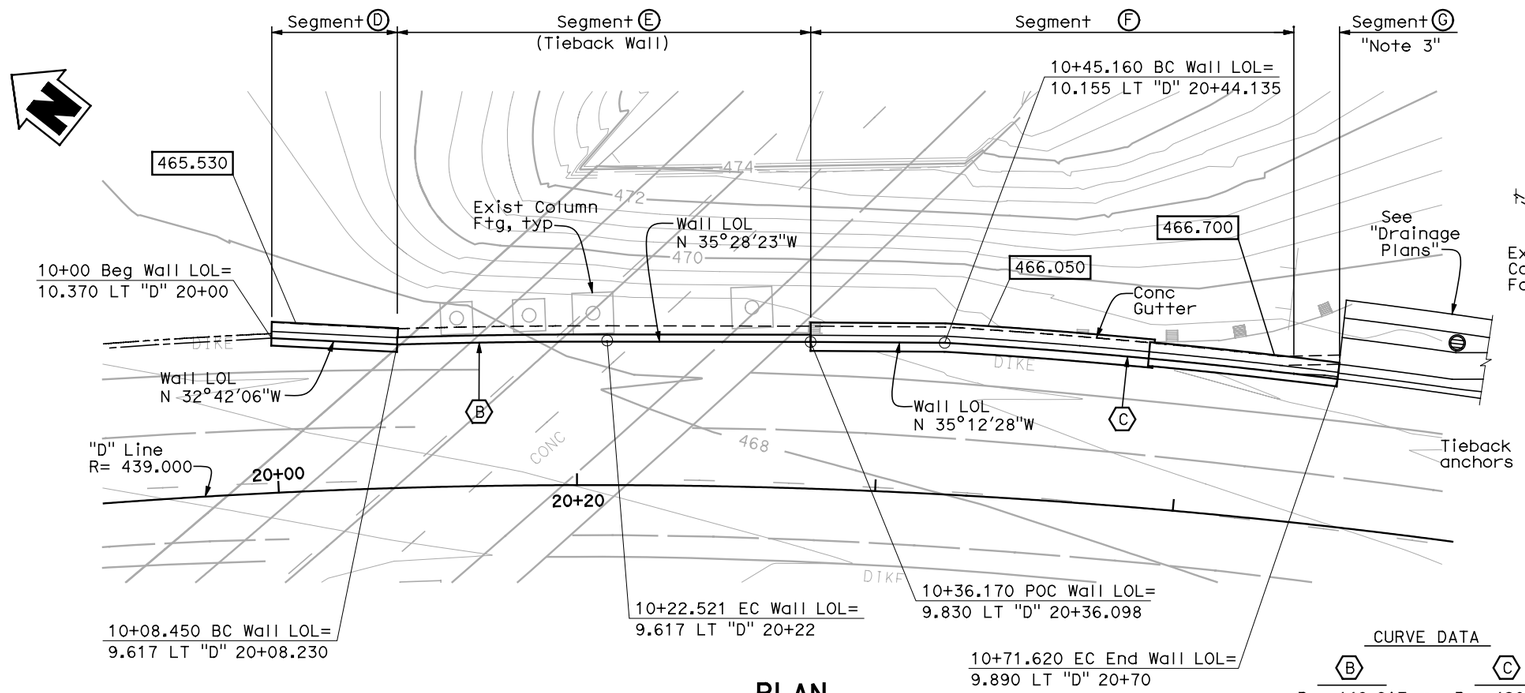
Horiz: 1:200
Vert: 1:100

Notes:

1. For RW-20 wall reinforcement, see "Wall Details No. 1" sheet.
2. For RW-20 details, see "Wall Details No. 1" sheet.
3. For RW-20 Segment (G), see "Wall Details No. 2" sheet.
4. For Type 1A wall modification, see "Wall Details No. 2" sheet.

LEGEND

Bottom of footing elevation (m)

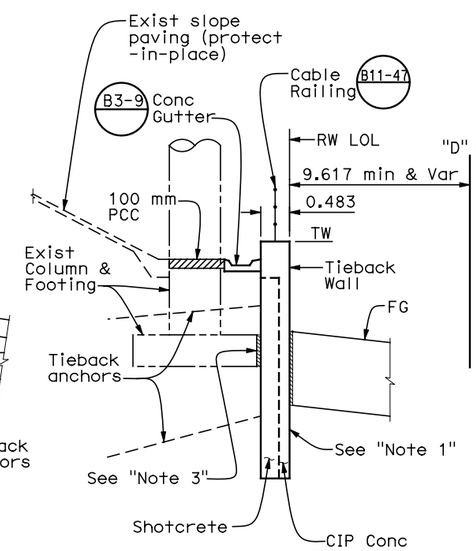


PLAN

1:200

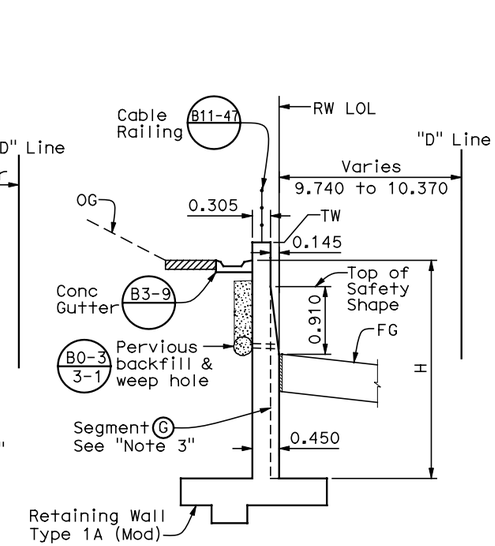
Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

Note: This plan accurate for Retaining Wall work only.



TYPICAL SECTION RW-20

No Scale
(Station 10+08.450 to 10+36.170)
Segment (E)



TYPICAL SECTION B3-3

No Scale
(Station 10+00 to 10+08.450 & Sta 10+36.170 to 10+71.620)
Segments (D) & (F)

CURVE DATA

(B)	(C)
R = 448.617 m	R = 420.370 m
Δ = 1°47'50"	Δ = 3°36'23"
T = 7.036 m	T = 13.233 m
L = 14.071 m	L = 26.460 m

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. KIM	CHECKED R. PRICE	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: HL-93 AND PERMIT DESIGN VEHICLE
SIGN OFF DATE	DETAILS	BY R. ANDRASEK	CHECKED M. CHAR	LAYOUT BY R. ANDRASEK	CHECKED M. CHAR
	QUANTITIES	BY D. KIM	CHECKED A. SIVATHASAN	SPECIFICATIONS BY M. CHAR	PLANS AND SPECS COMPARED M. CHAR

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO.
KILOMETER POST

RETAINING WALL NO. RW-19 & RW-20

GENERAL PLAN RW-20

DESIGN GENERAL PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 9/28/08 4/21/09 6/15/09

SHEET 2 OF 15

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

PLATE 3b

Caltrans Metric

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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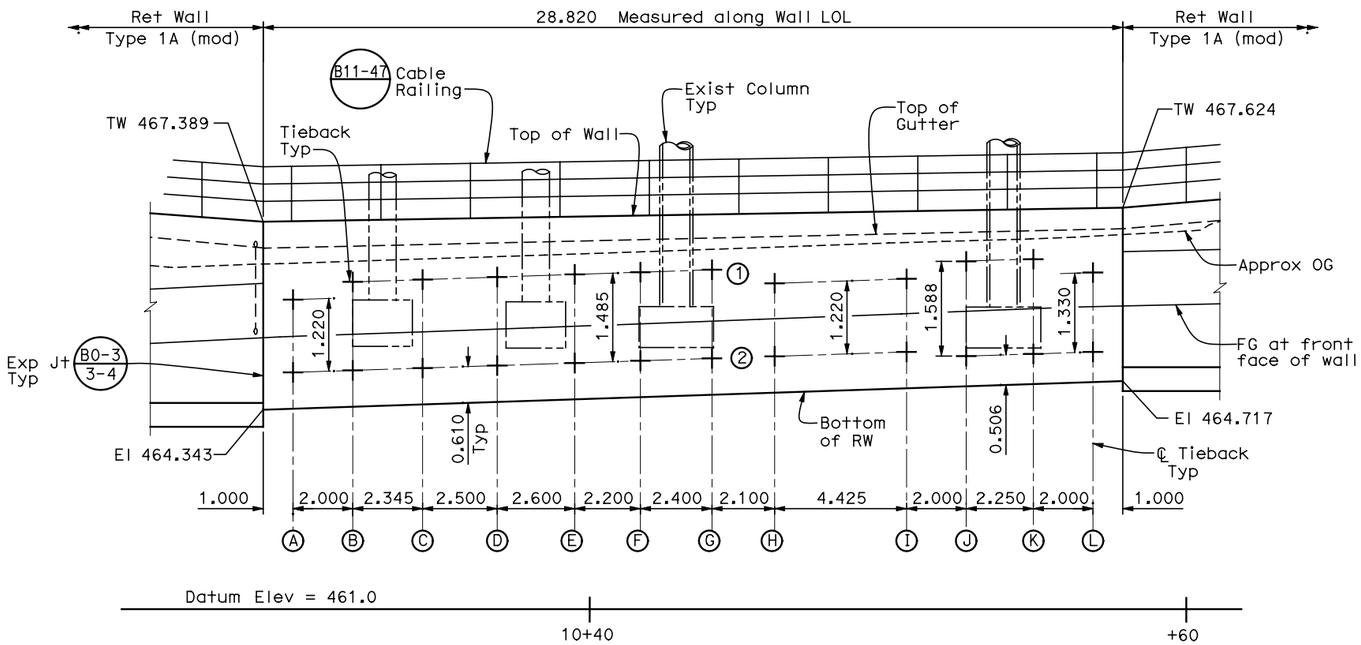
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



DEVELOPED ELEVATION

Horiz: 1:100
Vert: 1:50

Notes:

1. For wall section, see "Wall Details No. 1" sheet.
2. For wall drainage, see "Drainage Details" sheet.

LEGEND

1 Location ID

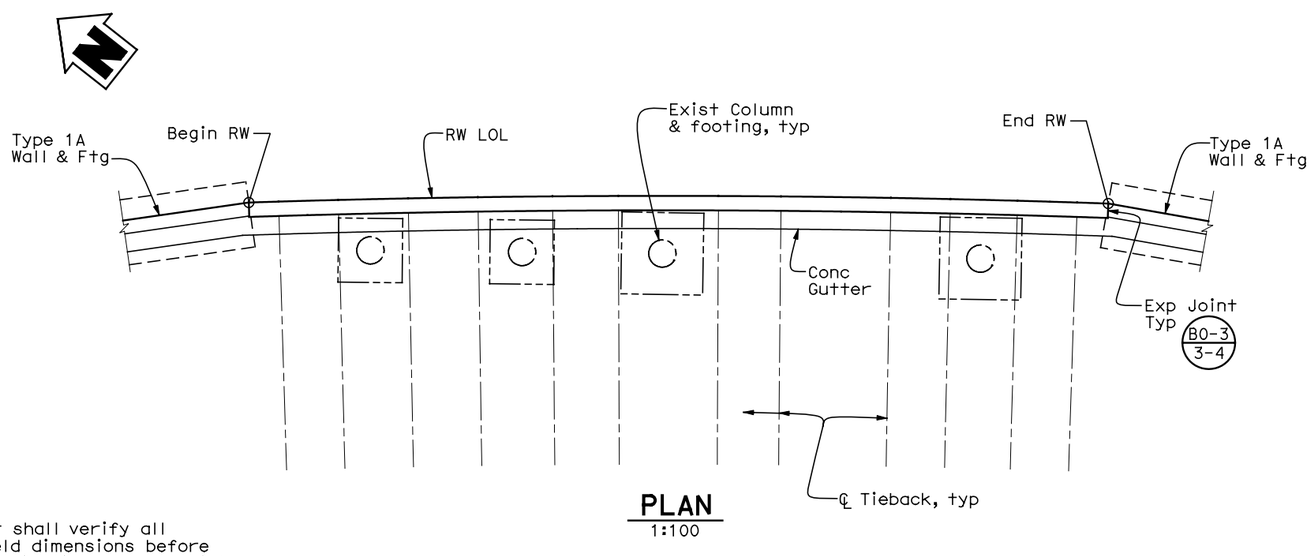
A Tieback Column ID

TIEBACK TENDON FORCE TABLE												
T(kN)												
Location	A	B	C	D	E	F	G	H	I	J	K	L
1	250	250	275	300	275	300	300	200	200	275	275	300
2	275	300	300	350	325	350	350	225	200	325	325	325

TIEBACK ANCHOR BONDED LENGTH (MINIMUM)												
(M)												
Location	A	B	C	D	E	F	G	H	I	J	K	L
1	5.0	5.0	5.5	6.0	5.5	6.0	6.0	4.0	4.0	5.5	5.5	6.0
2	5.5	6.0	6.0	7.0	6.5	7.0	7.0	4.5	4.0	6.5	6.5	6.5

Bonding Note:
Bonded lengths shown are for information only. The bonded length shall be determined by field test by the Contractor.

TIEBACK ANCHOR ANGLE (TO HORIZONTAL LINE)												
(Degree)												
Location	A	B	C	D	E	F	G	H	I	J	K	L
1	15	5	5	5	5	5	5	15	15	7	7	15



PLAN

1:100

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF

SIGN OFF DATE

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/05)

	BY	CHECKED
DESIGN	D. KIM	R. PRICE
DETAILS	R. ANDRASEK	M. CHAR
QUANTITIES	D. KIM	A. SIVATHASAN

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

CU 08
EA 449311

BRIDGE NO.

KILOMETER POST

RETAINING WALL NO. RW-19 & RW-20

TIEBACK WALL LAYOUT RW-19

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 4/21/09 6/15/09

SHEET 4 OF 15

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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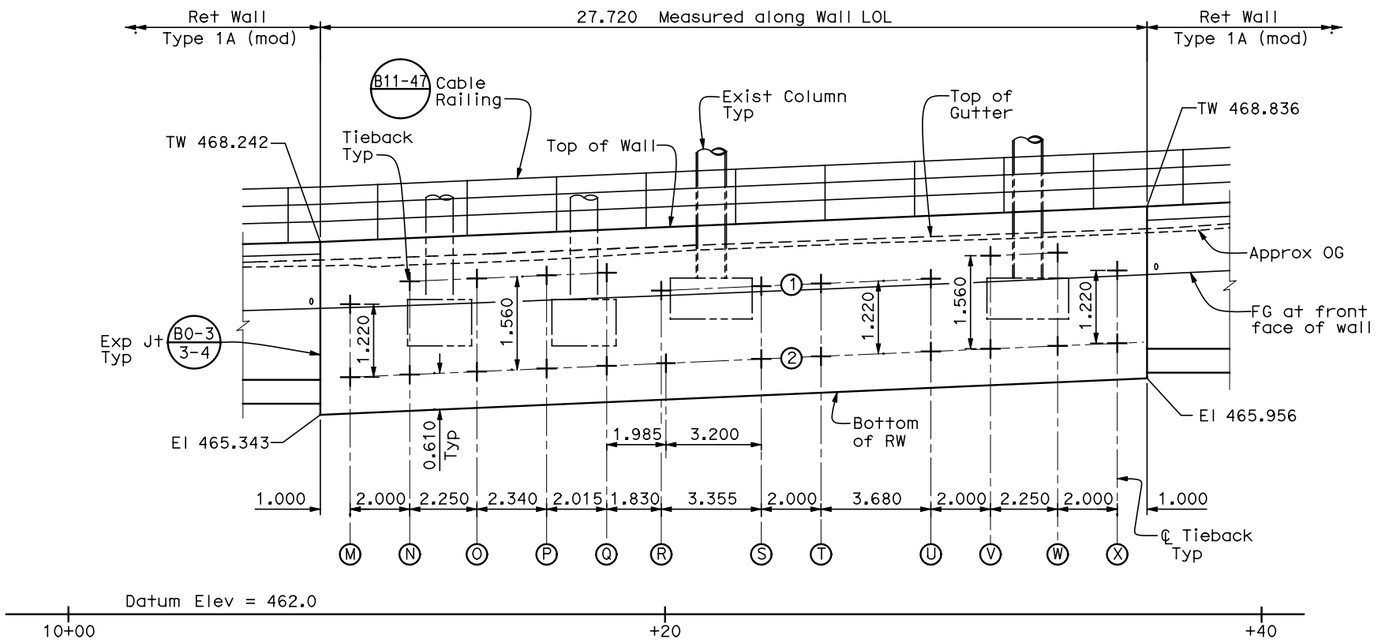
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

PLATE 3c

Caltrans Metric



DEVELOPED ELEVATION

Horiz: 1:100
Vert: 1:50

Notes:

1. For wall section, see "Wall Details No. 1" sheet.
2. For wall drainage, see "Drainage Details" sheet.

LEGEND

(1) Location ID

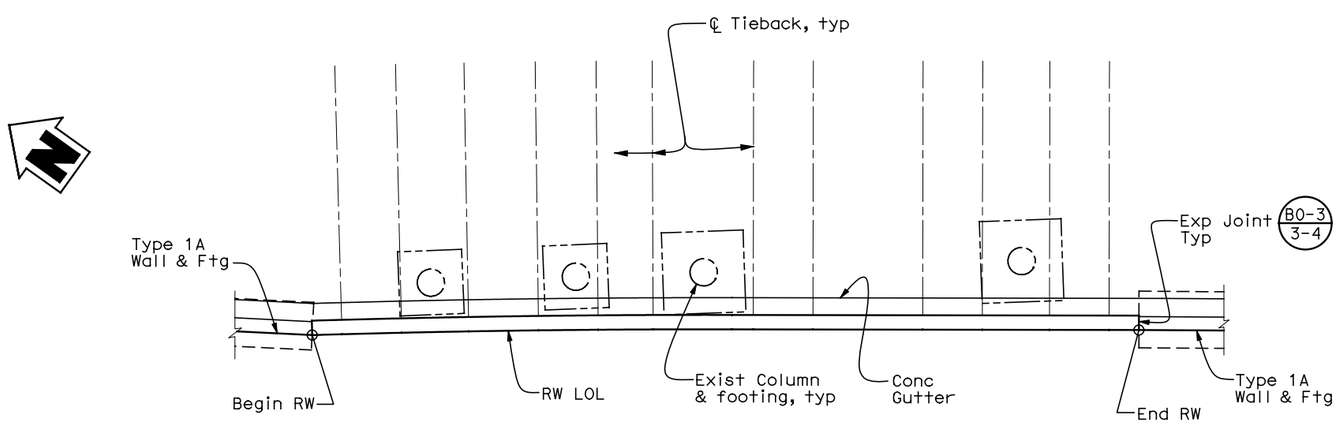
(A) Tieback Column ID

TIEBACK TENDON FORCE TABLE												
T(kN)												
Location	M	N	O	P	Q	R	S	T	U	V	W	X
1	225	275	275	250	225	400	400	200	175	275	275	275
2	275	325	325	300	275	350	350	175	200	350	350	350

TIEBACK ANCHOR BONDED LENGTH (MINIMUM)												
(M)												
Location	M	N	O	P	Q	R	S	T	U	V	W	X
1	8.0	5.0	5.0	5.0	4.5	8.0	8.0	4.0	4.0	6.5	6.5	6.5
2	5.5	6.0	6.0	6.0	5.5	7.0	7.0	3.5	3.5	6.0	6.0	6.0

Bonding Note:
Bonded lengths shown are for information only. The bonded length shall be determined by field test by the Contractor.

TIEBACK ANGLE TO HORIZONTAL LINE												
(Degree)												
Location	M	N	O	P	Q	R	S	T	U	V	W	X
1	15	5	5	7	7	15	15	15	15	5	5	15



PLAN

1:100

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. KIM	CHECKED R. PRICE
SIGN OFF DATE	DETAILS	BY R. ANDRASEK	CHECKED M. CHAR
	QUANTITIES	BY D. KIM	CHECKED A. SIVATHASAN

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO.
KILOMETER POST

RETAINING WALL NO. RW-19 & RW-20

TIEBACK WALL LAYOUT RW-20

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 4/21/09 6/15/09

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 5 OF 15

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

PLATE 3d

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

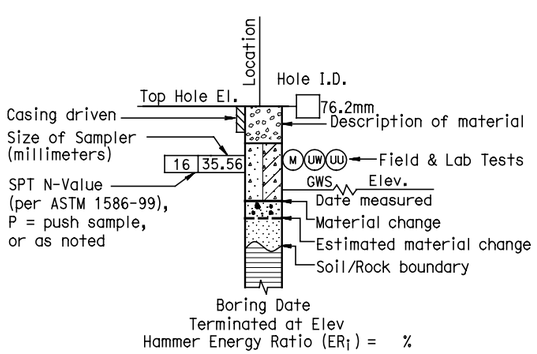
BOREHOLE IDENTIFICATION

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 (25.4mm soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

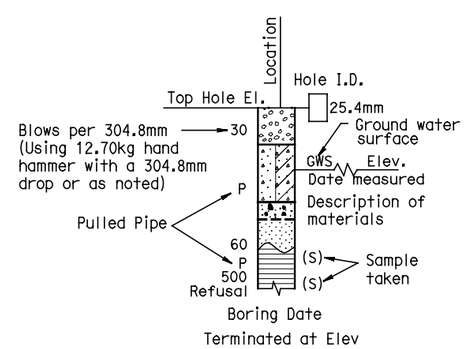
Note: Size in millimeters.

PLASTICITY OF FINE-GRAINED SOILS

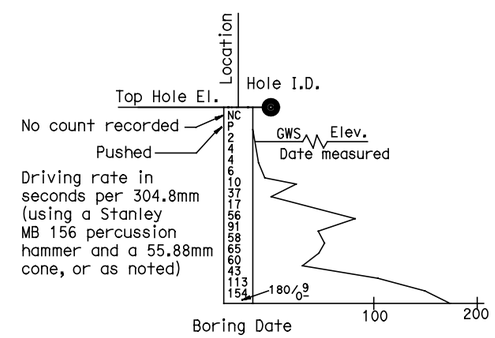
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



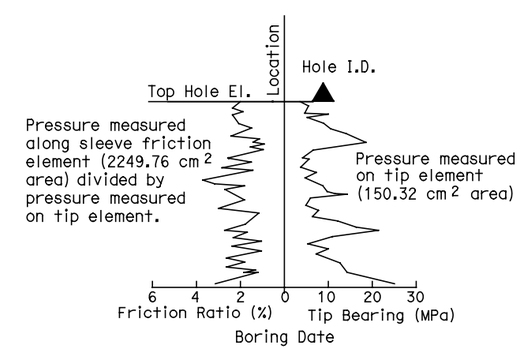
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY	C. AMANTE	C. AMANTE, PROJECT ENGINEER

BRIDGE NO. / KILOMETER POST

RETAINING WALL NO. RW-19 & RW-20

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 6/12/09

REVISION DATES

SHEET 10 OF 15

FILE => u:\bridge\rctc0601-east j2\95% ret walls\56-0507r-z-ltb01.dgn

USERNAME => LAN DATE PLOTTED => 6/16/2009 TIME PLOTTED => 1:52:58 PM

PLATE 4a

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO.

KILOMETER POST

RETAINING WALL NO. RW-19 & RW-20

SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 6/12/09

REVISION DATES

SHEET 11 OF 15

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLATE 4b

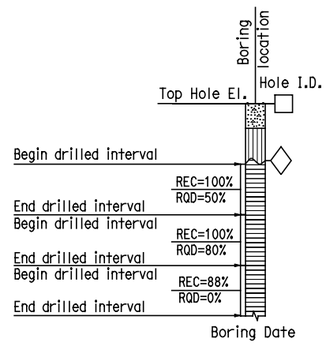
Caltrans Metric

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

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO.

KILOMETER POST

RETAINING WALL NO. RW-19 & RW-20
ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 6/12/09

REVISION DATES

SHEET 12 OF 15

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
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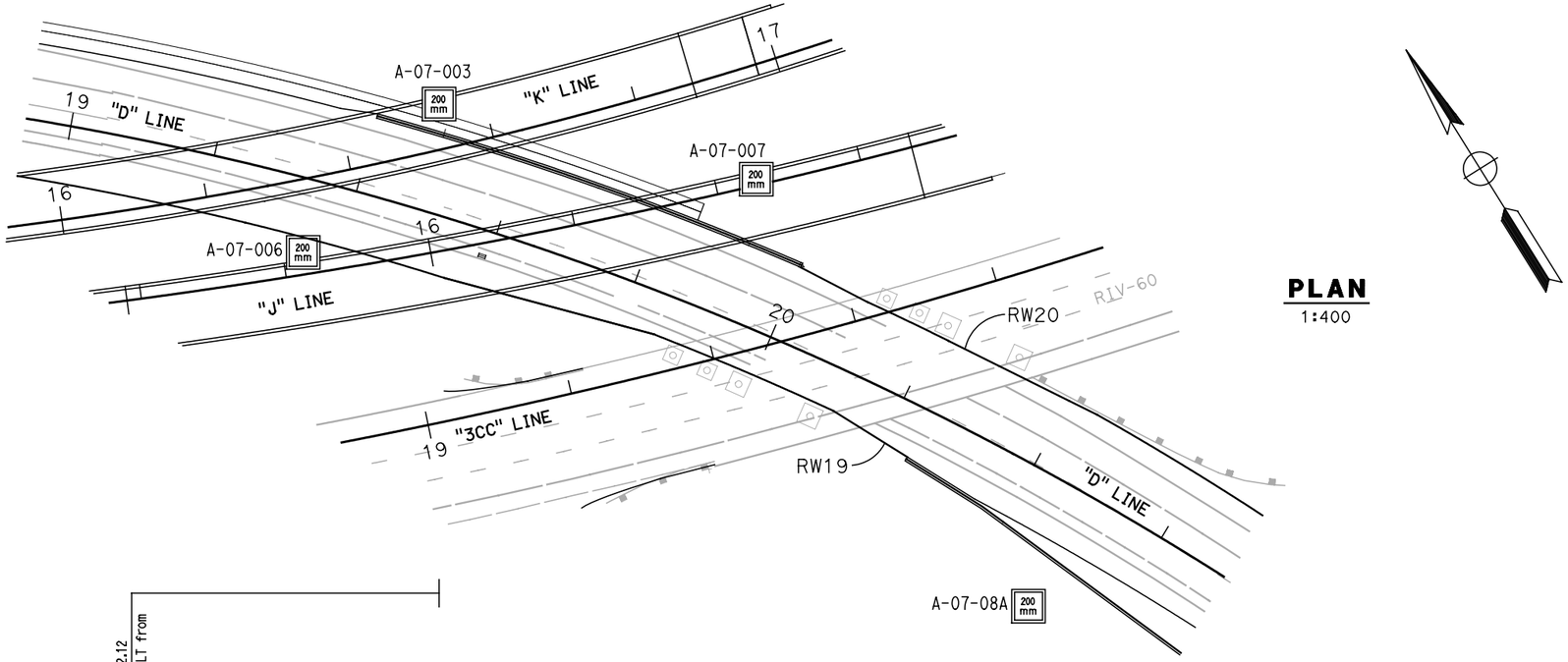
REDLANDS, CALIFORNIA 92374



PLAN
1:400

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

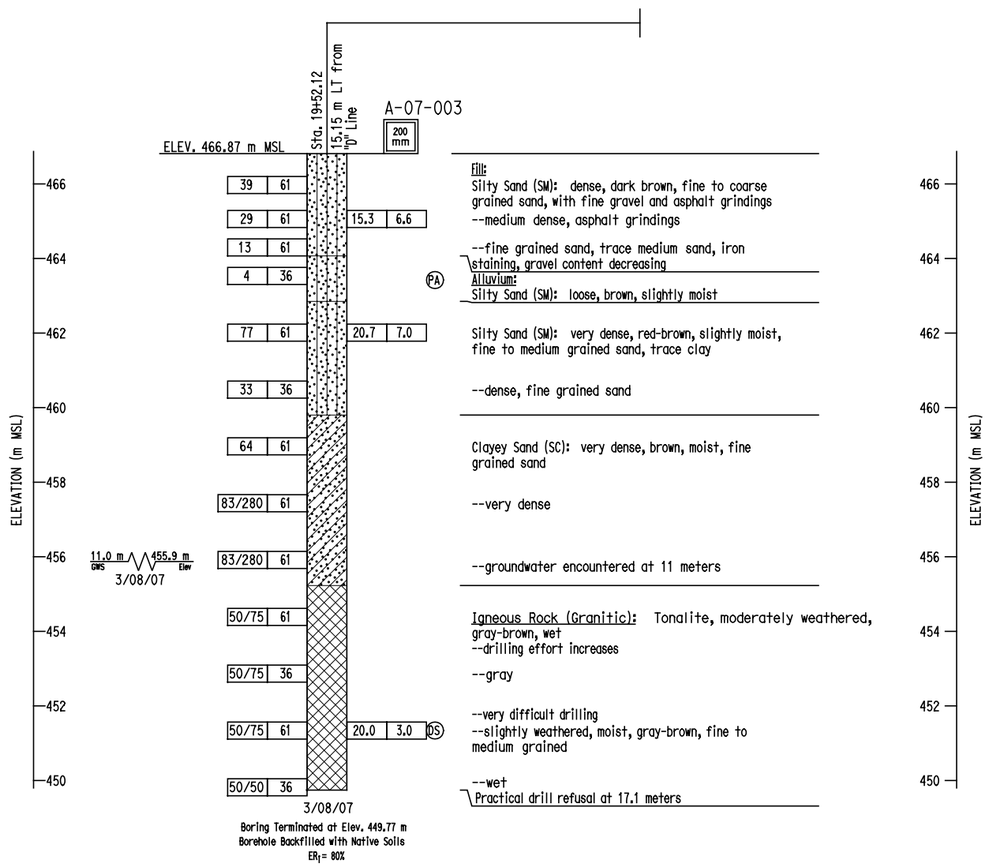
NOTES:

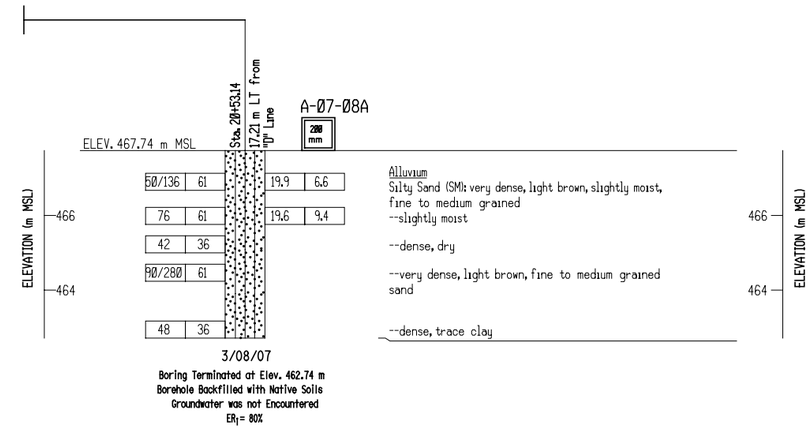
1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).





PROFILE
VERTICAL SCALE 1:2

PLATE 4c

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY	C. AMANTE	C. AMANTE, PROJECT ENGINEER

BRIDGE NO. / KILOMETER POST

RETAINING WALL NO. RW-19 & RW-20
LOG OF TEST BORINGS 1 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 6/12/09

REVISION DATES

SHEET 13 OF 15

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08	Riv	215/60			

Caltrans Metric

Carlos V. Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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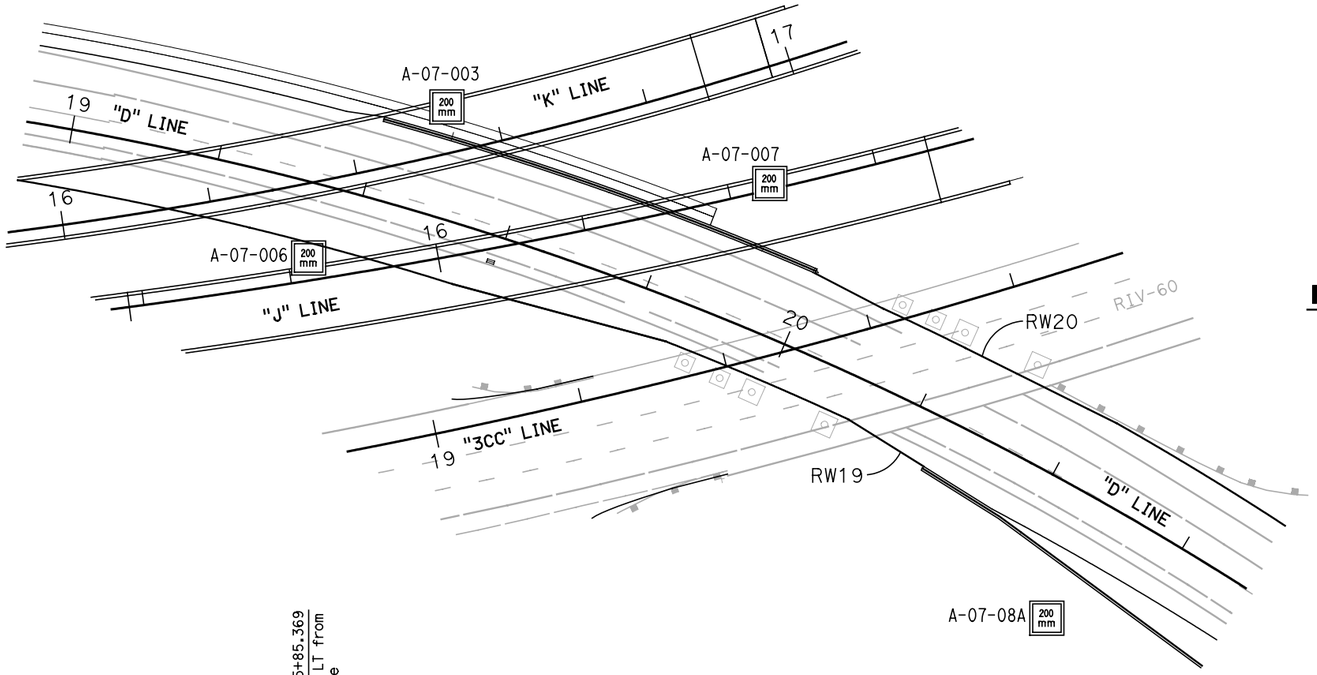
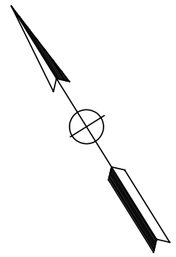


PLAN
1:400



BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.
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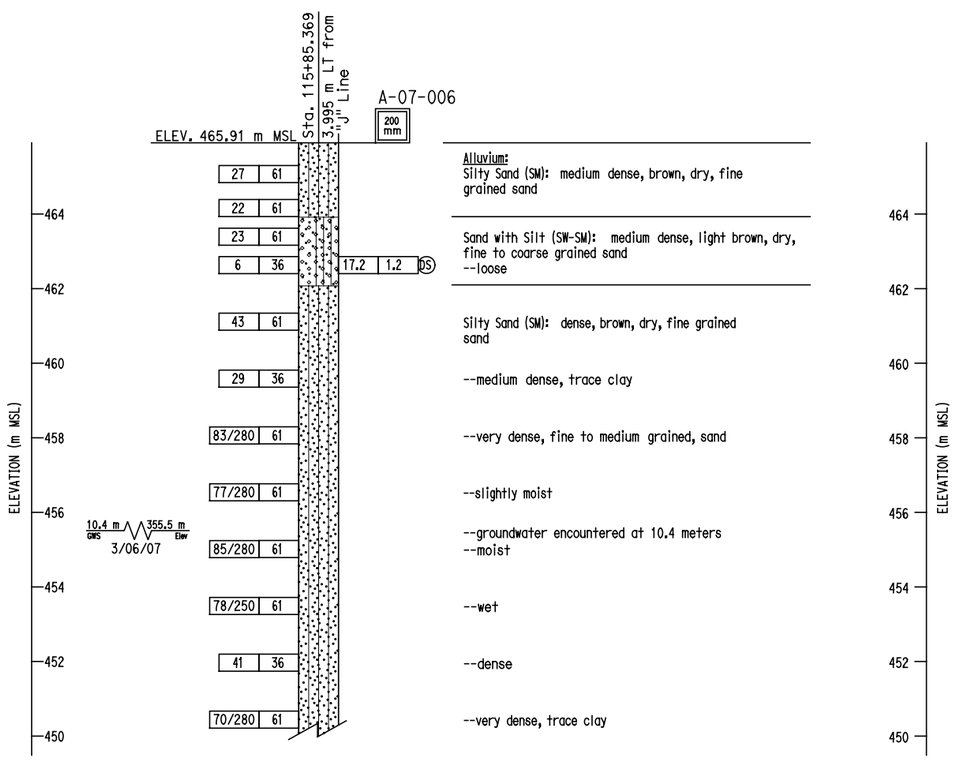

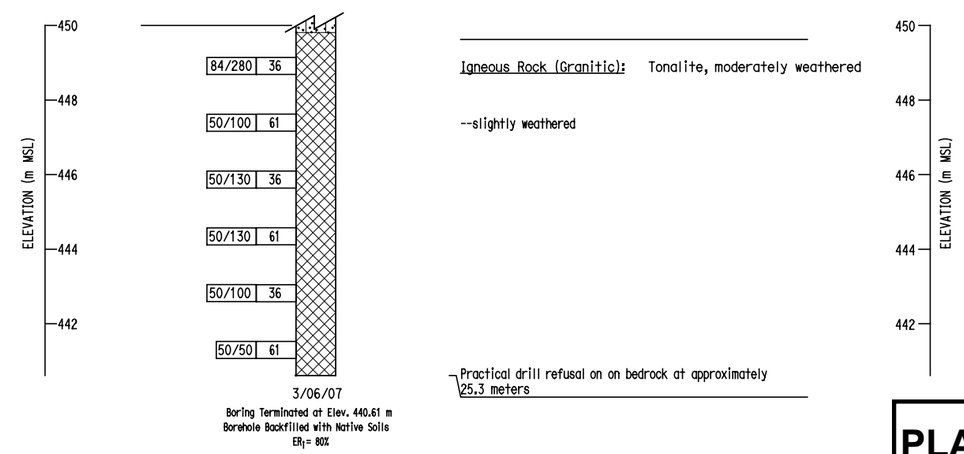

PROFILE
VERTICAL SCALE 1:2

PLATE 4d

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO.

KILOMETER POST

RETAINING WALL NO. RW-19 & RW-20

LOG OF TEST BORINGS 2 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 6/12/09

SHEET 14 OF 15

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED GEOTECHNICAL ENGINEER

PLANS APPROVAL DATE

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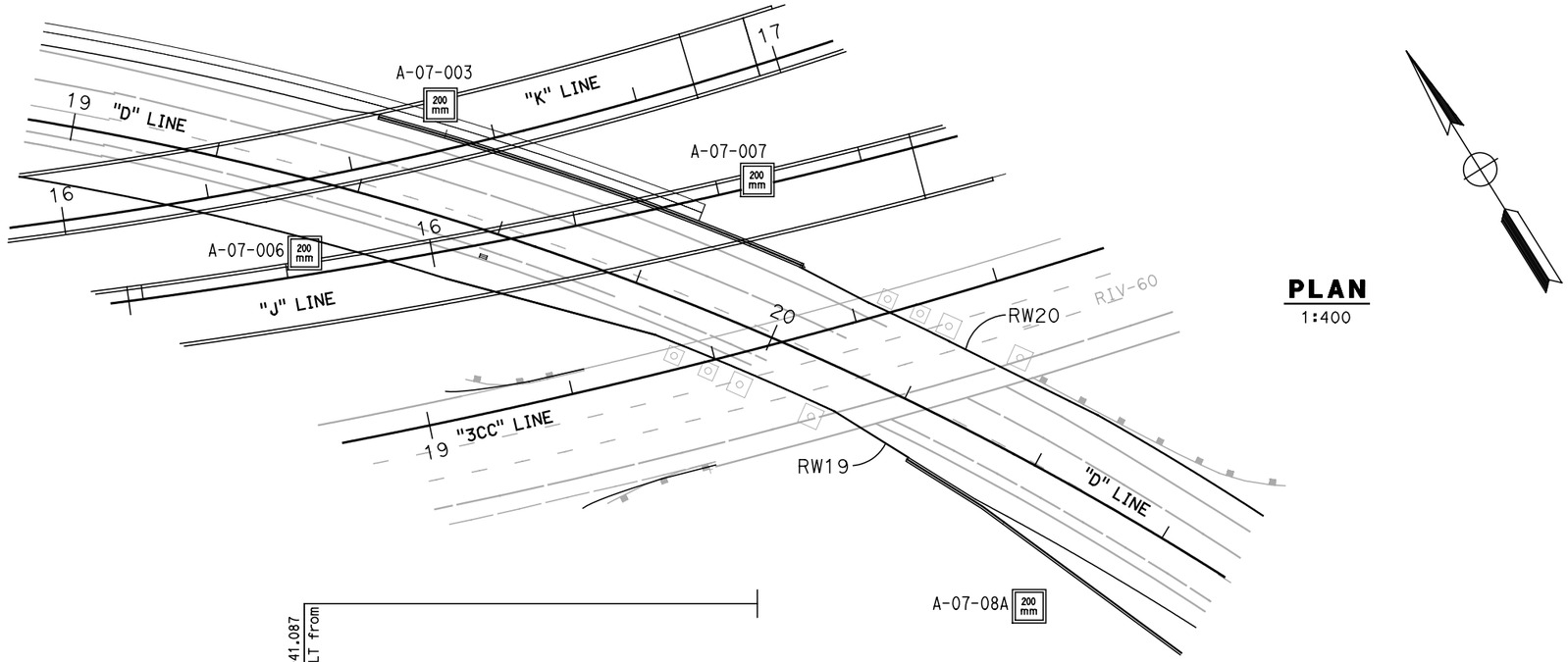

PLAN
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BENCH MARK:

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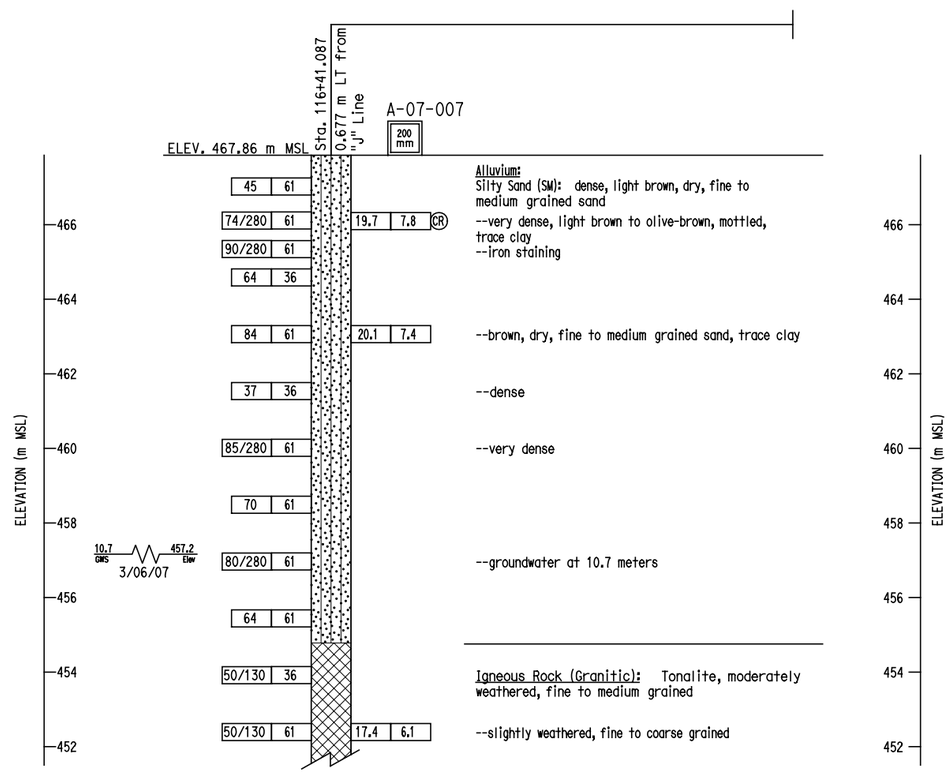

PROFILE
VERTICAL SCALE 1:2

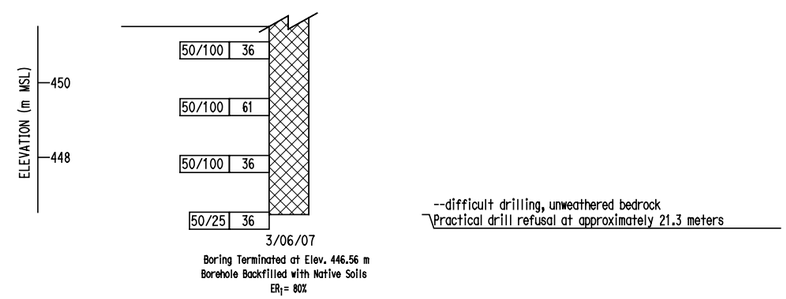

PLATE 4f

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY	C. AMANTE	C. AMANTE PROJECT ENGINEER

BRIDGE NO. / KILOMETER POST

RETAINING WALL NO. RW-19 & RW-20
LOG OF TEST BORINGS 3 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 6/12/09

REVISION DATES | SHEET 15 OF 15

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CALTRANS BRIDGE DESIGN ARS CURVE

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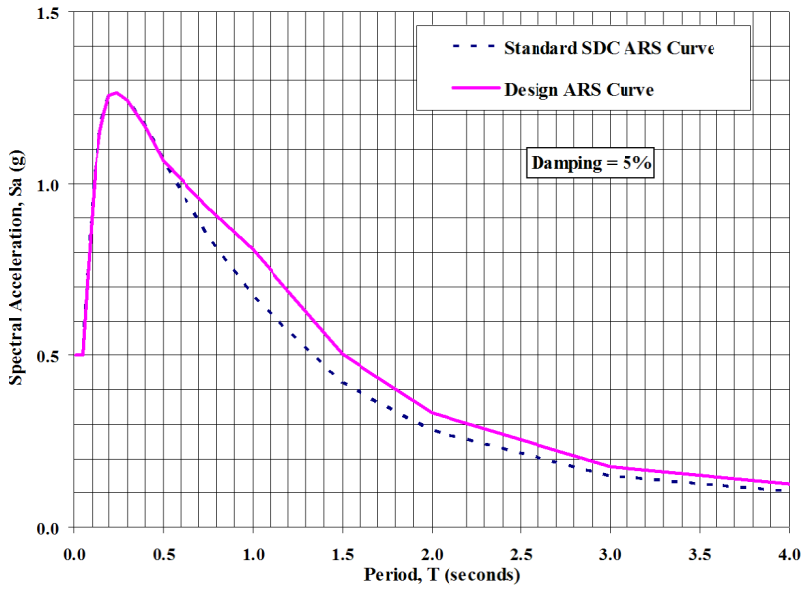
(Licensed to: Kleinfelder West, Inc. - Redlands, California)

PROJECT INFORMATION	
Project Name	Retaining Walls, Rt 60/215 Sep Br, East Jn
Project No.	76979
Location	Riverside County, California

INPUT PARAMETERS	
Controlling Fault Name	San Jacinto (SJO)
Fault Type	Strike-slip (SS)
MCE Moment Magnitude	7.50
Distance to Fault	8.80 kilometers
Peak Bedrock Acceleration Based on 1996 California Seismic Hazard Map	0.5 g
Soil Profile Type	C

COMPUTED RESULTS	
Peak Bedrock Acceleration Based on Sadigh et al. (1997)[1]	0.46 g
Design Peak Bedrock Acceleration (g)	0.50 g



COMPUTED ARS CURVES

Period T (seconds)	Standard SDC ARS Curve[2] Sa (g)	Design ARS Curve[3] Sa (g)
0.010	0.500	0.500
0.020	0.500	0.500
0.030	0.500	0.500
0.050	0.500	0.500
0.075	0.719	0.719
0.100	0.919	0.919
0.120	1.037	1.037
0.150	1.155	1.155
0.170	1.207	1.207
0.200	1.256	1.256
0.240	1.264	1.264
0.300	1.244	1.244
0.400	1.168	1.168
0.500	1.067	1.067
0.750	0.847	0.932
1.000	0.674	0.808
1.500	0.419	0.503
2.000	0.278	0.334
3.000	0.147	0.177
4.000	0.104	0.125

Prepared By:_____ Date: _____
Reviewed By: _____ Date: _____

NOTES:

[1]Peak Bedrock Acceleration (PBA):
Estimated using attenuation relationship by Sadigh et al. (1997) for rock site.
Sadigh et al. (1997) recommended no increase for Strike-Slip Fault, 10% increase for Oblique Fault; and 20% increase for Reverse/Thrust Fault. If type of fault is unknown, a 10% increase is assumed.

[2]Standard Seismic Design Criteria (SDC) ARS Curve:
Used Caltrans standard SDC ARS curve for the given PBA, magnitude, and soil profile type.

[3]Design ARS Curve:
When the bridge is located within 15 km of the controlling fault, the standard SDC ARS curve was modified as follows to account for fault rupture directivity effect:
- For Periods < 0.5 sec, no increase in standard SDC spectral acceleration values.
- For Periods > 1.0 sec, the standard SDC spectral acceleration values were increased by 20%.
- For Periods between 0.5 sec and 1.0 sec, spectral acceleration values were linearly interpolated.

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PROJECT NO.	76979
DRAWN:	5/22/09
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p5.dwg

PRELIMINARY DESIGN ARS CURVE

RETAINING WALLS RW-19 AND RW-20
ROUTE 60/215 SEPARATION (BRIDGE NO. 56-0507R)
I-215 / SR-60 EAST JUNCTION PROJECT
RIVERSIDE COUNTY, CALIFORNIA

PLATE
5

ATTACHED IMAGES: Images: Plate6-ARS Curve_1.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\052209_Retain-D-Wall_Bridge-56-0507R\ LAYOUT: 5 PLOTTED: 11 Jun 2009, 6:51pm, dfahrney

APPENDIX A

FIELD EXPLORATION

APPENDIX A
FIELD EXPLORATION

The subsurface exploration program for the proposed retaining wall consisted of four borings HV-3, HV-6, HV-7, and HV-9 (LOTB Nos. A-07-003, A-07-006, A-07-007, and A-07-009), which were drilled during the period from March 6, 2007 to March 8, 2007. These borings were advanced to depths ranging from approximately 5.0 to 25.3 meters below the existing ground surface (bgs). The borings were advanced using a Mobile B-61, truck-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer delivery system. The borings were logged and sampled using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. In addition, representative bulk samples were collected from the borings. Following drilling, sampling and logging, the borings were backfilled with native cuttings.

The boring locations are shown on Plates 2a and 2b. The boring locations, stations and offsets, and elevations were obtained from survey data provided by LAN Engineering.

The boring logs are presented on Plates A2 through A5 at the end of this appendix. The logs describe the earth materials encountered during drilling, and indicate the locations of the samples obtained. The excavations were logged by a staff professional from Kleinfelder using methods outlined in the Unified Soil Classification System (USCS) and general procedures established in ASTM D2488. The boundaries between soil and rock type(s) shown on the logs are approximate because the transition between different soil and rock layer(s) may be gradual.

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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	ID	DESCRIPTION	MAJOR DIVISION		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Well-graded gravels, gravel-sand mixtures	FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands
		GP		Poorly-graded gravels, gravel-sand mixtures			CL		Inorganic clays of low to medium plasticity; gravelly clays silty clays,sandy clays, lean clays
		GM		Silty gravels, gravel-sand-silt mixtures			OL		Organic silts and organic silt-clays of low plasticity
		GC		Clayey gravels, gravel-sand-clay mixtures		SILTS AND CLAYS LL > 50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
	SAND AND SANDY SOILS	SW		Well-graded sands, gravelly sands			CH		Inorganic clays of medium to high plasticity
		SP		Poorly-graded sands and gravelly sands			OH		Organic clays of medium to high plasticity
		SM		Silty sands, sand-silt mixture		HIGHLY ORGANIC SOILS	Pt		Peat, muck and other highly organic soils
		SC		Clayey sands, sand-clay mixture					

▼ Approximate water level observed in boring following drilling

SOIL SAMPLE

- Bulk Sample
- Drive Sample - California Sample
- Shelby Tube Sample
- Standard Penetration Test (SPT) Sample

ADDITIONAL TESTS

CN	- Consolidation
COR	- Corrosion
CP	- Collapse Potential
DS	- Direct Shear
EI	- Expansion Potential
MAX	- Maximum Dry Density
OC	- Organic Content
PI	- Plasticity Index
RV	- R-Value
SE	- Sand Equivalent
GS	- Grain Size Distribution

NOTES:

Blow counts represent the number of blows of a 140-pound hammer falling 30 inches required to drive a sampler through the last 12 inches of an 18-inch penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

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LEGEND TO LOGS

PLATE A-1

Date Drilled	3/8/07	Water Depth:	11 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	467 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1					**Fill**			
466	1	2	39			SM	**Silty Sand:** dark brown, dense, fine to coarse grained sand, with fine gravel and asphalt grindings			
465	2	3	29				--medium dense, asphalt grindings	15.3	6.6	
		4	13				--fine grained sand, trace medium sand, iron staining, gravel content decreasing			
464	3	5	4			SM	**Alluvium** **Silty Sand:** brown, slightly moist, loose			GS
463	4									
462	5	6	77			SM	**Silty Sand:** red-brown, slightly moist, very dense, fine to medium grained sand, trace clay	20.7	7.0	
461	6	7	33				--dense, fine grained sand			
460	7									
459	8	8	64			SC	**Clayey Sand:** brown, moist, very dense, fine grained sand			
458	9	9	33, 50/13				--very dense			
457										

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-2a

PROJECT NO. 76979

LOG OF BORING HV- 3

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAININ WALL.GPJ KA_RDLND.GDT 1/30/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
456 11	10	33, 50/13				--groundwater encountered at 11 meters			
455 12	11	50/75				**Bedrock:** Tonalite, gray-brown, wet, moderately weathered --drilling effort increases			
454 13									
453 14	12	50/75				--gray			
452 15						--very difficult drilling			
	13	50/75				--slightly weathered, moist, gray-brown, fine to medium grained	20.0	3.0	DS
451 16									
450 17	14	50/50				--wet Practical drill refusal at 17.1 meters			

Boring terminated at 17.1 meters due to practical refusal.
Groundwater encountered at 11 meters.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

LOG OF BORING HV- 3

PLATE
A-2b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

Date Drilled	3/6/07	Water Depth:	10 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/6/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	466 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
465	1	1, 2	27			SM	**Alluvium** **Silty Sand:** brown, dry, medium dense, fine grained sand			
464	2	3	22							
		4	23			SW-SM	**Sand with Silt:** light brown, dry, medium dense, fine to coarse grained sand	17.2	1.2	DS
463	3	5	6				--loose			GS
462	4									
461	5	6	43			SM	**Silty Sand:** brown, dry, dense, fine grained sand			
460	6	7	29				--medium dense, trace clay			
459	7									
458	8	8	33, 50/13"				--very dense, fine to medium grained, sand			
457	9	9	27, 50/13"				--slightly moist			
456										

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

LOG OF BORING HV- 6

PLATE
A-3a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAININ WALL.GPJ KA_RDLND.GDT 1/30/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--groundwater encountered at 10.4 meters			
455 11	10	35, 50/130				--moist			
454 12	11	28, 50/100				--wet			
453 13									
452 14	12	41				--dense			
451 15	13	20, 50/130				--very dense, trace clay			
450 16									
449 17	14	34, 50/130				**Bedrock:** Tonalite, moderately weathered			
448 18	15	50/100				--slightly weathered			
447 19									
446 20	16	50/130							
445 21									

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

LOG OF BORING HV- 6

PLATE

A-3b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAININ WALL.GPJ KA_RDLND.GDT 1/30/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
	17	50/130					18.4	20.8	
444 22									
443 23	18	50/100							
442 24									
	19	50/50							
441 25									
						Practical drill refusal on on bedrock at approximately 25.3 meters			
						Boring terminated at 25.3 meters due to practical refusal. Groundwater encountered at 10.4 meters. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

LOG OF BORING HV- 6

PLATE

A-3c

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAININ WALL.GPJ KA_RDLND.GDT 1/30/09

Date Drilled	3/6/07	Water Depth:	11 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/6/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	468 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium** **Silty Sand:** light brown, dry, dense, fine to medium grained sand			
467	1	1 2	45							COR
466	2	3	24, 50/130				--very dense, light brown to olive-brown, mottled, trace clay	19.7	7.8	
		4	40, 50/130				--iron staining			
465	3	5	64							
464	4									
463	5	6	84				--brown, dry, fine to medium grained sand, trace clay	20.1	7.4	
462	6	7	37				--dense			
461	7									
460	8	8	35, 50/130				--very dense			
459	9	9	70							
458	10									

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I-215/SR60 East Junction
Proposed Retaining Walls
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PLATE
A-4a

PROJECT NO. 76979

LOG OF BORING HV- 7

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAINING WALL.GPJ KA_RDLND.GDT 1/30/09

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
457	11	10	30, 50/13				--groundwater at 10.7 meters			
456	12	11	64							
455	13									
454	14	12	50/130				**Bedrock:** Tonalite, moderately weathered, fine to medium grained			
453	15	13	50/130				--slightly weathered, fine to coarse grained	17.4	6.1	
452	16									
451	17	14	50/100							
450	18	15	50/100							
449	19									
448	20	16	50/100							
447	21	17	50/25				--difficult drilling, unweathered bedrock Practical drill refusal at approximately 21.3 meters			

Boring terminated at 21.3 meters due to practical refusal.
Groundwater encountered at 10.7 meters.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-4b

PROJECT NO. 76979

LOG OF BORING HV- 7

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAINING WALL.GPJ KA_RDLND.GDT 1/30/09

Date Drilled	3/7/07	Water Depth:	Not Encountered(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	468 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1					**Alluvium**			
467	1	2	50/130			SM	**Silty Sand:** light brown, slightly moist, very dense, fine to medium grained	19.9	6.6	
466	2	3	76				--slightly moist	19.6	9.4	
465	3	4	42				--dry, dense			GS
464	4	5	40, 50/13[illegible]				--light brown, very dense, fine to medium grained sand			
463	5	6	48				--dense, trace clay			

Boring terminated at 5.0 meters.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-5

PROJECT NO. 76979

LOG OF BORING HV- 9

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAININ WALL.GPJ KA_RDLND.GDT 1/30/09

APPENDIX B

LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

Laboratory tests were performed on drive and bulk soil samples to estimate engineering characteristics of the various earth materials encountered. Testing was performed in general accordance with procedures outlined by the American Society for Testing and Materials, the California Department of Transportation, or other accepted procedures.

IN-SITU MOISTURE CONTENT AND DRY UNIT WEIGHT

In-situ moisture content and dry unit weight tests were performed on samples that could be recovered in a relatively undisturbed condition. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937. The test results are presented on the Logs of Borings in Appendix A, Field Exploration.

GRAIN SIZE DISTRIBUTION

Sieve analyses were performed on selected samples of the materials encountered at the site to evaluate the grain size distribution characteristics of the soils and to aid in their classification. The tests were performed in general accordance with ASTM Standard Test Method D 422. The results of these tests are presented on Plate B-1 through B-3, Grain Size Distribution.

DIRECT SHEAR TEST

Two direct shear tests were performed on samples to evaluate the drained shear strength of the soils. The samples were soaked and tested in a near-saturated condition in general accordance with ASTM Test Method D 3080 (consolidated, drained). The results of these tests are presented on Plates B-4 through B-5, Direct Shear Test, and summarized in Table B-1, below.

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Table B-1
Direct Shear Test Results

Boring No.	Depth (m)	USCS Soil Type	Dry Unit Weight (kN/m^3)	Angle of Internal Friction (degrees)	Cohesion (kPa)
HV-3	15.2	Tonalite	20.0	43	0
HV-6	2.3	SW-SM	17.2	42	0

CORROSIVITY TESTS

Chemical analyses were performed on sample of boring HV-7 of the sub-surface soil to estimate pH, resistivity, soluble sulfate, and chloride contents in general accordance with Caltrans Standard Test Methods 532 (pH), 643 (resistivity), 417 (sulfates), and 422 (chlorides). The test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to the construction materials. The test results are summarized in Table B-2, below.

Table B-2
Corrosion Test Results

Boring No.	Depth (m)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
HV-7	0.9 - 2.4	3,200	7.9	5	126

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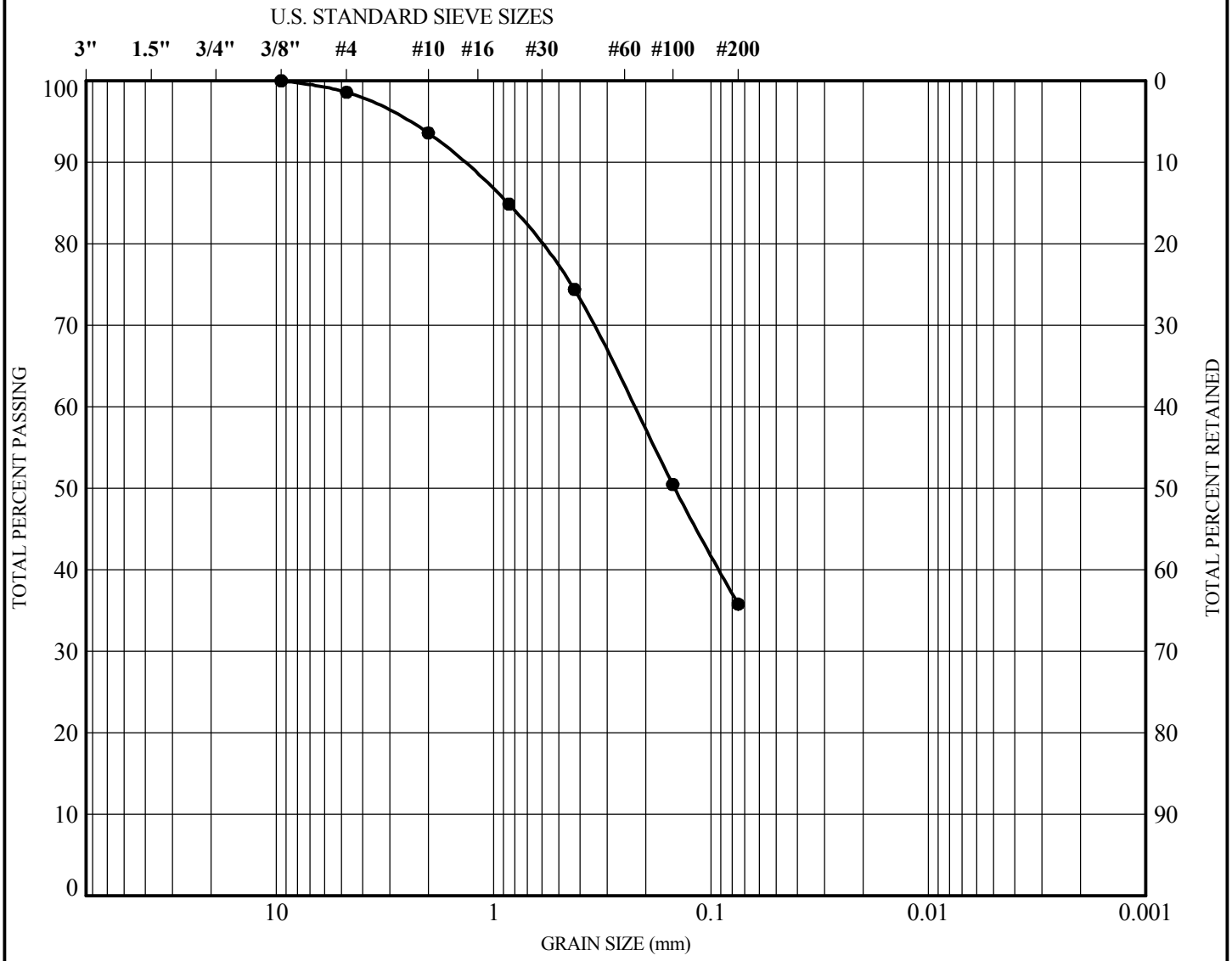
SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV- 3	3	Silty Sand	SM

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I-215/SR60 East Junction
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Riverside, California

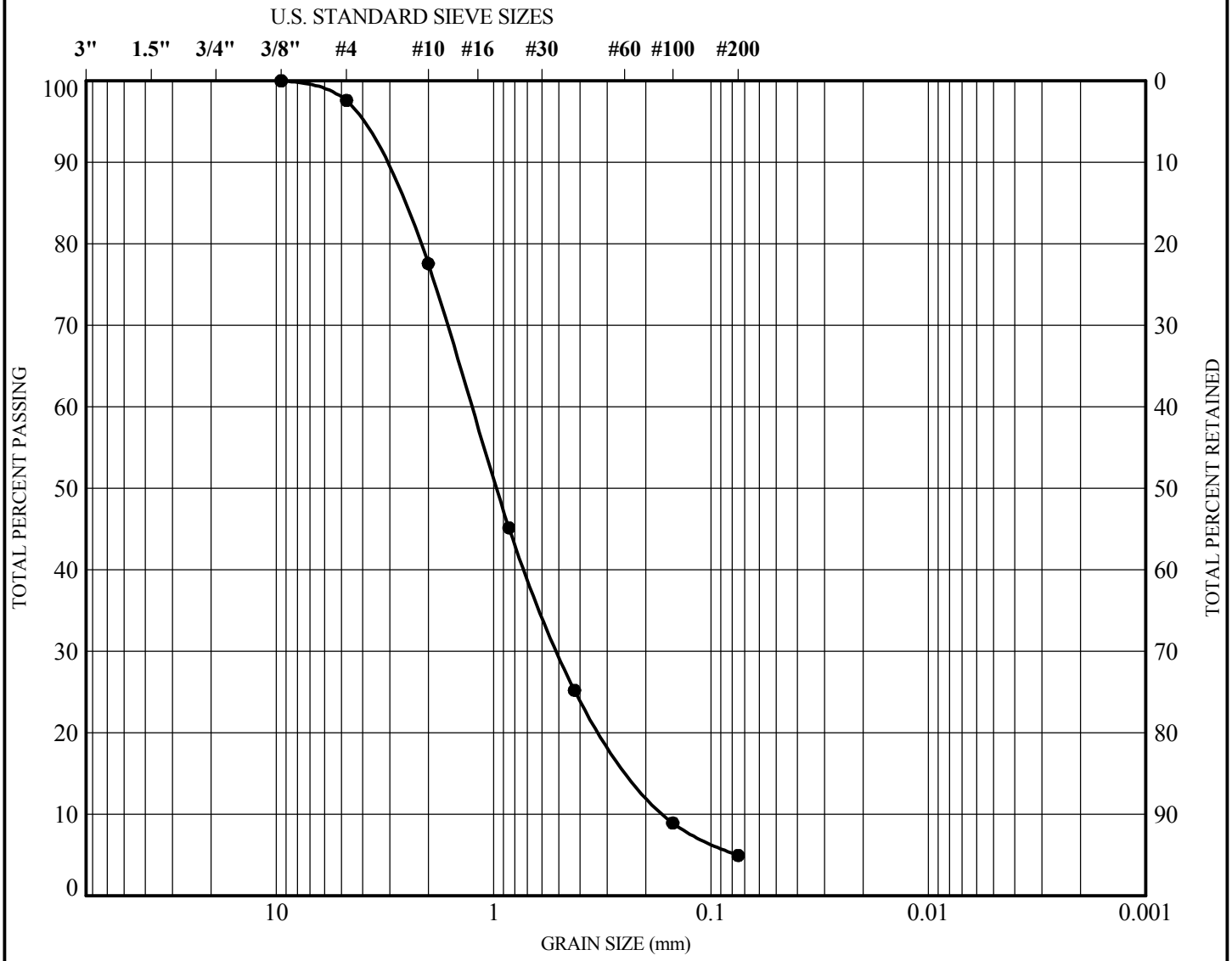
GRAIN SIZE DISTRIBUTION

PLATE

B-1

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/28/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV- 6	3	Sand with Silt	SW-SM

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

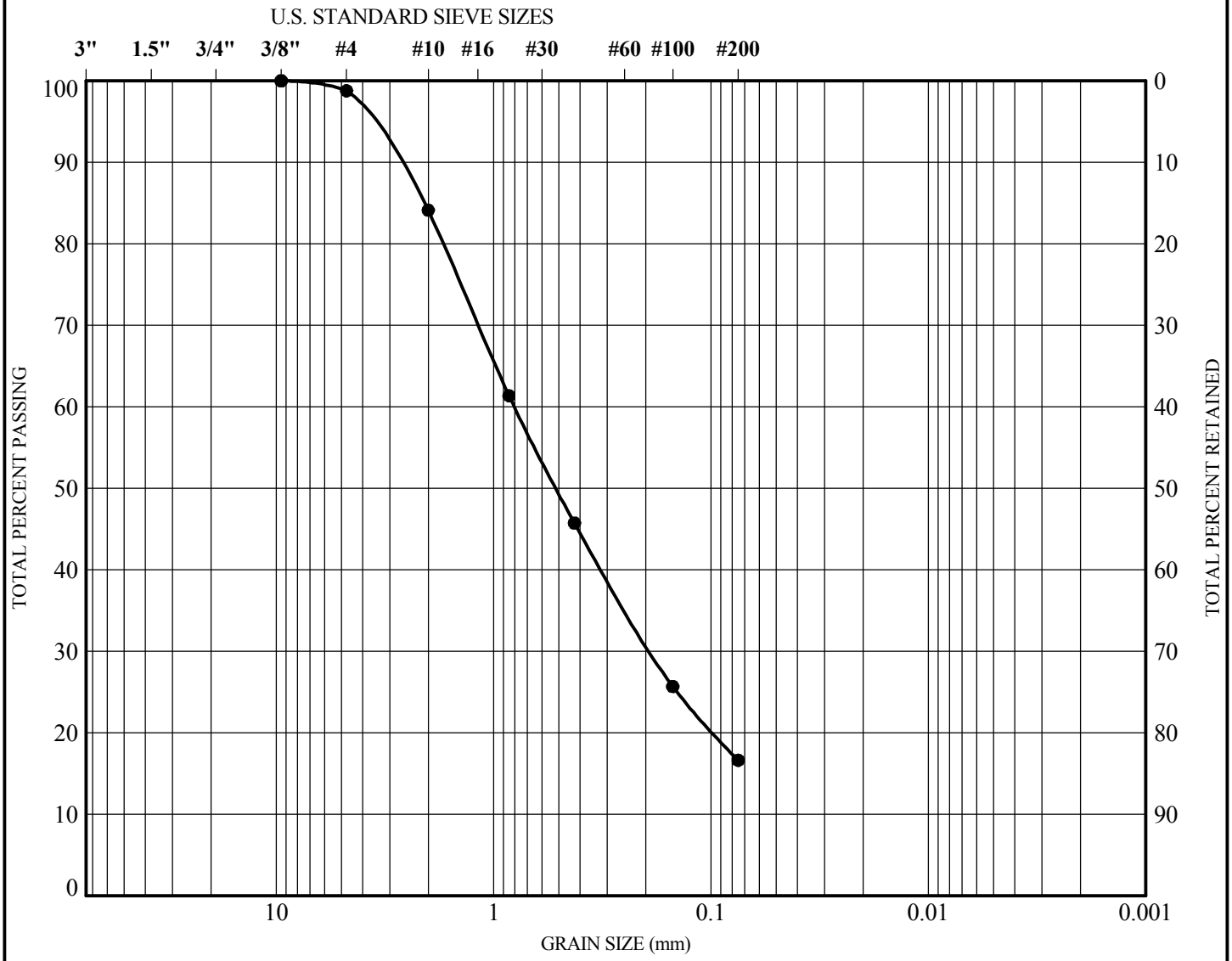
GRAIN SIZE DISTRIBUTION

PLATE

B-2

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/28/09

SIEVE ANALYSIS	HYDROMETER



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

Symbol	Boring	Depth (m)	Description	Classification
●	HV- 9	2	Silty Sand	SM

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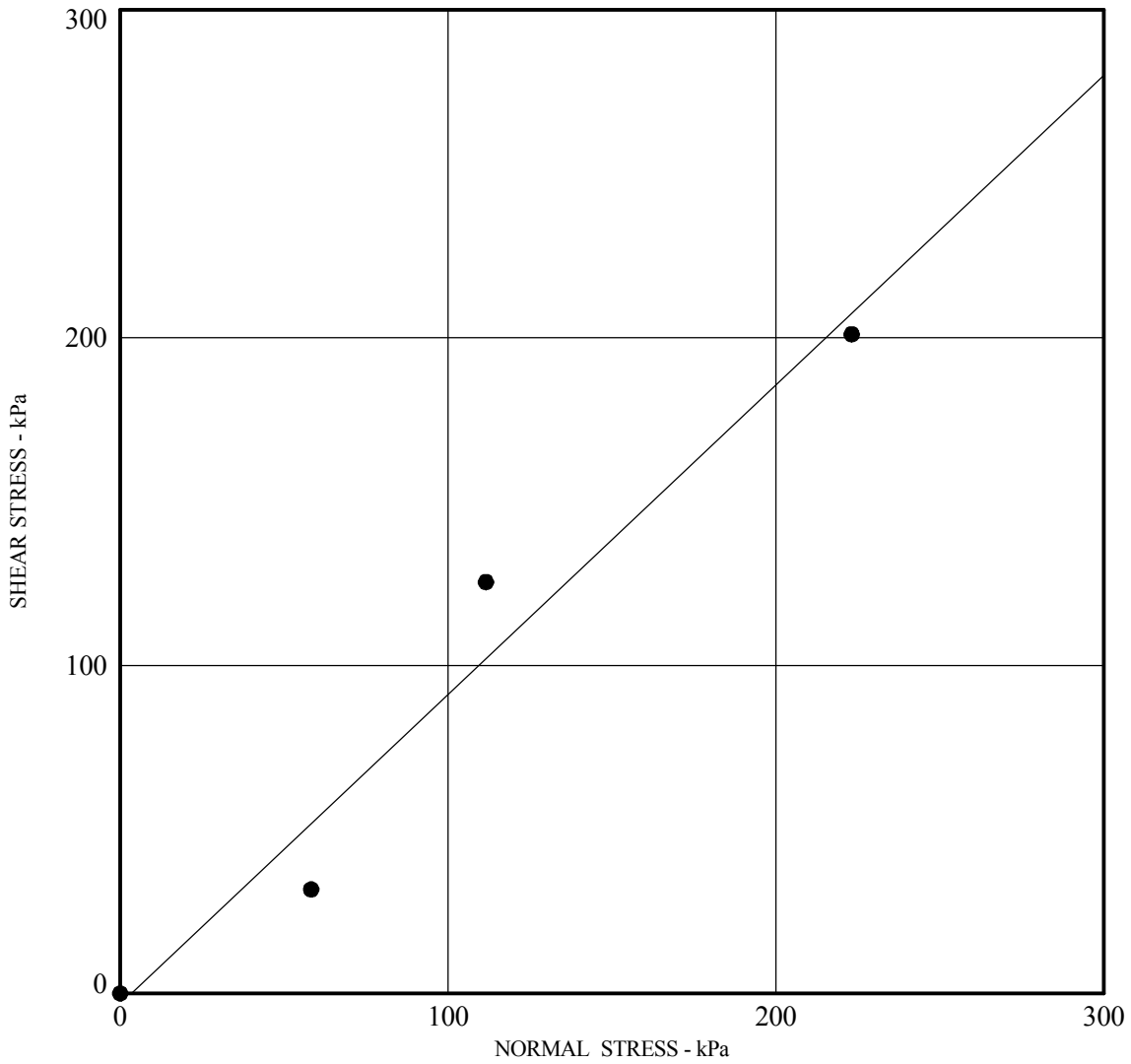
I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

GRAIN SIZE DISTRIBUTION

PLATE

B-3

GRAIN SIZE 76979 I-215 SR-60.GPJ KA_RDLND.GDT 1/28/09



Boring	**HV- 3**
Depth (m)	**15**
Friction Angle - deg	**43**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**20.0**
Moisture Content (%) *	**3.0**
Description	**Tonalite**
Classification	

*** In-situ Test**

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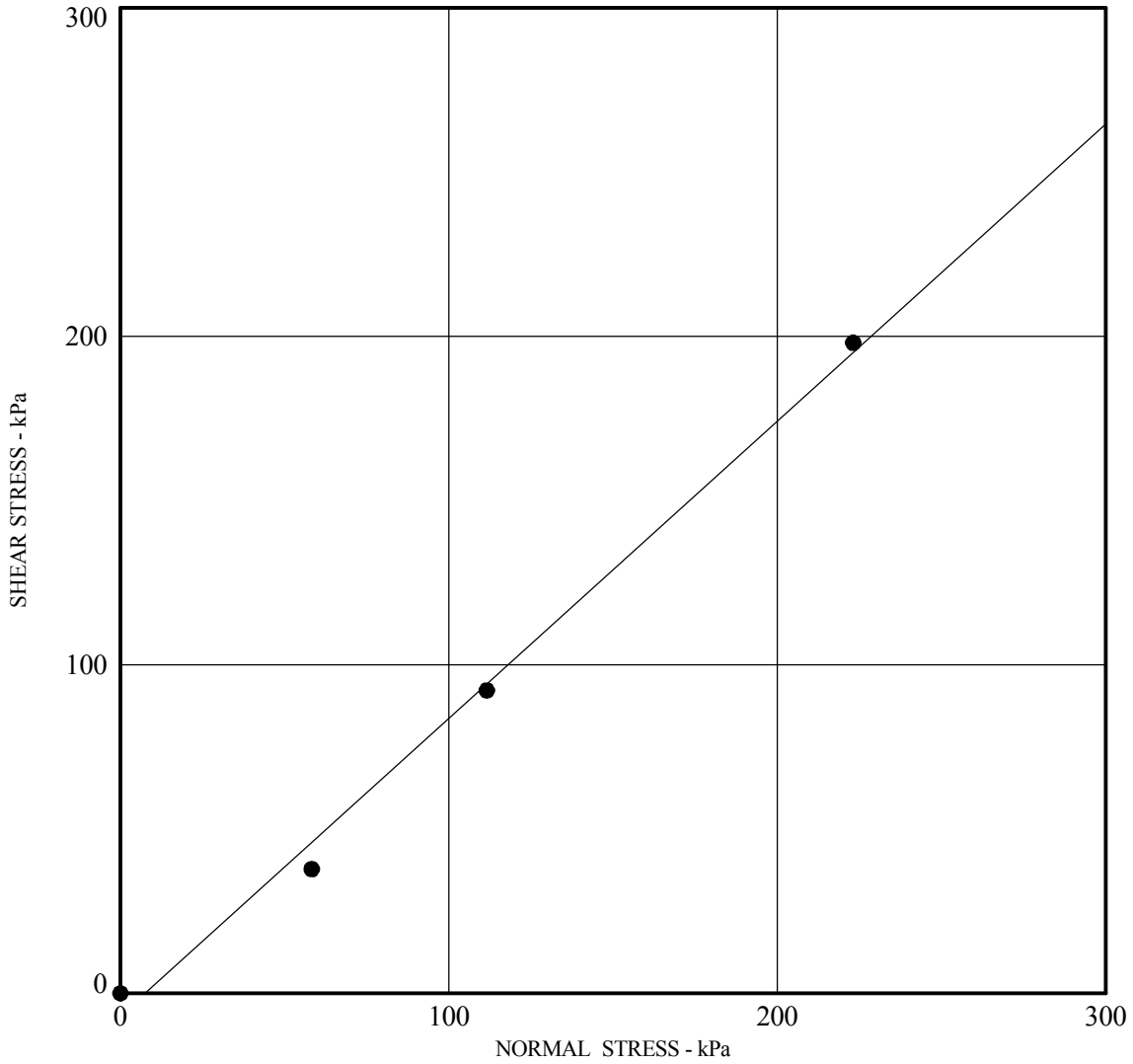
I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

DIRECT SHEAR TEST

PLATE

B-4

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 2/6/09



Boring	**HV- 6**
Depth (m)	**2**
Friction Angle - deg	**42**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**17.2**
Moisture Content (%) *	**1.2**
Description	**Sand with Silt**
Classification	**SW-SM**

*** In-situ Test**

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

DIRECT SHEAR TEST

PLATE

B-5

DIRECT SHEAR STATION 76979 I-215 SR-60.GPJ KA_RDLND.GDT 2/6/09

APPENDIX C

ENGINEERING ANALYSES

C-1

ANALYSIS OF LIQUEFACTION POTENTIAL AND SEISMICALLY INDUCED SETTLEMENTS

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	I-215/SR-60 East Junction
Project No.	76979
Location	Moreno Valley, California

GENERAL INPUT DATA	
Exploration No.	HV-6
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1529.0 feet
Proposed Grade Elevation	1529.0 feet
Unit Weight of Proposed Fill on Surface	120.0 pcf
GWT Elevation During Test	1494.9 feet
GWT Elevation For Design	1494.9 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1529.0	1522.5	6.5	SM	Y	120.0	14.00	15.0
1522.5	1515.9	13.1	SP	Y	110.0	11.00	10.0
1515.9	1510.9	18.1	SM	Y	120.0	28.00	15.0
1510.9	1505.9	23.1	SM	Y	120.0	29.00	15.0
1505.9	1500.9	28.1	SM	Y	120.0	64.00	15.0
1500.9	1495.9	33.1	SM	Y	120.0	64.00	15.0
1495.9	1490.9	38.1	SM	Y	120.0	64.00	15.0
1490.9	1485.9	43.1	SM	Y	120.0	64.00	15.0
1485.9	1480.9	48.1	SM	Y	120.0	41.00	15.0
1480.9	1474.9	54.1	SM	Y	120.0	64.00	15.0
1474.9	1469.9	59.1	BEDROCK/FORMATION	N	125.0	100.00	10.0
1469.9	1464.9	64.1	BEDROCK/FORMATION	N	125.0	96.00	10.0
1464.9	1459.9	69.1	BEDROCK/FORMATION	N	125.0	100.00	10.0
1459.9	1454.9	74.1	BEDROCK/FORMATION	N	125.0	64.00	10.0
1454.9	1449.9	79.1	BEDROCK/FORMATION	N	125.0	100.00	10.0
1449.9	1446.0	83.0	BEDROCK/FORMATION	N	125.0	100.00	10.0

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215 SR-60 East Junction
Project No.	76979
Location	Moreno Valley, California

GENERAL INPUT DATA

Exploration No.	HV-6
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1529.00 feet
Proposed Grade Elevation	1529.00 feet
Unit Weight of Proposed Fill on Surface	120.00 pcf
GWT Elevation During Test	1494.90 feet
GWT Elevation For Design	1494.90 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<==== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.14 inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.14 inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count. $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ $CSR = 0.65 A_{max} (\sigma_v/\sigma_v') r_d$
* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5} MSF K_\sigma K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_α =1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma w_i$ x $f(FS_{liq})$ x H_i (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1529.0	1528.0	SM	Y	120.0	14	15.0
1528.0	1527.0	SM	Y	120.0	14	15.0
1527.0	1526.0	SM	Y	120.0	14	15.0
1526.0	1525.0	SM	Y	120.0	14	15.0
1525.0	1524.0	SM	Y	120.0	14	15.0
1524.0	1523.0	SM	Y	120.0	14	15.0
1523.0	1522.0	SP	Y	110.0	11	10.0
1522.0	1521.0	SP	Y	110.0	11	10.0
1521.0	1520.0	SP	Y	110.0	11	10.0
1520.0	1519.0	SP	Y	110.0	11	10.0
1519.0	1518.0	SP	Y	110.0	11	10.0
1518.0	1517.0	SP	Y	110.0	11	10.0
1517.0	1516.0	SP	Y	110.0	11	10.0
1516.0	1515.0	SM	Y	120.0	28	15.0
1515.0	1514.0	SM	Y	120.0	28	15.0
1514.0	1513.0	SM	Y	120.0	28	15.0
1513.0	1512.0	SM	Y	120.0	28	15.0
1512.0	1511.0	SM	Y	120.0	28	15.0
1511.0	1510.0	SM	Y	120.0	29	15.0
1510.0	1509.0	SM	Y	120.0	29	15.0
1509.0	1508.0	SM	Y	120.0	29	15.0
1508.0	1507.0	SM	Y	120.0	29	15.0
1507.0	1506.0	SM	Y	120.0	29	15.0
1506.0	1505.0	SM	Y	120.0	64	15.0
1505.0	1504.0	SM	Y	120.0	64	15.0
1504.0	1503.0	SM	Y	120.0	64	15.0
1503.0	1502.0	SM	Y	120.0	64	15.0
1502.0	1501.0	SM	Y	120.0	64	15.0
1501.0	1500.0	SM	Y	120.0	64	15.0
1500.0	1499.0	SM	Y	120.0	64	15.0
1499.0	1498.0	SM	Y	120.0	64	15.0
1498.0	1497.0	SM	Y	120.0	64	15.0
1497.0	1496.0	SM	Y	120.0	64	15.0
1496.0	1495.0	SM	Y	120.0	64	15.0
1495.0	1494.0	SM	Y	120.0	64	15.0
1494.0	1493.0	SM	Y	120.0	64	15.0
1493.0	1492.0	SM	Y	120.0	64	15.0
1492.0	1491.0	SM	Y	120.0	64	15.0
1491.0	1490.0	SM	Y	120.0	64	15.0
1490.0	1489.0	SM	Y	120.0	64	15.0
1489.0	1488.0	SM	Y	120.0	64	15.0
1488.0	1487.0	SM	Y	120.0	64	15.0
1487.0	1486.0	SM	Y	120.0	64	15.0
1486.0	1485.0	SM	Y	120.0	41	15.0
1485.0	1484.0	SM	Y	120.0	41	15.0
1484.0	1483.0	SM	Y	120.0	41	15.0

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
0.5	1.700	0.750	31.1	0.999	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	28.6	N/A	0.012	0.014	0.00	0.14
1.5	1.700	0.750	31.1	0.997	N/A	0.253	N/A	N/A	NO	N/A	Soil above GWT	28.6	N/A	0.021	0.024	0.00	0.14
2.5	1.630	0.750	29.9	0.994	N/A	0.252	N/A	N/A	NO	N/A	Soil above GWT	27.5	N/A	0.027	0.033	0.00	0.13
3.5	1.560	0.750	28.8	0.992	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	26.4	N/A	0.032	0.042	0.01	0.13
4.5	1.497	0.750	27.7	0.990	N/A	0.251	N/A	N/A	NO	N/A	Soil above GWT	25.4	N/A	0.037	0.050	0.01	0.12
5.5	1.438	0.750	26.7	0.987	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	24.4	N/A	0.041	0.059	0.01	0.11
6.5	1.386	0.750	18.7	0.985	N/A	0.250	N/A	N/A	NO	N/A	Soil above GWT	18.5	N/A	0.052	0.112	0.01	0.10
7.5	1.339	0.750	18.1	0.983	N/A	0.249	N/A	N/A	NO	N/A	Soil above GWT	17.9	N/A	0.056	0.125	0.02	0.09
8.5	1.296	0.850	19.8	0.980	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	19.5	N/A	0.057	0.115	0.01	0.07
9.5	1.255	0.850	19.2	0.978	N/A	0.248	N/A	N/A	NO	N/A	Soil above GWT	19.0	N/A	0.060	0.127	0.02	0.06
10.5	1.217	0.850	18.7	0.976	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	18.4	N/A	0.064	0.139	0.02	0.04
11.5	1.181	0.850	18.1	0.973	N/A	0.247	N/A	N/A	NO	N/A	Soil above GWT	17.9	N/A	0.067	0.151	0.02	0.02
12.5	1.147	0.850	17.6	0.971	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	17.4	N/A	0.070	0.164	0.02	0.00
13.5	1.114	0.850	45.0	0.969	N/A	0.246	N/A	N/A	NO	N/A	Soil above GWT	41.9	N/A	0.049	0.000	0.00	0.00
14.5	1.081	0.850	43.7	0.966	N/A	0.245	N/A	N/A	NO	N/A	Soil above GWT	40.7	N/A	0.051	0.000	0.00	0.00
15.5	1.050	0.950	47.3	0.964	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	44.1	N/A	0.051	0.000	0.00	0.00
16.5	1.021	0.950	46.0	0.962	N/A	0.244	N/A	N/A	NO	N/A	Soil above GWT	42.9	N/A	0.053	0.000	0.00	0.00
17.5	0.993	0.950	44.9	0.959	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	41.7	N/A	0.056	0.000	0.00	0.00
18.5	0.967	0.950	45.2	0.957	N/A	0.243	N/A	N/A	NO	N/A	Soil above GWT	42.1	N/A	0.057	0.000	0.00	0.00
19.5	0.942	0.950	44.1	0.955	N/A	0.242	N/A	N/A	NO	N/A	Soil above GWT	41.0	N/A	0.059	0.000	0.00	0.00
20.5	0.919	0.950	43.1	0.952	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	40.0	N/A	0.061	0.000	0.00	0.00
21.5	0.896	0.950	42.1	0.950	N/A	0.241	N/A	N/A	NO	N/A	Soil above GWT	39.1	N/A	0.063	0.000	0.00	0.00
22.5	0.875	0.950	41.1	0.948	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	38.2	N/A	0.065	0.000	0.00	0.00
23.5	0.854	0.950	85.8	0.945	N/A	0.240	N/A	N/A	NO	N/A	Soil above GWT	80.8	N/A	0.050	0.000	0.00	0.00
24.5	0.835	0.950	83.9	0.943	N/A	0.239	N/A	N/A	NO	N/A	Soil above GWT	79.0	N/A	0.052	0.000	0.00	0.00
25.5	0.816	0.950	82.1	0.941	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	77.2	N/A	0.053	0.000	0.00	0.00
26.5	0.799	0.950	80.3	0.938	N/A	0.238	N/A	N/A	NO	N/A	Soil above GWT	75.6	N/A	0.054	0.000	0.00	0.00
27.5	0.782	0.950	78.7	0.936	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	74.0	N/A	0.055	0.000	0.00	0.00
28.5	0.765	1.000	81.0	0.934	N/A	0.237	N/A	N/A	NO	N/A	Soil above GWT	76.2	N/A	0.056	0.000	0.00	0.00
29.5	0.750	1.000	79.4	0.931	N/A	0.236	N/A	N/A	NO	N/A	Soil above GWT	74.7	N/A	0.057	0.000	0.00	0.00
30.5	0.735	1.000	77.9	0.926	N/A	0.235	N/A	N/A	NO	N/A	Soil above GWT	73.2	N/A	0.058	0.000	0.00	0.00
31.5	0.720	1.000	76.4	0.918	N/A	0.233	N/A	N/A	NO	N/A	Soil above GWT	71.8	N/A	0.058	0.000	0.00	0.00
32.5	0.706	1.000	75.0	0.909	N/A	0.231	N/A	N/A	NO	N/A	Soil above GWT	70.5	N/A	0.059	0.000	0.00	0.00
33.5	0.693	1.000	73.6	0.901	N/A	0.228	N/A	N/A	NO	N/A	Soil above GWT	69.2	N/A	0.059	0.000	0.00	0.00
34.5	0.683	1.000	72.6	0.893	0.755	0.228	N/A	N/A	NO	N/A	Dense/stiff soil	68.2	N/A	N/A	0.000	0.00	0.00
35.5	0.677	1.000	71.9	0.885	0.750	0.229	N/A	N/A	NO	N/A	Dense/stiff soil	67.6	N/A	N/A	0.000	0.00	0.00
36.5	0.671	1.000	71.3	0.877	0.746	0.230	N/A	N/A	NO	N/A	Dense/stiff soil	67.0	N/A	N/A	0.000	0.00	0.00
37.5	0.665	1.000	70.7	0.869	0.742	0.231	N/A	N/A	NO	N/A	Dense/stiff soil	66.4	N/A	N/A	0.000	0.00	0.00
38.5	0.659	1.000	70.1	0.861	0.738	0.232	N/A	N/A	NO	N/A	Dense/stiff soil	65.9	N/A	N/A	0.000	0.00	0.00
39.5	0.653	1.000	69.5	0.852	0.734	0.233	N/A	N/A	NO	N/A	Dense/stiff soil	65.3	N/A	N/A	0.000	0.00	0.00
40.5	0.648	1.000	69.0	0.844	0.730	0.234	N/A	N/A	NO	N/A	Dense/stiff soil	64.8	N/A	N/A	0.000	0.00	0.00
41.5	0.643	1.000	68.4	0.836	0.726	0.234	N/A	N/A	NO	N/A	Dense/stiff soil	64.2	N/A	N/A	0.000	0.00	0.00
42.5	0.637	1.000	67.9	0.828	0.723	0.234	N/A	N/A	NO	N/A	Dense/stiff soil	63.7	N/A	N/A	0.000	0.00	0.00
43.5	0.632	1.000	44.0	0.820	0.719	0.235	N/A	N/A	NO	N/A	Dense/stiff soil	41.0	N/A	N/A	0.000	0.00	0.00
44.5	0.627	1.000	43.7	0.812	0.715	0.235	N/A	N/A	NO	N/A	Dense/stiff soil	40.6	N/A	N/A	0.000	0.00	0.00
45.5	0.622	1.000	43.4	0.804	0.712	0.235	N/A	N/A	NO	N/A	Dense/stiff soil	40.3	N/A	N/A	0.000	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction
Project No.	76979
Location	Moreno Valley, California

GENERAL INPUT DATA

Exploration No.	HV-6
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1529.00 feet
Proposed Grade Elevation	1529.00 feet
Unit Weight of Proposed Fill on Surface	120.00 pcf
GWT Elevation During Test	1494.90 feet
GWT Elevation For Design	1494.90 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.39 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<==== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 - 15 : "Moderate" liquefaction effects (usually associated with sandboils)
		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
Earthquake-Induced Settlements (in the upper 50 feet):		
- Liquefaction-Induced Settlement =	0.00 inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.14 inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.14 inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ CSR = 0.65 A_{max} (σ_v/σ_v') r_d
* FS_{liq} = (CRR/CSR), where CRR = $CRR_{7.5}$ MSF K_σ K_α ; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_α =1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. LPI = Σ w_i x f(FS_{liq}) x H_i (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1483.0	1482.0	SM	Y	120.0	41	15.0
1482.0	1481.0	SM	Y	120.0	41	15.0
1481.0	1480.0	SM	Y	120.0	64	15.0
1480.0	1479.0	SM	Y	120.0	64	15.0
1479.0	1478.0	SM	Y	120.0	64	15.0
1478.0	1477.0	SM	Y	120.0	64	15.0
1477.0	1476.0	SM	Y	120.0	64	15.0
1476.0	1475.0	SM	Y	120.0	64	15.0
1475.0	1474.0	BEDROCK FORMATION	N	125.0	100	10.0
1474.0	1473.0	BEDROCK FORMATION	N	125.0	100	10.0
1473.0	1472.0	BEDROCK FORMATION	N	125.0	100	10.0
1472.0	1471.0	BEDROCK FORMATION	N	125.0	100	10.0
1471.0	1470.0	BEDROCK FORMATION	N	125.0	100	10.0
1470.0	1469.0	BEDROCK FORMATION	N	125.0	96	10.0
1469.0	1468.0	BEDROCK FORMATION	N	125.0	96	10.0
1468.0	1467.0	BEDROCK FORMATION	N	125.0	96	10.0
1467.0	1466.0	BEDROCK FORMATION	N	125.0	96	10.0
1466.0	1465.0	BEDROCK FORMATION	N	125.0	96	10.0
1465.0	1464.0	BEDROCK FORMATION	N	125.0	100	10.0
1464.0	1463.0	BEDROCK FORMATION	N	125.0	100	10.0
1463.0	1462.0	BEDROCK FORMATION	N	125.0	100	10.0
1462.0	1461.0	BEDROCK FORMATION	N	125.0	100	10.0
1461.0	1460.0	BEDROCK FORMATION	N	125.0	100	10.0
1460.0	1459.0	BEDROCK FORMATION	N	125.0	64	10.0
1459.0	1458.0	BEDROCK FORMATION	N	125.0	64	10.0
1458.0	1457.0	BEDROCK FORMATION	N	125.0	64	10.0
1457.0	1456.0	BEDROCK FORMATION	N	125.0	64	10.0
1456.0	1455.0	BEDROCK FORMATION	N	125.0	64	10.0
1455.0	1454.0	BEDROCK FORMATION	N	125.0	100	10.0
1454.0	1453.0	BEDROCK FORMATION	N	125.0	100	10.0
1453.0	1452.0	BEDROCK FORMATION	N	125.0	100	10.0
1452.0	1451.0	BEDROCK FORMATION	N	125.0	100	10.0
1451.0	1450.0	BEDROCK FORMATION	N	125.0	100	10.0
1450.0	1449.0	BEDROCK FORMATION	N	125.0	100	10.0
1449.0	1448.0	BEDROCK FORMATION	N	125.0	100	10.0
1448.0	1447.0	BEDROCK FORMATION	N	125.0	100	10.0
1447.0	1446.0	BEDROCK FORMATION	N	125.0	100	10.0

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +

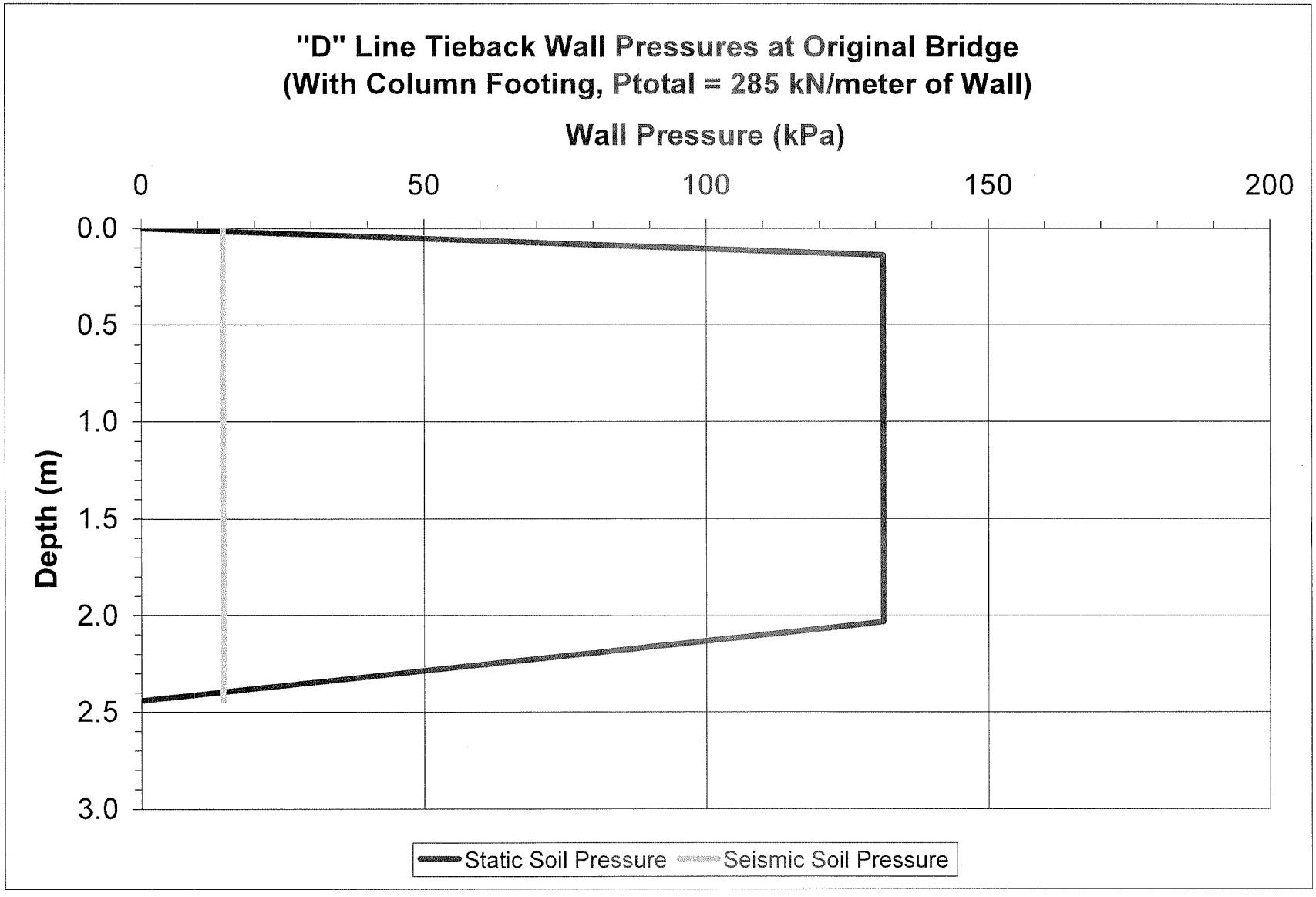
Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks
46.5	0.617	1.000	43.0	0.795	0.708	0.235	N/A	N/A	NO	N/A	Dense/stiff soil
47.5	0.612	1.000	42.7	0.787	0.705	0.234	N/A	N/A	NO	N/A	Dense/stiff soil
48.5	0.607	1.000	64.8	0.779	0.702	0.234	N/A	N/A	NO	N/A	Dense/stiff soil
49.5	0.602	1.000	64.3	0.771	0.698	0.234	N/A	N/A	NO	N/A	Dense/stiff soil
50.5	0.597	1.000	63.8	0.763	0.695	0.233	N/A	N/A	NO	N/A	Dense/stiff soil
51.5	0.593	1.000	63.3	0.755	0.692	0.233	N/A	N/A	NO	N/A	Dense/stiff soil
52.5	0.588	1.000	62.8	0.747	0.689	0.232	N/A	N/A	NO	N/A	Dense/stiff soil
53.5	0.584	1.000	62.4	0.738	0.686	0.231	N/A	N/A	NO	N/A	Dense/stiff soil
54.5	0.579	1.000	N/A	0.730	N/A	0.230	N/A	N/A	NO	N/A	Bedrock Formation
55.5	0.574	1.000	N/A	0.722	N/A	0.230	N/A	N/A	NO	N/A	Bedrock Formation
56.5	0.570	1.000	N/A	0.714	N/A	0.229	N/A	N/A	NO	N/A	Bedrock Formation
57.5	0.565	1.000	N/A	0.706	N/A	0.227	N/A	N/A	NO	N/A	Bedrock Formation
58.5	0.561	1.000	N/A	0.698	N/A	0.226	N/A	N/A	NO	N/A	Bedrock Formation
59.5	0.556	1.000	N/A	0.690	N/A	0.225	N/A	N/A	NO	N/A	Bedrock Formation
60.5	0.552	1.000	N/A	0.682	N/A	0.224	N/A	N/A	NO	N/A	Bedrock Formation
61.5	0.547	1.000	N/A	0.673	N/A	0.222	N/A	N/A	NO	N/A	Bedrock Formation
62.5	0.543	1.000	N/A	0.665	N/A	0.221	N/A	N/A	NO	N/A	Bedrock Formation
63.5	0.539	1.000	N/A	0.657	N/A	0.220	N/A	N/A	NO	N/A	Bedrock Formation
64.5	0.535	1.000	N/A	0.649	N/A	0.218	N/A	N/A	NO	N/A	Bedrock Formation
65.5	0.531	1.000	N/A	0.641	N/A	0.217	N/A	N/A	NO	N/A	Bedrock Formation
66.5	0.527	1.000	N/A	0.633	N/A	0.215	N/A	N/A	NO	N/A	Bedrock Formation
67.5	0.523	1.000	N/A	0.625	N/A	0.213	N/A	N/A	NO	N/A	Bedrock Formation
68.5	0.519	1.000	N/A	0.616	N/A	0.211	N/A	N/A	NO	N/A	Bedrock Formation
69.5	0.515	1.000	N/A	0.608	N/A	0.210	N/A	N/A	NO	N/A	Bedrock Formation
70.5	0.512	1.000	N/A	0.600	N/A	0.208	N/A	N/A	NO	N/A	Bedrock Formation
71.5	0.508	1.000	N/A	0.592	N/A	0.206	N/A	N/A	NO	N/A	Bedrock Formation
72.5	0.504	1.000	N/A	0.584	N/A	0.204	N/A	N/A	NO	N/A	Bedrock Formation
73.5	0.501	1.000	N/A	0.576	N/A	0.202	N/A	N/A	NO	N/A	Bedrock Formation
74.5	0.497	1.000	N/A	0.568	N/A	0.200	N/A	N/A	NO	N/A	Bedrock Formation
75.5	0.494	1.000	N/A	0.560	N/A	0.198	N/A	N/A	NO	N/A	Bedrock Formation
76.5	0.490	1.000	N/A	0.557	N/A	0.198	N/A	N/A	NO	N/A	Bedrock Formation
77.5	0.487	1.000	N/A	0.555	N/A	0.198	N/A	N/A	NO	N/A	Bedrock Formation
78.5	0.483	1.000	N/A	0.553	N/A	0.198	N/A	N/A	NO	N/A	Bedrock Formation
79.5	0.480	1.000	N/A	0.550	N/A	0.198	N/A	N/A	NO	N/A	Bedrock Formation
80.5	0.477	1.000	N/A	0.548	N/A	0.198	N/A	N/A	NO	N/A	Bedrock Formation
81.5	0.474	1.000	N/A	0.545	N/A	0.198	N/A	N/A	NO	N/A	Bedrock Formation
82.5	0.470	1.000	N/A	0.543	N/A	0.197	N/A	N/A	NO	N/A	Bedrock Formation

RESIDUAL STRENGTH AND GROUND SETTLEMENT

Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
40.0	N/A	N/A	0.000	0.00	0.00
39.7	N/A	N/A	0.000	0.00	0.00
60.7	N/A	N/A	0.000	0.00	0.00
60.3	N/A	N/A	0.000	0.00	0.00
59.8	N/A	N/A	0.000	0.00	N/A
59.3	N/A	N/A	0.000	0.00	N/A
58.9	N/A	N/A	0.000	0.00	N/A
58.5	N/A	N/A	0.000	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A
N/A	N/A	N/A	N/A	0.00	N/A

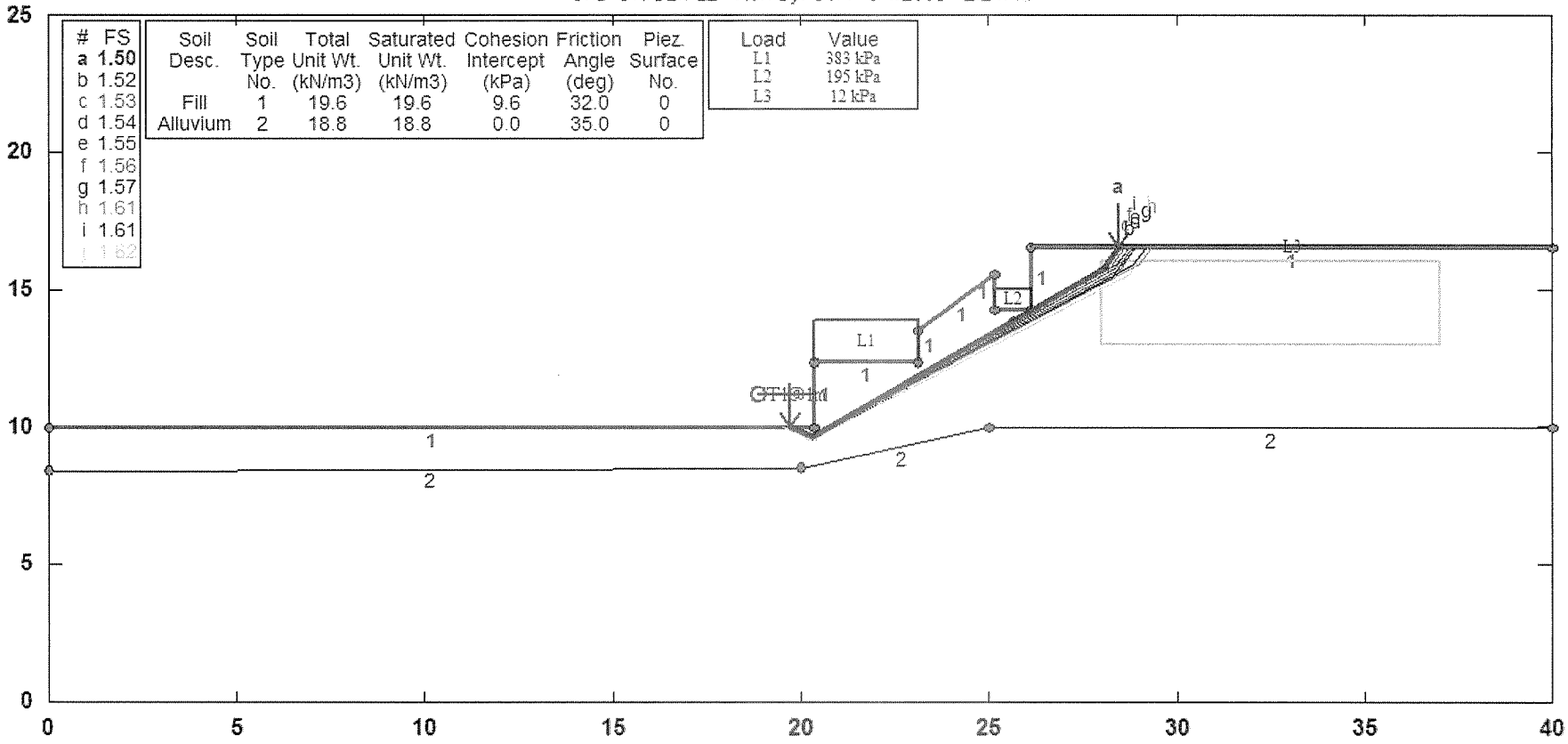
C-2

LATERAL EARTH PRESSURES


"D" Line Tieback Wall Pressures at Original Bridge
(With Column Footing, Ptotal = 285 kN/meter of Wall)
Wall Pressure (kPa)
0
50
100
150
200
Depth (m)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Static Soil Pressure
Seismic Soil Pressure

D Line Walls at Original Bridge, Ptotal=285 kN/meter of Wall

C:\D-ORIG2.PL2 Run By: CVA 6/1/2009 2:21PM



GSTABL7 v.2 FSmin=1.50

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

d-orig2.OUT
*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 6/1/2009
Time of Run: 2:21PM
Run By: CVA
Input Data Filename: C:d-orig2.si
Output Filename: C:d-orig2.OUT
Unit System: SI

Plotted Output Filename: C:d-orig2.PLT

PROBLEM DESCRIPTION: D Line Walls at Original Bridge,
Ptotal=285 kN/meter of Wall

BOUNDARY COORDINATES

9 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	9.93	20.34	9.93	1
2	20.34	9.93	20.35	12.37	1
3	20.35	12.37	23.09	12.37	1
4	23.09	12.37	23.10	13.52	1
5	23.10	13.52	25.14	15.56	1
6	25.14	15.56	25.15	14.26	1
7	25.15	14.26	26.09	14.26	1
8	26.09	14.26	26.10	16.50	1
9	26.10	16.50	40.00	16.50	1
10	0.00	8.40	20.00	8.50	2
11	20.00	8.50	25.00	9.93	2
12	25.00	9.93	40.00	9.93	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	9.6	32.0	0.00	0.0	0
2	18.8	18.8	0.0	35.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

3 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	20.35	23.09	383.0	0.0
2	25.15	26.09	195.0	0.0
3	26.10	40.00	12.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

TIEBACK LOAD(S)

1 Tieback Load(s) Specified

Tieback No.	X-Pos (m)	Y-Pos (m)	Load (kN)	Spacing (m)	Inclination (deg)	Length (m)	Force Method
1	20.34	11.15	285.0	1.0	0.00	0.0	2

NOTE - An Equivalent Line Load Is Calculated For Each Row Of Tiebacks
Assuming A Uniform Distribution Of Load Horizontally Between Individual
Tiebacks. Force Method 1 Considers Only Tangential Tieback Forces.
Force Method 2 Considers Both Tangential and Normal Tieback Forces.

Janbus Empirical Coef is being used for the case of c & phi both > 0

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.

The Active And Passive Portions Of The Sliding Surfaces
Are Generated According To The Rankine Theory.

500 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 1.0

Box No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Height (m)
1	20.20	9.60	20.40	9.60	0.20
2	28.00	14.50	37.00	14.50	3.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Simplified Janbu Method * *

Total Number of Trial Surfaces Evaluated = 500

Statistical Data On All Valid FS Values:
FS Max = 5.245 FS Min = 1.499 FS Ave = 2.963
Standard Deviation = 0.821 Coefficient of Variation = 27.71 %

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.69	9.93
2	20.31	9.59
3	28.05	15.77
4	28.46	16.50

Factor of Safety
*** 1.499 ***

Individual data on the 11 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.6	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	2.7	88.9	0.0	0.0	197.6	133.2	0.0	0.0	1049.4
5	0.0	0.2	0.0	0.0	0.2	0.4	0.0	0.0	0.0
6	2.0	76.4	0.0	0.0	18.1	58.8	0.0	0.0	0.0
7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.9	8.0	0.0	0.0	0.0	0.0	0.0	0.0	183.3
9	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1.9	57.9	0.0	0.0	0.0	0.0	0.0	0.0	23.4
11	0.4	2.9	0.0	0.0	0.0	0.0	0.0	0.0	4.9

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.74	9.93
2	20.32	9.61
3	28.41	15.92
4	28.73	16.50

Factor of Safety
*** 1.524 ***

1

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)

1	19.52	9.93
2	20.28	9.51
3	28.14	15.58
4	28.62	16.46
5	28.65	16.50

Factor of Safety
*** 1.534 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.82	9.93
2	20.31	9.66
3	28.56	15.91
4	28.89	16.50

Factor of Safety
*** 1.544 ***

1

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.58	9.93
2	20.29	9.53
3	28.50	15.74
4	28.92	16.50

Factor of Safety
*** 1.546 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.85	9.93
2	20.30	9.69
3	28.35	15.75
4	28.77	16.50

Factor of Safety
*** 1.559 ***

1

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)

1	19.63	9.93
2	20.30	9.55
3	28.86	15.89
4	29.19	16.50

Factor of Safety
*** 1.566 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.71	9.93
2	20.30	9.60
3	29.01	15.89
4	29.35	16.50

Factor of Safety
*** 1.605 ***

1

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.72	9.93
2	20.25	9.63
3	28.23	15.40
4	28.71	16.28
5	28.83	16.50

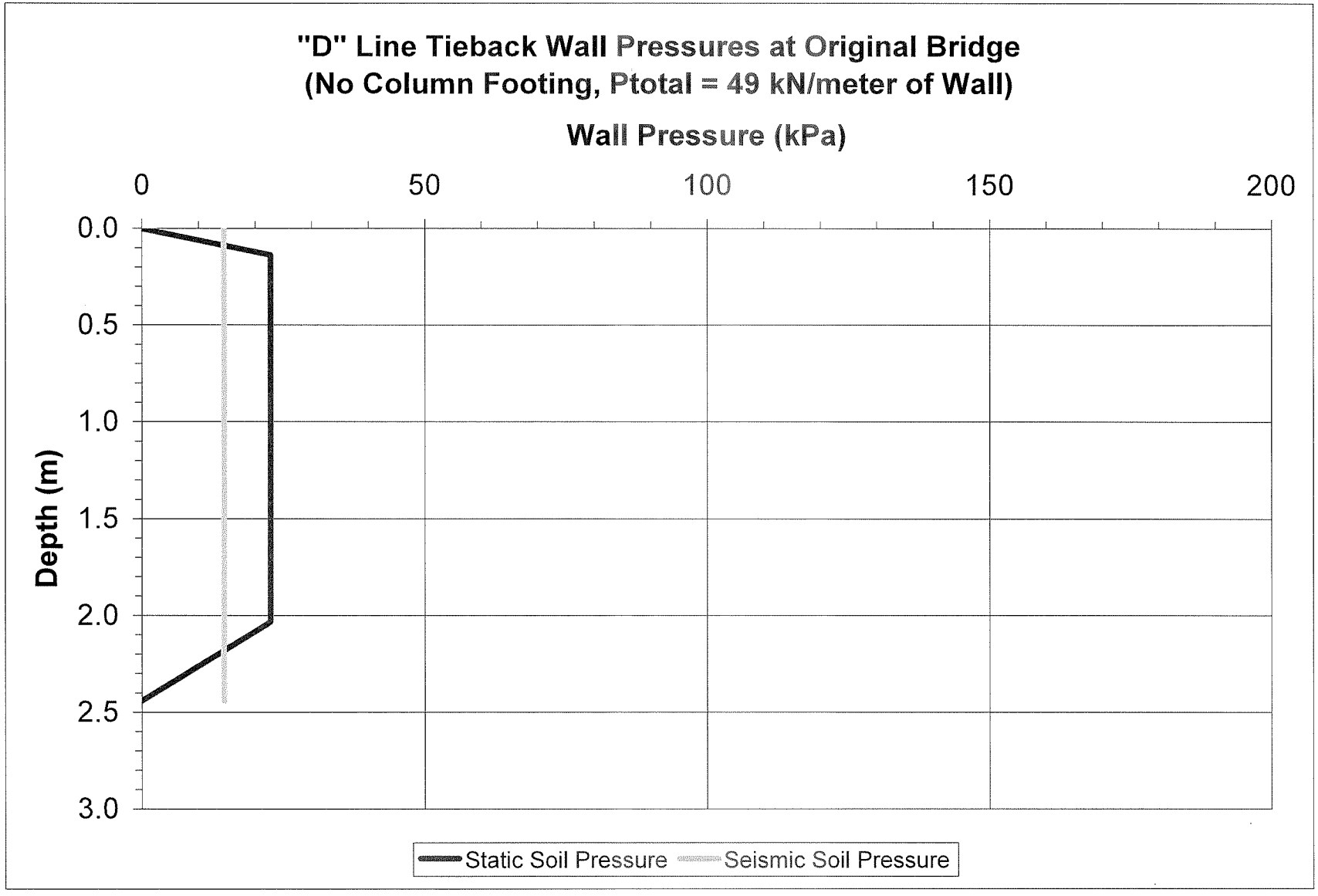
Factor of Safety
*** 1.608 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.49	9.93
2	20.26	9.50
3	28.74	15.55
4	29.22	16.42
5	29.26	16.50

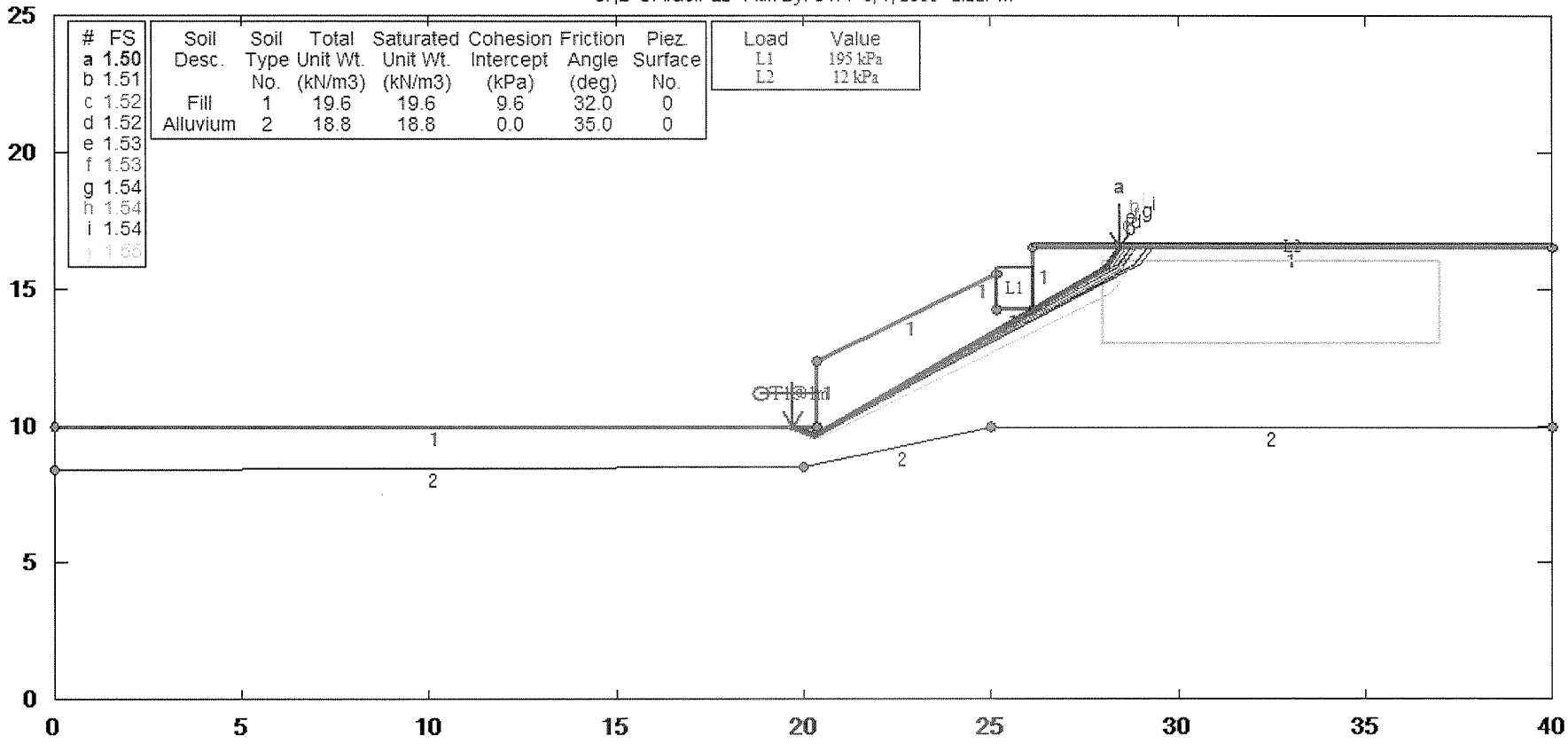
Factor of Safety
*** 1.618 ***

**** END OF GSTABL7 OUTPUT ****


"D" Line Tieback Wall Pressures at Original Bridge
(No Column Footing, Ptotal = 49 kN/meter of Wall)
Wall Pressure (kPa)
0
50
100
150
200
Depth (m)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Static Soil Pressure
Seismic Soil Pressure

D Line Walls at Original Bridge, No Col Ftg, Ptotal=49 kN/meter of Wall

C:\D-ORIG3.PL2 Run By: CVA 6/1/2009 2:22PM



GSTABL7 v.2 FSmin=1.50

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

d-orig3.OUT
*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 6/1/2009
Time of Run: 2:22PM
Run By: CVA
Input Data Filename: C:d-orig3.si
Output Filename: C:d-orig3.OUT
Unit System: SI

Plotted Output Filename: C:d-orig3.PLT

PROBLEM DESCRIPTION: D Line Walls at Original Bridge,
No Col Ftg, Ptotal=49 kN/meter of Wall

BOUNDARY COORDINATES

7 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	9.93	20.34	9.93	1
2	20.34	9.93	20.35	12.37	1
3	20.35	12.37	25.14	15.56	1
4	25.14	15.56	25.15	14.26	1
5	25.15	14.26	26.09	14.26	1
6	26.09	14.26	26.10	16.50	1
7	26.10	16.50	40.00	16.50	1
8	0.00	8.40	20.00	8.50	2
9	20.00	8.50	25.00	9.93	2
10	25.00	9.93	40.00	9.93	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	9.6	32.0	0.00	0.0	0
2	18.8	18.8	0.0	35.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	25.15	26.09	195.0	0.0
2	26.10	40.00	12.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

TIEBACK LOAD(S)

1 Tieback Load(s) Specified

Tieback No.	X-Pos (m)	Y-Pos (m)	Load (kN)	Spacing (m)	Inclination (deg)	Length (m)	Force Method
1	20.34	11.15	49.0	1.0	0.00	0.0	2

NOTE - An Equivalent Line Load Is Calculated For Each Row Of Tiebacks
Assuming A Uniform Distribution Of Load Horizontally Between Individual
Tiebacks. Force Method 1 Considers Only Tangential Tieback Forces.
Force Method 2 Considers Both Tangential and Normal Tieback Forces.

Janbus Empirical Coef is being used for the case of c & phi both > 0

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.

The Active And Passive Portions Of The Sliding Surfaces
Are Generated According To The Rankine Theory.

500 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 1.0

Box No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Height (m)
1	20.20	9.60	20.40	9.60	0.20
2	28.00	14.50	37.00	14.50	3.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Simplified Janbu Method * *

Total Number of Trial Surfaces Evaluated = 500

Statistical Data On All Valid FS Values:
FS Max = 3.237 FS Min = 1.503 FS Ave = 2.219
Standard Deviation = 0.416 Coefficient of Variation = 18.76 %

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.69	9.93
2	20.31	9.59
3	28.05	15.77
4	28.46	16.50

Factor of Safety
*** 1.503 ***

Individual data on the 9 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.6	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4.8	228.5	0.0	0.0	22.9	40.5	0.0	0.0	0.0
5	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.9	8.0	0.0	0.0	0.7	3.3	0.0	0.0	183.3
7	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1.9	57.9	0.0	0.0	0.0	0.0	0.0	0.0	23.4
9	0.4	2.9	0.0	0.0	0.0	0.0	0.0	0.0	4.9

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.74	9.93
2	20.32	9.61
3	28.41	15.92
4	28.73	16.50

Factor of Safety
*** 1.512 ***

1

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.52	9.93
2	20.28	9.51
3	28.14	15.58
4	28.62	16.46
5	28.65	16.50

Factor of Safety
*** 1.522 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.82	9.93
2	20.31	9.66
3	28.56	15.91
4	28.89	16.50

Factor of Safety
*** 1.523 ***

1

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.85	9.93
2	20.30	9.69
3	28.35	15.75
4	28.77	16.50

Factor of Safety
*** 1.527 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.58	9.93
2	20.29	9.53
3	28.50	15.74
4	28.92	16.50

Factor of Safety
*** 1.531 ***

1

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.63	9.93
2	20.30	9.55
3	28.86	15.89
4	29.19	16.50

Factor of Safety
*** 1.538 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.72	9.93
2	20.25	9.63
3	28.23	15.40
4	28.71	16.28
5	28.83	16.50

Factor of Safety
*** 1.538 ***

1

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.71	9.93
2	20.30	9.60
3	29.01	15.89
4	29.35	16.50

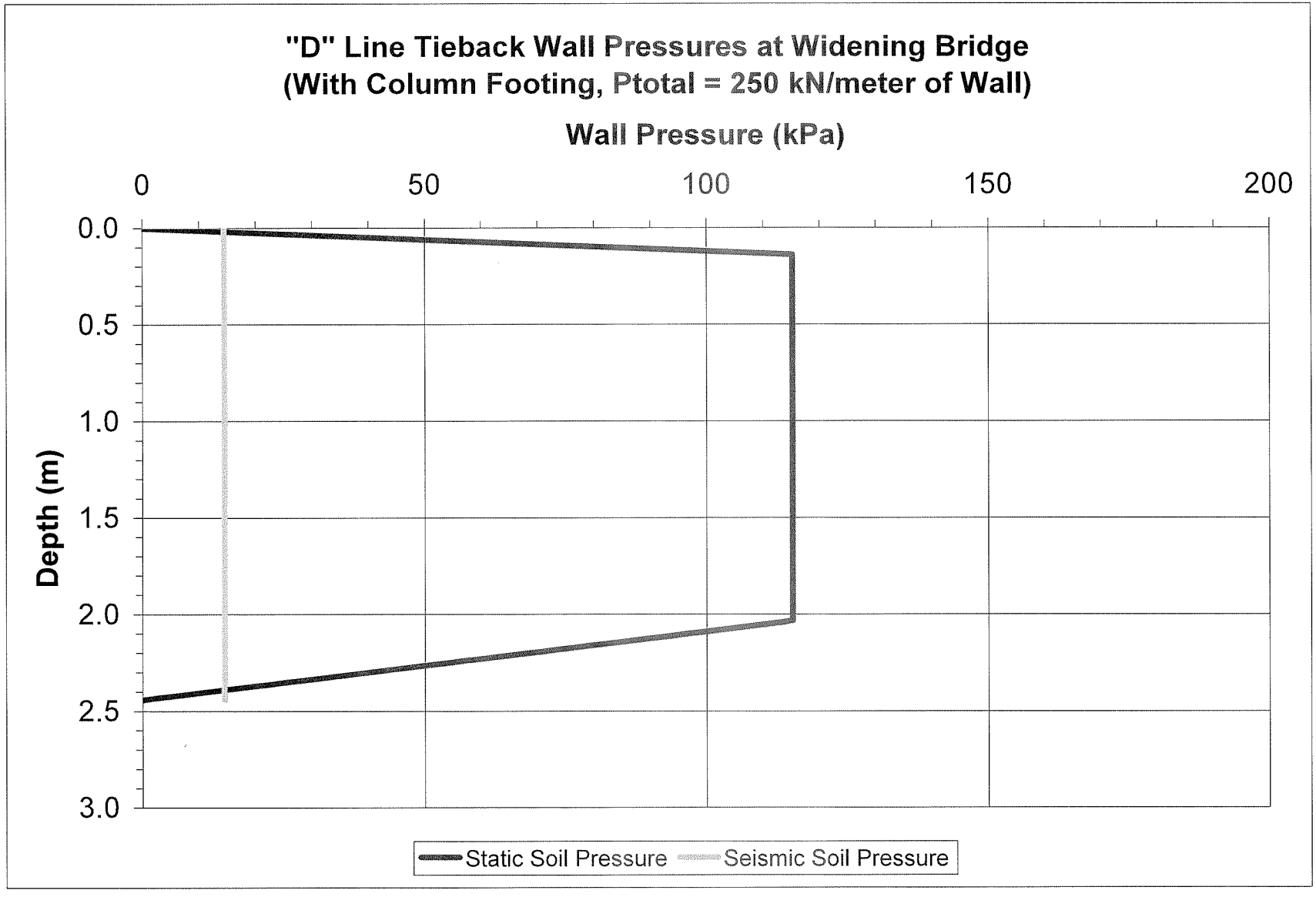
Factor of Safety
*** 1.541 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.62	9.93
2	20.38	9.51
3	28.19	14.87
4	28.68	15.75
5	29.09	16.50

Factor of Safety
*** 1.553 ***

**** END OF GSTABL7 OUTPUT ****


"D" Line Tieback Wall Pressures at Widening Bridge
(With Column Footing, Ptotal = 250 kN/meter of Wall)
Wall Pressure (kPa)
0
50
100
150
200
Depth (m)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Static Soil Pressure
Seismic Soil Pressure

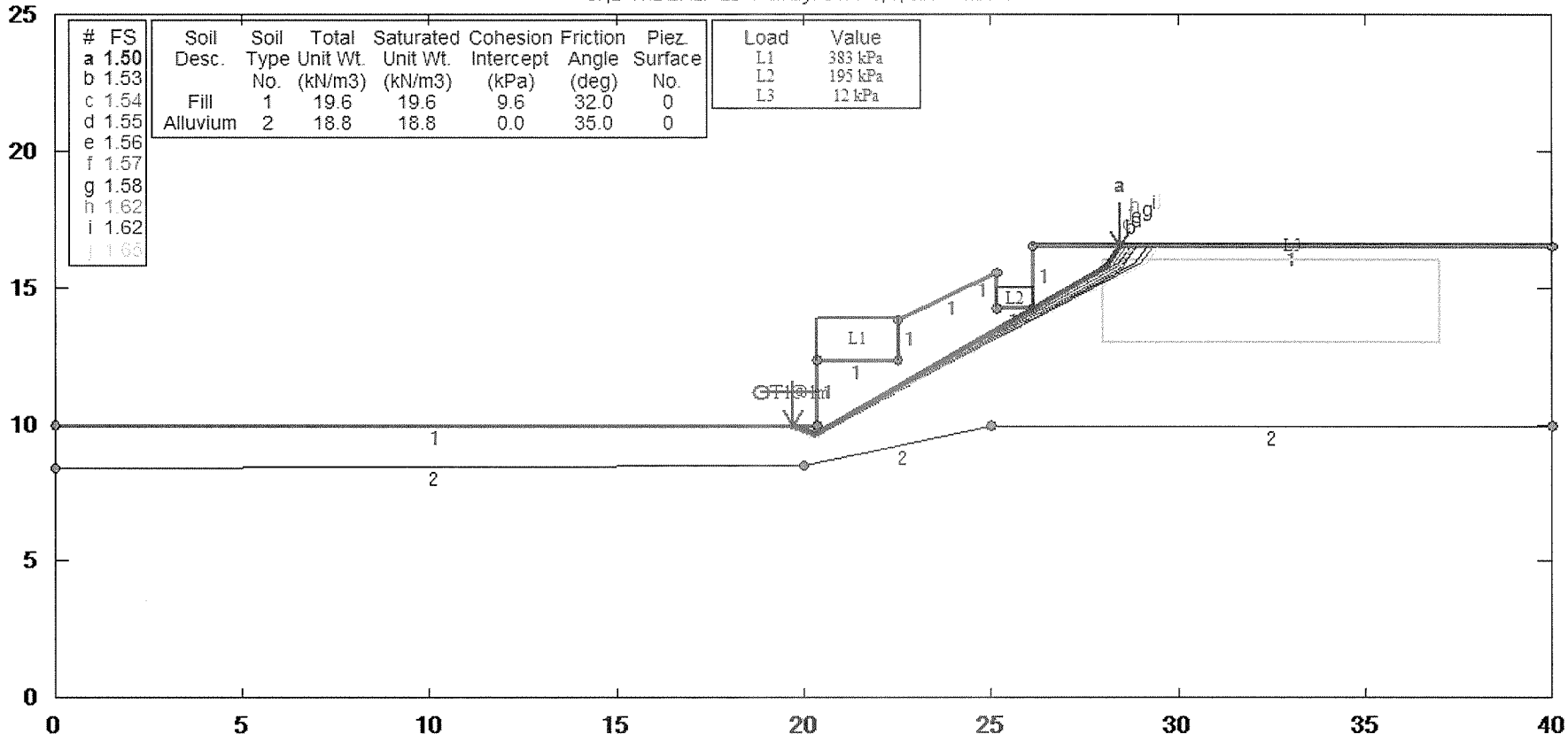
D Line Walls at Widening Bridge, Ptotal=250 kN/meter of Wall

C:\D-WIDEN2.PL2 Run By: CVA 6/1/2009 2:23PM

#	FS
a	1.50
b	1.53
c	1.54
d	1.55
e	1.56
f	1.57
g	1.58
h	1.62
i	1.62
j	1.65

Soil Desc.	Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Piez. Surface No.
Fill	1	19.6	19.6	9.6	32.0	0
Alluvium	2	18.8	18.8	0.0	35.0	0

Load	Value
L1	383 kPa
L2	195 kPa
L3	12 kPa



GSTABL7 v.2 FSmin=1.50

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 6/1/2009
Time of Run: 2:23PM
Run By: CVA
Input Data Filename: C:d-widen2.si
Output Filename: C:d-widen2.OUT
Unit System: SI

Plotted Output Filename: C:d-widen2.PLT

PROBLEM DESCRIPTION: D Line Walls at Widening Bridge,
Ptotal=250 kN/meter of Wall

BOUNDARY COORDINATES

9 Top Boundaries
12 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	9.93	20.34	9.93	1
2	20.34	9.93	20.35	12.37	1
3	20.35	12.37	22.50	12.37	1
4	22.50	12.37	22.51	13.81	1
5	22.51	13.81	25.14	15.56	1
6	25.14	15.56	25.15	14.26	1
7	25.15	14.26	26.09	14.26	1
8	26.09	14.26	26.10	16.50	1
9	26.10	16.50	40.00	16.50	1
10	0.00	8.40	20.00	8.50	2
11	20.00	8.50	25.00	9.93	2
12	25.00	9.93	40.00	9.93	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	9.6	32.0	0.00	0.0	0
2	18.8	18.8	0.0	35.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

3 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	20.35	22.50	383.0	0.0
2	25.15	26.09	195.0	0.0
3	26.10	40.00	12.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

TIEBACK LOAD(S)

1 Tieback Load(s) Specified

Tieback No.	X-Pos (m)	Y-Pos (m)	Load (kN)	Spacing (m)	Inclination (deg)	Length (m)	Force Method
1	20.34	11.15	250.0	1.0	0.00	0.0	2

NOTE - An Equivalent Line Load Is Calculated For Each Row Of Tiebacks
Assuming A Uniform Distribution Of Load Horizontally Between Individual
Tiebacks. Force Method 1 Considers Only Tangential Tieback Forces.
Force Method 2 Considers Both Tangential and Normal Tieback Forces.

Janbus Empirical Coef is being used for the case of c & phi both > 0

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.

The Active And Passive Portions Of The Sliding Surfaces
Are Generated According To The Rankine Theory.

500 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 1.0

Box No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Height (m)
1	20.20	9.60	20.40	9.60	0.20
2	28.00	14.50	37.00	14.50	3.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Simplified Janbu Method * *

Total Number of Trial Surfaces Evaluated = 500

Statistical Data On All Valid FS Values:
FS Max = 5.000 FS Min = 1.495 FS Ave = 2.930
Standard Deviation = 0.759 Coefficient of Variation = 25.91 %

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.69	9.93
2	20.31	9.59
3	28.05	15.77
4	28.46	16.50

Factor of Safety
*** 1.495 ***

Individual data on the 11 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.6	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	2.2	79.7	0.0	0.0	182.1	65.2	0.0	0.0	823.5
5	0.0	0.3	0.0	0.0	0.3	0.5	0.0	0.0	0.0
6	2.6	118.2	0.0	0.0	29.1	85.1	0.0	0.0	0.0
7	0.0	0.3	0.0	0.0	0.1	0.2	0.0	0.0	0.0
8	0.9	8.0	0.0	0.0	0.0	0.0	0.0	0.0	183.3
9	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	1.9	57.9	0.0	0.0	0.0	0.0	0.0	0.0	23.4
11	0.4	2.9	0.0	0.0	0.0	0.0	0.0	0.0	4.9

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.74	9.93
2	20.32	9.61
3	28.41	15.92
4	28.73	16.50

Factor of Safety
*** 1.533 ***

1

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)

1	19.52	9.93
2	20.28	9.51
3	28.14	15.58
4	28.62	16.46
5	28.65	16.50

Factor of Safety
*** 1.545 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.82	9.93
2	20.31	9.66
3	28.56	15.91
4	28.89	16.50

Factor of Safety
*** 1.554 ***

1

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.58	9.93
2	20.29	9.53
3	28.50	15.74
4	28.92	16.50

Factor of Safety
*** 1.557 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.85	9.93
2	20.30	9.69
3	28.35	15.75
4	28.77	16.50

Factor of Safety
*** 1.565 ***

1

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)

1	19.63	9.93
2	20.30	9.55
3	28.86	15.89
4	29.19	16.50

Factor of Safety
*** 1.582 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.72	9.93
2	20.25	9.63
3	28.23	15.40
4	28.71	16.28
5	28.83	16.50

Factor of Safety
*** 1.616 ***

1

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.71	9.93
2	20.30	9.60
3	29.01	15.89
4	29.35	16.50

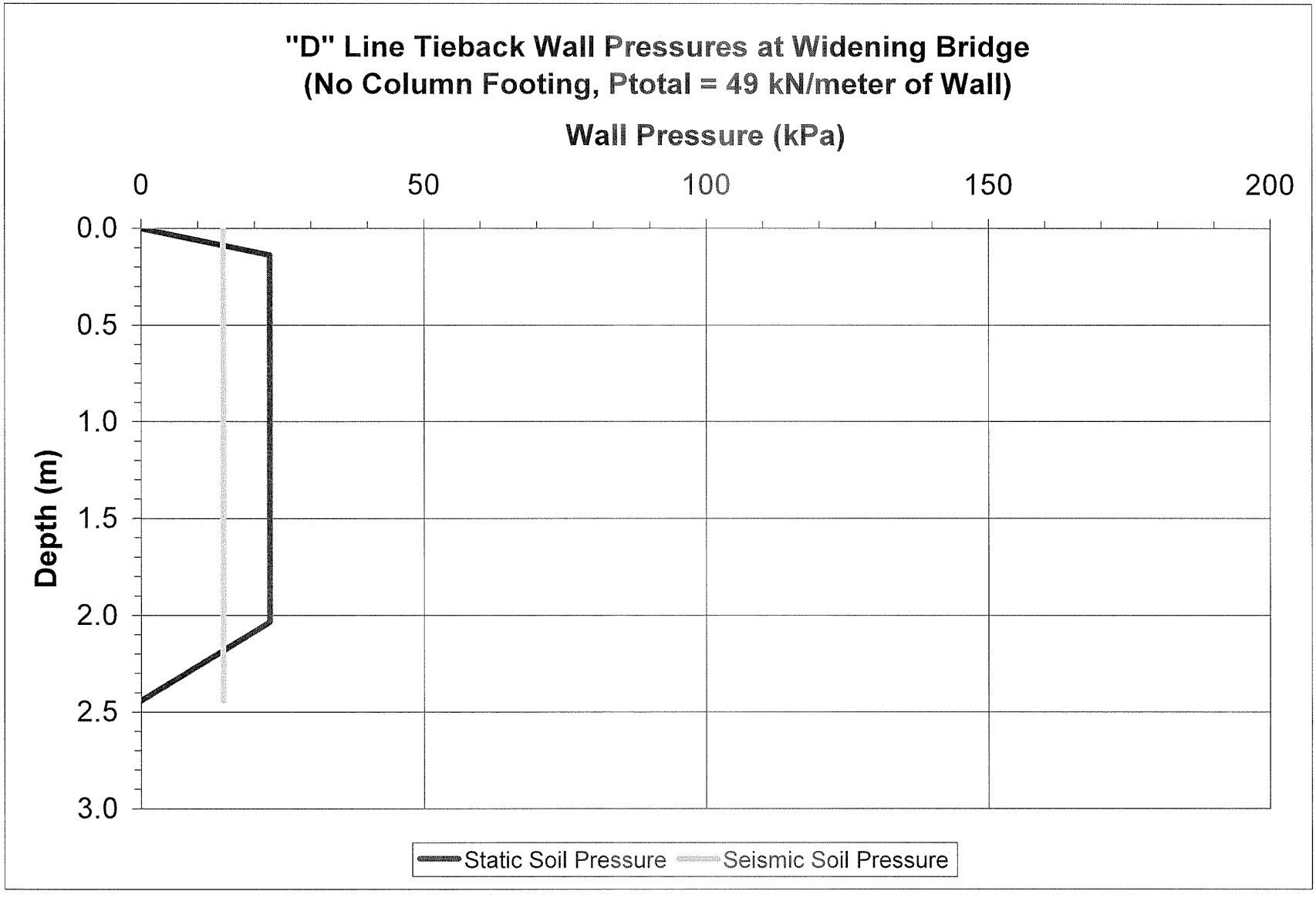
Factor of Safety
*** 1.617 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.79	9.93
2	20.30	9.65
3	29.16	15.88
4	29.50	16.50

Factor of Safety
*** 1.654 ***

**** END OF GSTABL7 OUTPUT ****


"D" Line Tieback Wall Pressures at Widening Bridge
(No Column Footing, Ptotal = 49 kN/meter of Wall)
Wall Pressure (kPa)
0
50
100
150
200
Depth (m)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Static Soil Pressure
Seismic Soil Pressure

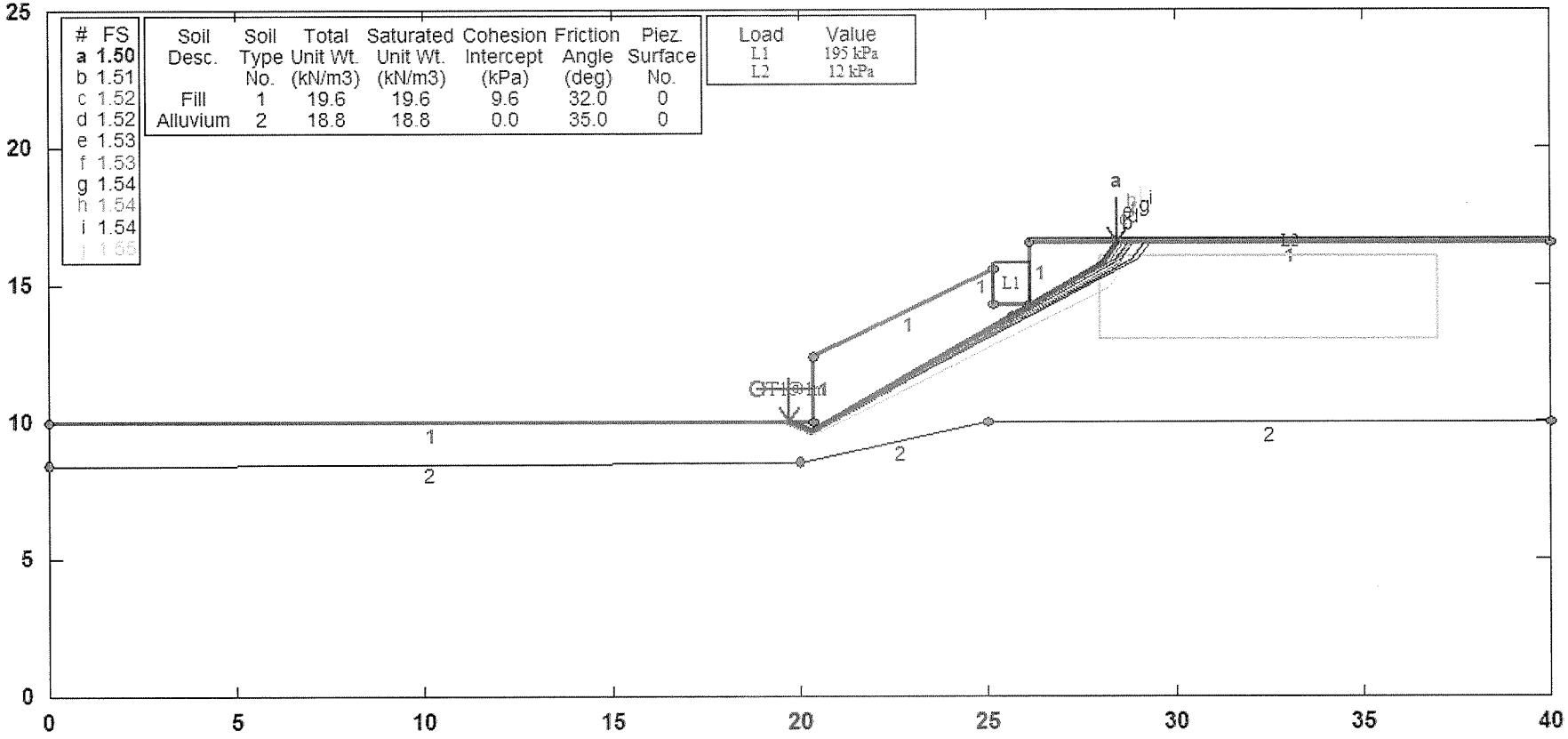
D Line Walls at Widening Bridge, No Col Ftg, Ptotal=49 kN/meter of Wall

C:\D-WIDEN3.PL2 Run By: CVA 6/1/2009 2:24PM

#	FS
a	1.50
b	1.51
c	1.52
d	1.52
e	1.53
f	1.53
g	1.54
h	1.54
i	1.54
j	1.55

Soil Desc.	Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Piez. Surface No.
Fill	1	19.6	19.6	9.6	32.0	0
Alluvium	2	18.8	18.8	0.0	35.0	0

Load	Value
L1	195 kPa
L2	12 kPa



GSTABL7 v.2 FSmin=1.50

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

d-widen3.OUT
*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 6/1/2009
Time of Run: 3:06PM
Run By: CVA
Input Data Filename: C:d-widen3.si
Output Filename: C:d-widen3.OUT
Unit System: SI

Plotted Output Filename: C:d-widen3.PLT

PROBLEM DESCRIPTION: D Line Walls at Widening Bridge,
No Col Ftg, Ptotal=49 kN/meter of Wall

BOUNDARY COORDINATES

7 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	9.93	20.34	9.93	1
2	20.34	9.93	20.35	12.37	1
3	20.35	12.37	25.14	15.56	1
4	25.14	15.56	25.15	14.26	1
5	25.15	14.26	26.09	14.26	1
6	26.09	14.26	26.10	16.50	1
7	26.10	16.50	40.00	16.50	1
8	0.00	8.40	20.00	8.50	2
9	20.00	8.50	25.00	9.93	2
10	25.00	9.93	40.00	9.93	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	9.6	32.0	0.00	0.0	0
2	18.8	18.8	0.0	35.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	25.15	26.09	195.0	0.0
2	26.10	40.00	12.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

TIEBACK LOAD(S)

1 Tieback Load(s) Specified

Tieback No.	X-Pos (m)	Y-Pos (m)	Load (kN)	Spacing (m)	Inclination (deg)	Length (m)	Force Method
1	20.34	11.15	49.0	1.0	0.00	0.0	2

NOTE - An Equivalent Line Load Is Calculated For Each Row Of Tiebacks
Assuming A Uniform Distribution Of Load Horizontally Between Individual
Tiebacks. Force Method 1 Considers Only Tangential Tieback Forces.
Force Method 2 Considers Both Tangential and Normal Tieback Forces.

Janbus Empirical Coef is being used for the case of c & phi both > 0

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Sliding Block Surfaces, Has Been
Specified.

The Active And Passive Portions Of The Sliding Surfaces
Are Generated According To The Rankine Theory.

500 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of
Sliding Block Is 1.0

Box No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Height (m)
1	20.20	9.60	20.40	9.60	0.20
2	28.00	14.50	37.00	14.50	3.00

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Simplified Janbu Method * *

Total Number of Trial Surfaces Evaluated = 500

Statistical Data On All Valid FS Values:
FS Max = 3.237 FS Min = 1.503 FS Ave = 2.219
Standard Deviation = 0.416 Coefficient of Variation = 18.76 %

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.69	9.93
2	20.31	9.59
3	28.05	15.77
4	28.46	16.50

Factor of Safety
*** 1.503 ***

Individual data on the 9 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.6	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4.8	228.5	0.0	0.0	22.9	40.5	0.0	0.0	0.0
5	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.9	8.0	0.0	0.0	0.7	3.3	0.0	0.0	183.3
7	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1.9	57.9	0.0	0.0	0.0	0.0	0.0	0.0	23.4
9	0.4	2.9	0.0	0.0	0.0	0.0	0.0	0.0	4.9

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.74	9.93
2	20.32	9.61
3	28.41	15.92
4	28.73	16.50

Factor of Safety
*** 1.512 ***

1

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.52	9.93
2	20.28	9.51
3	28.14	15.58
4	28.62	16.46
5	28.65	16.50

Factor of Safety
*** 1.522 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.82	9.93
2	20.31	9.66
3	28.56	15.91
4	28.89	16.50

Factor of Safety
*** 1.523 ***

1

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.85	9.93
2	20.30	9.69
3	28.35	15.75
4	28.77	16.50

Factor of Safety
*** 1.527 ***

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.58	9.93
2	20.29	9.53
3	28.50	15.74
4	28.92	16.50

Factor of Safety
*** 1.531 ***

1

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.63	9.93
2	20.30	9.55
3	28.86	15.89
4	29.19	16.50

Factor of Safety
*** 1.538 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.72	9.93
2	20.25	9.63
3	28.23	15.40
4	28.71	16.28
5	28.83	16.50

Factor of Safety
*** 1.538 ***

1

Failure Surface Specified By 4 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.71	9.93
2	20.30	9.60
3	29.01	15.89
4	29.35	16.50

Factor of Safety
*** 1.541 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	19.62	9.93
2	20.38	9.51
3	28.19	14.87
4	28.68	15.75
5	29.09	16.50

Factor of Safety
*** 1.553 ***

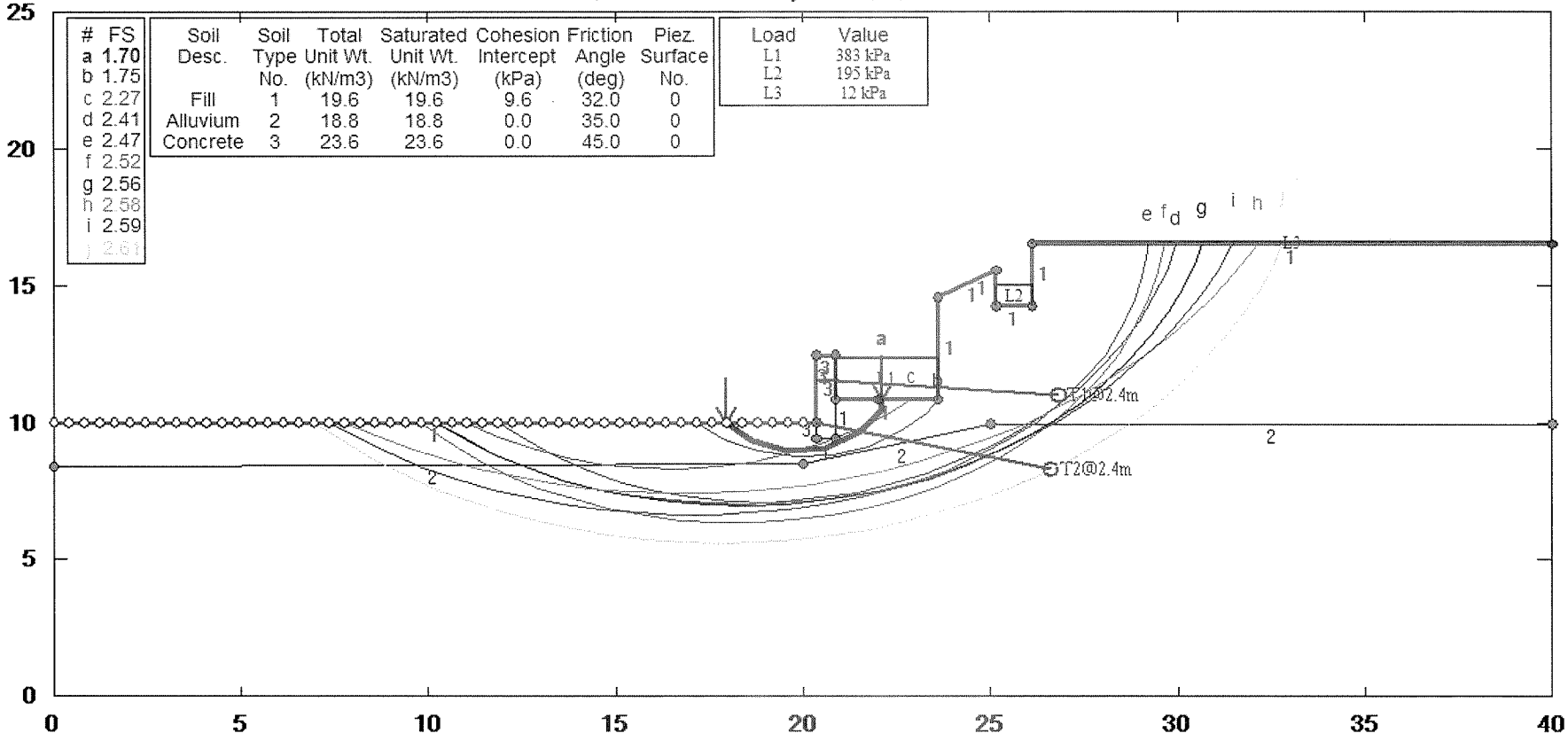
**** END OF GSTABL7 OUTPUT ****

C-3

SLOPE STABILITY

RW-19 Section F-G, Static

C:\RW19-FG1.PL2 Run By: CVA 6/17/2009 12:08PM



#	FS
a	1.70
b	1.75
c	2.27
d	2.41
e	2.47
f	2.52
g	2.56
h	2.58
i	2.59
j	2.61

Soil Desc.	Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Piez. Surface No.
Fill	1	19.6	19.6	9.6	32.0	0
Alluvium	2	18.8	18.8	0.0	35.0	0
Concrete	3	23.6	23.6	0.0	45.0	0

Load	Value
L1	383 kPa
L2	195 kPa
L3	12 kPa

GSTABL7 v.2 FSmin=1.70

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 6/17/2009
Time of Run: 12:31PM
Run By: CVA
Input Data Filename: C:rw19-fg1.si
Output Filename: C:rw19-fg1.OUT
Unit System: SI

Plotted Output Filename: C:rw19-fg1.PLT

PROBLEM DESCRIPTION: RW-19 Section F-G,
Static

BOUNDARY COORDINATES

11 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	10.00	20.34	10.00	1
2	20.34	10.00	20.35	12.47	3
3	20.35	12.47	20.83	12.47	3
4	20.83	12.47	20.84	10.84	3
5	20.84	10.84	23.58	10.84	1
6	23.58	10.84	23.59	14.53	1
7	23.59	14.53	25.14	15.56	1
8	25.14	15.56	25.15	14.26	1
9	25.15	14.26	26.09	14.26	1
10	26.09	14.26	26.10	16.50	1
11	26.10	16.50	40.00	16.50	1
12	20.34	10.00	20.35	9.39	3
13	20.35	9.39	20.83	9.39	1
14	20.83	9.39	20.84	10.84	1
15	0.00	8.40	20.00	8.50	2
16	20.00	8.50	25.00	9.93	2
17	25.00	9.93	40.00	9.93	2

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type	Total Unit Wt.	Saturated Unit Wt.	Cohesion Intercept	Friction Angle	Pore Pressure	Pressure Constant	Piez. Surface

No.	(kN/m3)	(kN/m3)	(kPa)	(deg)	Param.	(kPa)	No.
1	19.6	19.6	9.6	32.0	0.00	0.0	0
2	18.8	18.8	0.0	35.0	0.00	0.0	0
3	23.6	23.6	0.0	45.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

3 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	20.84	23.58	383.0	0.0
2	25.15	26.09	195.0	0.0
3	26.10	40.00	12.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

TIEBACK LOAD(S)

2 Tieback Load(s) Specified

Tieback No.	X-Pos (m)	Y-Pos (m)	Load (kN)	Spacing (m)	Inclination (deg)	Length (m)	Force Method
1	20.35	11.56	300.0	2.4	5.00	6.5	2
2	20.34	10.00	350.0	2.4	15.00	6.5	2

NOTE - An Equivalent Line Load Is Calculated For Each Row Of Tiebacks
Assuming A Uniform Distribution Of Load Horizontally Between Individual
Tiebacks. Force Method 1 Considers Only Tangential Tieback Forces.
Force Method 2 Considers Both Tangential and Normal Tieback Forces.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

5000 Trial Surfaces Have Been Generated.

100 Surfaces Initiate From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 20.00(m)

Each Surface Terminates Between X = 22.00(m)
and X = 40.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

1.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are

Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 5000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 20 Iterations.

Number of Trial Surfaces with Non-Converged FS = 1

Number of Trial Surfaces with Misleading FS = 2948

Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Evaluated = 59.0 %

Statistical Data On All Valid FS Values:
FS Max = 492.408 FS Min = 1.699 FS Ave = 7.907
Standard Deviation = 19.614 Coefficient of Variation = 248.07 %

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	17.96	10.00
2	18.67	9.30
3	19.62	8.97
4	20.61	9.07
5	21.47	9.59
6	22.03	10.41
7	22.10	10.84

Circle Center At X = 19.9 ; Y = 11.3 and Radius, 2.3

Factor of Safety
*** 1.699 ***

Individual data on the 10 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.7	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.9	16.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.7	14.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.3	20.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.2	16.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.6	17.9	0.0	0.0	0.0	0.0	0.0	0.0	241.5
9	0.6	9.2	0.0	0.0	125.2	84.3	0.0	0.0	213.9
10	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	25.4

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	17.14	10.00

2	17.92	9.37
3	18.82	8.94
4	19.80	8.75
5	20.80	8.81
6	21.76	9.11
7	22.61	9.64
8	23.30	10.36
9	23.58	10.84

Circle Center At X = 20.1 ; Y = 12.8 and Radius, 4.0

Factor of Safety
*** 1.753 ***

I

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	11.02	10.00
2	11.87	9.47
3	12.77	9.04
4	13.72	8.71
5	14.69	8.47
6	15.68	8.34
7	16.68	8.31
8	17.68	8.39
9	18.66	8.57
10	19.62	8.86
11	20.54	9.24
12	21.42	9.72
13	22.24	10.29
14	22.89	10.84

Circle Center At X = 16.4 ; Y = 17.8 and Radius, 9.5

Factor of Safety
*** 2.267 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	10.20	10.00
2	10.98	9.37
3	11.81	8.81
4	12.69	8.33
5	13.60	7.91
6	14.54	7.57
7	15.50	7.31
8	16.49	7.13
9	17.48	7.04
10	18.48	7.02
11	19.48	7.09
12	20.47	7.24
13	21.44	7.47
14	22.39	7.78
15	23.31	8.17
16	24.20	8.63
17	25.04	9.17
18	25.84	9.77
19	26.59	10.44

20	27.28	11.16
21	27.90	11.94
22	28.46	12.77
23	28.95	13.64
24	29.36	14.55
25	29.70	15.49
26	29.96	16.46
27	29.97	16.50

Circle Center At X = 18.2 ; Y = 19.1 and Radius, 12.1

Factor of Safety
*** 2.413 ***

1

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	11.84	10.00
2	12.58	9.33
3	13.39	8.74
4	14.25	8.23
5	15.16	7.81
6	16.10	7.48
7	17.07	7.24
8	18.06	7.10
9	19.06	7.05
10	20.06	7.10
11	21.05	7.26
12	22.02	7.50
13	22.96	7.84
14	23.86	8.27
15	24.71	8.79
16	25.52	9.39
17	26.26	10.06
18	26.93	10.80
19	27.52	11.61
20	28.03	12.46
21	28.46	13.37
22	28.80	14.31
23	29.04	15.28
24	29.19	16.27
25	29.20	16.50

Circle Center At X = 19.0 ; Y = 17.3 and Radius, 10.2

Factor of Safety
*** 2.470 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	9.80	10.00
2	10.51	9.30
3	11.28	8.66
4	12.10	8.09
5	12.97	7.60
6	13.88	7.18
7	14.82	6.84
8	15.79	6.59

9	16.77	6.42
10	17.77	6.34
11	18.77	6.34
12	19.77	6.43
13	20.75	6.61
14	21.72	6.87
15	22.65	7.22
16	23.56	7.64
17	24.42	8.14
18	25.24	8.72
19	26.01	9.36
20	26.71	10.07
21	27.36	10.84
22	27.93	11.66
23	28.43	12.52
24	28.85	13.43
25	29.19	14.37
26	29.45	15.34
27	29.63	16.32
28	29.64	16.50

Circle Center At X = 18.2 ; Y = 17.8 and Radius, 11.5

Factor of Safety
*** 2.516 ***

1

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	10.20	10.00
2	10.99	9.38
3	11.82	8.82
4	12.69	8.33
5	13.60	7.92
6	14.54	7.57
7	15.50	7.30
8	16.48	7.11
9	17.48	7.00
10	18.48	6.96
11	19.48	7.01
12	20.47	7.13
13	21.45	7.33
14	22.41	7.61
15	23.34	7.96
16	24.25	8.39
17	25.12	8.89
18	25.94	9.45
19	26.72	10.08
20	27.45	10.77
21	28.12	11.51
22	28.72	12.30
23	29.27	13.14
24	29.74	14.02
25	30.15	14.94
26	30.48	15.88
27	30.64	16.50

Circle Center At X = 18.4 ; Y = 19.6 and Radius, 12.6

Factor of Safety
*** 2.559 ***

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.76	10.00
2	8.62	9.50
3	9.52	9.05
4	10.43	8.66
5	11.37	8.31
6	12.33	8.03
7	13.30	7.79
8	14.29	7.62
9	15.28	7.50
10	16.28	7.43
11	17.28	7.43
12	18.28	7.48
13	19.27	7.59
14	20.26	7.76
15	21.23	7.98
16	22.19	8.26
17	23.14	8.59
18	24.06	8.98
19	24.96	9.42
20	25.83	9.90
21	26.67	10.44
22	27.48	11.03
23	28.26	11.66
24	28.99	12.34
25	29.69	13.05
26	30.35	13.81
27	30.96	14.60
28	31.52	15.43
29	32.04	16.28
30	32.15	16.50

Circle Center At X = 16.9 ; Y = 24.8 and Radius, 17.4

Factor of Safety
*** 2.583 ***

1

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.35	10.00
2	8.15	9.40
3	8.99	8.86
4	9.86	8.37
5	10.76	7.93
6	11.69	7.56
7	12.64	7.24
8	13.60	6.99
9	14.59	6.80
10	15.58	6.68
11	16.58	6.62
12	17.58	6.62
13	18.57	6.69
14	19.57	6.82
15	20.55	7.01
16	21.51	7.27
17	22.46	7.59
18	23.38	7.97
19	24.28	8.41
20	25.15	8.91
21	25.99	9.46

22	26.78	10.06
23	27.54	10.72
24	28.25	11.42
25	28.92	12.16
26	29.54	12.95
27	30.10	13.77
28	30.61	14.63
29	31.07	15.52
30	31.46	16.44
31	31.48	16.50

Circle Center At X = 17.0 ; Y = 22.1 and Radius, 15.5

Factor of Safety
*** 2.590 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	6.94	10.00
2	7.68	9.33
3	8.47	8.71
4	9.29	8.14
5	10.15	7.62
6	11.03	7.16
7	11.95	6.76
8	12.89	6.42
9	13.84	6.13
10	14.82	5.91
11	15.81	5.75
12	16.80	5.65
13	17.80	5.61
14	18.80	5.64
15	19.80	5.74
16	20.78	5.89
17	21.76	6.11
18	22.72	6.39
19	23.66	6.73
20	24.58	7.13
21	25.47	7.58
22	26.33	8.09
23	27.15	8.66
24	27.94	9.28
25	28.69	9.94
26	29.39	10.65
27	30.05	11.41
28	30.65	12.20
29	31.21	13.03
30	31.71	13.90
31	32.16	14.79
32	32.55	15.71
33	32.82	16.50

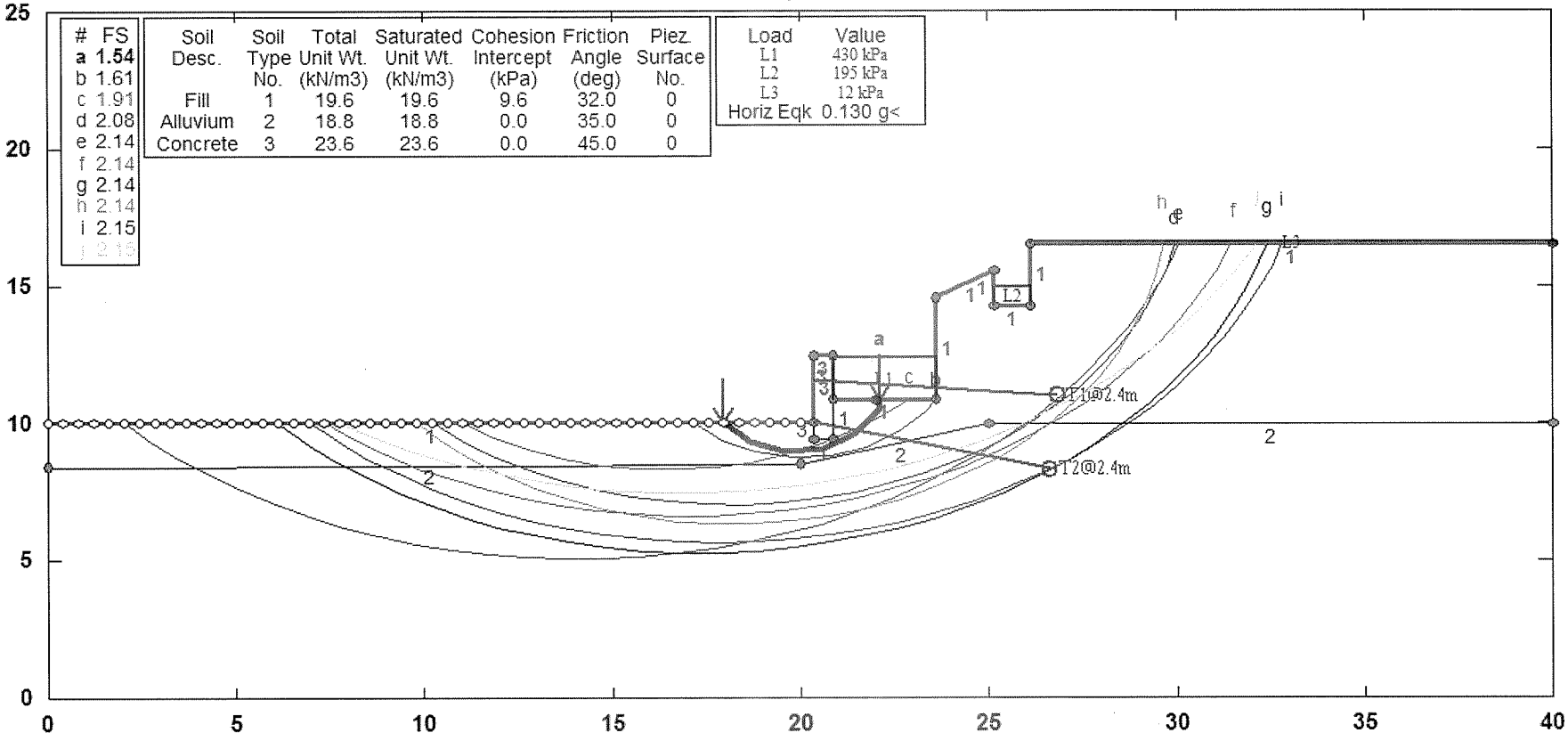
Circle Center At X = 17.8 ; Y = 21.4 and Radius, 15.8

Factor of Safety
*** 2.607 ***

**** END OF GSTABL7 OUTPUT ****

RW-19 Section F-G, Seismic

C:\RW19-FG2.PL2 Run By: CVA 6/17/2009 12:10PM



#	FS
a	1.54
b	1.61
c	1.91
d	2.08
e	2.14
f	2.14
g	2.14
h	2.14
i	2.15
j	2.15

Soil Desc.	Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Piez. Surface No.
Fill	1	19.6	19.6	9.6	32.0	0
Alluvium	2	18.8	18.8	0.0	35.0	0
Concrete	3	23.6	23.6	0.0	45.0	0

Load	Value
L1	430 kPa
L2	195 kPa
L3	12 kPa
Horiz Eqk	0.130 g<

GSTABL7 v.2 FSmin=1.54

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 6/17/2009
Time of Run: 12:10PM
Run By: CVA
Input Data Filename: C:RW19-FG2.SI
Output Filename: C:RW19-FG2.OUT
Unit System: SI

Plotted Output Filename: C:RW19-FG2.PLT

PROBLEM DESCRIPTION: RW-19 Section F-G,
Seismic

BOUNDARY COORDINATES

11 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	10.00	20.34	10.00	1
2	20.34	10.00	20.35	12.47	3
3	20.35	12.47	20.83	12.47	3
4	20.83	12.47	20.84	10.84	3
5	20.84	10.84	23.58	10.84	1
6	23.58	10.84	23.59	14.53	1
7	23.59	14.53	25.14	15.56	1
8	25.14	15.56	25.15	14.26	1
9	25.15	14.26	26.09	14.26	1
10	26.09	14.26	26.10	16.50	1
11	26.10	16.50	40.00	16.50	1
12	20.34	10.00	20.35	9.39	3
13	20.35	9.39	20.83	9.39	1
14	20.83	9.39	20.84	10.84	1
15	0.00	8.40	20.00	8.50	2
16	20.00	8.50	25.00	9.93	2
17	25.00	9.93	40.00	9.93	2

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type	Total Unit Wt.	Saturated Unit Wt.	Cohesion Intercept	Friction Angle	Pore Pressure	Pressure Constant	Piez. Surface

No.	(kN/m3)	(kN/m3)	(kPa)	(deg)	Param.	(kPa)	No.
1	19.6	19.6	9.6	32.0	0.00	0.0	0
2	18.8	18.8	0.0	35.0	0.00	0.0	0
3	23.6	23.6	0.0	45.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

3 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	20.84	23.58	430.0	0.0
2	25.15	26.09	195.0	0.0
3	26.10	40.00	12.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

TIEBACK LOAD(S)

2 Tieback Load(s) Specified

Tieback No.	X-Pos (m)	Y-Pos (m)	Load (kN)	Spacing (m)	Inclination (deg)	Length (m)	Force Method
1	20.35	11.56	300.0	2.4	5.00	6.5	2
2	20.34	10.00	350.0	2.4	15.00	6.5	2

NOTE - An Equivalent Line Load Is Calculated For Each Row Of Tiebacks
Assuming A Uniform Distribution Of Load Horizontally Between Individual
Tiebacks. Force Method 1 Considers Only Tangential Tieback Forces.
Force Method 2 Considers Both Tangential and Normal Tieback Forces.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

5000 Trial Surfaces Have Been Generated.

100 Surfaces Initiate From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 20.00(m)

Each Surface Terminates Between X = 22.00(m)
and X = 40.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

1.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 5000

Number of Trial Surfaces with Misleading FS = 2852

Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Evaluated = 57.0 %

Statistical Data On All Valid FS Values:
FS Max = 471.849 FS Min = 1.540 FS Ave = 8.744
Standard Deviation = 30.392 Coefficient of Variation = 347.56 %

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	17.96	10.00
2	18.67	9.30
3	19.62	8.97
4	20.61	9.07
5	21.47	9.59
6	22.03	10.41
7	22.10	10.84

Circle Center At X = 19.9 ; Y = 11.3 and Radius, 2.3

Factor of Safety
*** 1.540 ***

Individual data on the 10 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.7	4.9	0.0	0.0	0.0	0.0	0.6	0.0	0.0
2	0.9	16.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0
3	0.7	14.1	0.0	0.0	0.0	0.0	1.8	0.0	0.0
4	0.0	0.5	0.0	0.0	0.0	0.0	0.1	0.0	0.0
5	0.3	20.8	0.0	0.0	0.0	0.0	2.7	0.0	0.0
6	0.2	16.9	0.0	0.0	0.0	0.0	2.2	0.0	0.0
7	0.0	0.5	0.0	0.0	0.0	0.0	0.1	0.0	0.0
8	0.6	17.9	0.0	0.0	0.0	0.0	2.3	0.0	271.2
9	0.6	9.2	0.0	0.0	125.2	84.3	1.2	0.0	240.2
10	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	28.5

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)

1	17.14	10.00
2	17.92	9.37
3	18.82	8.94
4	19.80	8.75
5	20.80	8.81
6	21.76	9.11
7	22.61	9.64
8	23.30	10.36
9	23.58	10.84

Circle Center At X = 20.1 ; Y = 12.8 and Radius, 4.0

Factor of Safety
*** 1.614 ***

1

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	11.02	10.00
2	11.87	9.47
3	12.77	9.04
4	13.72	8.71
5	14.69	8.47
6	15.68	8.34
7	16.68	8.31
8	17.68	8.39
9	18.66	8.57
10	19.62	8.86
11	20.54	9.24
12	21.42	9.72
13	22.24	10.29
14	22.89	10.84

Circle Center At X = 16.4 ; Y = 17.8 and Radius, 9.5

Factor of Safety
*** 1.912 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	10.20	10.00
2	10.98	9.37
3	11.81	8.81
4	12.69	8.33
5	13.60	7.91
6	14.54	7.57
7	15.50	7.31
8	16.49	7.13
9	17.48	7.04
10	18.48	7.02
11	19.48	7.09
12	20.47	7.24
13	21.44	7.47
14	22.39	7.78
15	23.31	8.17
16	24.20	8.63
17	25.04	9.17

18	25.84	9.77
19	26.59	10.44
20	27.28	11.16
21	27.90	11.94
22	28.46	12.77
23	28.95	13.64
24	29.36	14.55
25	29.70	15.49
26	29.96	16.46
27	29.97	16.50

Circle Center At X = 18.2 ; Y = 19.1 and Radius, 12.1

Factor of Safety
*** 2.075 ***

1

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.04	10.00
2	2.77	9.31
3	3.53	8.67
4	4.34	8.07
5	5.17	7.53
6	6.04	7.03
7	6.94	6.58
8	7.86	6.19
9	8.80	5.85
10	9.76	5.57
11	10.73	5.35
12	11.72	5.18
13	12.71	5.08
14	13.71	5.03
15	14.71	5.04
16	15.71	5.11
17	16.70	5.23
18	17.68	5.42
19	18.65	5.66
20	19.61	5.97
21	20.54	6.32
22	21.45	6.73
23	22.34	7.20
24	23.20	7.71
25	24.02	8.28
26	24.81	8.89
27	25.56	9.55
28	26.28	10.25
29	26.95	10.99
30	27.57	11.77
31	28.15	12.59
32	28.68	13.44
33	29.16	14.31
34	29.58	15.22
35	29.95	16.15
36	30.07	16.50

Circle Center At X = 14.0 ; Y = 22.0 and Radius, 16.9

Factor of Safety
*** 2.140 ***

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.35	10.00
2	8.15	9.40
3	8.99	8.86
4	9.86	8.37
5	10.76	7.93
6	11.69	7.56
7	12.64	7.24
8	13.60	6.99
9	14.59	6.80
10	15.58	6.68
11	16.58	6.62
12	17.58	6.62
13	18.57	6.69
14	19.57	6.82
15	20.55	7.01
16	21.51	7.27
17	22.46	7.59
18	23.38	7.97
19	24.28	8.41
20	25.15	8.91
21	25.99	9.46
22	26.78	10.06
23	27.54	10.72
24	28.25	11.42
25	28.92	12.16
26	29.54	12.95
27	30.10	13.77
28	30.61	14.63
29	31.07	15.52
30	31.46	16.44
31	31.48	16.50

Circle Center At X = 17.0 ; Y = 22.1 and Radius, 15.5

Factor of Safety
*** 2.141 ***

1

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	6.12	10.00
2	6.84	9.31
3	7.61	8.66
4	8.41	8.06
5	9.25	7.52
6	10.12	7.03
7	11.02	6.59
8	11.95	6.22
9	12.89	5.90
10	13.86	5.65
11	14.84	5.45
12	15.83	5.32
13	16.83	5.26
14	17.83	5.26
15	18.83	5.32
16	19.82	5.44
17	20.80	5.63
18	21.77	5.88
19	22.72	6.19
20	23.65	6.56
21	24.56	6.99

22	25.43	7.47
23	26.27	8.01
24	27.08	8.61
25	27.84	9.25
26	28.57	9.94
27	29.24	10.68
28	29.87	11.45
29	30.45	12.27
30	30.98	13.12
31	31.45	14.00
32	31.86	14.91
33	32.22	15.85
34	32.42	16.50

Circle Center At X = 17.4 ; Y = 20.9 and Radius, 15.7

Factor of Safety
*** 2.144 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	9.80	10.00
2	10.51	9.30
3	11.28	8.66
4	12.10	8.09
5	12.97	7.60
6	13.88	7.18
7	14.82	6.84
8	15.79	6.59
9	16.77	6.42
10	17.77	6.34
11	18.77	6.34
12	19.77	6.43
13	20.75	6.61
14	21.72	6.87
15	22.65	7.22
16	23.56	7.64
17	24.42	8.14
18	25.24	8.72
19	26.01	9.36
20	26.71	10.07
21	27.36	10.84
22	27.93	11.66
23	28.43	12.52
24	28.85	13.43
25	29.19	14.37
26	29.45	15.34
27	29.63	16.32
28	29.64	16.50

Circle Center At X = 18.2 ; Y = 17.8 and Radius, 11.5

Factor of Safety
*** 2.145 ***

1

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)

1	6.94	10.00
2	7.68	9.33
3	8.47	8.71
4	9.29	8.14
5	10.15	7.62
6	11.03	7.16
7	11.95	6.76
8	12.89	6.42
9	13.84	6.13
10	14.82	5.91
11	15.81	5.75
12	16.80	5.65
13	17.80	5.61
14	18.80	5.64
15	19.80	5.74
16	20.78	5.89
17	21.76	6.11
18	22.72	6.39
19	23.66	6.73
20	24.58	7.13
21	25.47	7.58
22	26.33	8.09
23	27.15	8.66
24	27.94	9.28
25	28.69	9.94
26	29.39	10.65
27	30.05	11.41
28	30.65	12.20
29	31.21	13.03
30	31.71	13.90
31	32.16	14.79
32	32.55	15.71
33	32.82	16.50

Circle Center At X = 17.8 ; Y = 21.4 and Radius, 15.8

Factor of Safety
*** 2.146 ***

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.76	10.00
2	8.62	9.50
3	9.52	9.05
4	10.43	8.66
5	11.37	8.31
6	12.33	8.03
7	13.30	7.79
8	14.29	7.62
9	15.28	7.50
10	16.28	7.43
11	17.28	7.43
12	18.28	7.48
13	19.27	7.59
14	20.26	7.76
15	21.23	7.98
16	22.19	8.26
17	23.14	8.59
18	24.06	8.98
19	24.96	9.42
20	25.83	9.90
21	26.67	10.44
22	27.48	11.03
23	28.26	11.66
24	28.99	12.34
25	29.69	13.05

26	30.35	13.81
27	30.96	14.60
28	31.52	15.43
29	32.04	16.28
30	32.15	16.50

Circle Center At X = 16.9 ; Y = 24.8 and Radius, 17.4

Factor of Safety
*** 2.147 ***

**** END OF GSTABL7 OUTPUT ****

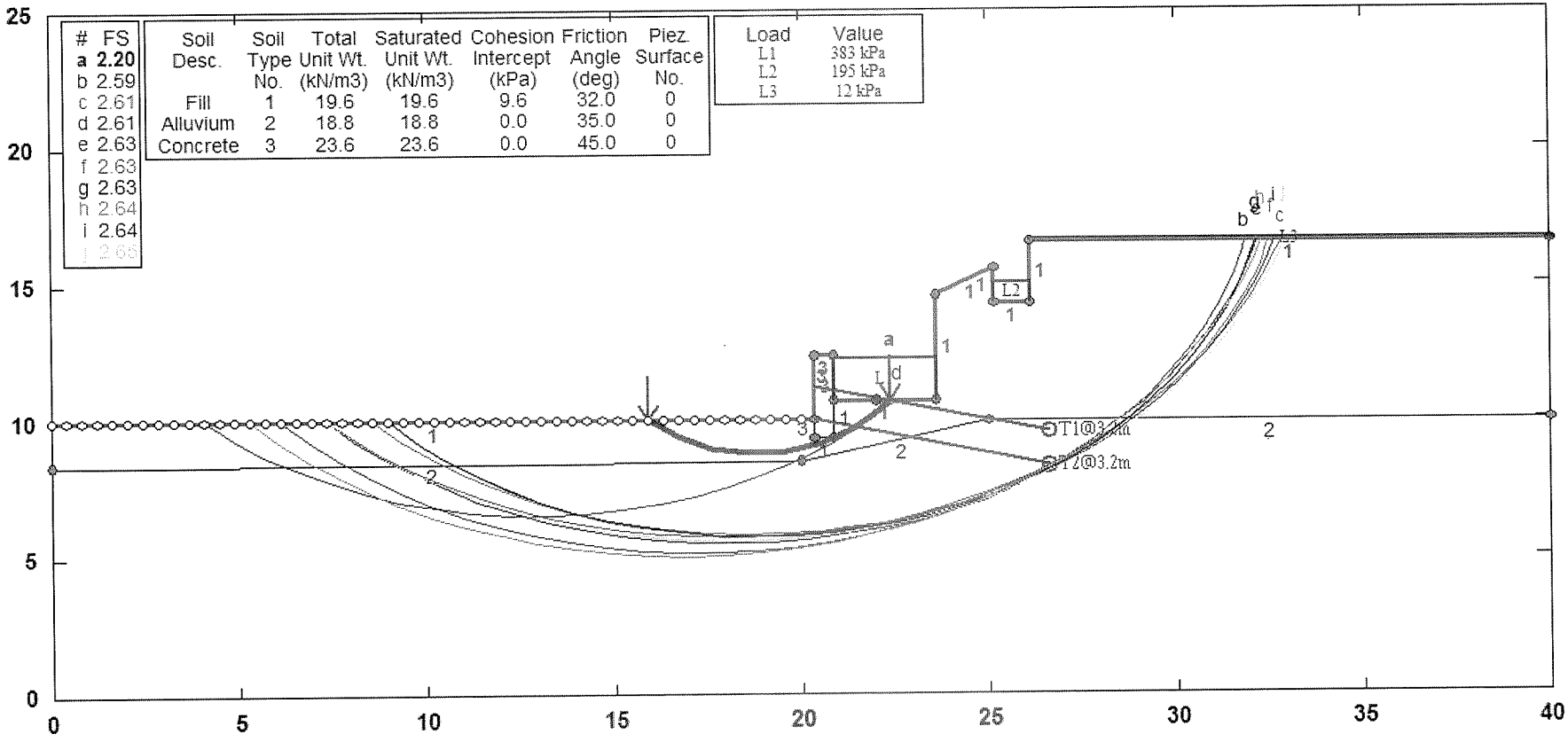
RW-20 Section R-S, Static

C:\RW20-RS1.PL2 Run By: CVA 6/17/2009 12:05PM

#	FS
a	2.20
b	2.59
c	2.61
d	2.61
e	2.63
f	2.63
g	2.63
h	2.64
i	2.64
j	2.65

Soil Desc.	Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Piez. Surface No.
Fill	1	19.6	19.6	9.6	32.0	0
Alluvium	2	18.8	18.8	0.0	35.0	0
Concrete	3	23.6	23.6	0.0	45.0	0

Load	Value
L1	383 kPa
L2	195 kPa
L3	12 kPa



GSTABL7 v.2 FSmin=2.20

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

RW20-RS1.OUT
*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 6/17/2009
Time of Run: 12:05PM
Run By: CVA
Input Data Filename: C:RW20-RS1.SI
Output Filename: C:RW20-RS1.OUT
Unit System: SI

Plotted Output Filename: C:RW20-RS1.PLT

PROBLEM DESCRIPTION: RW-20 Section R-S,
Static

BOUNDARY COORDINATES

11 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	10.00	20.34	10.00	1
2	20.34	10.00	20.35	12.34	3
3	20.35	12.34	20.83	12.34	3
4	20.83	12.34	20.84	10.71	3
5	20.84	10.71	23.58	10.71	1
6	23.58	10.71	23.59	14.53	1
7	23.59	14.53	25.14	15.56	1
8	25.14	15.56	25.15	14.26	1
9	25.15	14.26	26.09	14.26	1
10	26.09	14.26	26.10	16.50	1
11	26.10	16.50	40.00	16.50	1
12	20.34	10.00	20.35	9.36	3
13	20.35	9.36	20.83	9.36	1
14	20.83	9.36	20.84	10.71	1
15	0.00	8.40	20.00	8.50	2
16	20.00	8.50	25.00	9.93	2
17	25.00	9.93	40.00	9.93	2

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type	Total Unit Wt.	Saturated Unit Wt.	Cohesion Intercept	Friction Angle	Pore Pressure	Pressure Constant	Piez. Surface

No.	(kN/m3)	(kN/m3)	(kPa)	(deg)	Param.	(kPa)	No.
1	19.6	19.6	9.6	32.0	0.00	0.0	0
2	18.8	18.8	0.0	35.0	0.00	0.0	0
3	23.6	23.6	0.0	45.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

3 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	20.84	23.58	383.0	0.0
2	25.15	26.09	195.0	0.0
3	26.10	40.00	12.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

TIEBACK LOAD(S)

2 Tieback Load(s) Specified

Tieback No.	X-Pos (m)	Y-Pos (m)	Load (kN)	Spacing (m)	Inclination (deg)	Length (m)	Force Method
1	20.35	11.22	400.0	3.2	15.00	6.5	2
2	20.34	10.00	350.0	3.2	15.00	6.5	2

NOTE - An Equivalent Line Load Is Calculated For Each Row Of Tiebacks
Assuming A Uniform Distribution Of Load Horizontally Between Individual
Tiebacks. Force Method 1 Considers Only Tangential Tieback Forces.
Force Method 2 Considers Both Tangential and Normal Tieback Forces.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

5000 Trial Surfaces Have Been Generated.

100 Surfaces Initiate From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 20.00(m)

Each Surface Terminates Between X = 22.00(m)
and X = 40.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

1.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial

Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 5000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 20 Iterations.

Number of Trial Surfaces with Non-Converged FS = 1

Number of Trial Surfaces with Misleading FS = 3015

Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Evaluated = 60.3 %

Statistical Data On All Valid FS Values:
FS Max = 307.993 FS Min = 2.203 FS Ave = 8.454
Standard Deviation = 19.088 Coefficient of Variation = 225.80 %

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	15.92	10.00
2	16.71	9.38
3	17.62	8.97
4	18.60	8.79
5	19.60	8.85
6	20.56	9.14
7	21.42	9.65
8	22.13	10.35
9	22.35	10.71

Circle Center At X = 18.9 ; Y = 13.0 and Radius, 4.2

Factor of Safety
*** 2.203 ***

Individual data on the 12 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.8	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.9	14.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1.0	21.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	1.0	23.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.7	15.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.5	0.0	0.0	2.9	-0.9	0.0	0.0	0.0
7	0.2	15.6	0.0	0.0	72.6	-18.2	0.0	0.0	0.0
8	0.3	19.9	0.0	0.0	146.2	-55.6	0.0	0.0	0.0
9	0.0	0.5	0.0	0.0	6.6	-1.9	0.0	0.0	0.0
10	0.6	13.9	0.0	0.0	524.5	-59.7	0.0	0.0	220.8
11	0.7	9.9	0.0	0.0	79.3	80.9	0.0	0.0	273.4
12	0.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	85.1

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.98	10.00
2	9.69	9.29
3	10.45	8.64
4	11.25	8.05
5	12.10	7.52
6	12.98	7.05
7	13.90	6.65
8	14.84	6.32
9	15.81	6.06
10	16.79	5.88
11	17.79	5.77
12	18.79	5.73
13	19.79	5.77
14	20.78	5.89
15	21.76	6.07
16	22.73	6.33
17	23.67	6.67
18	24.59	7.07
19	25.47	7.54
20	26.31	8.07
21	27.12	8.67
22	27.87	9.32
23	28.58	10.03
24	29.23	10.79
25	29.82	11.59
26	30.35	12.44
27	30.82	13.33
28	31.21	14.25
29	31.54	15.19
30	31.80	16.16
31	31.86	16.50

Circle Center At X = 18.8 ; Y = 19.1 and Radius, 13.4

Factor of Safety
*** 2.594 ***

1

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.35	10.00
2	8.09	9.33
3	8.88	8.72
4	9.71	8.15
5	10.56	7.64
6	11.46	7.19
7	12.37	6.79
8	13.32	6.45
9	14.28	6.18
10	15.25	5.97
11	16.24	5.82
12	17.24	5.73
13	18.24	5.71
14	19.24	5.76
15	20.23	5.87
16	21.22	6.04
17	22.19	6.27
18	23.14	6.57
19	24.08	6.93
20	24.99	7.35
21	25.87	7.82
22	26.71	8.35

23	27.53	8.94
24	28.30	9.57
25	29.03	10.25
26	29.71	10.98
27	30.35	11.76
28	30.93	12.57
29	31.46	13.41
30	31.94	14.29
31	32.36	15.20
32	32.72	16.13
33	32.83	16.50

Circle Center At X = 18.1 ; Y = 21.2 and Radius, 15.5

Factor of Safety
*** 2.605 ***

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	4.08	10.00
2	4.84	9.35
3	5.65	8.76
4	6.50	8.24
5	7.39	7.78
6	8.31	7.39
7	9.26	7.07
8	10.23	6.83
9	11.22	6.66
10	12.21	6.56
11	13.21	6.54
12	14.21	6.60
13	15.20	6.73
14	16.18	6.94
15	17.14	7.22
16	18.07	7.57
17	18.98	8.00
18	19.85	8.49
19	20.68	9.04
20	21.47	9.66
21	22.21	10.34
22	22.56	10.71

Circle Center At X = 13.0 ; Y = 19.7 and Radius, 13.1

Factor of Safety
*** 2.612 ***

1

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	6.12	10.00
2	6.83	9.29
3	7.58	8.63
4	8.38	8.02
5	9.21	7.47
6	10.07	6.97
7	10.97	6.52
8	11.89	6.14

9	12.84	5.81
10	13.80	5.55
11	14.78	5.35
12	15.77	5.22
13	16.77	5.15
14	17.77	5.14
15	18.77	5.20
16	19.76	5.32
17	20.74	5.51
18	21.71	5.76
19	22.66	6.08
20	23.59	6.45
21	24.49	6.89
22	25.36	7.38
23	26.19	7.93
24	26.99	8.53
25	27.75	9.18
26	28.47	9.88
27	29.14	10.62
28	29.75	11.41
29	30.32	12.23
30	30.83	13.09
31	31.29	13.98
32	31.68	14.90
33	32.02	15.84
34	32.21	16.50

Circle Center At X = 17.4 ; Y = 20.5 and Radius, 15.4

Factor of Safety
*** 2.627 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.57	10.00
2	9.30	9.32
3	10.08	8.69
4	10.90	8.12
5	11.76	7.60
6	12.65	7.15
7	13.57	6.76
8	14.51	6.43
9	15.48	6.17
10	16.46	5.98
11	17.45	5.86
12	18.45	5.81
13	19.45	5.83
14	20.45	5.92
15	21.44	6.07
16	22.41	6.30
17	23.37	6.59
18	24.30	6.95
19	25.21	7.38
20	26.08	7.86
21	26.92	8.41
22	27.72	9.01
23	28.47	9.67
24	29.18	10.38
25	29.83	11.13
26	30.43	11.93
27	30.97	12.77
28	31.46	13.65
29	31.88	14.56
30	32.23	15.49
31	32.52	16.45
32	32.54	16.50

Circle Center At X = 18.7 ; Y = 20.1 and Radius, 14.3

Factor of Safety
*** 2.627 ***

1

Failure Surface Specified By 31 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	8.98	10.00
2	9.69	9.30
3	10.45	8.65
4	11.26	8.06
5	12.11	7.53
6	12.99	7.06
7	13.91	6.67
8	14.86	6.34
9	15.82	6.08
10	16.80	5.89
11	17.80	5.77
12	18.80	5.73
13	19.79	5.76
14	20.79	5.87
15	21.77	6.05
16	22.74	6.30
17	23.69	6.62
18	24.61	7.01
19	25.50	7.46
20	26.35	7.98
21	27.17	8.56
22	27.93	9.21
23	28.65	9.90
24	29.32	10.65
25	29.93	11.44
26	30.48	12.28
27	30.96	13.15
28	31.38	14.06
29	31.74	14.99
30	32.02	15.95
31	32.14	16.50

Circle Center At X = 18.9 ; Y = 19.3 and Radius, 13.6

Factor of Safety
*** 2.630 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	5.31	10.00
2	6.02	9.30
3	6.77	8.64
4	7.56	8.03
5	8.39	7.47
6	9.25	6.96
7	10.15	6.51
8	11.07	6.12
9	12.01	5.78
10	12.97	5.50

11	13.94	5.29
12	14.93	5.13
13	15.93	5.04
14	16.93	5.00
15	17.93	5.04
16	18.92	5.13
17	19.91	5.28
18	20.89	5.50
19	21.85	5.78
20	22.79	6.11
21	23.71	6.51
22	24.60	6.96
23	25.46	7.46
24	26.29	8.02
25	27.09	8.63
26	27.84	9.29
27	28.55	9.99
28	29.22	10.74
29	29.83	11.52
30	30.40	12.35
31	30.92	13.20
32	31.38	14.09
33	31.78	15.00
34	32.13	15.94
35	32.30	16.50

Circle Center At X = 16.9 ; Y = 21.0 and Radius, 16.0

Factor of Safety
*** 2.639 ***

1

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.35	10.00
2	8.07	9.31
3	8.84	8.67
4	9.65	8.08
5	10.49	7.55
6	11.37	7.07
7	12.28	6.65
8	13.22	6.30
9	14.17	6.00
10	15.14	5.77
11	16.13	5.61
12	17.13	5.51
13	18.13	5.48
14	19.13	5.51
15	20.12	5.61
16	21.11	5.78
17	22.08	6.01
18	23.04	6.30
19	23.97	6.66
20	24.88	7.07
21	25.76	7.55
22	26.60	8.08
23	27.41	8.67
24	28.18	9.31
25	28.90	10.01
26	29.58	10.74
27	30.20	11.52
28	30.78	12.34
29	31.29	13.20
30	31.75	14.09
31	32.15	15.00
32	32.49	15.94

33	32.65	16.50

Circle Center At X = 18.1 ; Y = 20.6 and Radius, 15.1

Factor of Safety
*** 2.644 ***

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.35	10.00
2	8.08	9.32
3	8.86	8.69
4	9.67	8.11
5	10.52	7.59
6	11.41	7.12
7	12.32	6.71
8	13.26	6.36
9	14.21	6.07
10	15.19	5.84
11	16.17	5.68
12	17.17	5.58
13	18.17	5.55
14	19.17	5.58
15	20.16	5.68
16	21.15	5.84
17	22.12	6.07
18	23.08	6.36
19	24.02	6.71
20	24.93	7.12
21	25.81	7.59
22	26.67	8.11
23	27.48	8.69
24	28.26	9.32
25	28.99	10.00
26	29.68	10.73
27	30.32	11.50
28	30.90	12.30
29	31.44	13.15
30	31.92	14.03
31	32.34	14.94
32	32.70	15.87
33	32.89	16.50

Circle Center At X = 18.2 ; Y = 20.9 and Radius, 15.4

Factor of Safety
*** 2.654 ***

**** END OF GSTABL7 OUTPUT ****

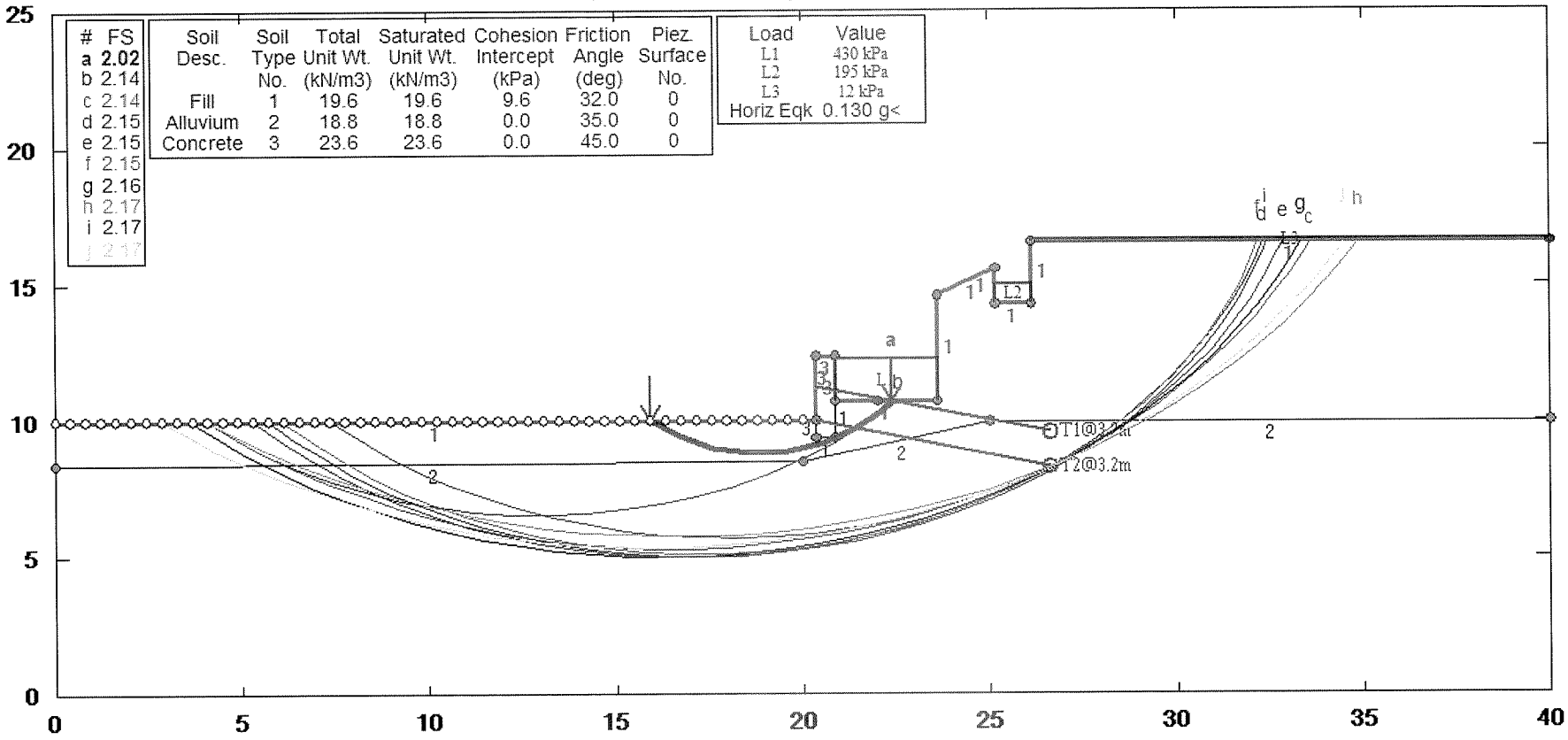
RW-20 Section R-S, Seismic

C:\RW20-RS2.PL2 Run By: CVA 6/17/2009 12:12PM

#	FS
a	2.02
b	2.14
c	2.14
d	2.15
e	2.15
f	2.15
g	2.16
h	2.17
i	2.17
j	2.17

Soil Desc.	Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Piez. Surface No.
Fill	1	19.6	19.6	9.6	32.0	0
Alluvium	2	18.8	18.8	0.0	35.0	0
Concrete	3	23.6	23.6	0.0	45.0	0

Load	Value
L1	430 kPa
L2	195 kPa
L3	12 kPa
Horiz Eqk	0.130 g<



GSTABL7 v.2 FSmin=2.02

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

RW20-RS2.OUT
*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 6/17/2009
Time of Run: 12:12PM
Run By: CVA
Input Data Filename: C:RW20-RS2.SI
Output Filename: C:RW20-RS2.OUT
Unit System: SI

Plotted Output Filename: C:RW20-RS2.PLT

PROBLEM DESCRIPTION: RW-20 Section R-S,
Seismic

BOUNDARY COORDINATES

11 Top Boundaries
17 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	10.00	20.34	10.00	1
2	20.34	10.00	20.35	12.34	3
3	20.35	12.34	20.83	12.34	3
4	20.83	12.34	20.84	10.71	3
5	20.84	10.71	23.58	10.71	1
6	23.58	10.71	23.59	14.53	1
7	23.59	14.53	25.14	15.56	1
8	25.14	15.56	25.15	14.26	1
9	25.15	14.26	26.09	14.26	1
10	26.09	14.26	26.10	16.50	1
11	26.10	16.50	40.00	16.50	1
12	20.34	10.00	20.35	9.36	3
13	20.35	9.36	20.83	9.36	1
14	20.83	9.36	20.84	10.71	1
15	0.00	8.40	20.00	8.50	2
16	20.00	8.50	25.00	9.93	2
17	25.00	9.93	40.00	9.93	2

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type	Total Unit Wt.	Saturated Unit Wt.	Cohesion Intercept	Friction Angle	Pore Pressure	Pressure Constant	Piez. Surface

No.	(kN/m3)	(kN/m3)	(kPa)	(deg)	Param.	(kPa)	No.
1	19.6	19.6	9.6	32.0	0.00	0.0	0
2	18.8	18.8	0.0	35.0	0.00	0.0	0
3	23.6	23.6	0.0	45.0	0.00	0.0	0

1

BOUNDARY LOAD(S)

3 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	20.84	23.58	430.0	0.0
2	25.15	26.09	195.0	0.0
3	26.10	40.00	12.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.130 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

TIEBACK LOAD(S)

2 Tieback Load(s) Specified

Tieback No.	X-Pos (m)	Y-Pos (m)	Load (kN)	Spacing (m)	Inclination (deg)	Length (m)	Force Method
1	20.35	11.22	400.0	3.2	15.00	6.5	2
2	20.34	10.00	350.0	3.2	15.00	6.5	2

NOTE - An Equivalent Line Load Is Calculated For Each Row Of Tiebacks
Assuming A Uniform Distribution Of Load Horizontally Between Individual
Tiebacks. Force Method 1 Considers Only Tangential Tieback Forces.
Force Method 2 Considers Both Tangential and Normal Tieback Forces.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

5000 Trial Surfaces Have Been Generated.

100 Surfaces Initiate From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 20.00(m)

Each Surface Terminates Between X = 22.00(m)
and X = 40.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

1.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 5000

WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 20 Iterations.

Number of Trial Surfaces with Non-Converged FS = 4

Number of Trial Surfaces with Misleading FS = 2928

Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Evaluated = 58.6 %

Statistical Data On All Valid FS Values:
FS Max = 352.718 FS Min = 2.015 FS Ave = 8.178
Standard Deviation = 24.908 Coefficient of Variation = 304.58 %

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	15.92	10.00
2	16.71	9.38
3	17.62	8.97
4	18.60	8.79
5	19.60	8.85
6	20.56	9.14
7	21.42	9.65
8	22.13	10.35
9	22.35	10.71

Circle Center At X = 18.9 ; Y = 13.0 and Radius, 4.2

Factor of Safety
*** 2.015 ***

Individual data on the 12 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.8	4.8	0.0	0.0	0.0	0.0	0.6	0.0	0.0
2	0.9	14.7	0.0	0.0	0.0	0.0	1.9	0.0	0.0
3	1.0	21.6	0.0	0.0	0.0	0.0	2.8	0.0	0.0
4	1.0	23.1	0.0	0.0	0.0	0.0	3.0	0.0	0.0
5	0.7	15.1	0.0	0.0	0.0	0.0	2.0	0.0	0.0

6	0.0	0.5	0.0	0.0	2.9	-0.9	0.1	0.0	0.0
7	0.2	15.6	0.0	0.0	72.6	-18.2	2.0	0.0	0.0
8	0.3	19.9	0.0	0.0	146.2	-55.6	2.6	0.0	0.0
9	0.0	0.5	0.0	0.0	6.6	-1.9	0.1	0.0	0.0
10	0.6	13.9	0.0	0.0	524.5	-59.7	1.8	0.0	247.9
11	0.7	9.9	0.0	0.0	79.3	80.9	1.3	0.0	306.9
12	0.2	0.8	0.0	0.0	0.0	0.0	0.1	0.0	95.6

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	4.08	10.00
2	4.84	9.35
3	5.65	8.76
4	6.50	8.24
5	7.39	7.78
6	8.31	7.39
7	9.26	7.07
8	10.23	6.83
9	11.22	6.66
10	12.21	6.56
11	13.21	6.54
12	14.21	6.60
13	15.20	6.73
14	16.18	6.94
15	17.14	7.22
16	18.07	7.57
17	18.98	8.00
18	19.85	8.49
19	20.68	9.04
20	21.47	9.66
21	22.21	10.34
22	22.56	10.71

Circle Center At X = 13.0 ; Y = 19.7 and Radius, 13.1

Factor of Safety
*** 2.143 ***

1

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	4.08	10.00
2	4.85	9.36
3	5.65	8.76
4	6.48	8.20
5	7.34	7.69
6	8.23	7.23
7	9.14	6.81
8	10.07	6.45
9	11.01	6.13
10	11.98	5.86
11	12.96	5.65
12	13.94	5.49
13	14.94	5.38
14	15.93	5.32
15	16.93	5.32
16	17.93	5.37
17	18.93	5.48
18	19.92	5.63
19	20.89	5.84
20	21.86	6.10
21	22.81	6.42

22	23.74	6.78
23	24.65	7.19
24	25.54	7.65
25	26.40	8.16
26	27.24	8.71
27	28.04	9.31
28	28.81	9.94
29	29.54	10.62
30	30.24	11.34
31	30.90	12.09
32	31.52	12.88
33	32.09	13.69
34	32.62	14.54
35	33.11	15.42
36	33.55	16.32
37	33.62	16.50

Circle Center At X = 16.5 ; Y = 24.1 and Radius, 18.7

Factor of Safety
*** 2.145 ***

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	5.31	10.00
2	6.02	9.30
3	6.77	8.64
4	7.56	8.03
5	8.39	7.47
6	9.25	6.96
7	10.15	6.51
8	11.07	6.12
9	12.01	5.78
10	12.97	5.50
11	13.94	5.29
12	14.93	5.13
13	15.93	5.04
14	16.93	5.00
15	17.93	5.04
16	18.92	5.13
17	19.91	5.28
18	20.89	5.50
19	21.85	5.78
20	22.79	6.11
21	23.71	6.51
22	24.60	6.96
23	25.46	7.46
24	26.29	8.02
25	27.09	8.63
26	27.84	9.29
27	28.55	9.99
28	29.22	10.74
29	29.83	11.52
30	30.40	12.35
31	30.92	13.20
32	31.38	14.09
33	31.78	15.00
34	32.13	15.94
35	32.30	16.50

Circle Center At X = 16.9 ; Y = 21.0 and Radius, 16.0

Factor of Safety
*** 2.148 ***

1

Failure Surface Specified By 33 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.35	10.00
2	8.09	9.33
3	8.88	8.72
4	9.71	8.15
5	10.56	7.64
6	11.46	7.19
7	12.37	6.79
8	13.32	6.45
9	14.28	6.18
10	15.25	5.97
11	16.24	5.82
12	17.24	5.73
13	18.24	5.71
14	19.24	5.76
15	20.23	5.87
16	21.22	6.04
17	22.19	6.27
18	23.14	6.57
19	24.08	6.93
20	24.99	7.35
21	25.87	7.82
22	26.71	8.35
23	27.53	8.94
24	28.30	9.57
25	29.03	10.25
26	29.71	10.98
27	30.35	11.76
28	30.93	12.57
29	31.46	13.41
30	31.94	14.29
31	32.36	15.20
32	32.72	16.13
33	32.83	16.50

Circle Center At X = 18.1 ; Y = 21.2 and Radius, 15.5

Factor of Safety
*** 2.152 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	6.12	10.00
2	6.83	9.29
3	7.58	8.63
4	8.38	8.02
5	9.21	7.47
6	10.07	6.97
7	10.97	6.52
8	11.89	6.14
9	12.84	5.81
10	13.80	5.55
11	14.78	5.35
12	15.77	5.22
13	16.77	5.15
14	17.77	5.14
15	18.77	5.20

16	19.76	5.32
17	20.74	5.51
18	21.71	5.76
19	22.66	6.08
20	23.59	6.45
21	24.49	6.89
22	25.36	7.38
23	26.19	7.93
24	26.99	8.53
25	27.75	9.18
26	28.47	9.88
27	29.14	10.62
28	29.75	11.41
29	30.32	12.23
30	30.83	13.09
31	31.29	13.98
32	31.68	14.90
33	32.02	15.84
34	32.21	16.50

Circle Center At X = 17.4 ; Y = 20.5 and Radius, 15.4

Factor of Safety
*** 2.154 ***

1

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	3.67	10.00
2	4.42	9.34
3	5.21	8.72
4	6.02	8.14
5	6.87	7.61
6	7.74	7.12
7	8.64	6.69
8	9.57	6.30
9	10.51	5.96
10	11.47	5.67
11	12.44	5.44
12	13.42	5.26
13	14.41	5.13
14	15.41	5.06
15	16.41	5.04
16	17.41	5.07
17	18.41	5.16
18	19.40	5.31
19	20.38	5.50
20	21.34	5.75
21	22.30	6.05
22	23.23	6.41
23	24.15	6.81
24	25.04	7.26
25	25.91	7.76
26	26.75	8.31
27	27.55	8.90
28	28.33	9.53
29	29.07	10.20
30	29.77	10.92
31	30.43	11.67
32	31.05	12.45
33	31.62	13.27
34	32.16	14.12
35	32.64	14.99
36	33.08	15.89
37	33.33	16.50

Circle Center At X = 16.3 ; Y = 23.5 and Radius, 18.5

Factor of Safety
*** 2.159 ***

Failure Surface Specified By 37 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	4.08	10.00
2	4.89	9.42
3	5.73	8.87
4	6.60	8.37
5	7.48	7.90
6	8.39	7.49
7	9.32	7.11
8	10.26	6.78
9	11.22	6.50
10	12.19	6.26
11	13.17	6.07
12	14.16	5.92
13	15.16	5.83
14	16.16	5.78
15	17.16	5.78
16	18.16	5.82
17	19.15	5.92
18	20.14	6.06
19	21.12	6.25
20	22.09	6.49
21	23.05	6.77
22	24.00	7.10
23	24.93	7.47
24	25.83	7.89
25	26.72	8.35
26	27.59	8.85
27	28.43	9.40
28	29.24	9.98
29	30.02	10.60
30	30.77	11.26
31	31.49	11.95
32	32.18	12.68
33	32.83	13.44
34	33.45	14.23
35	34.02	15.05
36	34.56	15.89
37	34.90	16.50

Circle Center At X = 16.7 ; Y = 26.6 and Radius, 20.9

Factor of Safety
*** 2.167 ***

1

Failure Surface Specified By 35 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	5.71	10.00
2	6.42	9.29
3	7.18	8.64
4	7.97	8.02
5	8.80	7.47

6	9.66	6.96
7	10.55	6.51
8	11.47	6.12
9	12.41	5.78
10	13.38	5.51
11	14.35	5.30
12	15.34	5.15
13	16.34	5.06
14	17.34	5.04
15	18.34	5.07
16	19.33	5.18
17	20.32	5.34
18	21.29	5.57
19	22.25	5.86
20	23.19	6.20
21	24.10	6.61
22	24.99	7.07
23	25.84	7.59
24	26.66	8.16
25	27.44	8.79
26	28.19	9.46
27	28.88	10.17
28	29.54	10.93
29	30.14	11.73
30	30.69	12.57
31	31.18	13.43
32	31.63	14.33
33	32.01	15.26
34	32.33	16.20
35	32.41	16.50

Circle Center At X = 17.2 ; Y = 20.8 and Radius, 15.8

Factor of Safety
*** 2.168 ***

Failure Surface Specified By 38 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.86	10.00
2	3.65	9.39
3	4.47	8.82
4	5.32	8.29
5	6.19	7.80
6	7.08	7.35
7	8.00	6.94
8	8.93	6.58
9	9.88	6.27
10	10.84	6.00
11	11.82	5.77
12	12.80	5.60
13	13.79	5.47
14	14.79	5.39
15	15.79	5.35
16	16.79	5.37
17	17.79	5.43
18	18.78	5.54
19	19.77	5.69
20	20.75	5.90
21	21.72	6.15
22	22.67	6.44
23	23.61	6.78
24	24.53	7.17
25	25.44	7.60
26	26.32	8.07
27	27.18	8.59
28	28.01	9.14

29	28.81	9.74
30	29.59	10.37
31	30.33	11.03
32	31.04	11.74
33	31.72	12.47
34	32.36	13.24
35	32.97	14.04
36	33.53	14.86
37	34.05	15.71
38	34.49	16.50

Circle Center At X = 16.0 ; Y = 26.3 and Radius, 20.9

Factor of Safety
*** 2.170 ***

**** END OF GSTABL7 OUTPUT ****

C-4

SOIL BEARING CAPACITY

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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(Licensed to: Kleinfelder West, Inc. - Redlands, California)

PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction, Proposed "D" Line Walls
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	RW-19
Footing Description	Wall Footing
Footing Width, B	1.58 feet
Footing Length, L	94.61 feet
Min. Footing Embedment Depth, D_f	3.94 feet
Bottom of Footing Elevation	1,528.40 feet
Design GWT Elevation	1,496.00 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	30.00 degrees

FOOTING LOADS

Design Method	WSD
Normal Gravity Load, Q	420.00 kips
Shear Load (along X-axis), P_x	143.42 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	543.54 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,532.34 feet
Depth to Design GWT, Z_w	36.34 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	1.29 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	143.42 kips
Effective Footing Width, $B' = B - 2e_x$	-1.01 feet
Effective Footing Length, $L' = L - 2e_y$	94.61 feet
Effective Footing Area, $A_f = B' L'$	-95.39 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	2.81 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	30.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	1.37 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	472.80 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	20.00 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.00
Depth Factor Parameter, k	1.19
Exponent, n	0.99

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	30.14	30.14	30.14	30.14
N_q	22.46	18.40	18.40	18.40
N_γ	19.11	15.67	15.07	22.40
Shape Factors, s_c	1.01	1.01	0.99	0.99
s_q	N/A	1.01	0.99	0.99
s_γ	0.80	1.01	1.00	1.00
Depth Factors, d_c	N/A	1.86	1.48	1.48
d_q	N/A	1.43	1.34	1.34
d_γ	N/A	1.43	1.00	1.00
Inclination Factors, i_c	N/A	0.62	1.01	1.00
i_q	N/A	0.62	1.01	1.00
i_γ	N/A	0.14	1.02	1.01
Ground Factors (base on slope), g_c	N/A	N/A	1.00	1.01
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	22.5	19.8	19.2

Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	19.5 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	6.5 ksf
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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(Licensed to: Kleinfelder West, Inc. - Redlands, California)

PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction, Proposed "D" Line Walls
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	RW-20
Footing Description	Wall Footing
Footing Width, B	1.58 feet
Footing Length, L	91.01 feet
Min. Footing Embedment Depth, D_f	3.94 feet
Bottom of Footing Elevation	1,527.33 feet
Design GWT Elevation	1,496.00 feet
Ground Slope Angle, β	0.00 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	120.00 pcf
Saturated Soil Unit Weight, γ_{sat}	120.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	30.00 degrees

FOOTING LOADS

Design Method	WSD
Normal Gravity Load, Q	408.81 kips
Shear Load (along X-axis), P_x	160.01 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	786.26 kip-foot

RESISTANCE FACTORS

LRFD (Strength Limit State)	0.45
LRFD (Extreme Event Limit State)	1.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,531.27 feet
Depth to Design GWT, Z_w	35.27 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	1.92 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	160.01 kips
Effective Footing Width, $B' = B - 2e_x$	-2.27 feet
Effective Footing Length, $L' = L - 2e_y$	91.01 feet
Effective Footing Area, $A_f = B' L'$	-206.28 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(B' \times L')$	2.84 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	30.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	1.37 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	120.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	472.80 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	20.00 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.00
Depth Factor Parameter, k	1.19
Exponent, n	0.97

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	30.14	30.14	30.14	30.14
N_q	22.46	18.40	18.40	18.40
N_γ	19.11	15.67	15.07	22.40
Shape Factors, s_c	1.01	1.01	0.98	0.98
s_q	N/A	1.01	0.99	0.99
s_γ	0.80	1.01	1.01	1.01
Depth Factors, d_c	N/A	1.86	1.48	1.48
d_q	N/A	1.43	1.34	1.34
d_γ	N/A	1.43	1.00	1.00
Inclination Factors, i_c	N/A	0.58	1.01	1.00
i_q	N/A	0.58	1.01	1.00
i_γ	N/A	0.08	1.01	1.00
Ground Factors (base on slope), g_c	N/A	N/A	1.00	1.00
g_q	N/A	N/A	1.00	1.00
g_γ	N/A	N/A	1.00	1.00
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	20.8	18.3	17.3

Ultimate Gross Bearing Capacity, $q_{ult-nve}$	17.8 ksf
Allowable Gross Bearing Capacity, WSD q_{all}	5.9 ksf
Factored Gross Nominal Bearing Resistance-LRFD (Strength)	N/A ksf
Factored Gross Nominal Bearing Resistance-LRFD (Extreme Event)	N/A ksf

Notes:

* The footing should be checked for tolerable settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

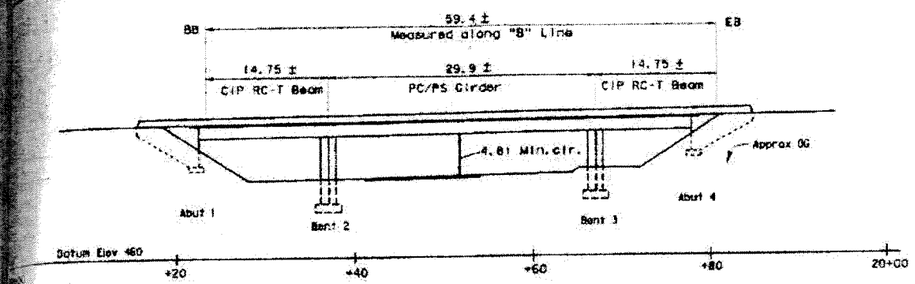
APPENDIX D

AS-BUILT PLANS OF THE EXISTING BRIDGE

DIST.	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	Riv	215.60	R61.8/66.8, R19.5/23.0	223	2

REGISTERED ENGINEER - CIVIL 5-11-99
4-17-00
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.

Caltrans Metric



MIRROR ELEVATION

1:250

Notes:

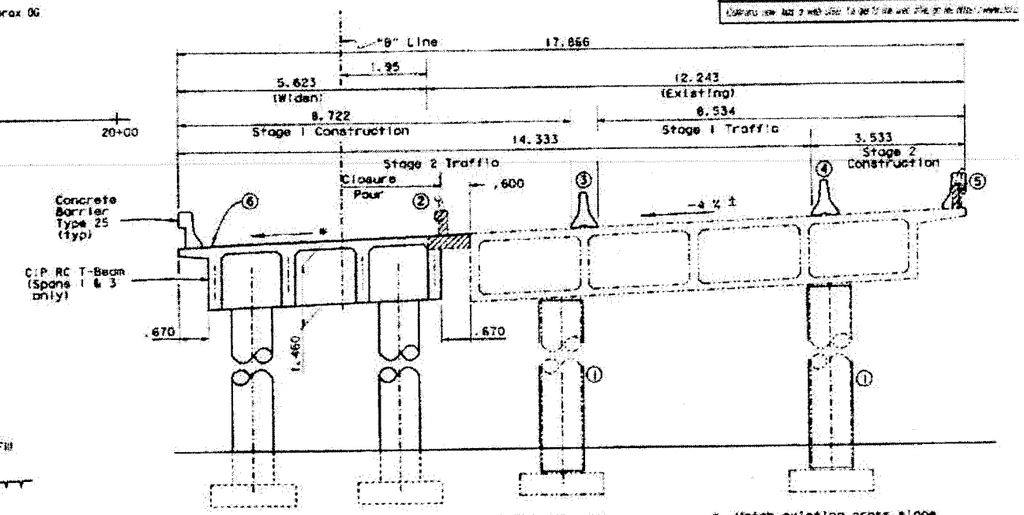
1. Case Columns full height (Class P/ F I)
2. Remove existing Type I Railing and deck overhang
3. Temporary Railing (Type K) Stage I "See Road Plans"
4. Temporary Railing (Type K) Stage 2 "See Road Plans"
5. Remove existing Type I Railing, construct Concrete Barrier Type 25, See "Barrier Replacement Detail" on "Abutment Details" sheet
6. 13 mm AC Overlay to match existing

● Point of minimum vertical clearance

Notes:

- Indicates limits of bridge removal
- Indicates existing structure
- Indicates new construction

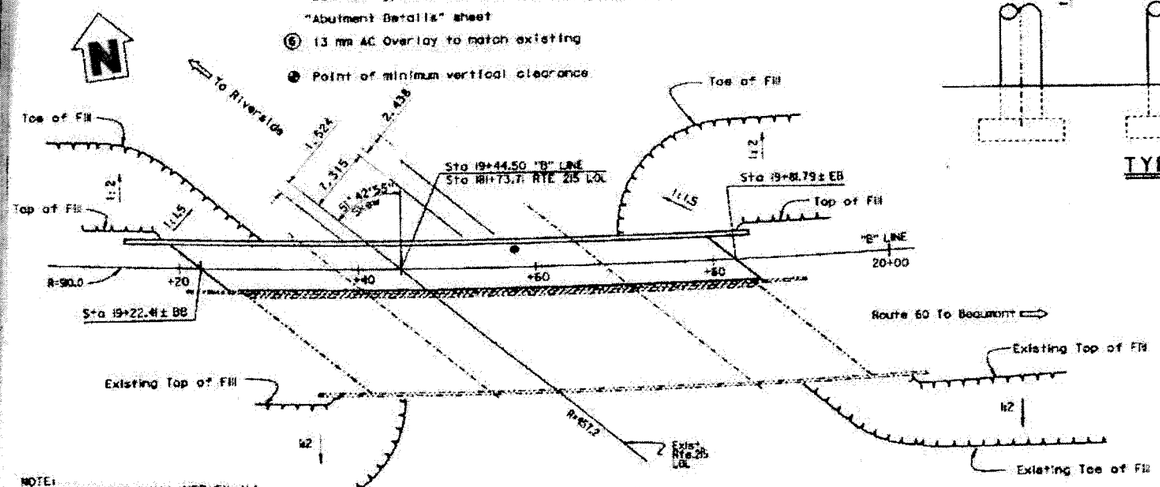
For "Index to Plans, General Notes and Std Plans", see "Index to Plans" sheet.



TYPICAL SECTION

1:50

* Match existing cross slope



PLAN

1:250

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

QUANTITIES

BRIDGE REMOVAL (PORTION), LOCATION A	LUMP SUM
STRUCTURE EXCAVATION (BRIDGE)	189 m^3
STRUCTURE BACKFILL (BRIDGE)	143 m^3
STRUCTURAL CONCRETE, BRIDGE FOOTING	30 m^3
STRUCTURAL CONCRETE, BRIDGE	232 m^3
FURNISH PRECAST PRESTRESSED CONCRETE GIRDER (25 M - 30 M)	4 EA
ERECT PRECAST PRESTRESSED CONCRETE GIRDER	4 EA
BAR REINFORCING STEEL (BRIDGE)	37,600 kg
ASPHALT MEMBRANE WATERPROOFING	28 m^2
COLUMN CASING	5,200 kg
STRUCTURE DRAINAGE SYSTEM	LUMP SUM
CONCRETE BARRIER (TYPE 25)	138 m

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN	Carmen Shantz	CHECKED	Yusuf Saleh
DETAILS	Doug Wooten	CHECKED	Yusuf Saleh
QUANTITIES	Lawrence Okoye	CHECKED	Tim Grautert

DESIGN ENGINEER

LOAD FACTOR DESIGN — LIVE LOADING: HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD
Layout: Carmen Shantz — CHECKED: Yusuf Saleh
SPECIFICATIONS: Ruth Fernandes — CHECKED: Spec Coordinator

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 10

CU 08
EA 453001

BRIDGE NO. 56-0507R
KILOMETER POST R19.633

ROUTE 60/215 SEPARATION (WIDEN)

GENERAL PLAN

DESIGNING AGENCIES REGARDING ELECTRICAL REVISION DATES

STRUCTURE'S MEDIUM GENERAL PLAN SHEET METRIC REV. 3/17/97

FILE = 5 36-453001-0223-27134729

		NORTH	EAST
A	17+08.183 B.C. "B" LINE	697693.5462	1903380.9473
B	19 + 44.50 P.O.C. "B" LINE 19 + 73.71 P.O.C. ℄ ERB 215	697608.5529	1903589.6751
C	21+ 83.082 E.C. "B" LINE	697582.3801	1903836.1312
D	184 + 06.187 E.C. ℄ ERB 215	697748.6993	1903417.3309
E	178 + 56.751 B.C. ℄ ERB 215	697412.6534	1903686.0986

CURVE DATA

"B" LINE	℄ ERB 215
R - 980.00m	R - 457.2m
Δ - 29°50'16"	Δ - 56°19'22"
L - 473.90m	L - 449.436m
T - 242.45m	T - 244.752m
N 698492.1822	N 697327.7792
E 1903817.1522	E 1903238.8444

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	RIV	215.60	R61.8/66.8, R19.5/23.0	225	281

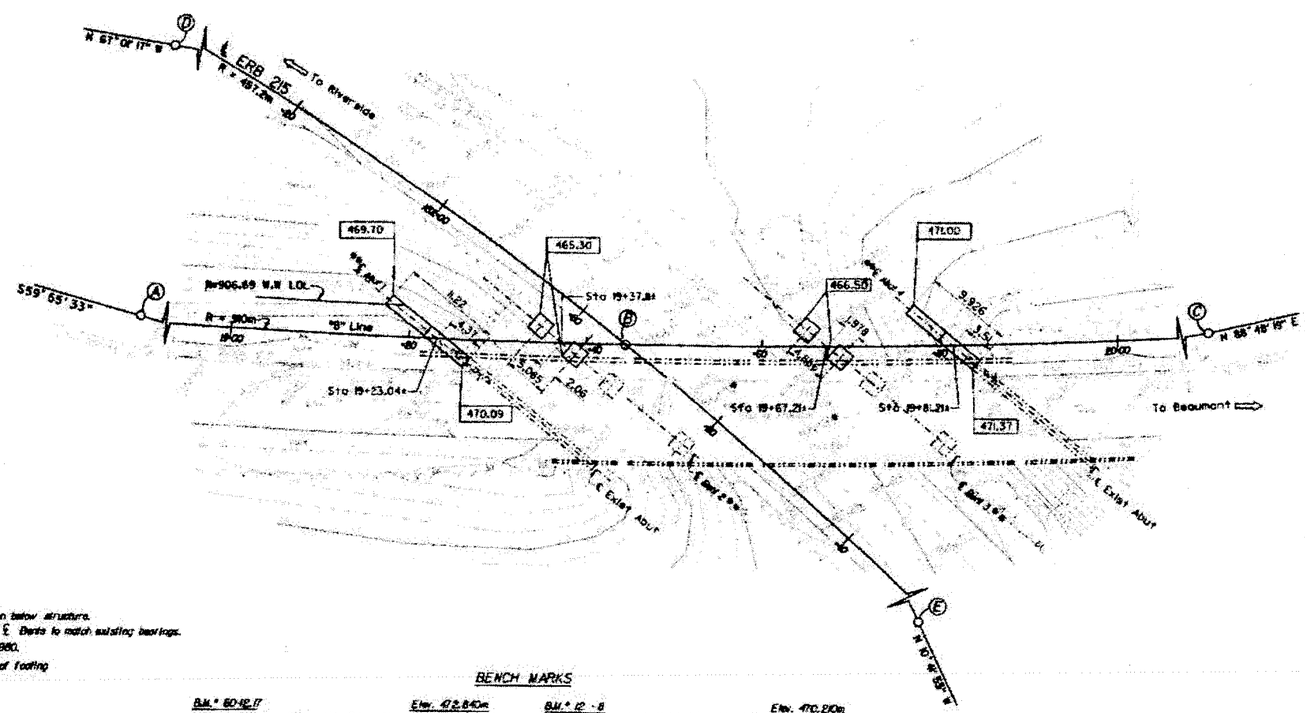
REGISTERED ENGINEER-CIVIL 5-11-99

Yusuf Saleh
No. 54566
Exp. 12-31-99
CIVIL
STATE OF CALIFORNIA

4-17-00
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.

Caltrans Metric



NOTES

+ denotes spot elevation.
s denotes grade elevation below structure.
** Layout Abutments and ℄ Bents to match existing bearings.
Datum: NGVD 29, Adj. 1980.
Indicates bottom of footing elevations.

BENCH MARKS

B.M.* 60-92.17 — Elev. 472.840m
Fd. brass disk on Sth'ly shldr. E-bnd. Rte 60, approx. 5.7m from ETW. N 697855.8819, E 1903200.1880

B.M.* 12 - 8 — Elev. 470.210m
Fd. aerial target on E'ly shldr N-bnd Rte 215, N 697440.7520, E 1903690.7769

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

PRELIMINARY INVESTIGATION SECTION						
SCALE 1:250	DATUM SEE NOTES	PHOTOGRAMMETRY AS OF:	DRAWN M. MENNING 2/98	DESIGN Carmen Shantz	CHECKED Yusuf Saleh	
ALIGNMENT TIES		SURVEYED	TRACED	DETAILS Doug Wooten	CHECKED Yusuf Saleh	
		FIELD BOOKS L. MANABO 2/98	CHECKED L. MANABO 3/98	QUANTITIES Tim Greutert	CHECKED Lawrence Okoye	

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 10

CU 08
EA 453001

BRIDGE NO. 56-0507R
KILOMETER POST R19.633

ROUTE 60/215 SEPARATION WIDEN
FOUNDATION PLAN

DISREGARD PRINTS BEARING EARLIER REVISION DATES 5-27-98 5-11-99
REVISION DATES (PRELIMINARY STAGE ONLY)
SHEET 3 OF 14

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

FILE - c:\09-453001\2025_C7\3473A

DATE PLOTTED = 27-Apr-2000
TIME PLOTTED = 07:46:16

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	Riv	215, 60	R01.8/R6.8, R19.2/23.0	228	25

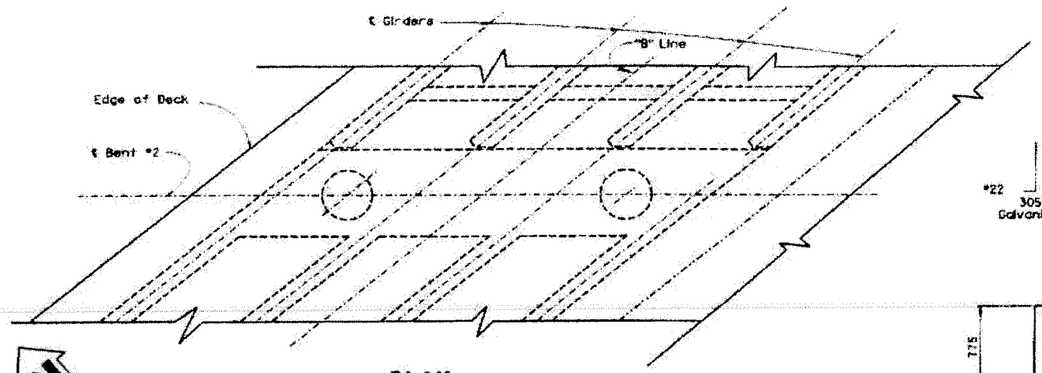
REGISTERED CIVIL ENGINEER 5-11-99

4-17-00
PLANS APPROVAL DATE

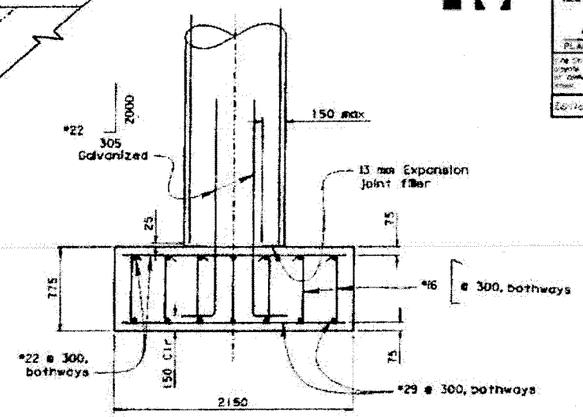
Yusuf Saleh 54584 12-31-99 CIVIL STATE OF CALIFORNIA

The name of contractor or its affiliate or agents shall not be inscribed on the accuracy or completeness of electronic copies of this plan sheet.

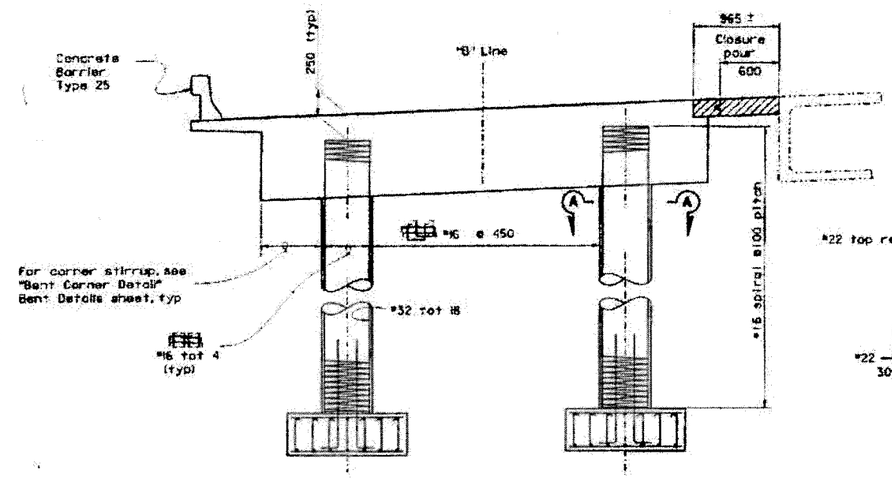
Contractor may log on and offer to get the most up to date plan available.



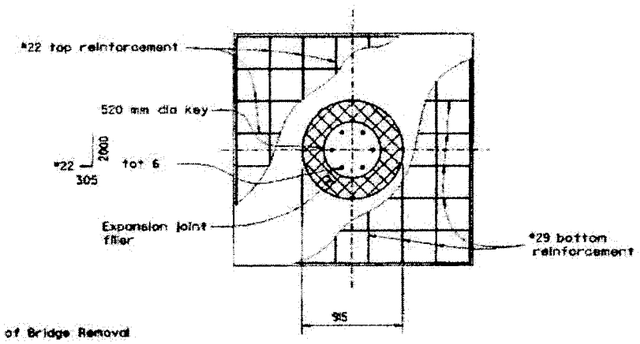
PLAN
1:40



FOOTING ELEVATION
1:20



ELEVATION
1:40

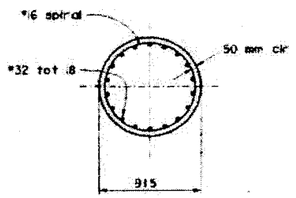


FOOTING PLAN
1:20

Indicates limits of Bridge Removal

Notes:

1. No splices permitted in column main vertical reinforcement
2. No lap splices and no field welding allowed in Bent Caps main reinforcement
3. Spiral may be discontinuous at Bent Cap main bottom reinforcement
4. Bent 2 shown, Bent 3 similar



SECTION A-A
1:20

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN	Carmen Shantz	CHECKED	Yusuf Saleh
DETAILS	Doug Wooten	CHECKED	Yusuf Saleh
QUANTITIES	Tim Greutert	CHECKED	Lawrence Okaye

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 10

CU 08
EA 453001

BRIDGE NO. 56-0507R
KILOMETER POST R19.633

ROUTE 60/215 SEPARATION (WIDEN.
BENT LAYOUT

STRUCTURES DESIGN DETAIL SHEET METRIC REV. 1/3/98

DRAWING SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

SUBMITTED FOR PROJECT ENGINEER ACCEPTANCE

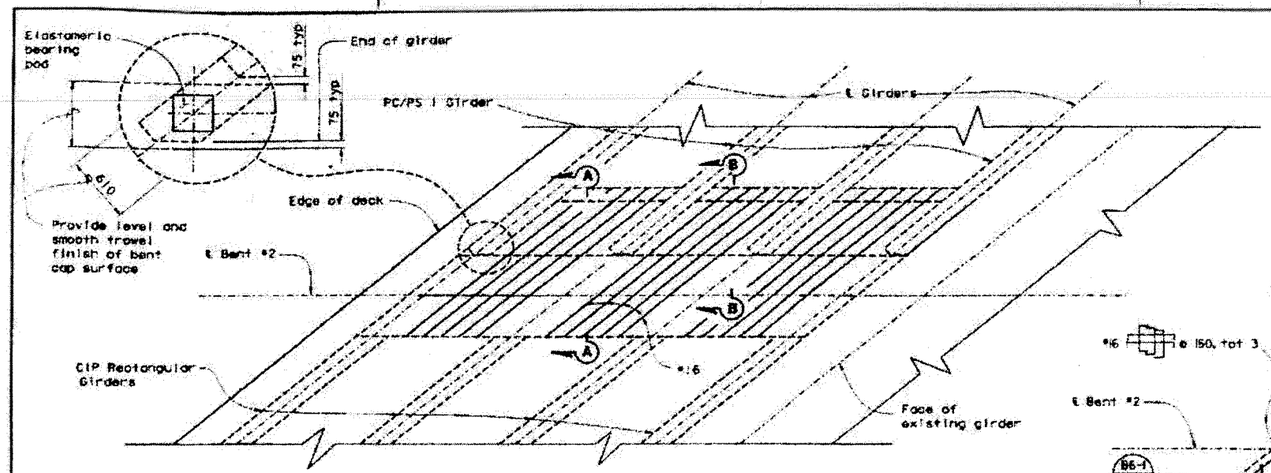
REVISED FOR PROJECT ENGINEER ACCEPTANCE

SHEET 6

DIST	COUNTY	ROUTE	TOTAL PROJECT	SHEET No.	TOTAL SHEETS
08	Riv	215, 60	RB1: 5-00-0 RB2: 5-00-0	229	281

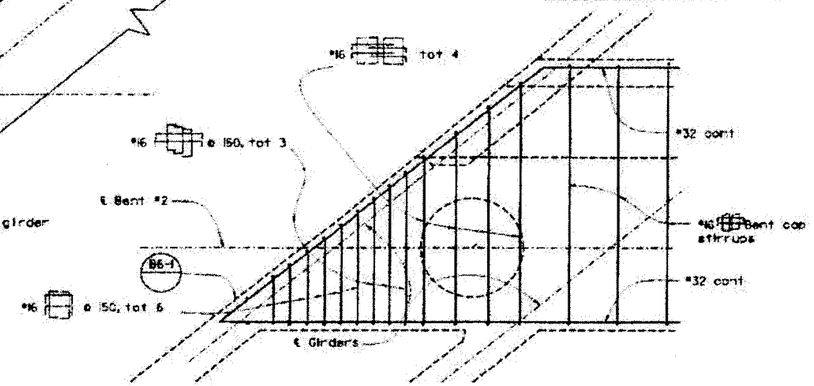
REGISTERED CIVIL ENGINEER 5-11-99

4-17-00
PLANS APPROVAL DATE



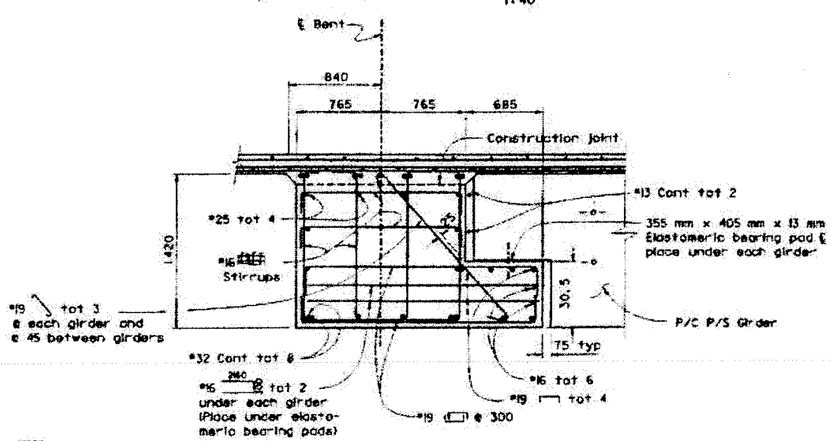
PART PLAN

1:40



BENT CORNER DETAIL

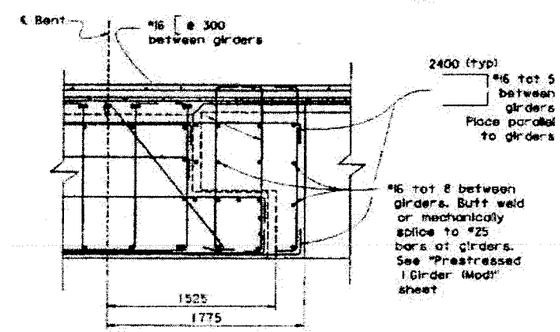
1:20



NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

SECTION A-A

1:20



SECTION B-B (BETWEEN GIRDERS)

1:20

Notes:

1. Bent 2 shown. Bent 3 similar
2. For reinforcement not shown see "SECTION A-A"
3. Space stirrups and ties along centerline bent and place normal to centerline bents unless otherwise noted.

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN	BY Carmen Shantz	CHECKED Yusuf Saleh	
DETAILS	BY Doug Wooten	CHECKED Yusuf Saleh	
QUANTITIES	BY Tim Greutert	CHECKED Lawrence Okoye	

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 10

BRIDGE NO. 56-050TR
ALIGNMENT POST R19.633

CU 08
EA 45300

ROUTE 60/215 SEPARATION (WIDEN)

BENT DETAILS

7 | 14

STRUCTURES DESIGN DETAIL SHEET METRIC REV. 5/2/96

DRAWING SCALE IN MILLIMETERS FOR REDUCED PLANS

DIMENSIONS PRINTED BEARING EARLIER REVISION DATES

FILE -- 56-453001-0226,271-0756

DATE PLOTTED -- 27-Apr-2000 TIME PLOTTED -- 11:15

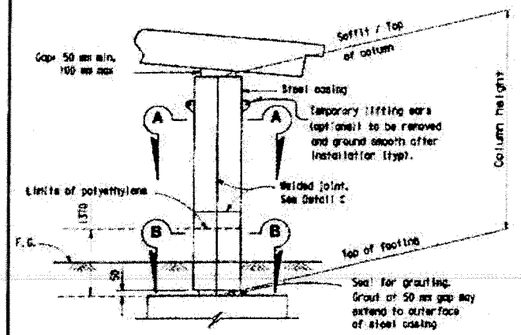
DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.
08	Riv	215,60	R6.8/R6.8, R19.5/R19.5	230

REGISTERED CIVIL ENGINEER 5-11-99

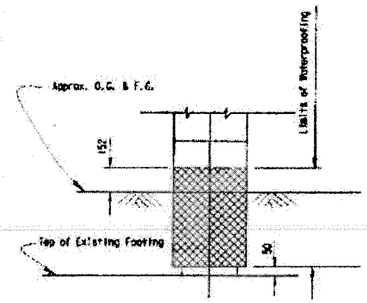
4-17-00
PLANS APPROVAL DATE

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.

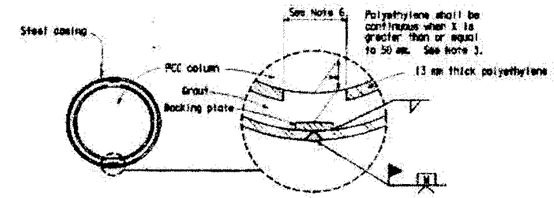
California law requires you to go to the web site, go to http://www.



CLASS P/F COLUMN



WATERPROOFING LIMITS

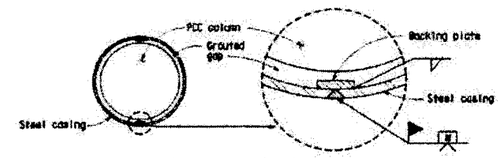


SECTION B-B
ROUND COLUMN

Minimum inside diameter of steel casing = 65 mm greater than nominal column diameter for Class P/F.

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

BENT	SOFFIT / TOP OF COLUMN L	SOFFIT / TOP OF COLUMN R	TOP OF FOOTING	O.G
2	472.26	472.86	465.96 ±	467.50 ±
3	472.94	473.38	467.64 ±	468.00 ±

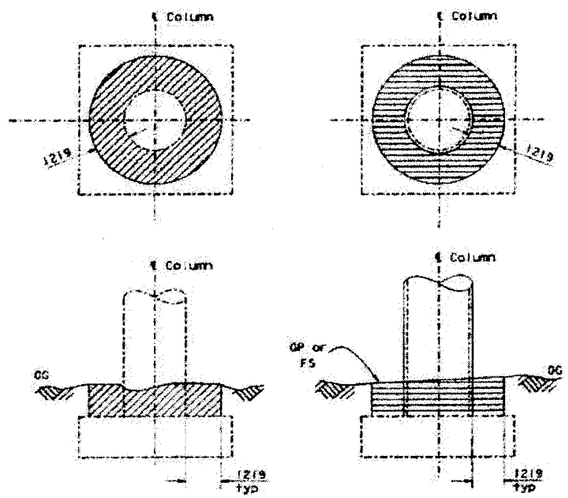


SECTION A-A
ROUND COLUMN

Minimum inside diameter of steel casing = 65 mm greater than nominal column diameter for Class P/F

Notes:

1. Drill 25 mm dia hole through intersection of joint. For more than 2 weld intersection drill 50 mm dia. hole.
2. Appropriate injection nozzles to be provided on casing, but removed and ground flush following completion of grouting operation.
3. All voids between steel casing and polyethelene to be filled with grout.
4. Location and number of vertical and horizontal welds to be determined by the Contractor, and subject to the approval of the Engineer. No skip welds allowed.
5. All steel casing to be 9 mm thick. Backing plates shall be the same thickness as the casing.
6. The location of casing welds are for illustration. The Fabricator may choose alternate locations and identify them on the shop plans.

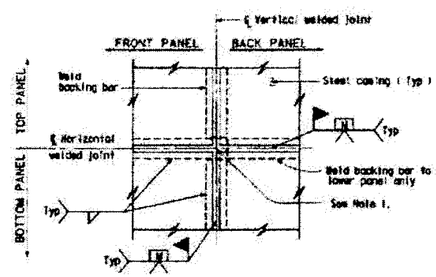


EXCAVATION

BACKFILL

COLUMN CASING ONLY

No Scale



(TWO WELDED INTERSECTION JOINT)

DETAIL C

No Scale

LEGEND

- Indicates Existing Structure
- Indicates New Construction
- Indicates Structure Excavation (Bridge)
- Indicates Structure Backfill (Bridge)

ABBREVIATIONS

OG	Original Ground
FS	Planned Finish Surface
GP	Planned Graded Plane

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN	Carmen Shantz	CHECKED	Yusuf Saleh
DETAILS	Doug Wooten	CHECKED	Yusuf Saleh
QUANTITIES	Tim Greutert	CHECKED	Lawrence Okoye

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 10

BRIDGE NO. 56-0507R
KILOMETER POST R19.633

ROUTE 60/215 SEPARATION (WIDE
BENT RETROFIT DETAILS

CU 08
EA 453001

STRUCTURES DESIGN DETAIL SHEET RETROFIT REV. 9/2/98

SCALE: 1:50 MILLIMETERS FOR ORIGINAL PLANS

FILE = D:\08-453001\0230.271\2757

CURRENT PROJECT BASELINE DIMENSION REVISION DATES

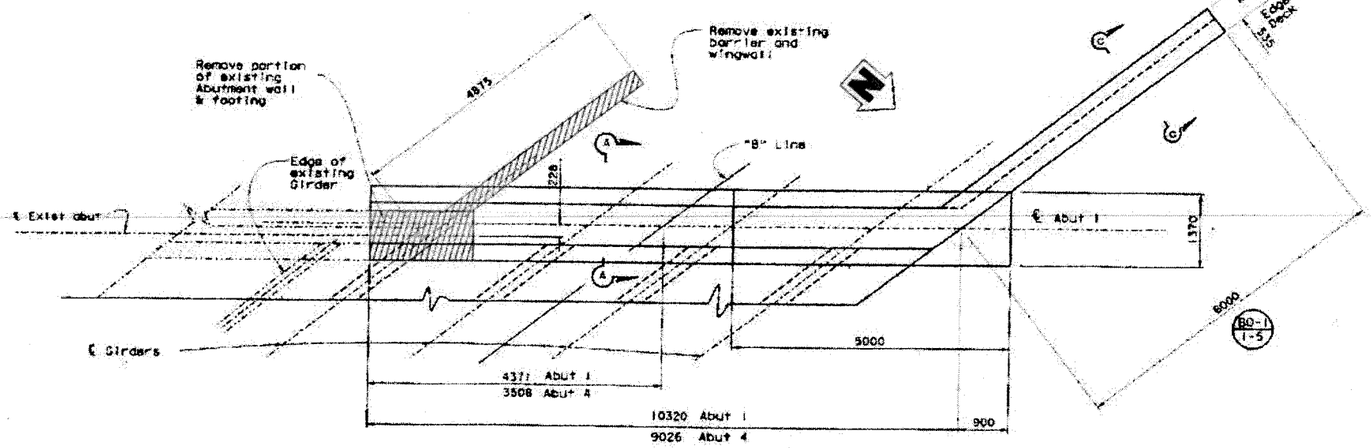
DATE							
5-11-99							

SHEET 8

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
08	Riv	215,60	R61.8/66.8, R13.5/23.0	226	281

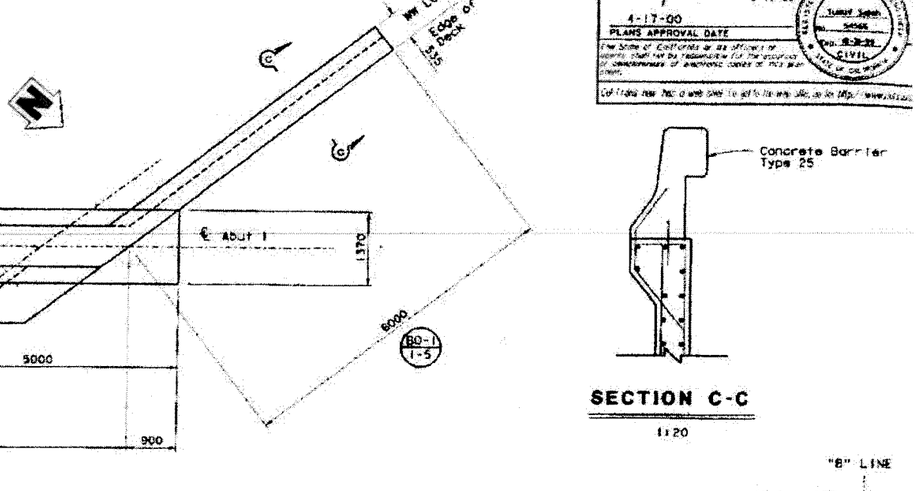
REGISTERED CIVIL ENGINEER 5-11-99

4-17-00
PLANS APPROVAL DATE



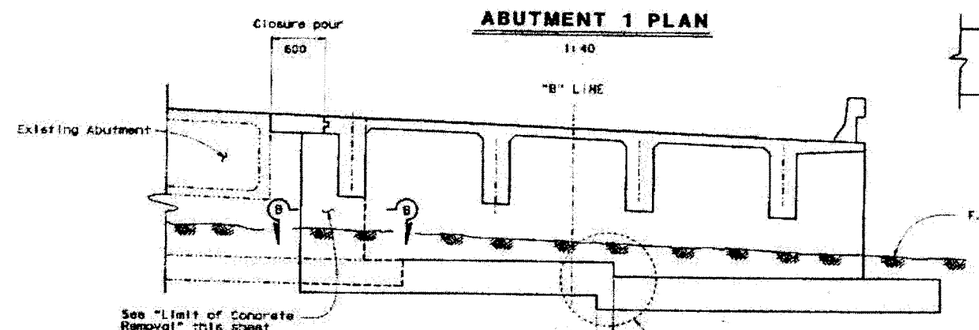
ABUTMENT 1 PLAN

1:40



SECTION C-C

1:20

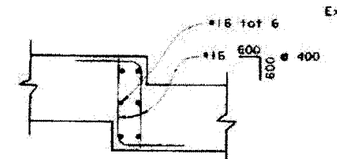


Note: Abutment 1 shown. Abutment 4 similar

NOTE:
THE CONTRACTOR SHALL VERIFY ALL CONTROLLING FIELD DIMENSIONS BEFORE ORDERING OR FABRICATING ANY MATERIAL.

ABUTMENT 1 ELEVATION

1:40

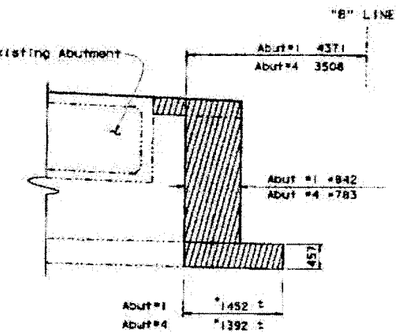


DETAIL "A"

1:20

Denotes areas of existing structure to be removed

Note:
For SECTION A-A & SECTION B-B, see "ABUTMENT DETAILS" sheet.



Remove existing footing & Abut. For existing reinf. to remain see "Section B-B" Abutment Details Sheet

*Along ℄ of Existing Abutment

LIMIT OF CONCRETE REMOVAL

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN	Carmen Shantz	CHECKED	Yusuf Saleh
DETAILS	Doug Wooten	CHECKED	Yusuf Saleh
QUANTITIES	Joe Siemers	CHECKED	Tim Greutert

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 10

BRIDGE NO. 56-0507R
KILOMETER POST R19.633

CU 08
EA 45300

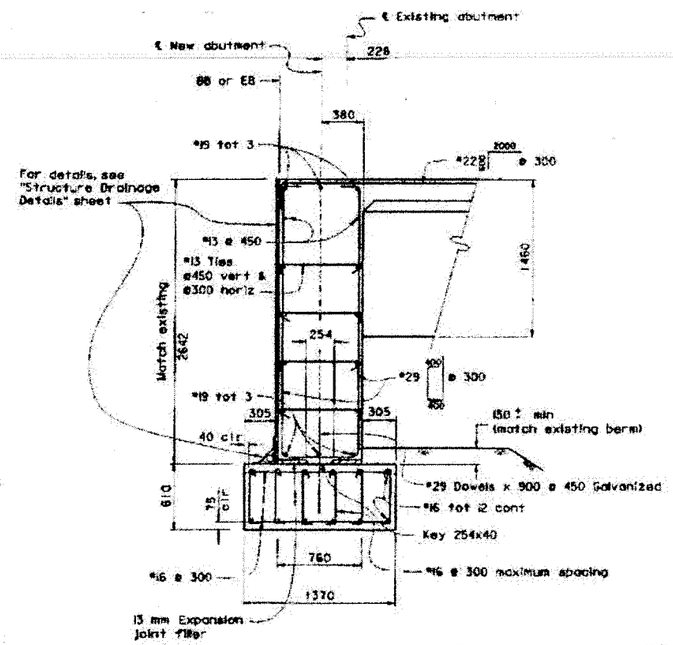
ROUTE 60/215 SEPARATION (WIDEN)
ABUTMENT LAYOUT

SHEET 4 OF 14

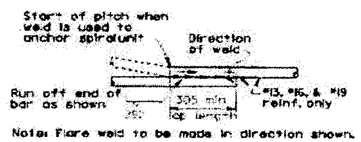
DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
08	RIV	215, 60	R67.8/66.8, R18.5/23.0	227	261

REGISTERED CIVIL ENGINEER 5-11-99

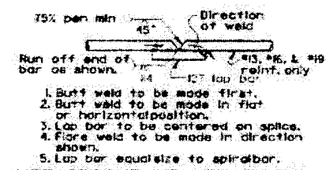
4-17-00
PLANS APPROVAL DATE



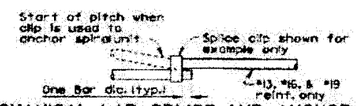
SECTION A-A



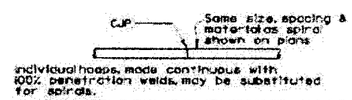
WELDED LAP SPLICE AND ANCHOR



VEE GROOVE WELDED SPLICE

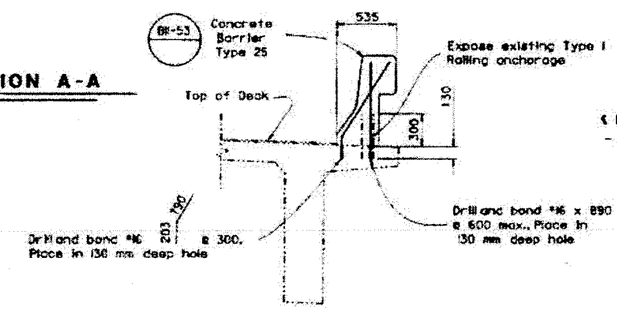


MECHANICAL LAP SPLICE AND ANCHOR



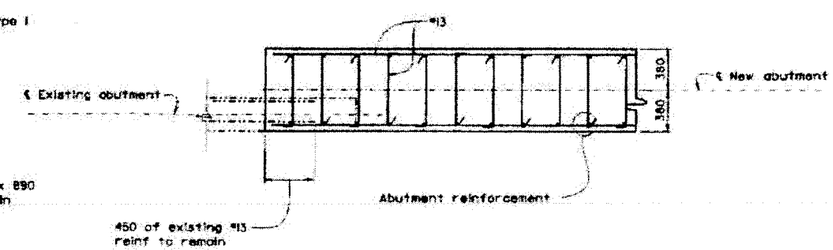
BUTT WELDED CONTINUOUS HOOP

BAR SPIRAL SPLICE & SPIRAL ANCHOR AND HOOP DETAIL



BARRIER REPLACEMENT DETAIL

1:20



SECTION B-B

1:20

NOTE:
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ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN	Carmen Shantz	CHECKED	Yusuf Salah
DETAILS	Doug Wooten	CHECKED	Yusuf Salah
QUANTITIES	Tim Greutert	CHECKED	Lawrence Okoye

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

DIVISION OF STRUCTURES
STRUCTURE DESIGN 10

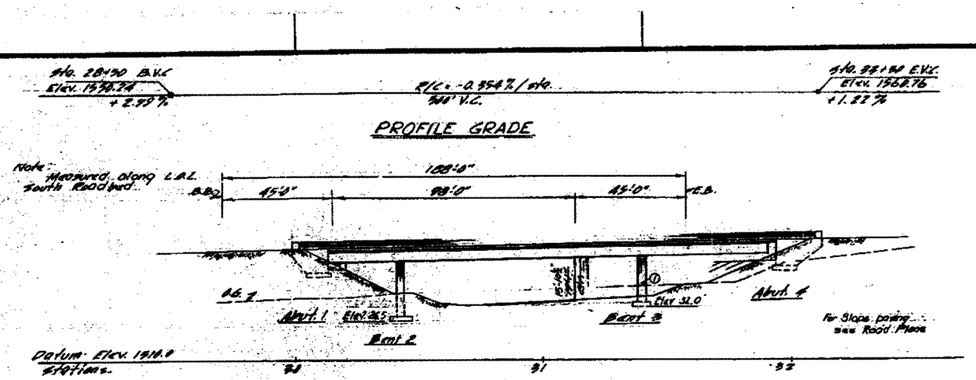
BRIDGE NO. 56-0507R
KILOMETER POST R19.633

ROUTE 60/215 SEPARATION (WIDEN)
ABUTMENT DETAILS

CU 08
EA 453001

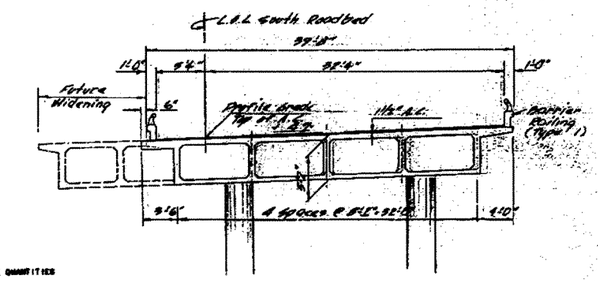
SHEET 5 OF 14

U-057-2(3) F-057-2(4)



ELEVATION
Scale: 1"=20'

Permanent Elevations
"x" chiseled on top of bolt
Datum: 1500

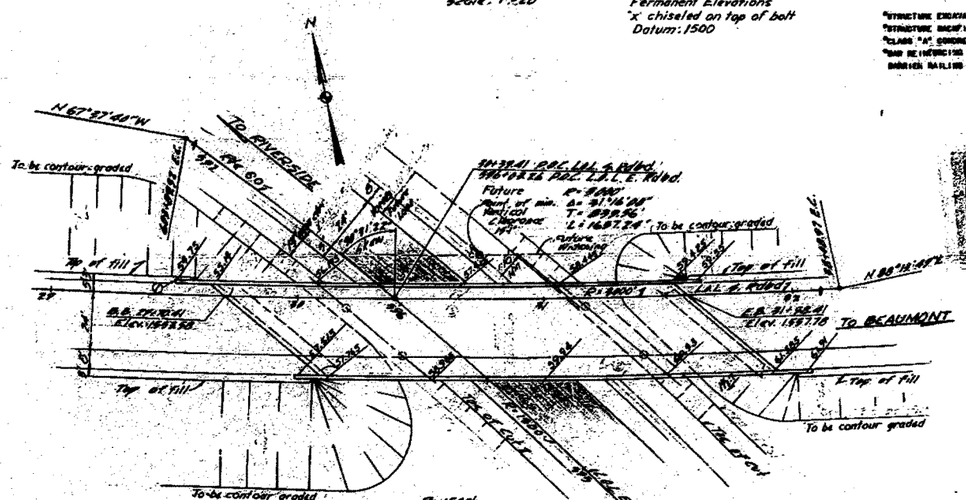


TYPICAL SECTION
Scale: 1/8"=1'-0"

APPROXIMATE QUANTITIES

*STRUCTURE EXCAVATION (BRIDGE)	700 C.Y.
*STRUCTURE BACKFILL (BRIDGE)	230 C.Y.
*CLASS "A" CONCRETE (BRIDGE)	600 C.Y.
*BAR REINFORCING STEEL (BRIDGE)	165,000 LBS.
BARRIER RAILING (TYPE 1)	439 L.F.

*FINAL QUANTITIES



PLAN
Scale: 1"=50'

[redacted]

INDEX TO PLANS

Sheet No.	Title
1	General Plan
2	Grid Sheet
3	Foundation Plan
4	Abutment Details
5	Bent Details
6	Typical Section / Girder Layout
7	Girder Reinforcement
8	Log of Test Borings

Bridge Details

B1	Standard Details No 1 (Box Girder)
B2	Standard Details No 1 (T-Beam)
B3	Barrier Railing Sheet 1
B4	Barrier Railing Sheet 2

Sheet Numbers prefixed with B are grouped together as "Bridge Details" and apply to several structures.

THIS SET OF PLANS WAS REVISED TO CORRESPOND TO THE "AS BUILT" PLANS DATED 7-66 AS SUBMITTED BY RESIDENT ENGINEER Gonzalez
TRACING CORRECTED BY [illegible] DATE: 7-14-66

SHEET 1 OF 8

DESIGN SECTION 13

Foundation Plan

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

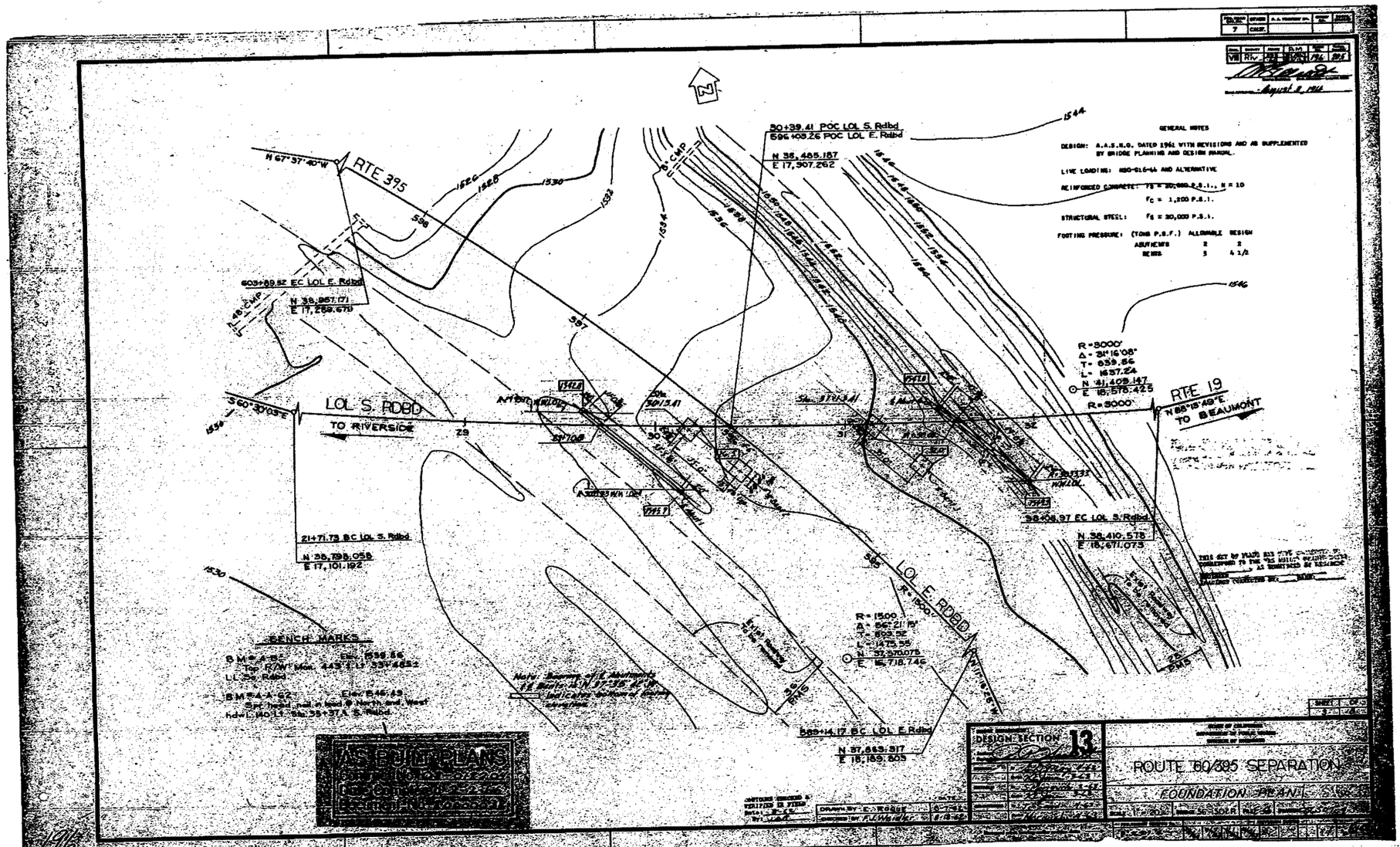
ROUTE 60/395 SEPARATION

LOCATED 5 MILES S.E. OF THE CITY OF RIVERSIDE, APPROX. 200' S. OF EXISTING RTE. 60/395 BEF. UR 054-70 IN RIVERSIDE COUNTY

GENERAL PLAN

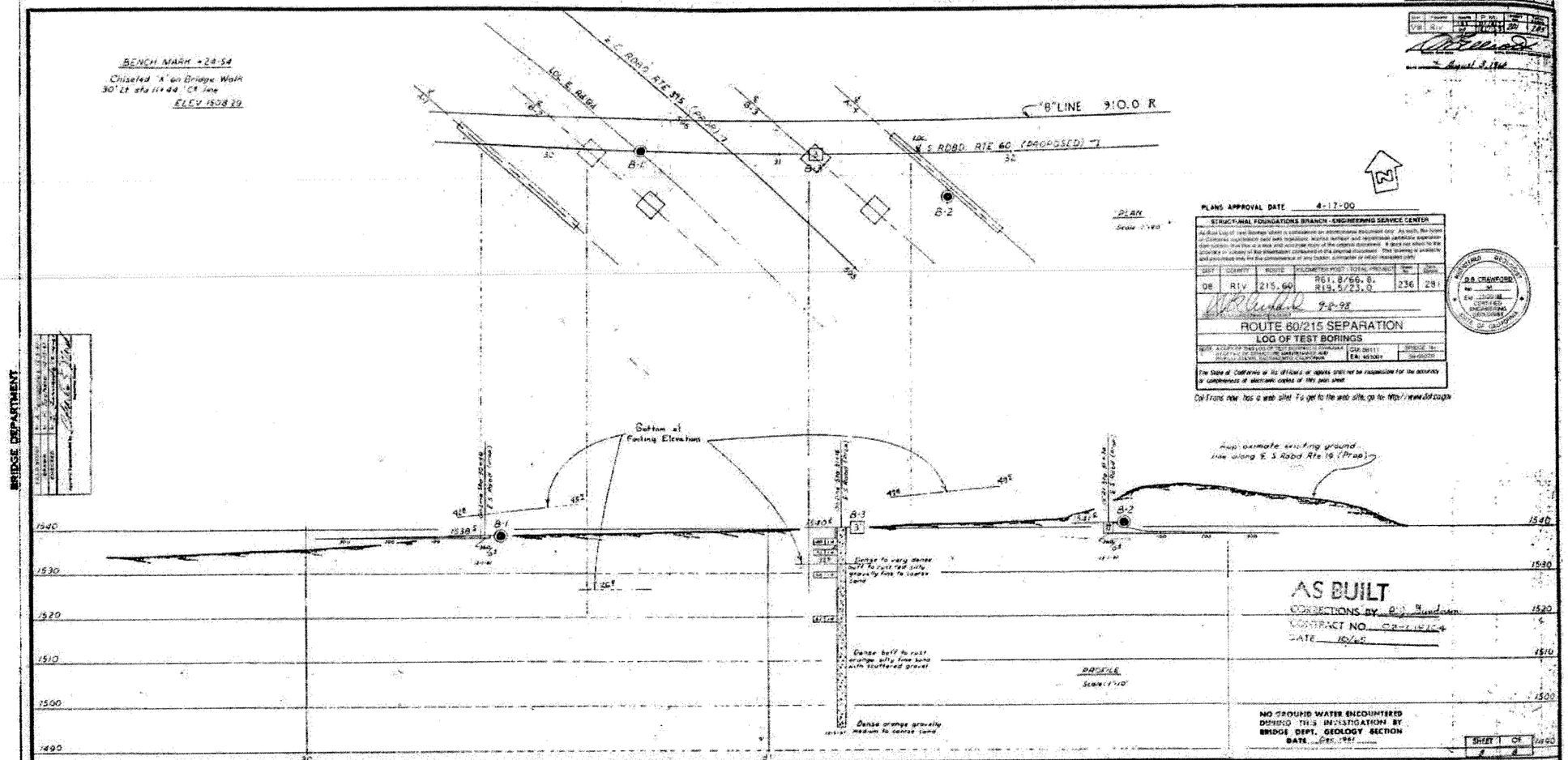
SCALE AS NOTED | BRIDGE 56-507R | FILE | DRAWING 56507-2

194


GENERAL NOTES
DESIGN: A.A.S.H.O. DATED 1961 WITH REVISIONS AND AS SUPPLEMENTED BY BRIDGE PLANNING AND DESIGN MANUAL.
LIVE LOADING: HSO-GL6-44 AND ALTERNATIVE
REINFORCED CONCRETE: fs = 20,000 P.S.I., n = 10
fc = 1,200 P.S.I.
STRUCTURAL STEEL: fs = 20,000 P.S.I.
FOOTING PRESSURE: (TONS P.S.F.) ALLOWABLE DESIGN
ABUTMENTS 2 2
BENTS 3 4 1/2
RTE 395
N 67°37'40"W
LOL S. RDBD
TO RIVERSIDE
S60°30'05"E
30+39.41 POC LOL S. Rdbd
596+05.26 POC LOL E. Rdbd
N 38,485.187
E 17,907.262
603+89.52 EC LOL E. Rdbd
N 38,957.171
E 17,269.670
21+71.73 BC LOL S. Rdbd
N 38,798.058
E 17,101.192
R=3000'
Δ=31°16'08"
T=839.86
L=1637.24
N 41,409.147
E 16,576.425
R=3000'
RTE 19
N 88°18'49"E
TO BEAUMONT
98+08.97 EC LOL S. Rdbd
N 38,410.578
E 18,671.073
LOL E. RDBD
R=1500'
R=1500
Δ=64°21'19"
T=903.92
L=1675.55
N 37,970.075
E 15,718.746
N 11°57'26"E
BENCH MARKS
B.M. A-82 Elev. 1558.86
Top R/W Mon. 443' Lt. 33' 4652
LL 26 Rdbd
B.M. A-A 62 Elev. 1545.63
Spk head nail in head @ North and West
hdwl. 140 Lt. 35+37.A S. Rdbd
Note: Bearing of E. Abutments is Radial. N 37°26' E. indicates bottom of footing elevation
889+14.17 BC LOL E. Rdbd
N 37,663.317
E 15,169.805
DESIGN SECTION 13
ROUTE 60/395 SEPARATION
FOUNDATION PLAN
AS BUILT PLANS

BRIDGE DEPARTMENT

BENCH MARK #24-54
Chiseled 'X' on Bridge Walk
30' Lt sta 11+44 'C' line
ELEV 1508.29



PLANS APPROVAL DATE 4-17-00

STRUCTURAL FOUNDATIONS BRANCH - ENGINEERING SERVICE CENTER

As-Built Log of Test Borings sheet is considered an electronic document only. As such, the holder of Contract capitulation and web installation, marks defined and repetitious particular supervision does not in fact or in a true and accurate copy of the original document. It does not attest to the accuracy or validity of the information contained in the original document. This drawing is provided and provided only for the convenience of any bidder, contractor or other interested party.

DIST	COUNTY	ROUTE	KILOMETER POST / TOTAL PROJECT	TOTAL SHEETS	SHEET NO.
08	RIV	215, 60	R61.8/66.8, R19.5/23.0	236	291

9-8-98

ROUTE 60/215 SEPARATION
LOG OF TEST BORINGS

NOTE: A COPY OF THE LOG OF TEST BORINGS DRAWING IS KEPT AT THE DIRECTOR'S DEPARTMENT AND PROJECT ENGINEER, SOUTHWESTERN CALIFORNIA

DGN 09111
EA: 451001

BRIDGE No. 56-507R

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Caltrans now has a web site! To get to the web site, go to: http://www.dot.ca.gov

D.B. CRAWFORD
No. 34
Exp. 12/31/98
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

AS BUILT
CORRECTIONS BY D.J. Sundown
CONTRACT NO. 08-1E704
DATE 10/98

NO GROUND WATER ENCOUNTERED
DURING THIS INVESTIGATION BY
BRIDGE DEPT. GEOLOGY SECTION
DATE Dec. 1981

SHEET 1 OF 4

CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS

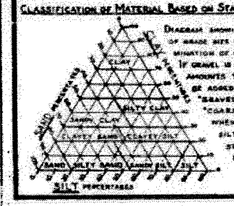


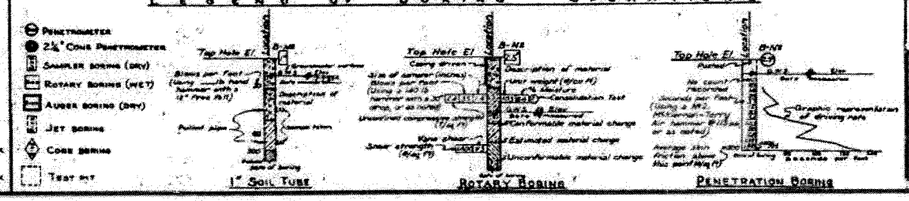
DIAGRAM SHOWING THE BASIS FOR ESTIMATES OF GRADE SIZE DISTRIBUTION USED IN DETERMINATION OF CLASS NAMES.
IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIZ. "GRAVELLY SAND". THE TERMS "COARSE", "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE SAND, SILT AND GRAVEL REFER TO STANDARD GRADE SIZE LIMITS.

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/OR ORGANIC MATTER
- FILL MATERIAL
- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

LEGEND OF BORING OPERATIONS

- PENETROMETER
- 2½" CONE PENETROMETER
- SAMPLER BORING (DRY)
- ROTARY BORING (WET)
- AUGER BORING (DRY)
- JET BORING
- CORE BORING
- TEST PIT



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

ROUTE 60/395 SEPARATION
LOG OF TEST BORINGS

SCALE As Noted | BRIDGE 56-507R | FILE | DRAWING 56507-12

br56-507R.tif

REVISED
STRUCTURE FOUNDATION REPORT
RETAINING WALLS FOR WESTBOUND AND EASTBOUND STATE ROUTE 60 HOV CONNECTORS
BRIDGE NOS. 56-0841 AND 56-0842
INTERSTATE 215/STATE ROUTE 60 EAST JUNCTION IMPROVEMENTS
CITY OF RIVERSIDE, CALIFORNIA
08-RIV-215/60-KP 61.7/62.6, 19.4/21.5
CALTRANS EA NO. 08-449311

Prepared for:

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER WEST, INC.
1220 Research Drive, Suite B
Redlands, CA 92374

Kleinfelder Project No. 76979

Revised June 15, 2009
February 16, 2009

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APPROVAL LETTER

State of California Business, Transportation and Housing Agency

Flex your power!
Be energy efficient!

Memorandum

To: Mr. Denix D. Anbiah
Department of Transportation
Division of Engineering Services
Office of Special Funded Projects MS #9- 2/7G

Date: October 13, 2009

File: EA 08-449311
08-RIV-56-0841
WB 60 HOV Conn
08-Riv-56-0842
EB 60 HOV Conn

Attention: Robert Zezoff

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES - MS #5
OFFICE OF GEOTECHNICAL DESIGN SOUTH-2

Subject: Caltrans OSFP Review Comments

References: Addendum Report No. 2, Structure Foundation Report (dated February 16, 2009), and Addendum Report No. 1 (Dated August 19, 2009) Proposed Retaining Walls, Westbound and Eastbound SR60 HOV Connectors, Bridge Nos. 56-0841 and 56-2842, Interstate 215/State Route 60 East Junction Improvements, City of Riverside, California, 08-Riv-215/60, KP 61.7/62.6, 19.4/21.5, Caltrans EA No. 08-449311, dated October 13, 2009, by Kleinfelder West, Inc., Project No. 76979

(Half Size) General Plans WB SR60 HOV Connector 56-0841, 32 sheets and EB SR60 HOV Connector 56-0842, 31 sheets, respectively dated 10/2/09, by LAN Engineering Corp.

The submitted Addendums and Revised Plans to the Structure Foundation Report by Kleinfelder West, Inc. and LAN Engineering for the above-proposed project generally satisfy the requirements of Caltrans' Structure Foundation Report Guidelines and are accepted.

Any questions regarding the review comments and recommendations should be directed to the attention of K. Douglas Cook (916) 227-4514 or Angel Perez-Cobo (916) 227-7167, Office of Geotechnical Design South-2 A.

Prepared by:

K. Douglas Cook, CEG date: 10-13-09
Engineering Geologist

KDC

Reviewed by:

Angel Perez-Cobo, PE date: 10/13/09
Senior Transportation Engineer
Office of Geotechnical Design South-2

Distribution: (2) Addressee

ADDENDUM No. 2

1220 Research Drive
Suite B
Redlands, CA 92374
p| 909.793.2691
f| 909.792.1704
kleinfelder.com

October 1, 2009
Project No. 76979

Mr. Norman Suydam, PE
AECOM LAN
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

via Electronic Mail
Mohan.Char@aecom.com
Kimberly.Gee@aecom.com

Subject: Addendum Report No. 2
Structure Foundation Report (Dated February 16, 2009) and
Addendum Report No. 1 (Dated August 19, 2009)
Proposed Retaining Walls, WB and EB SR-60 HOV Connectors
Bridge Nos. 56-0841 and 56-0842
Interstate 215/State Route 60 East Junction Improvements
City of Riverside, California
08-Riv-215/60-KP 61.7/62.6, 19.4/21.5
Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder has prepared this addendum report in response to comments provided by the California Department of Transportation (Caltrans) Office of Geotechnical Design South-2 on our Structure Foundation Report dated February 16, 2009 and Addendum Report dated August 19, 2009 for the proposed retaining walls associated with the State Route 60 HOV Connectors. The Caltrans review comments and our responses to these comments are attached.

CLOSURE

The information contained in this report/letter is subject to the conditions and limitations contained within the structure foundation report. We appreciate the opportunity to be of service on this project. If you have any questions, comments or require additional information, please do not hesitate to contact our office at your convenience.

Copyright 2009 Kleinfelder

Respectfully submitted,
KLEINFELDER WEST, INC.

Madan Chirumalla, PE
Staff Engineer

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

MC/CVA:lg

Attachments: Caltrans Review Comments Matrix
Revised Log of Test Borings (LOTB) Sheets
Direct Shear Test Data (PLATE 1)

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Project Name: **I-215/SR-60 East Junction**
08-SBd-215/60 CU08 -EA449311
Review Phase: **Foundation Report Review**
Retaining Walls for WB and EB SR60 HOV Connectors Bridge No. 56-0841/56-0842
Responses by: **Carlos Amante and Madan Chirumalla**

This document contains the response to Caltrans comments dated September 17, 2009 on Addendum to Structure Foundation Report.

RESPONSE TO COMMENTS ON FOUNDATION REPORT REVIEW – RETAINING WALLS FOR WB AND EB SR60 HOV CONNECTORS

Comment No.	Review Comments by Douglas Cook and Asef Wardak	Responses	✓
1	The Response to Comment 1 of the July 27, 2009 Review Comments was found acceptable.	Response is not required.	
2	The Response to Comment 2 of the July 27, 2009 Review Comments was found acceptable with comment. The subject table attached to the response was listed as "Table la (Revised 8-19-09)" where as it should be listed as **"Table lb"** when appended onto page 2 of the report revised dated June 15, 2009. Please comply.	We confirmed that Retaining Wall Table for EB SR60 HOV Connector is “Table 1a” and not “Table 1b”.	
3	The Response to Comment 3 of the July 27, 2009 Review Comments was found unacceptable. Under what conditions and what were the values of the "large toe pressure and settlement that change the foundation **type** from spread footing to deep foundation" as reported in the response?	Lateral loads control the design. According to the project structural engineer at AECOM LAN, walls that are 4.2 meters and higher should be supported on piles due to seismic loading and/or barrier impact loading on top as applicable. Therefore, we recommend that portions of retaining walls with height less than 4.2 meters be supported on spread footings. Retaining wall plans have been revised by AECOM LAN to show pile support for walls that are 4.2 meters and higher.	
4	The response to Comment 4 of the July 27, 2009 Review Comments was found unacceptable. Based on your calculations presented in Appendix C of the report, the explanation or response to our comments number 3 and 4 are not acceptable. Please revise and respond.	The bearing capacity calculations provided in Appendix C of our report are based on bearing capacity theory without consideration for settlement. Permissible total and differential settlement criteria of 1 inch and ½ inch, respectively, were used in our design.	
5	The Response to Comment 5 of the July 27, 2009 Review Comments was found acceptable.	Response is not required.	

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Project Name: **I-215/SR-60 East Junction**
08-SBd-215/60 CU08 -EA449311
Review Phase: **Foundation Report Review**
Retaining Walls for WB and EB SR60 HOV Connectors **Bridge No. 56-0841/56-0842**
Responses by: **Carlos Amante and Madan Chirumalla**

Comment No.	Review Comments by Douglas Cook and Asef Wardak	Responses	✓
6	The Response to Comment 6 of the July 27, 2009 Review Comments was found unacceptable. If the retaining wall number 1 at westbound SR60 HOV connector started at station 14+53.076 as it shown in Table la, yet the revised general plan still does not show the entire wall.Please revise.	AECOM LAN will show the entire wall with broken line in the middle. The reason for doing this is that without the broken line the entire plan would need to be shifted significantly to the right. This will result in not being able to line up elevation with the plan due to the title block of the border at top right. Also, the Typical Section needs to be shifted to the next sheet which will result in adding an extra sheet. In view of these, AECOM LAN will show the entire wall with broken line in the middle.	
7	The Response to Comment 7 of the July 27, 2009 Review Comments was found unacceptable. The Log of Test Boring (LOTB) still does not meet the requirement of Caltrans Soil and Rock Logging, Classification, and Presentation Manual, June 2007.	Our revised boring logs attached in this addendum include the following revisions based on Caltrans Soil and Rock Logging, Classification, and Presentation Manual, June 2007: • The apparent density of cohesionless soil based on a corrected SPT N60. • Bedrock descriptions.	
8	The Response to Comment 8 of the July 27, 2009 Review Comments was found unacceptable as it did not address the comment. The differences should be stated and explained in the report.	Based on compiled direct shear test data (see attached Plate 1) for alluvial soil deposits along the proposed connectors, the strength parameters we used for slope stability analysis and foundation design are reasonable for this project.	

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

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4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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 (25.4 mm soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

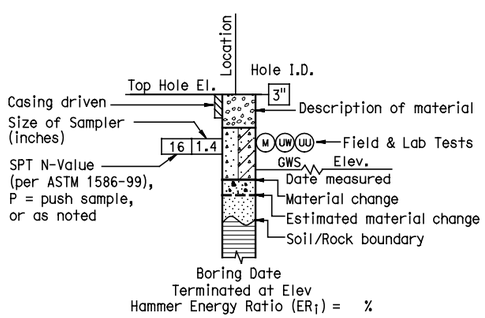
Note: Size in millimeters.

CONSISTENCY OF COHESIVE SOILS

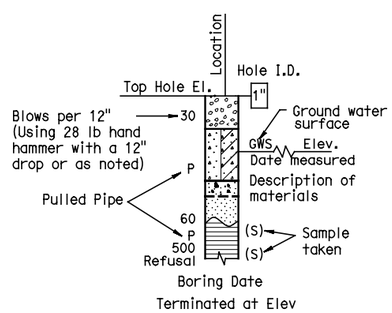
Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

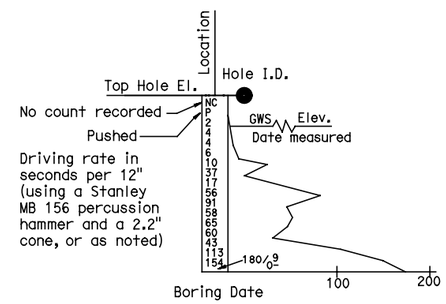
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



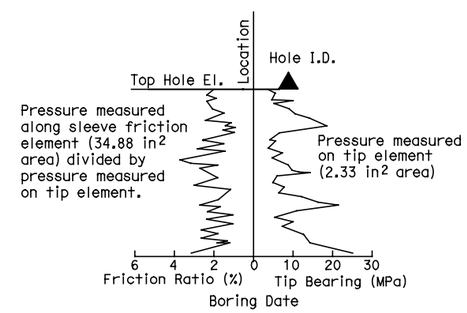
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/18/09 6/18/09 8/28/09 10/2/09

SHEET 27 OF 32

FILE => U:\BRIDGE\RCTC0601-East J2\0 - EPS FILES\EPS FINAL\56-0841\56-0841-z-lfb01.dgn

USERNAME => LAN DATE PLOTTED => 10/1/2009 TIME PLOTTED => 4:34:38 PM

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

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KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 2/18/09 6/18/09 8/28/09 10/2/09

SHEET 28 OF 32

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos D'Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

PLANS APPROVAL DATE

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

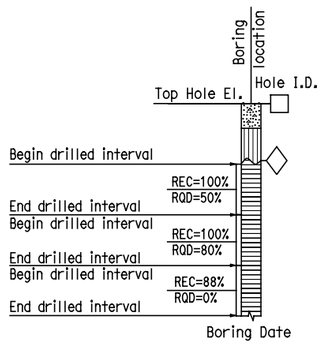
KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 2/13/09 6/18/09 8/28/09 10/2/09

SHEET 29 OF 32

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

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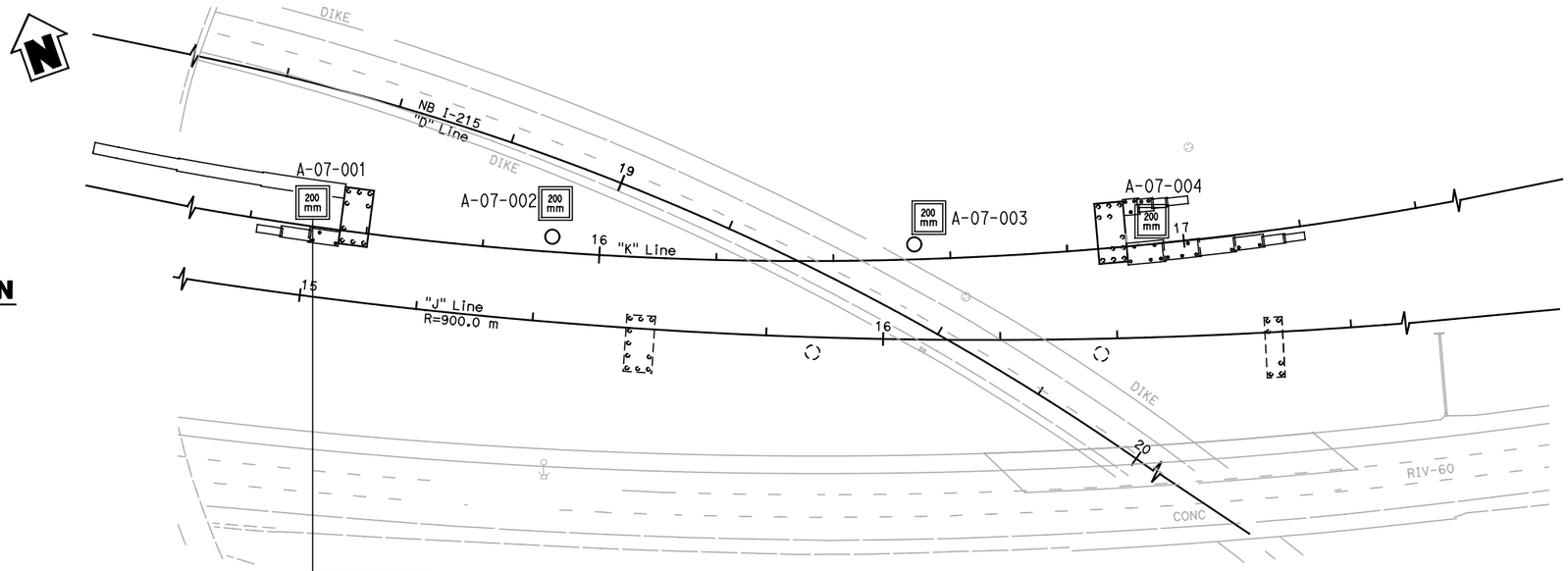
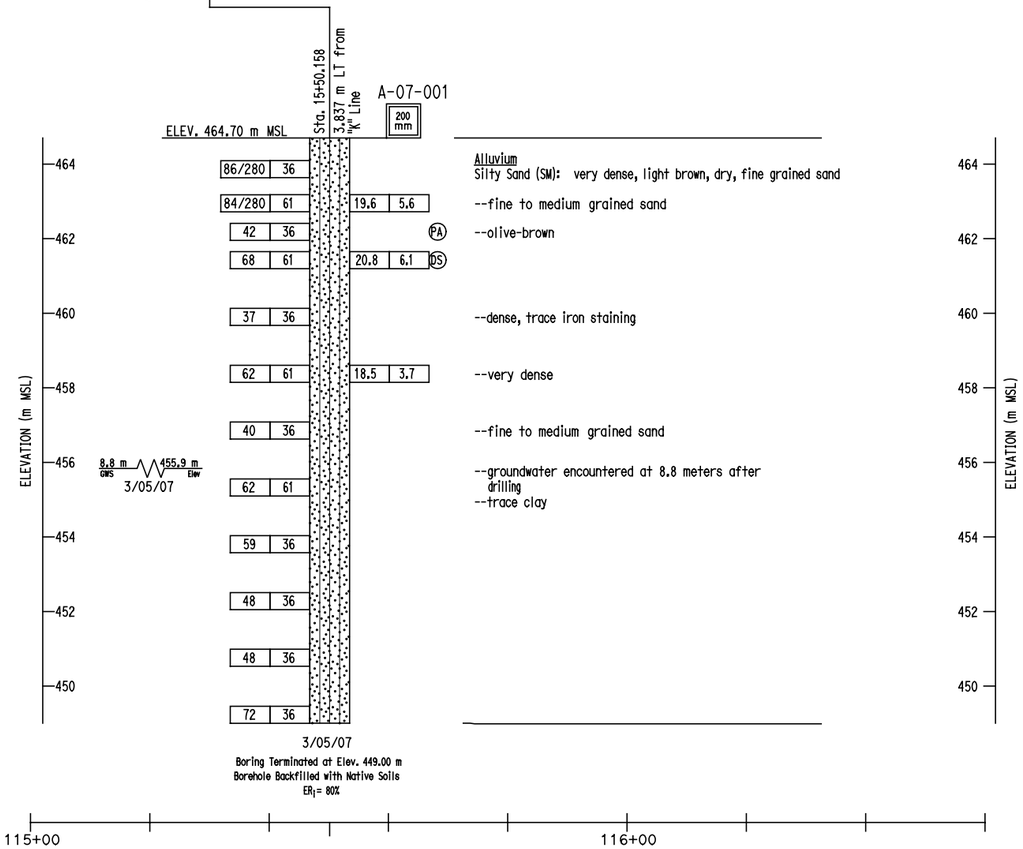
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500





PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.
2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.
3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.
4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT
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CHECKED BY C. AMANTE

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C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 1 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES
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SHEET 30 OF 32

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
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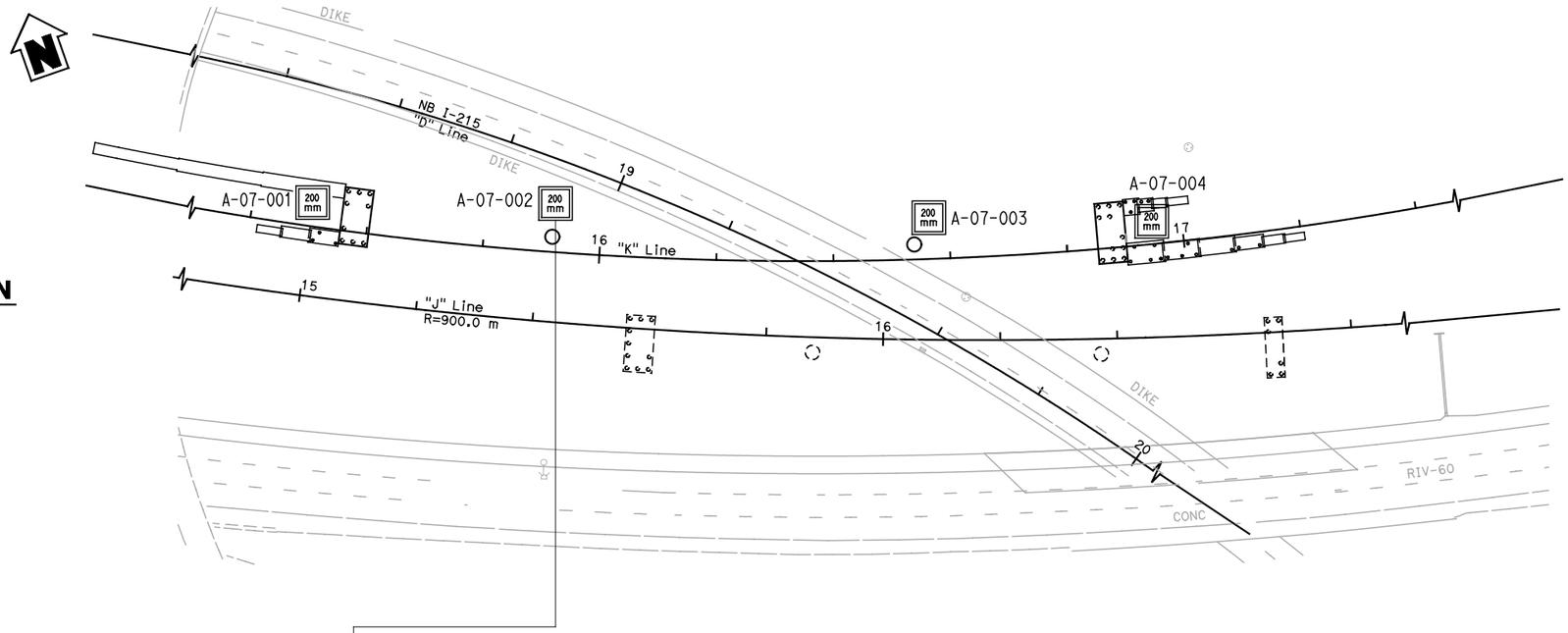
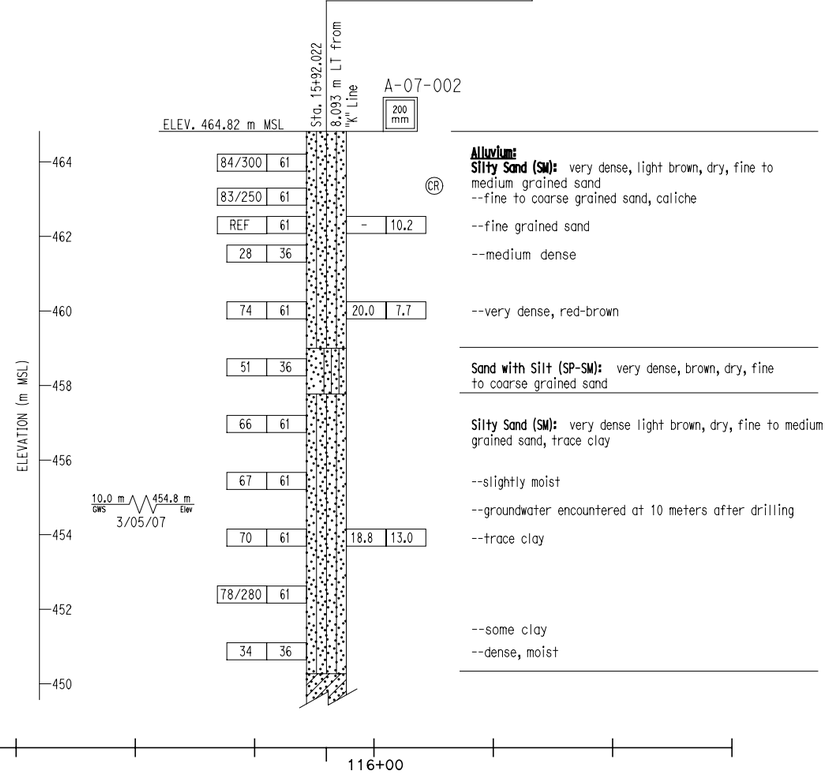
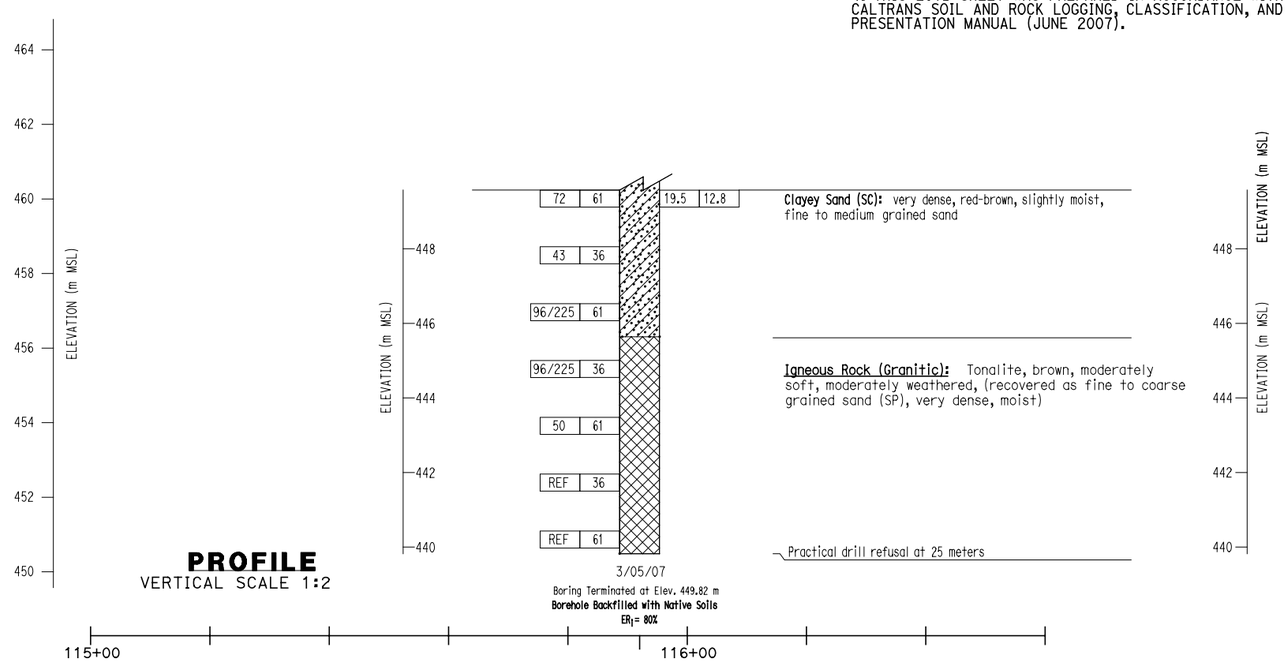
KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500





PROFILE
VERTICAL SCALE 1:2



BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

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DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY: D. FAHRNEY
CHECKED BY: C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 2 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

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SHEET 31 OF 32

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Caltrans Metric

Carlos V Amante 10/02/09
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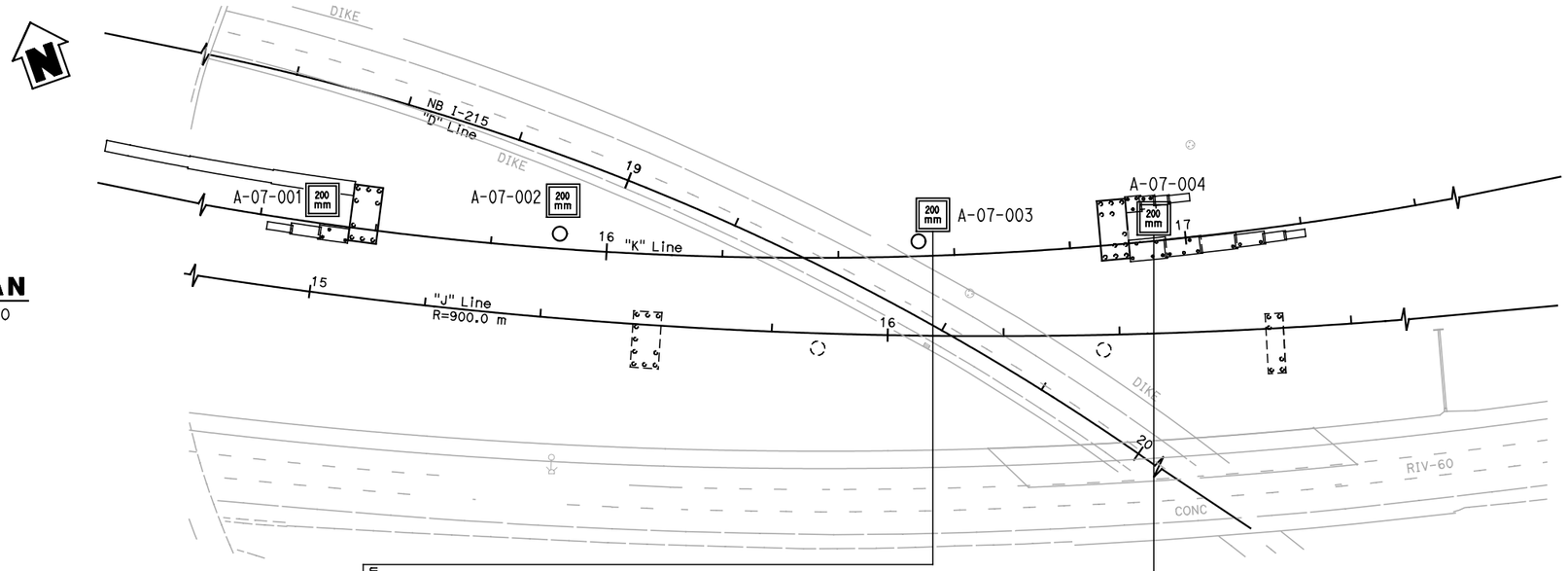
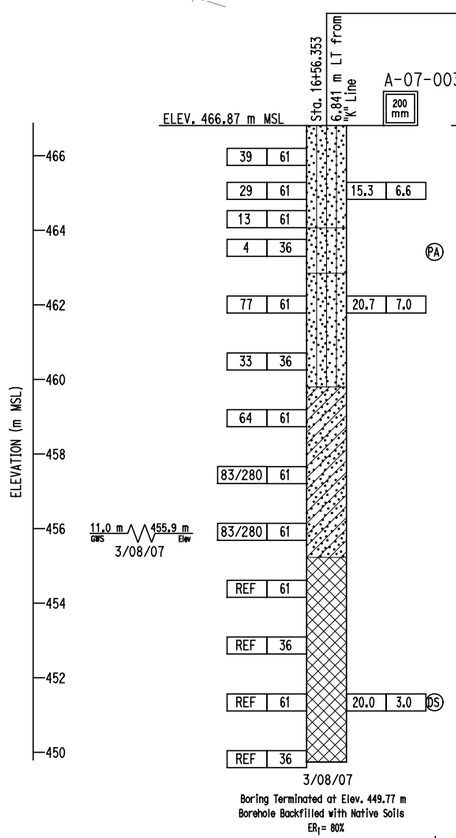
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500





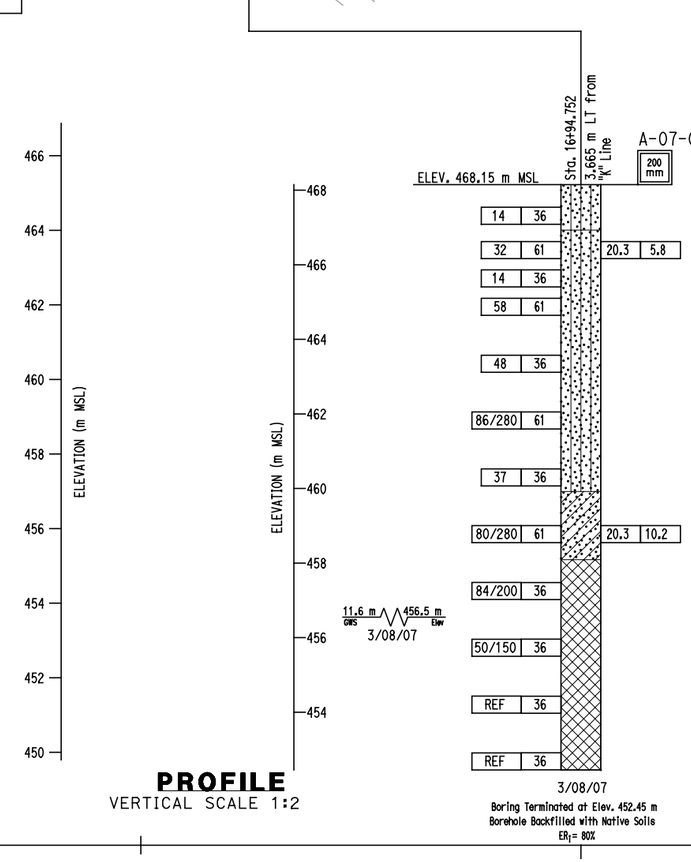
Fill:
Silty Sand (SM): dense, dark brown, fine to coarse grained sand, with fine gravel and asphalt grindings
--medium dense, asphalt grindings
--fine grained sand, trace medium sand, iron staining, gravel content decreasing

Alluvium:
Silty Sand (SM): loose, brown, slightly moist

Silty Sand (SM): very dense, red-brown, slightly moist, fine to medium grained sand, trace clay
--dense, fine grained sand

Clayey Sand (SC): very dense, brown, moist, fine grained sand
--groundwater encountered at 11 meters

Igneous Rock (Granitic): Tonalite, gray-bown, moderately soft, moderately weathered, (recovered as fine to coarse grained sand (SP), very dense, wet)
--drilling effort increases
--gray
--very difficult drilling
--slightly weathered, moist, gray-brown, fine to medium grained
--wet
Practical drill refusal at 17.1 meters



Fill:
Silty Sand (SM): medium dense, red-brown, dry, fine to medium grained sand, trace coarse sand

Alluvium:
Silty Sand (SM): medium dense, brown, slightly moist, fine to coarse grained sand
--roots
--very dense, brown, slightly moist, fine grained sand
--orange-brown, dry
--dense

Clayey Sand (SC): very dense, red-brown, moist, fine to coarse grained sand

Igneous Rock (Granitic): Tonalite, tan-brown, moderately soft, slightly weathered, (recovered as fine to medium grained sand (SP), very dense, moist)
--groundwater encountered at approximately 11.6 meters

PROFILE
VERTICAL SCALE 1:2

116+40 117+00

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
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ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 3 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

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SHEET 32 OF 32

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08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V Amante 10/02/09
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KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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 (25.4 mm soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

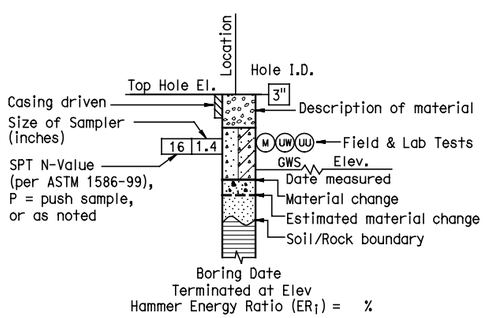
Note: Size in millimeters.

CONSISTENCY OF COHESIVE SOILS

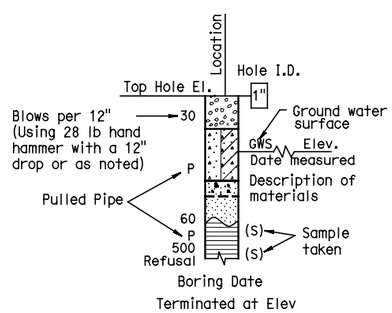
Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

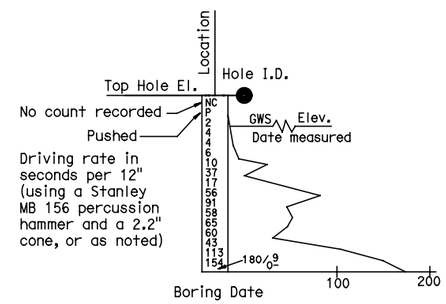
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



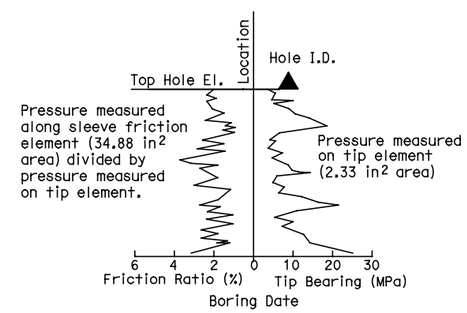
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D.FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/18/09 6/18/09 8/28/09 10/2/09

SHEET 25 OF 31

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

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DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

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SHEET 26 OF 31

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Caltrans Metric

Carlos V Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

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1220 RESEARCH DRIVE, SUITE B
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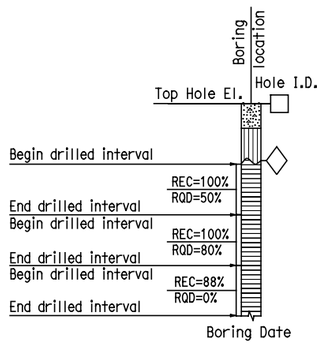
REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \geq}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 2/16/09 6/18/09 8/28/09 10/2/09

SHEET 27 OF 31

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

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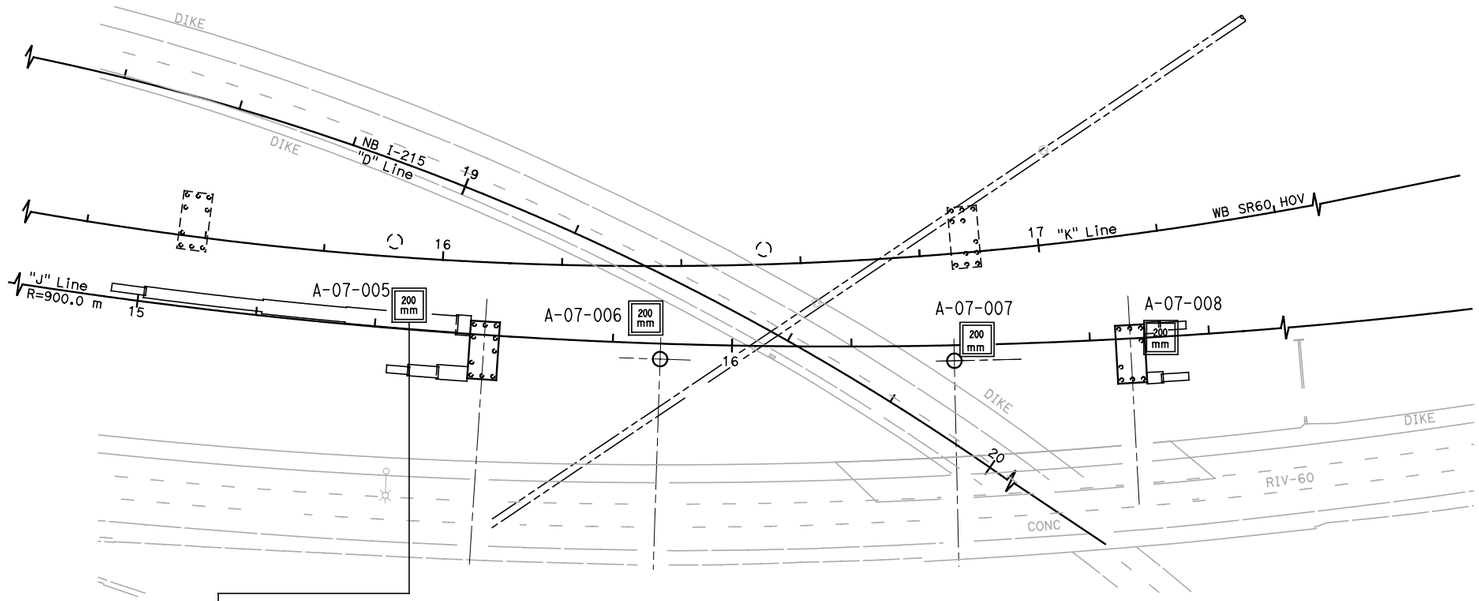
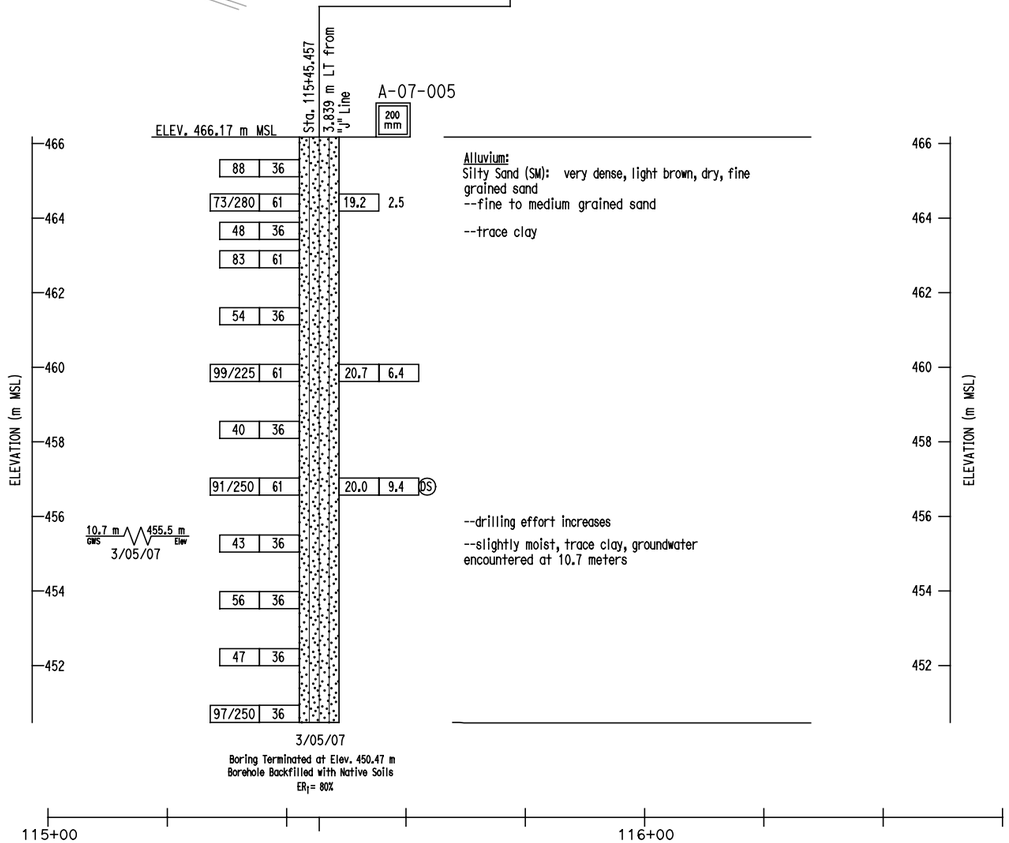
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500





Alluvium:
Silty Sand (SM): very dense, light brown, dry, fine grained sand
--fine to medium grained sand

--trace clay

--drilling effort increases

--slightly moist, trace clay, groundwater encountered at 10.7 meters

PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

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C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 1 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

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SHEET 28 OF 31

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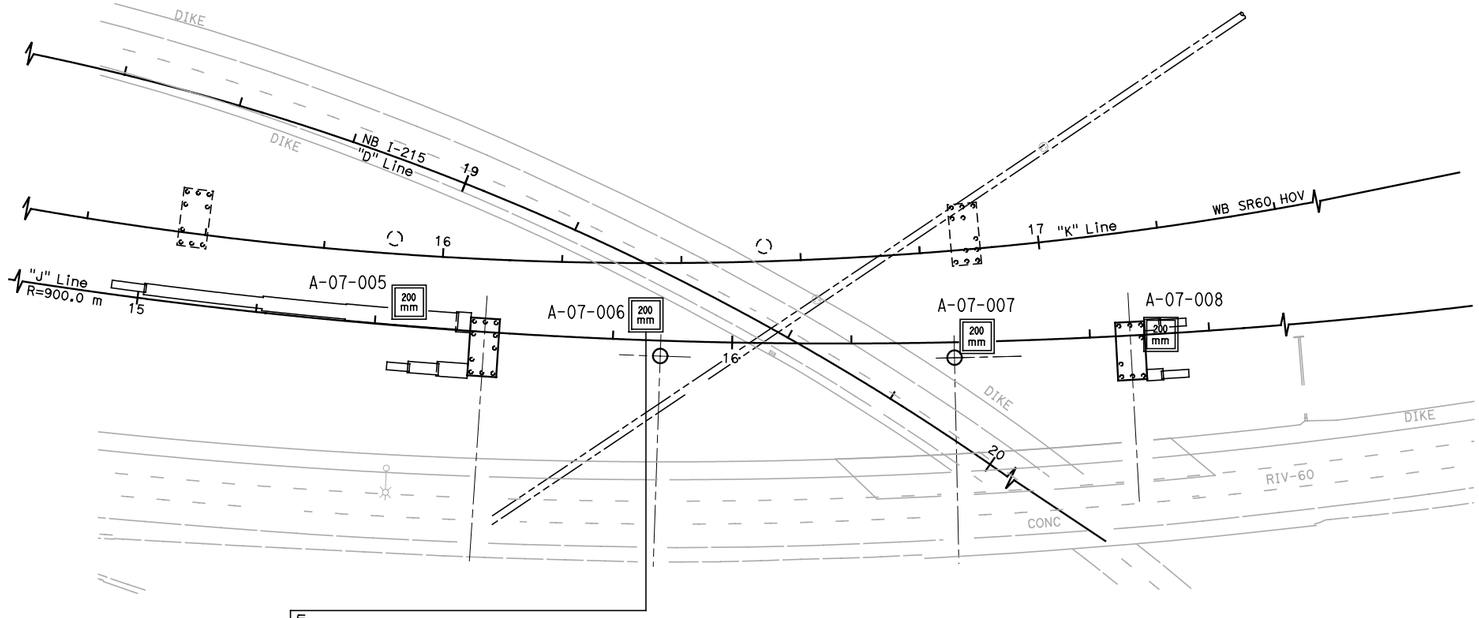
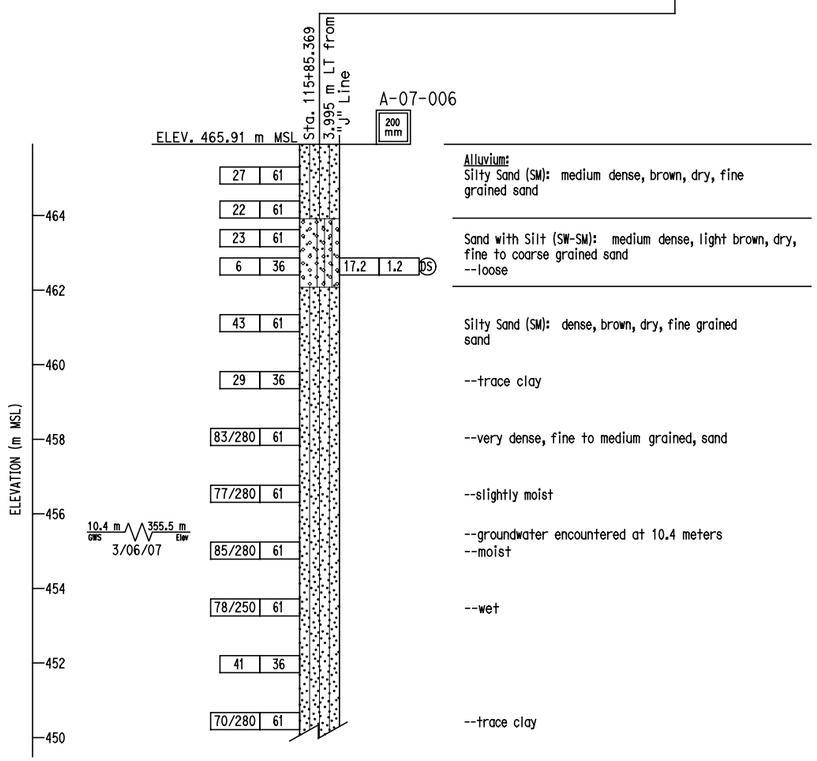
PLAN
1:500





Alluvium:
Silty Sand (SM): medium dense, brown, dry, fine grained sand

Sand with Silt (SW-SM): medium dense, light brown, dry, fine to coarse grained sand
--loose

Silty Sand (SM): dense, brown, dry, fine grained sand

--trace clay

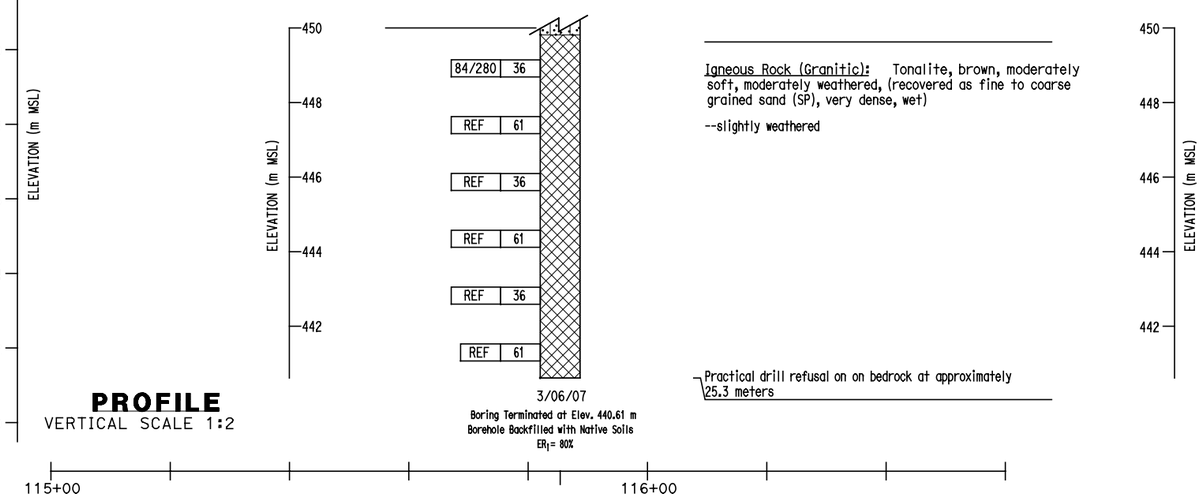
--very dense, fine to medium grained, sand

--slightly moist

--groundwater encountered at 10.4 meters
--moist

--wet

--trace clay



Igneous Rock (Granitic): Tonalite, brown, moderately soft, moderately weathered, (recovered as fine to coarse grained sand (SP), very dense, wet)

--slightly weathered

Practical drill refusal on on bedrock at approximately 25.3 meters

PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
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EB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 2 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

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REVISION DATES 3/12/08 7/21/08 11/4/08 2/13/09 6/15/09 8/28/09 10/2/09

SHEET 29 OF 31

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Carlos V. Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

PLANS APPROVAL DATE

REGISTERED GEOLOGIST — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

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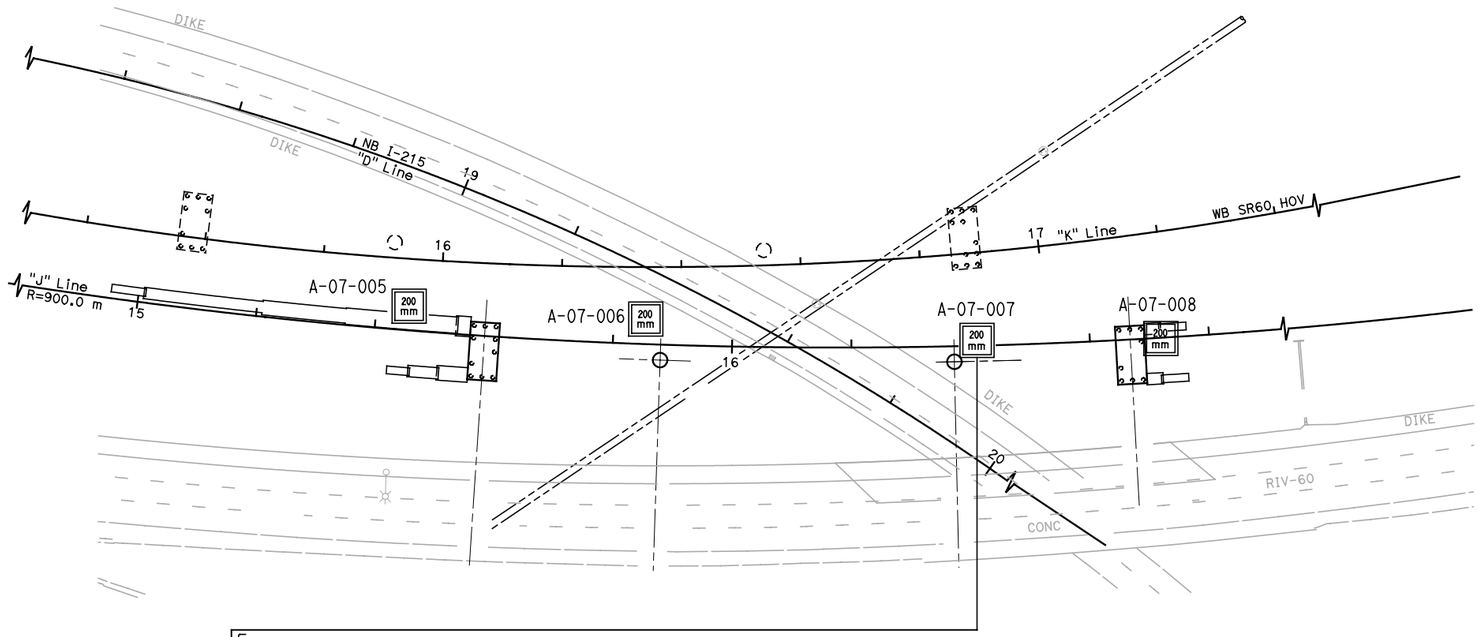
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374



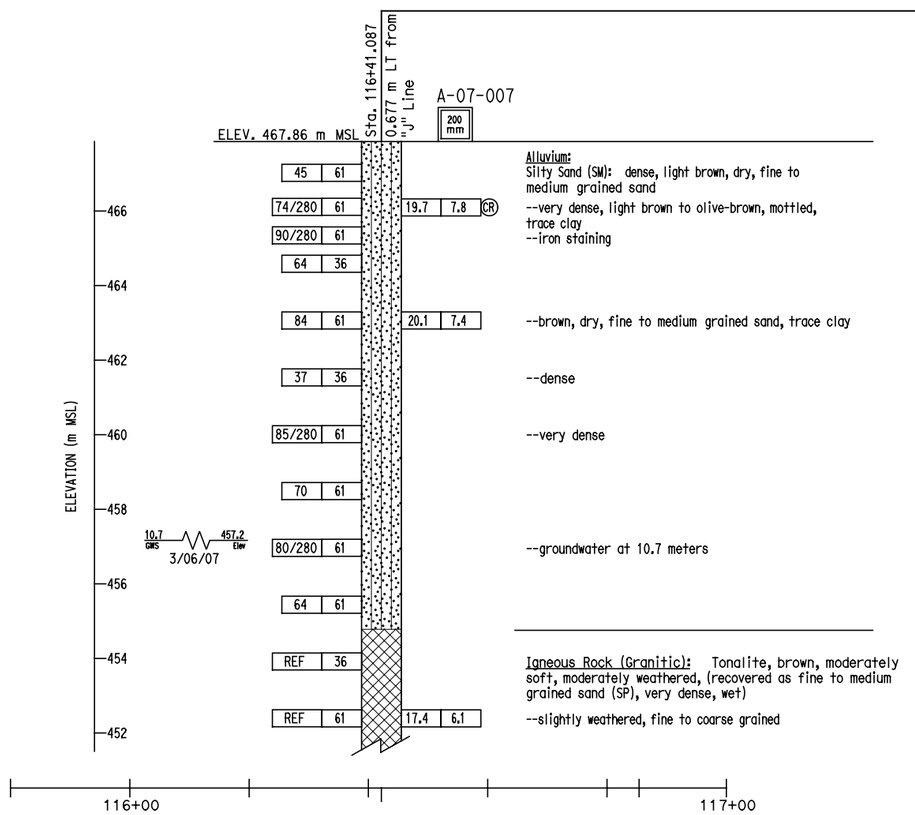
PLAN
1:500

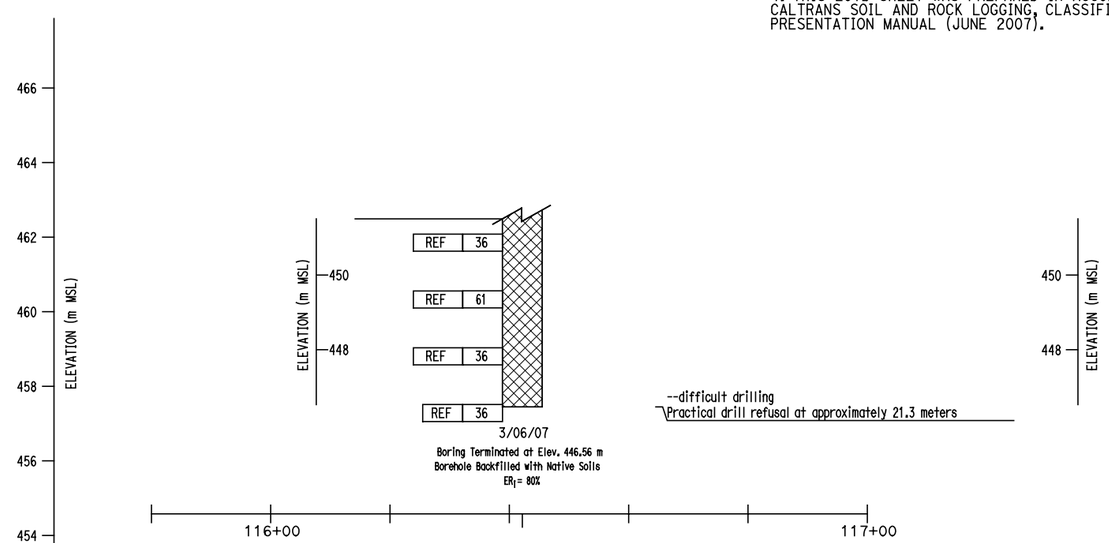
BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.
2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.
3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.
4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).





PROFILE
VERTICAL SCALE 1:2

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D.FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 3 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 6/18/09 8/28/09 10/2/09

SHEET 30 OF 31

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Carlos V Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

PLANS APPROVAL DATE

REGISTERED GEOLOGIST — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

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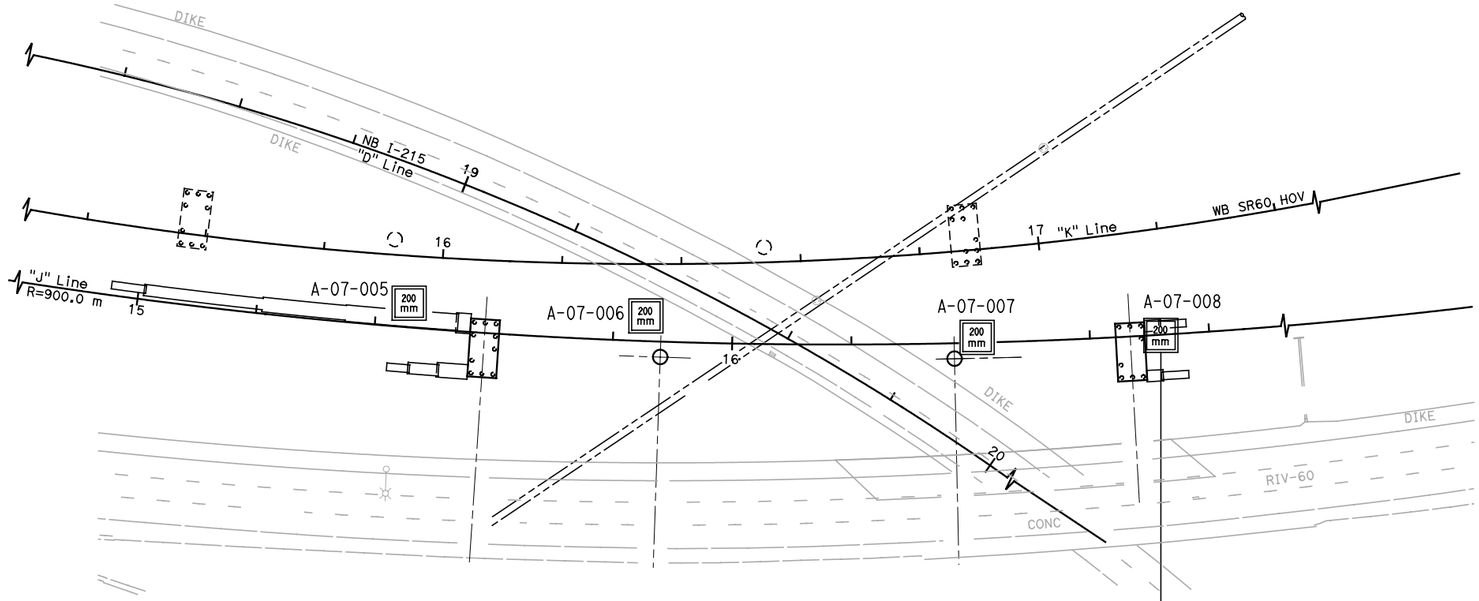
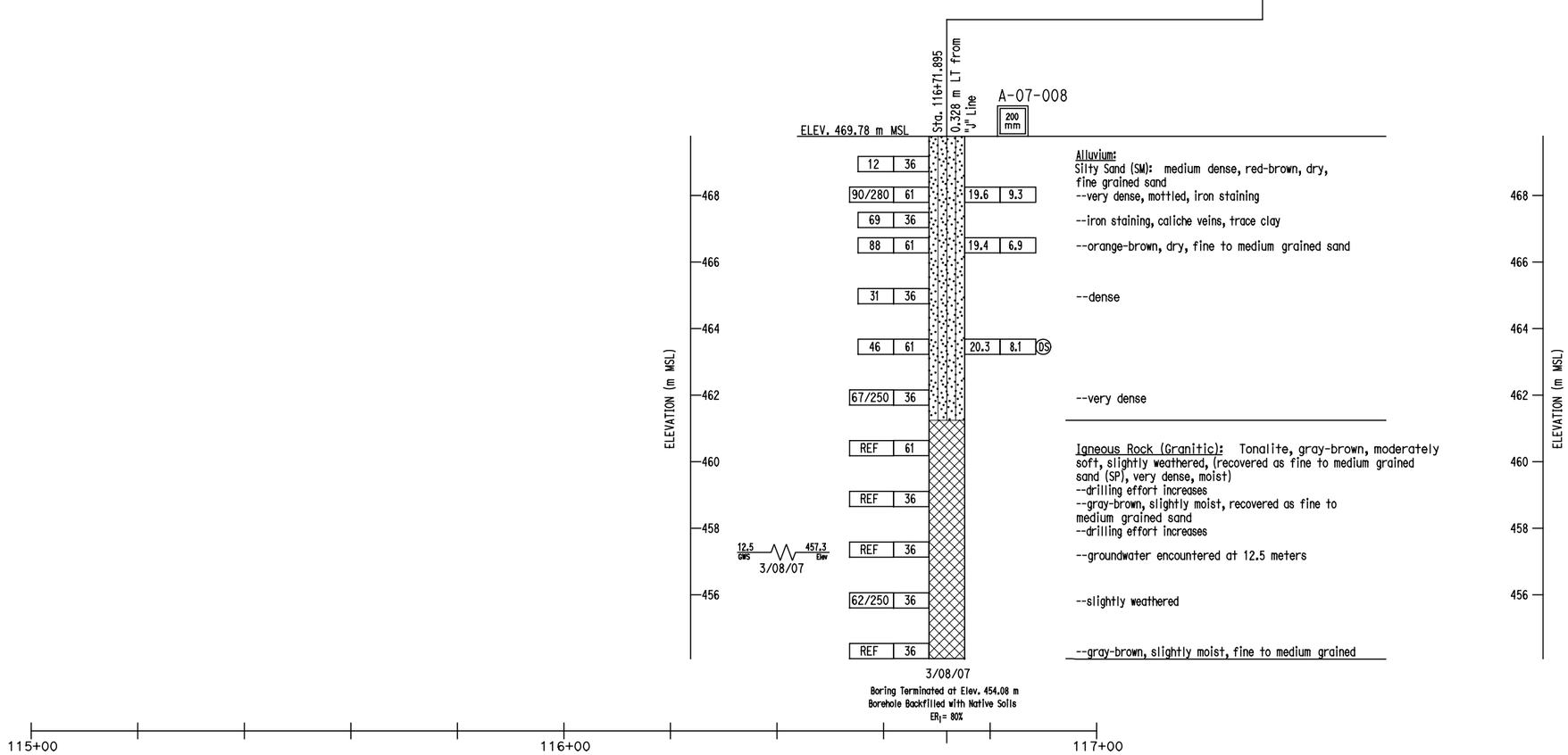
REDLANDS, CALIFORNIA 92374

PLAN
1:500





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PROFILE
VERTICAL SCALE 1:2

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 4 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 6/18/09 8/28/09 10/2/09

SHEET 31 OF 31

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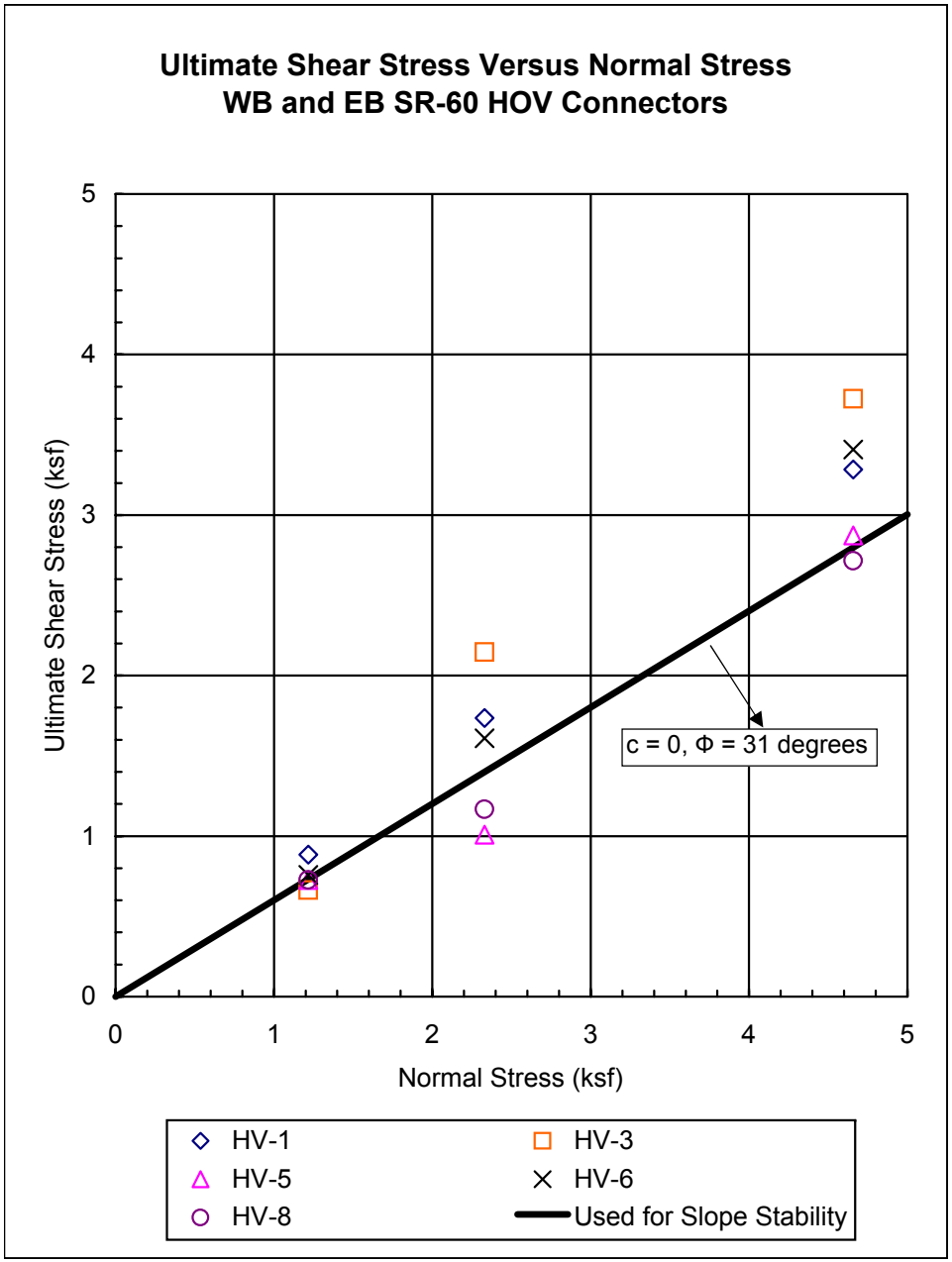
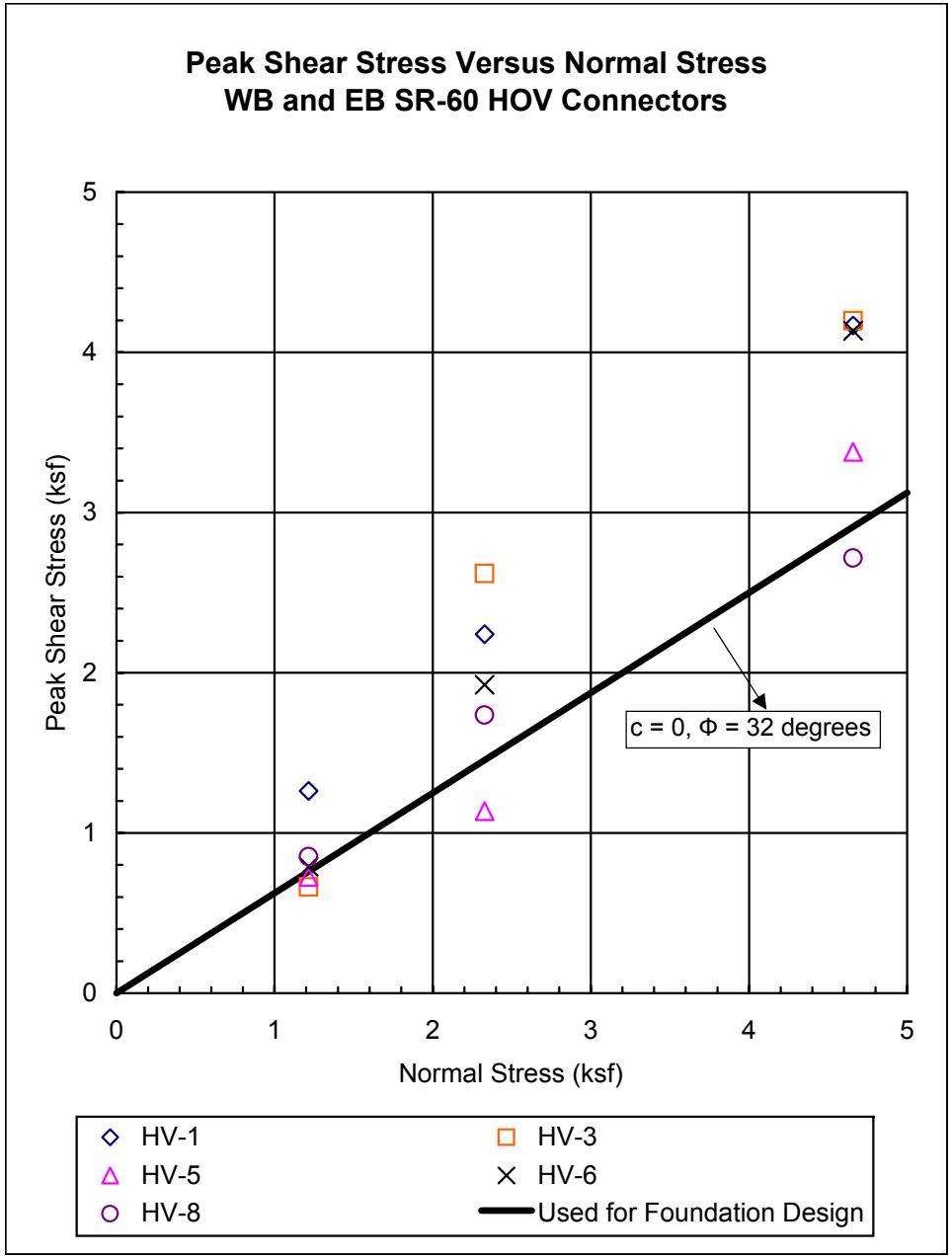

Ultimate Shear Stress Versus Normal Stress
WB and EB SR-60 HOV Connectors
Ultimate Shear Stress (ksf)
Normal Stress (ksf)
0
1
2
3
4
5
c = 0, Φ = 31 degrees
HV-1
HV-3
HV-5
HV-6
HV-8
Used for Slope Stability


Peak Shear Stress Versus Normal Stress
WB and EB SR-60 HOV Connectors
Peak Shear Stress (ksf)
Normal Stress (ksf)
0
1
2
3
4
5
c = 0, Φ = 32 degrees
HV-1
HV-3
HV-5
HV-6
HV-8
Used for Foundation Design

ADDENDUM

1220 Research Drive
Suite B
Redlands, CA 92374
p| 909.793.2691
f| 909.792.1704
kleinfelder.com

August 19, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

via Electronic Mail
Mohan.Char@lanengineering.com
Kimberly.Gee@lanengineering.com

Subject: Addendum to Structure Foundation Report
(Dated February 16, 2009)
Proposed Retaining Walls
Westbound and Eastbound SR60 HOV Connectors
Bridge Nos. 56-0841 and 56-0842
Interstate 215/State Route 60 East Junction Improvements
City of Riverside, California
08-Riv-215/60-KP 61.7/62.6, 19.4/21.5
Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder has prepared this addendum report in response to comments provided by the California Department of Transportation (Caltrans), Division of Engineering Services, Geotechnical Services- MS #5, Office of Geotechnical Design South-2, pertaining to their review of our report entitled Structure Foundation Report, Proposed Retaining Walls, Eastbound and Westbound SR60 HOV Connectors, Bridge Nos. 56-0842 and 56-0841, Interstate 215/State Route 60 East Junction, City of Riverside, California, dated February 16, 2009. The Caltrans review comments and our responses to these comments are attached.

CLOSURE

The information contained in this report/letter is subject to the conditions and limitations contained within the structure foundation report. We appreciate the opportunity to be of service on this project. If you have any questions, comments or require additional information, please do not hesitate to contact our office at your convenience.

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Respectfully submitted,

KLEINFELDER WEST, INC.

Madan Chirumalla, PE
Staff Engineer

REGISTERED PROFESSIONAL ENGINEER
MADAN CHIRUMALLA, PE
No. 74186
Exp. 6/30/2011
CIVIL
STATE OF CALIFORNIA

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

for: Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

PROFESSIONAL GEOLOGIST
MICHAEL O. COOK
CEG #1716
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

MC/CVA:lg

Attachments: Response to Comments Form
Metric Exception Letter
Table 1a, Retaining Wall Data (EB SR60 HOV Connector)
Revised General Plan of WB SR-60 HOV Connector
Revised Log of Test Boring (LOTB) Sheets

REGISTERED PROFESSIONAL ENGINEER
CARLOS V. AMANTE
No. 2724
Exp 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

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Project Name: **I-215/SR-60 East Junction**
08-SBd-215/60 CU08 -EA449311
Review Phase: **Foundation Report Review**
Retaining Walls for WB and EB SR60 HOV Connectors Bridge No. 56-0841/56-0842
Responses by:

This document contains the response to Caltrans structure plans review comments dated July 27, 2009.

RESPONSE TO COMMENTS ON FOUNDATION REPORT REVIEW – RETAINING WALLS FOR WB AND EB SR60 HOV CONNECTORS

Comment No.	Sheet No.	Plan Comments by Asef Wardak	Response	✓
1	All pertaining Documents	Since 2006, Caltrans' projects utilize English system instead of Metric system. Please revise accordingly or explain.	A metric exception letter is included in this addendum letter.	
2	Project Description	Please complete the missing beginning and ending station in Table 1b for Retaining Wall Data (EB SR60 HOV Connector).	The beginning and ending stations are provided in the revised Table 1b and attached in this addendum letter.	
3	Retaining Wall Foundation Design	Based on the available Log of Test Boring (LOTB), the soils under the proposed retaining walls are competent enough that spread footings might be suitable for all retaining walls foundation, unless, there is excessive tension and lateral demanding design loads that spread footing can not resist. Please revise or explain.	Pile foundations were considered for design of higher sections of the walls due to large toe pressures and settlement considerations.	
4	Spread footing & App. C	The allowable gross bearing capacity shown on page 14 is not consistent with the allowable gross bearing capacity shown in Appendix C (Analysis of Soil Bearing Capacity of A Spread footing). Please revise.	Settlement of shallow foundations is also taken into account in recommending the allowable bearing capacity. In this case, 2.5 ksf (approximately 120 kPa) produces permissible total and differential settlement for the footings. Higher pressures results in higher settlement. Therefore, allowable bearing capacity of 120 kPa is recommended.	
5	Table 4a	The Pile Specified Tip Elevations should be reported to the whole number, and it may not equal to the Pile Design Tip Elevation. Please revise.	Based on our discussion with LAN Engineering, it is not necessary to report the specified tip elevations to the whole number particularly for metric units.	

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Project Name: **I-215/SR-60 East Junction**
08-SBd-215/60 CU08 -EA449311
Review Phase: **Foundation Report Review**
Retaining Walls for WB and EB SR60 HOV Connectors Bridge No. 56-0841/56-0842
Responses by:

Comment No.	Sheet No.	Plan Comments by Asef Wardak	Response	✓
6	**WB SR60 HOV Connector**	Please show the entire layout of retaining wall number 1 of Westbound SR60 HOV Connector on general plan.	The entire layout of Retaining Wall No. 1 is shown on the revised General Plan of WB SR60 HOV Connector, attached in this addendum letter.	
7	**Plate 4d through4m**	The consistency of soil should be based on corrected energy of blow counts (N60). Please refer to Caltrans' Soil & Rock Logging Classification and Presentation Manual (June 2007). Caltrans LOTB should be consistent with Caltrans Guidelines for Structures Foundation Reports, and can be found at the following website: http://www.dot.ca.gov/hq/esc/geotech/requests/logging_manual/logging_manual.html	The apparent density and consistency of the soils have been checked and modified as necessary, and presented on the revised LOTB sheets attached.	
8	**Table B-1**	The soil strength parameters used in engineering analyses (Appendix C) do not match the laboratory soil test results presented in Table B-1. However, the soil strength values in geotechnical practice, but the differences should be stated and explained in the geotechnical design report.	The soil strength parameters used in our engineering analyses are reasonable and falls within typical range of values used in geotechnical practice.	

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EXCEPTION REQUEST TO CONTINUE THE USE OF METRIC UNITS

Date: 11/29/06
District Co. Rte. 08/RIV/215, PM (38.3 / 38.9), **EA**: 44931
Program Code: HE11
Program Document and Year : PSR signed 6/12/1997, PE/ED Sept 2001
Location: ON RTE 215 FR N/O EUCALYPTUS AVE IC TO S/O BOX SPRINGS RD IC & ON RTE 60 FR 60/215 JCT TO W/O DAY ST. IC
Work Description: Construction of HOV connectors to close the gap between the existing HOV lanes and the ones built as part of the design sequence project (EA 33484).
PA&ED Complete? Yes
PS&E _20_% Compete
Scheduled PS&E Delivery to HQ OE: RCTC may perform AAA **
Proposed Advertisement Date : 01/2008
Construction. Cost Estimate: $30.5 Million
Project Manager: Nader Naguib **Phone**: (909) 388-7180
Project Engineer: Tuan A Truong **Phone**: (909) 383- 4006

Current Project Status / Progress to Date on Project:
On 10/01/2006 RCTC hired LAN engineering to prepare FINAL DESIGN.
Project 33484 (STIP Design Sequence) Segmented off this project (449311) during its final design due to funding constraints. Funding for the segmented work is now available from RCTC. We are currently using the same Metric topo map from project 33484 which is under construction. This project which is under design must be compatible with: 1) existing pavement. 2) the project currently under construction. 3) Ultimate configuration for interchange. Two metric GAD's prepared by Caltrans are being used for the current design. These 2 GAD's cover the current project and the Ultimate design at this interchange.

Reason for Request:
This project is being designed while project 33484 (A design Sequencing project) is being constructed. Numerous changes in the design are happening during construction. This project (449311) will start construction right after 33484 is completed with construction. There are no "As-Builts" which show what "exists". It was agreed that the 33484 Bid Documents will be used to show conditions which will exist when completed. In order for that to happen we must use the original topo modified with the roadway features currently being constructed. If a new English topo were flown today, it would not reflect what will be constructed over the next year. Because the design of the HOV lanes here are tightly woven through this interchange, keeping its design in metric will allow us to use the same station lines being used for the current project, facilitate faster reviews to ensure an accurate fit with the other project improvements, eliminate errors and schedule delays, reduce cost and provide a higher quality project.

Justification for Extension Request:
Cost to Convert to USCU: $250,000.00
Schedule Delay to convert to USCU: 5 Months

Requested By: Approved By:

Patricia Romo 12/1/06 1-17-07

Patricia Romo Date Kevin Herritt
Deputy District Director Chief, Office of Geometric Design Standards
Design/Engineering Services Division of Design

Terms of Exception:
Project must achieve RTL status by June 30, 2009 for this exception to remain valid.

Table 1a (Revised 8-19-09)
Retaining Wall Data
EB SR60 HOV Connector

Wall No.	Wall Location	Beginning Station	Ending Station	Length (meters)	Wall Height (meters)	Wall Type
1	Abutment 1 (North side)	14+95.407 (“J” Line 1.960 LT)	15+56.040 (“J” Line 1.960 LT)	60.500	1.8 to 4.8	Type 1
2	Abutment 1 (South side)	15+42.566 (“J” Line 7.145 RT)	15+56.059 (“J” Line 7.145 RT)	13.600	1.8 to 4.2	Type 1
3	Abutment 4 (North side)	16+69.219 (“J” Line 1.960 LT)	16+76.244 (“J” Line 1.960 LT)	7.010	3.0 to 4.2	Type 1
4	Abutment 4 (South side)	16+69.199 (“J” Line 7.145 RT)	16+76.154 (“J” Line 7.145 RT)	7.010	3.0 to 4.2	Type 1

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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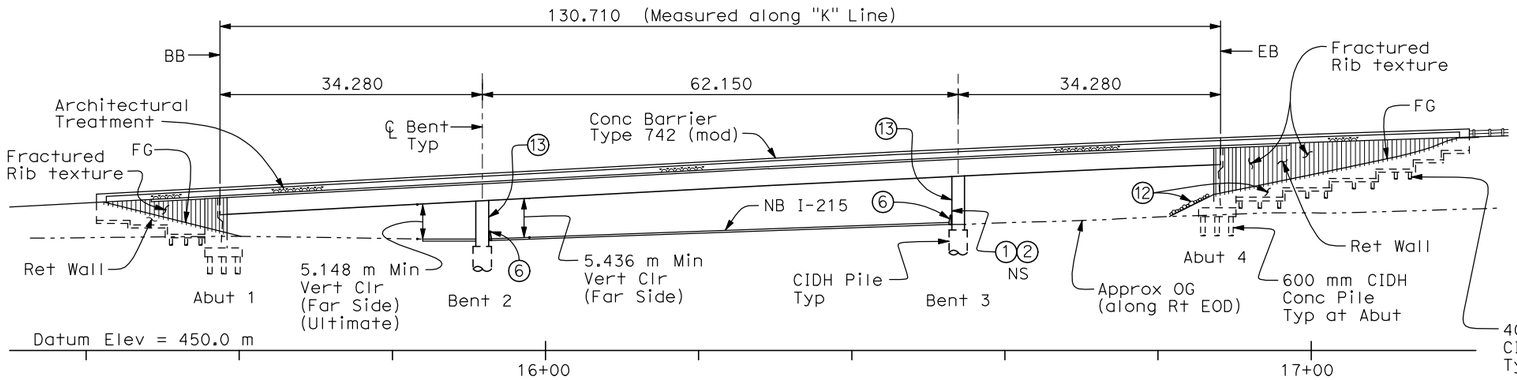
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

PROFILE GRADE
No Scale

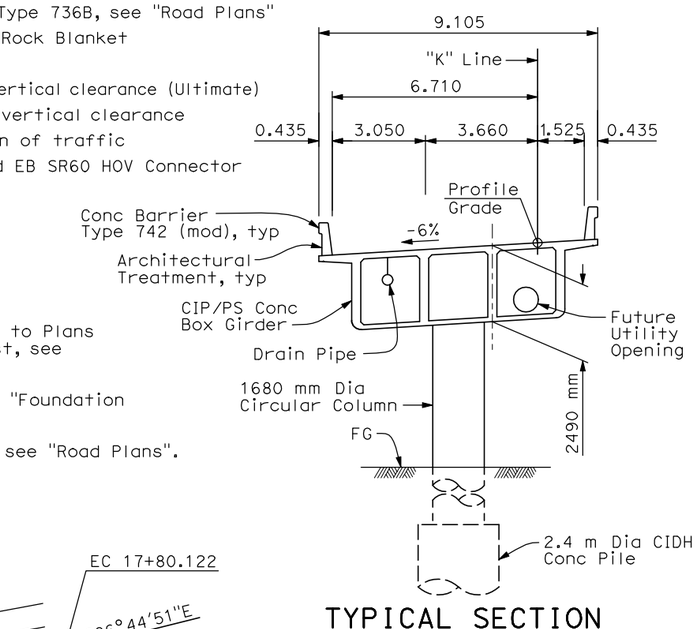


ELEVATION
1:400

NOTES:

1. Paint "Br. No. & Year Constructed"
2. Paint "WB SR60 HOV Connector"
3. Structure Approach Type N(9S)
4. MBGR, See "Road Plans"
5. Indicates Deck Drain
6. Concrete Barrier Type 60GC see "Road Plans"
7. Concrete Barrier Type 60D see "Road Plans"
8. Welded Steel Casing for Future Utility
9. Retaining Wall Type 1
10. Concrete Barrier Type 742A, see "Road Plans"
11. Concrete Barrier Type 736B, see "Road Plans"
12. Slope Paving with Rock Blanket
13. Paint "Bent No."

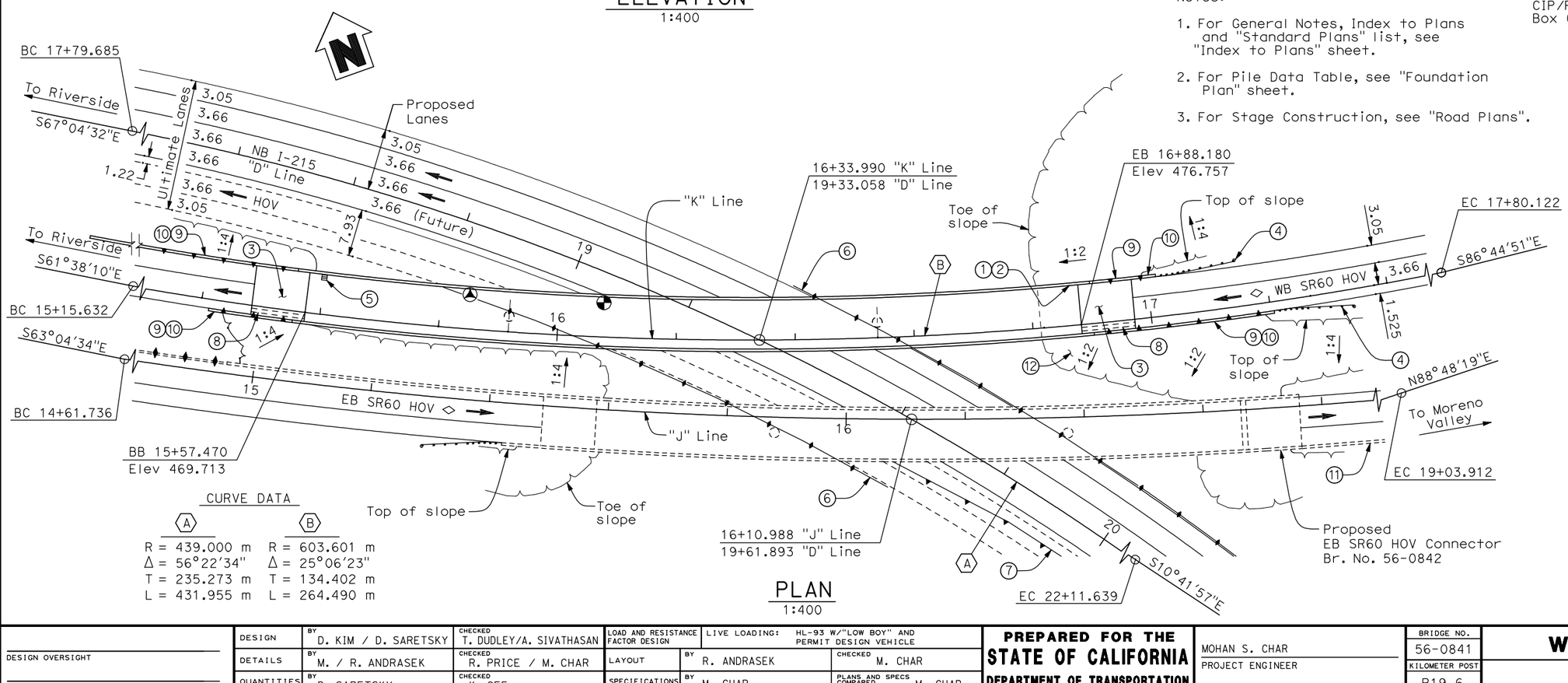
Point of minimum vertical clearance (Ultimate)
Point of minimum vertical clearance
Indicates direction of traffic
Indicates Proposed EB SR60 HOV Connector Br. No. 56-0842



TYPICAL SECTION
1:100

Notes:

1. For General Notes, Index to Plans and "Standard Plans" list, see "Index to Plans" sheet.
2. For Pile Data Table, see "Foundation Plan" sheet.
3. For Stage Construction, see "Road Plans".



CURVE DATA

(A)	(B)
R = 439.000 m	R = 603.601 m
Δ = 56°22'34"	Δ = 25°06'23"
T = 235.273 m	T = 134.402 m
L = 431.955 m	L = 264.490 m

PLAN
1:400

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DESIGN	BY D. KIM / D. SARETSKY	CHECKED T. DUDLEY/A. SIVATHASAN	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: HL-93 W/"LOW BOY" AND PERMIT DESIGN VEHICLE
	DETAILS	BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR	LAYOUT BY R. ANDRASEK	CHECKED M. CHAR
SIGN OFF DATE	QUANTITIES	BY D. SARETSKY	CHECKED K. GEE	SPECIFICATIONS BY M. CHAR	PLANS AND SPECS COMPARED M. CHAR

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/21/08 11/14/08 2/16/09 5/15/09 8/20/09

SHEET 1 OF 32

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER
CARLOS AMANTE
No. GE2724
Exp. 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

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KLEINFELDER
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REDLANDS, CALIFORNIA 92374

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.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

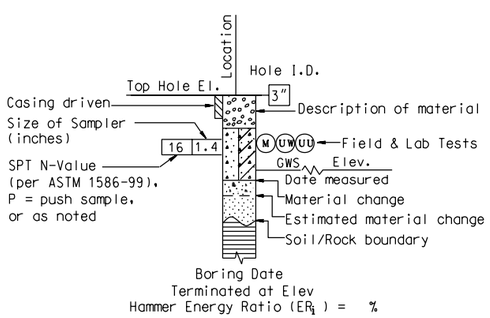
BOREHOLE IDENTIFICATION

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 (25.4 mm soil tube) Hand Auger
◎	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

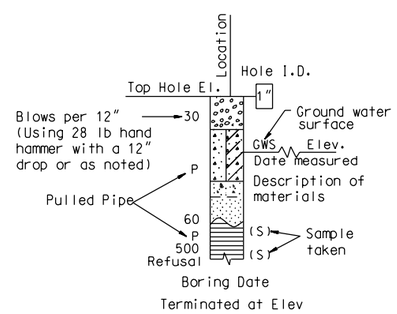
Note: Size in millimeters.

PLASTICITY OF FINE-GRAINED SOILS

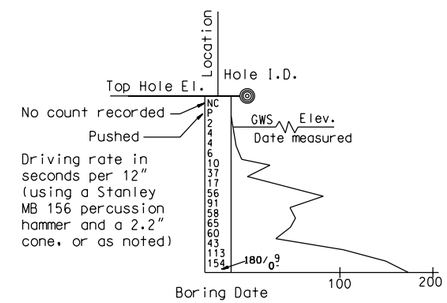
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



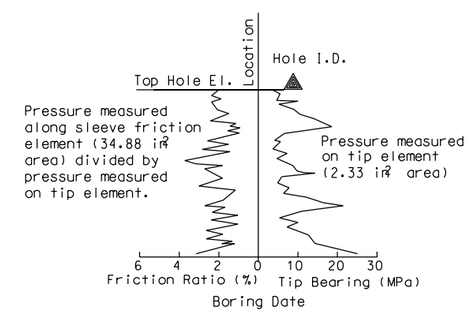
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY	C. AMANTE	C. AMANTE PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

REVISION DATES

SHEET 26 OF 31

FILE •) $REQUEST

USERNAME •)$USER DATE PLOTTED •) $DATE TIME PLOTTED •) $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER
CARLOS AMANTE
No. GE2724
Exp. 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

PLANS APPROVALDATE

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

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DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE •) $REQUEST

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SHEET 27 OF 31

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Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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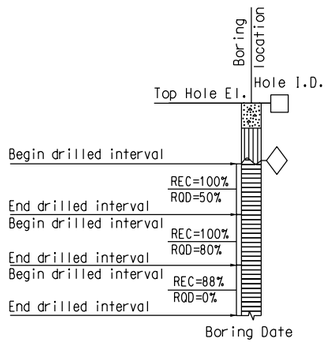
REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features: Chemical Weathering-Discoloration and/or oxidation: Body of Rock	Chemical Weathering-Discoloration and/or oxidation: Fracture Surfaces	Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning: Texture	Texture and Solutioning: Solutioning	General Characteristics
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 28 OF 31

FILE -) $REQUEST

USERNAME -*$USER DATE PLOTTED -) $DATE TIME PLOTTED -) $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

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CERTIFIED ENGINEERING GEOLOGIST

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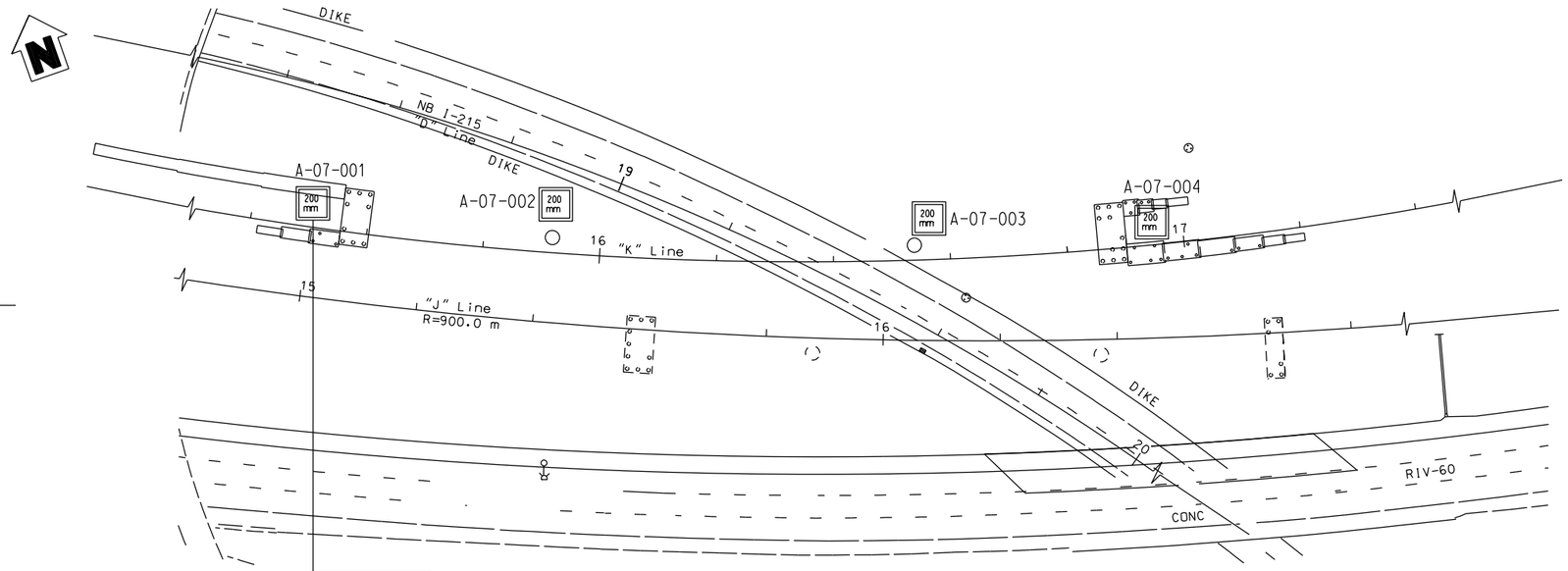
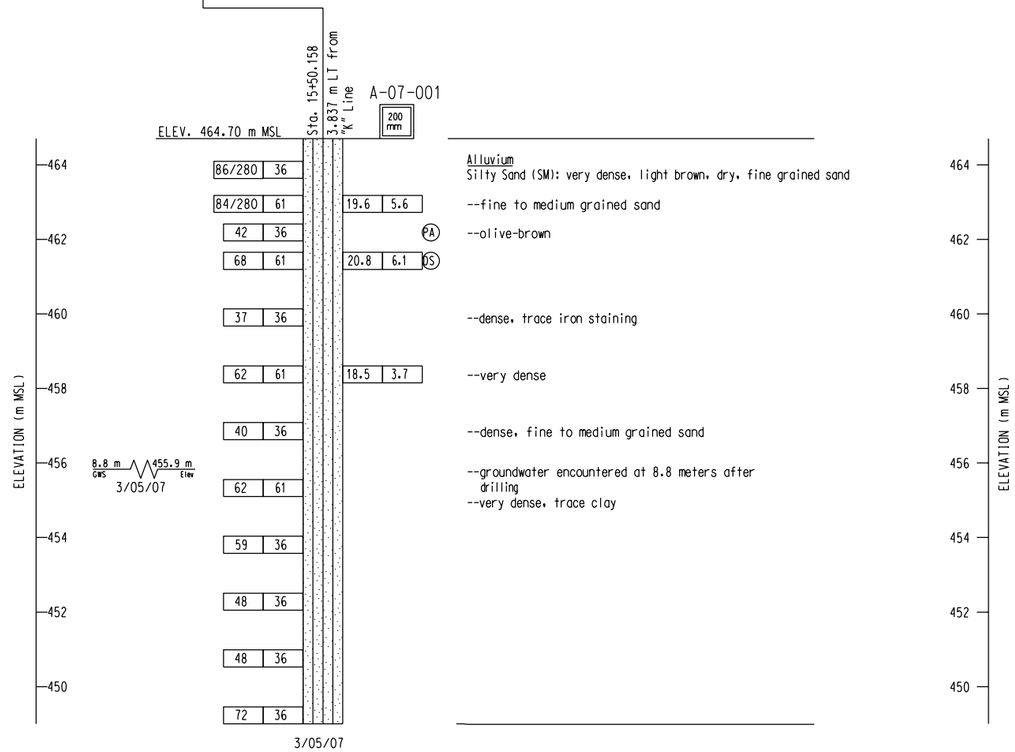
PLAN
1:500



PROFILE
VERTICAL SCALE 1:2



Alluvium
Silty Sand (SM): very dense, light brown, dry, fine grained sand

--fine to medium grained sand

--olive-brown

--dense, trace iron staining

--very dense

--dense, fine to medium grained sand

--groundwater encountered at 8.8 meters after drilling
--very dense, trace clay

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

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CHECKED BY C. AMANTE

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C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 1 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

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SHEET 29 OF 31

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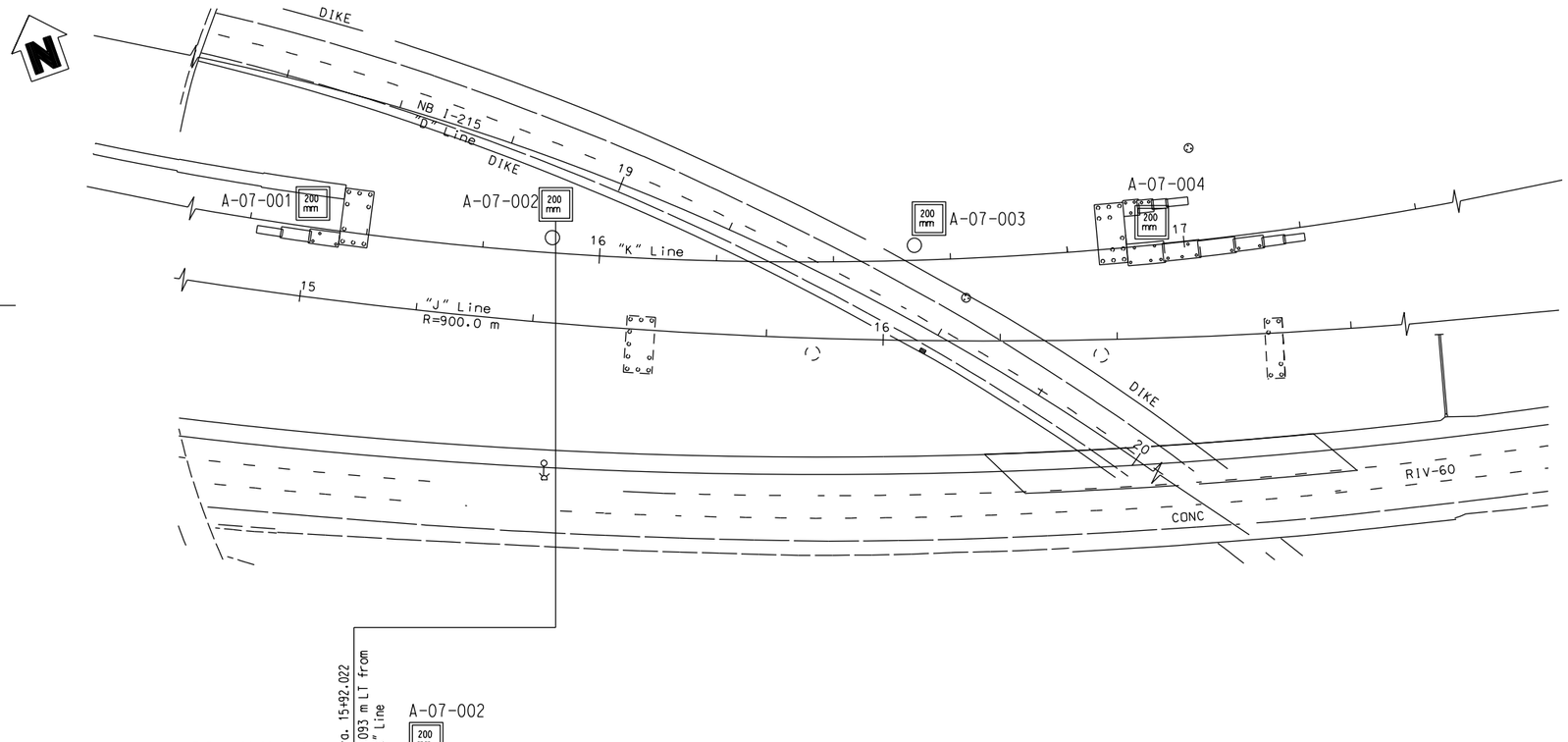
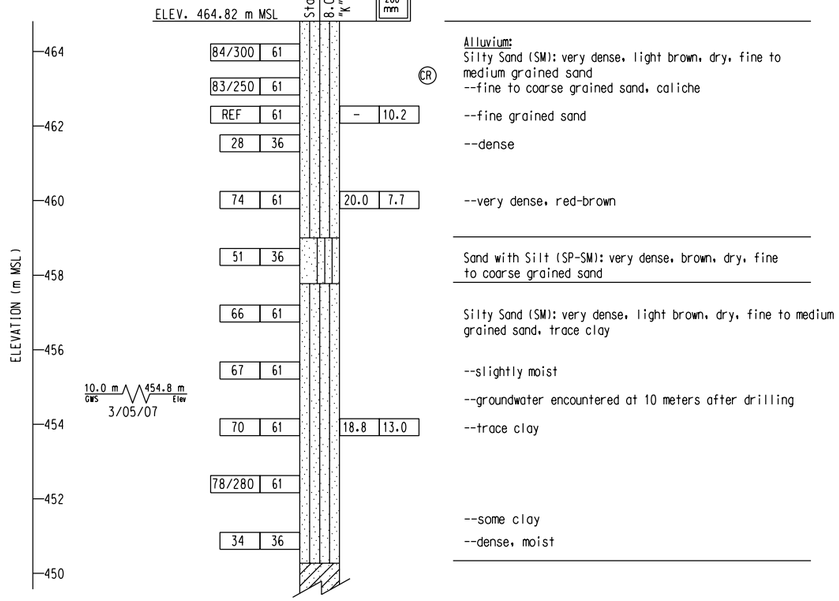
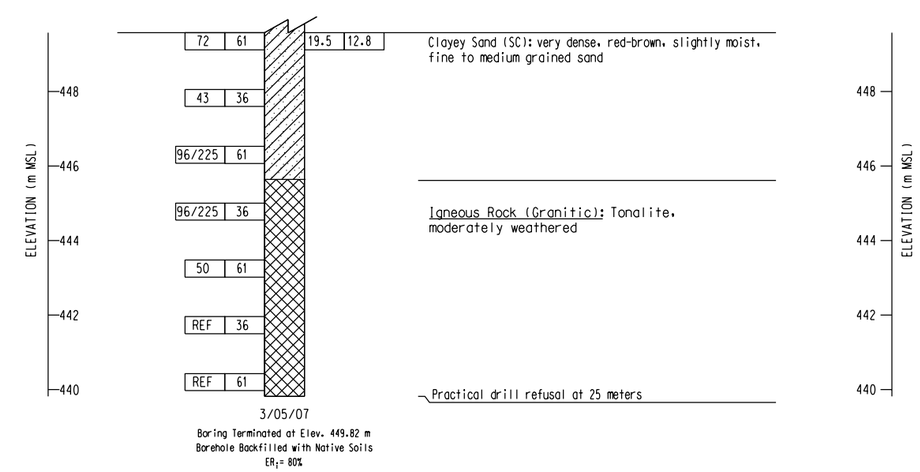
PLAN
1:500







PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

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4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

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C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 2 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

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REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVALDATE

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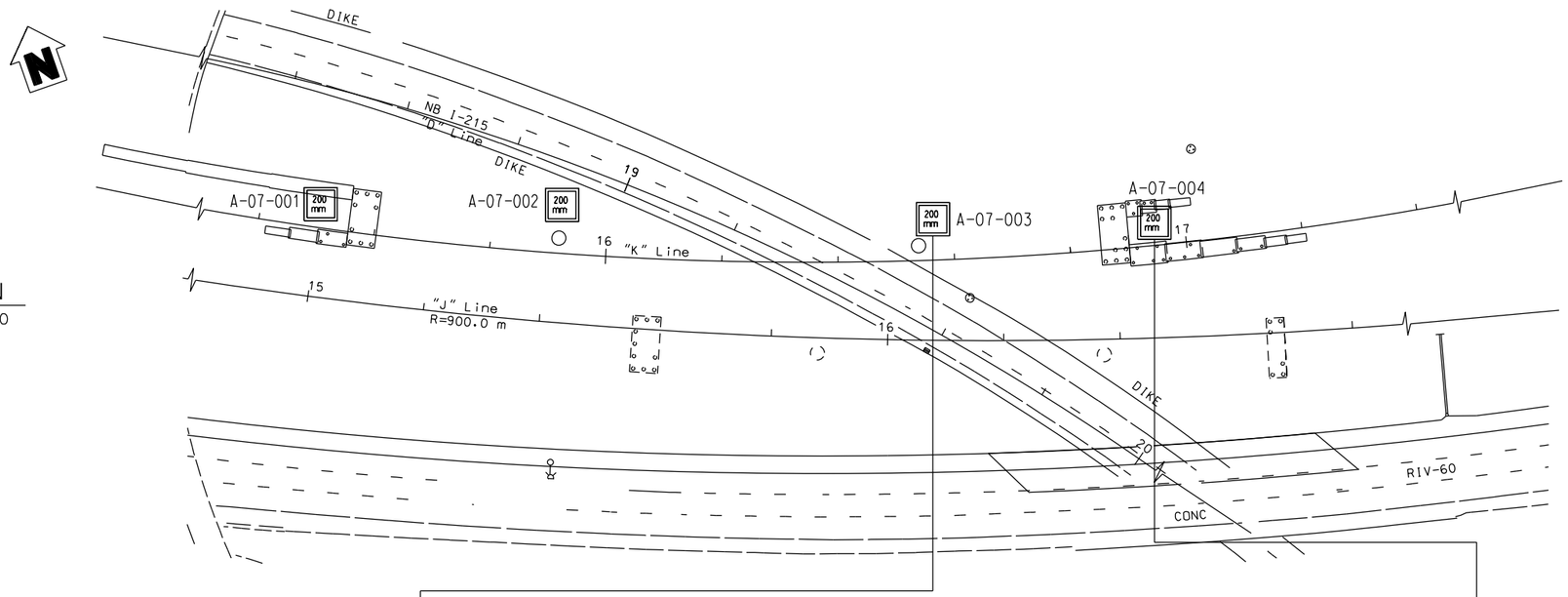
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500



BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

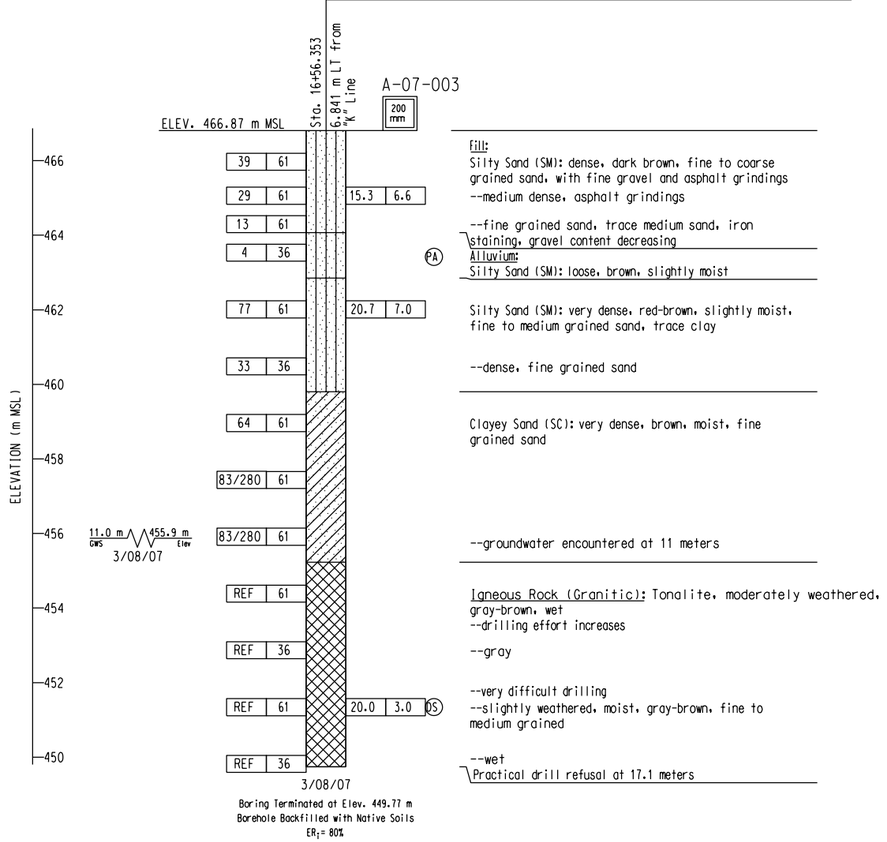
NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

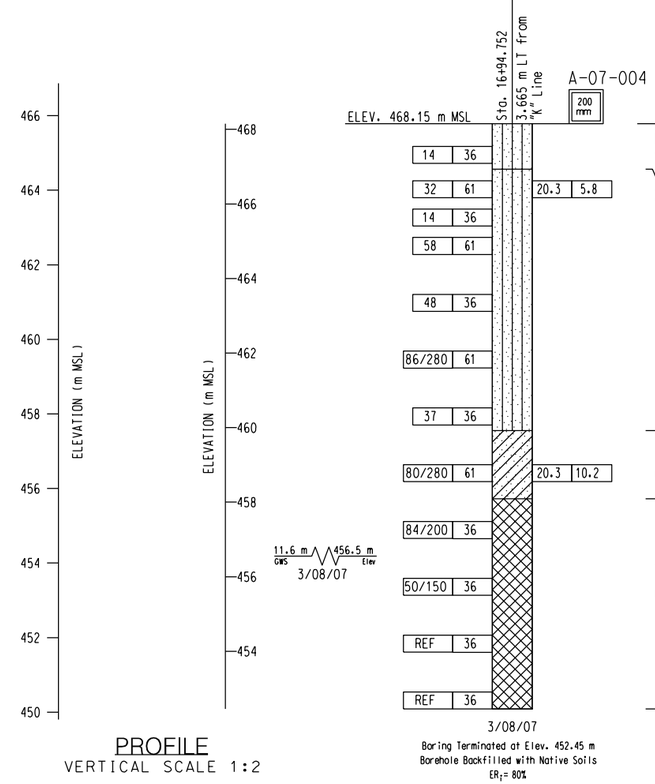
2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).



PROFILE
VERTICAL SCALE 1:2



ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY	C. AMANTE	C. AMANTE PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 3 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 31 OF 31

FILE -) $REQUEST

USERNAME -)$USER DATE PLOTTED -) $DATE TIME PLOTTED -) $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER
CARLOS AMANTE
No. GE2724
Exp. 6-30-10
GEOTECHNICAL
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SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

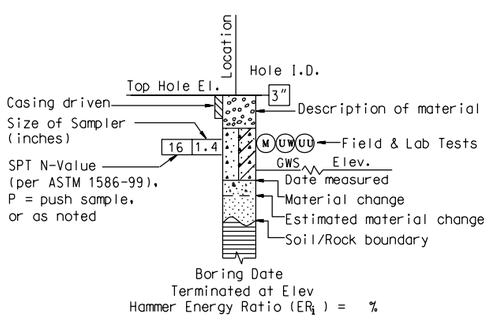
BOREHOLE IDENTIFICATION

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 (25.4 mm soil tube) Hand Auger
◎	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

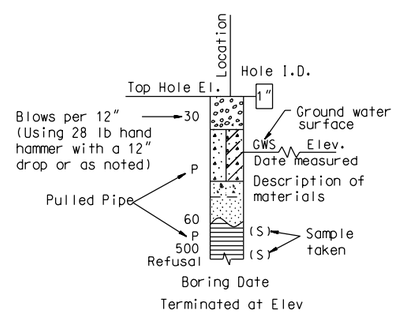
Note: Size in millimeters.

PLASTICITY OF FINE-GRAINED SOILS

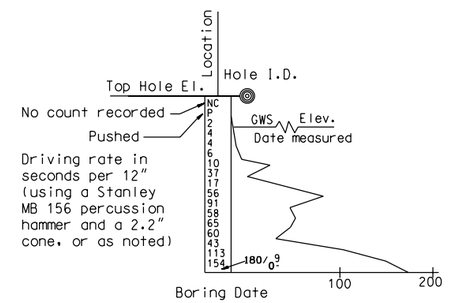
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



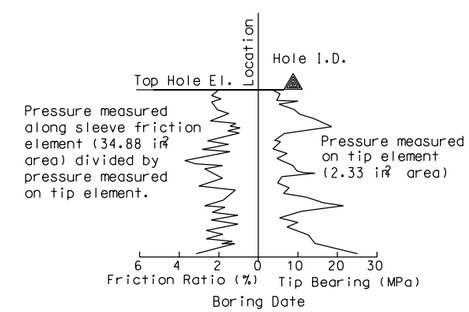
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D.FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. AMANTE PROJECT ENGINEER	BRIDGE NO. 56-0842
SIGN OFF DATE	CHECKED BY	C. AMANTE			KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

SOIL LEGEND NO.1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 24 OF 30

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Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER
CARLOS AMANTE
No. GE2724
Exp. 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

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SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 2/13/09 5/20/09

SHEET 25 OF 30

FILE •) $REQUEST

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
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Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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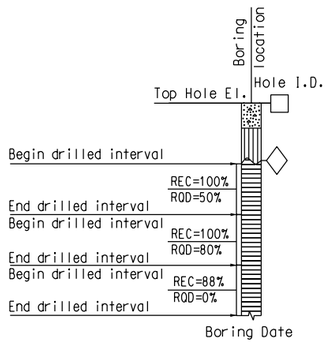
REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features: Chemical Weathering-Discoloration and/or oxidation: Body of Rock	Chemical Weathering-Discoloration and/or oxidation: Fracture Surfaces	Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning: Texture	Texture and Solutioning: Solutioning	General Characteristics
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 26 OF 30

FILE -) $REQUEST

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Caltrans Metric

Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER
CARLOS AMANTE
No. GE2724
Exp. 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

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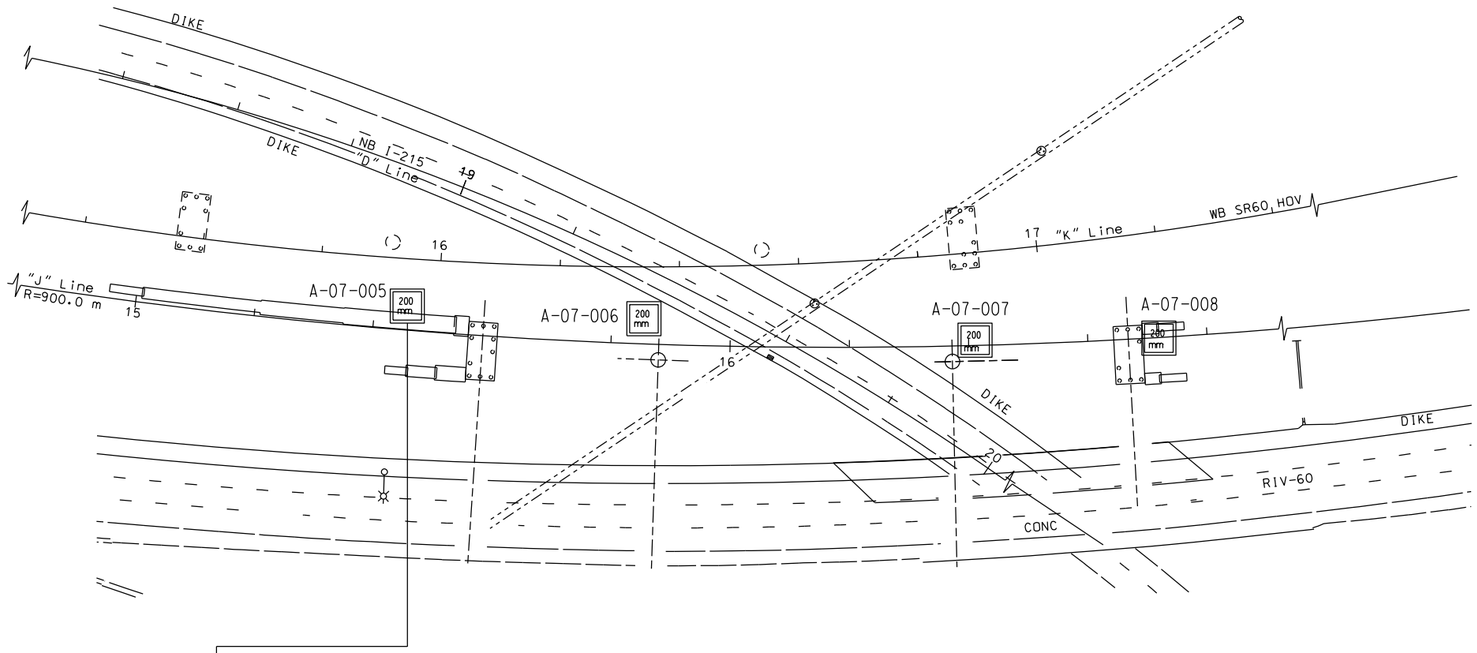

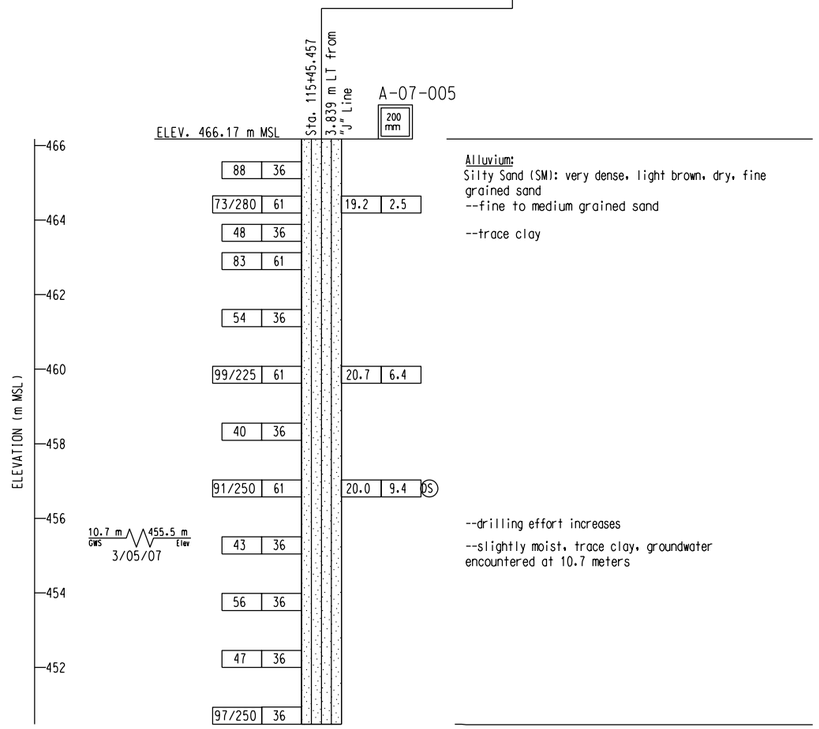

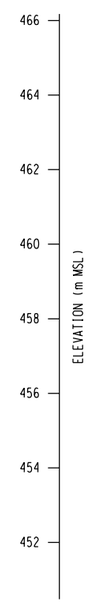

PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

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CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 1 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

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Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
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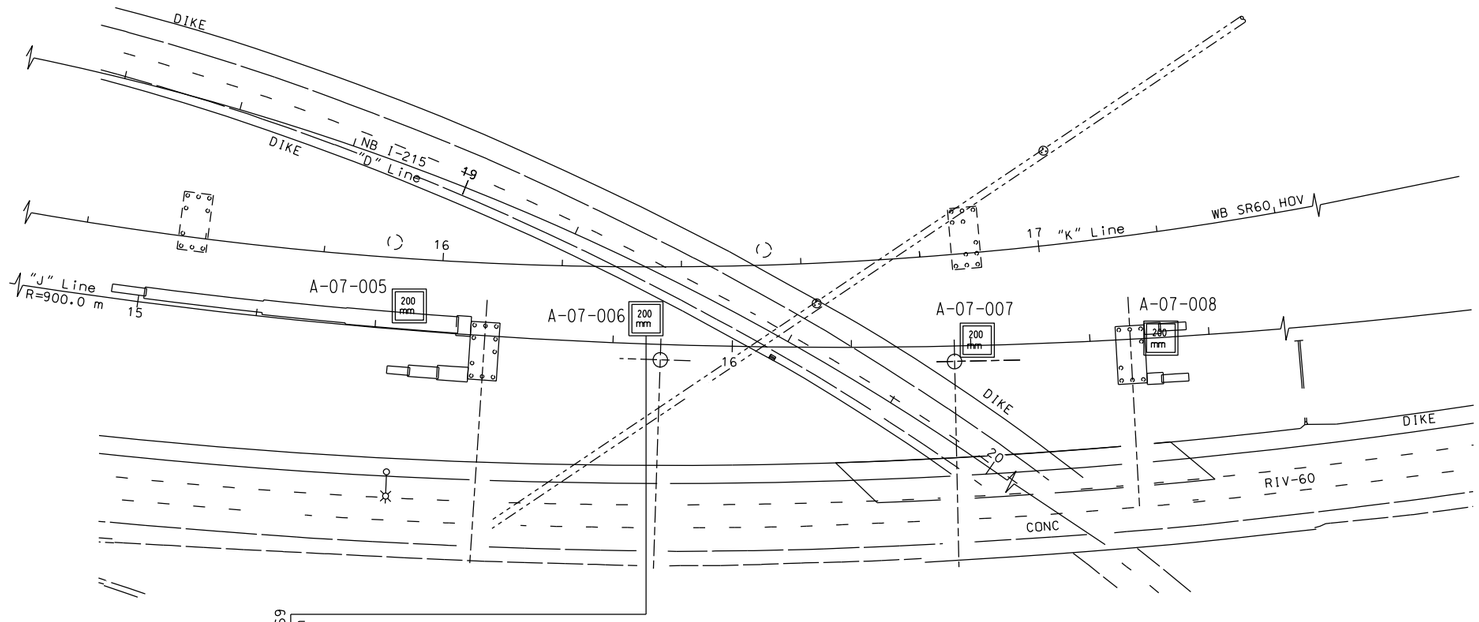
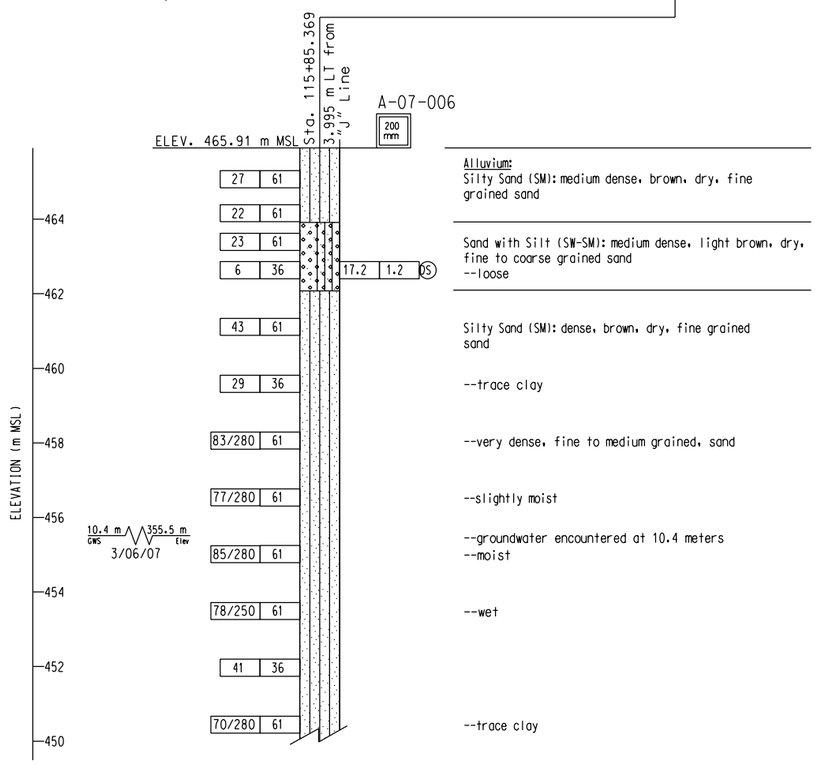




Alluvium:
Silty Sand (SM): medium dense, brown, dry, fine grained sand

Sand with Silt (SW-SM): medium dense, light brown, dry, fine to coarse grained sand
--loose

Silty Sand (SM): dense, brown, dry, fine grained sand

--trace clay

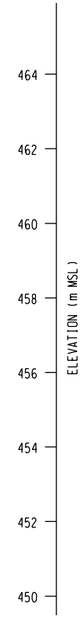
--very dense, fine to medium grained, sand

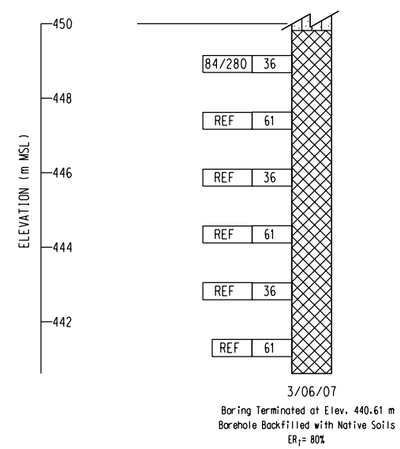
--slightly moist

--groundwater encountered at 10.4 meters
--moist

--wet

--trace clay



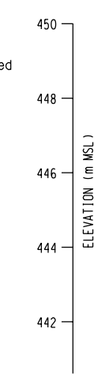


Boring Terminated at Elev. 440.61 m
Borehole Backfilled with Native Soils
ER_i= 80%

Igneous Rock (Granitic): Tonalite, moderately weathered

--slightly weathered

Practical drill refusal on on bedrock at approximately 25.3 meters



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DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 2 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

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Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER
CARLOS AMANTE
No. GE2724
Exp. 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

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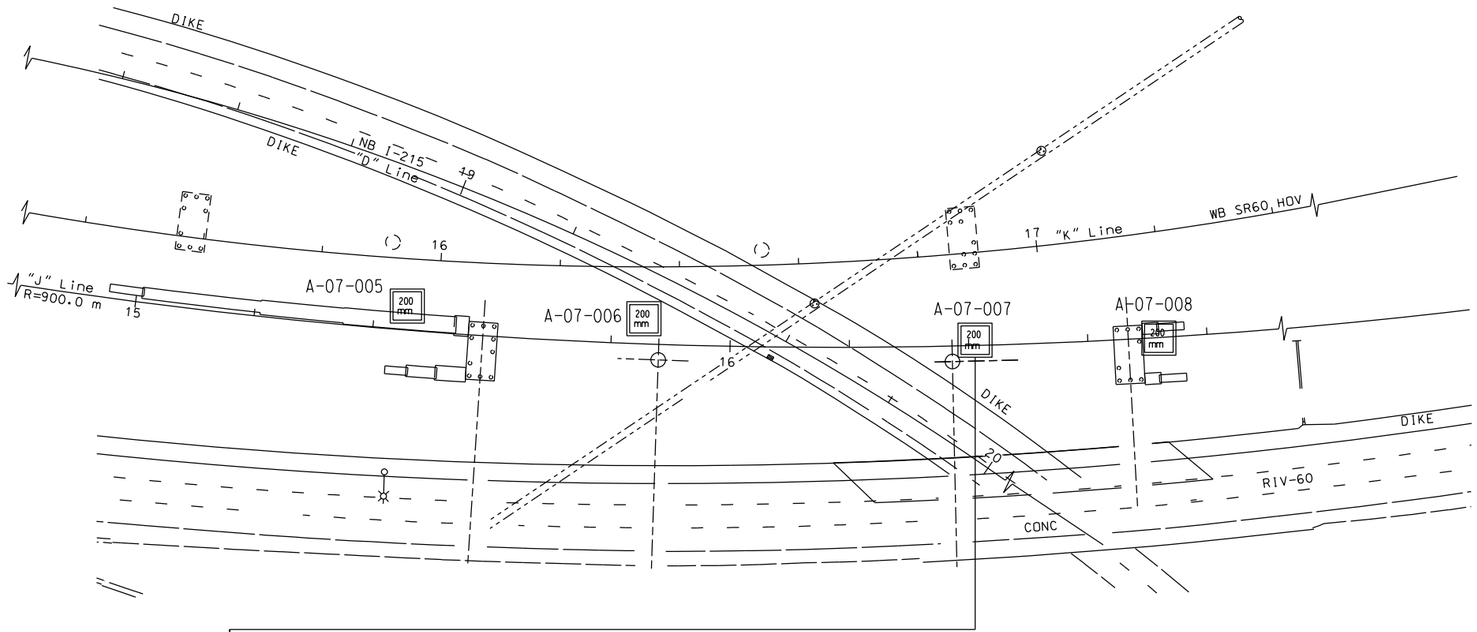

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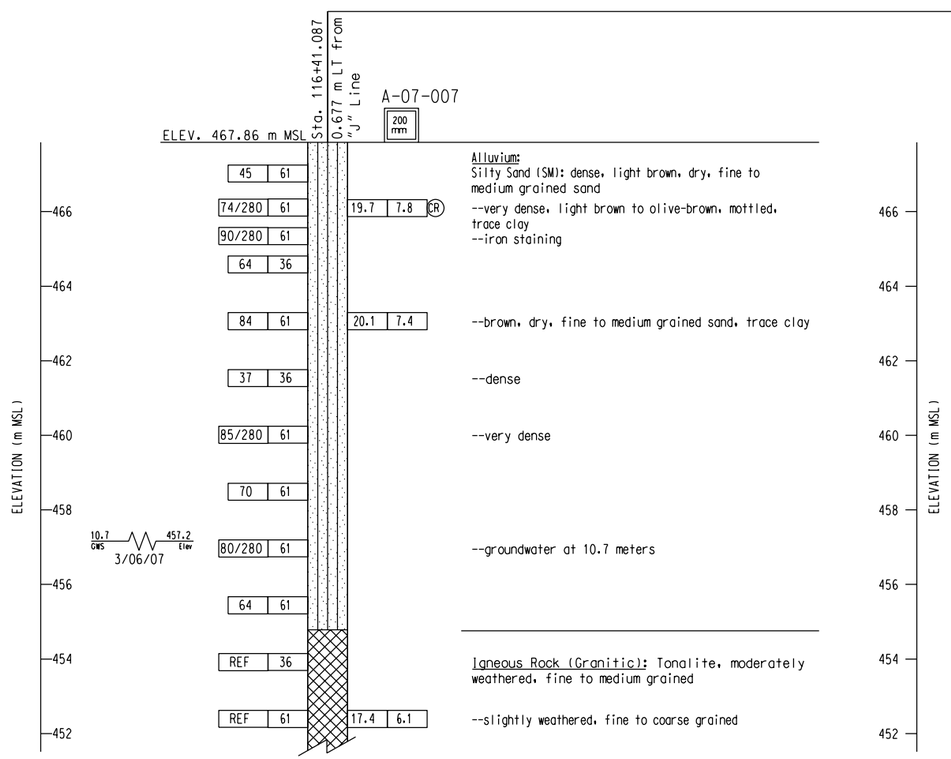

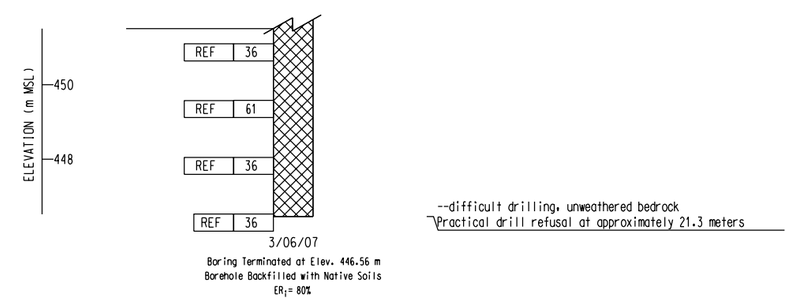

PROFILE
VERTICAL SCALE 1:2

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CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 3 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

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Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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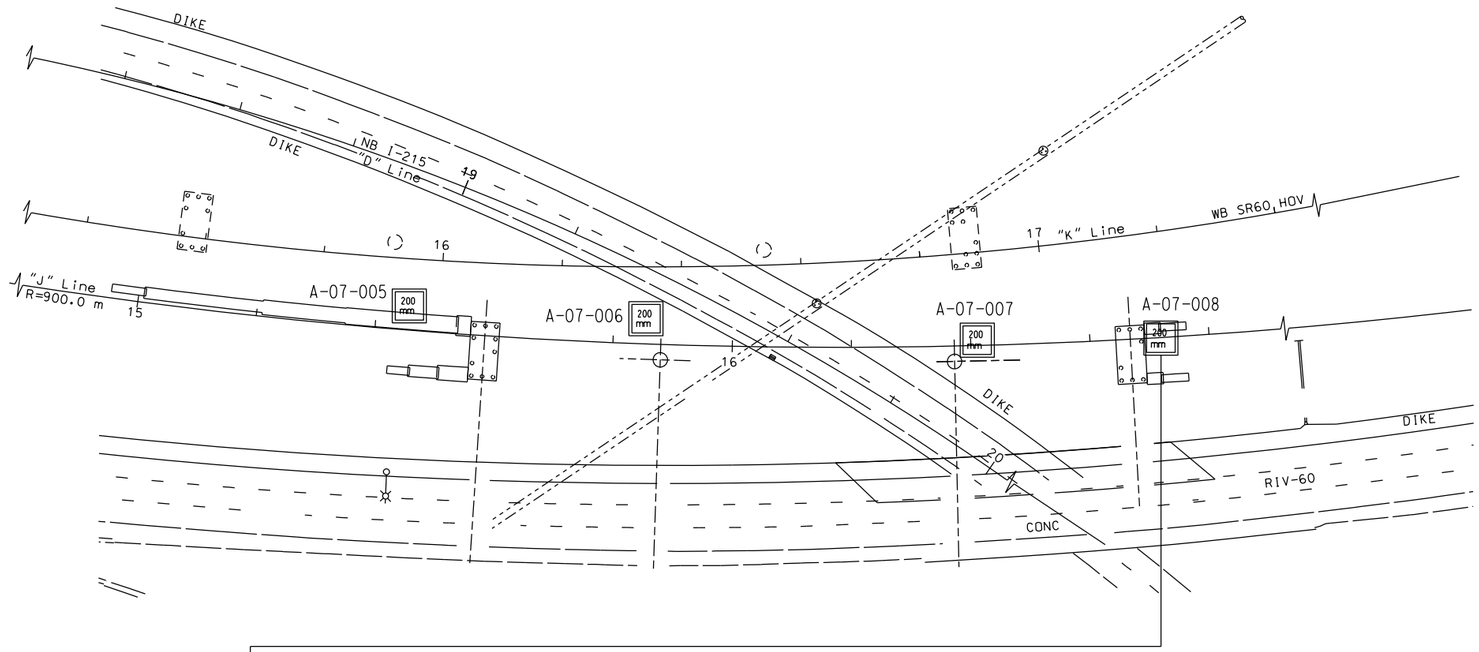

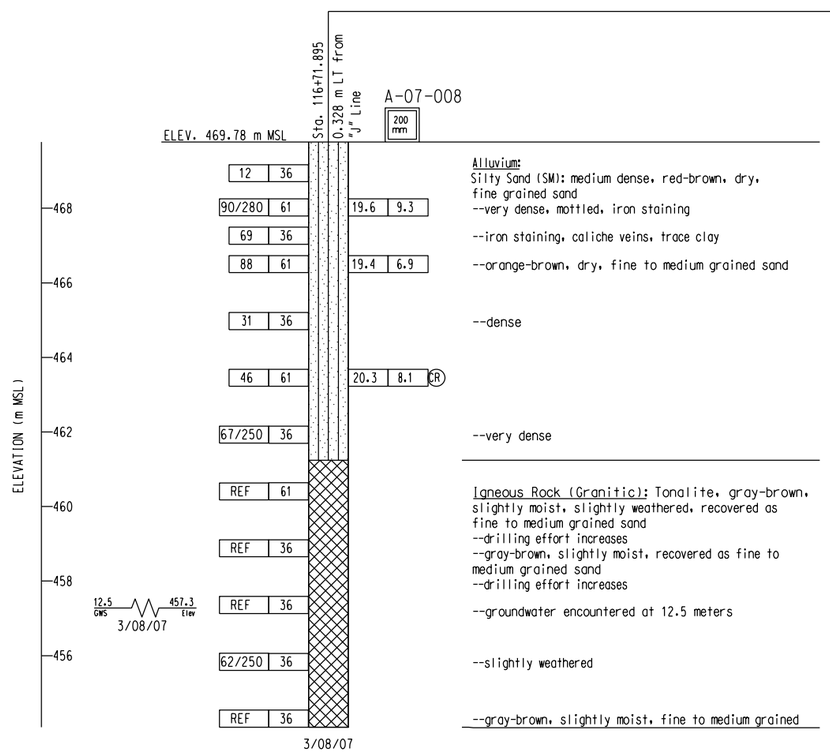

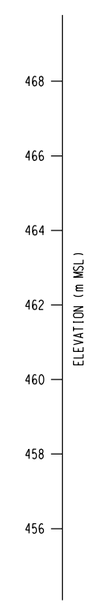

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CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 4 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

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REVISED FINAL STRUCTURE FOUNDATION REPORT

REVISED
STRUCTURE FOUNDATION REPORT
RETAINING WALLS FOR WESTBOUND AND EASTBOUND STATE ROUTE 60 HOV CONNECTORS
BRIDGE NOS. 56-0841 AND 56-0842
INTERSTATE 215/STATE ROUTE 60 EAST JUNCTION IMPROVEMENTS
CITY OF RIVERSIDE, CALIFORNIA
08-RIV-215/60-KP 61.7/62.6, 19.4/21.5
CALTRANS EA NO. 08-449311

Prepared for:

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER WEST, INC.
1220 Research Drive, Suite B
Redlands, CA 92374

Kleinfelder Project No. 76979

Revised June 15, 2009
February 16, 2009

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Revised June 15, 2009
February 16, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

Subject: **Revised Structure Foundation Report**
Retaining Walls for Westbound and Eastbound
State Route 60 HOV Connectors
Bridge Nos. 56-0841 and 56-0842
Interstate 215/State Route 60 East Junction Improvements
City of Riverside, California
08-Riv-215/60-KP 61.7/62.6, 19.4/21.5
Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) is pleased to present this Structure Foundation Report for the proposed retaining walls at State Route 60 High-Occupancy Vehicle (HOV) Connectors, to be located at the east junction of existing Interstate 215 and State Route 60, in the City of Riverside, California. The purpose of this report is to provide geotechnical engineering recommendations for design and construction of the proposed retaining walls.

The proposed project is geotechnically feasible provided that our recommendations in this report are properly incorporated into the design and construction of the project. Recommendations provided herein are contingent on the provisions outlined in the Additional Services and Limitations section of this report. The project Owner should become familiar with these provisions in order to assess potential impacts to the proposed project and further involvement by Kleinfelder.

We appreciate the opportunity to be of service on this project. If you have any questions and comments or require additional information, please do not hesitate to contact the undersigned.

Sincerely,
KLEINFELDER WEST, INC.

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
CARLOS V. AMANTE
No. 2724
Exp. 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

PROFESSIONAL GEOLOGIST
RICHARD F. ESCANDON
No. 1213
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

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1.0 INTRODUCTION

1.1 GENERAL

Kleinfelder West, Inc., (Kleinfelder) was retained by Lim & Nascimento Engineering Corporation (LAN Engineering) to conduct a geotechnical investigation along the proposed alignments of Westbound (WB) and Eastbound (EB) State Route 60 High Occupancy Vehicle (SR-60 HOV) Connectors, Bridge Nos. 56-0842 and 56-0841, located at the east junction of Interstate 215 (I-215) and State Route 60 (SR-60) in the City of Riverside, Riverside County, California (see Plate 1, *Site Location Map*). The scope of our services was provided in our proposal entitled *Revised Proposal for Geotechnical Support Services For Plans, Specifications, and Cost Estimates (PS&E), Two New SR-60 HOV Connectors at the I-215/SR-60 East Junction, Riverside, California, dated July 11, 2007.*

This report presents our recommendations relative to the geotechnical aspects of design and construction for the proposed retaining walls. Conclusions and recommendations presented in this report are based on the subsurface conditions encountered at the locations of our field excavations, and the provisions and requirements outlined in the Additional Services and Limitations sections of this report. Recommendations presented in this report should not be extrapolated to other areas or be used for other projects without our prior review.

1.2 PROJECT DESCRIPTION

The proposed project consists of adding two new HOV lane bridges at the east junction of I-215 and SR-60 between the Box Springs Overcrossing and the Day Street Undercrossing, and extending the existing HOV lanes to connect to the two new HOV lane bridges. The project will also include lowering and widening of the existing NB I-215 mainline to the WB SR-60.

The proposed three-span SR-60 HOV Connectors will be constructed with cast-in-place, prestressed concrete box girders with a total length of 109.2 and 130.7 meters (for the WB and EB structures, respectively) and width of 9.105 meters for both structures (see *General Plans* on Plates 2a and 2b). Both connectors will be supported on two

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abutments (Abutments 1 and 4) and two bents (Bents 2 and 3). Each bent will be supported by a single 1.68-m diameter column bearing on 2.44-m diameter cast-in-drilled-hole (CIDH) piles. The bridge abutments will be built on proposed 1:2 and 1:4 (Vertical:Horizontal, V:H) fill slopes and will be supported by 600-mm diameter CIDH piles. The bottom of pile cap elevations for the HOV Connectors are shown on the *Foundation Plans* (see Plates 3a and 3d, respectively). The proposed improvements will include retaining walls on the north and south sides of each abutment of the WB and EB SR-60 HOV Connectors (see Plates 2b and 2d). Retaining wall data are summarized in Tables 1a and 1b, below.

Table 1a
Retaining Wall Data (WB SR-60 HOV Connector)

Wall No.	Wall Location	Beginning Station	Ending Station	Length (meters)	Wall Height (meters)	Wall Type
1	Abutment 1 (North side)	14+53.076 (“K” Line 7.145 LT)	15+55.453 (“K” Line 7.145 LT)	101.910	1.8 to 4.2	Type 1
2	Abutment 1 (South side)	15+41.374 (“K” Line 1.960 RT)	15+54.488 (“K” Line 1.960 RT)	14.160	1.8 to 4.2	Type 1
3	Abutment 4 (North side)	16+90.195 (“K” Line 7.145 LT)	17+01.448 (“K” Line 7.145 LT)	11.120	1.8 to 4.8	Type 1
4	Abutment 4 (South side)	16+90.165 (“K” Line 1.96 RT)	17+20.566 (“K” Line 1.96 RT)	30.500	1.8 to 6.7	Type 1

Table 1b
Retaining Wall Data (EB SR-60 HOV Connector)

Wall No.	Wall Location	Beginning Station	Ending Station	Length (meters)	Wall Height (meters)	Wall Type
1	Abutment 1 (North side)	14+95.407 (“J” Line 1.960 LT)	15+56.040 (“J” Line 1.960 LT)	60.500	1.8 to 4.8	Type 1
2	Abutment 1 (South side)	15+42.566 (“J” Line 7.145 RT)	15+56.059 (“J” Line 7.145 RT)	13.600	1.8 to 4.2	Type 1
3	Abutment 4 (North side)	--	--	7.010	3.0 to 4.2	Type 1
4	Abutment 4 (South side)	--	--	7.010	3.0 to 4.2	Type 1

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A combination of spread footings and pile foundations consisting of 600 mm and 400 mm diameter CIDH concrete piles are proposed for the retaining walls. The retaining wall general plans are shown on Plates 3a through 3j.

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2.0 GEOTECHNICAL INVESTIGATION

The purpose of this investigation was to evaluate subsurface conditions along the proposed structure alignments and provide geotechnical recommendations for design and construction of the proposed development. A description of the scope of services performed is presented below.

Task 1 – Literature Review

We began our services by reviewing soils and geologic data in our files and from select public agencies (see References). We have completed a computerized search of appropriate seismic and faulting information as it relates to the site.

Task 2 – Field Exploration

Prior to conducting the field exploration, our proposed exploration locations were cleared of known existing utility lines through Underground Service Alert (USA). Our subsurface exploration program for the WB and EB SR-60 HOV Connectors and associated retaining walls consisted of drilling and logging eight exploratory soil borings A-07-001 through A-07-008 (HV-1 through HV-8) on March 5, 6 and 8, 2007. Locations of our borings are shown on the Logs of Test Borings sheets (see Plates 4d through 4f and 4j through 4m). These borings were advanced to depths ranging from approximately 15.7 to 23.5 meters below the existing ground surface (bgs). The borings were advanced using a Mobile B-61, truck-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer for sample collection.

The borings were logged and sampled by a staff geologist from our office using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Each soil sample was observed and described in general accordance with the Unified Soil Classification System (USCS). Following drilling, sampling and logging, the borings were backfilled with native cuttings. The boring logs are presented in Appendix A, *Field Exploration*.

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Task 3 – Laboratory Soil Testing

Laboratory testing was performed on the samples collected during our field exploration to substantiate field classifications and to assess the physical characteristics of the subsurface soils and rocks. A laboratory testing program was developed and performed to characterize and evaluate the engineering properties of the subsurface soils. Tests performed consisted of moisture content and in situ dry unit weight (ASTM D2216 and D2937); grain size distribution (ASTM D 422); direct shear (ASTM D 3080); and corrosivity tests consisting of electrical resistivity test (CTM 532), pH (CTM 643), sulfate content (CTM 417), and chloride content (CTM 422). The laboratory test procedures and results are presented in Appendix B, *Laboratory Testing*.

Task 4 – Geotechnical Analyses and Report Preparation

Field and laboratory findings were evaluated in conjunction with the proposed use project. This report includes conclusions and recommendations regarding the following:

- Regional geologic setting, geologic features, and geologic hazards including the potential for ground rupture due to surface faulting, liquefaction potential, and other seismically induced hazards;
- Subsurface materials encountered within the exploratory borings, anticipated groundwater levels and excavation characteristics of these materials;
- Corrosion potential of the near-surface soils;
- Acceleration Response Spectra (ARS) curves, including standard Caltrans ARS curve and modified (design) ARS curve;
- Recommendations for design and construction of shallow and deep foundations including recommended pile axial and lateral capacities, maximum bending moment, and total and differential settlements;
- Recommended active, at-rest and seismically induced lateral earth pressures for retaining walls and other below-grade structures; and
- Guidelines for earthwork including recommendations for site preparation, fill placement, and compaction.

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3.0 PERTINENT REPORTS AND INVESTIGATIONS

The following documents were reviewed for this study:

- Retaining Wall Layouts for WB and EB SR-60 HOV Connectors, prepared for the State of California, Department of Transportation, CU 08, EA 449311, by Lim & Nascimento Engineering, Revision Date June 15, 2009.

- Foundation Plans for WB and EB SR-60 HOV Connectors, prepared for the State of California, Department of Transportation, CU 08, EA 449311, by Lim & Nascimento Engineering, Revision Date June 15, 2009.

- General Plans for WB and EB SR-60 HOV Connector, prepared for the State of California, Department of Transportation, CU 08, EA 449311, by Lim & Nascimento Engineering, Revision Date June 15, 2009.

- Revised Structure Foundation Report, Proposed WB and EB SR-60 HOV Connectors, I-215/SR60 East Junction, City of Riverside, California, Kleinfelder Project No. 76979, dated June 12, 2009.

- Preliminary Foundation Report, Proposed WB & EB SR60 HOV Connector Bridges, I-215/SR60 East Junction, Riverside, California, Kleinfelder Project No. 76979, dated June 12, 2007.

- United States Geological Survey, 7-1/2 Minute Series, Riverside East Quadrangle, California, 1967, Photorevised 1980.

- United States Geological Survey, Geologic Map of the San Bernardino and Santa Ana 30’ X 60’ Quadrangle, California, Version 1.0, 2006.

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4.0 GEOLOGY, FAULTING AND SEISMICITY

4.1 REGIONAL AND LOCAL GEOLOGY

The project site is situated within the northern Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are a northwest-southeast oriented complex of blocks separated by similarly trending faults which extend 200 kilometers from the Transverse Ranges south to the Mexican border and beyond another 1250 kilometers to the tip of Baja California. The province varies in width from 50 to 160 kilometers and is bounded on the east by the Colorado Desert and the Gulf of California and on the west by the Pacific Ocean.

The Peninsular Ranges contain Jurassic-age and Cretaceous-age igneous and metamorphic rocks, as well as a thick sequence of marine and non-marine sedimentary rock. The Peninsular Ranges Province is further described by sub-units, which include the Perris Block, the Santa Ana Mountains, and the San Jacinto Mountains. The Perris Block is characterized as a broad area of intermixed valleys and low mountain ranges situated between the Elsinore and San Jacinto fault zones.

The project site is located in the northern portion of the Perris Block and Perris Valley. Typical lithographic units within this area consist of Quaternary alluvial deposits overlying granitic and metamorphic bedrock. Sporadic outcrops of bedrock dot the valley floor and represent remnants of eroded hills and mountains. Bedrock consists of mostly Cretaceous-age igneous rock (tonalite) forming the bedrock hills north of the site.

4.2 FAULTING AND SEISMICITY

The project site is located in the highly seismic southern California region within the influence of several fault systems that are considered to be active or potentially active. An active fault is defined by the State of California as “a sufficiently active and well defined fault, which has exhibited surface displacement within the Holocene time (the last 11,000 years).” A potentially active fault is defined by the State as “a fault with a history of movement within Pleistocene time (between 11,000 and 1.6 million years ago).” These active and potentially active faults are capable of producing potentially damaging seismic shaking at the site. It is anticipated that the project site will

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periodically experience ground acceleration as the result of moderate to large magnitude earthquakes. Other active faults without surface expression (blind faults) that are capable of generating an earthquake, or other potentially active seismic sources may be present that are not currently zoned.

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5.0 SUBSURFACE CONDITIONS

5.1 EARTH MATERIALS

5.1.1 Undocumented Artificial Fill (Afu)

Undocumented fill soils were encountered in borings A-07-003 and A-07-004 (HV-3 and HV-4) to depths of approximately 2.8 and 1.3 meters, respectively. The fill soils were likely placed as part of the development of the existing interchange. In general, the undocumented fill soils consist of silty sand (SM). Additional areas of undocumented fill soils may be encountered during earthwork operations that were not identified during this investigation.

5.1.2 Alluvium (Qal)

Alluvial soils were encountered below the fill soils in borings A-07-003 and A-07-004 (HV-3 and HV-4) and in the remaining borings excavated for the proposed project. The alluvial soils extend to depths ranging from approximately 8.5 to 19.5 meters below existing grades. The alluvial soil deposits encountered during our investigation consist of silty sand (SM), poorly graded and well graded sand with silt (SP-SM and SW-SM), and clayey sand (SC). The alluvial soils encountered are generally medium dense to very dense with several interbedded layers of loose soils.

5.1.3 Granitic Bedrock (Kgr)

Tonalite granitic bedrock was encountered in six of our eight borings excavated for the proposed project. The bedrock was encountered at depths ranging from approximately 8.5 to 19.5 meters below existing grades and extended to the maximum depth explored of 25.3 meters below the existing grade. In general, the tonalite rock is moderately to highly weathered and decomposed near the contact with the alluvial soils and becomes less weathered with depth.

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5.2 GROUNDWATER

Groundwater was encountered in all eight borings excavated for the proposed project at depths of 8.8 to 12.5 meters bgs. These depths to groundwater correspond to groundwater elevations of approximately 454.8 to 457.3 meters, above Mean Sea Level (MSL).

Fluctuations of the groundwater level, localized zones of perched water, and soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas on or immediately adjacent to the site can also cause a fluctuation of local groundwater levels.

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6.0 DISCUSSION AND RECOMMENDATIONS

6.1 SEISMIC DESIGN CRITERIA

6.1.1 Ground Surface Rupture and Deformation Potential

The site is not located within a currently delineated State of California Alquist-Priolo Earthquake Fault Zone (Hart and Bryant, 1997). No known active faults have been identified on the site, thus, the potential for future surface fault rupture at the site is considered to be "low." While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

6.1.2 Seismic Shaking

The 1996 California Seismic Hazard Map prepared by Caltrans (Mualchin, 1996a) indicates that the controlling fault for this project is the San Jacinto Fault (SJO), a strike slip fault with a maximum credible earthquake (MCE) moment magnitude of 7.5. The closest fault distance to the project site is approximately 8.8 km.

The horizontal peak bedrock acceleration (PBA) at the site based on the 1996 Caltrans Seismic Hazard Map is 0.5g, as shown on Plate 5, *Fault and PBA Map*. Caltrans Guidelines for Structures Foundation Reports (CGSFR), Version 2.0, dated March 2006 requires that the PBA determined above be verified with well-established attenuation relationships such as Sadigh et al. (1997) for controlling faults. The PBA value for the site, estimated using Sadigh et al. (1997) attenuation relationship, is 0.46g. Therefore, a PBA of 0.5g is recommended in accordance with Caltrans design practice.

Based on the results of our field exploration, our past experience, and in accordance with Table B.1 of Caltrans Seismic Design Criteria (SDC) (Version 1.4, dated June 2006), the site can be classified as Soil Profile Type C. The recommended seismic design parameters are summarized in the following Table 2.

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Table 2
Seismic Design Parameters

Seismic Parameters	Design Recommendation and Reference
Controlling Fault	San Jacinto (SJO), (Mualchin, 1996a)
Type of Fault	Strike-Slip (Mualchin, 1996b)
Closest Distance to the Fault	8.8 km (Mualchin, 1996a)
Earthquake Magnitude (MCE)	7.5 (Mualchin, 1996a,b)
Horizontal Peak Bedrock Acceleration (PBA)	0.5g
Soil Profile Type	C (Table B.1, 2006 Caltrans Seismic Design Criteria)

6.1.3 Design ARS Curve

The standard acceleration response spectra (ARS) curve presented in Figure B.5 of Caltrans SDC for PBA of 0.5g, magnitude 7.5 and Soil Profile Type C was selected for seismic design of the proposed bridges. This standard ARS curve was modified to account for near-source fault rupture directivity effect as follows:

- 20% increase in spectral values for periods equal to or greater than 1.0 second;
- No change for periods less than 0.5 seconds; and
- Spectral ordinates for periods between 0.5 and 1 second determined by linear interpolation.

The standard Caltrans SDC ARS curve, modified ARS curve and their ordinate values are presented on Plate 6, *Design ARS Curve*.

6.1.4 Liquefaction Potential

Seismically induced soil liquefaction generally occurs in loose, saturated, cohesionless soil when pore pressures within the soil increase during ground shaking. The increase in pore pressure transforms the soil from a solid to a semi-liquid state. The primary factors affecting the liquefaction potential of a soil deposit are: 1) intensity and duration of earthquake shaking, 2) soil type and relative density, 3) overburden pressures, and 4) depth to groundwater. Soils most susceptible to liquefaction are clean, loose, uniformly graded, fine-grained sands, and non-plastic silts that are saturated. Silty sands have also been shown to be susceptible to liquefaction. These soils typically lose a portion or all of their shear strength and regain strength sometime after shaking stops. Soil

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movements (both vertical and lateral) have been observed under these conditions due to consolidation of the liquefied soils and the reduced shear resistance of slopes.

According to a *Liquefaction Hazard Map* prepared by the County of Riverside (Generalized Liquefaction Figure S-3, 2002), the site is located in an area designated as having a "low" liquefaction susceptibility. Groundwater was encountered in our borings excavated for the proposed HOV Connectors at depths ranging from approximately 8.8 to 12.5 meters below existing grades. Based on the results of our liquefaction analysis (Youd and Idriss, 2001), it is our professional opinion that due to the dense nature of subsurface soils encountered on-site and the observed depth to groundwater, the site has a "low" liquefaction potential. Liquefaction potential calculations are presented in Appendix C-2.

6.1.5 Seismically Induced Settlements

Unconsolidated, loose to medium dense sandy soil deposits tend to densify or become more tightly packed during strong ground shaking, thereby causing ground settlement. Using an empirical procedure developed by Tokimatsu and Seed (1987), seismically induced settlements due to seismic compaction of dry or unsaturated soils below the foundations were estimated to be on the order of less than 13 mm. Seismically induced settlement calculations are presented in Appendix C-2.

6.2 RETAINING WALL FOUNDATION DESIGN

6.2.1 Foundation Type

The proposed retaining walls with design height up to 3 meters will be supported on spread footings and the retaining walls with design height of 3 meters or greater will be supported on 600-mm and 400-mm diameter CIDH concrete piles. Selection of these foundation types was made by LAN after consultation with Kleinfelder during the type selection phase of this project. The general plans for retaining walls are presented on Plates 3a through 3j. The retaining wall footing data for the proposed HOV Connectors are summarized in Tables 3a and 3b.

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Table 3a
Retaining Wall Footing Data (WB SR-60 HOV Connector)

Wall No.	Wall Location	Length (m)	Height (m)	Wall Type
1	Abutment 1 (North Side)	101.91	1.8 - 4.2	Type 1 Wall Supported on Spread Footing and 400-mm CIDH Pile
2	Abutment 1 (South Side)	14.16	1.8 - 4.2	Type 1 Wall Supported on Spread Footing and 400-mm CIDH Pile
3	Abutment 4 (North Side)	11.12	1.8 - 4.8	Type 1 Wall Supported on Spread Footing and 400-mm CIDH Pile
4	Abutment 4 (South Side)	30.50	1.8 - 6.7	Type 1 Wall Supported on Spread Footing and 400-mm/600-mm CIDH Pile

Table 3b
Retaining Wall Footing Data (EB SR-60 HOV Connector)

Wall No.	Wall Location	Length (m)	Height (m)	Wall Type
1	Abutment 1 (North Side)	60.50	1.8 – 6.1	Type 1 Wall Supported on Spread Footing and 400-mm CIDH Pile
2	Abutment 1 (South Side)	13.60	1.8 – 4.2	Type 1 Wall Supported on Spread Footing and 400-mm CIDH Pile
3	Abutment 4 (North Side)	7.01	3.0 – 4.2	Type 1 Wall Supported on Spread Footing and 400-mm CIDH Pile
4	Abutment 4 (South Side)	7.01	3.0 – 4.2	Type 1 Wall Supported on Spread Footing and 400-mm CIDH Pile

6.2.2 Spread Footing Bearing Capacity and Settlement

For retaining walls with height up to 3 meters supported on shallow foundations, we recommend an allowable gross bearing capacity of 120 kPa for service load. For the extreme event due to barrier impact load, we recommend an ultimate bearing capacity of 360 kPa. Bearing capacity calculations are presented in Appendix C-3.

The estimated total and differential static settlements of the proposed retaining walls supported on spread footings is in the order of 13 mm and 6 mm or less, respectively

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(see Appendix C-4). Since the subsurface soils at the site are generally granular, this settlement is anticipated during construction or shortly thereafter.

6.2.3 Axial Pile Capacity

The axial capacity of the proposed piles for retaining walls with design height of 3 meters or greater was estimated using the computer program SHAFT Version 5.0 (Ensoft, 1989-2003). Based on CGSFR (2006a), axial capacity for CIDH piles with a diameter less than or equal to 600 mm will include only skin friction. Hence, we ignored end bearing of the proposed CIDH piles at the retaining walls, where 600-mm and 400-mm diameter CIDH piles are proposed. Skin friction is also ignored for the portion of the piles embedded in new embankment fill. To calculate the allowable geotechnical capacity in compression, a factor of safety of 2.0 was applied to skin friction and a factor of safety of 3.0 was applied to end bearing. Axial pile capacity calculations are presented in Appendix C-5.

The recommended pile tip elevations for the proposed retaining walls for HOV Connectors are summarized in Tables 4a and 4b.

Table 4a
Pile Data (WB SR-60 HOV Connector)

Location	Pile Type[2]	Bottom of Pile Cap Elev. (m, MSL)	Design Loading	Nominal Resistance		Design Tip Elev. (m, MSL)[1]	Specified Tip Elevation (m, MSL)
				Compression	Tension		
RW No. 1	400-mm CIDH	463.87 – 463.92	400 kN	800 kN	0 kN	455.03 (1)	455.03
RW No. 2	400-mm CIDH	464.81	400 kN	800 kN	0 kN	455.97 (1)	455.97
RW No. 3	400-mm CIDH	471.00 – 472.28	400 kN	800 kN	0 kN	462.16 (1)	462.16
RW No. 4	400-mm CIDH	472.18 – 473.45	400 kN	800 kN	0 kN	463.34 (1)	463.34
RW No. 4	600-mm CIDH	469.60 – 470.87	900 kN	1800 kN	0 kN	458.32 (1)	458.32

Notes:
[1] Design tip elevation is controlled by the following demands: (1) Compression and (2) Lateral.
[2] The proposed piles should be spaced at a minimum of three pile diameters (center-to-center).

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Table 4b
Pile Data (EB SR-60 HOV Connector)

Location	Pile Type[2]	Bottom of Pile Cap Elev. (m, MSL)	Design Loading	Nominal Resistance		Design Tip Elev. (m, MSL) [1]	Specified Tip Elevation (m, MSL)
				Compression	Tension		
RW No. 1	400-mm CIDH	465.59 – 465.64	400 kN	800 kN	0 kN	456.75	456.75
RW No. 2	400-mm CIDH	466.86	400 kN	800 kN	0 kN	458.02	458.02
RW No. 3	400-mm CIDH	471.72	400 kN	800 kN	0 kN	462.88	462.88
RW No. 4	400-mm CIDH	471.72	400 kN	800 kN	0 kN	462.88	462.88

Notes:
[1] Design tip elevation is controlled by the following demands: (1) Compression and (2) Lateral.
[2] The proposed piles should be spaced at a minimum of three pile diameters (center-to-center).

Based on the foundation dimensions and anticipated loads, we estimate the maximum total settlement of foundations designed and constructed in accordance with the preceding recommendations to be a function of the pile length and sustained loads. The differential settlement due to static loading is estimated to be less than 13 mm.

Due to the granular nature of the on-site soils and relatively shallow bedrock, the settlement of foundations should be essentially completed shortly after initial application of the loads.

6.2.4 Lateral Pile Capacity

Lateral resistance and deflections of vertical pile foundations are governed primarily by the resistance-displacement characteristics of near-surface soils and the material strength of the piles. According to Section 4.5.6.5 of the Caltrans Bridge Design Specifications (BDS) dated November 2003, a lateral capacity of 58 kN may be used for the proposed 400-mm diameter CIDH pile. For the proposed 600-mm diameter CIDH pile, we performed our lateral pile capacity analyses using the computer program LPILE^{PLUS} 5.0 for Windows (Reese et al., Ensoft, Inc. 2004), which solves the beam on elastic foundation problem using independent nonlinear lateral springs, commonly referred to as p-y curves, to model the relationship between soil resistance and pile deflection. The bending stiffness of the piles was modeled using full section stiffness for static conditions and a 60% reduction in stiffness due to cracking for seismic conditions

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The results indicate that for 600-mm CIDH pile the lateral capacities of 129 kN and 222 kN may be used for pile head deflection of 6 mm and 25 mm, respectively, assuming pinned-head condition. Lateral pile capacity calculations are presented in Appendix C-6.

The values provided above are per pile. Piles in groups may be considered to act individually when the center-to-center spacing is greater than three pile diameters in the direction normal to loading and eight pile diameters in the direction parallel to loading (Caltrans Bridge Design Specifications, 2003). To account for group action in the direction parallel to loading, the lateral capacities provided above should be multiplied by an appropriate lateral group reduction factor as follows:

- For spacing of eight pile diameters or greater, no reduction in lateral capacity is necessary.
- For spacing of five pile diameters, a lateral group reduction factor of 0.9 should be applied.
- For spacing of three pile diameters, a lateral group reduction factor of 0.7 should be applied.

For spacing in between these values, a linear interpolation may be utilized to calculate the pile group reduction factor.

6.3 LATERAL EARTH PRESSURES

Active and passive lateral earth pressures are calculated using Rankine earth pressure theory assuming a total unit weight of 19.6 kN/m^3 and friction angle of 32 degrees for the backfill soil. At-rest earth pressures are calculated using Jaky's method. Lateral earth pressure calculations are presented in Appendix C-7.

We recommend that soil pressure values for calculating active lateral earth pressures developed from horizontal backfills behind retaining walls or below-grade structures that are free to rotate at least 0.1 percent of the wall height use an equivalent fluid pressure of 6 kN/m^3. Walls that are restrained against movement or rotation at the top should be designed for an at-rest equivalent fluid pressure of 9 kN/m^3. For sloping backfill behind

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the wall with gradient of 1:2 (V:H), we recommend an active and at-rest equivalent fluid pressures of 10 and 11.5 kN/m^3, respectively.

We recommend a coefficient of sliding resistance value of 0.4 for sliding stability analysis. This value is applicable for friction between cast-in-place concrete foundations and underlying soil. Passive pressure available in engineered fill may be taken as equivalent fluid pressure of 47 kN/m^3, not to exceed 120 kPa.

For seismic loading conditions, additional seismic/dynamic earth pressure should be added to the static active earth pressure. Seismic wall pressures for cantilever walls are generally estimated by the simplified approximation of Mononobe-Okabe Method proposed by Seed and Whitman (1970). In accordance with AASHTO (1992) seismic design guidelines, we used a horizontal seismic acceleration coefficient, k_h, equal to one-half the peak horizontal ground acceleration (k_h = 0.25). Using this approach, we recommend a dynamic earth pressure of 3.6 kPa per meter of depth. This additional pressure should be taken to act at a distance of 0.6H, where H is the wall height in feet. Note that the active earth pressure has a triangular distribution with the largest load occurring at the bottom of the wall, while the seismic earth pressure has an inverted triangular distribution with the largest load at the top of the wall.

In case of traffic coming closer than one-half of the height of the wall, we recommend a live load surcharge pressure equal to not less than 0.6 meter of soil surcharge with an average unit weight of 19.6 kN/m^3.

Our recommendations for the lateral earth pressures assume that all walls have adequate drainage provisions to prevent the buildup of hydrostatic pressures in the soil backfill. The drainage system may be designed in accordance with Caltrans Standard Plan BO-3, Detail 3-1. Pervious backfill material shall consist of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations thereof. Pervious backfill (other than sacked material at wall drain outlets) shall conform to the grading requirements in Section 19-3.065 of the Caltrans Standard Specifications. Sacked pervious backfill at wall drain outlets shall conform to the grading for 38 mm x 19 mm primary aggregate size specified in Section 90-3.02 of Caltrans Standard Specifications. As an alternate, geocomposite drain in Bridge Design Details, page 6-22, may be used in lieu of the pervious backfill.

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6.4 APPROACH EMBANKMENT FILL

The bridge General Plans (see Plates 2a and 2c) indicate that the approach embankments at the abutments will require fill with height up to approximately 4 meters at Abutment 1 and 6 meters at Abutment 4, with the slope ratios of 1:4 and 1:2 (vertical:horizontal), respectively. Fills placed within bridge approach zone should be compacted to 95 percent relative compaction per latest ASTM D1557. Our recommendations for the new embankment fill are provided in Section 7.1.2 of this report.

6.4.1 Settlement

The weight of the fill embankments will induce settlement in the underlying soils and a settlement monitoring period is recommended as discussed in Section 7.3 of this report. The proposed embankments are estimated to settle on the order of 50 to 75 mm assuming the slopes are designed and constructed as described in this report. Eambankment settlement calculations are presented in Appendix C-8.

Since the subsurface soils at the site are generally granular, this settlement is anticipated to occur during construction or shortly thereafter. We recommend a waiting period of 30 days. The settlement magnitude and the required waiting period are dependent on the amount of removal and replacement of the existing fill and type and amount of new fill materials placed. Caltrans requires that the remaining total settlement of the bridge approach embankments should not exceed 13 mm.

6.4.2 Slope Stability

The proposed 1:2 (V:H) fill slopes at Abutment 4 were analyzed for the overall (global) slope stability of both static and pseudostatic (seismic) conditions. Modified Bishop's Method for circular slip surfaces were applied using the computer program GSTABL7 with STEDWin3.0 (Van Aller and Gregory, 2001). The design criteria utilized are as follows: permanent abutment slopes are required to have a minimum factor of safety of 1.5 for the static condition; and a minimum factor of safety of 1.1 for the pseudostatic condition using the Caltrans recommended horizontal earthquake loading coefficient equal to one third (1/3) of the horizontal peak acceleration or 0.17g. The results of slope stability analyses for Abutment 4 embankment indicate that the required minimum static and pseudostatic factors of safety would be satisfied provided the minimum shear

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strength parameters for the new compacted fill are equal to or exceed the following values: (1) a friction angle of 32 degrees, and (2) a cohesion of 4.7 kPa. Slope stability analysis results are included in Appendix C-9.

The proposed 1:4 (V:H) fill slopes at Abutment 1 are expected to be grossly stable for both static and pseudostatic (seismic) conditions, provided the fill embankments are constructed in accordance with our recommendations in this report.

Although the proposed approach abutment slopes are expected to be grossly stable, erosion and surficial instability may be a concern during periods of heavy or intense rainfall. Erosion control and highway planting should be performed in accordance with Section 20 of Caltrans Standard Specifications. Excessive irrigation of slopes should be avoided. Appropriate drainage devices should be placed at the top of all slopes such that water does not flow over slope faces in an uncontrolled manner.

6.5 CORROSION POTENTIAL

To evaluate corrosion potential of the on-site soils, two of the soil samples collected from the borings were tested for pH, resistivity, sulfate and chloride concentrations in accordance with Caltrans Standard Test Methods 532, 643, 417, and 422, respectively. Testing was performed by AP Engineering and Testing, Inc. in Pomona, California. The test results are presented in Table 5, below.

Table 5
Corrosion Test Results

Boring Number	Depth of Sample (m)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
A-07-002 (HV-2)	0.9 - 2.4	1,200	7.4	7	254
A-07-007 (HV-7)	0.9 - 2.4	3,200	7.9	5	126

In accordance with Section 4.1 of Caltrans *Corrosion Guidelines* (dated September 2003), a corrosive area is defined as an area where the soil and/or water contains more than 500 ppm of chlorides, more than 2,000 ppm of sulfates, or has a pH of less than 5.5. In general, a minimum resistivity for soil and/or water less than 1,000 Ohm-cm

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indicates the presence of high quantities of soluble salts and a higher propensity for corrosion. Based on the laboratory test results and the above guidelines, the project site soils may generally be considered as non-corrosive.

Concrete in contact with the ground should be batched using a cement in accordance with the Caltrans Standard Specifications and Table 854.1A of the Highway Design Manual. In general, "Type IP (MS) Modified" or "Type II Modified" cement is acceptable for use along the project alignment. Adequate concrete cover over reinforcing steel should be provided in accordance with good construction practices and Caltrans design standards.

6.6 EXPANSION POTENTIAL

Expansive soils generally contain clay particles that swell considerably when wetted and shrink when dried. Foundations constructed on these soils are subjected to uplifting forces caused by the swelling. Based on our field exploration and the results of our laboratory testing, it is our opinion that soils within the upper portion of the project site have a low potential for expansion. Testing of the final subgrade soils after completion of grading should be conducted to evaluate their expansion potential and confirm or modify the recommendations presented herein.

6.7 SCOUR POTENTIAL

The proposed WB and EB SR-60 HOV Connectors will cross over the existing NB I-215 connector ramp to the WB SR-60 and are not located in a flood/drainage or river channel. Therefore, scour potential is not considered a design issue for this project.

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7.0 CONSTRUCTION CONSIDERATIONS

7.1 SITE PREPARATION

All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations, and other local, state, or federal specifications. All references to maximum unit weight should be established in accordance with the current ASTM Standard Test Method D1557 and may supersede references cited herein.

7.1.1 Stripping and Grubbing

Prior to general site grading, existing pavement, vegetation, organic topsoil, existing fill soils, and debris shall be stripped and disposed of outside the construction limits. Deeper stripping or grubbing may be required where concentrations of fill debris, organic soils, existing trees, or thick root mats are encountered during site grading. Stripped topsoil (less any debris) may be stockpiled and reused for landscape purposes elsewhere on the project; however, this material should not be incorporated into any engineered fill.

In areas where existing trees will be removed, care should be taken to remove the root-ball, roots exceeding 25 mm in diameter, and remaining organics, and to backfill the excavations with compacted engineered fill. We strongly recommend having a representative of Kleinfelder present during tree removal in areas to receive fill or beneath foundations to observe removal of large roots and subsequent scarification and recompaction. Engineered fill should be placed and compacted in accordance with recommendations provided below.

7.1.2 Earthwork and Backfill

After clearing and stripping, the surface should be excavated to a minimum depth of 0.6 meter before placement of new fill. The undocumented fill soils (if encountered) shall be removed during site development and grading and replaced with structural backfill. In addition, any compressible soils encountered shall be removed and replaced with compacted structural backfill in accordance with Caltrans Standard Specifications Section 19-3.06. The exposed surface should be proof-rolled with loaded heavy equipment. Any areas of loose or yielding soils should be over-excavated and re-

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compacted. Any soils that cannot be compacted, or are otherwise unsuitable for the planned use, should be excavated and disposed of from the project site. The exposed surface should then be scarified and compacted to the specified density before placement of new fill. New fill placed on or adjacent to the existing slopes should be properly benched into the existing fill in accordance with Caltrans Standard Specifications.

All earthwork should be performed in accordance with Caltrans Standard Specification Section 19. All materials to be placed as fill should be free of vegetation, organics, debris, and other deleterious materials. All fill placed around foundations and behind walls should be placed in thin loose lifts, moisture-conditioned, and compacted to Caltrans Standard Specification.

Abutment wall backfill shall be structural backfill according to Caltrans standard specifications. In addition, we recommend that abutment backfill be well-graded soil with maximum dimension of 100 mm, essentially non-plastic (liquid limit less than 30, plasticity index less than 12, and with less than 50 percent passing the No. 200) and non-expansive. Expansive soils, defined as soils with Expansion Index (EI) greater than 50 and/or soils with Sand Equivalent (SE) less than 20, should be excluded from the bridge abutments as required by Caltrans guidelines and shown on Plate 7, *Expansive Soil Exclusion Zone in Bridge Embankment*. Expansion Index should be determined in accordance with ASTM D4829. Sand Equivalent should be determined in accordance with California Test Method (CTM) 217.

The limits of bridge approach zone are considered to extend longitudinally 46 meters measured horizontally from the bridge abutment and either parallel or concentric with the roadway centerline, and transversely the full width of embankment except the outer 1.5 meters measured horizontally from the embankment side slopes. Fills placed within 46 meters of abutments should be compacted to 95 percent relative compaction per ASTM D1557.

7.1.3 Temporary Excavations and Shoring

All excavations must comply with the current CAL-OSHA Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We

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are providing the information below solely as a service to our client. Under no circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

A shoring design and safety plan should be required from the contractor and submitted to the Engineer for review and approval. Likewise, measures to control impact of both groundwater and surface water on the stability of temporary excavations and shoring should be employed and should remain the sole responsibility of the contractor.

7.2 PILE INSTALLATION

Practical drill refusal was encountered in four of the eight borings drilled for this geotechnical investigation at depths ranging from approximately 17.1 to 25.3 meters below existing grades. Due to anticipated depth to groundwater and potential for caving, permanent or temporary casing and the slurry (wet) method may be required for installation of CIDH piles. Construction of pile foundations should be performed in accordance with Section 49 of the Caltrans Standard Specifications (Caltrans, 2006).

Excavation and construction of the CIDH piles shall be observed by a qualified representative of the Geotechnical Engineer. Caving of soils may be encountered during construction of CIDH piles. The contractor shall consider the use of temporary casing to prevent caving of soils during construction and to ensure integrity of the CIDH piles. Hard drilling conditions should be anticipated in the lower portion of bedrock. Furthermore, groundwater may be encountered during installation of CIDH piles and wet installation method may become necessary. It is recommended that the bottoms of these shaft borings be adequately cleaned of loose or disturbed materials using a drilling bucket or an approved alternative method. When wet method is used, PVC inspection tubes should be installed in each pile in accordance with Caltrans Standard Provisions to permit gamma-gamma and/or cross-hole sonic testing of CIDH piles.

7.3 SURFACE WATER CONTROL

Ponding of water adjacent to the structures should be avoided. During and after construction, positive drainage should be provided to direct surface water away from structures and all excavations toward suitable, non-erosive drainage devices.

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8.0 ADDITIONAL SERVICES AND LIMITATIONS

8.1 ADDITIONAL SERVICES

The review of plans and specifications, and the observation and testing by Kleinfelder of earthwork and foundation related construction activities, are an integral part of the conclusions and recommendations made in this report. If Kleinfelder is not retained for these services, the client will be assuming our responsibility for any potential claims that may arise during or after construction. The recommended tests, observations, and consultation by Kleinfelder during construction include, but are not limited to:

- A review of preliminary plans and specifications;
- Observation of site clearing, undocumented fill removal, and subgrade preparation;
- Engineered fill placement and compaction;
- Construction observation and density testing of fill material placement, trench backfill, and subgrade preparation;
- Monitoring device installation;
- Observation of pile installation; and
- When any unusual conditions are encountered during construction.

These services may be performed in accordance with our current fee schedule.

8.2 LIMITATIONS

The conclusions and recommendations presented in this report are intended to provide preliminary geotechnical design data and recommendations for the proposed retaining walls at WB and EB SR-60 HOV Connectors, to be located at the east junction of the I-215 and SR-60 in the City of Riverside, California. The findings, conclusions and recommendations were prepared in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made. This report was based on the proposed project information provided to Kleinfelder. If any change (i.e., structure type, location, etc.) is implemented which materially alters the project, additional geotechnical services may be required, which could include revisions to the geotechnical recommendations presented herein.

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Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard. They are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

This report may be used only by the project designers and Caltrans and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on-site and off-site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party, and client agrees to defend, indemnify, and hold harmless Kleinfelder from any claim or liability associated with such unauthorized use or non-compliance.

Environmental site assessment for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater or atmosphere, or the presence of wetlands was not included in the scope of our services for this report.

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9.0 REFERENCES

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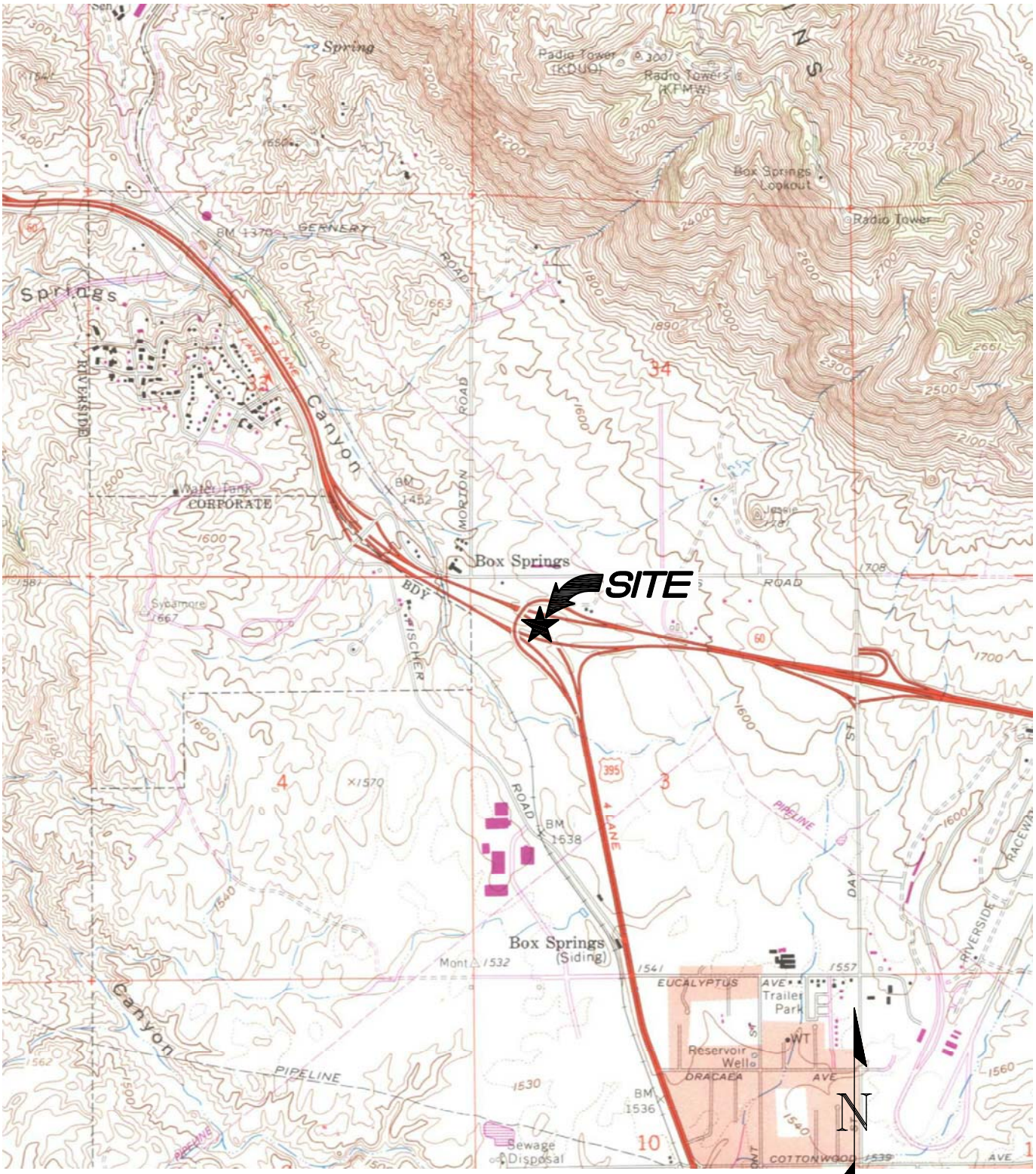
PLATES



SOURCE: U.S.G.S. 7.5' topographic series, Riverside East, California quadrangle dated 1967, photorevised 1980.

2,000 1,000 0 2,000

APPROXIMATE SCALE (feet)

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PROJECT NO.	76979
DRAWN:	01/16/09
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME: 76979p1.dwg	

SITE LOCATION MAP

PROPOSED RETAINING WALLS
I-215/SR-60 EAST JUNCTION
EB & WB SR60 HOV CONNECTORS
RIVERSIDE, CALIFORNIA

PLATE **1**

ATTACHED IMAGES: Images: 76979p1.jpg
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\021609_EB&WB-SR60-HOV\ LAYOUT: 1
PLOTTED: 16 Feb 2009, 11:48am, MGriffin

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

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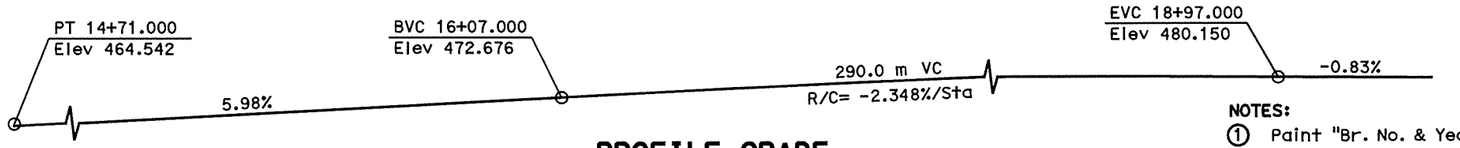
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



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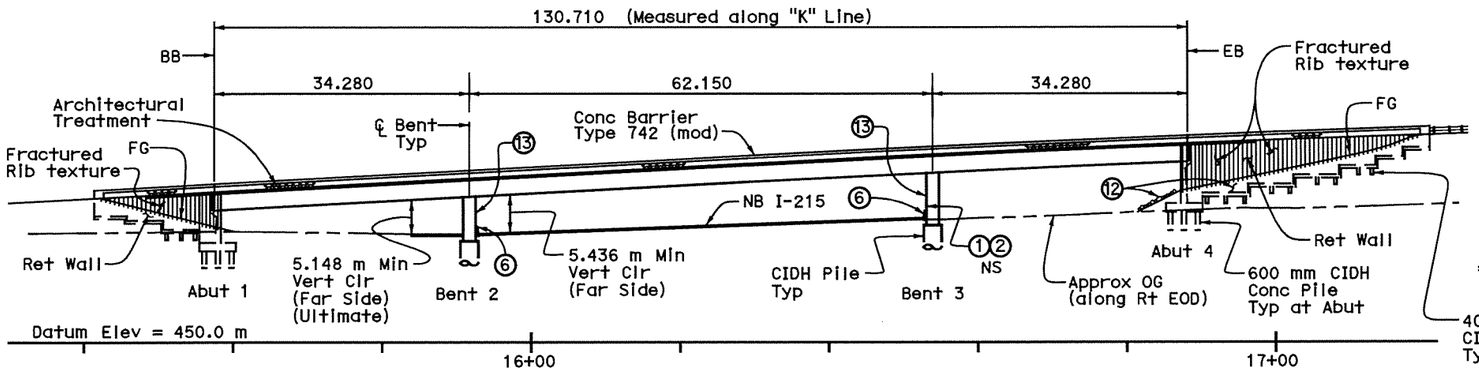


ELEVATION
1:400

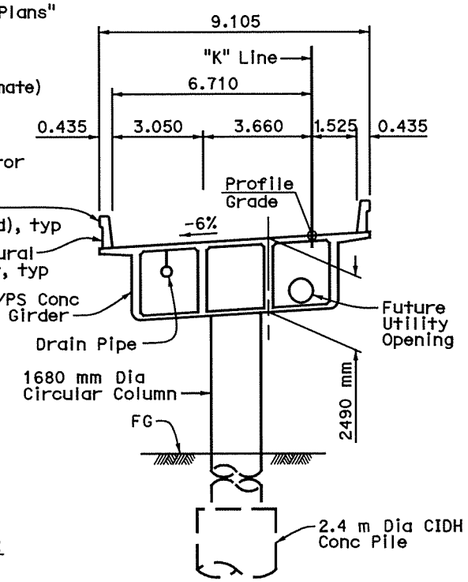
NOTES:

1. Paint "Br. No. & Year Constructed"
2. Paint "WB SR60 HOV Connector"
3. Structure Approach Type N(9S)
4. MBGR, See "Road Plans"
5. Indicates Deck Drain
6. Concrete Barrier Type 60GC see "Road Plans"
7. Concrete Barrier Type 60D see "Road Plans"
8. Welded Steel Casing for Future Utility
9. Retaining Wall Type 1
10. Concrete Barrier Type 742A, see "Road Plans"
11. Concrete Barrier Type 736B, see "Road Plans"
12. Slope Paving with Rockfacing
13. Paint "Bent No."

Ⓐ Point of minimum vertical clearance (Ultimate)
Ⓑ Point of minimum vertical clearance
→ Indicates direction of traffic
=== Indicates Proposed EB SR60 HOV Connector Br. No. 56-0842

Notes:

1. For General Notes, Index to Plans and "Standard Plans" list, see "Index to Plans" sheet.
2. For Pile Data Table, see "Foundation Plan" sheet.
3. For Stage Construction, see "Road Plans".



TYPICAL SECTION
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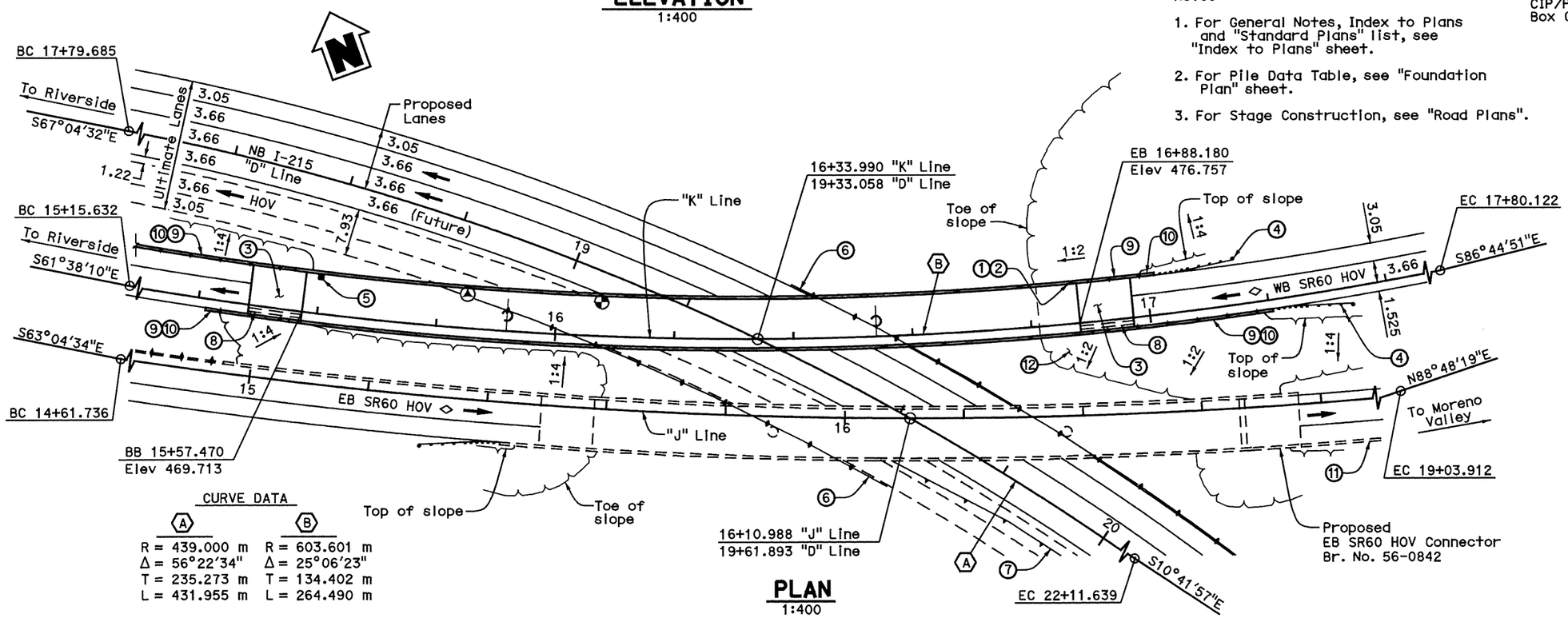

CURVE DATA

Ⓐ	Ⓑ
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Δ = 56°22'34"	Δ = 25°06'23"
T = 235.273 m	T = 134.402 m
L = 431.955 m	L = 264.490 m

PLAN
1:400

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. KIM / D. SARETSKY	CHECKED T. DUDLEY/A. SIVATHASAN	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: HL-93 AND PERMIT DESIGN VEHICLE
	DETAILS	BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR	LAYOUT BY R. ANDRASEK	CHECKED M. CHAR
SIGN OFF DATE	QUANTITIES	BY D. SARETSKY	CHECKED K. GEE	SPECIFICATIONS BY M. CHAR	PLANS AND SPECS COMPARED M. CHAR

DESIGN GENERAL PLAN SHEET (METRIC) (REV. 10/27/06)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

CU 08
EA 449311

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
GENERAL PLAN

DISREGARD PRINTS BEARING EARLIER REVISION DATES → REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/21/08 11/17/08 2/18/09 5/15/09

SHEET 1 OF 32

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

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SAN BERNARDINO, CALIFORNIA 92408

NOTES:

1. Paint "Br. No. & Year Constructed"
2. Paint "EB SR60 HOV Connector"
3. Structure Approach Type N(9S)
4. MBGR, See "Road Plans"
5. Indicates Deck Drain
6. Concrete Barrier Type 60GC, see "Road Plans"
7. Concrete Barrier Type 60D, see "Road Plans"
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12. Slope Paving with Rockfacing
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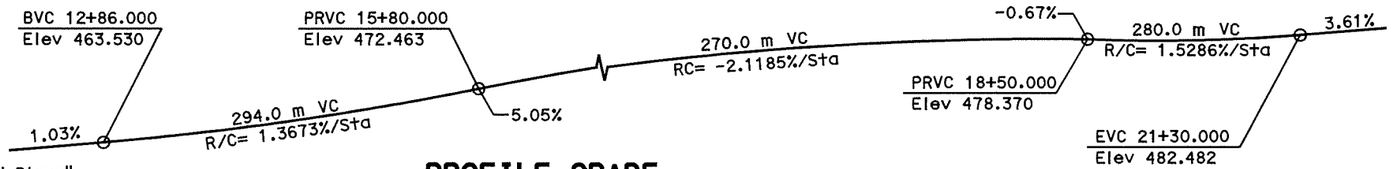
Point of minimum vertical clearance including "Ultimate"

Indicates Direction of traffic

=== Indicates WB SR60 HOV Connector Br. No. 56-0841



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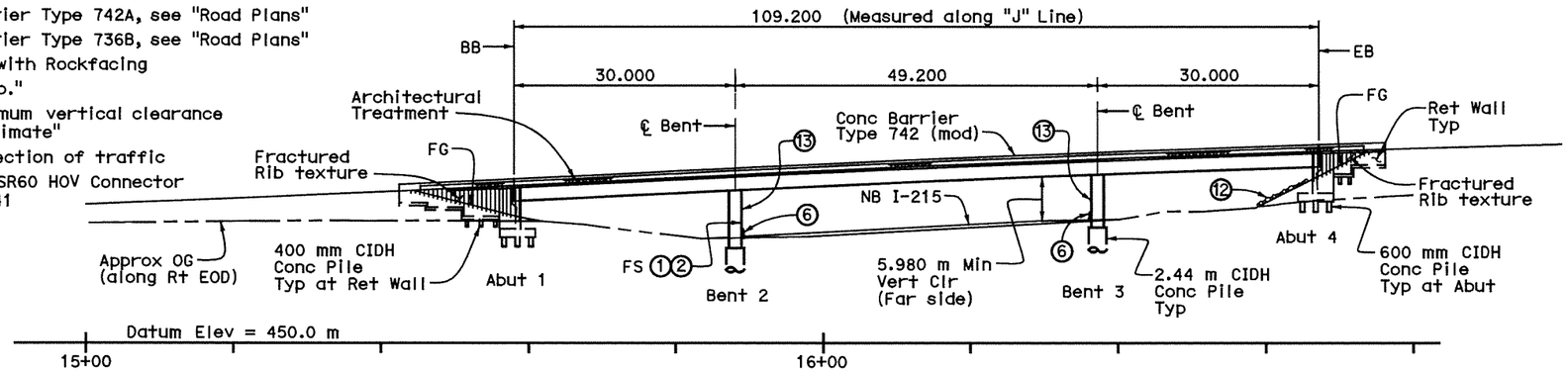

ELEVATION
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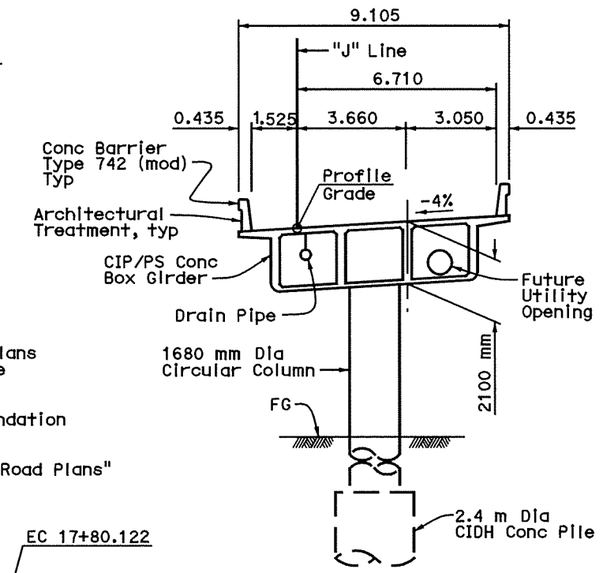
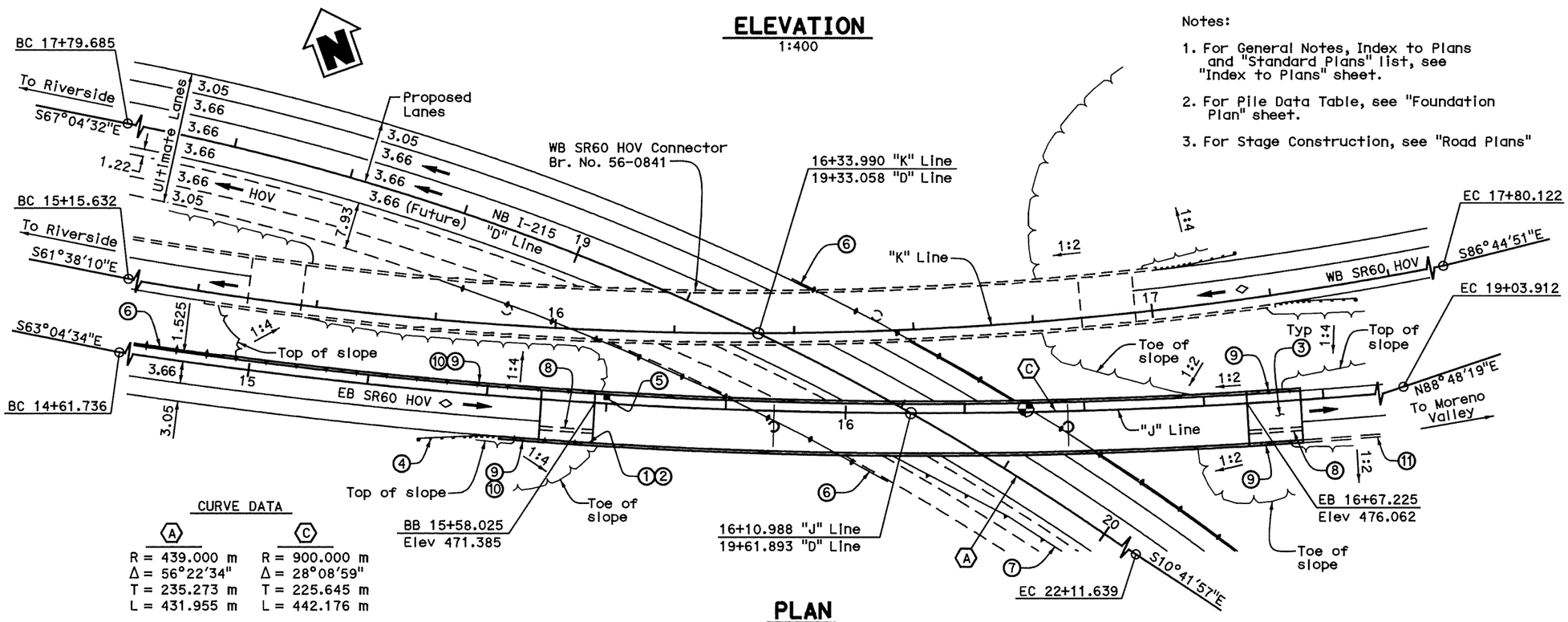


TYPICAL SECTION
1:100

Notes:

1. For General Notes, Index to Plans and "Standard Plans" list, see "Index to Plans" sheet.
2. For Pile Data Table, see "Foundation Plan" sheet.
3. For Stage Construction, see "Road Plans"



CURVE DATA

A	C
R = 439.000 m	R = 900.000 m
Δ = 56°22'34"	Δ = 28°08'59"
T = 235.273 m	T = 225.645 m
L = 431.955 m	L = 442.176 m

PLAN
1:400

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. KIM / K. GEE	CHECKED T. DUDLEY/A. SIVATHASAN	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: HL-93 W/ "LOW-BOY" AND PERMIT DESIGN VEHICLE	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	MOHAN S. CHAR PROJECT ENGINEER
	DETAILS	BY R. ANDRASEK	CHECKED R. PRICE / M. CHAR	LAYOUT	BY R. ANDRASEK CHECKED M. CHAR		
SIGN OFF DATE	QUANTITIES	BY K. GEE	CHECKED D. SARETSKY	SPECIFICATIONS	BY M. CHAR PLANS AND SPECS COMPARED M. CHAR		

BRIDGE NO. 56-0842 — KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
GENERAL PLAN

DESIGN GENERAL PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/06 7/27/06 11/7/06 12/18/06 5/15/09

SHEET 1 OF 31

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

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PILE DATA TABLE

LOCATION	PILE TYPE	DESIGN LOADING	NOMINAL RESISTANCE		DESIGN TIP ELEVATION (m)	SPECIFIED TIP ELEVATION (m)
			COMPRESSION	TENSION		
ABUT 1	600 mm CIDH	900 kN	1800 kN	0 kN	451.330 (1) 456.210 (2)	451.330
RW No. 1	400 mm CIDH	400 kN	800 kN	0 kN	455.030 (1)	455.030
RW No. 2	400 mm CIDH	400 kN	800 kN	0 kN	455.970 (1)	455.970
BENT 2	2.4 m CIDH	—	23 800 kN	0 kN	442.140 (1) 442.750 (2)	442.140
BENT 3	2.4 m CIDH	—	23 800 kN	0 kN	444.680 (1) 445.290 (2)	444.680
ABUT 4	600 mm CIDH	900 kN	1800 kN	0 kN	456.370 (1) 461.250 (2)	456.370
RW No. 3	400 mm CIDH	400 kN	800 kN	0 kN	462.160 (1)	462.160
RW No. 4	400 mm CIDH	400 kN	800 kN	0 kN	463.340 (1)	463.340
RW No. 4	600 mm CIDH	900 kN	1800 kN	0 kN	458.320 (1)	458.320

Notes: Design tip elevation is controlled by the following demands:
1. (1) Compression; (2) Lateral Loads.
2. Proposed piles spaced at minimum of 3 pile diameters (center to center).
3. The CIDH specified tip elevation shall not be raised.

BENCHMARKS

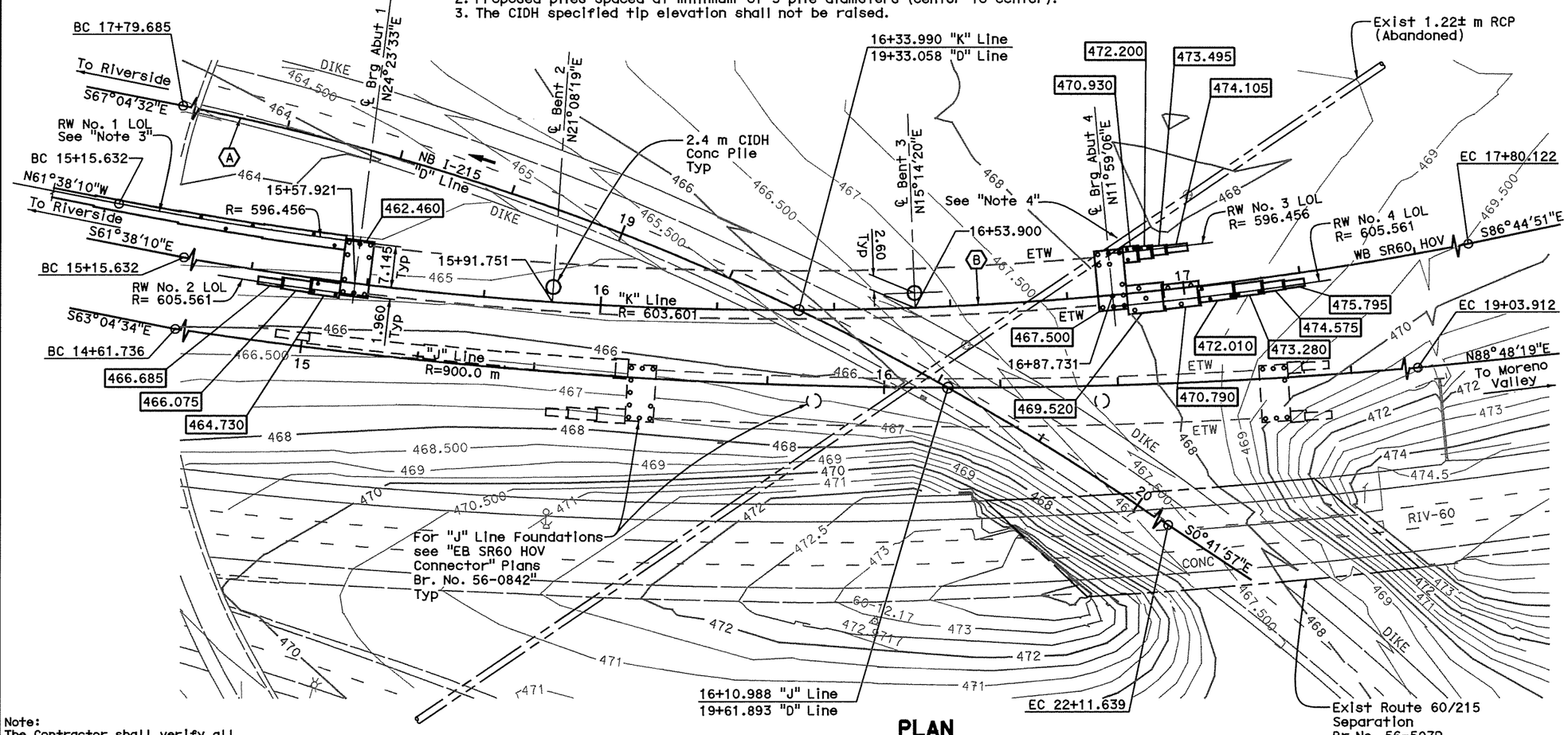
PT #865 Elevation 460.668 m

Found 25 mm iron pipe with Caltrans RP plug
North side of Box Springs Road.
N = 698034.479
E = 1903003.479

PT #3030 Elevation 472.840 m

Found 50 mm iron pipe with Brass Cap Stamped
"Dept of Trans RIV 60-12.7 1990"
34.14 m Southwesterly of bridge.
N = 697603.049
E = 1903554.738

Vertical Datum: NGVD-1929
Horizontal Datum: NAD-83, Zone 3(EPOCH 1984.0)



PLAN
1:400

CURVE DATA

Ⓐ	Ⓑ
R = 439.000 m	R = 603.601 m
Δ = 56°22'34"	Δ = 25°06'23"
T = 235.273 m	T = 134.402 m
L = 431.955 m	L = 264.490 m

LEGEND

Indicates bottom of footing elevation

400 mm or 600 mm CIDH Conc Pile

Indicates existing structure

Notes:

1. All ℄ Bents are radial to "K" Line.
2. Underground utility location as shown is approximate.
3. For Retaining Wall No. 1 layout & bottom of footing information, see Retaining Wall No.1 Layout 1 & 2 sheets.
4. Remove portion of RCP that conflicts with piles, and plug abandoned ends. For as-built RCP invert elevation, see "Abutment 4 layout" sheet.
5. For retaining wall footing pressure information, see General Notes on "Index to Plans" sheet.
6. Not all piles shown.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

GEOTECHNICAL PROFESSIONAL APPROVAL DATE 11/04/08

DESIGN OVERSIGHT ROBERT ZEZOFF	SCALE: AS SHOWN	VERT.DATUM NGVD-1929	HORZ.DATUM NAD-83, ZONE 3 (EPOCH 1984.0)	DESIGN BY D. KIM / D. SARETSKY	CHECKED T. DUDLEY/A. SIVATHASAN
	PHOTOGRAMMETRY AS OF:	ALIGNMENT TIES		DETAILS BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR
	SURVEYED BY J. TERRY	DRAFTED BY		QUANTITIES BY D. SARETSKY	CHECKED K. GEE
SIGN OFF DATE	FIELD CHECKED BY M. WILSON	CHECKED BY			

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

CU 08
EA 449311

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
FOUNDATION PLAN

FOUNDATION PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/21/08 11/4/08 2/14/09 5/15/09

SHEET 4 OF 32

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	19.4/21.5 61.7/62.6		

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

PILE DATA TABLE

LOCATION	PILE TYPE	DESIGN LOADING	NOMINAL RESISTANCE		DESIGN TIP ELEVATION (m)	SPECIFIED TIP ELEVATION (m)
			COMPRESSION	TENSION		
ABUT 1	600 mm CIDH	900 kN	1800 kN	0 kN	453.235 (1) 458.115 (2)	453.235
RW No. 1	400 mm CIDH	400 kN	800 kN	0 kN	456.750 (1)	456.750
RW No. 2	400 mm CIDH	400 kN	800 kN	0 kN	458.020 (1)	458.020
BENT 2	2.4 m CIDH	—	16 400 kN	0 kN	448.340 (1) 443.760 (2)	443.760
BENT 3	2.4 m CIDH	—	16 400 kN	0 kN	450.340 (1) 445.760 (2)	445.760
ABUT 4	600 mm CIDH	900 kN	1800 kN	0 kN	458.135 (1) 463.015 (2)	458.135
RW No. 3	400 mm CIDH	400 kN	800 kN	0 kN	462.880 (1)	462.880
RW No. 4	400 mm CIDH	400 kN	800 kN	0 kN	462.880 (1)	462.880

Notes: Design tip elevation is controlled by the following demands:
1. (1) Compression; (2) Lateral Loads.
2. Proposed piles spaced at minimum of 3 pile diameters (center to center).
3. The CIDH specified tip elevation shall not be raised.

BENCHMARKS

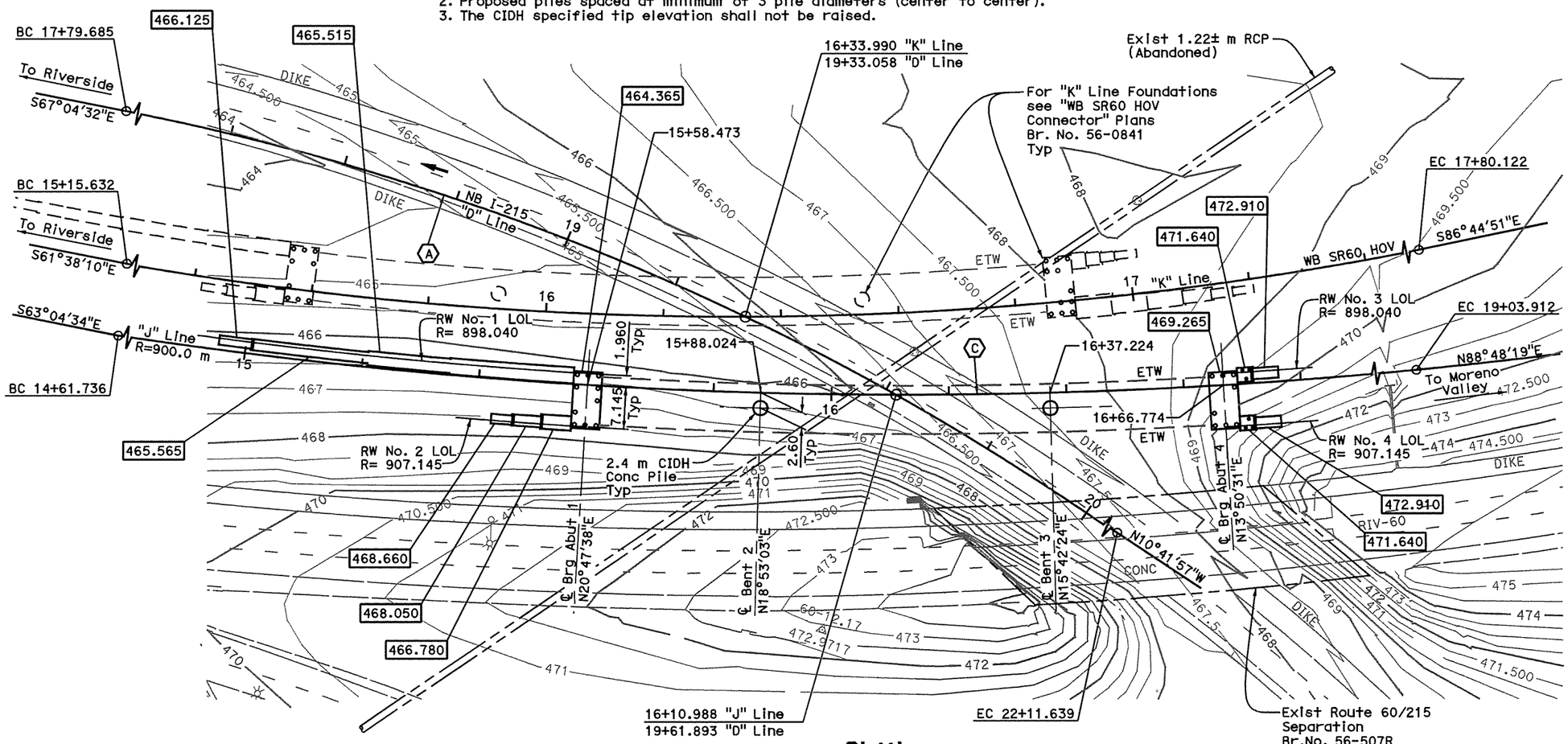
PT #865 Elevation 460.668 m

Found 25 mm iron pipe with Caltrans RP plug
North side of Box Springs Road.
N = 698034.479
E = 1903003.479

PT #3030 Elevation 472.840 m

Found 50 mm iron pipe with Brass Cap Stamped
"Dept of Trans RIV 60-12.7 1990"
34.14 m Southwesterly of bridge.
N = 697603.049
E = 1903554.738

Vertical Datum: NGVD-1929
Horizontal Datum: NAD-83, Zone 3(EPOCH 1984.0)



PLAN
1:400

CURVE DATA

(A)	(C)
R = 439.000 m	R = 900.000 m
Δ = 56°22'34"	Δ = 28°08'59"
T = 235.273 m	T = 225.645 m
L = 431.955 m	L = 442.176 m

LEGEND

Indicates bottom of footing elevation

400 mm or 600 mm CIDH Conc Pile

Indicates existing structure

Notes:

1. All ℄ Bents are radial to "J" Line.
2. Underground utility location as shown is approximate.
3. For retaining wall footing pressure information, see General Notes on "Index to Plans" sheet.
4. Not all piles shown.

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

GEOTECHNICAL PROFESSIONAL APPROVAL DATE 11/04/08

DESIGN OVERSIGHT ROBERT ZEZOFF	SCALE: AS SHOWN	VERT.DATUM NGVD-1929	HORZ.DATUM NAD-83, Zone 6 (EPOCH 1984.0)	DESIGN BY D. KIM / K. GEE	CHECKED T. DUDLEY/A. SIVATHASAN	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	MOHAN S. CHAR PROJECT ENGINEER
	PHOTOGRAMMETRY AS OF:	ALIGNMENT TIES		DETAILS BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR		
	SURVEYED BY J. TERRY	DRAFTED BY		QUANTITIES BY K. GEE	CHECKED K. GEE		
SIGN OFF DATE	FIELD CHECKED BY M. WILSON	CHECKED BY					

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
FOUNDATION PLAN

FOUNDATION PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/24/08 11/4/08 12/18/09 5/15/09

SHEET 4 OF 31

FILE -> U:\BRIDGE\RCTC0601-East J2\100% 56-0842 EB\56-0842-e-fdp01.dgn

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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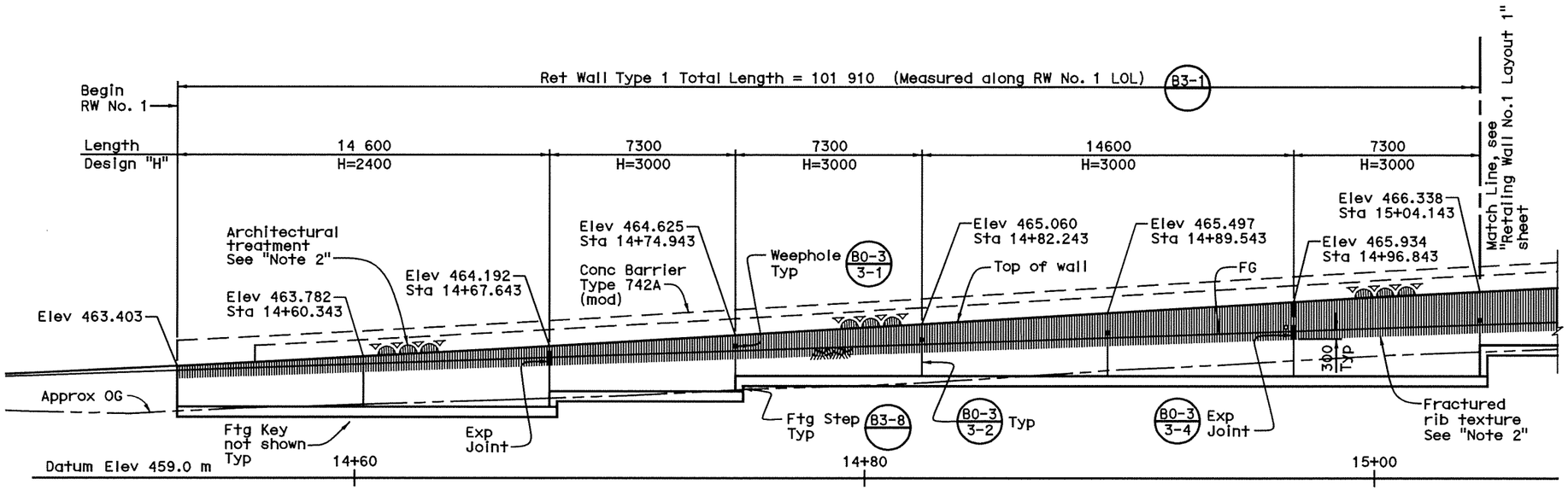
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



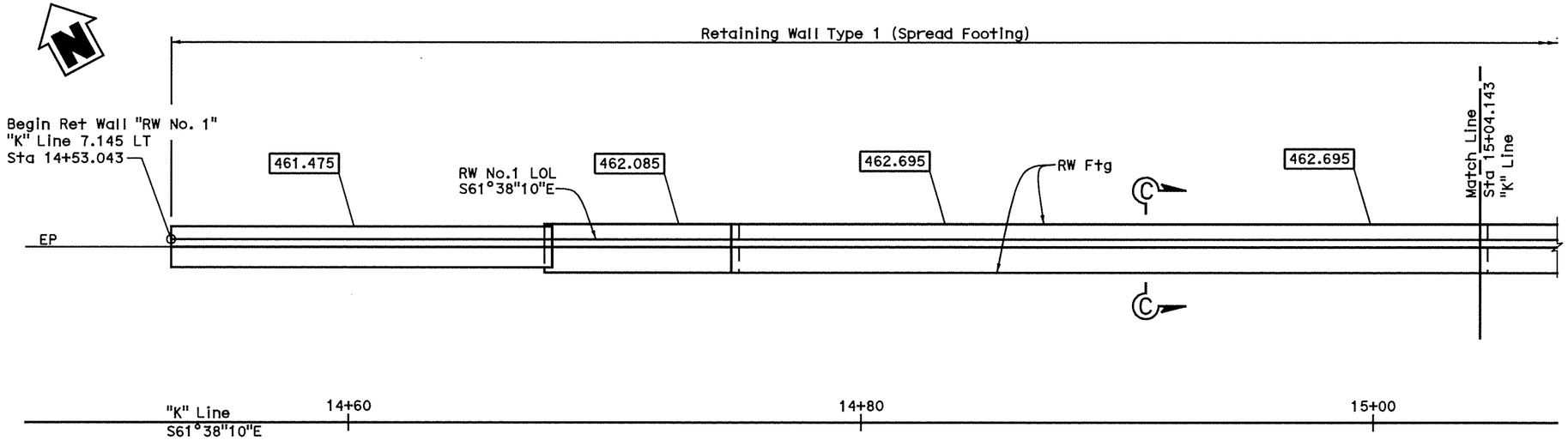
PART MIRROR ELEVATION
1:100

Notes:

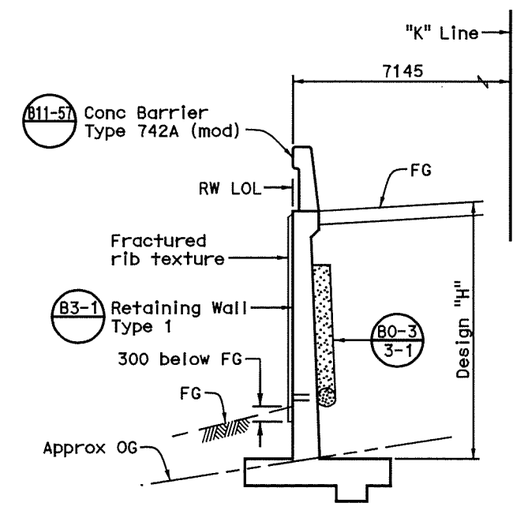
1. Top of wall elevations shown in meters.
2. For fractured rib texture & architectural treatment, see "Architectural Details" sheet.
3. For stem reinforcement only, see Modified Stem Reinforcement Detail on "Retaining Wall No. 2 Layout" sheet

LEGEND

Bottom of footing elevation (m)



PART PLAN
1:100



SECTION C-C
No Scale

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. SARETSKY/M. CHAR	CHECKED D. KIM
SIGN OFF DATE	DETAILS	BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR
	QUANTITIES	BY D. SARETSKY	CHECKED K. GEE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
RETAINING WALL NO. 1 LAYOUT 1

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/06)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/17/08 12/10/08 6/15/09

SHEET 10 OF 32

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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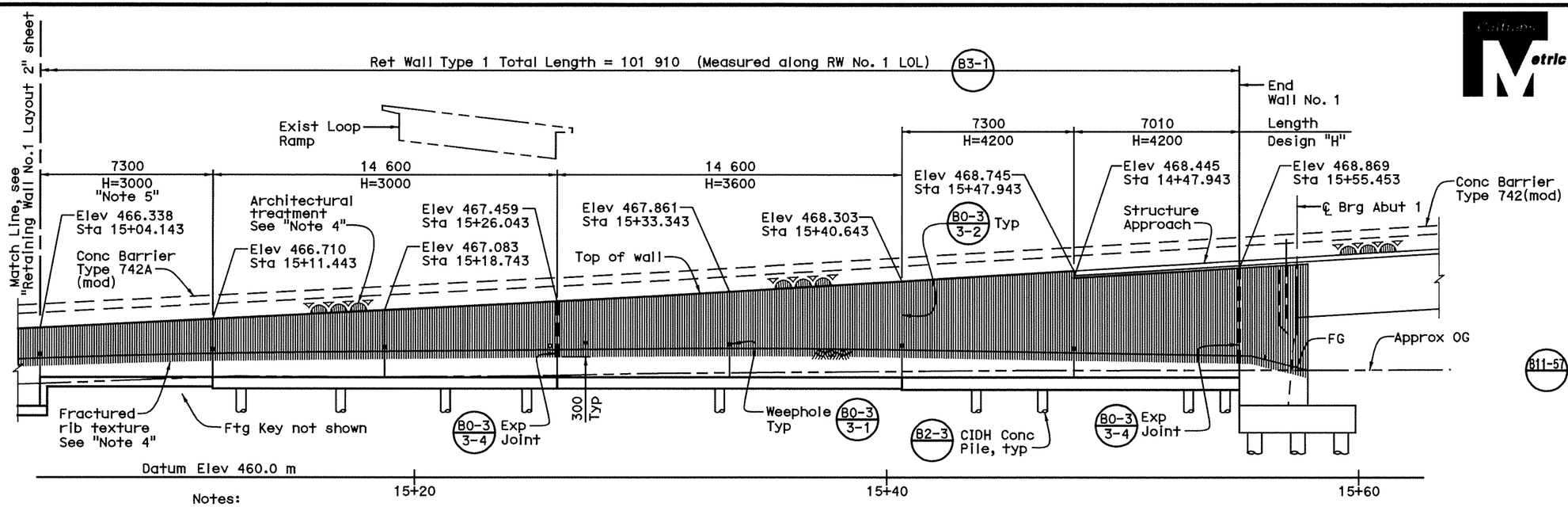
REGISTERED PROFESSIONAL ENGINEER — MOHAN S. CHAR — No. 57894 — Exp. 6/30/10 — CIVIL — STATE OF CALIFORNIA

RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



Notes:

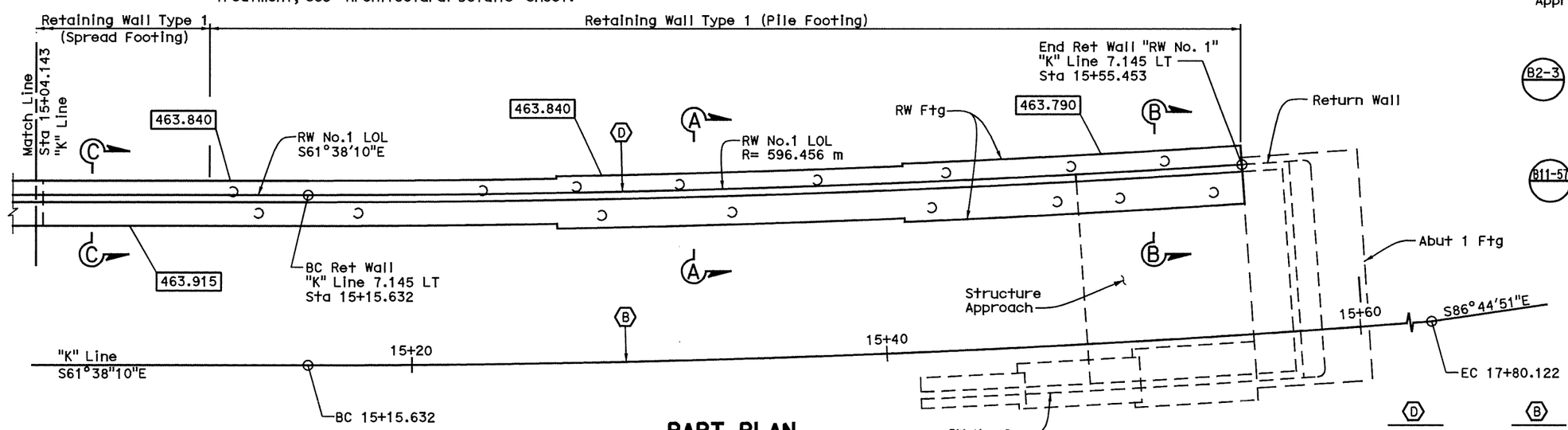
1. For pile layout, see "Retaining Wall No. 1 Pile Layout 1" sheet.
2. Top of wall elevations shown in meters.
3. For "Section C-C", see "Retaining Wall No. 1 Layout 1" sheet.
4. For fractured rib texture & architectural treatment, see "Architectural Details" sheet.
5. For stem reinforcement only, see Modified Stem Reinforcement Detail on "Retaining Wall No. 2 Layout" sheet

PART MIRROR ELEVATION
1:100

Note: Not all piles shown.

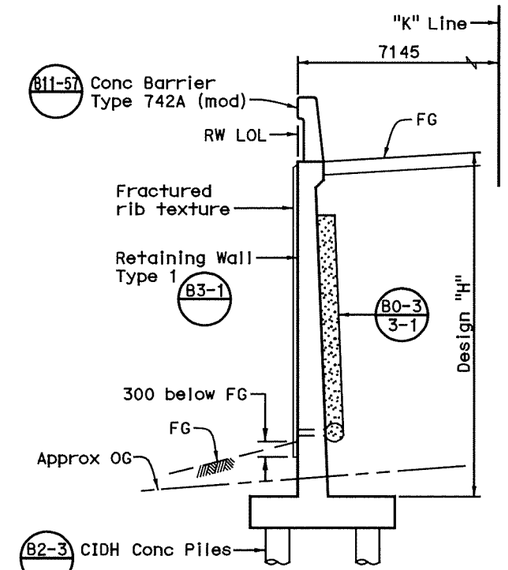
LEGEND

Bottom of footing elevation (m)

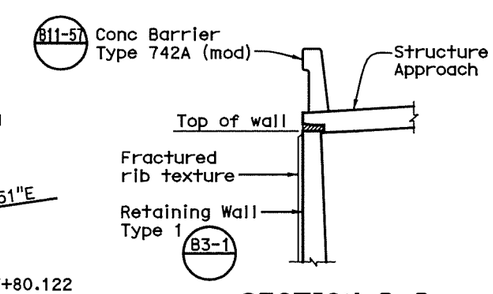


PART PLAN
1:100

Note: Not all piles shown.



SECTION A-A
No Scale



SECTION B-B
No Scale

For information not shown, see "Section A-A"

D	B
R = 596.456 m	R = 603.601 m
Δ = 3°46'57"	Δ = 23°06'23"
T = 19.695 m	T = 134.402 m
L = 29.376 m	L = 264.490 m

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF

SIGN OFF DATE

	BY	CHECKED
DESIGN	D. SARETSKY/M. CHAR	D. KIM
DETAILS	M. / R. ANDRASEK	R. PRICE / M. CHAR
QUANTITIES	D. SARETSKY	K. GEE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

CU 08
EA 449311

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
RETAINING WALL NO. 1 LAYOUT 2

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/21/08 2/18/09 6/15/09

SHEET 11 OF 32

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/06)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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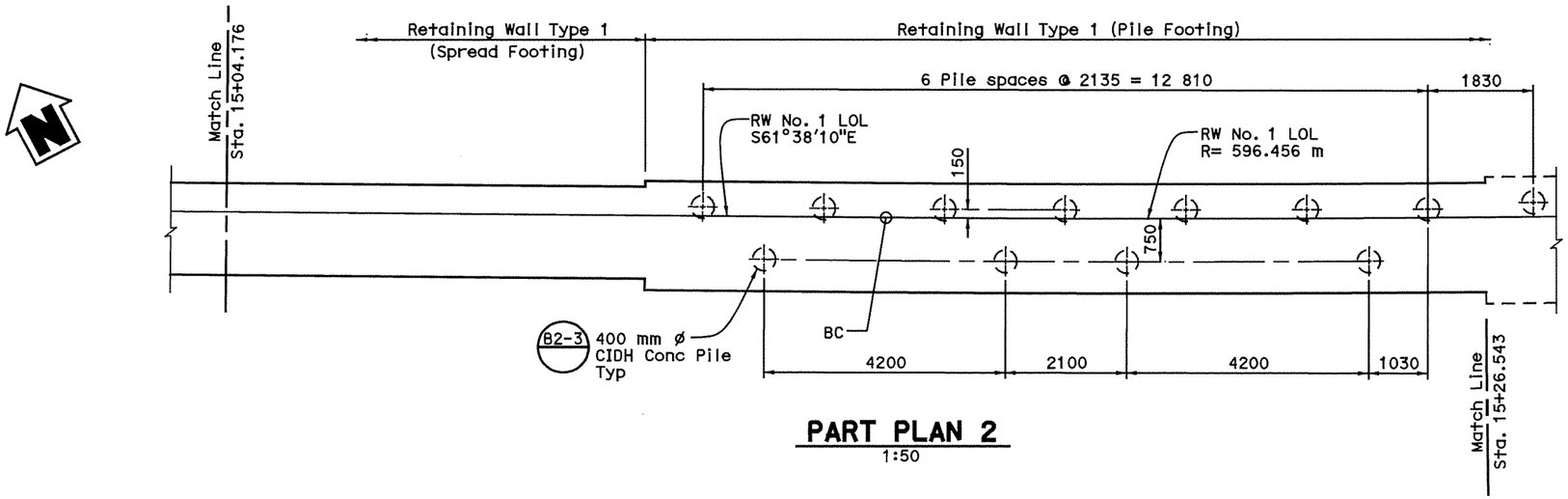
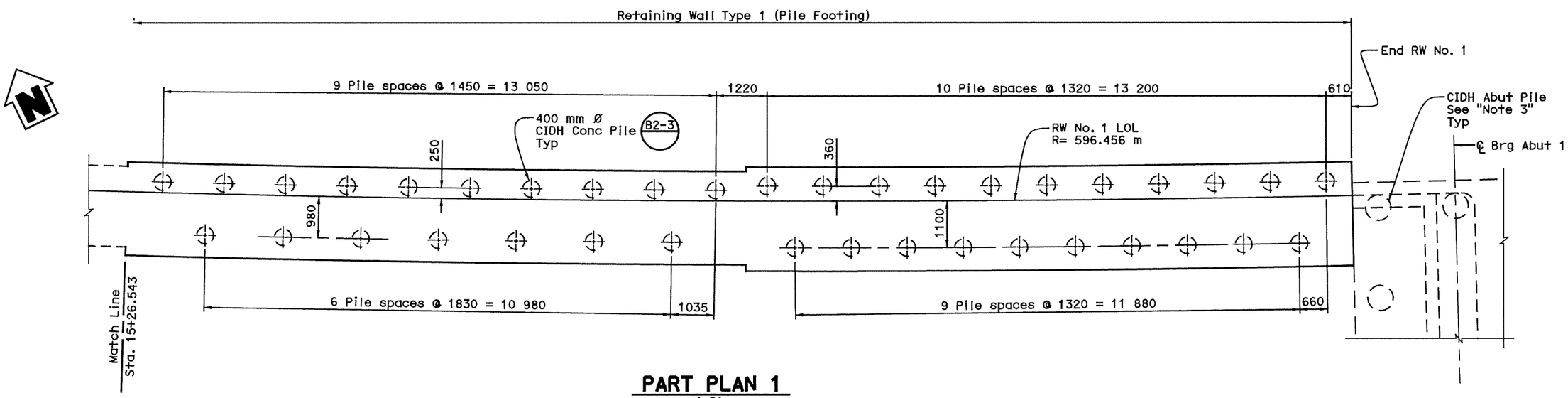
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



PART PLAN 2
1:50



PART PLAN 1
1:50

Notes:

1. All longitudinal pile dimensions are measured along RW LOL.
2. For "Pile Data Table", see "Foundation Plan" sheet.
3. For CIDH Pile Details, see "CIDH Pile Dteail" sheet

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. SARETSKY/M. CHAR	CHECKED D. KIM
SIGN OFF DATE	DETAILS	BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR
	QUANTITIES	BY D. SARETSKY	CHECKED K. GEE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
RETAINING WALL NO.1 PILE LAYOUT 1

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/27/08 12/16/08 6/15/09

SHEET 12 OF 32

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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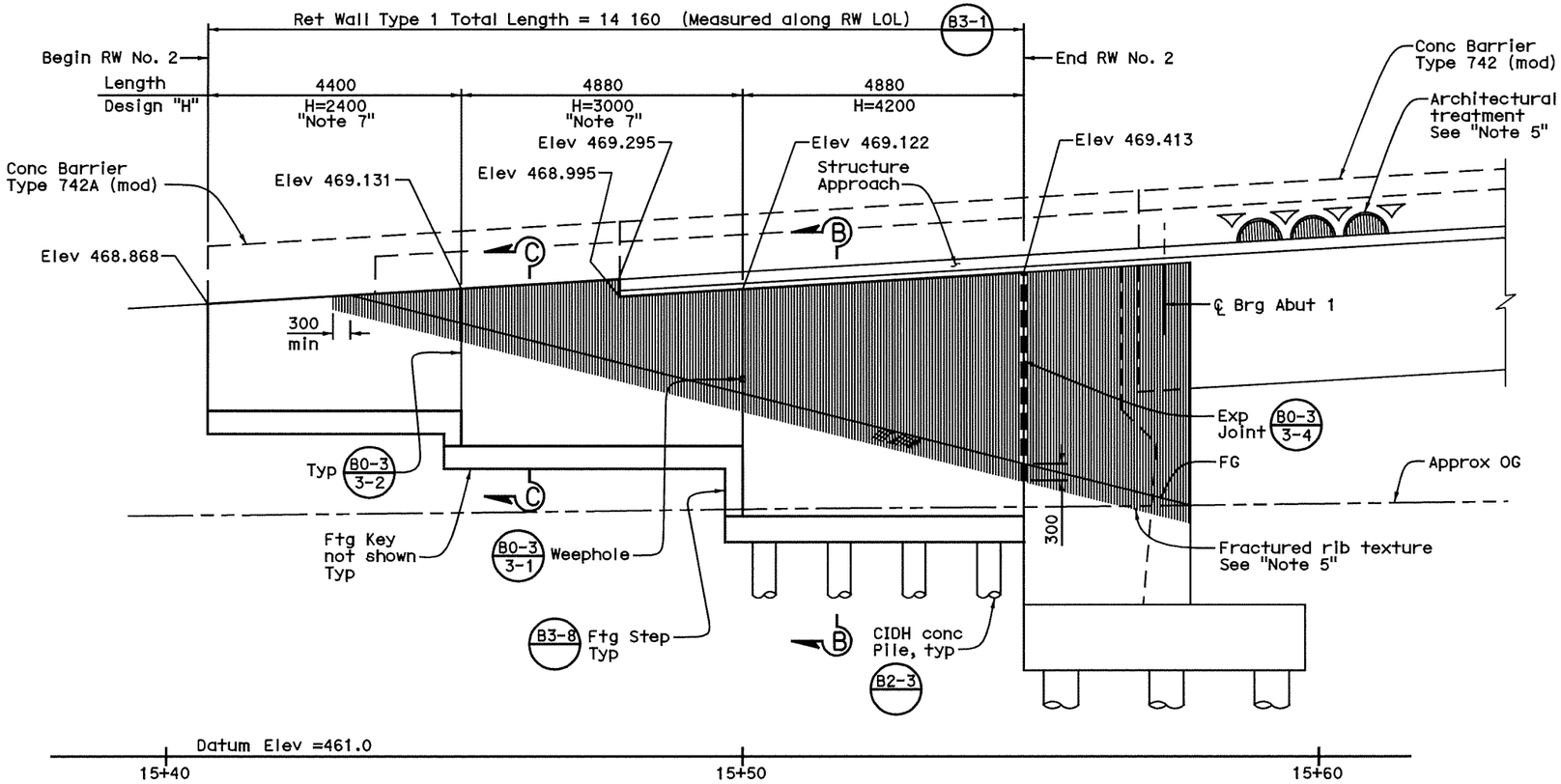
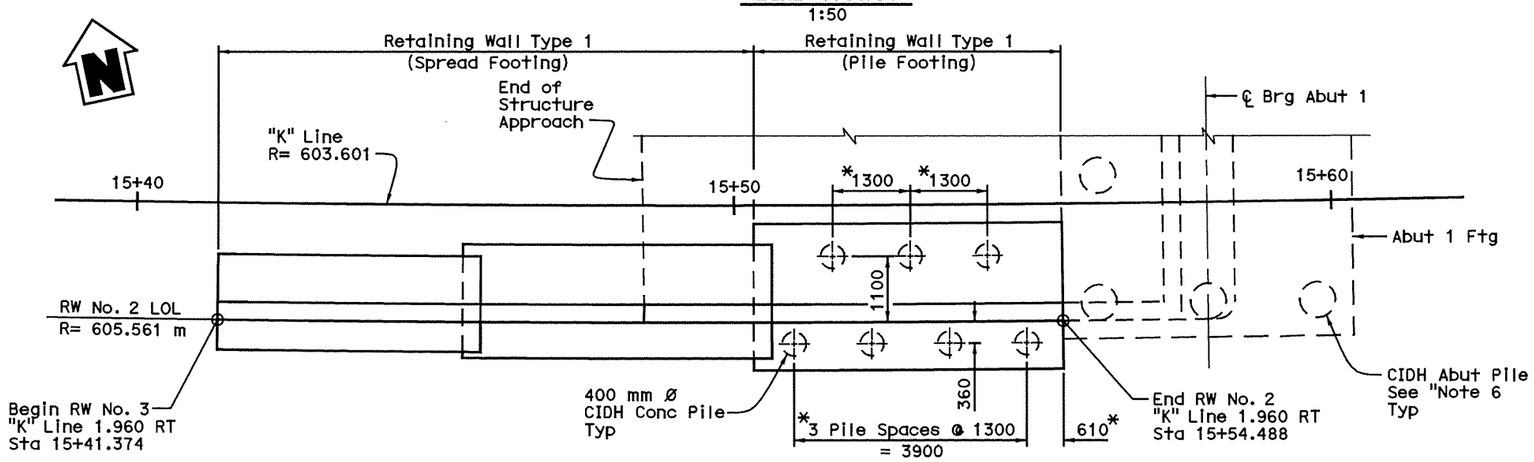
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



ELEVATION
1:50

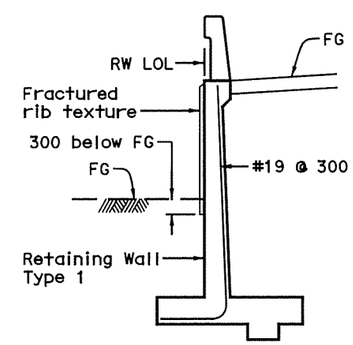


PLAN
1:50

* Measured along RW LOL

Notes:

1. For "Section B-B" see "Retaining Wall No. 1 Layout 2" sheet.
2. For "Section C-C" see "Retaining Wall No. 1 Layout 1" sheet.
3. Top of wall elevations shown in meters.
4. For Pile Data Table, see "Foundation Plan" sheet.
5. For fractured rib texture & architectural treatment, see "Architectural Details" sheet.
6. For CIDH Pile Detail, see "CIDH Pile Detail" sheet
7. For stem reinforcement only, see Modified Stem Reinforcment Detail.



MODIFIED STEM REINFORCEMENT
No Scale

Note: For reinforcement not shown, see B3-1

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. SARETSKY/M. CHAR	CHECKED D. KIM	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	MOHAN S. CHAR PROJECT ENGINEER
SIGN OFF DATE	DETAILS	BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR		
	QUANTITIES	BY D. SARETSKY	CHECKED K. GEE		

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
RETAINING WALL NO. 2 LAYOUT

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/17/08 12/18/08 6/15/09

SHEET 13 OF 32

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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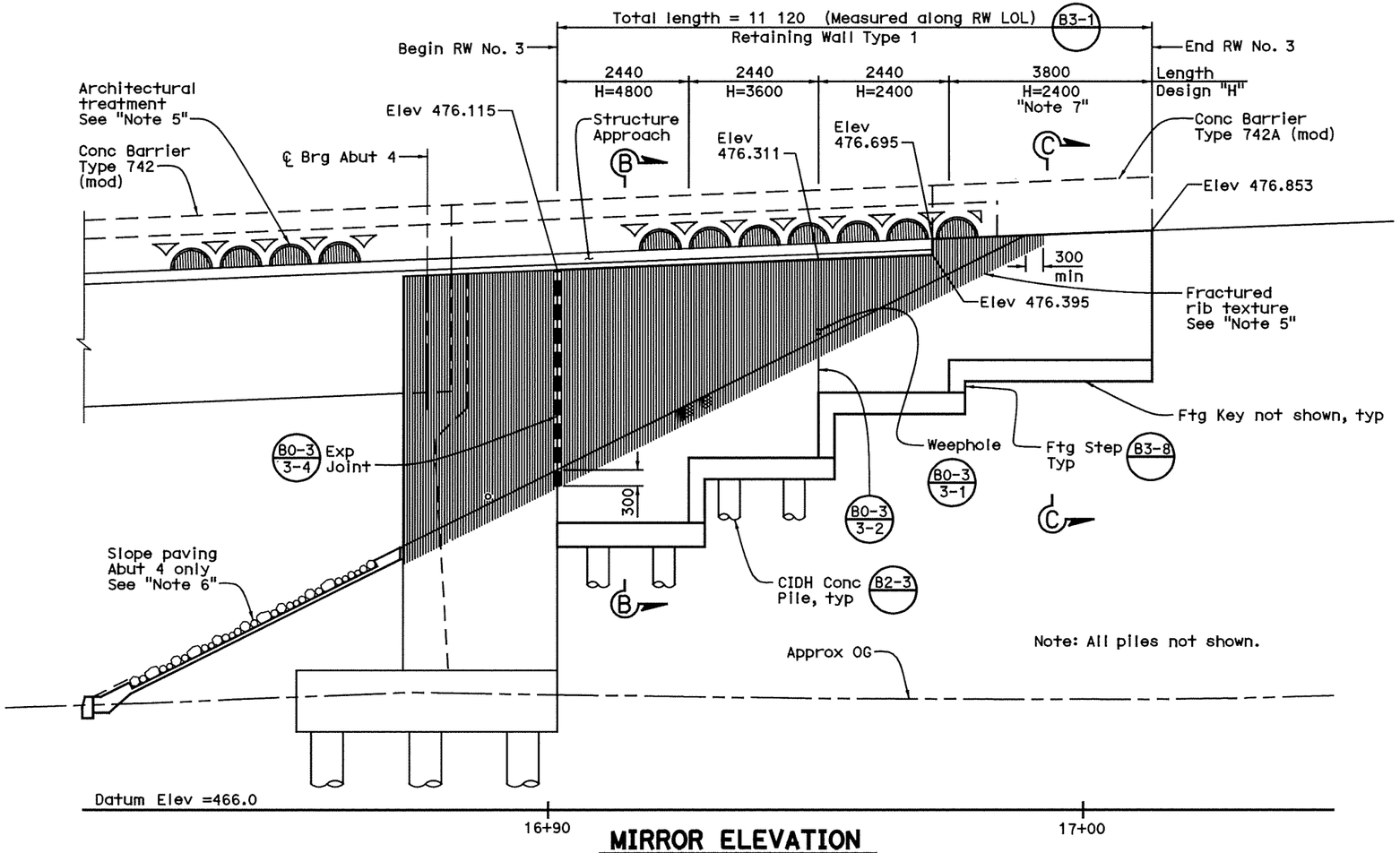
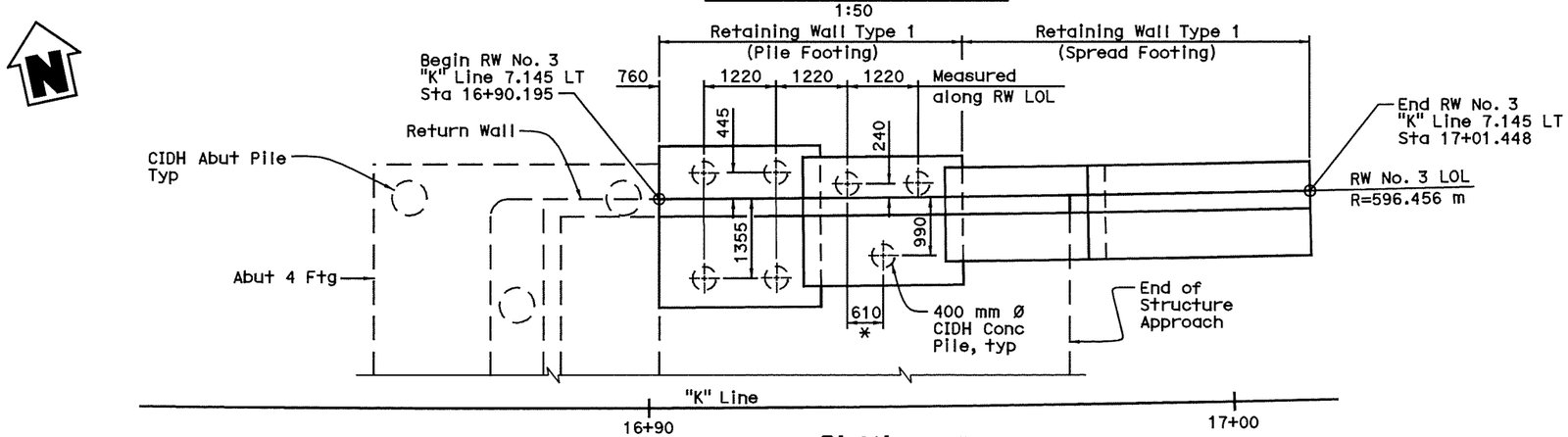
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



MIRROR ELEVATION
1:50



PLAN
1:50

*Measured along RW LOL

Notes:

1. For "Section B-B" see "Retaining Wall No. 1 Layout 2" sheet.
2. For "Section C-C" see "Retaining Wall No. 1 Layout 1" sheet.
3. Top of wall elevations shown in meters.
4. For pile cut-off elevation, see "Foundation Plan" sheet.
5. For fractured rib texture & architectural treatment, see "Architectural Details" sheet.
6. For slope paving, see "Slope Paving - Full Slope" and "Slope Paving - Architectural Treatment Details" sheets.
7. For stem reinforcement only, see Modified Stem Reinforcement Detail on "Retaining Wall No. 2 Layout" sheet

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. SARETSKY/M. CHAR	CHECKED D. KIM
SIGN OFF DATE	DETAILS	BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR
	QUANTITIES	BY D. SARETSKY	CHECKED K. GEE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
RETAINING WALL NO. 3 LAYOUT

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/06)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/21/08 12/18/08 6/15/09

SHEET 14 OF 32

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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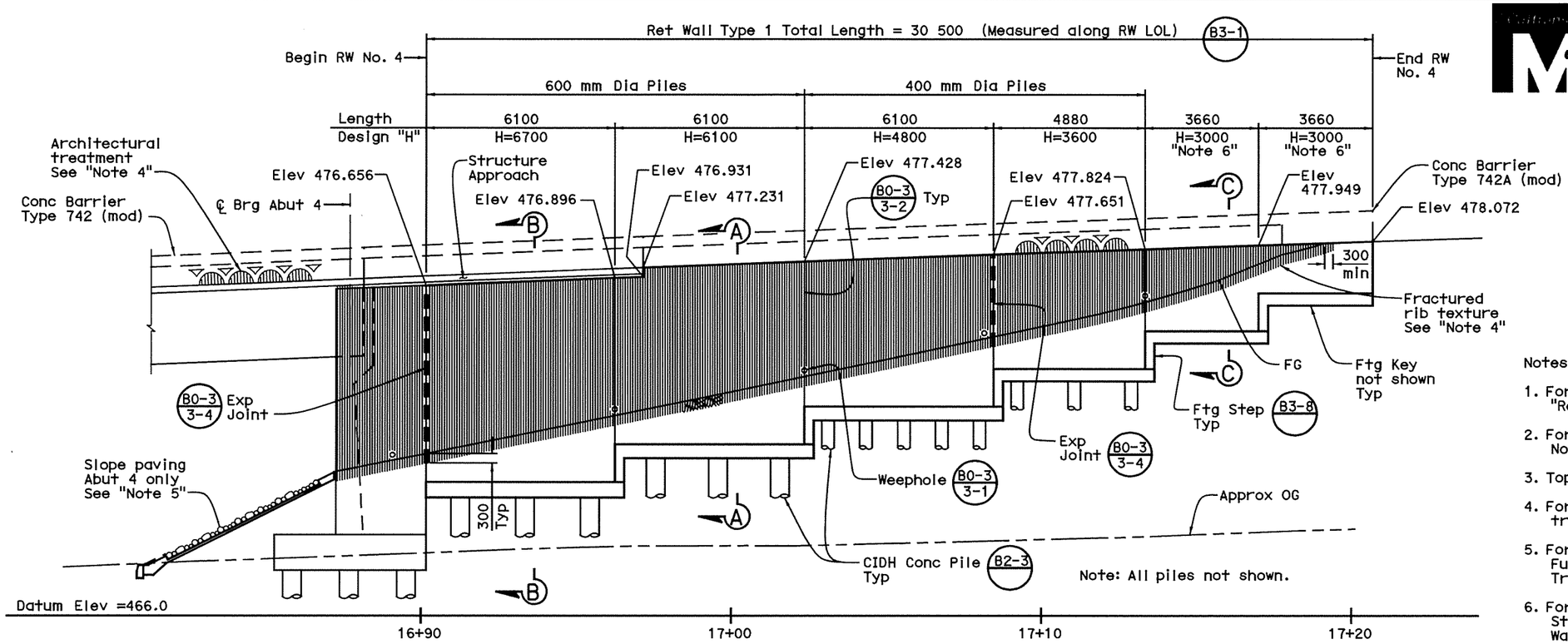
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

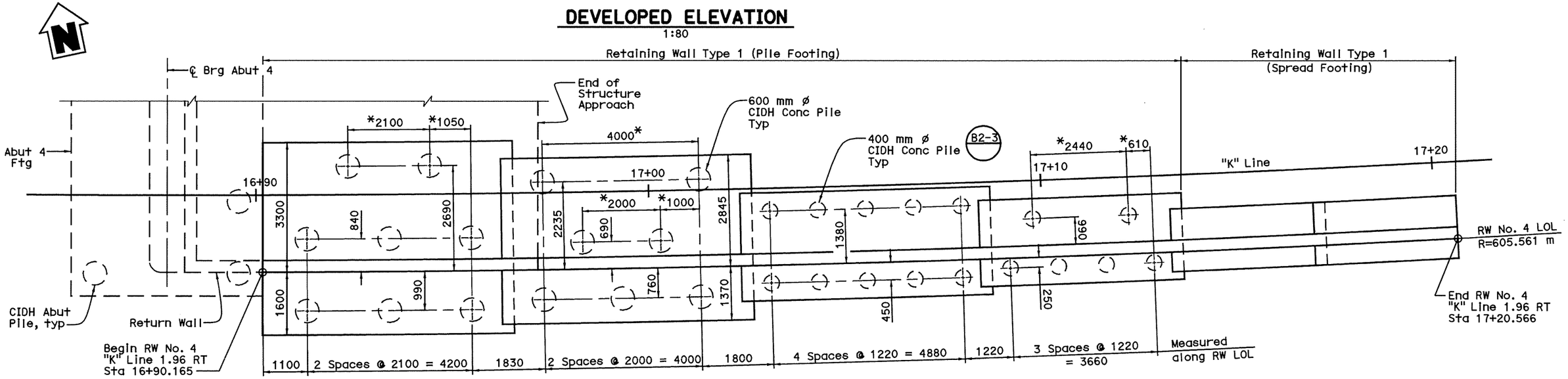
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



DEVELOPED ELEVATION
1:80

Notes:

1. For "Section A-A" & "Section B-B" see "Retaining Wall No. 1 Layout 2" sheet.
2. For "Section C-C" see "Retaining Wall No. 1 Layout 1" sheet.
3. Top of wall elevations shown in meters.
4. For fractured rib texture & architectural treatment, see "Architectural Details" sheet.
5. For slope paving, see "Slope Paving - Full Slope" and "Slope Paving - Architectural Treatment Details" sheets.
6. For stem reinforcement only, see Modified Stem Reinforcement Detail on "Retaining Wall No. 2 Layout" sheet



PLAN
1:50

*Measured along RW LOL

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. SARETSKY/M. CHAR	CHECKED D. KIM	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	MOHAN S. CHAR PROJECT ENGINEER
SIGN OFF DATE	DETAILS	BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR		
	QUANTITIES	BY D. SARETSKY	CHECKED K. GEE		

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
RETAINING WALL NO. 4 LAYOUT

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/21/08 12/18/08 6/15/09

SHEET 15 OF 32

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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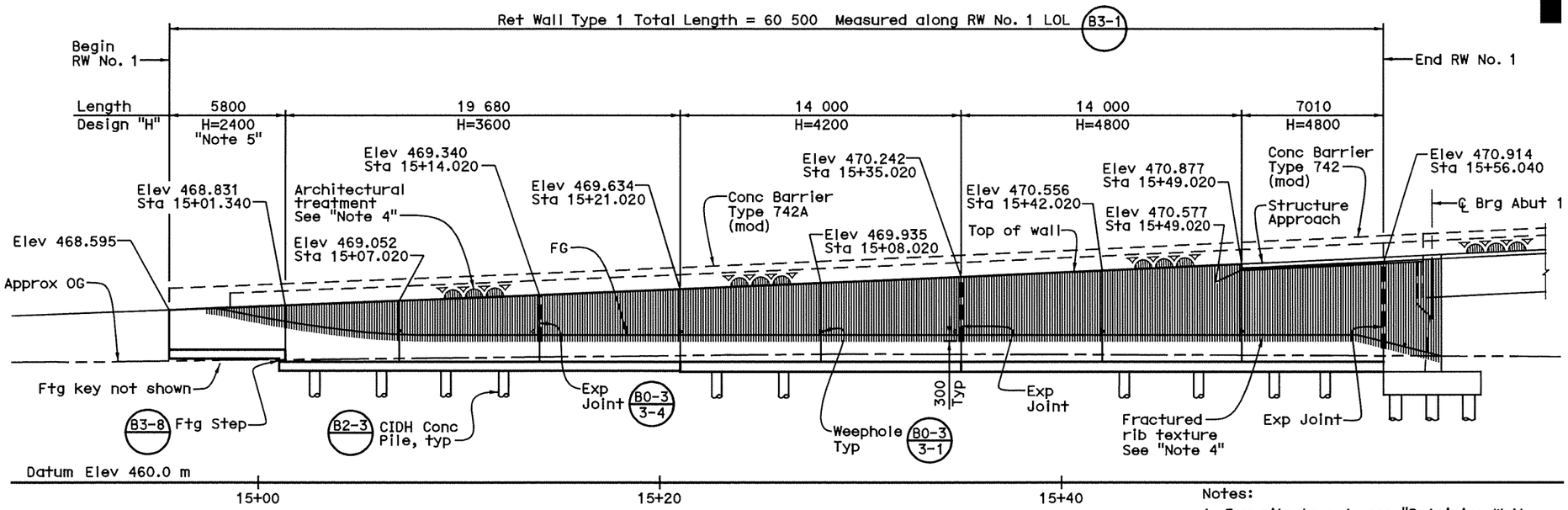
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



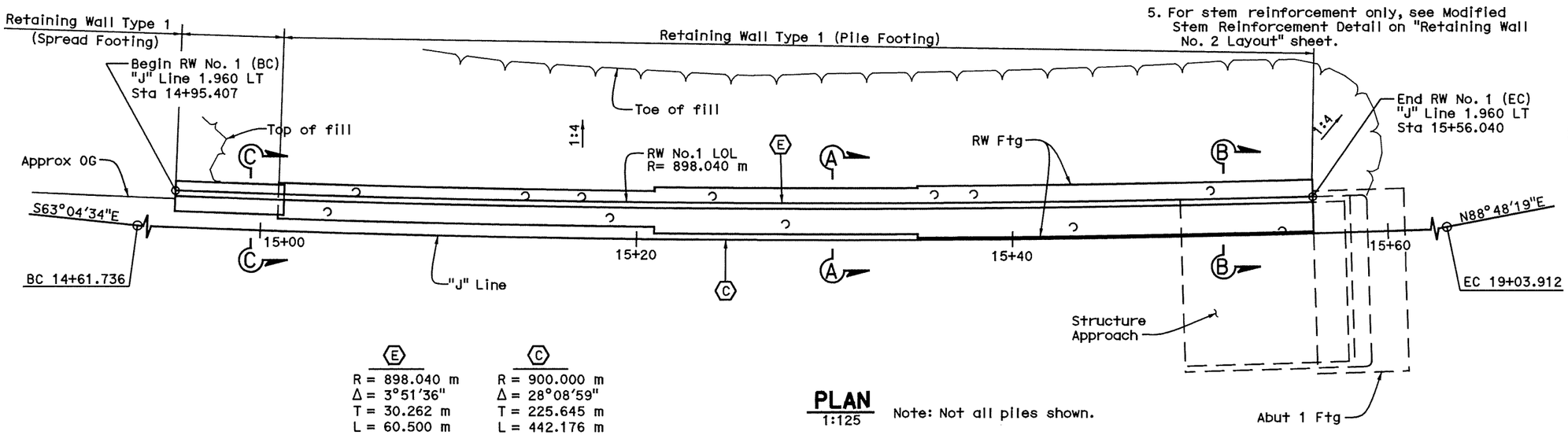
DEVELOPED MIRROR ELEVATION

1:125

Note: Not all piles shown.

Notes:

1. For pile layout, see "Retaining Wall No. 1 Pile Layout" sheet.
2. Top of wall elevations shown in meters.
3. For "Section C-C", see "Retaining Wall No. 2 Layout" sheet.
4. For fractured rib texture & architectural treatment, see "Architectural Details" sheet.
5. For stem reinforcement only, see Modified Stem Reinforcement Detail on "Retaining Wall No. 2 Layout" sheet.

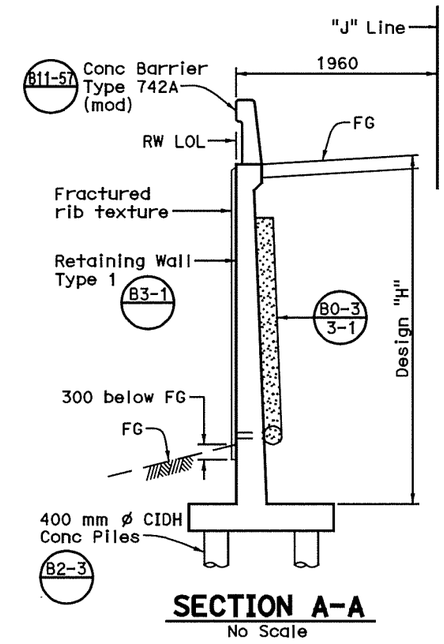


E	C
R = 898.040 m	R = 900.000 m
Δ = 3°51'36"	Δ = 28°08'59"
T = 30.262 m	T = 225.645 m
L = 60.500 m	L = 442.176 m

PLAN

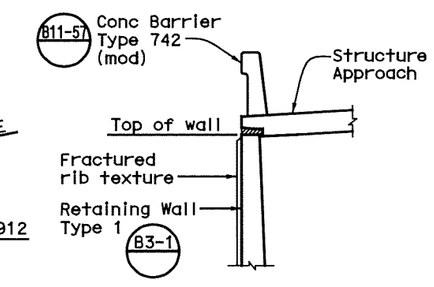
1:125

Note: Not all piles shown.



SECTION A-A

No Scale



SECTION B-B

No Scale

For information not shown, see "Section A-A" or "Section C-C".

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. SARETSKY/M. CHAR	CHECKED D. KIM
SIGN OFF DATE	DETAILS	BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR
	QUANTITIES	BY K. GEE	CHECKED D. SARETSKY

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
RETAINING WALL NO. 1 LAYOUT

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/21/08 2/18/09 5/15/09

SHEET 10 OF 31

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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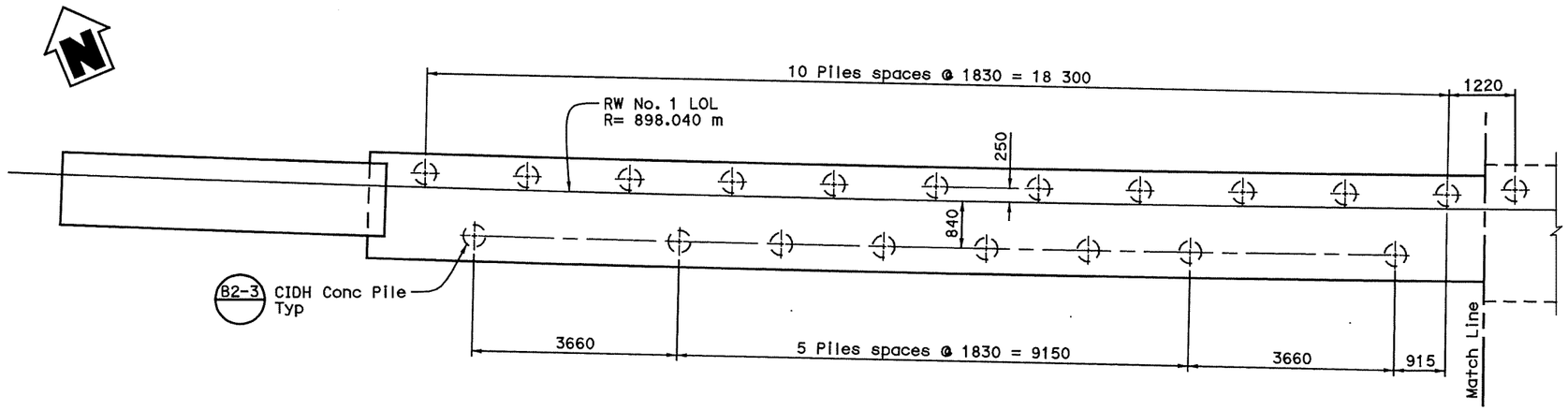
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

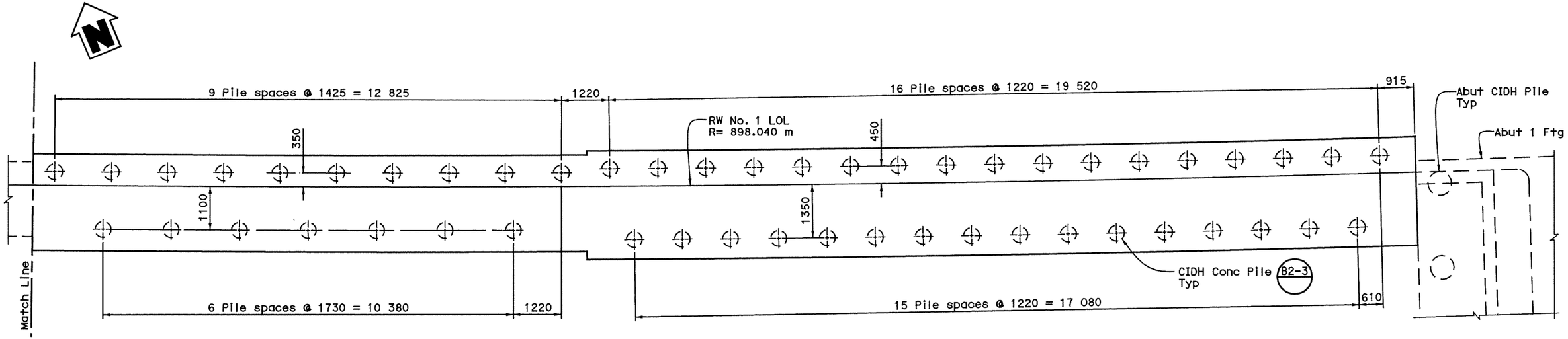
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



PART PLAN 1
1:50

Notes:

1. All longitudinal pile dimensions are measured along RW LOL.
2. For "Pile Data Table", see "Foundation Plan" sheet.



PART PLAN 2
1:50

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. SARETSKY/M. CHAR	CHECKED D. KIM
SIGN OFF DATE	DETAILS	BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR
	QUANTITIES	BY K. GEE	CHECKED D. SARETSKY

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
RETAINING WALL NO.1 PILE LAYOUT

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES → REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/21/08 2/18/09 5/18/09 6/15/09

SHEET 11 OF 31

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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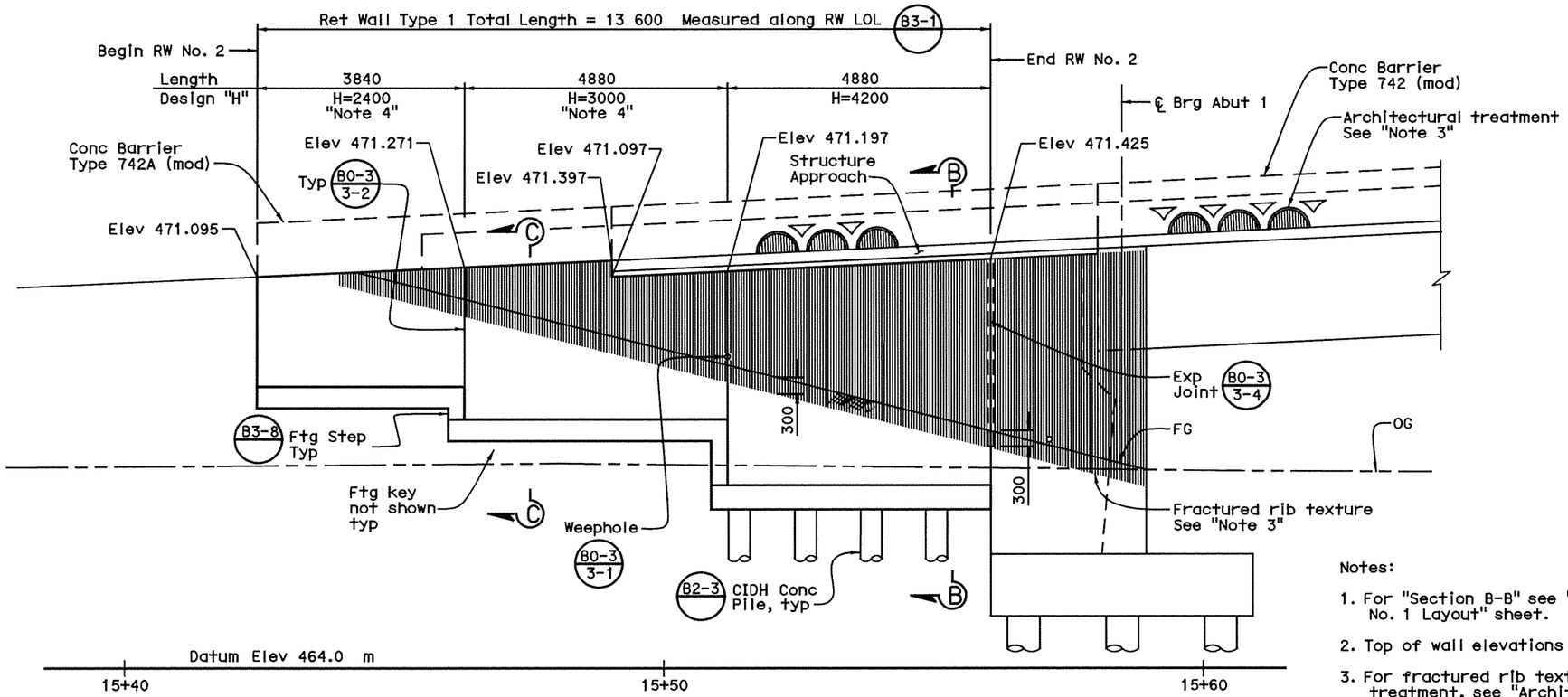
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

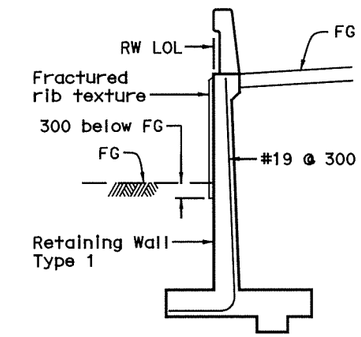
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



ELEVATION
1:50

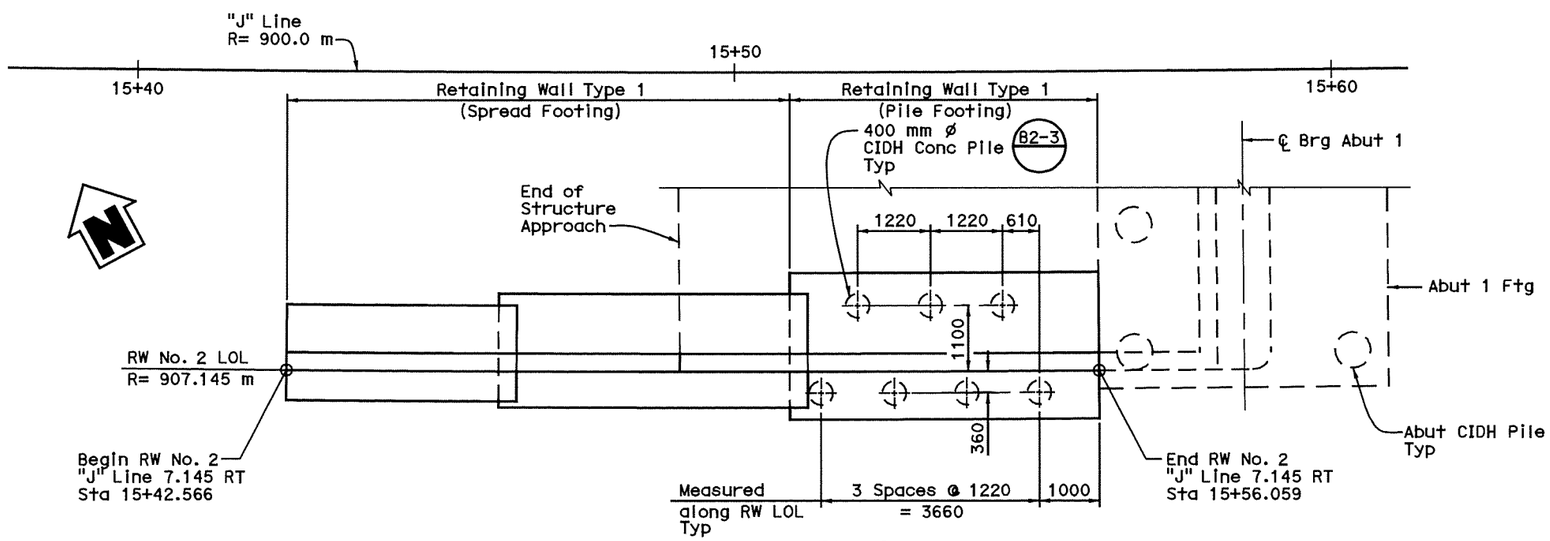
Notes:

1. For "Section B-B" see "Retaining Wall No. 1 Layout" sheet.
2. Top of wall elevations shown in meters.
3. For fractured rib texture & architectural treatment, see "Architectural Details" sheet.
4. For stem reinforcement only, see Modified Stem Reinforcement Detail.

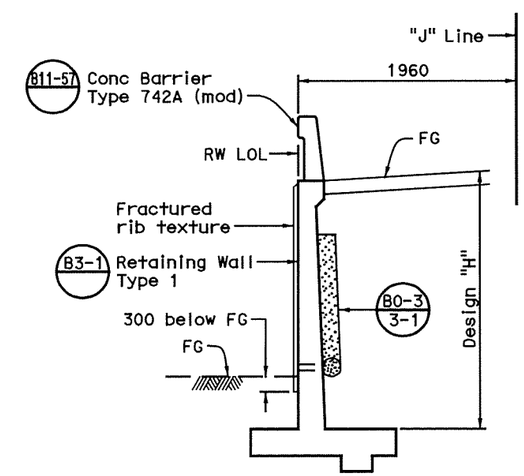


MODIFIED STEM REINFORCEMENT
No Scale

Note: For reinforcement not shown, see B3-1



PLAN
1:50



SECTION C-C
No Scale

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. SARETSKY/M. CHAR	CHECKED D. KIM
SIGN OFF DATE	DETAILS	BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR
	QUANTITIES	BY K. GEE	CHECKED D. SARETSKY

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
RETAINING WALL NO. 2 LAYOUT

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/06)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/21/08 12/09/08 5/18/09 6/15/09

SHEET 12 OF 31

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER MOHAN S. CHAR No. 57894 Exp. 6/30/10 CIVIL STATE OF CALIFORNIA

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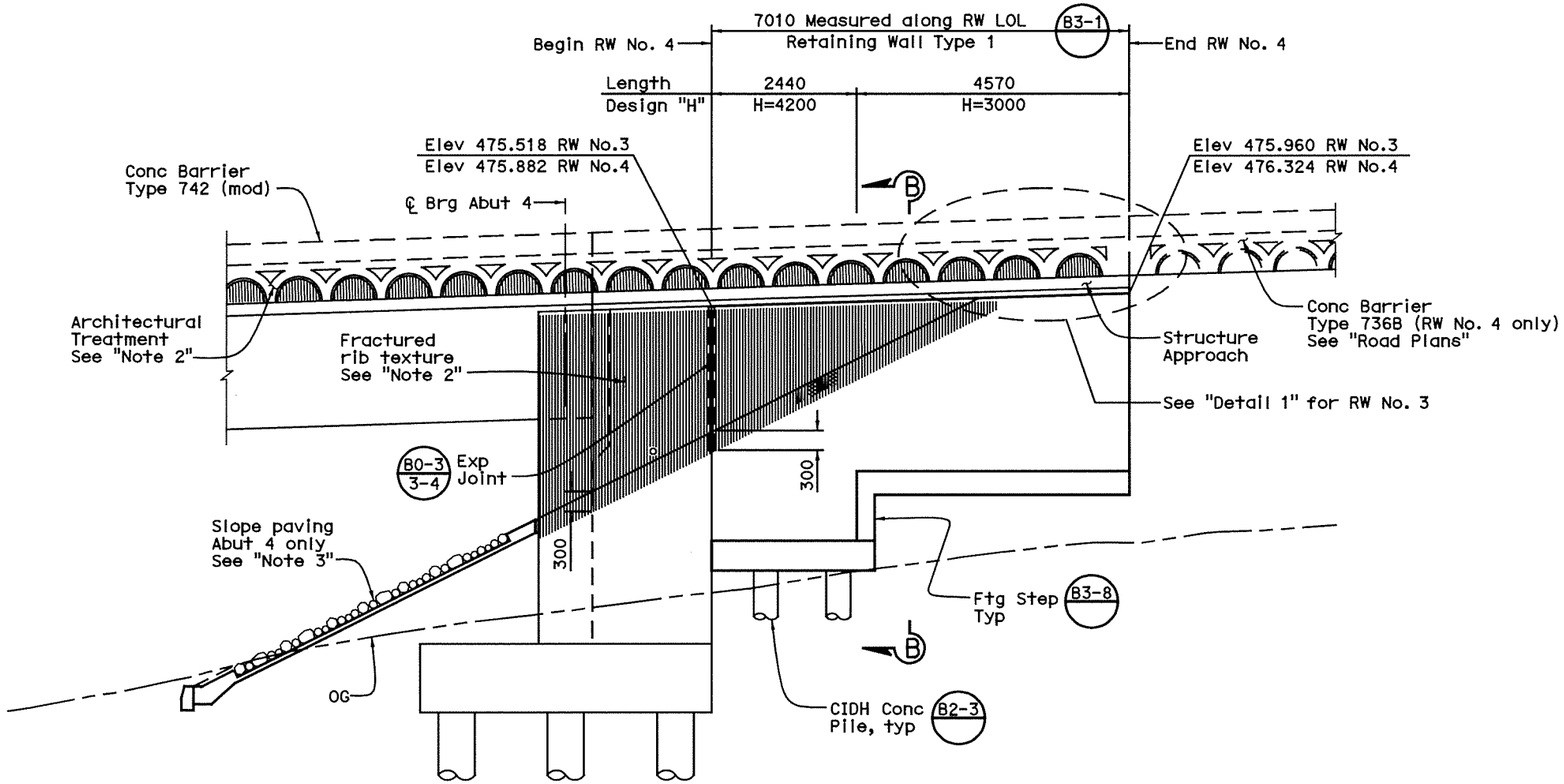
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

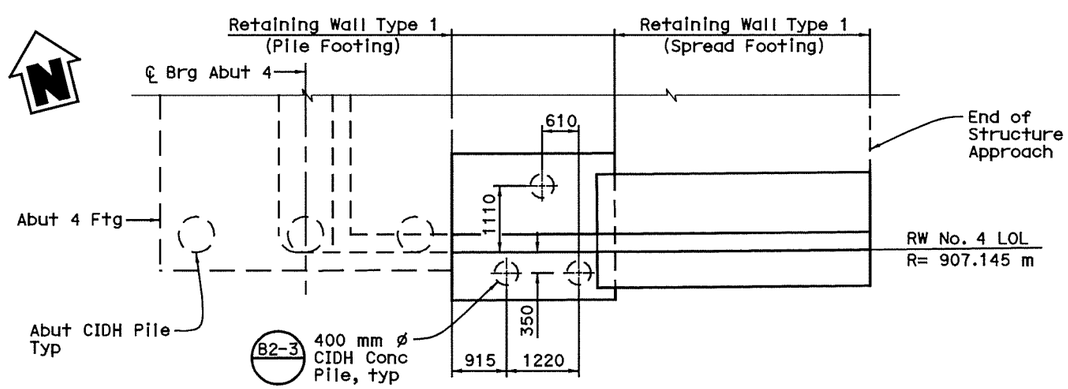
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



ELEVATION

1:50

Retaining Wall No. 4 shown,
Retaining Wall No. 3 similar



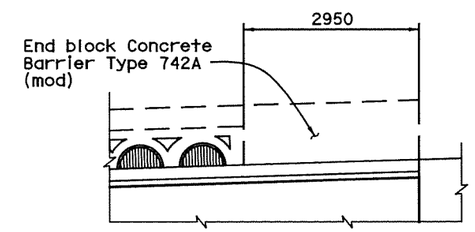
PLAN

1:50

Retaining Wall No. 4 shown,
Retaining Wall No. 3 similar

Notes:

1. For "Section B-B", see "Retaining Wall No. 1 Layout" sheet.
2. For fractured rib texture & architectural treatment, see "Architectural Details" sheet.
3. For slope paving, see "Slope Paving - Architectural Treatment Details" sheet.



DETAIL 1 - LIMITS OF BARRIER ARCHITECTURAL TREATMENT

1:50

Retaining Wall No. 3 shown

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	ROBERT ZEZOFF		
SIGN OFF DATE			
DESIGN	BY D. SARETSKY/M. CHAR	CHECKED D. KIM	
DETAILS	BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR	
QUANTITIES	BY K. GEE	CHECKED D. SARETSKY	

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

RETAINING WALL NO. 3 & 4 LAYOUT

DESIGN DETAIL SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/04 7/27/04 2/18/09 5/18/09 6/15/09

SHEET 13 OF 31

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

PLANS APPROVALDATE

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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 (25.4 mm soil tube) Hand Auger
	D	Dynamic Cone Penetration Boring
	CPT	Cone Penetration Test (ASTM D 5778-95)
	O	Other

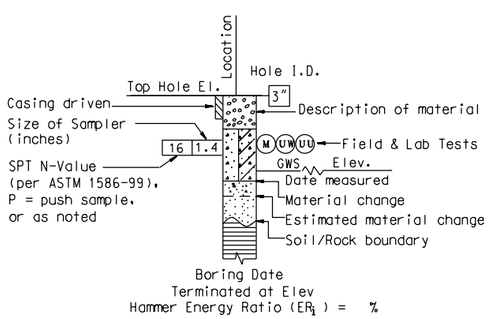
Note: Size in millimeters.

CONSISTENCY OF COHESIVE SOILS

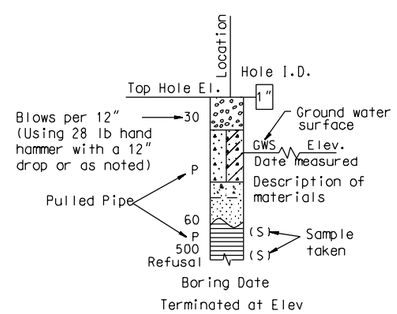
Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

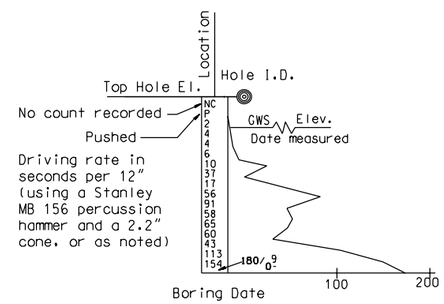
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



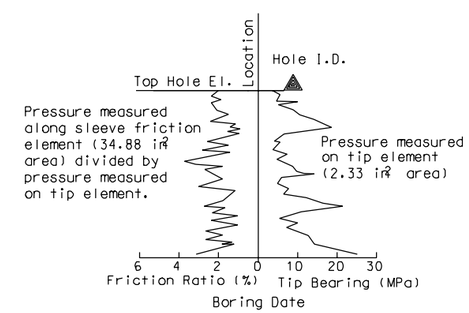
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY	C. AMANTE	C. AMANTE PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311
FILE -) $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 26 OF 31

USERNAME -)$USER DATE PLOTTED -)$DATE TIME PLOTTED -)$TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 27 OF 31

USERNAME -$USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

PLANS APPROVALDATE

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

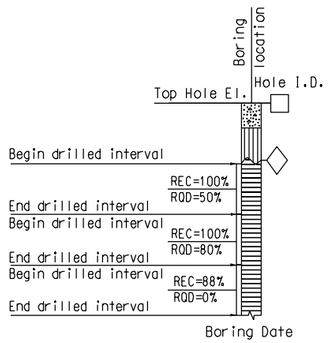
KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick: can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 28 OF 31

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V. Amante

CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVALDATE

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4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

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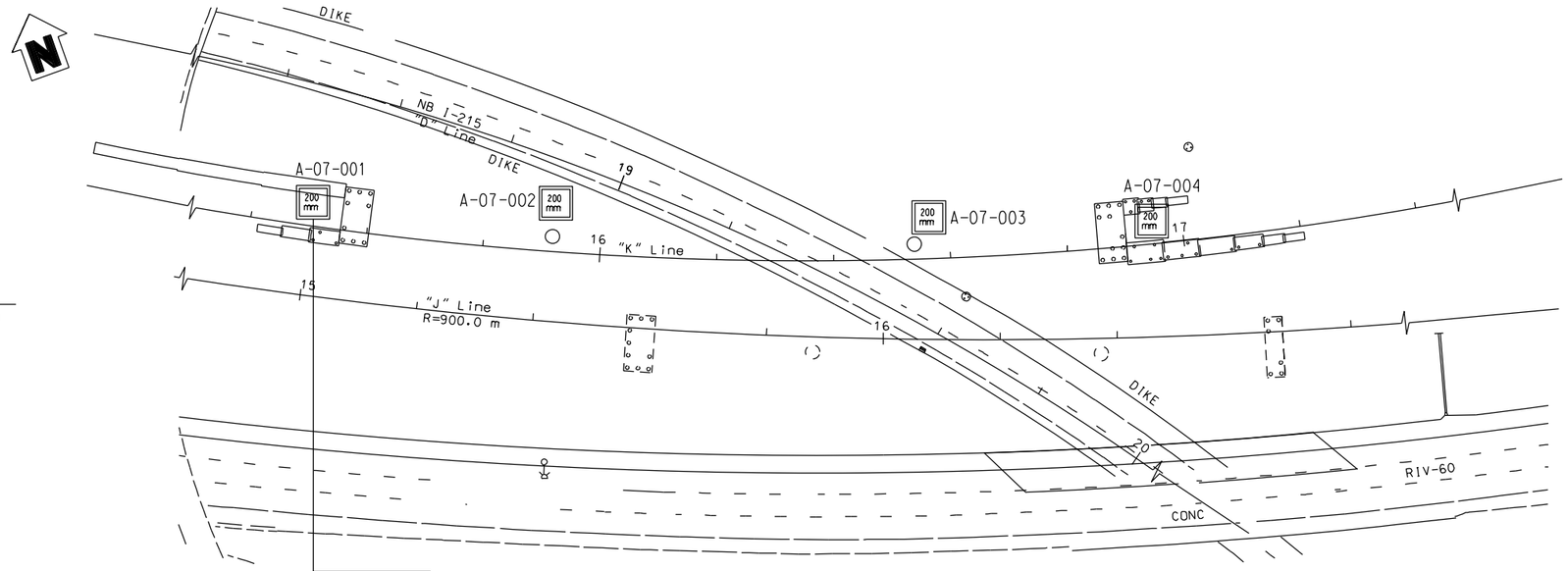
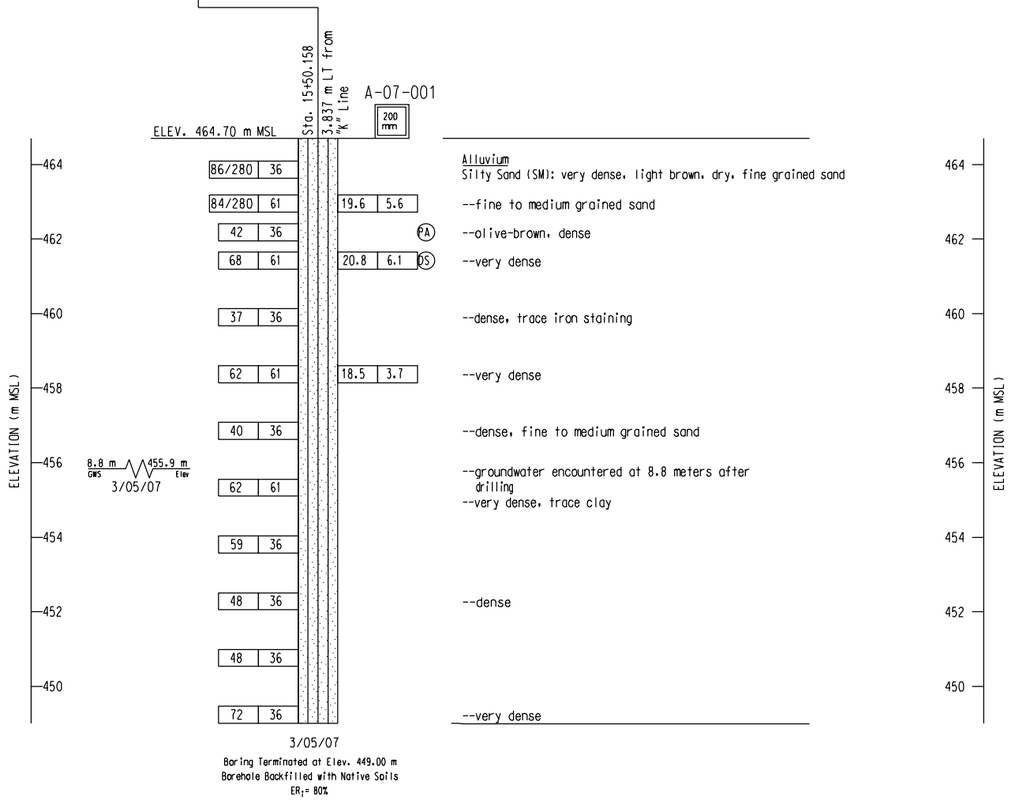
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500





PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 1 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 3/12/08 7/21/08 11/4/08 2/13/09 5/20/09

SHEET 29 OF 31

FILE => $REQUEST

USERNAME =>$USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

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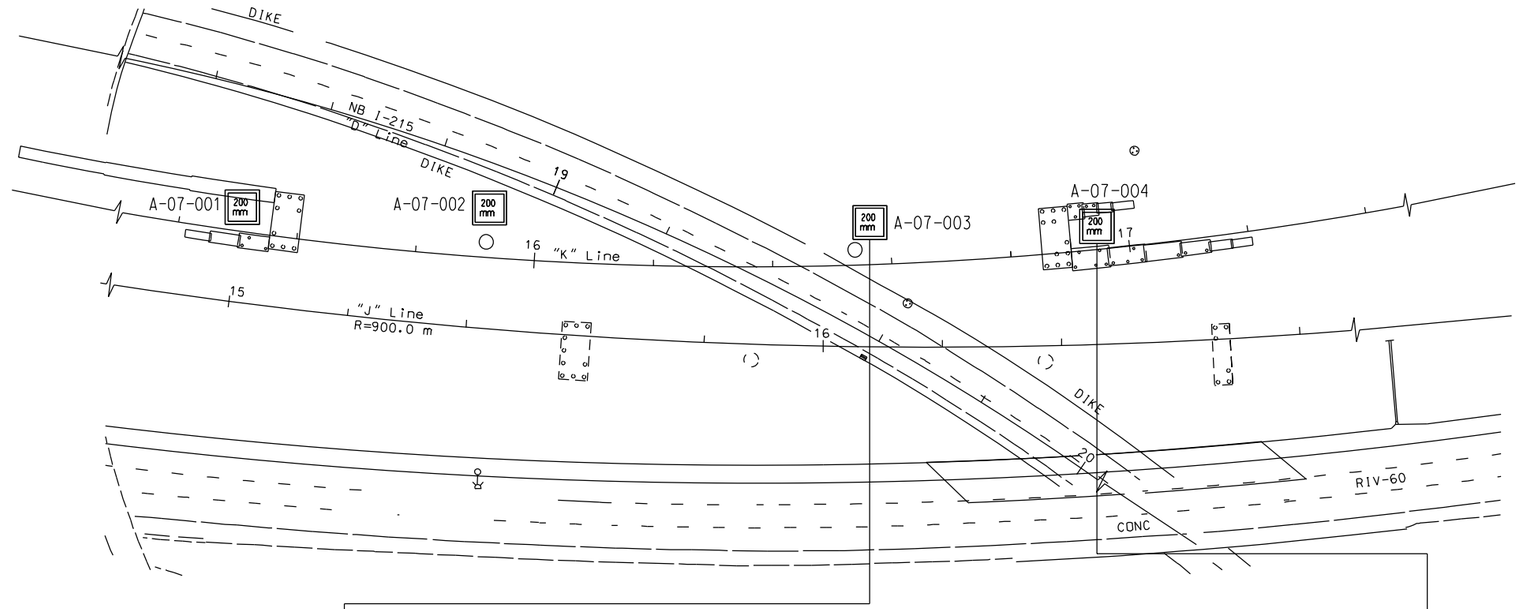
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500



BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

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1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

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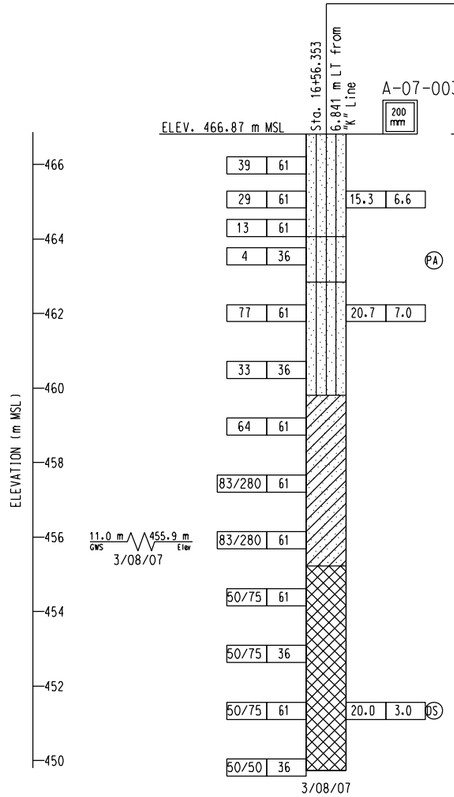
3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).



Fill:
Silty Sand (SM): dense, dark brown, fine to coarse grained sand, with fine gravel and asphalt grindings
--medium dense, asphalt grindings
--fine grained sand, trace medium sand, iron staining, gravel content decreasing

Alluvium:
Silty Sand (SM): loose, brown, slightly moist

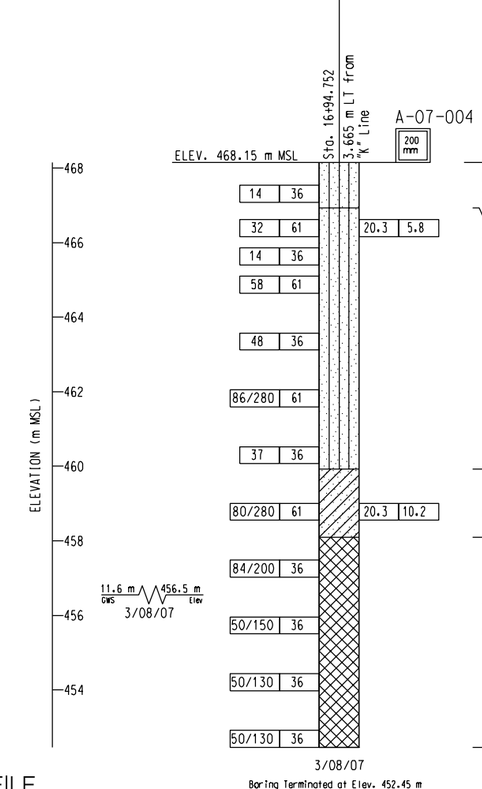
Silty Sand (SM): very dense, red-brown, slightly moist, fine to medium grained sand, trace clay
--dense, fine grained sand

Clayey Sand (SC): very dense, brown, moist, fine grained sand
--very dense
--groundwater encountered at 11 meters

Igneous Rock (Granitic): Tonalite, moderately weathered, gray-brown, wet
--drilling effort increases
--gray
--very difficult drilling
--slightly weathered, moist, gray-brown, fine to medium grained
--wet
Practical drill refusal at 17.1 meters

Boring Terminated at Elev. 449.77 m
Borehole Backfilled with Native Soils
ER_f= 80%

PROFILE
VERTICAL SCALE 1:2



fill:
Silty Sand (SM): medium dense, red-brown, dry, fine to medium grained sand, trace coarse sand

Alluvium:
Silty Sand (SM): medium dense, brown, slightly moist, fine to coarse grained sand
--roots
--very dense, brown, slightly moist, fine grained sand
--dense, orange-brown, dry
--dense

Clayey Sand (SC): very dense, red-brown, moist

Igneous Rock (Granitic): Tonalite, slightly weathered, tan-brown, dry, recovered as fine to medium grained sand
--groundwater encountered at approximately 11.6 meters

Boring Terminated at Elev. 452.45 m
Borehole Backfilled with Native Soils
ER_f= 80%

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 3 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 31 OF 31

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

PLANS APPROVALDATE

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RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

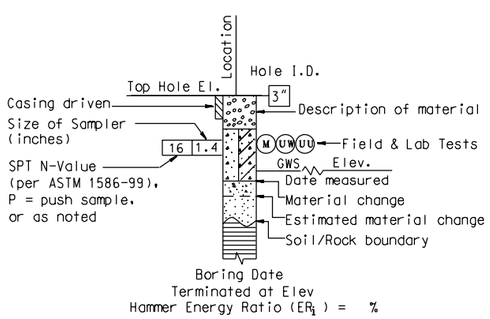
KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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.

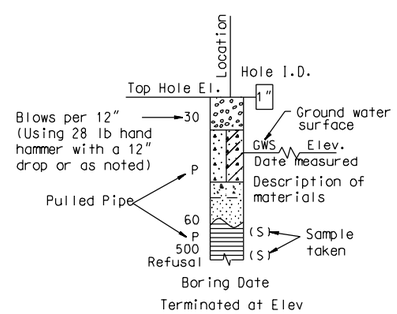
BOREHOLE IDENTIFICATION		
Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (25.4 mm soil tube) Hand Auger
	D	Dynamic Cone Penetration Boring
	CPT	Cone Penetration Test (ASTM D 5778-95)
	O	Other
Note: Size in millimeters.		

CONSISTENCY OF COHESIVE SOILS				
Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

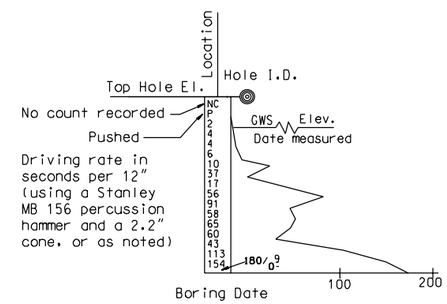
PLASTICITY OF FINE-GRAINED SOILS	
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic 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.



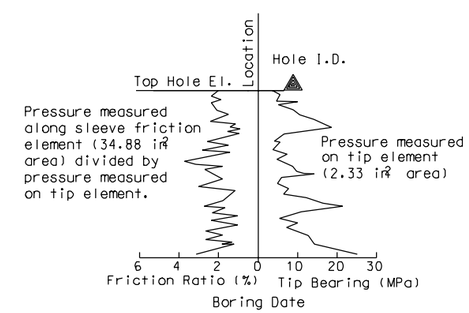
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D.FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE -) $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 24 OF 30

USERNAME -)$USER DATE PLOTTED -)$DATE TIME PLOTTED -)$TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

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REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 25 OF 30

USERNAME -$USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVALDATE

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

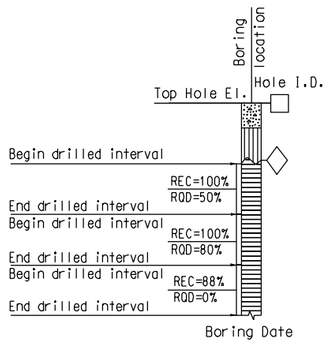
KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick: can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 26 OF 30

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

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4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

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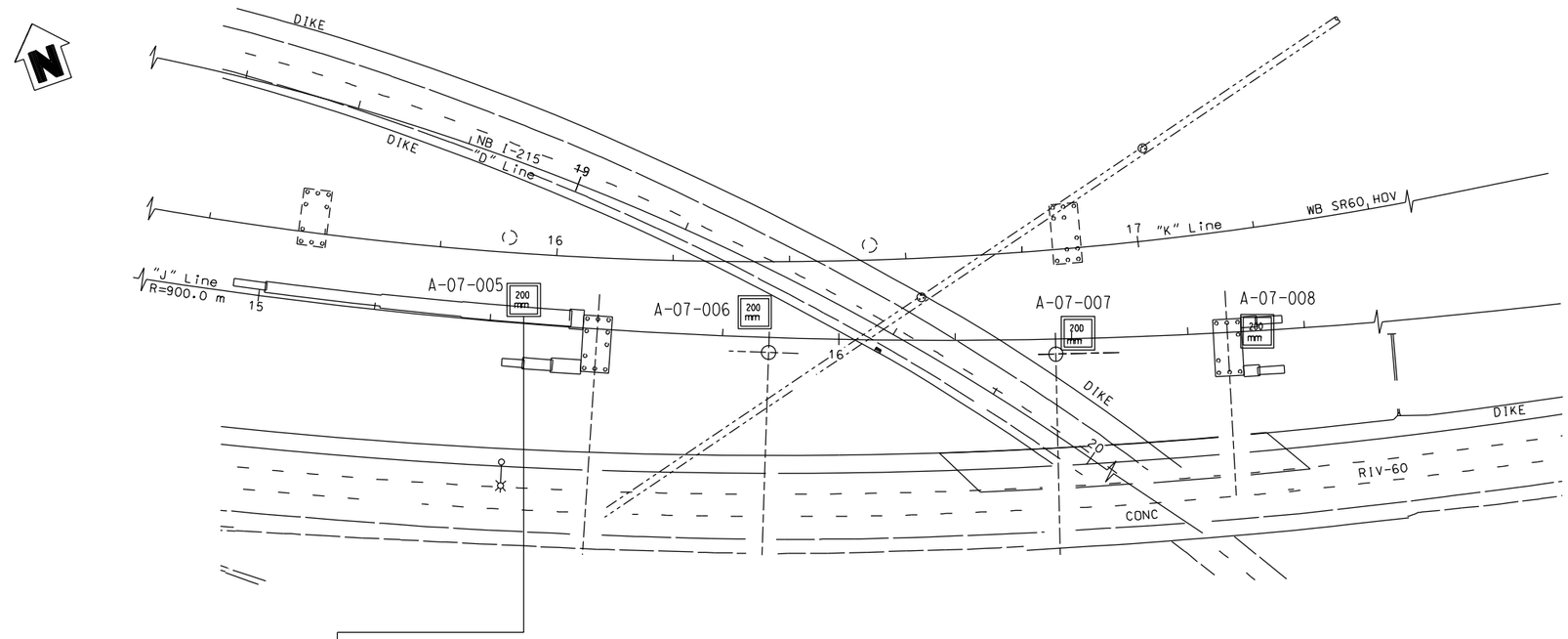
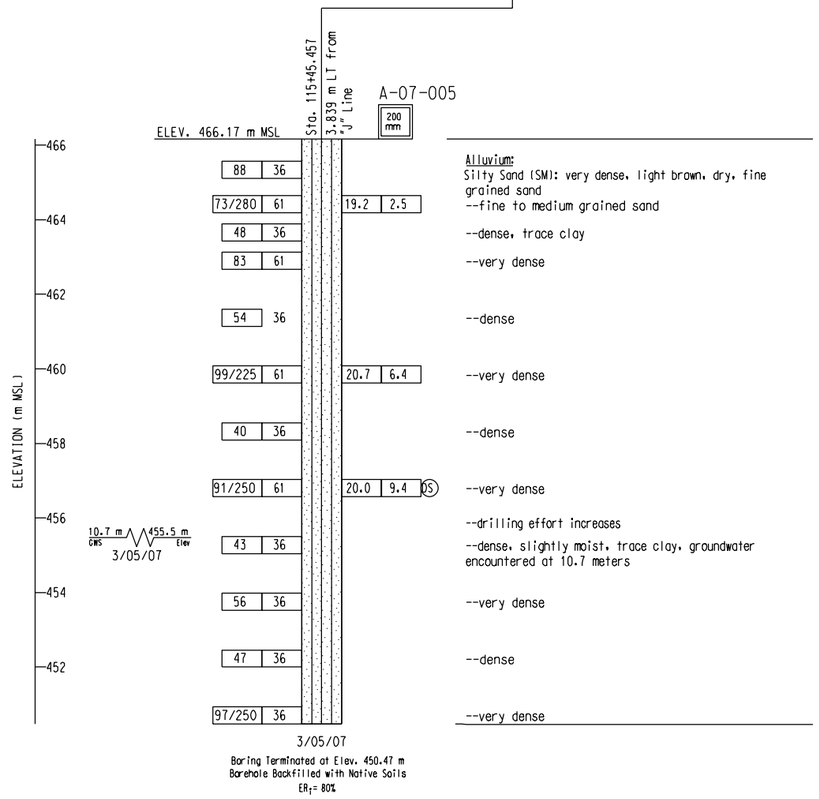
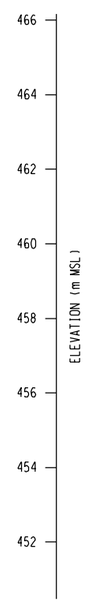
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500







PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 1 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 2/13/09 5/20/09

SHEET 27 OF 30

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST
CARLOS AMANTE
No. GE2724
Exp. 6-30-10
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

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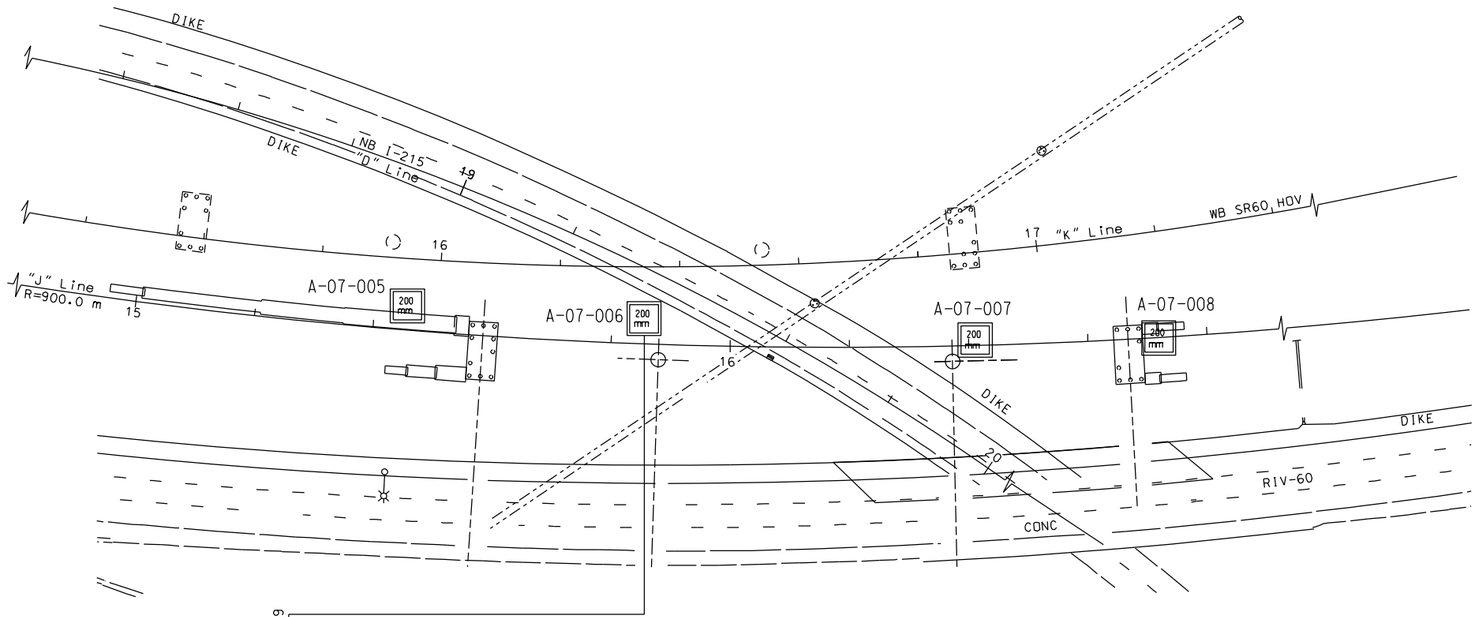
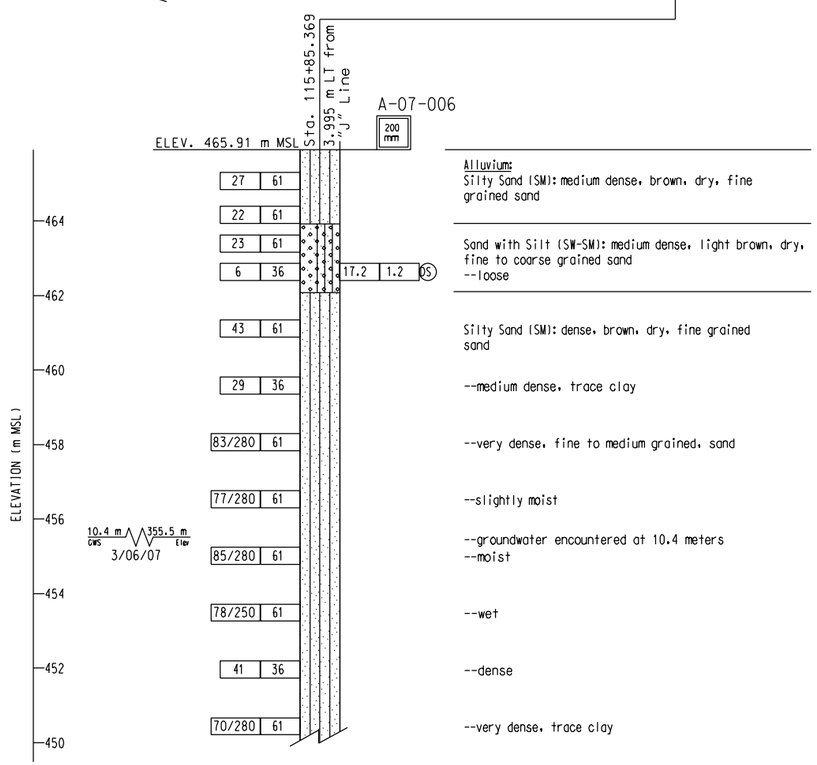
PLAN
1:500





Alluvium:
Silty Sand (SM): medium dense, brown, dry, fine grained sand

Sand with Silt (SW-SM): medium dense, light brown, dry, fine to coarse grained sand
--loose

Silty Sand (SM): dense, brown, dry, fine grained sand

--medium dense, trace clay

--very dense, fine to medium grained, sand

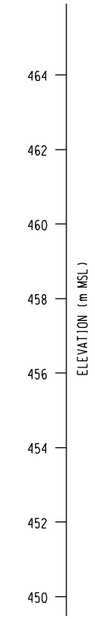
--slightly moist

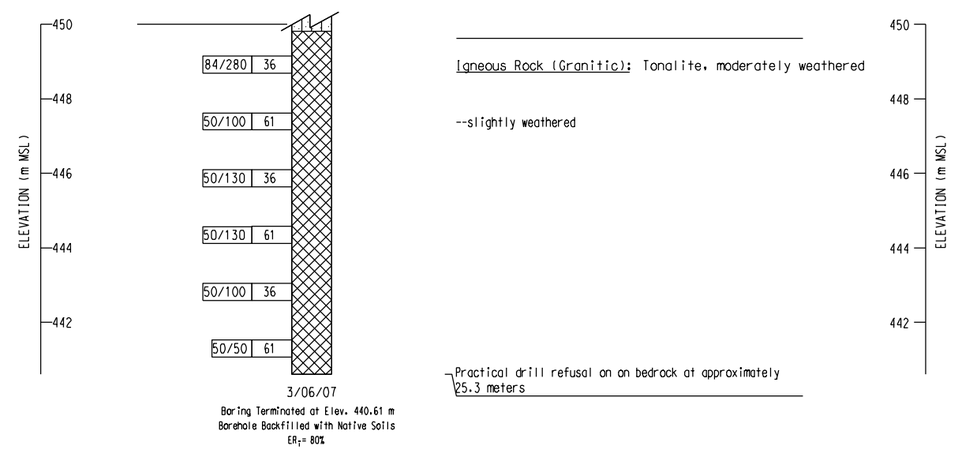
--groundwater encountered at 10.4 meters
--moist

--wet

--dense

--very dense, trace clay





PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

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DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 2 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

REVISION DATES

SHEET 28 OF 30

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08	Riv	215/60			

Caltrans Metric

Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

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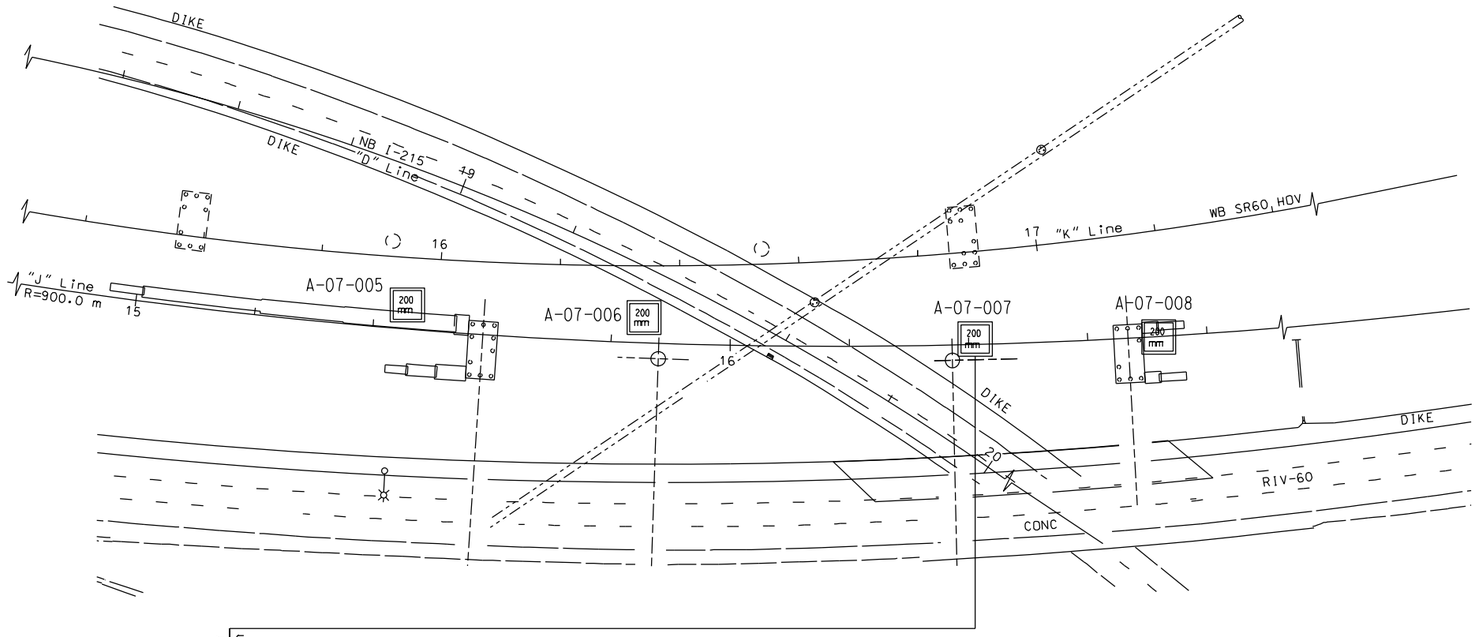

PLAN
1:500

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

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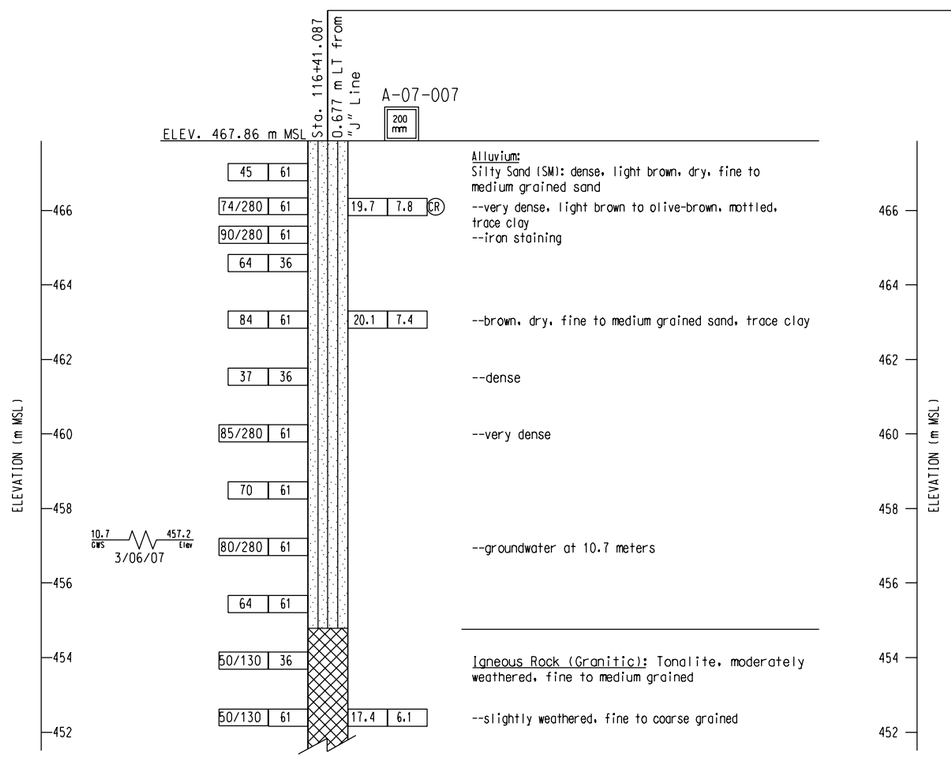

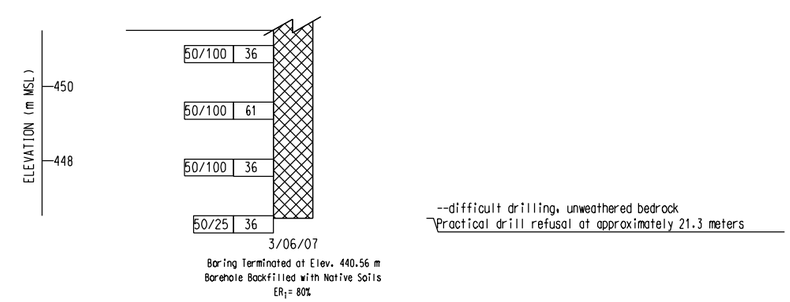

PROFILE
VERTICAL SCALE 1:2

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

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PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 3 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE -) $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 2/13/09 5/20/09

SHEET 29 OF 30

USERNAME -)$USER DATE PLOTTED -)$DATE TIME PLOTTED -)$TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

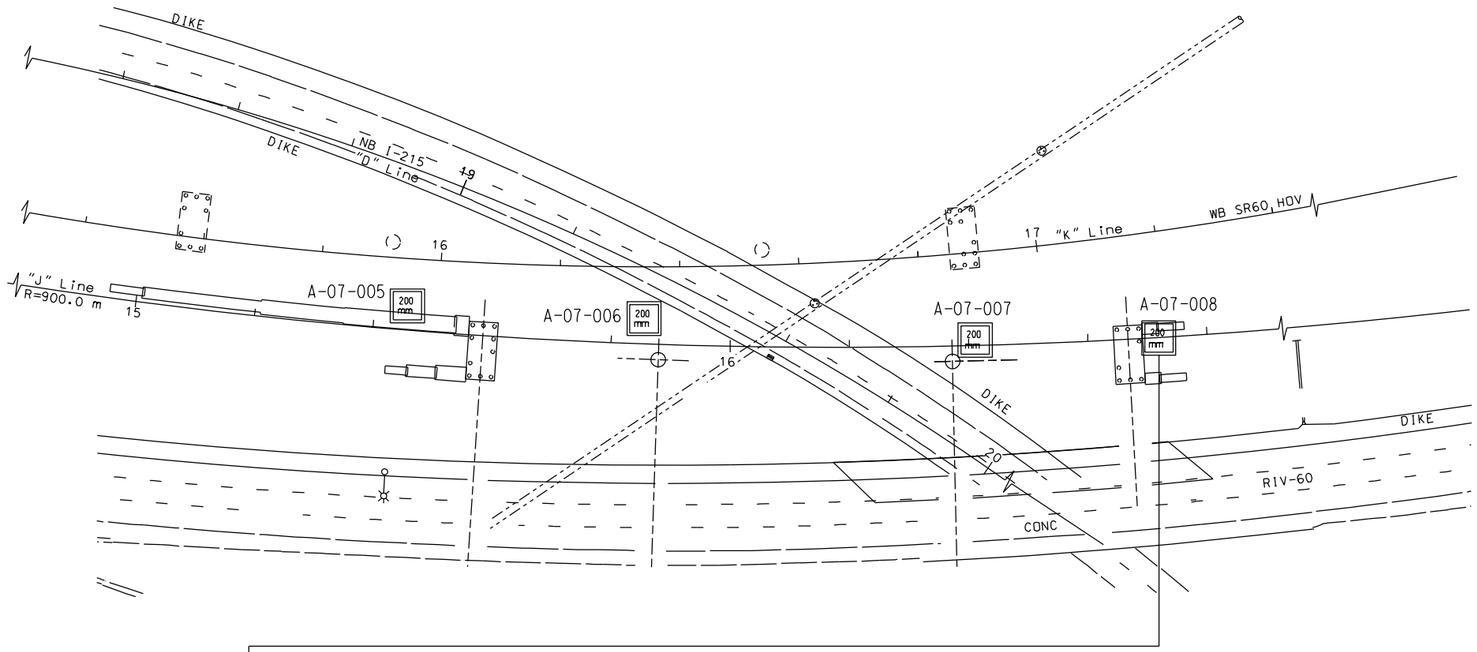
The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

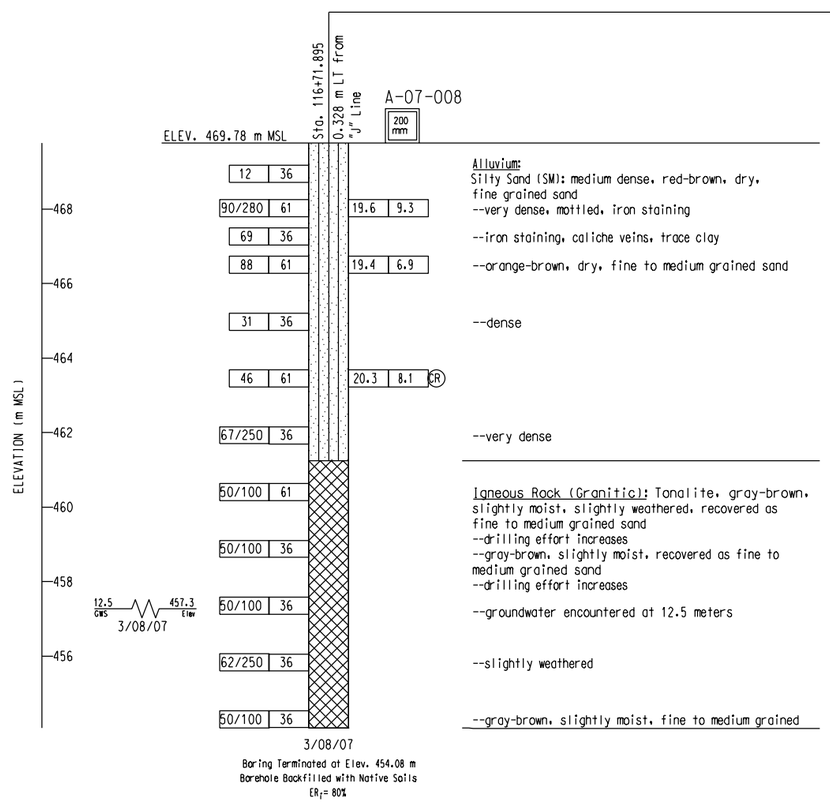
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

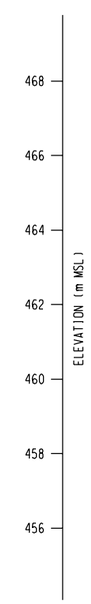
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500







PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 4 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE -) $REQUEST

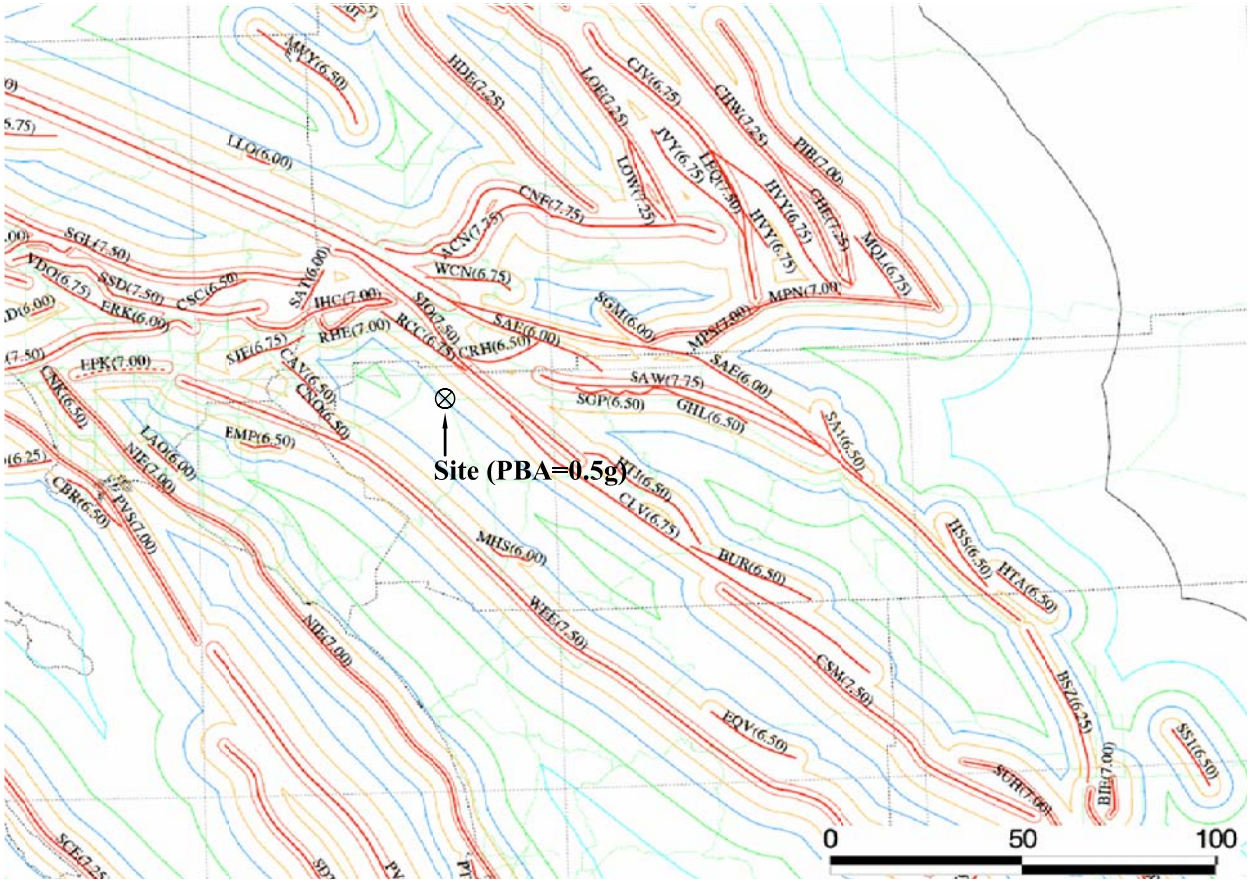
DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 30 OF 30

USERNAME -$USER DATE PLOTTED -) $DATE TIME PLOTTED -) $TIME

ATTACHED IMAGES: Images: Fault.tif Images: Fault-legend.tif
ATTACHED XREFS:
DIAMOND BAR, CA CAD FILE: L:\2009\CADD\76979\I-215_SR60\021609_EB&WB-SR60-HOV\ LAYOUT: 5 PLOTTED: 16 Feb 2009, 11:49am, MGriffin



APPROXIMATE SCALE (KILOMETERS)

LEGEND:

- 0.7g Peak Acceleration Contour
- 0.6g Peak Acceleration Contour
- 0.5g Peak Acceleration Contour
- 0.4g Peak Acceleration Contour
- 0.3g Peak Acceleration Contour
- 0.2g Peak Acceleration Contour
- 0.1g Peak Acceleration Contour
- Special Seismic Source (SSS)
- Faults with Fault Codes (MCE)
- State Highways
- County Boundary
- Latitude & Longitude

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PROJECT NO.	76979
DRAWN:	2/16/09
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p5.dwg

FAULT AND PBA MAP

PROPOSED RETAINING WALLS
I-215/SR60 EAST JUNCTION
EB & WB SR60 HOV CONNECTORS
RIVERSIDE, CALIFORNIA

PLATE
5

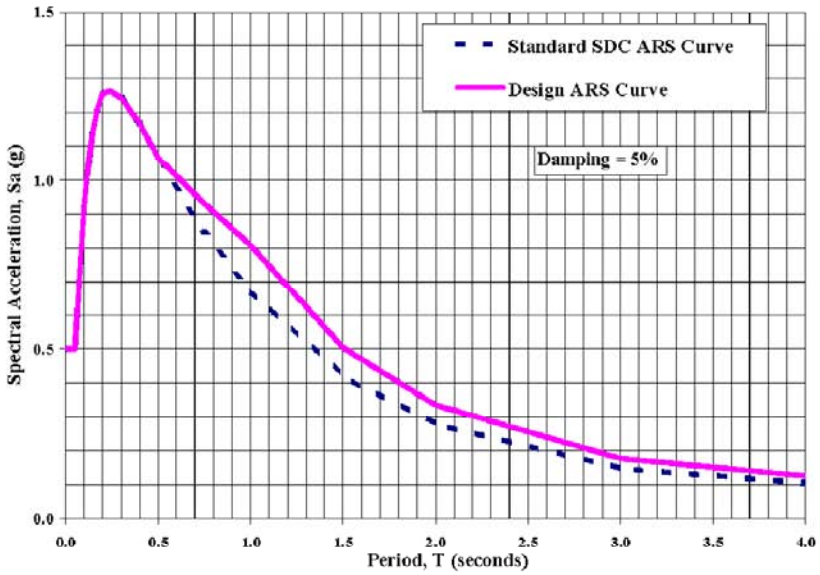
CALTRANS BRIDGE DESIGN ARS CURVE

(Version 4.0, Copyright 2007, Developed By: GeoSoftware Solutions, All Rights Reserved, http://www.geosoftwaresolutions.com)
(Licensed to: Kleinfelder West, Inc. - Redlands, California)

PROJECT INFORMATION	
Project Name	I-215/SR60 East Junction
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS	
Controlling Fault Name	San Jacinto (SJO)
Fault Type	Strike-slip (SS)
MCE Moment Magnitude	7.50
Distance to Fault	8.80 kilometers
Peak Bedrock Acceleration Based on 1996 California Seismic Hazard Map	0.5 g
Soil Profile Type	C

COMPUTED RESULTS	
Peak Bedrock Acceleration Based on Sadigh et al. (1997)[1]	0.46 g
Design Peak Bedrock Acceleration (g)	0.50 g



COMPUTED ARS CURVES

Period T (seconds)	Standard SDC ARS Curve[2] Sa (g)	Design ARS Curve[3] Sa (g)
0.010	0.500	0.500
0.020	0.500	0.500
0.030	0.500	0.500
0.050	0.500	0.500
0.075	0.719	0.719
0.100	0.919	0.919
0.120	1.037	1.037
0.150	1.155	1.155
0.170	1.207	1.207
0.200	1.256	1.256
0.240	1.264	1.264
0.300	1.244	1.244
0.400	1.168	1.168
0.500	1.067	1.067
0.750	0.847	0.932
1.000	0.674	0.808
1.500	0.419	0.503
2.000	0.278	0.334
3.000	0.147	0.177
4.000	0.104	0.125

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

NOTES:

[1]Peak Bedrock Acceleration (PBA):
Estimated using attenuation relationship by Sadigh et al. (1997) for rock site.
Sadigh et al. (1997) recommended no increase for Strike-Slip Fault, 10% increase for Oblique Fault; and 20% increase for Reverse/Thrust Fault. If type of fault is unknown, a 10% increase is assumed.

[2]Standard Seismic Design Criteria (SDC) ARS Curve:
Used Caltrans standard SDC ARS curve for the given PBA, magnitude, and soil profile type.

[3]Design ARS Curve:
When the bridge is located within 15 km of the controlling fault, the standard SDC ARS curve was modified as follows to account for fault rupture directivity effect:
- For Periods < 0.5 sec, no increase in standard SDC spectral acceleration values.
- For Periods > 1.0 sec, the standard SDC spectral acceleration values were increased by 20%.
- For Periods between 0.5 sec and 1.0 sec, spectral acceleration values were linearly interpolated.

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PROJECT NO.	76979
DRAWN:	01/16/09
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p6.dwg

PRELIMINARY DESIGN ARS CURVE

PROPOSED RETAINING WALLS
I-215/SR-60 EAST JUNCTION
EB & WB SR60 HOV CONNECTORS
RIVERSIDE, CALIFORNIA

PLATE
6

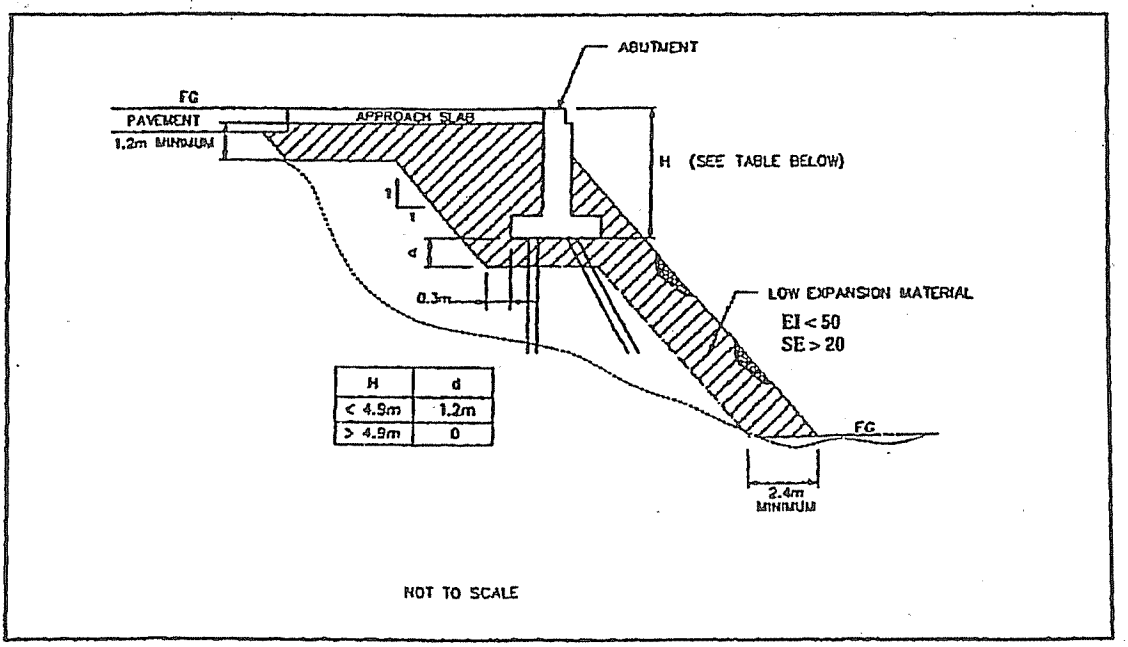
ATTACHED IMAGES: Images: Plate6-ARS Curve_1.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\021609_EB&WB-SR60-HOV\ LAYOUT: 6 PLOTTED: 16 Feb 2009, 11:49am, MGriffin

EXPANSIVE SOIL EXCLUSION ZONE

GUIDELINE FOR DEFINING EXPANSIVE SOIL AND THE ZONE AROUND BRIDGE ABUTMENTS IN WHICH EXPANSIVE SOIL IS TO BE EXCLUDED (ALSO APPLICABLE TO WINGWALLS AND RETAINING WALLS).

Expansive soil materials shall not be placed as part of the embankment within the limits of a bridge abutment as shown in Figure 7 below for the full width of the embankment. Expansive soil materials for this requirement are defined as having either an Expansion Index (EI) greater than 50, (Expansion Index to be determined in accordance with ASTM D 4829) or a Sand Equivalent (SE) less than 20 (Sand Equivalent to be determined in accordance with California Test Method 217). This requirement is exclusive of the structure backfill and pervious backfill material requirements as shown on the plans and set forth in the Standard Specifications under Sections 19-3.06 and 19-3.065 respectively.

TYPICAL SECTION - EXPANSIVE SOIL EXCLUSION ZONE IN BRIDGE EMBANKMENT



H	d
< 4.9m	1.2m
> 4.9m	0

PLATE 7

APPENDIX A

FIELD EXPLORATION

APPENDIX A
FIELD EXPLORATION

The subsurface exploration program for the Eastbound and Westbound SR60 HOV Connectors consisted of drilling and logging eight exploratory soil borings HV-1 through HV-8 (LOTB Nos. A-07-001 through A-07-008) on March 5, 6 and 8, 2007. These borings were advanced to depths ranging from approximately 15.7 to 23.5 meters below the existing ground surface (bgs). The borings were advanced using a Mobile B-61, truck-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer delivery system. The borings were logged and sampled using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Following drilling, sampling and logging, the borings were backfilled with native cuttings.

The boring locations are shown on Plates 4d through 4f for the WB HOV Connector and Plates 4j through 4m for the EB HOV Connector. The boring locations, stations and offsets, and elevations were obtained from survey data provided by LAN Engineering.

The boring logs are presented on Plates A2 through A8 at the end of this appendix. The logs describe the earth materials encountered during drilling, and indicate the locations of the samples obtained and infill thickness measured in the bedrock. The excavations were logged by a staff professional from Kleinfelder using methods outlined in the Unified Soil Classification System (USCS) and general procedures established in ASTM D2488. The boundaries between soil and rock type(s) shown on the logs are approximate because the transition between different soil and rock layer(s) may be gradual.

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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	ID	DESCRIPTION	MAJOR DIVISION		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Well-graded gravels, gravel-sand mixtures	FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands
		GP		Poorly-graded gravels, gravel-sand mixtures			CL		Inorganic clays of low to medium plasticity; gravelly clays silty clays,sandy clays, lean clays
		GM		Silty gravels, gravel-sand-silt mixtures			OL		Organic silts and organic silt-clays of low plasticity
		GC		Clayey gravels, gravel-sand-clay mixtures					
	SAND AND SANDY SOILS	SW		Well-graded sands, gravelly sands		SILTS AND CLAYS LL > 50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		SP		Poorly-graded sands and gravelly sands			CH		Inorganic clays of medium to high plasticity
		SM		Silty sands, sand-silt mixture			OH		Organic clays of medium to high plasticity
		SC		Clayey sands, sand-clay mixture		HIGHLY ORGANIC SOILS	Pt		Peat, muck and other highly organic soils

▼ Approximate water level observed in boring following drilling

SOIL SAMPLE

- Bulk Sample
- Drive Sample - California Sample
- Shelby Tube Sample
- Standard Penetration Test (SPT) Sample

ADDITIONAL TESTS

CN	- Consolidation
COR	- Corrosion
CP	- Collapse Potential
DS	- Direct Shear
EI	- Expansion Potential
MAX	- Maximum Dry Density
OC	- Organic Content
PI	- Plasticity Index
RV	- R-Value
SE	- Sand Equivalent
GS	- Grain Size Distribution

NOTES:

Blow counts represent the number of blows of a 64-kilogram hammer falling 760 mm required to drive a sampler through the last 300 mm of a 460 mm penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

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1220 Research Drive, Suite B, Redlands, CA 92374
PH. (909) 793-2691 • FAX (909) 792-1704

LEGEND TO LOGS

PLATE A-1

Date Drilled	3/5/07	Water Depth:	29 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/5/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	465 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
							Alluvium			
464	1	1	36, 50/130			SM	**Silty Sand:** light brown, dry, fine grained sand			
		2								
463	2	3	32, 50/130				--fine to medium grained sand	19.6	5.6	
		4	42				--olive-brown, dense			GS
462	3	5	68				--very dense	20.8	6.1	DS
461	4									
460	5	6	37				--dense, trace iron staining			
459	6	7	62				--very dense	18.5	3.7	
458	7									
457	8	8	40				--dense, fine to medium grained sand			
456	9					▼	--groundwater encountered at 8.3 meters after drilling			
		9	62				--very dense, trace clay			
455										

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PROJECT NO. 76979

I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV- 1

PLATE A-2a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
454	10	59							
11									
453									
12	11	48				--dense			
452									
13									
451	12	48							
14									
450									
15	13	72				--very dense			

Boring terminated at 15.7 meters.
Groundwater encountered at 8.8 meters after drilling.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV- 1

PLATE

A-2b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/5/07	Water Depth:	33 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/5/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	465 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
							Alluvium			
464	1	1	34, 50/150			SM	**Silty Sand:** light brown, dry, very dense, fine to medium grained sand			
		2								COR
463	2	3	33, 50/100				--fine to coarse grained sand, caliche			
		4	50/130				--fine grained sand		10.2	
462	3	5	28				--medium dense			
461	4									
460	5	6	74				--red-brown, very dense	20.0	7.7	
459	6	7	51			SP-SM	**Sand with Silt:** brown, dry, very dense, fine to coarse grained sand			
458	7									
457	8	8	66			SM	**Silty Sand:** light brown, dry, fine to medium grained sand, trace clay			
456	9	9	67				--slightly moist			
455										

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

PLATE A-3a

PROJECT NO. 76979

LOG OF BORING HV- 2

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--groundwater encountered at 10 meters after drilling			
454 / 11	10	70				--trace clay	18.8	13.0	
453 / 12	11	28, 50/13							
452 / 13						--some clay			
451 / 14	12	34				--moist, dense			
450 / 15	13	72			SC	**Clayey Sand:** red-brown, slightly moist, very dense, fine to medium grained sand	19.5	12.8	
449 / 16									
448 / 17	14	43				--dense			
447 / 18	15	46, 50/7				--very dense			
446 / 19									
445 / 20	16	46, 50/7				**<u>Bedrock:</u>** Tonalite, moderately weathered			
444 / 21									

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PROJECT NO. 76979

I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV- 2

PLATE

A-3b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
	17	50							
443									
22									
442									
23	18	50/75							
441									
24									
	19	50/50							
440						Practical drill refusal at 25 meters			

Boring terminated at 25 meters due to practical refusal, lead auger sheared in half at 25 meters due to tight drilling in bedrock.
Groundwater encountered at 10 meters after drilling.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV- 2

PLATE

A-3c

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/8/07	Water Depth:	36 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	467 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1					**Fill**			
466	1	2	39			SM	**Silty Sand:** dark brown, dense, fine to coarse grained sand, with fine gravel and asphalt grindings			
465	2	3	29				--medium dense, asphalt grindings	15.3	6.6	
		4	13				--fine grained sand, trace medium sand, iron staining, gravel content decreasing			
464	3	5	4			SM	**Alluvium** **Silty Sand:** brown, slightly moist, loose			GS
463	4									
462	5	6	77				--red-brown, slightly moist, very dense, fine to medium grained sand, trace clay	20.7	7.0	
461	6	7	33				--dense, fine grained sand			
460	7									
459	8	8	64			SC	**Clayey Sand:** brown, moist, very dense, fine grained sand			
458	9									
457		9	33, 50/13				--very dense			

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-2a

PROJECT NO. 76979

LOG OF BORING HV- 3

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
456 11	10	33, 50/13				--groundwater encountered at 11 meters			
455 12	11	50/75				**Bedrock:** Tonalite, gray-brown, wet, moderately weathered --drilling effort increases			
454 13									
453 14	12	50/75				--gray			
452 15						--very difficult drilling			
	13	50/75				--slightly weathered, moist, gray-brown, fine to medium grained	20.0	3.0	DS
451 16									
450 17	14	50/50				--wet Practical drill refusal at 17.1 meters			

Boring terminated at 17.1 meters due to practical refusal.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-2b

PROJECT NO. 76979

LOG OF BORING HV- 3

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/8/07	Water Depth:	38 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	468 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
468		1					**Fill**			
	1	2	14			SM	**Silty Sand:** red-brown, dry, medium dense, fine to medium grained sand, trace coarse sand			
467							**Alluvium**			
		3	32			SM	**Silty Sand:** brown, slightly moist, medium dense, fine to coarse grained sand	20.3	5.8	
	2	4	14				--roots			
466										
	3	5	58				--brown, slightly moist, very dense, fine grained sand			
465										
	4									
464		6	48				--orange-brown, dry, dense			
	5									
463										
	6	7	36, 50/13							
462										
	7									
461		8	37				--dense			
	8									
460										
	9	9	30, 50/13			SC	**Clayey Sand:** red-brown, moist, very dense	20.3	10.2	
459										

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

PLATE
A-5a

PROJECT NO. 76979

LOG OF BORING HV- 4

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
458									
11 / 457	10	34, 50/5				**Bedrock:** Tonalite, tan-brown, dry, slightly weathered, recovered as fine to medium grained sand			
					▼	--groundwater encountered at approximately 11.6 meters			
12 / 456	11	50/150							
13 / 455									
14 / 454	12	50/130							
15 / 453									
	13	50/130							
						Boring terminated at 15.7 meters. Groundwater encountered at 11.6 meters. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
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Riverside, California

LOG OF BORING HV- 4

PLATE

A-5b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/5/07	Water Depth:	35 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/5/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	466 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
466		1					**Alluvium**			
	1	2	88			SM	**Silty Sand:** light brown, dry, very dense, fine grained sand			
465		3	23, 50/130				--fine to medium grained sand	19.2	2.5	
	2	4	48				--dense, trace clay			
464										
	3	5	83				--very dense			
463										
	4									
462		6	54				--dense			
	5									
461										
	6	7	49, 50/78				--very dense	20.7	6.4	
460										
	7									
459		8	40				--dense			
	8									
458										
	9									
457		9	41, 50/100				--very dense	20.0	9.4	DS

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Riverside, California

LOG OF BORING HV- 5

PLATE

A-6a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
456						--drilling effort increases			
	10	43			▼	--slightly moist, dense, trace clay, groundwater encountered at 10.7 meters			
11 / 455									
12 / 454	11	56				--very dense			
13 / 453									
14 / 452	12	47				--dense			
15 / 451									
	13	47, 50/100				--very dense			
						Boring terminated at 15.7 meters. Groundwater encountered at 10.7 meters. Some caving observed in borehole after removal of augers. Hole backfilled and tamped using soil from cuttings.			

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LOG OF BORING HV- 5

PLATE

A-6b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/6/07	Water Depth:	34 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/6/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	466 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium** **Silty Sand:** brown, dry, medium dense, fine grained sand			
465	1	1 2	27							
		3	22							
464	2									
		4	23			SW-SM	**Sand with Silt:** light brown, dry, medium dense, fine to coarse grained sand	17.2	1.2	DS
463	3	5	6				--loose			GS
462	4									
		6	43			SM	**Silty Sand:** brown, dry, dense, fine grained sand			
461	5									
460	6	7	29				--medium dense, trace clay			
459	7									
458	8	8	33, 50/13				--very dense, fine to medium grained, sand			
457	9	9	27, 50/13				--slightly moist			
456										

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-3a

PROJECT NO. 76979

LOG OF BORING HV- 6

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--groundwater encountered at 10.4 meters			
455 11	10	35, 50/130				--moist			
454 12	11	28, 50/100				--wet			
453 13									
452 14	12	41				--dense			
451 15	13	20, 50/130				--very dense, trace clay			
450 16									
449 17	14	34, 50/130				**Bedrock:** Tonalite, moderately weathered			
448 18	15	50/100				--slightly weathered			
447 19									
446 20	16	50/130							
445 21									

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

LOG OF BORING HV- 6

PLATE
A-3b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
	17	50/130					18.4	20.8	
444 22									
443 23	18	50/100							
442 24									
	19	50/50							
441 25									
						Practical drill refusal on on bedrock at approximately 25.3 meters			
						Boring terminated at 25.3 meters due to practical refusal. Groundwater encountered at 10.4 meters. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

LOG OF BORING HV- 6

PLATE

A-3c

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/6/07	Water Depth:	35 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/6/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	468 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium** **Silty Sand:** light brown, dry, dense, fine to medium grained sand			
467	1	1 2	45							COR
466	2	3	24, 50/130				--very dense, light brown to olive-brown, mottled, trace clay	19.7	7.8	
		4	40, 50/130				--iron staining			
465	3	5	64							
464	4									
463	5	6	84				--brown, dry, fine to medium grained sand, trace clay	20.1	7.4	
462	6	7	37				--dense			
461	7									
460	8	8	35, 50/130				--very dense			
459	9	9	70							
458	10									

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-4a

PROJECT NO. 76979

LOG OF BORING HV- 7

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
457 / 11	10	30, 50/13				--groundwater at 10.7 meters			
456 / 12	11	64							
455 / 13									
454 / 14	12	50/130				**Bedrock:** Tonalite, moderately weathered, fine to medium grained			
453 / 15	13	50/130				--slightly weathered, fine to coarse grained	17.4	6.1	
452 / 16									
451 / 17	14	50/100							
450 / 18	15	50/100							
449 / 19									
448 / 20	16	50/100							
447 / 21	17	50/25				--difficult drilling, unweathered bedrock Practical drill refusal at approximately 21.3 meters			

Boring terminated at 21.3 meters due to practical refusal.
Groundwater encountered at 10.7 meters.
Hole backfilled and tamped using soil from cuttings.

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Proposed Retaining Walls
Riverside, California

PLATE
A-4b

PROJECT NO. 76979

LOG OF BORING HV- 7

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/8/07	Water Depth:	41 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	470 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
469	1	2 1	12			SM	**Alluvium** **Silty Sand:** red-brown, dry, medium dense, fine grained sand			
468	2	3	40, 50/13				--very dense, mottled, iron staining	19.6	9.3	
		4	69				--iron staining, caliche veins, trace clay			
467	3	5	88				--orange-brown, dry, fine to medium grained sand	19.4	6.9	
466	4									
465	5	6	31				--dense			
464	6	7	46					20.3	8.1	DS
463	7									
462	8	8	17, 50/10				--very dense			
461	9	9	50/100				**Bedrock:** Tonalite, gray-brown, slightly moist, slightly weathered, recovered as fine to medium grained sand			
460										

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV- 8

PLATE
A-9a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--drilling effort increases			
459 11	10	50/100				--gray-brown, slightly moist, recovered as fine to medium grained sand			
						--drilling effort increases			
458 12									
	11	50/100			▼	--groundwater encountered at 12.5 meters			
457 13									
456 14	12	15, 50/10				--slightly weathered			
455 15									
	13	50/100				--gray-brown, slightly moist, fine to medium grained			
						Boring terminated at 15.7 meters. Groundwater encountered at 12.5 meters. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
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LOG OF BORING HV- 8

PLATE

A-9b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

APPENDIX B

LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

Laboratory tests were performed on drive and bulk soil samples to estimate engineering characteristics of the various earth materials encountered. Testing was performed in general accordance with procedures outlined by the American Society for Testing and Materials, the California Department of Transportation, or other accepted procedures.

IN-SITU MOISTURE CONTENT AND DRY UNIT WEIGHT

In-situ moisture content and dry unit weight tests were performed on samples that could be recovered in a relatively undisturbed condition. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937. The test results are presented on the Logs of Borings in Appendix A, *Field Exploration*.

GRAIN SIZE DISTRIBUTION

Sieve analyses were performed on selected samples of the materials encountered at the site to evaluate the grain size distribution characteristics of the soils and to aid in their classification. The tests were performed in general accordance with ASTM Standard Test Method D 422. The results of these tests are presented on Plate B-1, *Grain Size Distribution*.

DIRECT SHEAR TEST

Five direct shear tests were performed on samples to evaluate the drained shear strength of the soils. The samples were soaked and tested in a near-saturated condition in general accordance with ASTM Test Method D 3080 (consolidated, drained). The results of these tests are presented on Plates B-2 through B-6, *Direct Shear Test*, and summarized in Table B-1, below.

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Table B-1
Direct Shear Test Results

Boring No.	Depth (m)	USCS Soil Type	Dry Unit Weight (kN/m^3)	Angle of Internal Friction (degrees)	Cohesion (kPa)
HV-1	3.0	SM	20.8	40	12.3
HV-3	15.2	Tonalite	20.0	43	0
HV-5	9.1	SM	20.0	36	0
HV-6	2.3	SW-SM	17.2	42	0
HV-8	6.1	SM	20.3	28	16.2

CORROSIVITY TESTS

Chemical analyses were performed on two samples of the sub-surface soil to estimate pH, resistivity, soluble sulfate, and chloride contents in general accordance with Caltrans Standard Test Methods 532 (pH), 643 (resistivity), 417 (sulfates), and 422 (chlorides). The test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to the construction materials. The test results are summarized in Table B-2, below.

Table B-2
Corrosion Test Results

Boring No.	Depth (m)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
HV-2	0.9 - 2.4	1,200	7.4	7	254
HV-7	0.9 - 2.4	3,200	7.9	5	126

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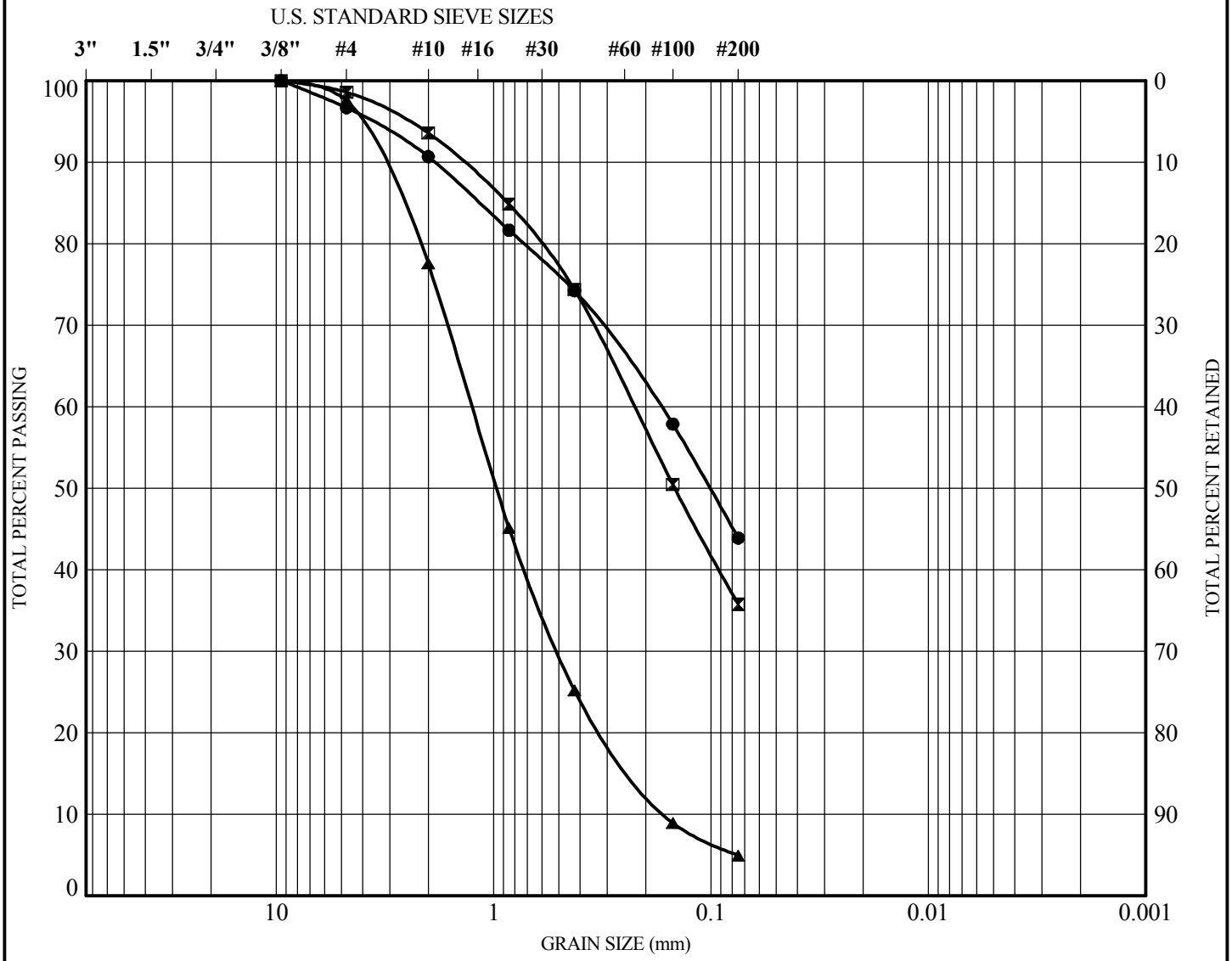
SIEVE ANALYSIS	HYDROMETER



GRAVEL	SAND					SILT	CLAY
	Very Coarse	Coarse	Medium	Fine	Very Fine		

Symbol	Test Pit	Depth (m)	USDA Description	USCS Classification
●	HV- 1	3	Silty Sand	SM
⧗	HV- 3	3	Silty Sand	SM
▲	HV- 6	3	Sand with Silt	SW-SM

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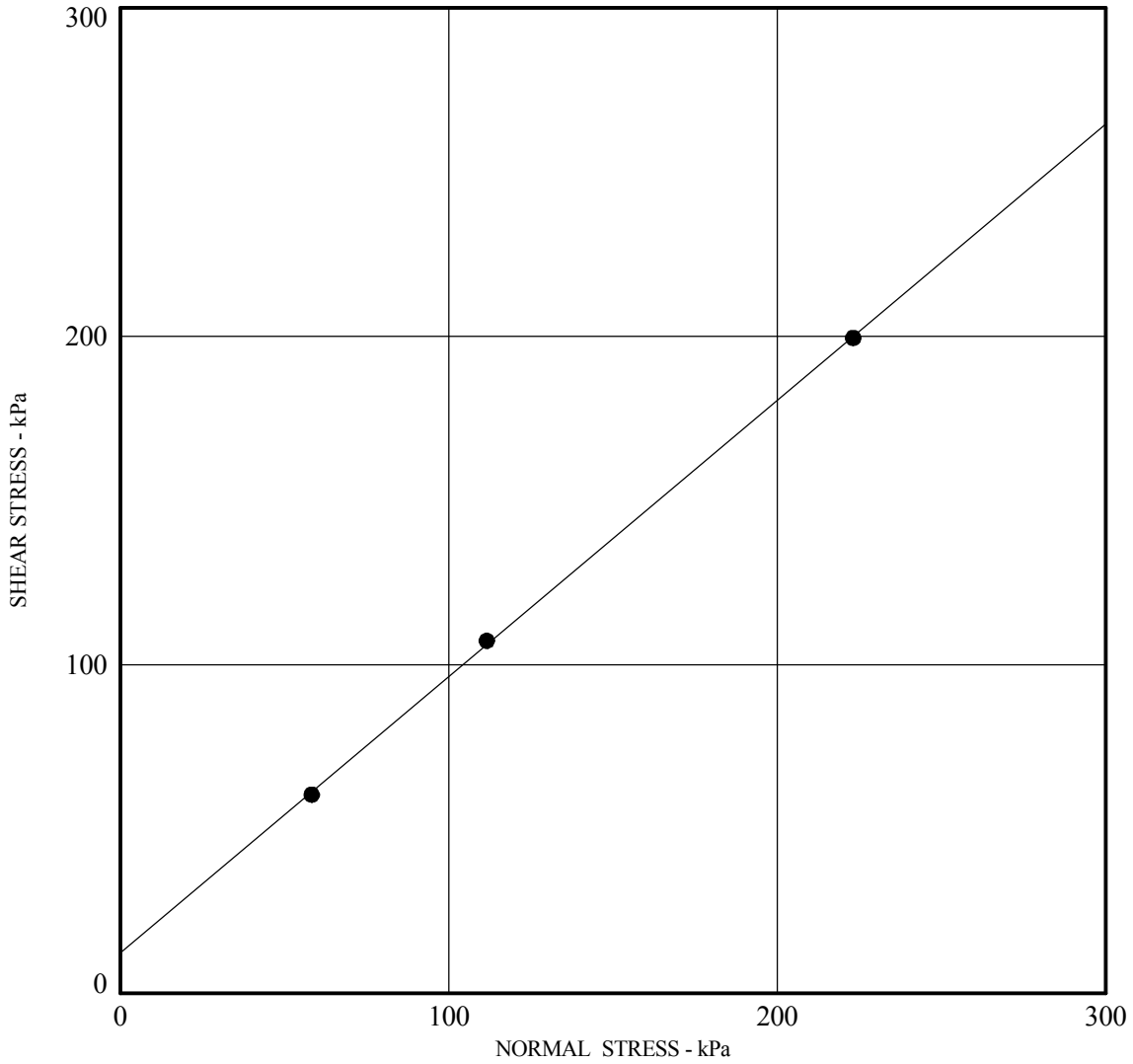
GRAIN SIZE DISTRIBUTION

PLATE

B-1

GRAIN SIZE USDA 76979 I-215 SR-EB&WB HOV CONNECTORS.GPJ KA_RDLND.GDT 2/16/09



Boring	**HV- 1**
Depth (m)	**3**
Friction Angle - deg	**40**
Cohesion (kPa)	**12.3**
Dry Density (kN/m^3)	**20.8**
Moisture Content (%) *	**6.1**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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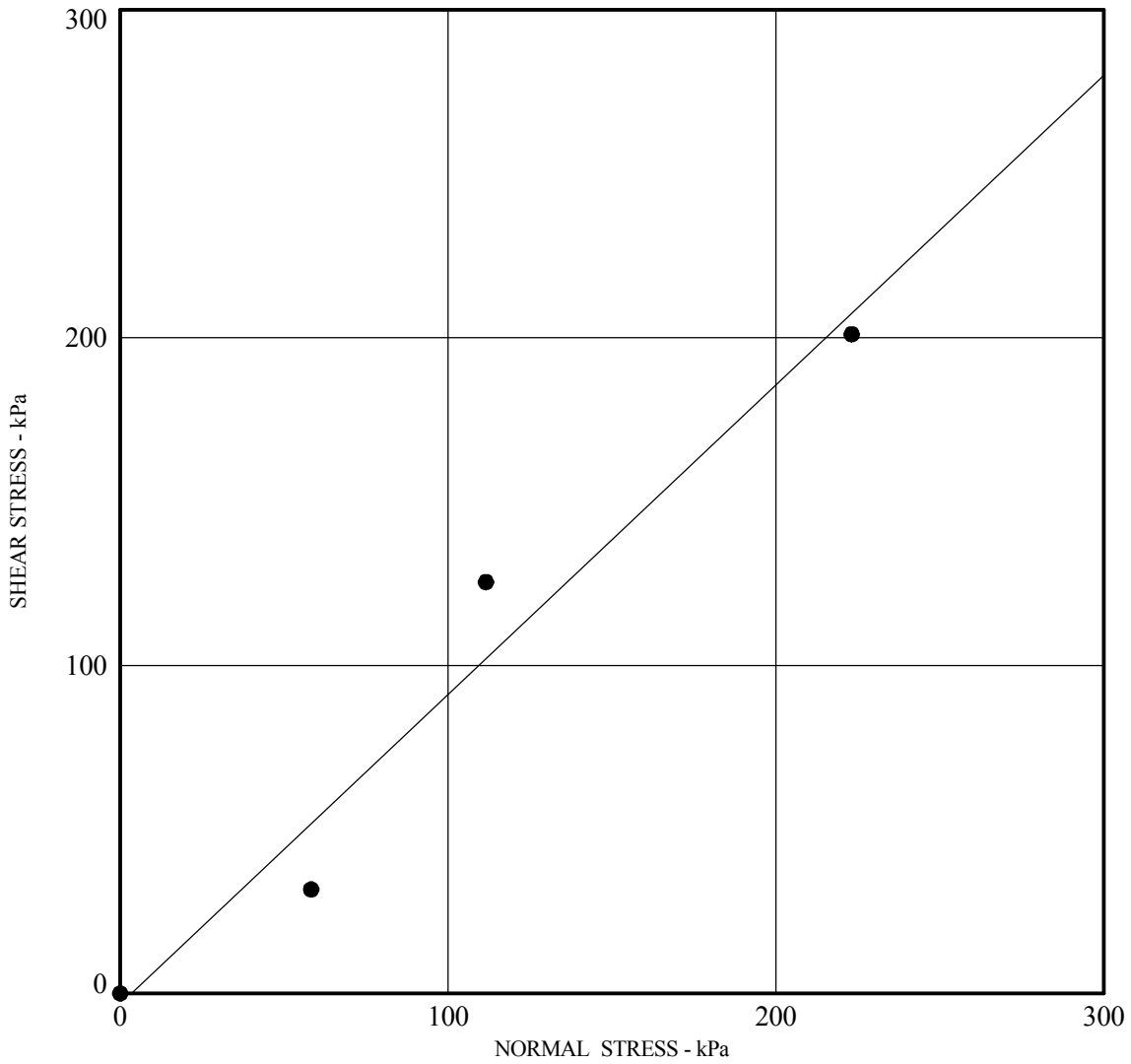
DIRECT SHEAR TEST

PLATE

B-2

DIRECT SHEAR STATION 76979 I-215 SR-EB&WB HOV CONNECTORS.GPJ KA_RDLND.GDT 2/16/09



Boring	**HV- 3**
Depth (m)	**15**
Friction Angle - deg	**43**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**20.0**
Moisture Content (%) *	**3.0**
Description	**Tonalite**
Classification	

*** In-situ Test**

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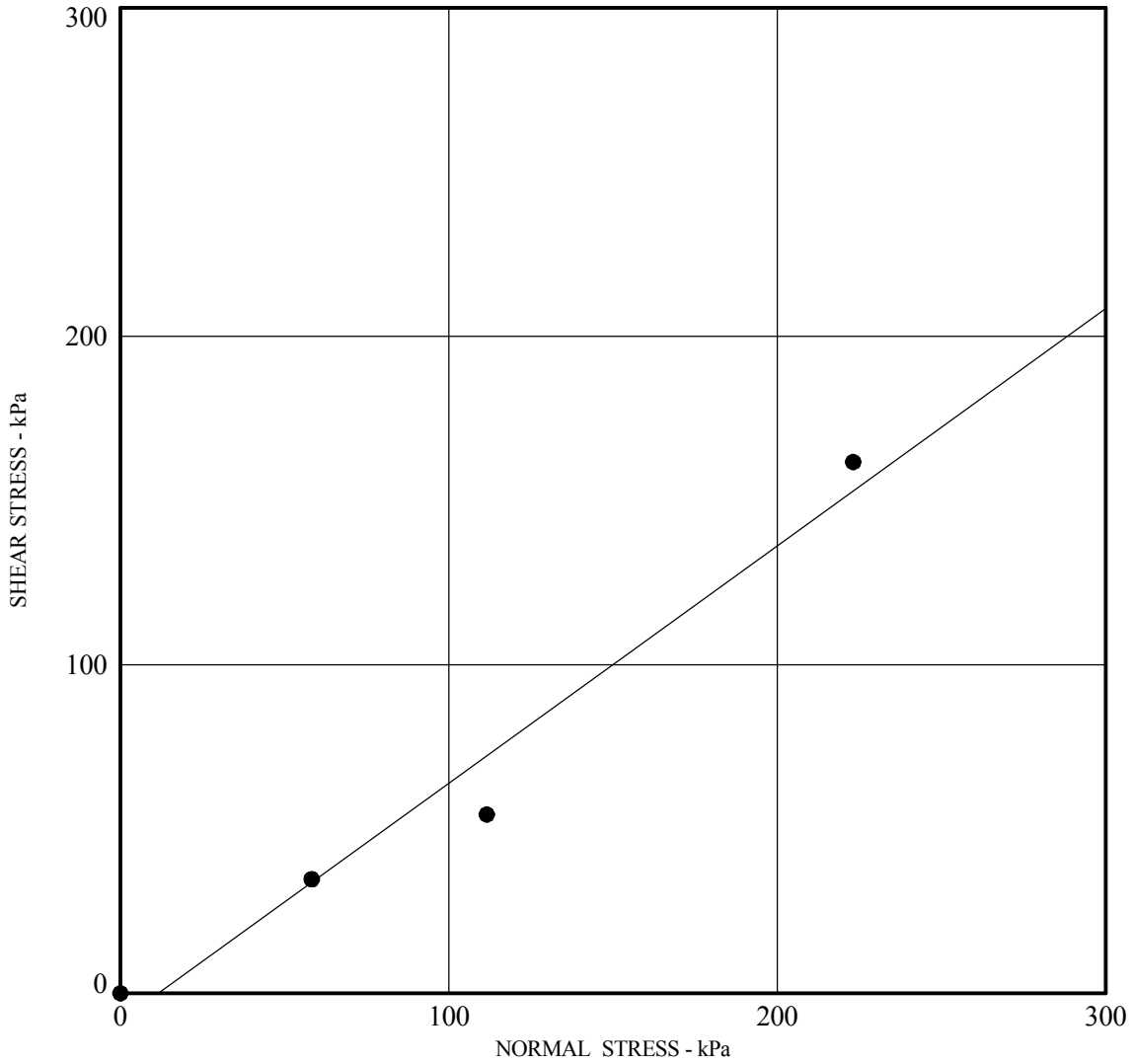
Riverside, California

DIRECT SHEAR TEST

PLATE

B-3

DIRECT SHEAR STATION 76979 I-215 SR-EB&WB HOV CONNECTORS.GPJ KA_RDLND.GDT 2/16/09



Boring	**HV- 5**
Depth (m)	**9**
Friction Angle - deg	**36**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**20.0**
Moisture Content (%) *	**9.4**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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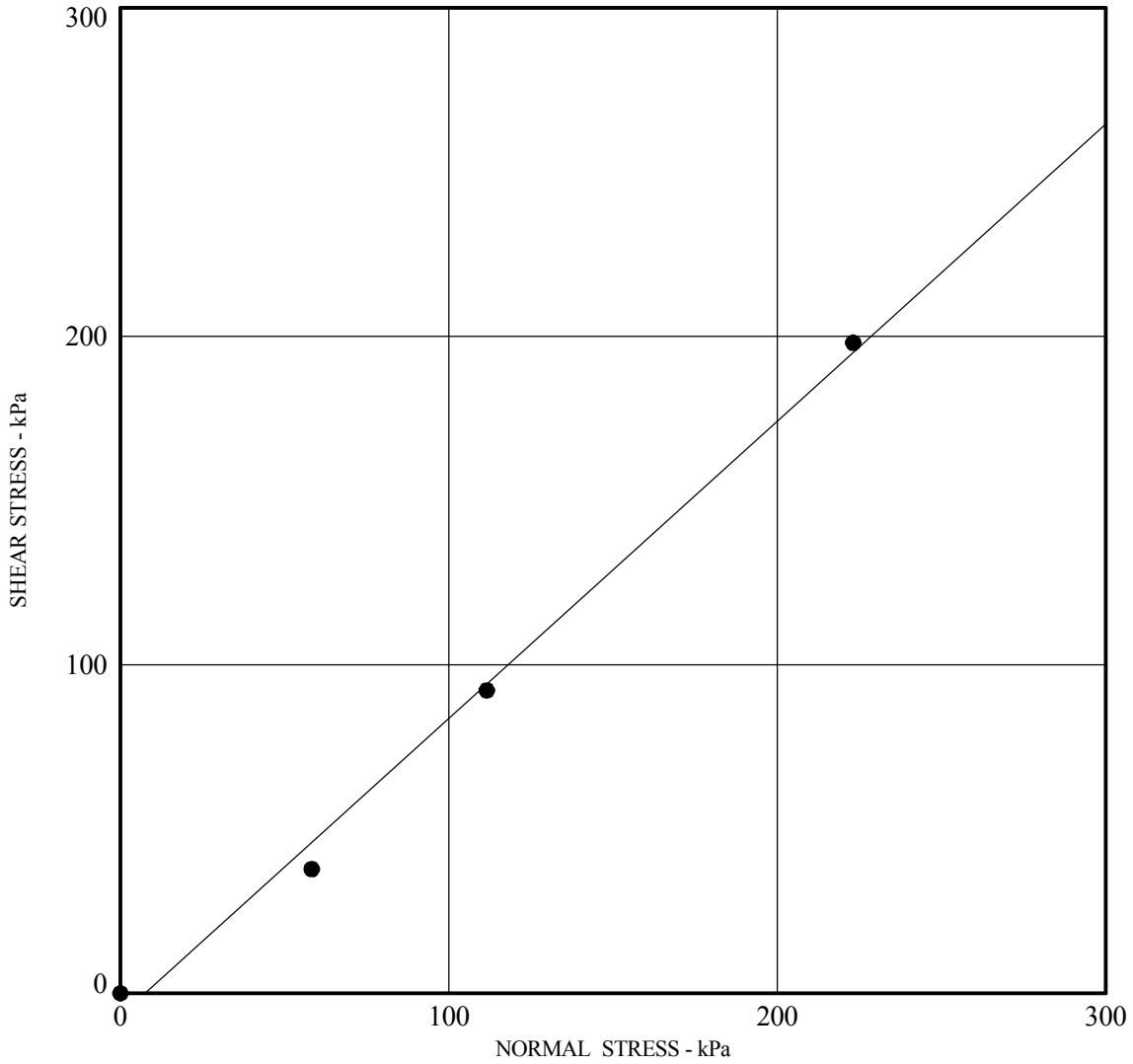
DIRECT SHEAR TEST

PLATE

B-4

DIRECT SHEAR STATION 76979 I-215 SR-EB&WB HOV CONNECTORS.GPJ KA_RDLND.GDT 2/16/09



Boring	**HV- 6**
Depth (m)	**2**
Friction Angle - deg	**42**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**17.2**
Moisture Content (%) *	**1.2**
Description	**Sand with Silt**
Classification	**SW-SM**

*** In-situ Test**

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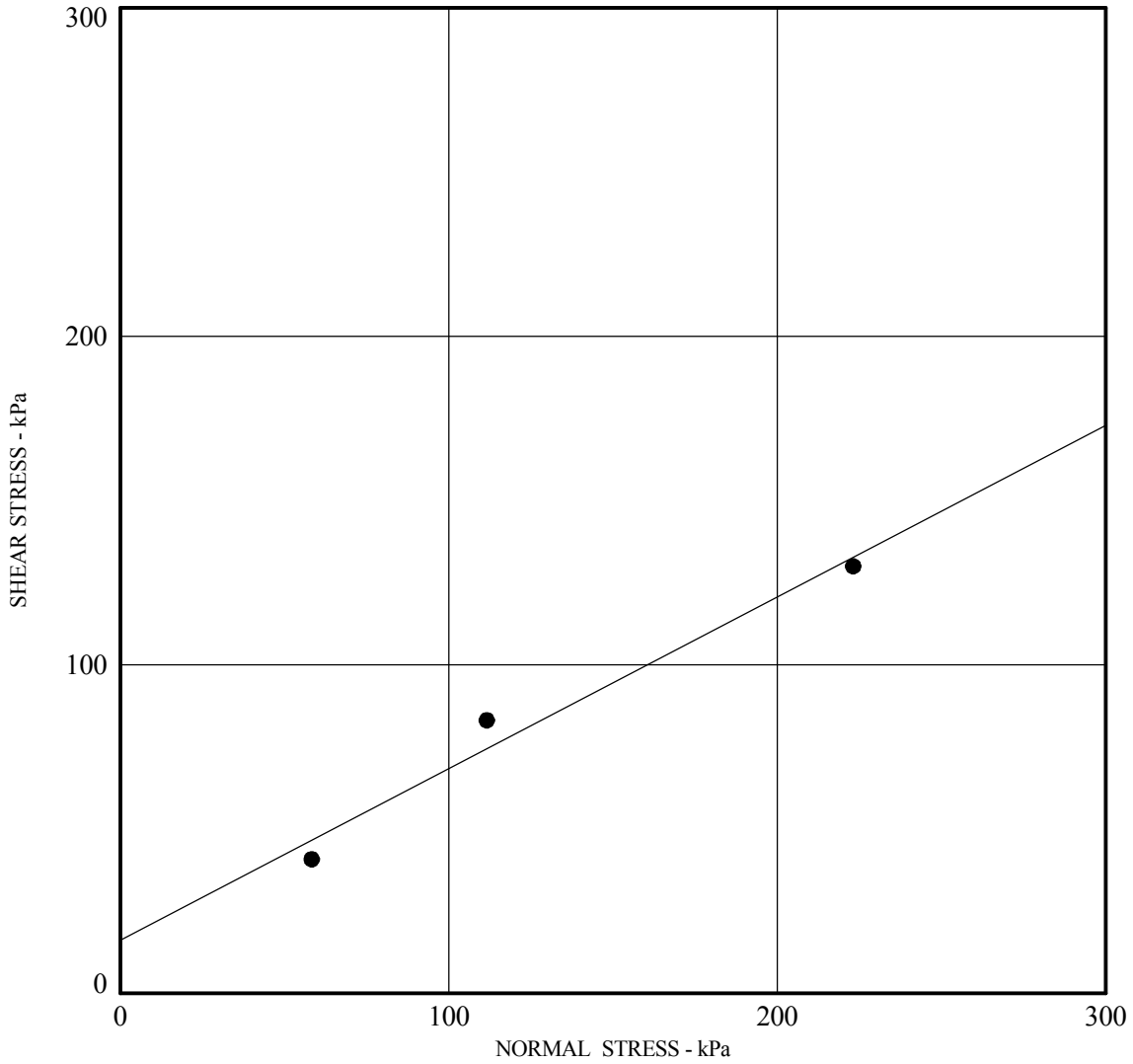
DIRECT SHEAR TEST

PLATE

B-5

DIRECT SHEAR STATION 76979 I-215 SR-EB&WB HOV CONNECTORS.GPJ KA_RDLND.GDT 2/16/09



Boring	**HV- 8**
Depth (m)	**6**
Friction Angle - deg	**28**
Cohesion (kPa)	**16.2**
Dry Density (kN/m^3)	**20.3**
Moisture Content (%) *	**8.1**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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DIRECT SHEAR TEST

PLATE

B-6

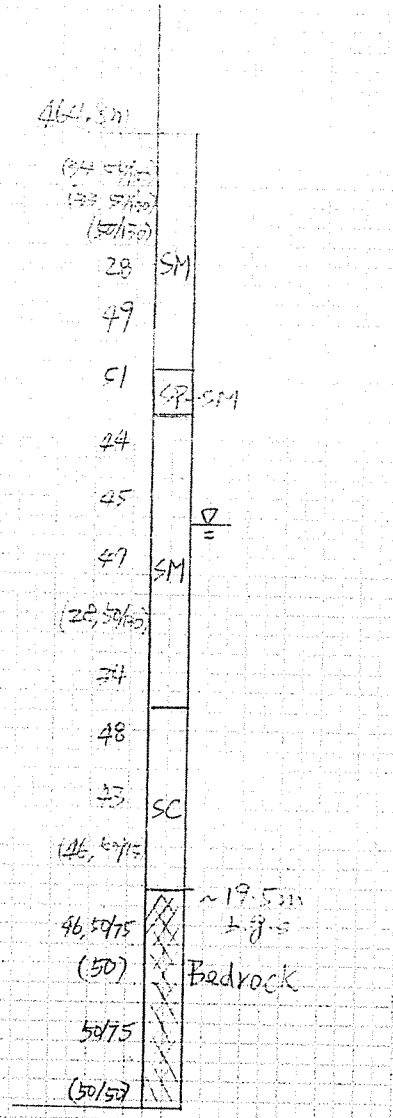
DIRECT SHEAR STATION 76979 I-215 SR-EB&WB HOV CONNECTORS.GPJ KA_RDLND.GDT 2/16/09

APPENDIX C

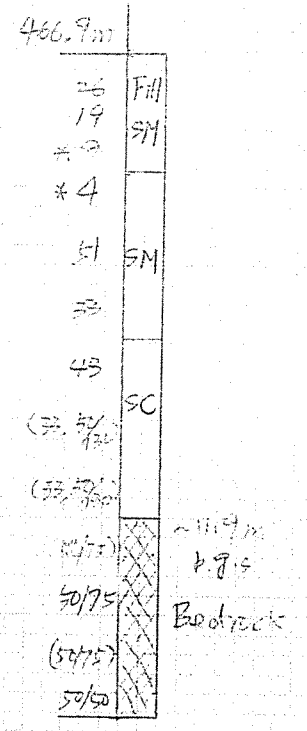
ENGINEERING ANALYSES

C-1

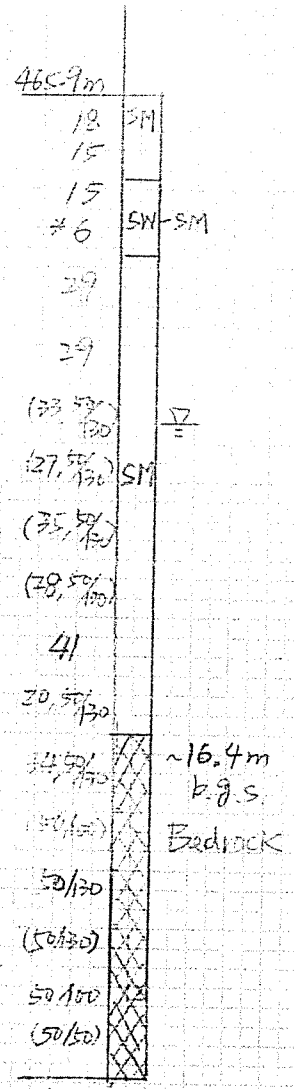
SOIL CROSS SECTIONS



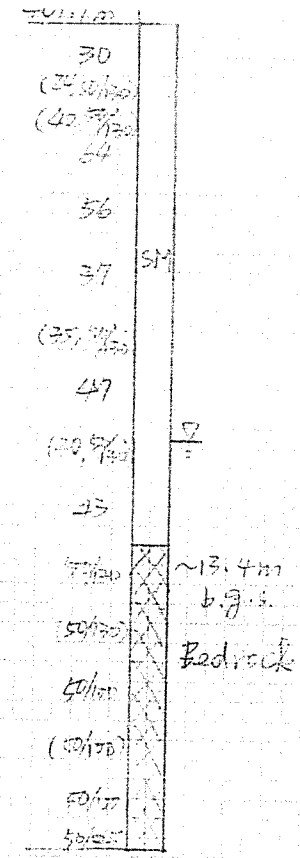
EOB 25.0m (Refusal)
G.W. 10.0m



EOB 17.1m (Refusal)
G.W. Φ



EOB 25.3m (Refusal)
G.W. 10.4m



EOB 21.3m (Refusal)
G.W. 10.7m

C-2

LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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(Licensed to: Kleinfelder West, Inc. - Redlands, California)

PROJECT INFORMATION	
Project Name	I-215/SR60 East Junction HOV Connector
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA	
Exploration No.	HV-3/No Soil Improv.
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1532.0 feet
Proposed Grade Elevation	1532.0 feet
Unit Weight of Proposed Fill on Surface	125.0 pcf
GWT Elevation During Test	1496.0 feet
GWT Elevation For Design	1502.0 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1532.0	1530.0	2.0	SM	Y	120.0	25.00	20.0
1530.0	1527.0	5.0	SM	Y	120.0	18.00	20.0
1527.0	1524.5	7.5	SM	Y	120.0	8.00	20.0
1524.5	1522.0	10.0	SM	Y	120.0	4.00	20.0
1522.0	1517.0	15.0	SM	Y	120.0	49.00	20.0
1517.0	1512.0	20.0	SM	Y	120.0	33.00	20.0
1512.0	1507.0	25.0	SC	Y	120.0	40.00	35.0
1507.0	1502.0	30.0	SC	Y	120.0	90.00	35.0
1502.0	1497.0	35.0	SC	Y	120.0	90.00	35.0
1497.0	1492.0	40.0	BEDROCK/FORMATION	N	135.0	90.00	10.0
1492.0	1487.0	45.0	BEDROCK/FORMATION	N	135.0	90.00	10.0
1487.0	1482.0	50.0	BEDROCK/FORMATION	N	135.0	90.00	10.0

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GWT Elevation During Test	1496.00 feet
GWT Elevation For Design	1502.00 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<==== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.24 inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.24 inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S \times f(FC)$
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ $CSR = 0.65 A_{max} (\sigma_v/\sigma_v') r_d$
* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5} MSF K_\sigma K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), $K_\alpha = 1.0$ (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1532.0	1531.0	SM	Y	120.0	25	20.0
1531.0	1530.0	SM	Y	120.0	25	20.0
1530.0	1529.0	SM	Y	120.0	18	20.0
1529.0	1528.0	SM	Y	120.0	18	20.0
1528.0	1527.0	SM	Y	120.0	18	20.0
1527.0	1526.0	SM	Y	120.0	8	20.0
1526.0	1525.0	SM	Y	120.0	8	20.0
1525.0	1524.0	SM	Y	120.0	4	20.0
1524.0	1523.0	SM	Y	120.0	4	20.0
1523.0	1522.0	SM	Y	120.0	4	20.0
1522.0	1521.0	SM	Y	120.0	49	20.0
1521.0	1520.0	SM	Y	120.0	49	20.0
1520.0	1519.0	SM	Y	120.0	49	20.0
1519.0	1518.0	SM	Y	120.0	49	20.0
1518.0	1517.0	SM	Y	120.0	49	20.0
1517.0	1516.0	SM	Y	120.0	33	20.0
1516.0	1515.0	SM	Y	120.0	33	20.0
1515.0	1514.0	SM	Y	120.0	33	20.0
1514.0	1513.0	SM	Y	120.0	33	20.0
1513.0	1512.0	SM	Y	120.0	33	20.0
1512.0	1511.0	SC	Y	120.0	40	35.0
1511.0	1510.0	SC	Y	120.0	40	35.0
1510.0	1509.0	SC	Y	120.0	40	35.0
1509.0	1508.0	SC	Y	120.0	40	35.0
1508.0	1507.0	SC	Y	120.0	40	35.0
1507.0	1506.0	SC	Y	120.0	90	35.0
1506.0	1505.0	SC	Y	120.0	90	35.0
1505.0	1504.0	SC	Y	120.0	90	35.0
1504.0	1503.0	SC	Y	120.0	90	35.0
1503.0	1502.0	SC	Y	120.0	90	35.0
1502.0	1501.0	SC	Y	120.0	90	35.0
1501.0	1500.0	SC	Y	120.0	90	35.0
1500.0	1499.0	SC	Y	120.0	90	35.0
1499.0	1498.0	SC	Y	120.0	90	35.0
1498.0	1497.0	SC	Y	120.0	90	35.0
1497.0	1496.0	BEDROCK/FORMATION	N	135.0	90	10.0
1496.0	1495.0	BEDROCK/FORMATION	N	135.0	90	10.0
1495.0	1494.0	BEDROCK/FORMATION	N	135.0	90	10.0
1494.0	1493.0	BEDROCK/FORMATION	N	135.0	90	10.0
1493.0	1492.0	BEDROCK/FORMATION	N	135.0	90	10.0
1492.0	1491.0	BEDROCK/FORMATION	N	135.0	90	10.0
1491.0	1490.0	BEDROCK/FORMATION	N	135.0	90	10.0
1490.0	1489.0	BEDROCK/FORMATION	N	135.0	90	10.0
1489.0	1488.0	BEDROCK/FORMATION	N	135.0	90	10.0
1488.0	1487.0	BEDROCK/FORMATION	N	135.0	90	10.0
1487.0	1486.0	BEDROCK/FORMATION	N	135.0	90	10.0
1486.0	1485.0	BEDROCK/FORMATION	N	135.0	90	10.0
1485.0	1484.0	BEDROCK/FORMATION	N	135.0	90	10.0
1484.0	1483.0	BEDROCK/FORMATION	N	135.0	90	10.0

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio +++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks
0.5	1.700	0.750	56.2	0.999	N/A	0.325	N/A	N/A	NO	N/A	Soil above GWT
1.5	1.700	0.750	56.2	0.997	N/A	0.324	N/A	N/A	NO	N/A	Soil above GWT
2.5	1.630	0.750	39.9	0.994	N/A	0.323	N/A	N/A	NO	N/A	Soil above GWT
3.5	1.560	0.750	38.4	0.992	N/A	0.322	N/A	N/A	NO	N/A	Soil above GWT
4.5	1.497	0.750	37.0	0.990	N/A	0.322	N/A	N/A	NO	N/A	Soil above GWT
5.5	1.438	0.750	17.9	0.987	N/A	0.321	N/A	N/A	NO	N/A	Soil above GWT
6.5	1.384	0.750	17.3	0.985	N/A	0.320	N/A	N/A	NO	N/A	Soil above GWT
7.5	1.333	0.750	10.2	0.983	N/A	0.319	N/A	N/A	NO	N/A	Soil above GWT
8.5	1.287	0.850	10.8	0.980	N/A	0.319	N/A	N/A	NO	N/A	Soil above GWT
9.5	1.243	0.850	10.6	0.978	N/A	0.318	N/A	N/A	NO	N/A	Soil above GWT
10.5	1.202	0.850	86.3	0.976	N/A	0.317	N/A	N/A	NO	N/A	Soil above GWT
11.5	1.164	0.850	83.7	0.973	N/A	0.316	N/A	N/A	NO	N/A	Soil above GWT
12.5	1.128	0.850	81.2	0.971	N/A	0.316	N/A	N/A	NO	N/A	Soil above GWT
13.5	1.095	0.850	78.9	0.969	N/A	0.315	N/A	N/A	NO	N/A	Soil above GWT
14.5	1.063	0.850	76.7	0.966	N/A	0.314	N/A	N/A	NO	N/A	Soil above GWT
15.5	1.033	0.950	57.1	0.964	N/A	0.313	N/A	N/A	NO	N/A	Soil above GWT
16.5	1.005	0.950	55.6	0.962	N/A	0.312	N/A	N/A	NO	N/A	Soil above GWT
17.5	0.978	0.950	54.2	0.959	N/A	0.312	N/A	N/A	NO	N/A	Soil above GWT
18.5	0.952	0.950	52.9	0.957	N/A	0.311	N/A	N/A	NO	N/A	Soil above GWT
19.5	0.928	0.950	51.7	0.955	N/A	0.310	N/A	N/A	NO	N/A	Soil above GWT
20.5	0.905	0.950	68.1	0.952	N/A	0.309	N/A	N/A	NO	N/A	Soil above GWT
21.5	0.884	0.950	66.6	0.950	N/A	0.309	N/A	N/A	NO	N/A	Soil above GWT
22.5	0.863	0.950	65.2	0.948	N/A	0.308	N/A	N/A	NO	N/A	Soil above GWT
23.5	0.843	0.950	63.8	0.945	N/A	0.307	N/A	N/A	NO	N/A	Soil above GWT
24.5	0.824	0.950	62.5	0.943	N/A	0.306	N/A	N/A	NO	N/A	Soil above GWT
25.5	0.806	0.950	131.5	0.941	N/A	0.306	N/A	N/A	NO	N/A	Soil above GWT
26.5	0.789	0.950	128.7	0.938	N/A	0.305	N/A	N/A	NO	N/A	Soil above GWT
27.5	0.772	0.950	126.1	0.936	N/A	0.304	N/A	N/A	NO	N/A	Soil above GWT
28.5	0.756	1.000	129.9	0.934	N/A	0.303	N/A	N/A	NO	N/A	Soil above GWT
29.5	0.741	1.000	127.4	0.931	N/A	0.303	N/A	N/A	NO	N/A	Soil above GWT
30.5	0.726	1.000	124.9	0.926	0.788	0.303	N/A	N/A	NO	N/A	Dense/stiff soil
31.5	0.712	1.000	122.6	0.918	0.783	0.306	N/A	N/A	NO	N/A	Dense/stiff soil
32.5	0.698	1.000	120.4	0.909	0.778	0.308	N/A	N/A	NO	N/A	Dense/stiff soil
33.5	0.685	1.000	118.2	0.901	0.773	0.310	N/A	N/A	NO	N/A	Dense/stiff soil
34.5	0.673	1.000	116.1	0.893	0.769	0.311	N/A	N/A	NO	N/A	Dense/stiff soil
35.5	0.660	1.000	N/A	0.885	N/A	0.313	N/A	N/A	NO	N/A	Bedrock/Formation
36.5	0.650	1.000	N/A	0.877	N/A	0.314	N/A	N/A	NO	N/A	Bedrock/Formation
37.5	0.643	1.000	N/A	0.869	N/A	0.315	N/A	N/A	NO	N/A	Bedrock/Formation
38.5	0.636	1.000	N/A	0.861	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation
39.5	0.630	1.000	N/A	0.852	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation
40.5	0.623	1.000	N/A	0.844	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation
41.5	0.617	1.000	N/A	0.836	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation
42.5	0.611	1.000	N/A	0.828	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation
43.5	0.604	1.000	N/A	0.820	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation
44.5	0.598	1.000	N/A	0.812	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation
45.5	0.593	1.000	N/A	0.804	N/A	0.315	N/A	N/A	NO	N/A	Bedrock/Formation
46.5	0.587	1.000	N/A	0.795	N/A	0.315	N/A	N/A	NO	N/A	Bedrock/Formation
47.5	0.581	1.000	N/A	0.787	N/A	0.314	N/A	N/A	NO	N/A	Bedrock/Formation
48.5	0.576	1.000	N/A	0.779	N/A	0.313	N/A	N/A	NO	N/A	Bedrock/Formation

RESIDUAL STRENGTH AND GROUND SETTLEMENT

Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
50.4	N/A	0.014	0.000	0.00	0.24
50.3	N/A	0.024	0.000	0.00	0.24
35.3	N/A	0.036	0.031	0.00	0.23
33.9	N/A	0.043	0.039	0.00	0.23
32.6	N/A	0.049	0.047	0.01	0.22
19.9	N/A	0.076	0.174	0.02	0.20
16.4	N/A	0.083	0.198	0.02	0.18
7.8	N/A	0.110	0.494	0.06	0.12
8.4	N/A	0.114	0.477	0.06	0.06
8.1	N/A	0.121	0.520	0.06	0.00
78.3	N/A	0.052	0.000	0.00	0.00
75.8	N/A	0.055	0.000	0.00	0.00
73.5	N/A	0.058	0.000	0.00	0.00
71.4	N/A	0.061	0.000	0.00	0.00
69.4	N/A	0.063	0.000	0.00	0.00
51.2	N/A	0.072	0.000	0.00	0.00
49.8	N/A	0.074	0.000	0.00	0.00
48.6	N/A	0.077	0.000	0.00	0.00
47.3	N/A	0.079	0.000	0.00	0.00
46.2	N/A	0.082	0.000	0.00	0.00
55.4	N/A	0.076	0.000	0.00	0.00
54.2	N/A	0.078	0.000	0.00	0.00
52.9	N/A	0.080	0.000	0.00	0.00
51.8	N/A	0.082	0.000	0.00	0.00
50.7	N/A	0.084	0.000	0.00	0.00
108.2	N/A	0.067	0.000	0.00	0.00
105.9	N/A	0.068	0.000	0.00	0.00
103.7	N/A	0.070	0.000	0.00	0.00
106.9	N/A	0.070	0.000	0.00	0.00
104.8	N/A	0.072	0.000	0.00	0.00
102.7	N/A	N/A	0.000	0.00	0.00
100.8	N/A	N/A	0.000	0.00	0.00
98.9	N/A	N/A	0.000	0.00	0.00
97.1	N/A	N/A	0.000	0.00	0.00
95.4	N/A	N/A	0.000	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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Project No.	76979
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For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<==== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 - 15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.24 inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.24 inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S \times f(FC)$

++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit

+++ $CSR = 0.65 A_{max} (\sigma_v/\sigma_v') r_d$

* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5} MSF K_\sigma K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), $K_\sigma = 1.0$ (level ground), and MSF = magnitude scaling factor

** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).

*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).

**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1483.0	1482.0	BEDROCK/FORMATION	N	135.0	90	10.0

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks
49.5	0.570	1.000	N/A	0.771	N/A	0.312	N/A	N/A	NO	N/A	Bedrock/Formation

RESIDUAL STRENGTH AND GROUND SETTLEMENT

Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
N/A	N/A	N/A	N/A	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	I-215/SR60 East Junction HOV Connector
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA	
Exploration No.	HV-6/No Soil Improv.
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1529.0 feet
Proposed Grade Elevation	1529.0 feet
Unit Weight of Proposed Fill on Surface	125.0 pcf
GWT Elevation During Test	1495.0 feet
GWT Elevation For Design	1499.0 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1529.0	1527.0	2.0	SM	Y	120.0	17.00	20.0
1527.0	1524.0	5.0	SM	Y	120.0	14.00	20.0
1524.0	1521.5	7.5	SW-SM	Y	120.0	15.00	6.0
1521.5	1519.0	10.0	SW-SM	Y	120.0	6.00	6.0
1519.0	1514.0	15.0	SM	Y	120.0	27.00	20.0
1514.0	1509.0	20.0	SM	Y	120.0	29.00	20.0
1509.0	1504.0	25.0	SC	Y	120.0	90.00	20.0
1504.0	1499.0	30.0	SC	Y	120.0	90.00	20.0
1499.0	1494.0	35.0	SC	Y	120.0	90.00	20.0
1494.0	1489.0	40.0	SM	Y	120.0	90.00	20.0
1489.0	1484.0	45.0	SM	Y	120.0	41.00	20.0
1484.0	1479.0	50.0	SM	Y	120.0	90.00	20.0

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<====	LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet		LPI = 5 - 15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<====	Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.26 inches	<====	Dry or Unsaturated Soils (Above GWT)
	0.26 inches	<====	Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S \times f(FC)$

++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < (5%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit

+++ $CSR = 0.65\, A_{max} (\sigma_v/\sigma_v')\, r_d$

* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5}\, MSF\, K_\sigma\, K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), $K_\alpha = 1.0$ (level ground), and MSF = magnitude scaling factor

** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).

*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).

**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma\, w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1529.0	1528.0	SM	Y	120.0	17	20.0
1528.0	1527.0	SM	Y	120.0	17	20.0
1527.0	1526.0	SM	Y	120.0	14	20.0
1526.0	1525.0	SM	Y	120.0	14	20.0
1525.0	1524.0	SM	Y	120.0	14	20.0
1524.0	1523.0	SW-SM	Y	120.0	15	6.0
1523.0	1522.0	SW-SM	Y	120.0	15	6.0
1522.0	1521.0	SW-SM	Y	120.0	6	6.0
1521.0	1520.0	SW-SM	Y	120.0	6	6.0
1520.0	1519.0	SW-SM	Y	120.0	6	6.0
1519.0	1518.0	SM	Y	120.0	27	20.0
1518.0	1517.0	SM	Y	120.0	27	20.0
1517.0	1516.0	SM	Y	120.0	27	20.0
1516.0	1515.0	SM	Y	120.0	27	20.0
1515.0	1514.0	SM	Y	120.0	27	20.0
1514.0	1513.0	SM	Y	120.0	29	20.0
1513.0	1512.0	SM	Y	120.0	29	20.0
1512.0	1511.0	SM	Y	120.0	29	20.0
1511.0	1510.0	SM	Y	120.0	29	20.0
1510.0	1509.0	SM	Y	120.0	29	20.0
1509.0	1508.0	SC	Y	120.0	90	20.0
1508.0	1507.0	SC	Y	120.0	90	20.0
1507.0	1506.0	SC	Y	120.0	90	20.0
1506.0	1505.0	SC	Y	120.0	90	20.0
1505.0	1504.0	SC	Y	120.0	90	20.0
1504.0	1503.0	SC	Y	120.0	90	20.0
1503.0	1502.0	SC	Y	120.0	90	20.0
1502.0	1501.0	SC	Y	120.0	90	20.0
1501.0	1500.0	SC	Y	120.0	90	20.0
1500.0	1499.0	SC	Y	120.0	90	20.0
1499.0	1498.0	SC	Y	120.0	90	20.0
1498.0	1497.0	SC	Y	120.0	90	20.0
1497.0	1496.0	SC	Y	120.0	90	20.0
1496.0	1495.0	SC	Y	120.0	90	20.0
1495.0	1494.0	SC	Y	120.0	90	20.0
1494.0	1493.0	SM	Y	120.0	90	20.0
1493.0	1492.0	SM	Y	120.0	90	20.0
1492.0	1491.0	SM	Y	120.0	90	20.0
1491.0	1490.0	SM	Y	120.0	90	20.0
1490.0	1489.0	SM	Y	120.0	90	20.0
1489.0	1488.0	SM	Y	120.0	41	20.0
1488.0	1487.0	SM	Y	120.0	41	20.0
1487.0	1486.0	SM	Y	120.0	41	20.0
1486.0	1485.0	SM	Y	120.0	41	20.0
1485.0	1484.0	SM	Y	120.0	41	20.0
1484.0	1483.0	SM	Y	120.0	90	20.0
1483.0	1482.0	SM	Y	120.0	90	20.0
1482.0	1481.0	SM	Y	120.0	90	20.0
1481.0	1480.0	SM	Y	120.0	90	20.0

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks
0.5	1.700	0.750	39.4	0.999	N/A	0.325	N/A	N/A	NO	N/A	Soil above GWT
1.5	1.700	0.750	39.4	0.997	N/A	0.324	N/A	N/A	NO	N/A	Soil above GWT
2.5	1.630	0.750	31.9	0.994	N/A	0.323	N/A	N/A	NO	N/A	Soil above GWT
3.5	1.560	0.750	30.7	0.992	N/A	0.322	N/A	N/A	NO	N/A	Soil above GWT
4.5	1.497	0.750	29.6	0.990	N/A	0.322	N/A	N/A	NO	N/A	Soil above GWT
5.5	1.438	0.750	24.9	0.987	N/A	0.321	N/A	N/A	NO	N/A	Soil above GWT
6.5	1.384	0.750	23.9	0.985	N/A	0.320	N/A	N/A	NO	N/A	Soil above GWT
7.5	1.333	0.750	9.2	0.983	N/A	0.319	N/A	N/A	NO	N/A	Soil above GWT
8.5	1.287	0.850	10.1	0.980	N/A	0.319	N/A	N/A	NO	N/A	Soil above GWT
9.5	1.243	0.850	9.8	0.978	N/A	0.318	N/A	N/A	NO	N/A	Soil above GWT
10.5	1.202	0.850	49.2	0.976	N/A	0.317	N/A	N/A	NO	N/A	Soil above GWT
11.5	1.164	0.850	47.7	0.973	N/A	0.316	N/A	N/A	NO	N/A	Soil above GWT
12.5	1.128	0.850	46.4	0.971	N/A	0.316	N/A	N/A	NO	N/A	Soil above GWT
13.5	1.095	0.850	45.1	0.969	N/A	0.315	N/A	N/A	NO	N/A	Soil above GWT
14.5	1.063	0.850	43.9	0.966	N/A	0.314	N/A	N/A	NO	N/A	Soil above GWT
15.5	1.033	0.950	50.6	0.964	N/A	0.313	N/A	N/A	NO	N/A	Soil above GWT
16.5	1.005	0.950	49.3	0.962	N/A	0.312	N/A	N/A	NO	N/A	Soil above GWT
17.5	0.978	0.950	48.1	0.959	N/A	0.312	N/A	N/A	NO	N/A	Soil above GWT
18.5	0.952	0.950	46.9	0.957	N/A	0.311	N/A	N/A	NO	N/A	Soil above GWT
19.5	0.928	0.950	45.8	0.955	N/A	0.310	N/A	N/A	NO	N/A	Soil above GWT
20.5	0.905	0.950	131.4	0.952	N/A	0.309	N/A	N/A	NO	N/A	Soil above GWT
21.5	0.884	0.950	128.3	0.950	N/A	0.309	N/A	N/A	NO	N/A	Soil above GWT
22.5	0.863	0.950	125.4	0.948	N/A	0.308	N/A	N/A	NO	N/A	Soil above GWT
23.5	0.843	0.950	122.6	0.945	N/A	0.307	N/A	N/A	NO	N/A	Soil above GWT
24.5	0.824	0.950	119.9	0.943	N/A	0.306	N/A	N/A	NO	N/A	Soil above GWT
25.5	0.806	0.950	117.4	0.941	N/A	0.306	N/A	N/A	NO	N/A	Soil above GWT
26.5	0.789	0.950	114.9	0.938	N/A	0.305	N/A	N/A	NO	N/A	Soil above GWT
27.5	0.772	0.950	112.6	0.936	N/A	0.304	N/A	N/A	NO	N/A	Soil above GWT
28.5	0.756	1.000	116.0	0.934	N/A	0.303	N/A	N/A	NO	N/A	Soil above GWT
29.5	0.741	1.000	113.7	0.931	N/A	0.303	N/A	N/A	NO	N/A	Soil above GWT
30.5	0.726	1.000	111.5	0.926	0.788	0.303	N/A	N/A	NO	N/A	Dense/stiff soil
31.5	0.712	1.000	109.3	0.918	0.783	0.306	N/A	N/A	NO	N/A	Dense/stiff soil
32.5	0.698	1.000	107.4	0.909	0.778	0.308	N/A	N/A	NO	N/A	Dense/stiff soil
33.5	0.685	1.000	105.5	0.901	0.773	0.310	N/A	N/A	NO	N/A	Dense/stiff soil
34.5	0.676	1.000	104.1	0.893	0.769	0.311	N/A	N/A	NO	N/A	Dense/stiff soil
35.5	0.670	1.000	103.2	0.885	0.764	0.313	N/A	N/A	NO	N/A	Dense/stiff soil
36.5	0.664	1.000	102.3	0.877	0.760	0.314	N/A	N/A	NO	N/A	Dense/stiff soil
37.5	0.659	1.000	101.5	0.869	0.755	0.315	N/A	N/A	NO	N/A	Dense/stiff soil
38.5	0.653	1.000	100.6	0.861	0.751	0.316	N/A	N/A	NO	N/A	Dense/stiff soil
39.5	0.647	1.000	99.8	0.852	0.747	0.317	N/A	N/A	NO	N/A	Dense/stiff soil
40.5	0.642	1.000	47.1	0.844	0.743	0.317	N/A	N/A	NO	N/A	Dense/stiff soil
41.5	0.637	1.000	46.7	0.836	0.739	0.318	N/A	N/A	NO	N/A	Dense/stiff soil
42.5	0.631	1.000	46.3	0.828	0.735	0.318	N/A	N/A	NO	N/A	Dense/stiff soil
43.5	0.626	1.000	46.0	0.820	0.731	0.318	N/A	N/A	NO	N/A	Dense/stiff soil
44.5	0.621	1.000	45.7	0.812	0.727	0.318	N/A	N/A	NO	N/A	Dense/stiff soil
45.5	0.616	1.000	95.2	0.804	0.723	0.317	N/A	N/A	NO	N/A	Dense/stiff soil
46.5	0.611	1.000	94.4	0.795	0.720	0.317	N/A	N/A	NO	N/A	Dense/stiff soil
47.5	0.606	1.000	93.7	0.787	0.716	0.317	N/A	N/A	NO	N/A	Dense/stiff soil
48.5	0.601	1.000	93.0	0.779	0.713	0.316	N/A	N/A	NO	N/A	Dense/stiff soil

RESIDUAL STRENGTH AND GROUND SETTLEMENT

Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
34.8	N/A	0.016	0.014	0.00	0.26
34.8	N/A	0.028	0.025	0.00	0.25
27.8	N/A	0.040	0.046	0.01	0.25
26.7	N/A	0.048	0.057	0.01	0.24
25.7	N/A	0.055	0.069	0.01	0.23
25.3	N/A	0.065	0.101	0.01	0.22
24.4	N/A	0.072	0.116	0.01	0.21
9.8	N/A	0.115	0.583	0.07	0.14
10.6	N/A	0.117	0.533	0.06	0.07
10.3	N/A	0.125	0.593	0.07	0.00
43.9	N/A	0.064	0.000	0.00	0.00
42.5	N/A	0.067	0.000	0.00	0.00
41.3	N/A	0.071	0.000	0.00	0.00
40.1	N/A	0.074	0.000	0.00	0.00
39.0	N/A	0.078	0.000	0.00	0.00
45.2	N/A	0.075	0.000	0.00	0.00
44.0	N/A	0.078	0.000	0.00	0.00
42.9	N/A	0.081	0.000	0.00	0.00
41.8	N/A	0.084	0.000	0.00	0.00
40.8	N/A	0.086	0.000	0.00	0.00
120.1	N/A	0.061	0.000	0.00	0.00
117.2	N/A	0.063	0.000	0.00	0.00
114.5	N/A	0.065	0.000	0.00	0.00
111.9	N/A	0.066	0.000	0.00	0.00
109.4	N/A	0.068	0.000	0.00	0.00
107.1	N/A	0.069	0.000	0.00	0.00
104.8	N/A	0.071	0.000	0.00	0.00
102.6	N/A	0.073	0.000	0.00	0.00
105.7	N/A	0.073	0.000	0.00	0.00
103.6	N/A	0.074	0.000	0.00	0.00
101.6	N/A	N/A	0.000	0.00	0.00
99.7	N/A	N/A	0.000	0.00	0.00
97.8	N/A	N/A	0.000	0.00	0.00
96.0	N/A	N/A	0.000	0.00	0.00
94.7	N/A	N/A	0.000	0.00	0.00
93.9	N/A	N/A	0.000	0.00	0.00
93.1	N/A	N/A	0.000	0.00	0.00
92.3	N/A	N/A	0.000	0.00	0.00
91.5	N/A	N/A	0.000	0.00	0.00
90.8	N/A	N/A	0.000	0.00	0.00
41.9	N/A	N/A	0.000	0.00	0.00
41.6	N/A	N/A	0.000	0.00	0.00
41.3	N/A	N/A	0.000	0.00	0.00
40.9	N/A	N/A	0.000	0.00	0.00
40.6	N/A	N/A	0.000	0.00	0.00
86.5	N/A	N/A	0.000	0.00	0.00
85.8	N/A	N/A	0.000	0.00	0.00
85.1	N/A	N/A	0.000	0.00	0.00
84.5	N/A	N/A	0.000	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR60 East Junction HOV Connector
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	HV-6/No Soil Improv
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1529.00 feet
Proposed Grade Elevation	1529.00 feet
Unit Weight of Proposed Fill on Surface	125.00 pcf
GWT Elevation During Test	1495.00 feet
GWT Elevation For Design	1499.00 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<==== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.26 inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.26 inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_S \times f(FC)$

++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit

+++ $CSR = 0.65\, A_{max} (\sigma_v/\sigma_v')\, r_d$

* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5}\, MSF\, K_\sigma\, K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), $K_\sigma = 1.0$ (level ground), and MSF = magnitude scaling factor

** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).

*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).

**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma\, w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1480.0	1479.0	SM	Y	120.0	90	20.0

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
49.5	0.597	1.000	92.3	0.771	0.709	0.315	N/A	N/A	NO	N/A	Dense/stiff soil	83.8	N/A	N/A	0.000	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	Ret. Walls @ Abut. 4 WB (HV-4)
Project No.	76979
Location	Riverside. California

GENERAL INPUT DATA	
Exploration No.	HV-4
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1536.0 feet
Proposed Grade Elevation	1540.0 feet
Unit Weight of Proposed Fill on Surface	125.0 pcf
GWT Elevation During Test	1498.0 feet
GWT Elevation For Design	1506.0 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1536.0	1533.5	2.5	SM	Y	120.0	15.00	15.0
1533.5	1531.0	5.0	SM	Y	120.0	22.00	15.0
1531.0	1528.5	7.5	SM	Y	120.0	14.00	15.0
1528.5	1526.0	10.0	SM	Y	120.0	40.00	15.0
1526.0	1523.5	12.5	SM	Y	120.0	48.00	15.0
1523.5	1518.5	17.5	SM	Y	120.0	51.00	15.0
1518.5	1513.5	22.5	SM	Y	120.0	37.00	15.0
1513.5	1508.5	27.5	SC	Y	120.0	51.00	25.0
1508.5	1506.0	30.0	BEDROCK/FORMATION	N	135.0	60.00	
1506.0	1503.5	32.5	BEDROCK/FORMATION	N	135.0	60.00	
1503.5	1498.5	37.5	BEDROCK/FORMATION	N	135.0	60.00	
1498.5	1493.5	42.5	BEDROCK/FORMATION	N	135.0	60.00	
1493.5	1488.5	47.5	BEDROCK/FORMATION	N	135.0	70.00	
1488.5	1484.5	51.5	BEDROCK/FORMATION	N	135.0	70.00	

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	Ret. Walls @ Abut. 4 WB (HV-4)
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

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Peak Ground Acceleration, A_{max}	0.50 g
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For Borehole Diameter, C_B	1.15
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SUMMARY OF RESULTS

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Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.04 inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.04 inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ $CSR = 0.65\, A_{max} (\sigma_v/\sigma_v')\, r_d$
* FS_{liq} = (CRR/CSR), where $CRR = CRR_{7.5}\, MSF\, K_\sigma\, K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_σ =1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma\, w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1536.0	1535.0	SM	Y	120.0	15	15.0
1535.0	1534.0	SM	Y	120.0	15	15.0
1534.0	1533.0	SM	Y	120.0	22	15.0
1533.0	1532.0	SM	Y	120.0	22	15.0
1532.0	1531.0	SM	Y	120.0	22	15.0
1531.0	1530.0	SM	Y	120.0	14	15.0
1530.0	1529.0	SM	Y	120.0	14	15.0
1529.0	1528.0	SM	Y	120.0	40	15.0
1528.0	1527.0	SM	Y	120.0	40	15.0
1527.0	1526.0	SM	Y	120.0	40	15.0
1526.0	1525.0	SM	Y	120.0	48	15.0
1525.0	1524.0	SM	Y	120.0	48	15.0
1524.0	1523.0	SM	Y	120.0	51	15.0
1523.0	1522.0	SM	Y	120.0	51	15.0
1522.0	1521.0	SM	Y	120.0	51	15.0
1521.0	1520.0	SM	Y	120.0	51	15.0
1520.0	1519.0	SM	Y	120.0	51	15.0
1519.0	1518.0	SM	Y	120.0	37	15.0
1518.0	1517.0	SM	Y	120.0	37	15.0
1517.0	1516.0	SM	Y	120.0	37	15.0
1516.0	1515.0	SM	Y	120.0	37	15.0
1515.0	1514.0	SM	Y	120.0	37	15.0
1514.0	1513.0	SC	Y	120.0	51	25.0
1513.0	1512.0	SC	Y	120.0	51	25.0
1512.0	1511.0	SC	Y	120.0	51	25.0
1511.0	1510.0	SC	Y	120.0	51	25.0
1510.0	1509.0	SC	Y	120.0	51	25.0
1509.0	1508.0	BEDROCK/FORMATION	N	135.0	60	
1508.0	1507.0	BEDROCK/FORMATION	N	135.0	60	
1507.0	1506.0	BEDROCK/FORMATION	N	135.0	60	
1506.0	1505.0	BEDROCK/FORMATION	N	135.0	60	
1505.0	1504.0	BEDROCK/FORMATION	N	135.0	60	
1504.0	1503.0	BEDROCK/FORMATION	N	135.0	60	
1503.0	1502.0	BEDROCK/FORMATION	N	135.0	60	
1502.0	1501.0	BEDROCK/FORMATION	N	135.0	60	
1501.0	1500.0	BEDROCK/FORMATION	N	135.0	60	
1500.0	1499.0	BEDROCK/FORMATION	N	135.0	60	
1499.0	1498.0	BEDROCK/FORMATION	N	135.0	60	
1498.0	1497.0	BEDROCK/FORMATION	N	135.0	60	
1497.0	1496.0	BEDROCK/FORMATION	N	135.0	60	
1496.0	1495.0	BEDROCK/FORMATION	N	135.0	60	
1495.0	1494.0	BEDROCK/FORMATION	N	135.0	60	
1494.0	1493.0	BEDROCK/FORMATION	N	135.0	70	
1493.0	1492.0	BEDROCK/FORMATION	N	135.0	70	
1492.0	1491.0	BEDROCK/FORMATION	N	135.0	70	
1491.0	1490.0	BEDROCK/FORMATION	N	135.0	70	
1490.0	1489.0	BEDROCK/FORMATION	N	135.0	70	
1489.0	1488.0	BEDROCK/FORMATION	N	135.0	70	
1488.0	1487.0	BEDROCK/FORMATION	N	135.0	70	

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks
0.5	1.700	0.750	33.2	0.990	N/A	0.322	N/A	N/A	NO	N/A	Soil above GWT
1.5	1.700	0.750	33.2	0.987	N/A	0.321	N/A	N/A	NO	N/A	Soil above GWT
2.5	1.639	0.750	45.6	0.985	N/A	0.320	N/A	N/A	NO	N/A	Soil above GWT
3.5	1.560	0.750	43.8	0.983	N/A	0.319	N/A	N/A	NO	N/A	Soil above GWT
4.5	1.497	0.750	42.1	0.980	N/A	0.319	N/A	N/A	NO	N/A	Soil above GWT
5.5	1.438	0.750	26.7	0.978	N/A	0.318	N/A	N/A	NO	N/A	Soil above GWT
6.5	1.384	0.750	25.8	0.976	N/A	0.317	N/A	N/A	NO	N/A	Soil above GWT
7.5	1.333	0.750	66.6	0.973	N/A	0.316	N/A	N/A	NO	N/A	Soil above GWT
8.5	1.287	0.850	72.6	0.971	N/A	0.316	N/A	N/A	NO	N/A	Soil above GWT
9.5	1.243	0.850	70.2	0.969	N/A	0.315	N/A	N/A	NO	N/A	Soil above GWT
10.5	1.202	0.850	81.1	0.966	N/A	0.314	N/A	N/A	NO	N/A	Soil above GWT
11.5	1.164	0.850	78.6	0.964	N/A	0.313	N/A	N/A	NO	N/A	Soil above GWT
12.5	1.128	0.850	80.9	0.962	N/A	0.312	N/A	N/A	NO	N/A	Soil above GWT
13.5	1.095	0.850	78.6	0.959	N/A	0.312	N/A	N/A	NO	N/A	Soil above GWT
14.5	1.063	0.850	76.4	0.957	N/A	0.311	N/A	N/A	NO	N/A	Soil above GWT
15.5	1.033	0.950	82.7	0.955	N/A	0.310	N/A	N/A	NO	N/A	Soil above GWT
16.5	1.005	0.950	80.5	0.952	N/A	0.309	N/A	N/A	NO	N/A	Soil above GWT
17.5	0.978	0.950	57.6	0.950	N/A	0.309	N/A	N/A	NO	N/A	Soil above GWT
18.5	0.952	0.950	56.2	0.948	N/A	0.308	N/A	N/A	NO	N/A	Soil above GWT
19.5	0.928	0.950	54.8	0.945	N/A	0.307	N/A	N/A	NO	N/A	Soil above GWT
20.5	0.905	0.950	53.5	0.943	N/A	0.306	N/A	N/A	NO	N/A	Soil above GWT
21.5	0.880	0.950	52.3	0.941	N/A	0.306	N/A	N/A	NO	N/A	Soil above GWT
22.5	0.863	0.950	75.6	0.938	N/A	0.305	N/A	N/A	NO	N/A	Soil above GWT
23.5	0.843	0.950	73.9	0.936	N/A	0.304	N/A	N/A	NO	N/A	Soil above GWT
24.5	0.824	0.950	72.4	0.934	N/A	0.303	N/A	N/A	NO	N/A	Soil above GWT
25.5	0.806	0.950	70.9	0.931	N/A	0.303	N/A	N/A	NO	N/A	Soil above GWT
26.5	0.789	0.950	69.4	0.926	N/A	0.301	N/A	N/A	NO	N/A	Soil above GWT
27.5	0.771	0.950	N/A	0.918	N/A	0.298	N/A	N/A	NO	N/A	Soil above GWT
28.5	0.753	1.000	N/A	0.909	N/A	0.296	N/A	N/A	NO	N/A	Soil above GWT
29.5	0.736	1.000	N/A	0.901	N/A	0.293	N/A	N/A	NO	N/A	Soil above GWT
30.5	0.720	1.000	N/A	0.893	N/A	0.292	N/A	N/A	NO	N/A	Bedrock/Formation
31.5	0.704	1.000	N/A	0.885	N/A	0.294	N/A	N/A	NO	N/A	Bedrock/Formation
32.5	0.689	1.000	N/A	0.877	N/A	0.295	N/A	N/A	NO	N/A	Bedrock/Formation
33.5	0.675	1.000	N/A	0.869	N/A	0.296	N/A	N/A	NO	N/A	Bedrock/Formation
34.5	0.661	1.000	N/A	0.861	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation
35.5	0.648	1.000	N/A	0.852	N/A	0.298	N/A	N/A	NO	N/A	Bedrock/Formation
36.5	0.636	1.000	N/A	0.844	N/A	0.299	N/A	N/A	NO	N/A	Bedrock/Formation
37.5	0.623	1.000	N/A	0.836	N/A	0.299	N/A	N/A	NO	N/A	Bedrock/Formation
38.5	0.614	1.000	N/A	0.828	N/A	0.299	N/A	N/A	NO	N/A	Bedrock/Formation
39.5	0.608	1.000	N/A	0.820	N/A	0.299	N/A	N/A	NO	N/A	Bedrock/Formation
40.5	0.602	1.000	N/A	0.812	N/A	0.299	N/A	N/A	NO	N/A	Bedrock/Formation
41.5	0.596	1.000	N/A	0.804	N/A	0.299	N/A	N/A	NO	N/A	Bedrock/Formation
42.5	0.590	1.000	N/A	0.795	N/A	0.298	N/A	N/A	NO	N/A	Bedrock/Formation
43.5	0.585	1.000	N/A	0.787	N/A	0.298	N/A	N/A	NO	N/A	Bedrock/Formation
44.5	0.579	1.000	N/A	0.779	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation
45.5	0.574	1.000	N/A	0.771	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation
46.5	0.568	1.000	N/A	0.763	N/A	0.296	N/A	N/A	NO	N/A	Bedrock/Formation
47.5	0.563	1.000	N/A	0.755	N/A	0.295	N/A	N/A	NO	N/A	Bedrock/Formation
48.5	0.558	1.000	N/A	0.747	N/A	0.294	N/A	N/A	NO	N/A	Bedrock/Formation

RESIDUAL STRENGTH AND GROUND SETTLEMENT

Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
30.6	N/A	0.053	0.058	0.01	0.01
30.6	N/A	0.058	0.063	0.01	0.01
42.5	N/A	0.053	0.000	0.00	0.01
40.7	N/A	0.058	0.000	0.00	0.01
39.1	N/A	0.063	0.000	0.00	0.01
24.4	N/A	0.082	0.117	0.01	0.02
23.6	N/A	0.088	0.129	0.02	0.03
62.5	N/A	0.060	0.000	0.00	0.03
68.2	N/A	0.061	0.000	0.00	0.03
66.0	N/A	0.063	0.000	0.00	0.03
76.4	N/A	0.062	0.000	0.00	0.03
74.0	N/A	0.065	0.000	0.00	0.03
76.1	N/A	0.066	0.000	0.00	0.03
73.9	N/A	0.068	0.000	0.00	0.03
71.8	N/A	0.071	0.000	0.00	0.03
77.0	N/A	0.070	0.000	0.00	0.03
75.8	N/A	0.072	0.000	0.00	0.03
53.9	N/A	0.083	0.000	0.00	0.03
52.5	N/A	0.085	0.000	0.00	0.03
51.2	N/A	0.087	0.000	0.00	0.03
50.0	N/A	0.089	0.000	0.00	0.03
48.8	N/A	0.091	0.000	0.00	0.03
65.9	N/A	0.082	0.000	0.00	0.03
64.5	N/A	0.084	0.000	0.00	0.03
63.1	N/A	0.085	0.000	0.00	0.03
61.7	N/A	0.087	0.000	0.00	0.03
60.4	N/A	0.088	0.000	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03
N/A	N/A	N/A	N/A	0.00	0.03

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	Rel. Walls @ Abut. 4 WB (HV-4)
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	HV-4
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1536.00 feet
Proposed Grade Elevation	1540.00 feet
Unit Weight of Proposed Fill on Surface	125.00 pcf
GWT Elevation During Test	1498.00 feet
GWT Elevation For Design	1506.00 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<=== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<=== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.04 inches	<=== Dry or Unsaturated Soils (Above GWT)
	0.04 inches	<=== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S \times f(FC)$

++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit

+++ $CSR = 0.65\, A_{max} (\sigma_v/\sigma_v')\, r_d$

* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5}\, MSF\, K_\sigma\, K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_α =1.0 (level ground), and MSF = magnitude scaling factor

** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).

*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).

**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma\, w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1487.0	1486.0	BEDROCK/FORMATION	N	135.0	70	
1486.0	1485.0	BEDROCK/FORMATION	N	135.0	7it	

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks
49.5	0.553	1.000	N/A	0.738	N/A	0.293	N/A	N/A	NO	N/A	Bedrock/Formation
50.5	0.548	1.000	N/A	0.730	N/A	0.291	N/A	N/A	NO	N/A	Bedrock/Formation

RESIDUAL STRENGTH AND GROUND SETTLEMENT

Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v 1%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
N/A	N/A	N/A	N/A	0.00	0.01
N/A	N/A	N/A	N/A	0.00	N/A

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	Ret. Walls @ Abut. 4 EB (HV-8)
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA	
Exploration No.	HV-8
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1541.5 feet
Proposed Grade Elevation	1546.0 feet
Unit Weight of Proposed Fill on Surface	125.0 pcf
GWT Elevation During Test	1500.5 feet
GWT Elevation For Design	1511.5 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1541.5	1539.5	2.0	SM	Y	120.0	12.00	15.0
1539.5	1536.5	5.0	SM	Y	120.0	50.00	15.0
1536.5	1535.5	6.0	SM	Y	120.0	69.00	15.0
1535.5	1534.0	7.5	SM	Y	120.0	69.00	15.0
1534.0	1531.5	10.0	SM	Y	120.0	55.00	15.0
1531.5	1529.0	12.5	SM	Y	120.0	31.00	15.0
1529.0	1524.0	17.5	SM	Y	120.0	31.00	15.0
1524.0	1519.0	22.5	SM	Y	120.0	55.00	15.0
1519.0	1514.0	27.5	SM	Y	120.0	60.00	15.0
1514.0	1511.5	30.0	BEDROCK/FORMATION	N	135.0	60.00	
1511.5	1509.0	32.5	BEDROCK/FORMATION	N	135.0	60.00	
1509.0	1504.0	37.5	BEDROCK/FORMATION	N	135.0	60.00	
1504.0	1499.0	42.5	BEDROCK/FORMATION	N	135.0	60.00	
1499.0	1494.0	47.5	BEDROCK/FORMATION	N	135.0	70.00	
1494.0	1490.0	51.5	BEDROCK/FORMATION	N	135.0	70.00	

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	Ret. Walls @ Abut. 4 EB (HV-8)
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	HV-8
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1541.50 feet
Proposed Grade Elevation	1546.00 feet
Unit Weight of Proposed Fill on Surface	125.00 pcf
GWT Elevation During Test	1500.50 feet
GWT Elevation For Design	1511.50 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<==== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 - 15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.02 inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.02 inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ $CSR = 0.65 A_{max} (\sigma_v/\sigma_v') r_d$
* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5}$ MSF $K_\sigma K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_α =1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1541.5	1540.5	SM	Y	120.0	12	15.0
1540.5	1539.5	SM	Y	120.0	12	15.0
1539.5	1538.5	SM	Y	120.0	50	15.0
1538.5	1537.5	SM	Y	120.0	50	15.0
1537.5	1536.5	SM	Y	120.0	50	15.0
1536.5	1535.5	SM	Y	120.0	69	15.0
1535.5	1534.5	SM	Y	120.0	69	15.0
1534.5	1533.5	SM	Y	120.0	55	15.0
1533.5	1532.5	SM	Y	120.0	55	15.0
1532.5	1531.5	SM	Y	120.0	35	15.0
1531.5	1530.5	SM	Y	120.0	31	15.0
1530.5	1529.5	SM	Y	120.0	31	15.0
1529.5	1528.5	SM	Y	120.0	31	15.0
1528.5	1527.5	SM	Y	120.0	31	15.0
1527.5	1526.5	SM	Y	120.0	31	15.0
1526.5	1525.5	SM	Y	120.0	31	15.0
1525.5	1524.5	SM	Y	120.0	31	15.0
1524.5	1523.5	SM	Y	120.0	55	15.0
1523.5	1522.5	SM	Y	120.0	55	15.0
1522.5	1521.5	SM	Y	120.0	55	15.0
1521.5	1520.5	SM	Y	120.0	55	15.0
1520.5	1519.5	SM	Y	120.0	55	15.0
1519.5	1518.5	SM	Y	120.0	60	15.0
1518.5	1517.5	SM	Y	120.0	60	15.0
1517.5	1516.5	SM	Y	120.0	60	15.0
1516.5	1515.5	SM	Y	120.0	60	15.0
1515.5	1514.5	SM	Y	120.0	60	15.0
1514.5	1513.5	BEDROCK/FORMATION	N	135.0	60	
1513.5	1512.5	BEDROCK/FORMATION	N	135.0	60	
1512.5	1511.5	BEDROCK/FORMATION	N	135.0	60	
1511.5	1510.5	BEDROCK/FORMATION	N	135.0	60	
1510.5	1509.5	BEDROCK/FORMATION	N	135.0	60	
1509.5	1508.5	BEDROCK/FORMATION	N	135.0	60	
1508.5	1507.5	BEDROCK/FORMATION	N	135.0	60	
1507.5	1506.5	BEDROCK/FORMATION	N	135.0	60	
1506.5	1505.5	BEDROCK/FORMATION	N	135.0	60	
1505.5	1504.5	BEDROCK/FORMATION	N	135.0	60	
1504.5	1503.5	BEDROCK/FORMATION	N	135.0	60	
1503.5	1502.5	BEDROCK/FORMATION	N	135.0	60	
1502.5	1501.5	BEDROCK/FORMATION	N	135.0	60	
1501.5	1500.5	BEDROCK/FORMATION	N	135.0	60	
1500.5	1499.5	BEDROCK/FORMATION	N	135.0	60	
1499.5	1498.5	BEDROCK/FORMATION	N	135.0	70	
1498.5	1497.5	BEDROCK/FORMATION	N	135.0	70	
1497.5	1496.5	BEDROCK/FORMATION	N	135.0	70	
1496.5	1495.5	BEDROCK/FORMATION	N	135.0	70	
1495.5	1494.5	BEDROCK/FORMATION	N	135.0	70	
1494.5	1493.5	BEDROCK/FORMATION	N	135.0	70	
1493.5	1492.5	BEDROCK/FORMATION	N	135.0	70	

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
0.5	1.700	0.750	27.0	0.988	N/A	0.321	N/A	N/A	NO	N/A	Soil above GWT	24.7	N/A	0.061	0.085	0.01	0.02
1.5	1.700	0.750	27.0	0.986	N/A	0.320	N/A	N/A	NO	N/A	Soil above GWT	24.7	N/A	0.067	0.093	0.01	0.01
2.5	1.630	0.750	100.5	0.984	N/A	0.320	N/A	N/A	NO	N/A	Soil above GWT	94.8	N/A	0.042	0.000	0.00	0.01
3.5	1.560	0.750	96.3	0.981	N/A	0.319	N/A	N/A	NO	N/A	Soil above GWT	90.8	N/A	0.045	0.000	0.00	0.01
4.5	1.497	0.750	92.5	0.979	N/A	0.318	N/A	N/A	NO	N/A	Soil above GWT	87.2	N/A	0.048	0.000	0.00	0.01
5.5	1.438	0.750	121.8	0.977	N/A	0.317	N/A	N/A	NO	N/A	Soil above GWT	115.1	N/A	0.046	0.000	0.00	0.01
6.5	1.384	0.750	117.3	0.974	N/A	0.317	N/A	N/A	NO	N/A	Soil above GWT	110.9	N/A	0.049	0.000	0.00	0.01
7.5	1.333	0.750	90.7	0.972	N/A	0.316	N/A	N/A	NO	N/A	Soil above GWT	85.5	N/A	0.055	0.000	0.00	0.01
8.5	1.287	0.850	98.9	0.970	N/A	0.315	N/A	N/A	NO	N/A	Soil above GWT	93.3	N/A	0.056	0.000	0.00	0.01
9.5	1.243	0.850	95.6	0.967	N/A	0.314	N/A	N/A	NO	N/A	Soil above GWT	90.2	N/A	0.058	0.000	0.00	0.01
10.5	1.202	0.850	53.2	0.965	N/A	0.314	N/A	N/A	NO	N/A	Soil above GWT	49.8	N/A	0.073	0.000	0.00	0.01
11.5	1.164	0.850	51.7	0.963	N/A	0.313	N/A	N/A	NO	N/A	Soil above GWT	48.2	N/A	0.076	0.000	0.00	0.01
12.5	1.128	0.850	50.2	0.960	N/A	0.312	N/A	N/A	NO	N/A	Soil above GWT	46.8	N/A	0.078	0.000	0.00	0.01
13.5	1.095	0.850	48.7	0.958	N/A	0.311	N/A	N/A	NO	N/A	Soil above GWT	45.4	N/A	0.081	0.000	0.00	0.01
14.5	1.063	0.850	47.4	0.956	N/A	0.311	N/A	N/A	NO	N/A	Soil above GWT	44.2	N/A	0.085	0.000	0.00	0.01
15.5	1.033	0.950	51.3	0.953	N/A	0.310	N/A	N/A	NO	N/A	Soil above GWT	47.9	N/A	0.083	0.000	0.00	0.01
16.5	1.005	0.950	49.9	0.951	N/A	0.309	N/A	N/A	NO	N/A	Soil above GWT	46.6	N/A	0.086	0.000	0.00	0.01
17.5	0.978	0.950	84.4	0.949	N/A	0.308	N/A	N/A	NO	N/A	Soil above GWT	79.5	N/A	0.073	0.000	0.00	0.01
18.5	0.952	0.950	82.3	0.946	N/A	0.308	N/A	N/A	NO	N/A	Soil above GWT	77.4	N/A	0.075	0.000	0.00	0.01
19.5	0.928	0.950	80.2	0.944	N/A	0.307	N/A	N/A	NO	N/A	Soil above GWT	75.5	N/A	0.077	0.000	0.00	0.01
20.5	0.905	0.950	78.3	0.942	N/A	0.306	N/A	N/A	NO	N/A	Soil above GWT	73.7	N/A	0.079	0.000	0.00	0.01
21.5	0.884	0.950	76.5	0.939	N/A	0.305	N/A	N/A	NO	N/A	Soil above GWT	71.9	N/A	0.081	0.000	0.00	0.01
22.5	0.863	0.950	81.3	0.937	N/A	0.305	N/A	N/A	NO	N/A	Soil above GWT	76.5	N/A	0.081	0.000	0.00	0.01
23.5	0.843	0.950	79.5	0.935	N/A	0.304	N/A	N/A	NO	N/A	Soil above GWT	74.8	N/A	0.082	0.000	0.00	0.01
24.5	0.824	0.950	77.8	0.932	N/A	0.303	N/A	N/A	NO	N/A	Soil above GWT	73.2	N/A	0.084	0.000	0.00	0.01
25.5	0.806	0.950	76.1	0.930	N/A	0.302	N/A	N/A	NO	N/A	Soil above GWT	71.6	N/A	0.086	0.000	0.00	0.01
26.5	0.789	0.950	74.5	0.922	N/A	0.300	N/A	N/A	NO	N/A	Soil above GWT	70.1	N/A	0.086	0.000	0.00	0.01
27.5	0.771	0.950	N/A	0.914	N/A	0.297	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.01
28.5	0.753	1.000	N/A	0.905	N/A	0.294	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.01
29.5	0.736	1.000	N/A	0.897	N/A	0.292	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.01
30.5	0.720	1.000	N/A	0.889	N/A	0.291	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
31.5	0.704	1.000	N/A	0.881	N/A	0.293	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
32.5	0.689	1.000	N/A	0.873	N/A	0.294	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
33.5	0.675	1.000	N/A	0.865	N/A	0.295	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
34.5	0.661	1.000	N/A	0.857	N/A	0.296	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
35.5	0.648	1.000	N/A	0.848	N/A	0.296	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
36.5	0.636	1.000	N/A	0.840	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
37.5	0.623	1.000	N/A	0.832	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
38.5	0.612	1.000	N/A	0.824	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
39.5	0.600	1.000	N/A	0.816	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
40.5	0.590	1.000	N/A	0.808	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
41.5	0.582	1.000	N/A	0.800	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
42.5	0.576	1.000	N/A	0.791	N/A	0.296	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
43.5	0.571	1.000	N/A	0.783	N/A	0.296	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
44.5	0.565	1.000	N/A	0.775	N/A	0.295	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
45.5	0.560	1.000	N/A	0.767	N/A	0.294	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
46.5	0.555	1.000	N/A	0.759	N/A	0.294	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
47.5	0.550	1.000	N/A	0.751	N/A	0.293	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
48.5	0.545	1.000	N/A	0.743	N/A	0.292	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	Ret. Walls @ Abut. 4 EB (HV-8)
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	HV-8
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1541.50 feet
Proposed Grade Elevation	1546.00 feet
Unit Weight of Proposed Fill on Surface	125.00 pcf
GWT Elevation During Test	1500.50 feet
GWT Elevation For Design	1511.50 feet
EarthquakeMoment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.00

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<==== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.02 inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.02 inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

\+ Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S \times f(FC)$
++ Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
+++ $CSR = 0.65\, A_{max}/g\, (\sigma_v/\sigma_v')\, r_d$
* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5}\, MSF\, K_\sigma\, K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), $K_\alpha = 1.0$ (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \sum w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1492.5	1491.5	BEDROCK/FORMATION	N	135.0	70	
1491.5	1490.5	BEDROCK/FORMATION	N	135.0	70	

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) +

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks
49.5	0.540	1.000	N/A	0.734	N/A	0.290	N/A	N/A	NO	N/A	Bedrock/Formation
50.5	0.535	1.000	N/A	0.726	N/A	0.289	N/A	N/A	NO	N/A	Bedrock/Formation

RESIDUAL STRENGTH AND GROUND SETTLEMENT

Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_s (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	N/A

C-3

SPREAD FOOTING BEARING CAPACITY

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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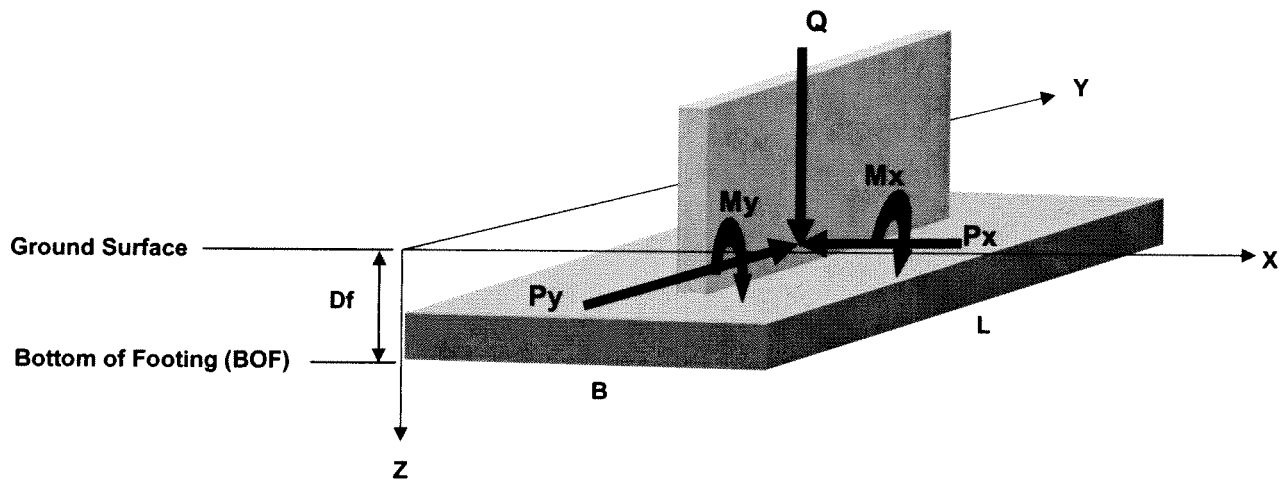
PROJECT INFORMATION	
Project Name	I-215/SR-60 East Junction
Project No.	76979
Location	Moreno Valley, California

FOOTING GEOMETRY	
Footing Location	RW-1 (EB Connector)
Footing Description	1.2 meter x 5.8 meter footing
Footing Width, B	4.00 feet
Footing Length, L	19.00 feet
Min. Footing Embedment Depth, D_f	4.00 feet
Bottom of Footing Elevation	1,531.00 feet
Design GWT Elevation	1,495.35 feet
Ground Slope Angle, β	26.56 degrees
Footing Base Angle, α	0.00 degrees

SOIL PARAMETERS	
Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS	
Normal Load, Q	190.00 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY	
Factor of Safety for Sliding Falure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Failure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear



ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction
Project No.	76979
Location	Moreno Valley, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	RW-1 (EB Connector)
Footing Description	1.2 meter x 5.8 meter footing
Footing Width, B	4.00 feet
Footing Length, L	19.00 feet
Min. Footing Embedment Depth, D_f	4.00 feet
Bottom of Footing Elevation	1,531.00 feet
Design GWT Elevation	1,495.35 feet
Ground Slope Angle, β	26.56 degrees
Footing Base Angle, α	0.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Normal Gravity Load, Q	190.00 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY

Factor of Safety for Sliding Falure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Falure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,535.00 feet
Depth to Design GWT, Z_w	39.65 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	0.00 kips
Effective Footing Width, $B' = B - 2e_x$	4.00 feet
Effective Footing Length, $L' = L - 2e_y$	19.00 feet
Effective Footing Area, $A_f = B' L'$	76.00 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(BL)$	2.50 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\, c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	3.61 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	125.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	500.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\, \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	1.00
Exponent, n	1.17

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.06	1.14	1.14	1.14
s_q	N/A	1.07	1.11	1.13
s_γ	0.80	1.07	0.92	0.92
Depth Factors, d_c	N/A	1.36	1.40	1.40
d_q	N/A	1.18	1.28	1.28
d_γ	N/A	1.18	1.00	1.00
Inclination Factors, i_c	N/A	1.00	1.00	1.00
i_q	N/A	1.00	1.00	1.00
i_γ	N/A	1.00	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.82	1.00
g_q	N/A	N/A	0.24	0.25
g_γ	N/A	N/A	0.24	0.25
Base Factors (tilted base), b_c	N/A	N/A	1.00	1.00
b_q	N/A	N/A	1.00	1.00
b_γ	N/A	N/A	1.00	1.00

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_c s_c d_c i_c g_c b_c + q_b N_q s_q d_q i_q g_q b_q + 0.5\gamma_{eff} N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\, S_u (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	14.3	17.2

Average Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	15.8 ksf
Average Allowable Gross Bearing Capacity, $q_{all} = q_{ult\text{-}ave}/FS_{bearing}$	5.3 ksf *
Maximum Shear Resistance: $P_{max} = Q \tan\delta + C_a B L$	8,434.2 kips
Check Sliding Failure: $(P_{max}/P) \geq FS_{sliding}$?	N/A
Check Load Eccentricity (along X-axis): $e_x \leq B/6$	N/A
Check Load Eccentricity (along Y-axis): $e_y \leq L/6$	N/A
Check Bearing Failure: $(q_{ult\text{-}ave}/q_{app}) \geq FS_{bearing}$?	Yes

Notes:

* The footing should be checked for tolerable settlement.
Allowable gross bearing capacity may be limited to 10 ksf due to settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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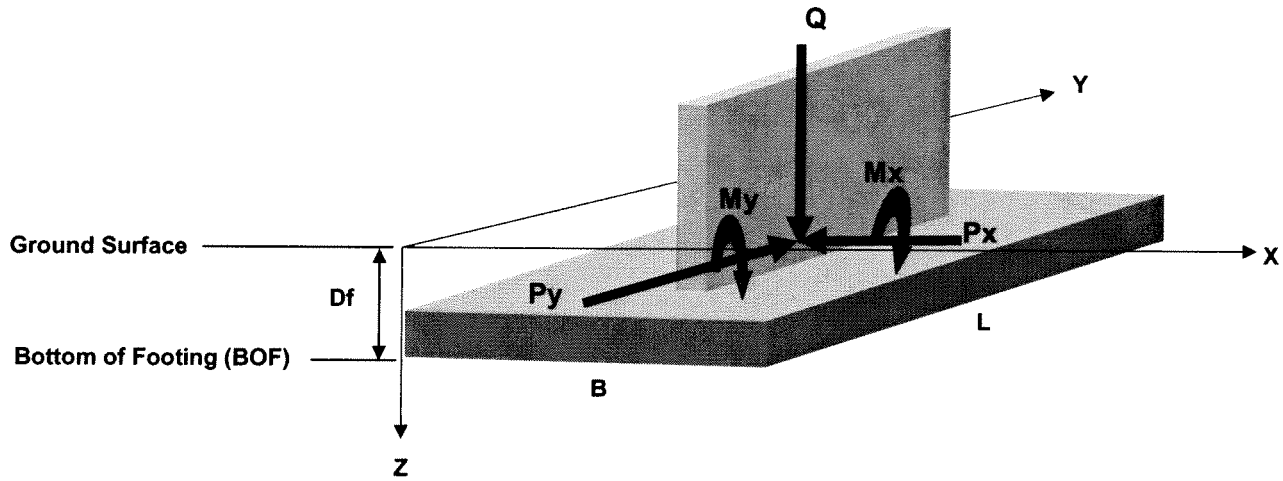
PROJECT INFORMATION	
Project Name	I-215/SR-60 East Junction
Project No.	76979
Location	Moreno Valley, California

FOOTING GEOMETRY	
Footing Location	RW-1 (WB Connector)
Footing Description	1.38 meter x 14.6 meter footing
Footing Width, B	4.50 feet
Footing Length, L	48.00 feet
Min. Footing Embedment Depth, D_f	4.00 feet
Bottom of Footing Elevation	1,518.00 feet
Design GWT Elevation	1,495.68 feet
Ground Slope Angle, β	26.56 degrees
Footing Base Angle, α	5.00 degrees

SOIL PARAMETERS	
Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS	
Normal Load, Q	540.00 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY	
Factor of Safety for Sliding Falure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Failure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear



ANALYSIS OF SOIL BEARING CAPACITY OF A SPREAD FOOTING

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PROJECT INFORMATION

Project Name	I-215/SR-60 East Junction
Project No.	76979
Location	Moreno Valley, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

FOOTING GEOMETRY

Footing Location	RW-1 (WB Connector)
Footing Description	1.38 meter x 14.6 meter footing
Footing Width, B	4.50 feet
Footing Length, L	48.00 feet
Min. Footing Embedment Depth, D_f	4.00 feet
Bottom of Footing Elevation	1,518.00 feet
Design GWT Elevation	1,495.68 feet
Ground Slope Angle, β	26.56 degrees
Footing Base Angle, α	5.00 degrees

INPUT SOIL PARAMETERS

Total Soil Unit Weight, γ_t	125.00 pcf
Saturated Soil Unit Weight, γ_{sat}	125.00 pcf
Soil Cohesion, c	200.00 psf
Soil Friction Angle, ϕ	32.00 degrees

FOOTING LOADS

Normal Gravity Load, Q	540.00 kips
Shear Load (along X-axis), P_x	0.00 kips
Shear Load (along Y-axis), P_y	0.00 kips
Moment (about X-axis), M_x	0.00 kip-foot
Moment (about Y-axis), M_y	0.00 kip-foot

FACTORS OF SAFETY

Factor of Safety for Sliding Failure, $FS_{sliding}$	1.50
Factor of Safety for Bearing Failure, $FS_{bearing}$	3.00
Bearing Capacity Failure Mode	General Shear

COMPUTED PARAMETERS

Min. Ground Surface Elevation	1,522.00 feet
Depth to Design GWT, Z_w	26.32 feet
Load Eccentricity (parallel to X-axis), $e_x = M_y/Q$	0.00 feet
Load Eccentricity (parallel to Y-axis), $e_y = M_x/Q$	0.00 feet
Resultant Shear Load, $P = (P_x^2 + P_y^2)^{1/2}$	0.00 kips
Effective Footing Width, $B' = B - 2e_x$	4.50 feet
Effective Footing Length, $L' = L - 2e_y$	48.00 feet
Effective Footing Area, $A_f = B'L'$	216.00 square feet
Applied Gross Bearing Pressure, $q_{app} = Q/(BL)$	2.50 ksf
Effective Cohesion, c_{eff}	200.00 psf
Effective Friction Angle, ϕ_{eff}	32.00 degrees
Footing Base Adhesion, $C_a = 0.55\ c_{eff}$	110.00 psf
Depth of Wedge Zone, $D = 0.5B \tan(45° + \phi_{eff}/2)$	4.06 feet
Effective Soil Unit Weight at Footing Base, γ_{eff}	125.00 pcf
Effective Soil Pressure at Footing Base, $q_b = \gamma_{eff} D_f$	500.00 psf
Angle of Friction Between Footing and Soil, $\delta = 2/3\ \phi_{eff}$	21.33 degrees
Angle of Load Eccentricity, $\theta = \tan^{-1}(e_x/e_y)$	0.00 degrees
Passive Earth Pressure Coefficient, $K_p = \tan^2(45° + \phi_{eff}/2)$	3.25
Depth Factor Parameter, k	0.89
Exponent, n	1.09

COMPUTED BEARING CAPACITY FACTORS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Bearing Capacity Factors, N_c	35.49	35.49	35.49	35.49
N_q	28.52	23.18	23.18	23.18
N_γ	26.87	22.02	20.79	30.21
Shape Factors, s_c	1.03	1.06	1.06	1.06
s_q	N/A	1.03	1.05	1.06
s_γ	0.80	1.03	0.96	0.96
Depth Factors, d_c	N/A	1.32	1.36	1.36
d_q	N/A	1.16	1.25	1.25
d_γ	N/A	1.16	1.00	1.00
Inclination Factors, i_c	N/A	1.00	1.00	1.00
i_q	N/A	1.00	1.00	1.00
i_γ	N/A	1.00	1.00	1.00
Ground Factors (base on slope), g_c	N/A	N/A	0.82	1.00
g_q	N/A	N/A	0.24	0.25
g_γ	N/A	N/A	0.24	0.25
Base Factors (tilted base), b_c	N/A	N/A	0.97	0.89
b_q	N/A	N/A	0.90	0.89
b_γ	N/A	N/A	0.86	0.89

SUMMARY OF RESULTS	ANALYSIS METHOD			
	Terzaghi	Meyerhof	Hansen	Vesic
Ultimate Gross Bearing Capacity, q_{ult} (ksf): General: $q_{ult} = cN_cs_cd_ci_cg_cb_c + q_bN_qs_qd_qi_qg_qb_q + 0.5\gamma_{eff}N_\gamma s_\gamma d_\gamma i_\gamma g_\gamma b_\gamma$ When $\phi = 0$: $q_{ult} = 5.14\ S_u\ (1 + s_c + d_c - i_c - b_c - g_c) + q_b$	N/A	N/A	12.5	14.3

Average Ultimate Gross Bearing Capacity, $q_{ult\text{-}ave}$	13.4 ksf
Average Allowable Gross Bearing Capacity, $q_{all} = q_{ult\text{-}ave}/FS_{bearing}$	4.5 ksf *
Maximum Shear Resistance: $P_{max} = Q \tan\delta + C_a B L$	23,970.9 kips
Check Sliding Failure: $(P_{max}/P) \geq FS_{sliding}$?	N/A
Check Load Eccentricity (along X-axis): $e_x \leq B/6$	N/A
Check Load Eccentricity (along Y-axis): $e_y \leq L/6$	N/A
Check Bearing Failure: $(q_{ult\text{-}ave}/q_{app}) \geq FS_{bearing}$?	Yes

Notes:

* The footing should be checked for tolerable settlement.
Allowable gross bearing capacity may be limited to 10 ksf due to settlement.

REFERENCES:

1. Bowles, J. (1988), "Bearing Capacity of Foundations," Found. Analysis and Design - 4th Ed., McGraw-Hill, Inc.
2. Caltrans Bridge Design Specifications (2003), Section 4 - Foundations, pp. 4-1 through 4-17, dated November 2003.
3. Hansen, J.B. (1970), "A Revised and Extended Formula for Bearing Capacity," Danish Geotech. Inst., Bull. No. 28.
4. Meyerhof, G.G. (1963), "Some Recent Research on Bearing Capacity of Found.," Canadian Geotech. Journ., Vol. 1, No. 1.
5. Terzaghi, K. (1934), Theoretical Soil Mechanics, John Wiley & Sons.
6. Vesic, A.S. (1973), "Analysis of Ultimate Loads of Shallow Foundations," JSMFD, ASCE, Vol. 99, SM 1, Jan., pp. 45-73.

C-4

SPREAD FOOTING SETTLEMENT

ANALYSIS OF SETTLEMENT OF A SPREAD FOOTING

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PROJECT INFORMATION

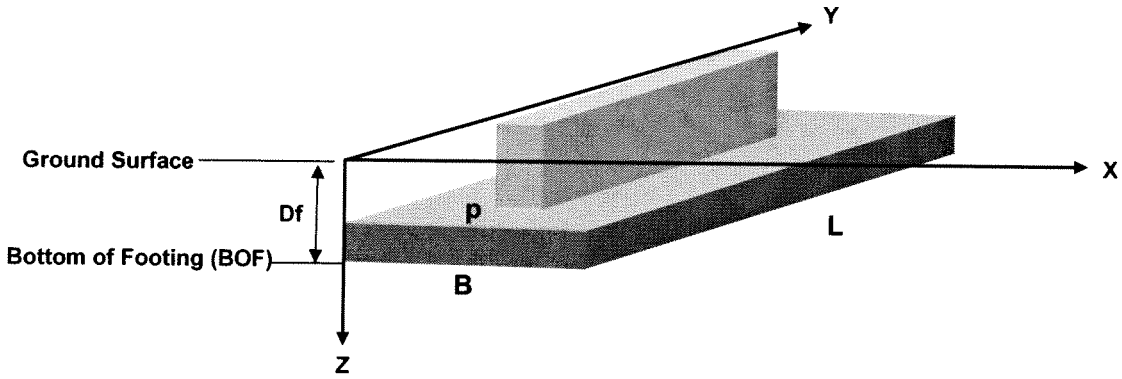
Project Name	I-215/SR-60 East Junction
Project No.	76979
Location	Moreno Valley, California

INPUT PARAMETERS

Footing Location	RW-1 (EB Connector)- Boring HV-1
Footing Description	
Stress Analysis Method	Boussinesq Method
Footing Width, B	4.00 feet
Footing Length, L	19.00 feet
Applied Net Bearing Pressure, p	2.50 ksf
Footing Embedment Depth, D_f	4.00 feet
Bottom of Footing Elevation	1,531.00 feet
GWT Elevation for Design	1,495.35 feet

INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,535.00	1,531.00	Cohesionless Soil	125.0					
1,531.00	1,525.00	Cohesionless Soil	125.0	800.0	0.30			1.0
1,525.00	1,520.00	Cohesionless Soil	120.0	800.0	0.30			1.0
1,520.00	1,515.00	Cohesionless Soil	120.0	800.0	0.30			1.0
1,515.00	1,510.00	Cohesionless Soil	120.0	800.0	0.30			1.0
1,510.00	1,505.00	Cohesionless Soil	120.0	550.0	0.30			1.0
1,505.00	1,500.00	Cohesionless Soil	120.0	600.0	0.30			1.0
1,500.00	1,495.35	Cohesionless Soil	120.0	600.0	0.30			1.0
1,495.35	1,490.00	Cohesionless Soil	120.0	600.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	700.0	0.30			1.0
1,485.00	1,480.00	Cohesionless Soil	120.0	700.0	0.30			1.0
1,480.00	1,475.00	Cohesionless Soil	120.0	700.0	0.30			1.0



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PROJECT INFORMATION

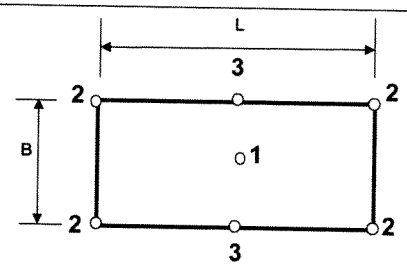
Project Name	I-215/SR-60 East Junction
Project No.	76979
Location	Moreno Valley, California

INPUT PARAMETERS

Footing Location	RW-1 (EB Connector)- Boring HV-1
Footing Description	
Stress Analysis Method	Boussinesq Method
Footing Width, B	4.00 feet
Footing Length, L	19.00 feet
Applied Net Bearing Pressure, p	2.50 ksf
Footing Embedment Depth, D_f	4.00 feet
Bottom of Footing Elevation	1,531.00 feet
GWT Elevation for Design	1,495.35 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.23	0.11	0.18
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.23	0.11	0.18



Performed By: _____ Date: _____

Reviewed By: _____ Date: _____

REFERENCES:

1. Bowles, J. (1988), Found. Analysis and Design, 4th Edition, McGraw-Hill, Inc., pp. 240-256.
2. Bhushan, K. and Haley, S. (1976), "Stress Dist. for Heavy Embedded Structures," JGED, ASCE, Vol. 102, No. GT7, pp. 807-810.
3. Cheney, R.S. and Chassie, R.G. (1982), Soils and Foundations Workshop Manual, FHWA, Chapter 5.

INPUT SOIL PROFILE DATA

Top of Elevation (feet)	Bottom of Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,535.00	1,531.00	Cohesionless Soil	125.0					
1,531.00	1,525.00	Cohesionless Soil	125.0	800.0	0.30			1.0
1,525.00	1,520.00	Cohesionless Soil	120.0	800.0	0.30			1.0
1,520.00	1,515.00	Cohesionless Soil	120.0	800.0	0.30			1.0
1,515.00	1,510.00	Cohesionless Soil	120.0	800.0	0.30			1.0
1,510.00	1,505.00	Cohesionless Soil	120.0	550.0	0.30			1.0
1,505.00	1,500.00	Cohesionless Soil	120.0	600.0	0.30			1.0
1,500.00	1,495.35	Cohesionless Soil	120.0	600.0	0.30			1.0
1,495.35	1,490.00	Cohesionless Soil	120.0	600.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	700.0	0.30			1.0
1,485.00	1,480.00	Cohesionless Soil	120.0	700.0	0.30			1.0
1,480.00	1,475.00	Cohesionless Soil	120.0	700.0	0.30			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	4.00	0.50	0.25	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
3.00	6.00	1.25	0.88	N/A	1.66	0.56	1.11	0.121	0.038	0.079	0.000	0.000	0.000
8.50	5.00	1.85	1.55	N/A	0.66	0.32	0.59	0.037	0.018	0.033	0.000	0.000	0.000
13.50	5.00	2.45	2.15	N/A	0.36	0.21	0.34	0.020	0.012	0.019	0.000	0.000	0.000
18.50	5.00	3.05	2.75	N/A	0.22	0.15	0.21	0.012	0.008	0.012	0.000	0.000	0.000
23.50	5.00	3.65	3.35	N/A	0.14	0.11	0.14	0.012	0.009	0.011	0.000	0.000	0.000
28.50	5.00	4.25	3.95	N/A	0.10	0.08	0.10	0.008	0.006	0.007	0.000	0.000	0.000
33.33	4.65	4.81	4.53	N/A	0.08	0.06	0.08	0.005	0.004	0.005	0.000	0.000	0.000
38.33	5.35	5.45	5.13	N/A	0.06	0.05	0.06	0.005	0.004	0.005	0.000	0.000	0.000
43.50	5.00	5.74	5.59	N/A	0.05	0.04	0.05	0.003	0.003	0.003	0.000	0.000	0.000
48.50	5.00	6.03	5.88	N/A	0.04	0.03	0.04	0.002	0.002	0.002	0.000	0.000	0.000
53.50	5.00	6.31	6.17	N/A	0.03	0.03	0.03	0.002	0.002	0.002	0.000	0.000	0.000

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PROJECT INFORMATION

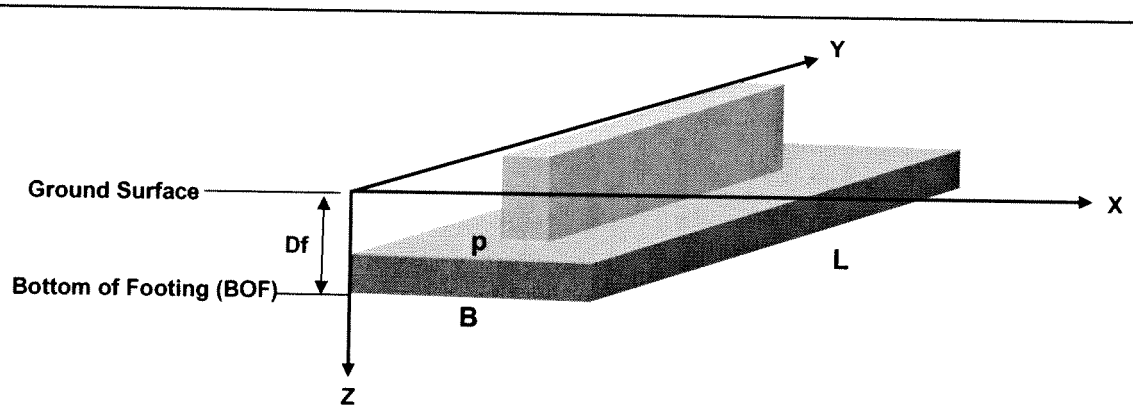
Project Name	I-215/SR-60 East Junction
Project No.	76979
Location	Moreno Valley, California

INPUT PARAMETERS

Footing Location	RW-1 (WB Connector)- Boring HV-5
Footing Description	
Stress Analysis Method	Boussinesq Method
Footing Width, B	4.50 feet
Footing Length, L	48.00 feet
Applied Net Bearing Pressure, p	2.50 ksf
Footing Embedment Depth, D_f	4.00 feet
Bottom of Footing Elevation	1,518.00 feet
GWT Elevation for Design	1,495.68 feet

INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Modulus E_s (ksf)	Poisson's Ratio ν	Comp. Ratio $C_c / (1 + e_0)$	Recomp. Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,522.00	1,518.00	Cohesionless Soil	125.0					
1,518.00	1,515.00	Cohesionless Soil	125.0	800.0	0.30			1.0
1,515.00	1,510.00	Cohesionless Soil	120.0	800.0	0.30			1.0
1,510.00	1,505.00	Cohesionless Soil	120.0	600.0	0.30			1.0
1,505.00	1,500.00	Cohesionless Soil	120.0	600.0	0.30			1.0
1,500.00	1,495.68	Cohesionless Soil	120.0	600.0	0.30			1.0
1,495.68	1,490.00	Cohesionless Soil	120.0	600.0	0.30			1.0
1,490.00	1,485.00	Cohesionless Soil	120.0	600.0	0.30			1.0
1,485.00	1,480.00	Cohesionless Soil	120.0	600.0	0.30			1.0
1,480.00	1,475.00	Cohesionless Soil	120.0	600.0	0.30			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	600.0	0.30			1.0



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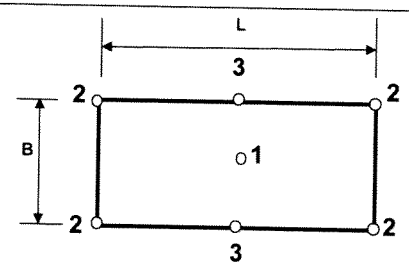
Footing Embedment Depth, D_f	4.00 feet
Bottom of Footing Elevation	1,518.00 feet
GWT Elevation for Design	1,495.68 feet

** SUMMARY OF RESULTS **

	Point 1	Point 2	Point 3
Total Elastic Settlement (inches)	0.32	0.14	0.26
Total Consol. Settlement (inches)	0.00	0.00	0.00
Total Footing Settlement (inches)	0.32	0.14	0.26



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1,485.00	1,480.00	Cohesionless Soil	120.0	600.0	0.30			1.0
1,480.00	1,475.00	Cohesionless Soil	120.0	600.0	0.30			1.0
1,475.00	1,470.00	Cohesionless Soil	120.0	600.0	0.30			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

BOF to Soil Depth z (feet)	Layer Thickness Hi (feet)	Ini. Effective Vert. Stress (bottom) p_{vob}' (ksf)	Initial Effective Vert. Stress (mid-layer) p_{vom}' (ksf)	Maximum Past Pressure p_c (ksf)	Load-Induced Stress Change Δp (ksf)			Elastic Settlement S_e (inches)			Consolidation Settlement S_c (inches)		
					Point 1	Point 2	Point 3	Point 1	Point 2	Point 3	Point 1	Point 2	Point 3
N/A	4.00	0.50	0.25	N/A	N/A	N/A	N/A	0.000	0.000	0.000	0.000	0.000	0.000
1.50	3.00	0.88	0.69	N/A	2.30	0.62	1.23	0.090	0.021	0.045	0.000	0.000	0.000
5.50	5.00	1.48	1.18	N/A	1.17	0.47	0.93	0.068	0.026	0.053	0.000	0.000	0.000
10.50	5.00	2.08	1.78	N/A	0.66	0.30	0.60	0.049	0.023	0.045	0.000	0.000	0.000
15.50	5.00	2.68	2.38	N/A	0.44	0.22	0.42	0.033	0.016	0.031	0.000	0.000	0.000
20.16	4.32	3.19	2.93	N/A	0.33	0.17	0.32	0.021	0.011	0.020	0.000	0.000	0.000
25.16	5.68	3.88	3.53	N/A	0.25	0.14	0.24	0.021	0.012	0.020	0.000	0.000	0.000
30.50	5.00	4.16	4.02	N/A	0.19	0.11	0.19	0.014	0.008	0.014	0.000	0.000	0.000
35.50	5.00	4.45	4.31	N/A	0.15	0.09	0.15	0.011	0.007	0.011	0.000	0.000	0.000
40.50	5.00	4.74	4.60	N/A	0.12	0.08	0.12	0.009	0.006	0.009	0.000	0.000	0.000
45.50	5.00	5.03	4.88	N/A	0.10	0.07	0.10	0.008	0.005	0.008	0.000	0.000	0.000

C-5

AXIAL PILE CAPACITY

Prelim 16_in CIDH for Wingwalls
VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
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HOV Wingwall Piles 1.33' CIDH

PROPOSED DEPTH = 55.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 30.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 2.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 3.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.114E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
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.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04

DEPTH, FT = 0.700E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.761E+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	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.300E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.761E+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	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.300E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.646E+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	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.400E+02

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.646E+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	= 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.400E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.454E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.380E+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	= 0.300E+04
DEPTH, FT	= 0.600E+02

LAYER NO 5----SAND

AT THE TOP

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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.600E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.293E+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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.800E+02

DRILLED SHAFT INFORMATION

DIAMETER OF STEM	=	1.333	FT.
DIAMETER OF BASE	=	1.333	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	=	2.011	SQ.IN.
ELASTIC MODULUS, Ec	=	0.360E+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	0.05	0.26	0.00	0.26	0.26	0.13	5.10
2.0	0.10	0.79	0.00	0.79	0.79	0.40	7.65
3.0	0.16	1.58	0.00	1.58	1.58	0.79	10.21
4.0	0.21	2.64	0.00	2.64	2.64	1.32	12.76
5.0	0.26	3.96	0.00	3.96	3.96	1.98	15.30
6.0	0.31	5.50	0.49	5.99	5.66	2.91	19.29
7.0	0.36	7.26	1.09	8.35	7.62	3.99	23.07

Prelim 16_in CIDH for Wingwalls

AT THE TOP

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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.600E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.293E+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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.800E+02

DRILLED SHAFT INFORMATION

DIAMETER OF STEM	=	1.333	FT.
DIAMETER OF BASE	=	1.333	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	=	2.011	SQ.IN.
ELASTIC MODULUS, Ec	=	0.360E+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	0.05	0.26	0.00	0.26	0.26	0.13	5.10
2.0	0.10	0.79	0.00	0.79	0.79	0.40	7.65
3.0	0.16	1.58	0.00	1.58	1.58	0.79	10.21
4.0	0.21	2.64	0.00	2.64	2.64	1.32	12.76
5.0	0.26	3.96	0.00	3.96	3.96	1.98	15.30
6.0	0.31	5.50	0.49	5.99	5.66	2.91	19.29
7.0	0.36	7.26	1.09	8.35	7.62	3.99	23.07

Prelim 16_in CIDH for Wingwalls

8.0	0.41	9.24	1.82	11.06	9.85	5.23	26.74
9.0	0.47	11.43	2.67	14.11	12.33	6.61	30.31
10.0	0.52	13.84	3.64	17.48	15.05	8.13	33.80
11.0	0.57	16.44	4.74	21.18	18.02	9.80	37.23
12.0	0.62	19.24	5.67	24.91	21.13	11.51	40.14
13.0	0.67	22.23	6.48	28.71	24.39	13.27	42.70
14.0	0.72	25.41	7.29	32.69	27.83	15.13	45.15
15.0	0.78	28.76	8.10	36.85	31.46	17.08	47.51
16.0	0.83	32.29	8.91	41.19	35.26	19.11	49.78
17.0	0.88	35.98	9.72	45.70	39.22	21.23	51.98
18.0	0.93	39.84	10.52	50.37	43.35	23.43	54.11
19.0	0.98	43.87	11.33	55.20	47.64	25.71	56.18
20.0	1.03	48.04	12.14	60.19	52.09	28.07	58.19
21.0	1.09	52.37	12.95	65.32	56.69	30.50	60.14
22.0	1.14	56.84	13.76	70.60	61.43	33.01	62.05
23.0	1.19	61.45	14.57	76.03	66.31	35.58	63.91
24.0	1.24	66.21	15.38	81.59	71.33	38.23	65.73
25.0	1.29	71.09	16.19	87.28	76.49	40.94	67.51
26.0	1.34	76.10	17.00	93.10	81.77	43.72	69.24
27.0	1.40	81.24	17.81	99.05	87.18	46.56	70.94
28.0	1.45	86.50	18.62	105.12	92.71	49.46	72.59
29.0	1.50	91.88	18.62	110.50	98.08	52.14	73.67
30.0	1.55	97.36	18.62	115.98	103.57	54.89	74.75
31.0	1.60	102.86	18.62	121.48	109.07	57.64	75.77
32.0	1.65	108.37	18.62	126.99	114.58	60.39	76.73
33.0	1.71	113.88	18.62	132.50	120.09	63.15	77.64
34.0	1.76	119.40	18.62	138.02	125.61	65.91	78.49
35.0	1.81	124.92	18.62	143.54	131.13	68.67	79.30
36.0	1.86	130.44	18.62	149.06	136.65	71.43	80.06
37.0	1.91	135.96	18.62	154.58	142.17	74.19	80.78
38.0	1.97	141.48	18.62	160.10	147.69	76.95	81.47
39.0	2.02	147.00	35.75	182.74	158.91	85.41	90.60
40.0	2.07	152.51	35.75	188.25	164.42	88.17	91.00
41.0	2.12	158.01	35.75	193.76	169.93	90.92	91.38
42.0	2.17	163.50	35.75	199.25	175.42	93.67	91.73
43.0	2.22	168.99	35.75	204.74	180.90	96.41	92.06
44.0	2.28	174.46	35.75	210.21	186.38	99.15	92.38
45.0	2.33	179.92	35.75	215.67	191.83	101.88	92.67
46.0	2.38	185.36	35.75	221.11	197.28	104.60	92.94
47.0	2.43	190.79	35.75	226.53	202.70	107.31	93.20
48.0	2.48	196.20	35.75	231.94	208.11	110.01	93.43
49.0	2.53	201.58	35.75	237.33	213.50	112.71	93.65
50.0	2.59	206.95	35.75	242.70	218.86	115.39	93.85
51.0	2.64	212.29	35.75	248.04	224.21	118.06	94.04
52.0	2.69	217.61	35.75	253.36	229.53	120.72	94.21
53.0	2.74	222.90	35.75	258.65	234.82	123.37	94.36
54.0	2.79	228.17	35.75	263.91	240.08	126.00	94.50
55.0	2.84	233.40	35.75	269.15	245.32	128.62	94.62

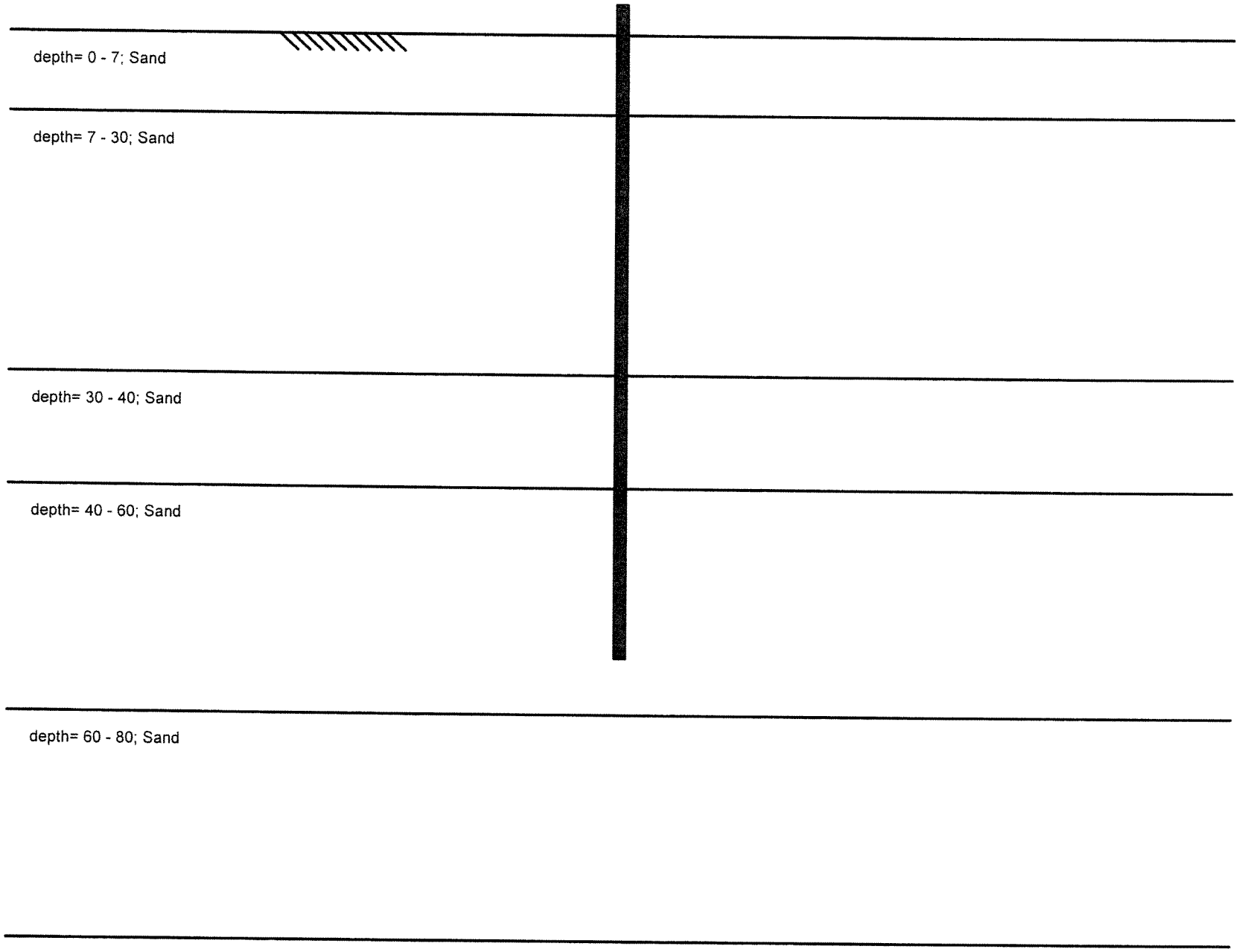
$L_{min} = 20'$ for both EB & WB Connect

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1363E+01	0.1175E-02	0.7820E-02	0.1000E-03
0.1385E+02	0.1186E-01	0.7820E-01	0.1000E-02
0.3456E+02	0.2988E-01	0.1955E+00	0.2500E-02
0.6410E+02	0.5807E-01	0.3910E+00	0.5000E-02
0.8717E+02	0.8296E-01	0.5865E+00	0.7500E-02
0.1057E+03	0.1048E+00	0.7820E+00	0.1000E-01
0.1656E+03	0.1909E+00	0.1955E+01	0.2500E-01
0.2015E+03	0.2644E+00	0.3910E+01	0.5000E-01

Prelim 16_in CIDH for Wingwalls

0.2175E+03	0.3127E+00	0.5865E+01	0.7500E-01
0.2259E+03	0.3508E+00	0.7775E+01	0.1000E+00
0.2388E+03	0.5238E+00	0.1768E+02	0.2500E+00
0.2474E+03	0.7899E+00	0.2677E+02	0.5000E+00
0.2550E+03	0.1054E+01	0.3478E+02	0.7500E+00
0.2601E+03	0.1314E+01	0.4031E+02	0.1000E+01
0.2711E+03	0.1934E+01	0.5219E+02	0.1600E+01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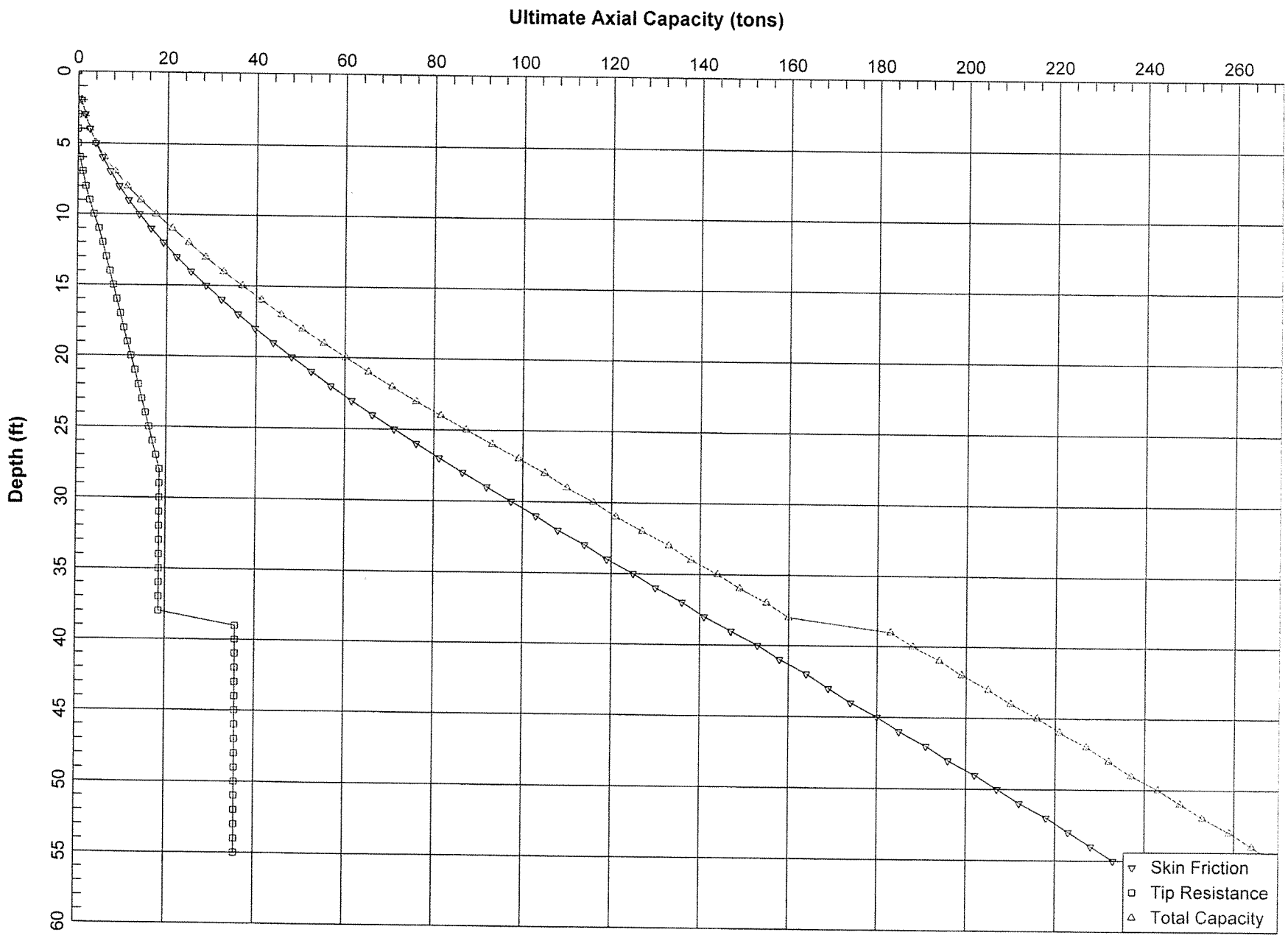
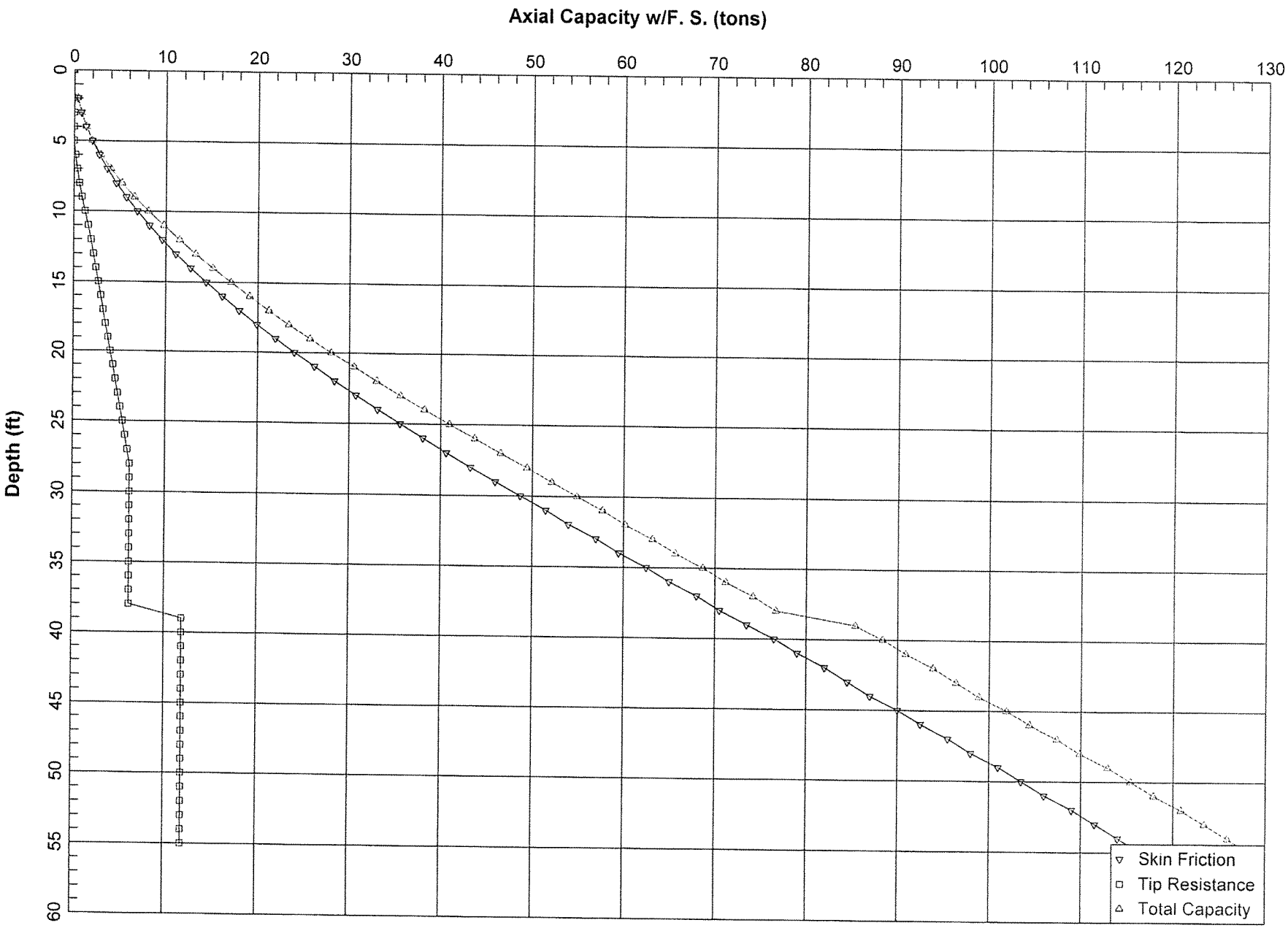
depth= 30 - 40; Sand
depth= 40 - 60; Sand
depth= 60 - 80; Sand


Ultimate Axial Capacity (tons)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Skin Friction
Tip Resistance
Total Capacity


Axial Capacity w/F. S. (tons)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Skin Friction
Tip Resistance
Total Capacity

Prelim 2' CIDH at Abutments
VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 5.0 (C) COPYRIGHT ENSOFT,INC. 1989,1995,1998,2001,2003

HOV Abutment Piles 2' CIDH

PROPOSED DEPTH = 55.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 30.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 2.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 3.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.114E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
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.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04

DEPTH, FT = 0.700E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.761E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.300E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.761E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.300E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.646E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.400E+02

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.646E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.400E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.454E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+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 = 0.300E+04
DEPTH, FT = 0.600E+02

LAYER NO 5----SAND

Prelim 2' CIDH at Abutments

AT THE TOP

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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.600E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.293E+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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.800E+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	=	0.360E+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	0.40	0.00	0.40	0.40	0.20	3.40
2.0	0.23	1.19	0.00	1.19	1.19	0.59	5.10
3.0	0.35	2.38	0.00	2.38	2.38	1.19	6.80
4.0	0.47	3.96	0.26	4.22	4.05	2.07	9.06
5.0	0.58	5.94	0.90	6.83	6.23	3.27	11.74
6.0	0.70	8.25	1.83	10.08	8.86	4.74	14.44
7.0	0.81	10.89	2.95	13.84	11.87	6.43	16.99

Prelim 2' CIDH at Abutments

8.0	0.93	13.86	4.25	18.12	15.28	8.35	19.46
9.0	1.05	17.15	5.74	22.89	19.07	10.49	21.86
10.0	1.16	20.76	7.40	28.16	23.22	12.85	24.20
11.0	1.28	24.66	9.25	33.91	27.75	15.42	26.49
12.0	1.40	28.86	11.28	40.14	32.62	18.19	28.75
13.0	1.51	33.35	13.49	46.84	37.85	21.17	30.96
14.0	1.63	38.11	15.89	54.00	43.40	24.35	33.14
15.0	1.75	43.14	18.46	61.60	49.29	27.72	35.29
16.0	1.86	48.43	21.22	69.65	55.51	31.29	37.41
17.0	1.98	53.98	23.71	77.68	61.88	34.89	39.27
18.0	2.09	59.77	25.76	85.53	68.36	38.47	40.83
19.0	2.21	65.80	27.59	93.39	75.00	42.10	42.24
20.0	2.33	72.06	29.41	101.47	81.87	45.83	43.60
21.0	2.44	78.55	31.23	109.78	88.96	49.69	44.92
22.0	2.56	85.26	33.05	118.31	96.28	53.65	46.21
23.0	2.68	92.18	34.87	127.06	103.81	57.72	47.47
24.0	2.79	99.31	36.69	136.00	111.54	61.89	48.70
25.0	2.91	106.64	38.52	145.15	119.48	66.16	49.89
26.0	3.03	114.16	40.34	154.49	127.60	70.52	51.06
27.0	3.14	121.86	41.51	163.37	135.70	74.77	52.00
28.0	3.26	129.75	41.90	171.65	143.72	78.84	52.68
29.0	3.37	137.82	41.90	179.72	151.78	82.87	53.25
30.0	3.49	146.05	41.90	187.95	160.02	86.99	53.84
31.0	3.61	154.30	41.90	196.20	168.26	91.11	54.39
32.0	3.72	162.56	41.90	204.45	176.52	95.24	54.90
33.0	3.84	170.83	41.90	212.72	184.79	99.38	55.39
34.0	3.96	179.10	41.90	221.00	193.07	103.52	55.86
35.0	4.07	187.38	41.90	229.28	201.35	107.66	56.29
36.0	4.19	195.67	41.90	237.56	209.63	111.80	56.71
37.0	4.31	203.95	55.66	259.61	222.50	120.53	60.29
38.0	4.42	212.23	72.18	284.41	236.29	130.17	64.31
39.0	4.54	220.50	80.44	300.94	247.31	137.06	66.31
40.0	4.65	228.77	80.44	309.20	255.58	141.20	66.43
41.0	4.77	237.02	80.44	317.46	263.83	145.32	66.54
42.0	4.89	245.26	80.44	325.70	272.08	149.44	66.64
43.0	5.00	253.49	80.44	333.92	280.30	153.56	66.73
44.0	5.12	261.70	80.44	342.13	288.51	157.66	66.82
45.0	5.24	269.88	80.44	350.32	296.70	161.75	66.90
46.0	5.35	278.05	80.44	358.48	304.86	165.84	66.97
47.0	5.47	286.19	80.44	366.62	313.00	169.91	67.03
48.0	5.59	294.30	80.44	374.74	321.11	173.96	67.09
49.0	5.70	302.38	80.44	382.82	329.19	178.00	67.14
50.0	5.82	310.43	80.44	390.87	337.24	182.03	67.18
51.0	5.93	318.45	80.44	398.88	345.26	186.03	67.21
52.0	6.05	326.42	80.44	406.86	353.23	190.02	67.24
53.0	6.17	334.36	80.44	414.80	361.17	193.99	67.25
54.0	6.28	342.26	80.44	422.69	369.07	197.94	67.26
55.0	6.40	350.11	80.44	430.54	376.92	201.87	67.27

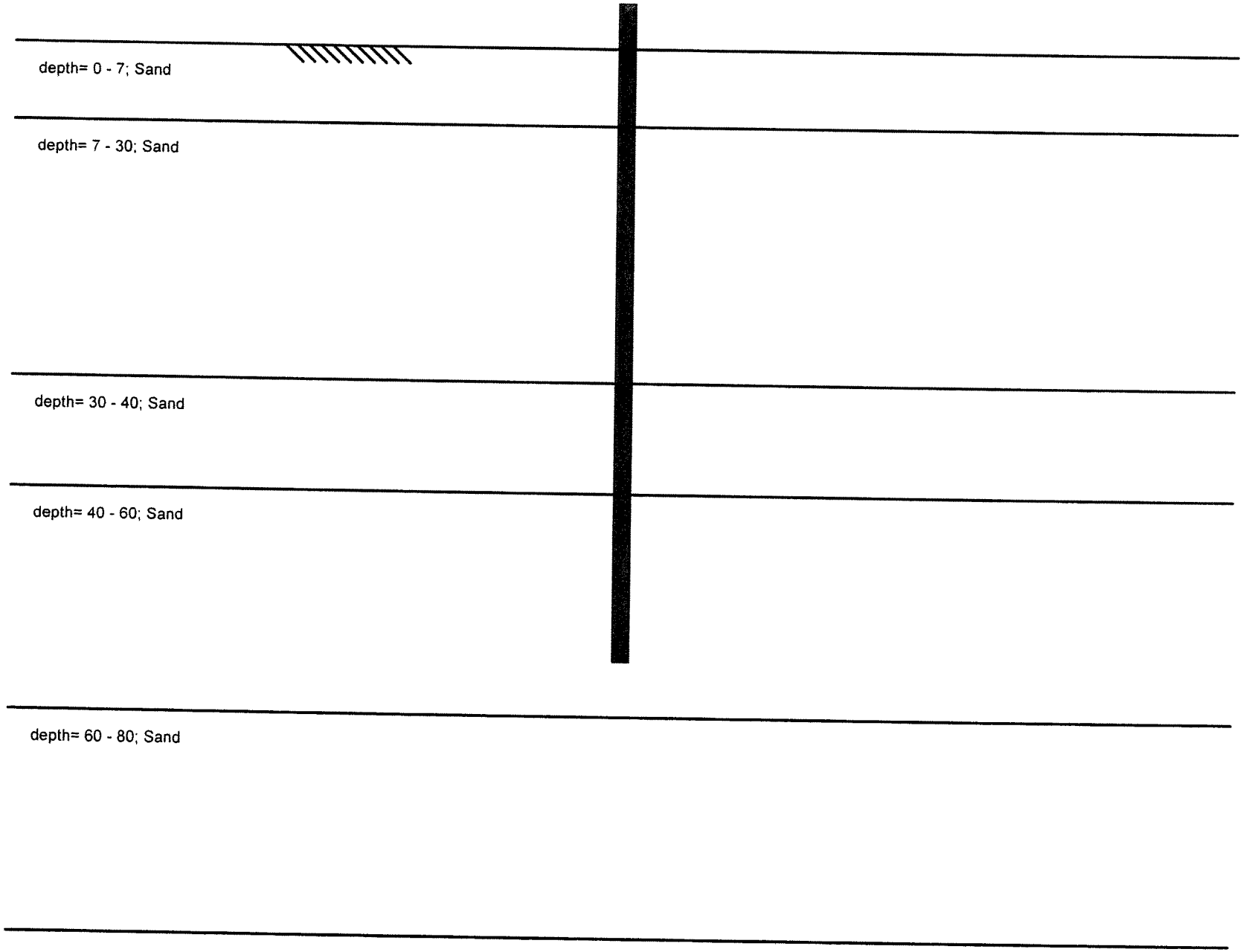
Lmin = 37' for both EB & WB Connect.

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.8186E+00	0.4367E-03	0.1173E-01	0.1000E-03
0.8186E+01	0.4367E-02	0.1173E+00	0.1000E-02
0.2059E+02	0.1094E-01	0.2933E+00	0.2500E-02
0.4145E+02	0.2198E-01	0.5865E+00	0.5000E-02
0.6211E+02	0.3302E-01	0.8798E+00	0.7500E-02
0.8174E+02	0.4390E-01	0.1173E+01	0.1000E-01
0.1728E+03	0.1011E+00	0.2933E+01	0.2500E-01
0.2513E+03	0.1674E+00	0.5865E+01	0.5000E-01

Prelim 2' CIDH at Abutments

0.2896E+03	0.2137E+00	0.8798E+01	0.7500E-01
0.3138E+03	0.2527E+00	0.1173E+02	0.1000E+00
0.3612E+03	0.4346E+00	0.2869E+02	0.2500E+00
0.3778E+03	0.6985E+00	0.4628E+02	0.5000E+00
0.3913E+03	0.9596E+00	0.6023E+02	0.7500E+00
0.4033E+03	0.1219E+01	0.7259E+02	0.1000E+01
0.4458E+03	0.2655E+01	0.1174E+03	0.2400E+01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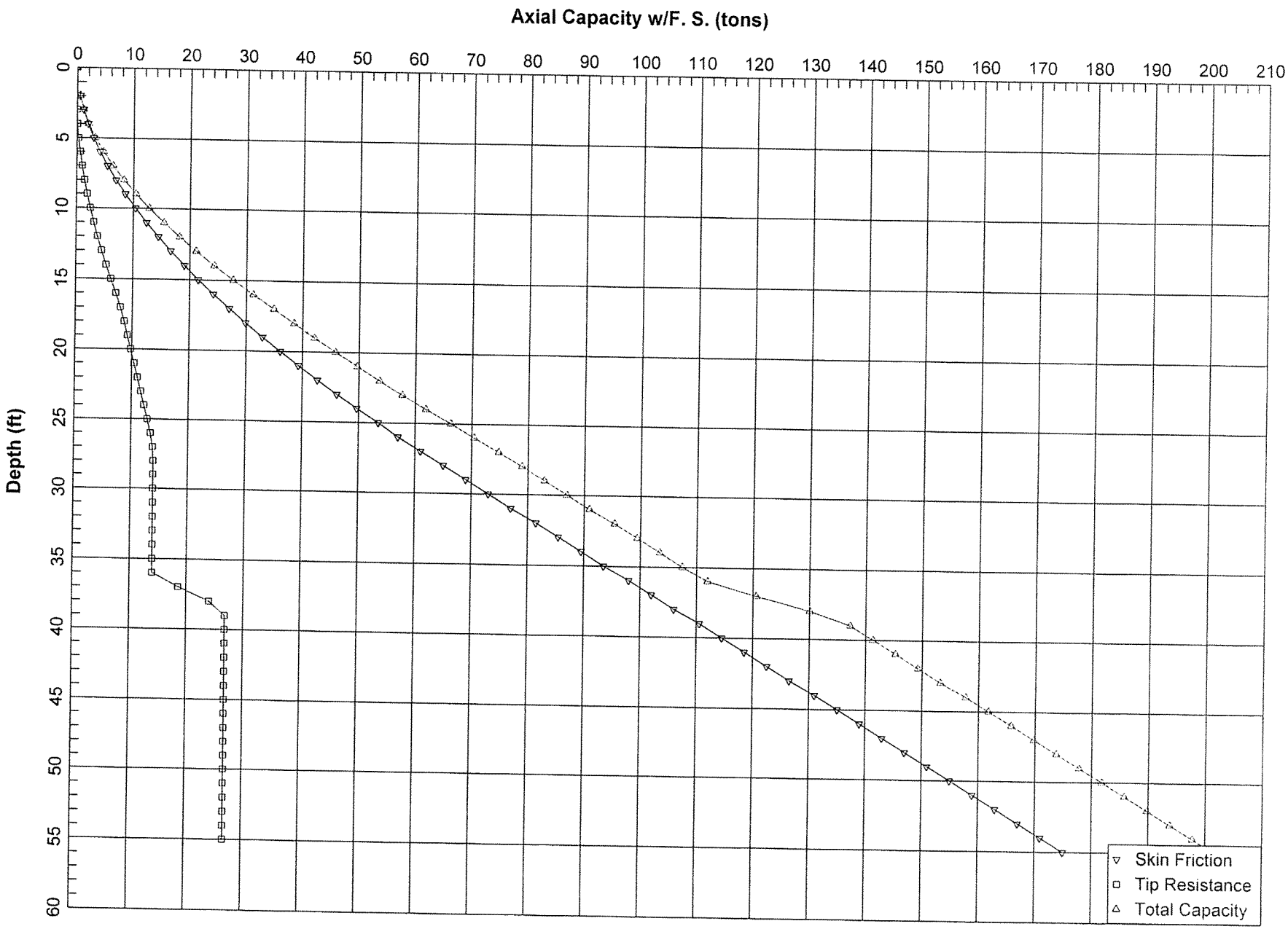
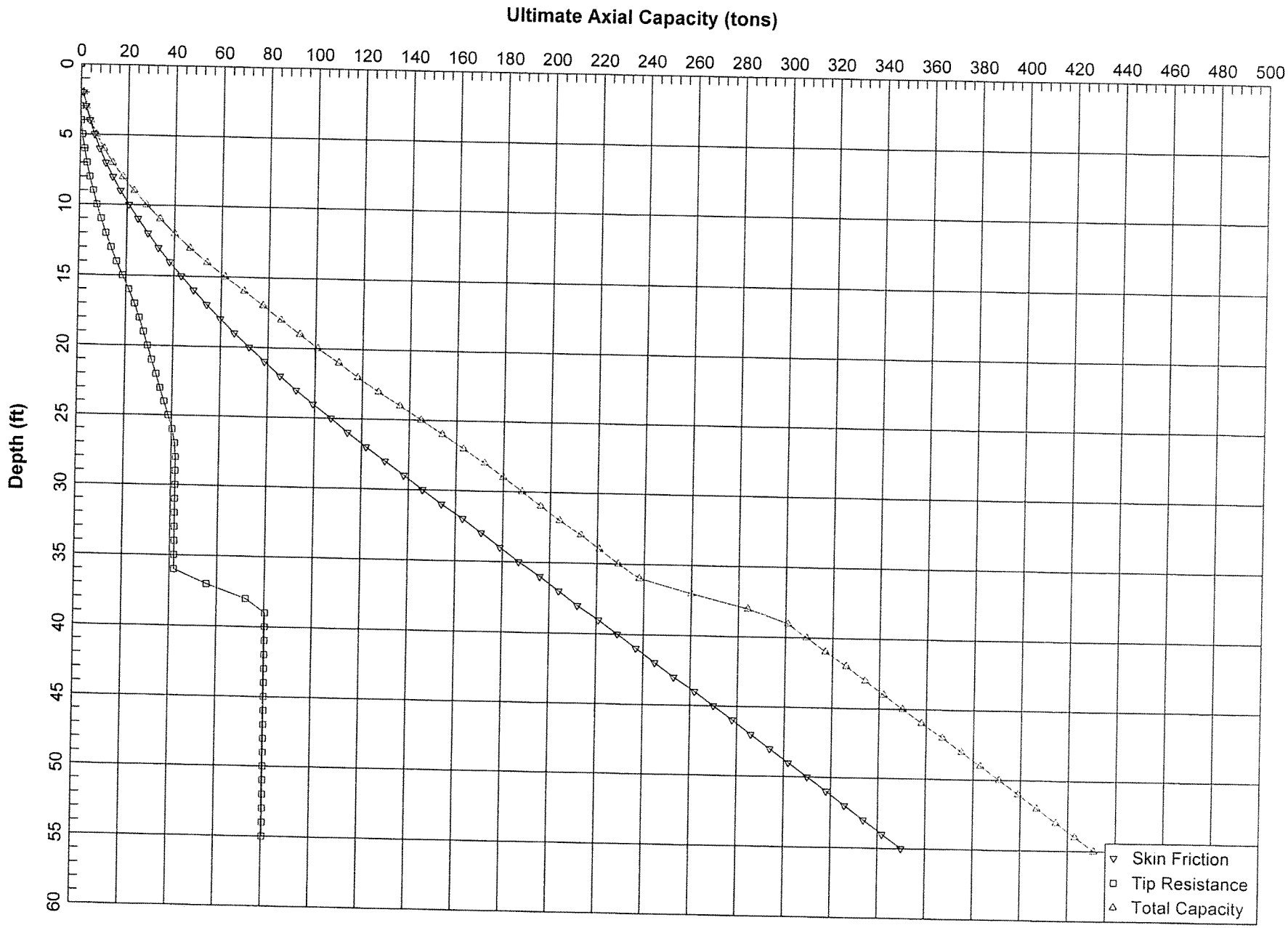

Axial Capacity w/F. S. (tons)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Skin Friction
Tip Resistance
Total Capacity


Ultimate Axial Capacity (tons)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Skin Friction
Tip Resistance
Total Capacity

C-6

LATERAL PILE CAPACITY

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LPILE Plus for Windows, Version 5.0 (5.0.22)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Path to file locations: C:\Documents and Settings\stien\My Documents\76979 related files\Engineering Analysis\Lateral Capacity\
Name of input data file: Preliminary Abut 24 inch CIDH FREE HEAD 0.25 inch.lpd
Name of output file: Preliminary Abut 24 inch CIDH FREE HEAD 0.25 inch.lpo
Name of plot output file: Preliminary Abut 24 inch CIDH FREE HEAD 0.25 inch.lpp
Name of runtime file: Preliminary Abut 24 inch CIDH FREE HEAD 0.25 inch.lpr

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Time and Date of Analysis

Date: February 26, 2008 Time: 17: 4:20

Problem Title

I215/SR60 HOV Abutments (2' CIDH) preliminary FREE HEAD 0.25" defl.

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 includes automatic computation of pile-top deflection vs. pile embedment length
- 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:

Preliminary Abut 24 inch CIDH FREE HEAD 0.25 inch.lpo

- 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 = 600.00 in
Depth of ground surface below top of pile = -24.00 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	16286.0000	452.0000	3600000.
2	600.0000	24.00000000	16286.0000	452.0000	3600000.

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -24.000 in
Distance from top of pile to bottom of layer = 84.000 in
p-y subgrade modulus k for top of soil layer = 50.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 84.000 in
Distance from top of pile to bottom of layer = 360.000 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 = 150.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 360.000 in
Distance from top of pile to bottom of layer = 480.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 480.000 in
Distance from top of pile to bottom of layer = 720.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 720.000 in
Distance from top of pile to bottom of layer = 1200.000 in
p-y subgrade modulus k for top of soil layer = 200.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 200.000 lbs/in**3

(Depth of lowest layer extends 600.00 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	-24.00	.06100
2	84.00	.06100
3	84.00	.06400
4	360.00	.07200
5	360.00	.03900
6	480.00	.03900
7	480.00	.03900
8	720.00	.03900
9	720.00	.07200
10	1200.00	.07200

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	-24.000	.00000	30.00	------	------
2	84.000	.00000	30.00	------	------
3	84.000	.00000	30.00	------	------
4	360.000	.00000	35.00	------	------
5	360.000	.00000	35.00	------	------
6	480.000	.00000	35.00	------	------
7	480.000	.00000	38.00	------	------
8	720.000	.00000	38.00	------	------
9	720.000	.00000	40.00	------	------
10	1200.000	.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.

Loading Type

Preliminary Abut 24 inch CIDH FREE HEAD 0.25 inch.lpo

Static loading criteria was used for computation of p-y curves

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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 = 29000.000 lbs
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 68000.000 lbs

(Zero moment at pile head for this load indicates a free-head 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 = 29000.000 lbs
Specified moment at pile head = .000 in-lbs
Specified axial load at pile head = 68000.000 lbs

(Zero moment for this load indicates free-head conditions)

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
0.000	.247311	9.0405E-08	29000.0000	-.0027142	150.4425	-214.8641
6.000	.231026	171240.	27562.2494	-.0027054	276.6170	-264.3861
12.000	.214846	332955.	25851.7750	-.0026796	395.7731	-305.7720
18.000	.198871	483648.	23903.7603	-.0026378	506.8082	-343.5662
24.000	.183193	621952.	21760.7115	-.0025813	608.7150	-370.7834
30.000	.167896	746883.	19468.4529	-.0025112	700.7673	-393.3028
36.000	.153058	857623.	17076.1411	-.0024291	782.3640	-404.1344
42.000	.138747	953778.	14641.0383	-.0023364	853.2142	-407.5665
48.000	.125021	1035222.	12225.8592	-.0022346	913.2241	-397.4932
54.000	.111931	1102312.	9859.0946	-.0021253	962.6582	-391.4283
60.000	.099518	1155265.	7563.1306	-.0020098	1001.6755	-373.8931
66.000	.087814	1194710.	5406.3557	-.0018895	1030.7394	-345.0319
72.000	.076843	1221683.	3453.9988	-.0017659	1050.6143	-305.7537
78.000	.066623	1237599.	1627.9347	-.0016400	1062.3413	-302.9343
84.000	.057163	1242557.	-154.7694	-.0015131	1065.9945	-291.3004
90.000	.048466	1236976.	-1877.9880	-.0013862	1061.8826	-283.1058
96.000	.040528	1221152.	-3537.9052	-.0012605	1050.2229	-270.1999
102.000	.033340	1195550.	-5135.1663	-.0011368	1031.3584	-262.2205
108.000	.026886	1160458.	-6681.1977	-.0010163	1005.5016	-253.1233
114.000	.021145	1116205.	-8159.9949	-.0008998	972.8947	-239.8091
120.000	.016089	1063272.	-9545.3123	-.0007882	933.8923	-221.9634
126.000	.011686	1002304.	-10727.5975	-.0006825	888.9694	-172.1317
132.000	.007899	935098.	-11611.8920	-.0005834	839.4498	-122.6332
138.000	.004685	863438.	-12209.4319	-.0004914	786.6484	-76.5468
144.000	.002002	788986.	-12542.1683	-.0004068	731.7900	-34.3653

150.000	-.000197	713263.	-12634.6313	-.0003300	675.9958	3.5443
156.000	-.001958	637639.	-12513.1887	-.0002608	620.2736	36.9366
162.000	-.003327	563318.	-12205.3313	-.0001994	565.5116	65.6825
168.000	-.004350	491338.	-11739.0023	-.0001454	512.4746	89.7605
174.000	-.005072	422569.	-11141.9805	-9.8662E-05	461.8034	109.2467
180.000	-.005534	357715.	-10441.3297	-5.8736E-05	414.0171	124.3035
186.000	-.005777	297321.	-9662.9182	-2.5219E-05	369.5170	135.1670
192.000	-.005837	241780.	-8831.0159	2.3662E-06	328.5932	142.1338
198.000	-.005748	191347.	-7967.9692	2.4529E-05	291.4322	145.5484
204.000	-.005543	146145.	-7093.9541	4.1798E-05	258.1261	145.7899
210.000	-.005247	106185.	-6226.8061	5.4709E-05	228.6827	143.2594
216.000	-.004886	71378.2729	-5381.9216	6.3795E-05	203.0361	138.3688
222.000	-.004481	41549.8629	-4572.2263	6.9573E-05	181.0576	131.5296
228.000	-.004051	16454.7854	-3808.2048	7.2541E-05	162.5668	123.1442
234.000	-.003611	-4207.7881	-3097.9816	7.3168E-05	153.5429	113.5969
240.000	-.003173	-20780.6986	-2447.4482	7.1889E-05	165.7543	103.2476
246.000	-.002748	-33635.8283	-1860.4262	6.9105E-05	175.2263	92.4264
252.000	-.002344	-43162.2026	-1338.8585	6.5175E-05	182.2456	81.4295
258.000	-.001966	-49755.3134	-883.0211	6.0421E-05	187.1036	70.5163
264.000	-.001619	-53807.7585	-491.7464	5.5121E-05	190.0896	59.9085
270.000	-.001305	-55701.2496	-162.6530	4.9518E-05	191.4848	49.7893
276.000	-.001025	-55800.0016	107.6272	4.3813E-05	191.5575	40.3041
282.000	-.000779	-54445.4748	323.2277	3.8172E-05	190.5595	31.5627
288.000	-.000567	-51952.4169	488.8384	3.2727E-05	188.7225	23.6408
294.000	-.000386	-48606.1191	609.5115	2.7582E-05	186.2569	16.5835
300.000	-.000236	-44660.7855	690.4864	2.2810E-05	183.3498	10.4081
306.000	-.000112	-40338.8951	737.0349	1.8460E-05	180.1654	5.1081
312.000	-1.41E-05	-35831.4297	754.3288	1.4563E-05	176.8441	.6565585
318.000	6.23E-05	-31298.8321	747.3292	1.1128E-05	173.5044	-2.9898
324.000	.000119	-26872.5595	720.6987	8.1511E-06	170.2430	-5.8871
330.000	.000160	-22657.0991	678.7355	5.6168E-06	167.1369	-8.1007
336.000	.000187	-18732.3169	625.3277	3.4989E-06	164.2450	-9.7019
342.000	.000202	-15156.0216	563.9271	1.7649E-06	161.6099	-10.7650
348.000	.000208	-11966.6319	497.5401	3.7706E-07	159.2598	-11.3641
354.000	.000207	-9185.8485	428.7343	-7.0529E-07	157.2109	-11.5712
360.000	.000200	-6821.2448	367.0040	-1.5243E-06	155.4686	-9.0056
366.000	.000188	-4780.5569	314.0683	-2.1180E-06	153.9649	-8.6397
372.000	.000174	-3050.6974	263.7891	-2.5187E-06	152.6903	-8.1200
378.000	.000158	-1613.0322	216.9577	-2.7573E-06	151.6310	-7.4904
384.000	.000141	-444.9551	174.1192	-2.8627E-06	150.7703	-6.7891
390.000	.000124	478.7338	135.6055	-2.8609E-06	150.7952	-6.0488
396.000	.000107	1184.6455	101.5676	-2.7758E-06	151.3154	-5.2972
402.000	9.05E-05	1699.8096	72.0062	-2.6282E-06	151.6949	-4.5566
408.000	7.52E-05	2050.8639	46.8012	-2.4363E-06	151.9536	-3.8450
414.000	6.12E-05	2263.4118	25.7386	-2.2155E-06	152.1102	-3.1759
420.000	4.86E-05	2361.5345	8.5345	-1.9789E-06	152.1825	-2.5588
426.000	3.75E-05	2367.4404	-5.1430	-1.7369E-06	152.1869	-2.0003
432.000	2.78E-05	2301.2361	-15.6551	-1.4980E-06	152.1381	-1.5037
438.000	1.95E-05	2180.8010	-23.3768	-1.2687E-06	152.0494	-1.0702
444.000	1.26E-05	2021.7492	-28.6832	-1.0536E-06	151.9322	-.6986348
450.000	6.86E-06	1837.4620	-31.9392	-8.5618E-07	151.7964	-.3866751
456.000	2.29E-06	1639.1779	-33.4910	-6.7828E-07	151.6503	-.1306099
462.000	-1.28E-06	1436.1233	-33.6606	-5.2092E-07	151.5007	.0740681
468.000	-3.96E-06	1235.6752	-32.7412	-3.8421E-07	151.3530	.2324031
474.000	-5.89E-06	1043.5421	-30.9949	-2.6759E-07	151.2114	.3497185
480.000	-7.18E-06	863.9552	-28.6896	-1.6998E-07	151.0791	.4187132
486.000	-7.93E-06	699.4060	-26.0273	-8.9987E-08	150.9578	.4686965
492.000	-8.26E-06	551.7006	-23.1389	-2.5969E-08	150.8490	.4941080
498.000	-8.24E-06	421.7601	-20.1582	2.3841E-08	150.7532	.4994776
504.000	-7.97E-06	309.7832	-17.1929	6.1273E-08	150.6707	.4889384
510.000	-7.51E-06	215.3951	-14.3276	8.8146E-08	150.6012	.4661774
516.000	-6.91E-06	137.7804	-11.6258	1.0622E-07	150.5440	.4344096
522.000	-6.23E-06	75.7987	-9.1335	1.1715E-07	150.4983	.3963685

528.000	-5.51E-06	28.0831	-6.8814	1.2246E-07	150.4632	.3543129
534.000	-4.76E-06	-6.8785	-4.8884	1.2355E-07	150.4475	.3100454
540.000	-4.02E-06	-30.6780	-3.1634	1.2162E-07	150.4651	.2649409
546.000	-3.30E-06	-44.9385	-1.7086	1.1776E-07	150.4756	.2199823
552.000	-2.61E-06	-51.2777	-.5212768	1.1283E-07	150.4803	.1758017
558.000	-1.95E-06	-51.2859	.4043071	1.0758E-07	150.4803	.1327263
564.000	-1.32E-06	-46.5138	1.0750	1.0258E-07	150.4768	.0908271
570.000	-7.18E-07	-38.4700	1.4974	9.8232E-08	150.4708	.0499713
576.000	-1.40E-07	-28.6256	1.6769	9.4798E-08	150.4636	.0098755
582.000	4.20E-07	-18.4245	1.6170	9.2391E-08	150.4561	-.0298370
588.000	9.68E-07	-9.2968	1.3188	9.0973E-08	150.4493	-.0695765
594.000	1.51E-06	-2.6734	.7808745	9.0360E-08	150.4444	-.1097247
600.000	2.05E-06	0.0000	0.0000	9.0223E-08	150.4425	-.1505669

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.24731139 in
Computed slope at pile head	=	-.00271417
Maximum bending moment	=	1242557. lbs-in
Maximum shear force	=	29000.00000 lbs
Depth of maximum bending moment	=	84.00000000 in
Depth of maximum shear force	=	0.00000 in
Number of iterations	=	14
Number of zero deflection points	=	4

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= 29000.	M= 0.000	68000.0000	.2473114	1242557.	29000.0000

Pile-head Deflection vs. Pile Length

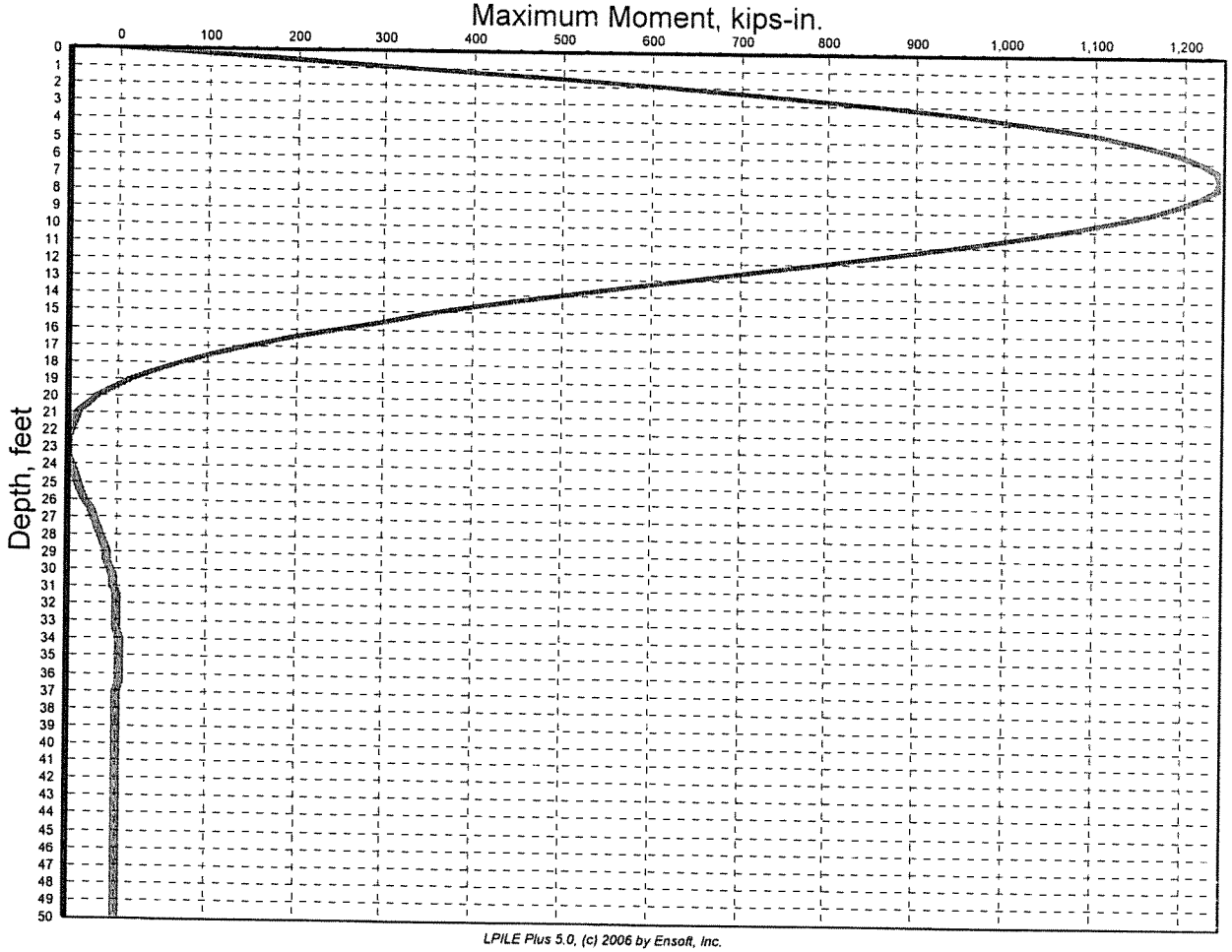
Boundary Condition Type 1, Shear and Moment

Shear	=	29000. lbs
Moment	=	0. in-lbs
Axial Load	=	68000. lbs

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
600.000	.24731139	1242557.	29000.00000
570.000	.24643932	1242514.	29000.00000
540.000	.24613424	1242569.	29000.00000
510.000	.24599956	1242826.	29000.00000
480.000	.24605467	1242901.	29000.00000
450.000	.24609628	1242711.	29000.00000
420.000	.24535923	1244506.	29000.00000
390.000	.24573150	1242932.	29000.00000
360.000	.24556150	1243548.	29000.00000
330.000	.24561698	1243065.	29000.00000

The analysis ended normally.

Bending Moment vs. Depth



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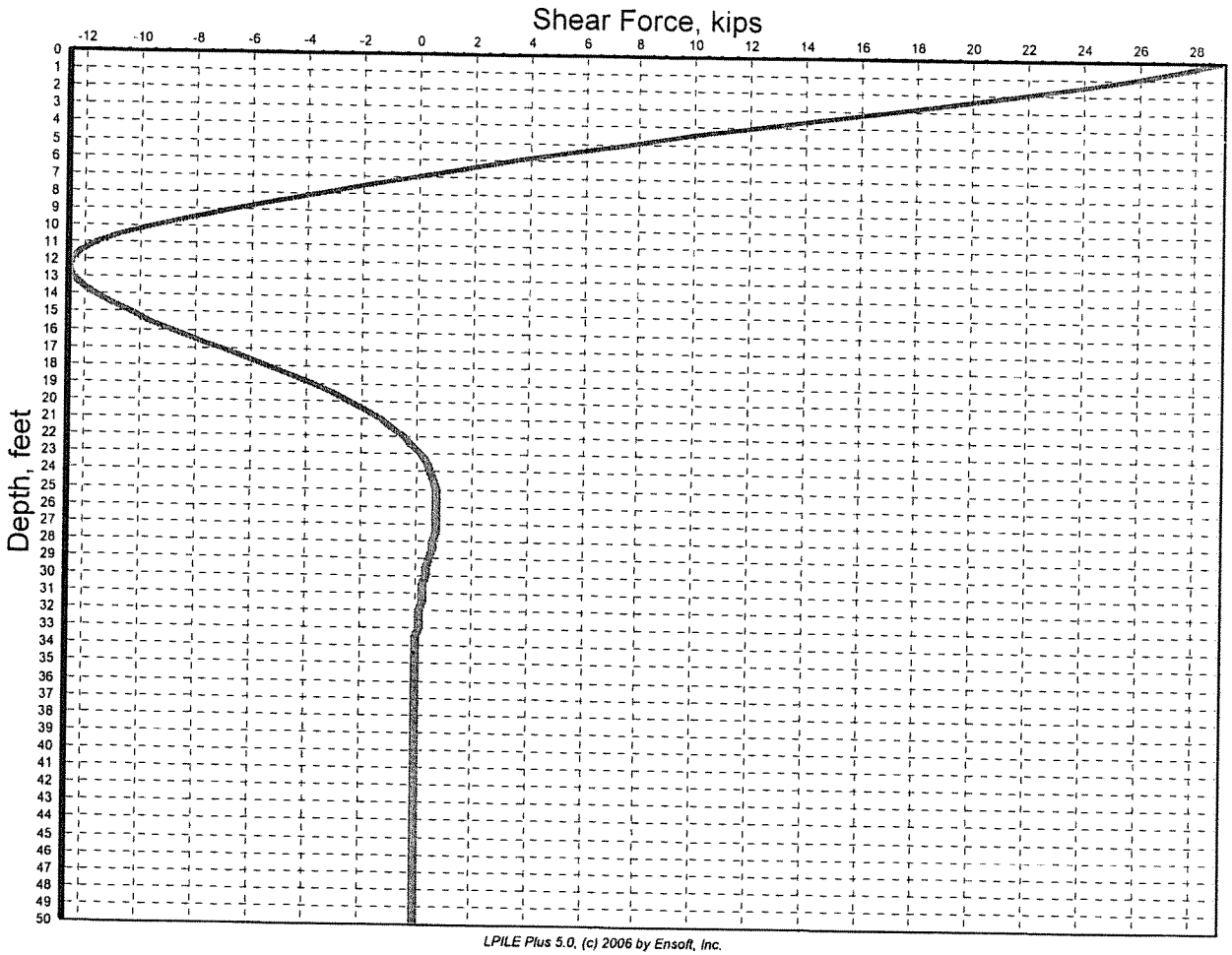
Shear Force vs. Depth



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LPILE Plus for Windows, Version 5.0 (5.0.22)

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Path to file locations: C:\Documents and Settings\stien\My Documents\76979 related files\Engineering Analysis\Lateral Capacity\
Name of input data file: Preliminary Abut 24 inch CIDH 1 inch deflect.lpd
Name of output file: Preliminary Abut 24 inch CIDH 1 inch deflect.lpo
Name of plot output file: Preliminary Abut 24 inch CIDH 1 inch deflect.lpp
Name of runtime file: Preliminary Abut 24 inch CIDH 1 inch deflect.lpr

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Time and Date of Analysis

Date: February 26, 2008 Time: 17: 5:25

Problem Title

I215/SR60 HOV Abutments (2' CIDH) preliminary 1 " defl.

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 includes automatic computation of pile-top deflection vs. pile embedment length
- 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:

Preliminary Abut 24 inch CIDH 1 inch deflect.lpo

- 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 = 600.00 in
Depth of ground surface below top of pile = -24.00 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	6514.0000	452.0000	3600000.
2	600.0000	24.00000000	6514.0000	452.0000	3600000.

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -24.000 in
Distance from top of pile to bottom of layer = 84.000 in
p-y subgrade modulus k for top of soil layer = 50.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 84.000 in
Distance from top of pile to bottom of layer = 360.000 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 = 150.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 360.000 in
Distance from top of pile to bottom of layer = 480.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 480.000 in
Distance from top of pile to bottom of layer = 720.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 720.000 in
Distance from top of pile to bottom of layer = 1200.000 in
p-y subgrade modulus k for top of soil layer = 200.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 200.000 lbs/in**3

(Depth of lowest layer extends 600.00 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	-24.00	.06100
2	84.00	.06100
3	84.00	.06400
4	360.00	.07200
5	360.00	.03900
6	480.00	.03900
7	480.00	.03900
8	720.00	.03900
9	720.00	.07200
10	1200.00	.07200

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	-24.000	.00000	30.00	------	------
2	84.000	.00000	30.00	------	------
3	84.000	.00000	30.00	------	------
4	360.000	.00000	35.00	------	------
5	360.000	.00000	35.00	------	------
6	480.000	.00000	35.00	------	------
7	480.000	.00000	38.00	------	------
8	720.000	.00000	38.00	------	------
9	720.000	.00000	40.00	------	------
10	1200.000	.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.

Loading Type

Preliminary Abut 24 inch CIDH 1 inch deflect.lpo

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 115000.000 lbs
Slope at pile head = .000 in/in
Axial load at pile head = 68000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Specified shear force at pile head = 115000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 68000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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
0.000	1.004	-6462754.	115000.	3.7007E-17	12056.0385	-339.4287
6.000	.999334	-5778527.	112693.	-.0015660	10795.5639	-429.7132
12.000	.985503	-5109166.	109863.	-.0029589	9562.4761	-513.3525
18.000	.963828	-4457752.	106527.	-.0041828	8362.4507	-598.8775
24.000	.935309	-3827432.	102705.	-.0052427	7201.2847	-674.9889
30.000	.900915	-3221013.	98440.8511	-.0061444	6084.1471	-746.4235
36.000	.861577	-2641128.	93843.9180	-.0068943	5015.8920	-785.8875
42.000	.818183	-2089260.	88991.5992	-.0074995	3999.2479	-831.5521
48.000	.771583	-1567109.	83919.5091	-.0079673	3037.3495	-859.1446
54.000	.722576	-1075724.	78622.4531	-.0083053	2132.1271	-906.5407
60.000	.671918	-616863.	73086.5066	-.0085219	1286.8185	-938.7748
66.000	.620314	-191733.	67409.4181	-.0086253	503.6495	-953.5881
72.000	.568414	199089.	61702.0043	-.0086244	517.2005	-948.8832
78.000	.516821	555729.	55908.6381	-.0085278	1174.1987	-982.2389
84.000	.466081	876951.	50004.4944	-.0083445	1765.9491	-985.8090
90.000	.416687	1162592.	44010.5451	-.0080836	2292.1534	-1012.1741
96.000	.369077	1411674.	37889.8841	-.0077543	2751.0080	-1028.0463
102.000	.323635	1623598.	31672.9913	-.0073660	3141.4124	-1044.2513
108.000	.280685	1797760.	25379.3897	-.0069283	3462.2512	-1053.6159
114.000	.240495	1933804.	19063.8341	-.0064509	3712.8699	-1051.5693
120.000	.203274	2031790.	12796.4885	-.0059436	3893.3780	-1037.5459
126.000	.169172	2092212.	6650.5041	-.0054160	4004.6866	-1011.1156
132.000	.138282	2116016.	701.2252	-.0048777	4048.5371	-971.9774
138.000	.110640	2104607.	-4974.5224	-.0043377	4027.5203	-919.9385
144.000	.086229	2059861.	-10298.9355	-.0038050	3945.0897	-854.8659

150.000	.064981	1984125.	-15193.3036	-.0032876	3805.5693	-776.5902
156.000	.046778	1880224.	-19577.1935	-.0027933	3614.1650	-684.7065
162.000	.031461	1751478.	-23365.7120	-.0023287	3376.9902	-578.1330
168.000	.018834	1601736.	-26265.9172	-.0018997	3101.1376	-388.6021
174.000	.008665	1437837.	-27991.6508	-.0015108	2799.2054	-186.6425
180.000	.000704	1267069.	-28599.0135	-.0011648	2484.6188	-15.8118
186.000	-.005312	1095599.	-28273.5645	-.0008625	2168.7399	124.2948
192.000	-.009646	928490.	-27195.9794	-.0006036	1860.8934	234.9002
198.000	-.012555	769740.	-25537.5930	-.0003863	1568.4466	317.8952
204.000	-.014283	622354.	-23456.8529	-.0002083	1296.9342	375.6849
210.000	-.015054	488428.	-21096.6817	-6.6149E-05	1050.2170	411.0389
216.000	-.015076	369248.	-18582.7152	4.3573E-05	830.6654	426.9500
222.000	-.014531	265399.	-16022.3514	.0001248	639.3577	426.5046
228.000	-.013579	176878.	-13504.5281	.0001813	476.2841	412.7698
234.000	-.012355	103197.	-11100.1298	.0002172	340.5508	388.6963
240.000	-.010973	43498.9047	-8862.9159	.0002359	230.5756	357.0417
246.000	-.009524	-3350.3749	-6830.8589	.0002411	156.6145	320.3107
252.000	-.008080	-38668.1201	-5027.7822	.0002357	221.6763	280.7149
258.000	-.006696	-63876.0931	-3465.1931	.0002226	268.1141	240.1481
264.000	-.005409	-80432.0646	-2144.2148	.0002041	298.6133	200.1780
270.000	-.004246	-89773.2333	-1057.5325	.0001823	315.8215	162.0495
276.000	-.003221	-93271.2502	-191.2828	.0001589	322.2655	126.7005
282.000	-.002339	-92198.3135	473.1738	.0001352	320.2889	94.7851
288.000	-.001599	-87703.4898	957.6389	.0001122	312.0086	66.7033
294.000	-.000993	-80798.1921	1285.6539	9.0632E-05	299.2878	42.6350
300.000	-.000511	-72349.5989	1481.2865	7.1040E-05	283.7239	22.5758
306.000	-.000140	-63080.7227	1568.1341	5.3714E-05	266.6489	6.3733
312.000	.000134	-53575.8210	1568.5409	3.8791E-05	249.1391	-6.2377
318.000	.000325	-44289.8846	1503.0202	2.6271E-05	232.0327	-15.6025
324.000	.000449	-35561.0149	1389.8641	1.6055E-05	215.9525	-22.1162
330.000	.000518	-27624.6165	1244.9217	7.9720E-06	201.3322	-26.1979
336.000	.000544	-20628.4597	1081.5227	1.7990E-06	188.4439	-28.2684
342.000	.000539	-14647.8118	910.5219	-2.7139E-06	177.4265	-28.7319
348.000	.000512	-9699.9828	740.4404	-5.8287E-06	168.3117	-27.9619
354.000	.000470	-5757.7712	577.6819	-7.8062E-06	161.0494	-26.2909
360.000	.000418	-2761.4299	442.1941	-8.8961E-06	155.5295	-18.8717
366.000	.000363	-444.1826	335.6596	-9.3061E-06	151.2607	-16.6398
372.000	.000307	1274.0788	242.8618	-9.2000E-06	152.7896	-14.2928
378.000	.000252	2477.6665	164.1208	-8.7200E-06	155.0068	-11.9542
384.000	.000202	3250.6445	99.1064	-7.9872E-06	156.4308	-9.7173
390.000	.000157	3673.4604	47.0085	-7.1014E-06	157.2097	-7.6486
396.000	.000117	3820.5416	6.6876	-6.1427E-06	157.4806	-5.7917
402.000	8.28E-05	3758.7235	-23.1989	-5.1731E-06	157.3667	-4.1705
408.000	5.46E-05	3546.3762	-44.0903	-4.2385E-06	156.9756	-2.7933
414.000	3.19E-05	3233.0986	-57.4395	-3.3712E-06	156.3984	-1.6564
420.000	1.42E-05	2859.8537	-64.6482	-2.5918E-06	155.7109	-.7465326
426.000	8.32E-07	2459.4350	-67.0209	-1.9113E-06	154.9732	-.0443797
432.000	-8.75E-06	2057.1620	-65.7337	-1.3335E-06	154.2322	.4734675
438.000	-1.52E-05	1671.7190	-61.8161	-8.5644E-07	153.5221	.8323993
444.000	-1.90E-05	1316.0680	-56.1442	-4.7422E-07	152.8669	1.0582
450.000	-2.09E-05	998.3755	-49.4417	-1.7813E-07	152.2817	1.1759
456.000	-2.12E-05	722.9125	-42.2873	4.2073E-08	151.7742	1.2089
462.000	-2.04E-05	490.8930	-35.1267	1.9736E-07	151.3468	1.1780
468.000	-1.88E-05	301.2306	-28.2874	2.9869E-07	150.9974	1.1018
474.000	-1.68E-05	151.2007	-21.9948	3.5657E-07	150.7210	.9957426
480.000	-1.45E-05	37.0018	-16.4664	3.8065E-07	150.5106	.8470552
486.000	-1.22E-05	-46.7070	-11.7614	3.7941E-07	150.5285	.7212800
492.000	-9.96E-06	-104.4449	-7.8086	3.6007E-07	150.6349	.5963280
498.000	-7.88E-06	-140.7041	-4.5864	3.2871E-07	150.7017	.4777321
504.000	-6.02E-06	-159.7502	-2.0454	2.9027E-07	150.7368	.3692681
510.000	-4.40E-06	-165.4860	-.1179017	2.4866E-07	150.7473	.2732379
516.000	-3.03E-06	-161.3679	1.2741	2.0685E-07	150.7397	.1907468
522.000	-1.92E-06	-150.3661	2.2122	1.6697E-07	150.7195	.1219642

528.000	-1.03E-06	-134.9579	2.7772	1.3047E-07	150.6911	.0663606
534.000	-3.52E-07	-117.1466	3.0450	9.8215E-08	150.6583	.0229156
540.000	1.47E-07	-98.4982	3.0846	7.0628E-08	150.6239	-.0097055
546.000	4.96E-07	-80.1889	2.9565	4.7769E-08	150.5902	-.0330046
552.000	7.21E-07	-63.0593	2.7119	2.9443E-08	150.5586	-.0485347
558.000	8.49E-07	-47.6704	2.3928	1.5277E-08	150.5303	-.0578097
564.000	9.04E-07	-34.3577	2.0327	4.7835E-09	150.5058	-.0622382
570.000	9.06E-07	-23.2820	1.6567	-2.5904E-09	150.4854	-.0630783
576.000	8.73E-07	-14.4747	1.2833	-7.4206E-09	150.4691	-.0614073
582.000	8.17E-07	-7.8765	.9247472	-1.0280E-08	150.4570	-.0581062
588.000	7.49E-07	-3.3693	.5888701	-1.1719E-08	150.4487	-.0538528
594.000	6.77E-07	-.8005043	.2799444	-1.2252E-08	150.4440	-.0491224
600.000	6.02E-07	0.0000	0.0000	-1.2354E-08	150.4425	-.0441924

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection              =     1.00429479 in
Computed slope at pile head       =   3.700743E-17
Maximum bending moment            =      -6462754. lbs-in
Maximum shear force               =   115000.00000 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  =              4
```

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
2	V= 1.15E+05	S= 0.000	68000.0000	1.0043	-6462754.	115000.

Pile-head Deflection vs. Pile Length

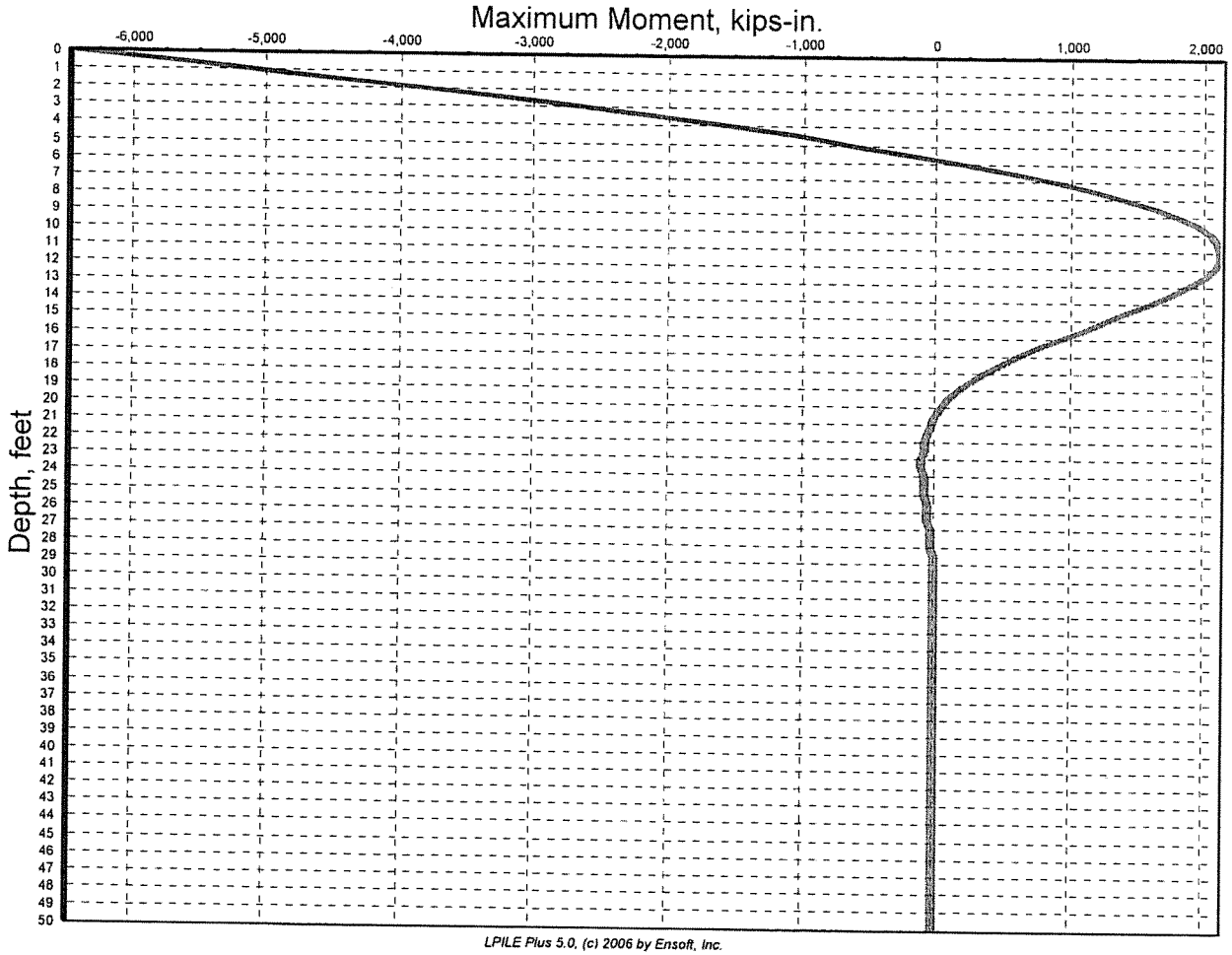
Boundary Condition Type 2, Shear and Slope

```
Shear      =        115000. lbs
Slope      =         .00000
Axial Load =         68000. lbs
```

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
600.000	1.00429479	-6462754.	115000.00000
570.000	.99844524	-6454776.	115000.00000
540.000	.99533554	-6451710.	115000.00000
510.000	.99371553	-6450205.	115000.00000
480.000	.99351608	-6450116.	115000.00000
450.000	.99459858	-6451376.	115000.00000
420.000	.98769872	-6444001.	115000.00000
390.000	.99173284	-6448124.	115000.00000
360.000	.98963978	-6446156.	115000.00000
330.000	.98998369	-6446378.	115000.00000

The analysis ended normally.

Bending Moment vs. Depth



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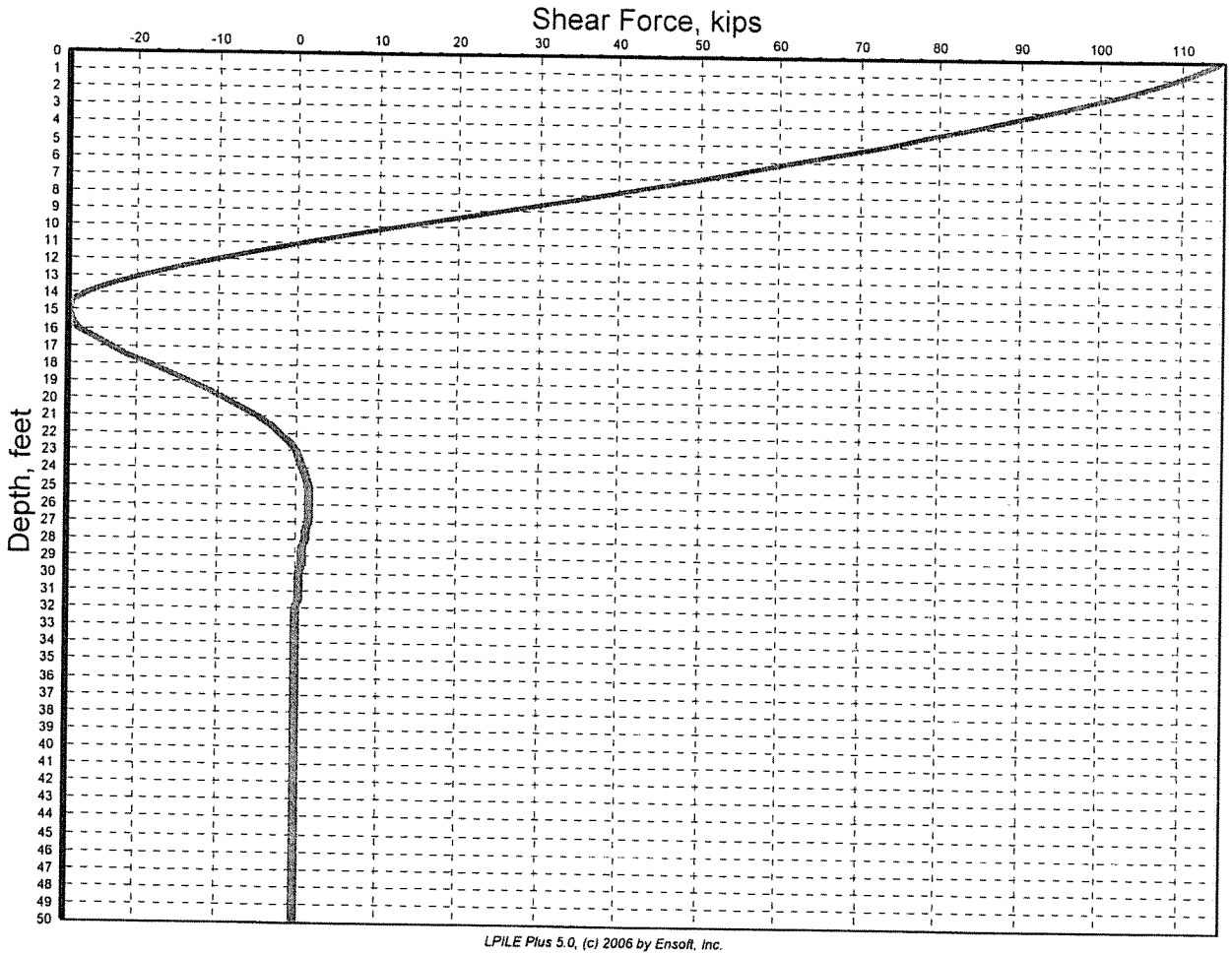
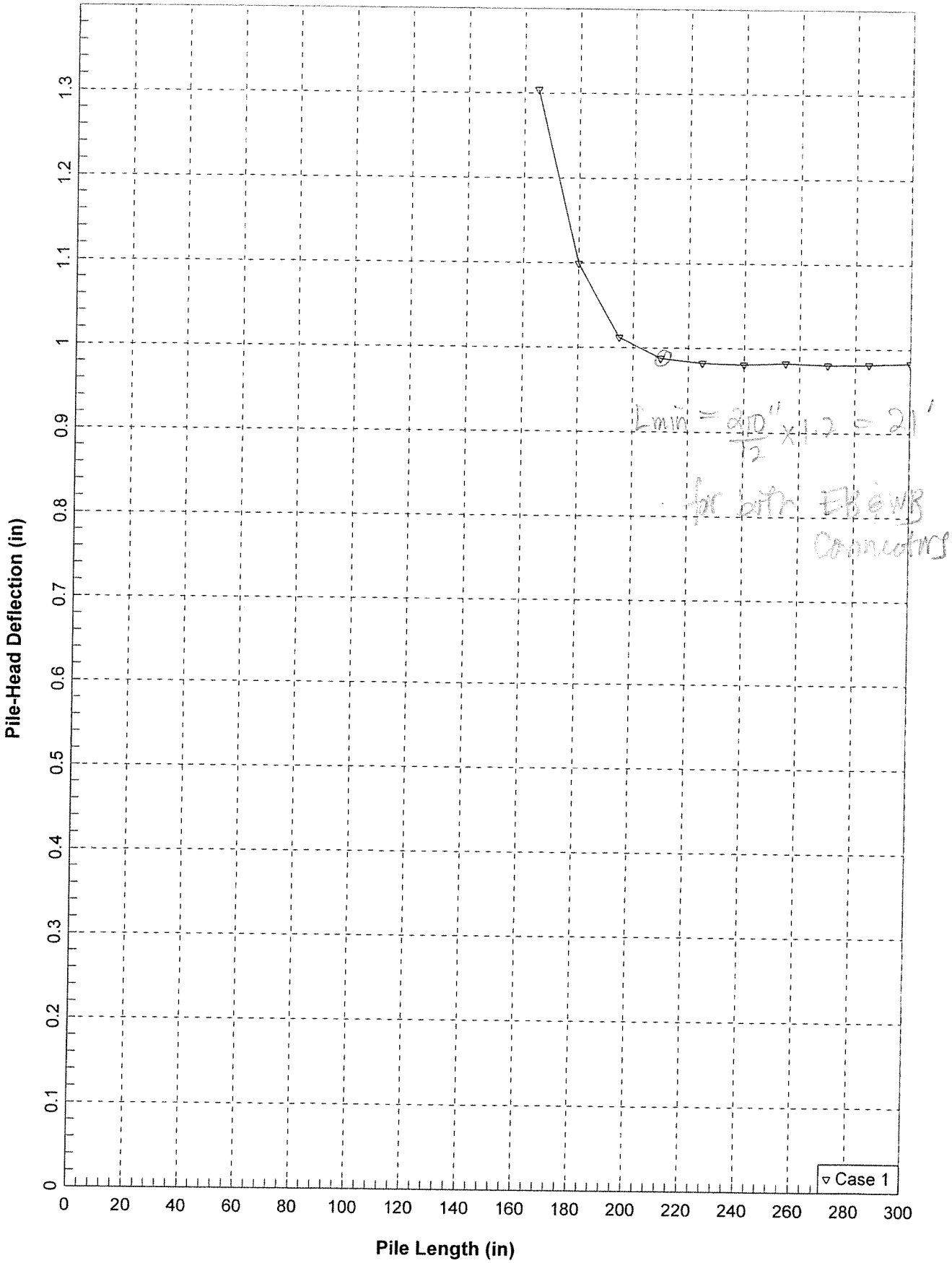
Shear Force vs. Depth



LPILE Plus 5.0, (c) 2006 by Ensoft, Inc.


Pile-Head Deflection (in)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
Pile Length (in)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Case 1
Lmin = 2ID"/12 × 12 = 21'
for both EB & WB
Connections

C-7

LATERAL EARTH PRESSURES

LATERAL EARTH PRESSURES

A Spreadsheet Developed By: R. Diaz, Rev 2.1 by M. Trias (11-Feb-04)

PROJECT INFORMATION

Project Name	SR60 HOV Connectors
Project Number	
Project Location	Riverside, CA
Wall Number/Location	1, 2, 3 & 4

INPUT PARAMETERS

Units	METRIC
Method for Calculating Active Condition	RANKINE
Soil Friction Angle, ø	32 (degrees)
Type of Wall Material	CONCRETE (soil-wall friction is equal to 2/3 soil friction)
Angle of Wall to Vertical, β	0.0 (degrees)
Angle of Backfill, i	0.0 (degrees)
Horizontal Ground Acceleration, K_H	0.25 g
Vertical Ground Acceleration, K_V	0.00 g
Soil Unit Weight Above Groundwater, γ_T	19.6 (kN/M3)
Soil Unit Weight Below Groundwater, γ'	19.6 (kN/m3)

OUTPUT PARAMETERS

Coefficients of Pressure		Equivalent Fluid Pressures	
		Above Groundwater	Below Groundwater
At Rest[1] (K_o)	0.47	9 (kN/m3)	9 (kN/m3)
Active (K_A)	0.31	6 (kN/m3)	6 (kN/m3)
Passive[2] (K_P)	3.25	64 (kN/m3)	64 (kN/m3)
Combined Static and Seismic[3] (K_{AE})	0.47	9 (kN/m3)	9 (kN/m3)
Seismic[3] (K_E)	0.16	3 (kN/m3)	3 (kN/m3)

Coefficient of Friction Between Footing and Soil[4]	0.41

Based on : 1) Jaky's Method, 2) Rankine's Method, 3) Mononabe-Okabe's Method, 4) A soil-footing interface friction angle equal to 7/10 soil friction.

REMARKS

Performed By: _____	**Date:** _____	**Calculation No.**	**Revision No.**
Checked By: _____	**Date:** _____		

LATERAL EARTH PRESSURES			
A Spreadsheet Developed By: R. Diaz, Rev 2.1 by M. Trias (11-Feb-04)			
REVISION/ VERSION No.	**Description of Modification**	**Date**	**Modified By**
2.1	Revised Rankine method so can calculate for flat or sloped backfill and revised formatting to show Kh and Kv to two decimal places per RD.	2/11/2004	MT
2.0	Added Rankine or Coulomb Option for calculating active earth pressures per HM. Rankine method for i = 0 (flat backfill only).	2/5/2004	MT
1.2	Formatting, cleaning up, correcting formulas, edit error messages, edit comments, per RD.	1/14/2004	MT
1.1	Formatting, changed active calculation to Coulomb Method with flat or sloping backfill, added calculation for Coefficient of Friction Between Footing and Soil, and added calculation for above and below groundwater per RD & MT.	1/13/2004	JSP
1.0	Created basic sheet to calculate Ka, Kp, Ko, Kae, Ke. Rankine (flat backfill) and Mononobe Okabe Methods only.	6/2003	RD

LATERAL EARTH PRESSURES

A Spreadsheet Developed By: R. Diaz, Rev 2.1 by M. Trias (11-Feb-04)

PROJECT INFORMATION

Project Name	SR60 HOV Connectors
Project Number	
Project Location	Riverside, CA
Wall Number/Location	1, 2, 3 & 4

INPUT PARAMETERS

Units	METRIC	
Method for Calculating Active Condition	RANKINE	
Soil Friction Angle, ø	32	(degrees)
Type of Wall Material	CONCRETE	(soil-wall friction is equal to 2/3 soil friction)
Angle of Wall to Vertical, β	0.0	(degrees)
Angle of Backfill, i	26.6	(degrees)
Horizontal Ground Acceleration, K_H	0.25	Kh must be ≤ (1 - Kv) Tan (ø - i)
Vertical Ground Acceleration, K_V	0.00	g
Soil Unit Weight Above Groundwater, γ_T	19.6	(kN/M3)
Soil Unit Weight Below Groundwater, γ'	19.6	(kN/m3)

OUTPUT PARAMETERS

Coefficients of Pressure		Equivalent Fluid Pressures	
		Above Groundwater	Below Groundwater
At Rest[1] (K_o)	0.47	9 (kN/m3)	9 (kN/m3)
Active (K_A)	0.52	10 (kN/m3)	10 (kN/m3)
Passive[2] (K_P)	1.93	38 (kN/m3)	38 (kN/m3)
Combined Static and Seismic[3] (K_{AE})	Check Kh	ERROR (kN/m3)	ERROR (kN/m3)
Seismic[3] (K_E)	Check Kh	ERROR (kN/m3)	ERROR (kN/m3)

Coefficient of Friction Between Footing and Soil[4]	0.41

Based on : 1) Jaky's Method, 2) Rankine's Method, 3) Mononabe-Okabe's Method, 4) A soil-footing interface friction angle equal to 7/10 soil friction.

REMARKS

Performed By: _____	**Date:** _____	**Calculation No.**	**Revision No.**
Checked By: _____	**Date:** _____		

LATERAL EARTH PRESSURES			
A Spreadsheet Developed By: R. Diaz, Rev 2.1 by M. Trias (11-Feb-04)			
REVISION/ VERSION No.	**Description of Modification**	**Date**	**Modified By**
2.1	Revised Rankine method so can calculate for flat or sloped backfill and revised formatting to show Kh and Kv to two decimal places per RD.	2/11/2004	MT
2.0	Added Rankine or Coulomb Option for calculating active earth pressures per HM. Rankine method for i = 0 (flat backfill only).	2/5/2004	MT
1.2	Formatting, cleaning up, correcting formulas, edit error messages, edit comments, per RD.	1/14/2004	MT
1.1	Formatting, changed active calculation to Coulomb Method with flat or sloping backfill, added calculation for Coefficient of Friction Between Footing and Soil, and added calculation for above and below groundwater per RD & MT.	1/13/2004	JSP
1.0	Created basic sheet to calculate Ka, Kp, Ko, Kae, Ke. Rankine (flat backfill) and Mononobe Okabe Methods only.	6/2003	RD

C-8

EMBANKMENT SETTLEMENT

ANALYSIS OF SETTLEMENTS BENEATH A TRAPEZOIDAL EMBANKMENT

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PROJECT INFORMATION

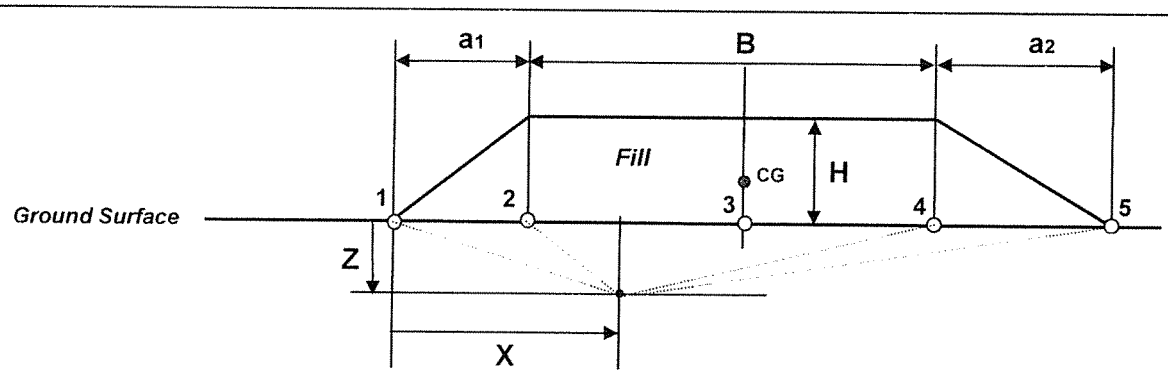
Project Name	I-215/SR60 East Junction HOV Connectors
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Analysis Description	Approach Embankment at Abutment 1 (Boring HV-1)
Stress Analysis Method	Boussinesq Method
Embankment Height, H	19.00 feet
Top Width of Embankment, B	90.00 feet
Left Side Slope Width, a_1	38.00 feet
Right Side Slope Width, a_2	38.00 feet
Ground Surface Elevation	1,524.00 feet
GWT Elevation for Design	1,497.00 feet
Unit Weight of Fill, $\gamma_{t,fill}$	125.00 pcf

INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Soil Modulus E_s (ksf)	Poisson's Ratio ν	Compression Ratio $C_c / (1 + e_0)$	Recompression Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,524.00	1,519.00	Cohesionless Soil	120.0	1,350.0	0.25			1.0
1,519.00	1,514.00	Cohesionless Soil	125.0	570.0	0.25			1.0
1,514.00	1,509.00	Cohesionless Soil	125.0	600.0	0.25			1.0
1,509.00	1,504.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,504.00	1,499.00	Cohesionless Soil	125.0	560.0	0.25			1.0
1,499.00	1,494.00	Cohesionless Soil	125.0	550.0	0.25			1.0
1,494.00	1,489.00	Cohesionless Soil	125.0	560.0	0.25			1.0
1,489.00	1,484.00	Cohesionless Soil	125.0	740.0	0.25			1.0
1,484.00	1,479.00	Cohesionless Soil	125.0	630.0	0.25			1.0
1,479.00	1,474.00	Cohesionless Soil	125.0	630.0	0.25			1.0



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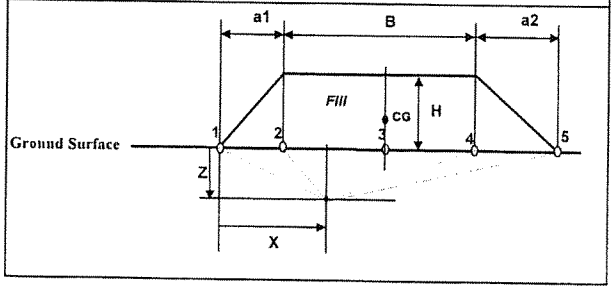
Stress Analysis Method	Boussinesq Method
Embankment Height, H	19.00 feet
Top Width of Embankment, B	90.00 feet
Left Side Slope Width, a_1	38.00 feet
Right Side Slope Width, a_2	38.00 feet
Ground Surface Elevation at Toe	1,524.00 feet
GWT Elevation for Design	1,497.00 feet
Unit Weight of Fill, $\gamma_{t,fill}$	125.00 pcf

** SUMMARY OF RESULTS **	Station 1	Station 2	Station 3	Station 4	Station 5
Distance, X (feet)	0.00	38.00	83.00	128.00	166.00
Total Elastic Settlement (inches)	0.33	1.64	1.93	1.64	0.33
Total Consol. Settlement (inches)	0.00	0.00	0.00	0.00	0.00
Total Settlement (inches)	0.33	1.64	1.93	1.64	0.33

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____



INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Soil Modulus E_s (ksf)	Soil Poisson's Ratio ν	Compression Ratio (For Clay) $C_c / (1 + e_0)$	Recompression Ratio (For Clay) $C_r / (1 + e_0)$	Overconsol. Ratio (For Clay) OCR
1,524.00	1,519.00	Cohesionless Soil	120.0	1,350.0	0.25			1.0
1,519.00	1,514.00	Cohesionless Soil	125.0	570.0	0.25			1.0
1,514.00	1,509.00	Cohesionless Soil	125.0	600.0	0.25			1.0
1,509.00	1,504.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,504.00	1,499.00	Cohesionless Soil	125.0	560.0	0.25			1.0
1,499.00	1,494.00	Cohesionless Soil	125.0	550.0	0.25			1.0
1,494.00	1,489.00	Cohesionless Soil	125.0	560.0	0.25			1.0
1,489.00	1,484.00	Cohesionless Soil	125.0	740.0	0.25			1.0
1,484.00	1,479.00	Cohesionless Soil	125.0	630.0	0.25			1.0
1,479.00	1,474.00	Cohesionless Soil	125.0	630.0	0.25			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

Soil Depth Z (feet)	Layer Thickness H_i (feet)	Load-Induced Stress Change Δp (ksf)					Elastic Settlement S_e (inches)					Consolidation Settlement S_c (inches)				
		Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5
2.50	5.00	0.05	2.33	2.37	2.33	0.05	0.002	0.117	0.120	0.117	0.002	0.000	0.000	0.000	0.000	0.000
7.50	5.00	0.15	2.23	2.37	2.23	0.15	0.013	0.219	0.236	0.219	0.013	0.000	0.000	0.000	0.000	0.000
12.50	5.00	0.24	2.13	2.37	2.13	0.24	0.020	0.189	0.211	0.189	0.020	0.000	0.000	0.000	0.000	0.000
17.50	5.00	0.33	2.05	2.35	2.05	0.33	0.031	0.204	0.236	0.204	0.031	0.000	0.000	0.000	0.000	0.000
22.50	5.00	0.40	1.97	2.33	1.97	0.40	0.036	0.180	0.214	0.180	0.036	0.000	0.000	0.000	0.000	0.000
27.50	5.00	0.47	1.89	2.30	1.89	0.47	0.043	0.175	0.214	0.175	0.043	0.000	0.000	0.000	0.000	0.000
32.50	5.00	0.53	1.83	2.26	1.83	0.53	0.047	0.165	0.205	0.165	0.047	0.000	0.000	0.000	0.000	0.000
37.50	5.00	0.58	1.77	2.22	1.77	0.58	0.039	0.121	0.152	0.121	0.039	0.000	0.000	0.000	0.000	0.000
42.50	5.00	0.62	1.71	2.17	1.71	0.62	0.050	0.137	0.174	0.137	0.050	0.000	0.000	0.000	0.000	0.000
47.50	5.00	0.66	1.66	2.11	1.66	0.66	0.053	0.133	0.169	0.133	0.053	0.000	0.000	0.000	0.000	0.000

ANALYSIS OF SETTLEMENTS BENEATH A TRAPEZOIDAL EMBANKMENT

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PROJECT INFORMATION

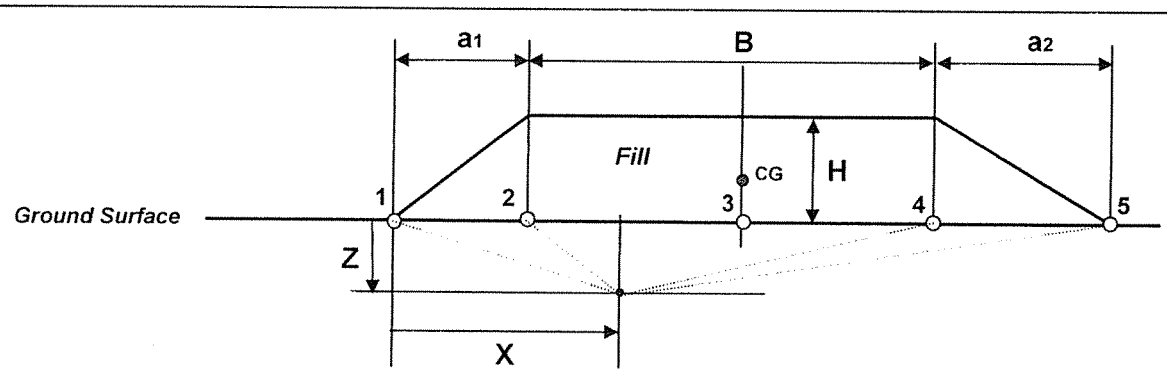
Project Name	I-215/SR60 East Junction HOV Connectors
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Analysis Description	Approach Embankment at Abutment 4 (Boring HV-4)
Stress Analysis Method	Boussinesq Method
Embankment Height, H	29.00 feet
Top Width of Embankment, B	104.00 feet
Left Side Slope Width, a_1	58.00 feet
Right Side Slope Width, a_2	58.00 feet
Ground Surface Elevation	1,536.00 feet
GWT Elevation for Design	1,506.00 feet
Unit Weight of Fill, $\gamma_{t,fill}$	125.00 pcf

INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Soil Modulus E_s (ksf)	Poisson's Ratio ν	Compression Ratio $C_c / (1 + e_0)$	Recompression Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,536.00	1,532.00	Cohesionless Soil	120.0	290.0	0.25			1.0
1,532.00	1,527.00	Cohesionless Soil	125.0	320.0	0.25			1.0
1,527.00	1,523.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,523.00	1,518.00	Cohesionless Soil	125.0	630.0	0.25			1.0
1,518.00	1,513.00	Cohesionless Soil	125.0	1,050.0	0.25			1.0
1,513.00	1,508.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,508.00	1,502.00	Cohesionless Soil	125.0	1,050.0	0.25			1.0
1,502.00	1,492.00	Incompressible Soil	130.0	2,000.0	0.25			1.0
1,492.00	1,482.00	Incompressible Soil	130.0	2,000.0	0.25			1.0



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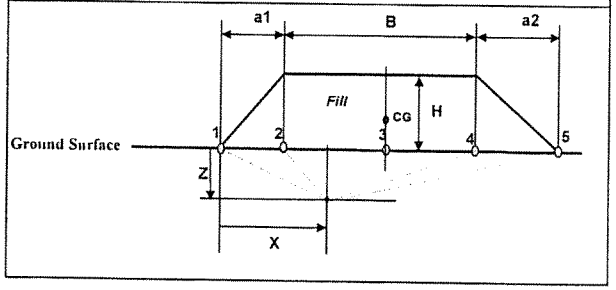
Top Width of Embankment, B	104.00 feet
Left Side Slope Width, a_1	58.00 feet
Right Side Slope Width, a_2	58.00 feet
Ground Surface Elevation at Toe	1,536.00 feet
GWT Elevation for Design	1,506.00 feet
Unit Weight of Fill, $\gamma_{t,fill}$	125.00 pcf

** SUMMARY OF RESULTS **

	Station 1	Station 2	Station 3	Station 4	Station 5
Distance, X (feet)	0.00	58.00	110.00	162.00	220.00
Total Elastic Settlement (inches)	0.16	2.68	2.86	2.68	0.16
Total Consol. Settlement (inches)	0.00	0.00	0.00	0.00	0.00
Total Settlement (inches)	0.16	2.68	2.86	2.68	0.16



Prepared By: _____ Date: _____

Reviewed By: _____ Date: _____

INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Soil Modulus E_s (ksf)	Soil Poisson's Ratio ν	Compression Ratio (For Clay) $C_c / (1 + e_0)$	Recompression Ratio (For Clay) $C_r / (1 + e_0)$	Overconsol. Ratio (For Clay) OCR
1,536.00	1,532.00	Cohesionless Soil	120.0	290.0	0.25			1.0
1,532.00	1,527.00	Cohesionless Soil	125.0	320.0	0.25			1.0
1,527.00	1,523.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,523.00	1,518.00	Cohesionless Soil	125.0	630.0	0.25			1.0
1,518.00	1,513.00	Cohesionless Soil	125.0	1,050.0	0.25			1.0
1,513.00	1,508.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,508.00	1,502.00	Cohesionless Soil	125.0	1,050.0	0.25			1.0
1,502.00	1,492.00	Incompressible Soil	130.0	2,000.0	0.25			1.0
1,492.00	1,482.00	Incompressible Soil	130.0	2,000.0	0.25			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

Soil Depth Z (feet)	Layer Thickness H_i (feet)	Load-Induced Stress Change Δp (ksf)					Elastic Settlement S_e (inches)					Consolidation Settlement S_c (inches)				
		Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5
2.00	4.00	0.04	3.59	3.62	3.59	0.04	0.005	0.775	0.786	0.775	0.005	0.000	0.000	0.000	0.000	0.000
6.50	5.00	0.13	3.50	3.62	3.50	0.13	0.020	0.670	0.698	0.670	0.020	0.000	0.000	0.000	0.000	0.000
11.00	4.00	0.22	3.41	3.62	3.41	0.22	0.017	0.295	0.316	0.295	0.017	0.000	0.000	0.000	0.000	0.000
15.50	5.00	0.30	3.32	3.61	3.32	0.30	0.024	0.285	0.313	0.285	0.024	0.000	0.000	0.000	0.000	0.000
20.50	5.00	0.39	3.23	3.60	3.23	0.39	0.019	0.162	0.182	0.162	0.019	0.000	0.000	0.000	0.000	0.000
25.50	5.00	0.48	3.14	3.57	3.14	0.48	0.046	0.314	0.359	0.314	0.046	0.000	0.000	0.000	0.000	0.000
31.00	6.00	0.56	3.05	3.54	3.05	0.56	0.032	0.179	0.209	0.179	0.032	0.000	0.000	0.000	0.000	0.000
39.00	10.00	0.68	2.92	3.47	2.92	0.68	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49.00	10.00	0.80	2.78	3.35	2.78	0.80	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ANALYSIS OF SETTLEMENTS BENEATH A TRAPEZOIDAL EMBANKMENT

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PROJECT INFORMATION

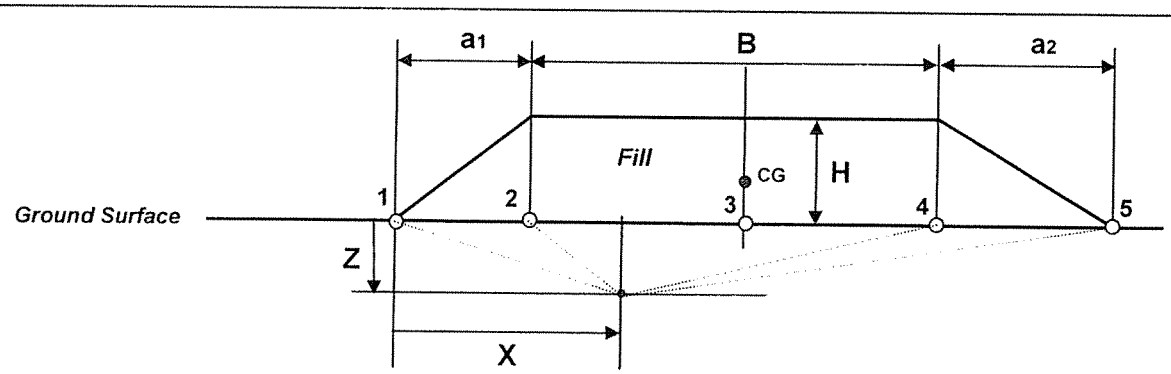
Project Name	I-215/SR60 East Junction HOV Connectors
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Analysis Description	Approach Embankment at Abutment 4 (Boring HV-8)
Stress Analysis Method	Boussinesq Method
Embankment Height, H	29.00 feet
Top Width of Embankment, B	104.00 feet
Left Side Slope Width, a_1	58.00 feet
Right Side Slope Width, a_2	58.00 feet
Ground Surface Elevation	1,541.00 feet
GWT Elevation for Design	1,511.00 feet
Unit Weight of Fill, $\gamma_{t,fill}$	125.00 pcf

INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Soil Modulus E_s (ksf)	Poisson's Ratio ν	Compression Ratio $C_c / (1 + e_0)$	Recompression Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,541.00	1,537.00	Cohesionless Soil	120.0	270.0	0.25			1.0
1,537.00	1,532.00	Cohesionless Soil	125.0	850.0	0.25			1.0
1,532.00	1,528.00	Cohesionless Soil	125.0	700.0	0.25			1.0
1,528.00	1,523.00	Cohesionless Soil	125.0	460.0	0.25			1.0
1,523.00	1,518.00	Cohesionless Soil	130.0	440.0	0.25			1.0
1,518.00	1,513.00	Cohesionless Soil	130.0	1,050.0	0.25			1.0
1,513.00	1,503.00	Incompressible Soil	130.0	2,000.0	0.25			1.0
1,503.00	1,493.00	Incompressible Soil	130.0	2,000.0	0.25			1.0



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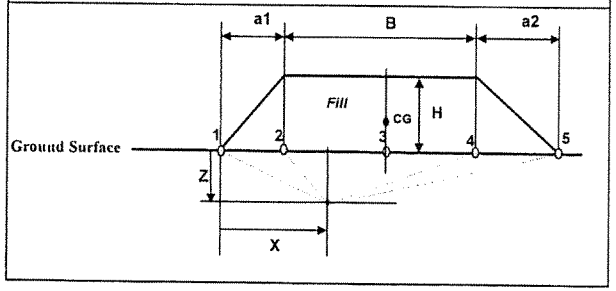
Right Side Slope Width, a_2	58.00 feet
Ground Surface Elevation at Toe	1,541.00 feet
GWT Elevation for Design	1,511.00 feet
Unit Weight of Fill, $\gamma_{t,fill}$	125.00 pcf

** SUMMARY OF RESULTS **	Station 1	Station 2	Station 3	Station 4	Station 5
Distance, X (feet)	0.00	58.00	110.00	162.00	220.00
Total Elastic Settlement (inches)	0.13	2.24	2.38	2.24	0.13
Total Consol. Settlement (inches)	0.00	0.00	0.00	0.00	0.00
Total Settlement (inches)	0.13	2.24	2.38	2.24	0.13



Prepared By: _____ Date: _____

Reviewed By: _____ Date: _____

INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Soil Modulus E_s (ksf)	Soil Poisson's Ratio ν	Compression Ratio (For Clay) $C_c / (1 + e_0)$	Recompression Ratio (For Clay) $C_r / (1 + e_0)$	Overconsol. Ratio (For Clay) OCR
1,541.00	1,537.00	Cohesionless Soil	120.0	270.0	0.25			1.0
1,537.00	1,532.00	Cohesionless Soil	125.0	850.0	0.25			1.0
1,532.00	1,528.00	Cohesionless Soil	125.0	700.0	0.25			1.0
1,528.00	1,523.00	Cohesionless Soil	125.0	460.0	0.25			1.0
1,523.00	1,518.00	Cohesionless Soil	130.0	440.0	0.25			1.0
1,518.00	1,513.00	Cohesionless Soil	130.0	1,050.0	0.25			1.0
1,513.00	1,503.00	Incompressible Soil	130.0	2,000.0	0.25			1.0
1,503.00	1,493.00	Incompressible Soil	130.0	2,000.0	0.25			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

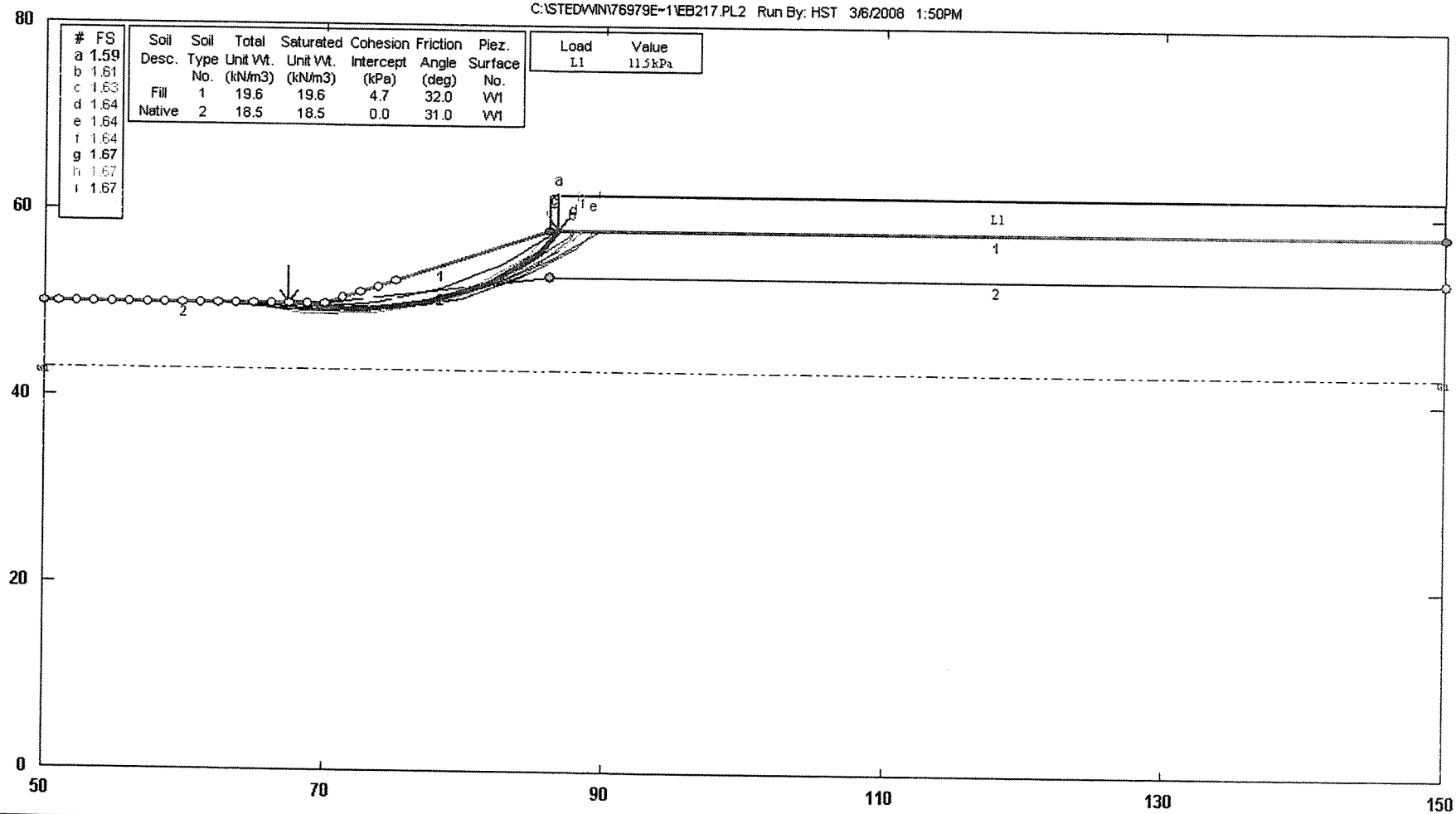
Soil Depth Z (feet)	Layer Thickness H_i (feet)	Load-Induced Stress Change Δp (ksf)					Elastic Settlement S_e (inches)					Consolidation Settlement S_c (inches)				
		Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5
2.00	4.00	0.04	3.59	3.62	3.59	0.04	0.006	0.833	0.844	0.833	0.006	0.000	0.000	0.000	0.000	0.000
6.50	5.00	0.13	3.50	3.62	3.50	0.13	0.008	0.252	0.263	0.252	0.008	0.000	0.000	0.000	0.000	0.000
11.00	4.00	0.22	3.41	3.62	3.41	0.22	0.012	0.220	0.235	0.220	0.012	0.000	0.000	0.000	0.000	0.000
15.50	5.00	0.30	3.32	3.61	3.32	0.30	0.033	0.391	0.428	0.391	0.033	0.000	0.000	0.000	0.000	0.000
20.50	5.00	0.39	3.23	3.60	3.23	0.39	0.044	0.387	0.434	0.387	0.044	0.000	0.000	0.000	0.000	0.000
25.50	5.00	0.48	3.14	3.57	3.14	0.48	0.023	0.155	0.178	0.155	0.023	0.000	0.000	0.000	0.000	0.000
33.00	10.00	0.59	3.02	3.52	3.02	0.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43.00	10.00	0.73	2.86	3.42	2.86	0.73	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

C-9

SLOPE STABILITY

I-215/SR60 East Junction HOV Lane, EB Riverside, California

C:\STEDWIN\76979E~1\EB217.PL2 Run By: HST 3/6/2008 1:50PM



#	FS
a	1.59
b	1.61
c	1.63
d	1.64
e	1.64
f	1.64
g	1.67
h	1.67
i	1.67

Soil Desc.	Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Piez. Surface No.
Fill	1	19.6	19.6	4.7	32.0	W1
Native	2	18.5	18.5	0.0	31.0	W1

Load	Value
L1	11.5kPa

KLEINFELDER

GSTABL7 v.2 FSmin=1.59

Safety Factors Are Calculated By The Modified Bishop Method

eb217

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **

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****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 3/6/2008
Time of Run: 1:50PM
Run By: HST
Input Data Filename: C:eb217.in
Output Filename: C:eb217.OUT
Unit System: SI

Plotted Output Filename: C:eb217.PLT

PROBLEM DESCRIPTION: I-215/SR60 East Junction HOV Lane, EB
Riverside, California

BOUNDARY COORDINATES

3 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	50.00	50.00	70.00	50.00	2
2	70.00	50.00	86.00	58.00	1
3	86.00	58.00	150.00	58.00	1
4	70.00	50.00	86.00	53.00	2
5	86.00	53.00	150.00	53.00	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	4.7	32.0	0.00	0.0	1
2	18.5	18.5	0.0	31.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	50.00	43.00
2	150.00	43.00

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	86.00	150.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 51.00(m)
and X = 75.00(m)

Each Surface Terminates Between X = 86.00(m)
and X = 150.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = 0.00(m)

5.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Evaluated. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 19.248 FS Min = 1.594 FS Ave = 4.863
Standard Deviation = 2.696 Coefficient of Variation = 55.44 %

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	67.42	50.00
2	72.37	49.29
3	77.31	50.07
4	81.79	52.29
5	85.42	55.73
6	86.68	58.00

Circle Center At X = 72.3 ; Y = 65.6 and Radius, 16.3

Factor of Safety
*** 1.594 ***

Individual data on the 8 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	2.6	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2.4	50.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4.9	258.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4.2	295.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.3	17.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	3.6	198.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.6	18.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.7	8.2	0.0	0.0	0.0	0.0	0.0	0.0	7.9

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.16
3	74.81	49.53
4	79.56	51.10
5	83.78	53.78
6	87.23	57.39
7	87.58	58.00

Circle Center At X = 70.8 ; Y = 69.6 and Radius, 20.5

Factor of Safety
*** 1.613 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	66.16	50.00
2	71.09	49.20
3	76.05	49.87
4	80.59	51.96
5	84.33	55.27
6	86.01	58.00

Circle Center At X = 71.3 ; Y = 65.8 and Radius, 16.7

Factor of Safety
*** 1.625 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	69.95	50.00
2	74.93	49.53
3	79.80	50.65
4	84.08	53.24
5	87.33	57.04
6	87.72	58.00

Circle Center At X = 73.9 ; Y = 64.9 and Radius, 15.5

Factor of Safety

*** 1.637 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.11
3	74.81	49.33
4	79.63	50.65
5	84.05	52.99
6	87.84	56.26
7	89.13	58.00

Circle Center At X = 71.3 ; Y = 71.6 and Radius, 22.5

Factor of Safety
*** 1.639 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.56	49.13
3	73.55	49.33
4	78.39	50.58
5	82.86	52.83
6	86.75	55.97
7	88.39	58.00

Circle Center At X = 70.1 ; Y = 72.6 and Radius, 23.5

Factor of Safety
*** 1.642 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.61	49.53
3	73.57	50.13
4	78.30	51.76

5	82.58	54.34
6	86.22	57.77
7	86.38	58.00

Circle Center At X = 68.3 ; Y = 73.1 and Radius, 23.6

Factor of Safety
*** 1.669 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.52	48.92
3	73.51	48.99
4	78.37	50.21
5	82.81	52.49
6	86.62	55.74
7	88.28	58.00

Circle Center At X = 70.7 ; Y = 70.5 and Radius, 21.7

Factor of Safety
*** 1.670 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	62.37	50.00
2	67.31	49.22
3	72.31	49.33
4	77.21	50.33
5	81.85	52.18
6	86.09	54.83
7	89.58	58.00

Circle Center At X = 69.2 ; Y = 77.2 and Radius, 28.0

Factor of Safety
*** 1.671 ***

Failure Surface Specified By 5 Coordinate Points

eb217

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.61
2	76.21	50.52
3	80.96	52.08
4	84.92	55.13
5	86.80	58.00

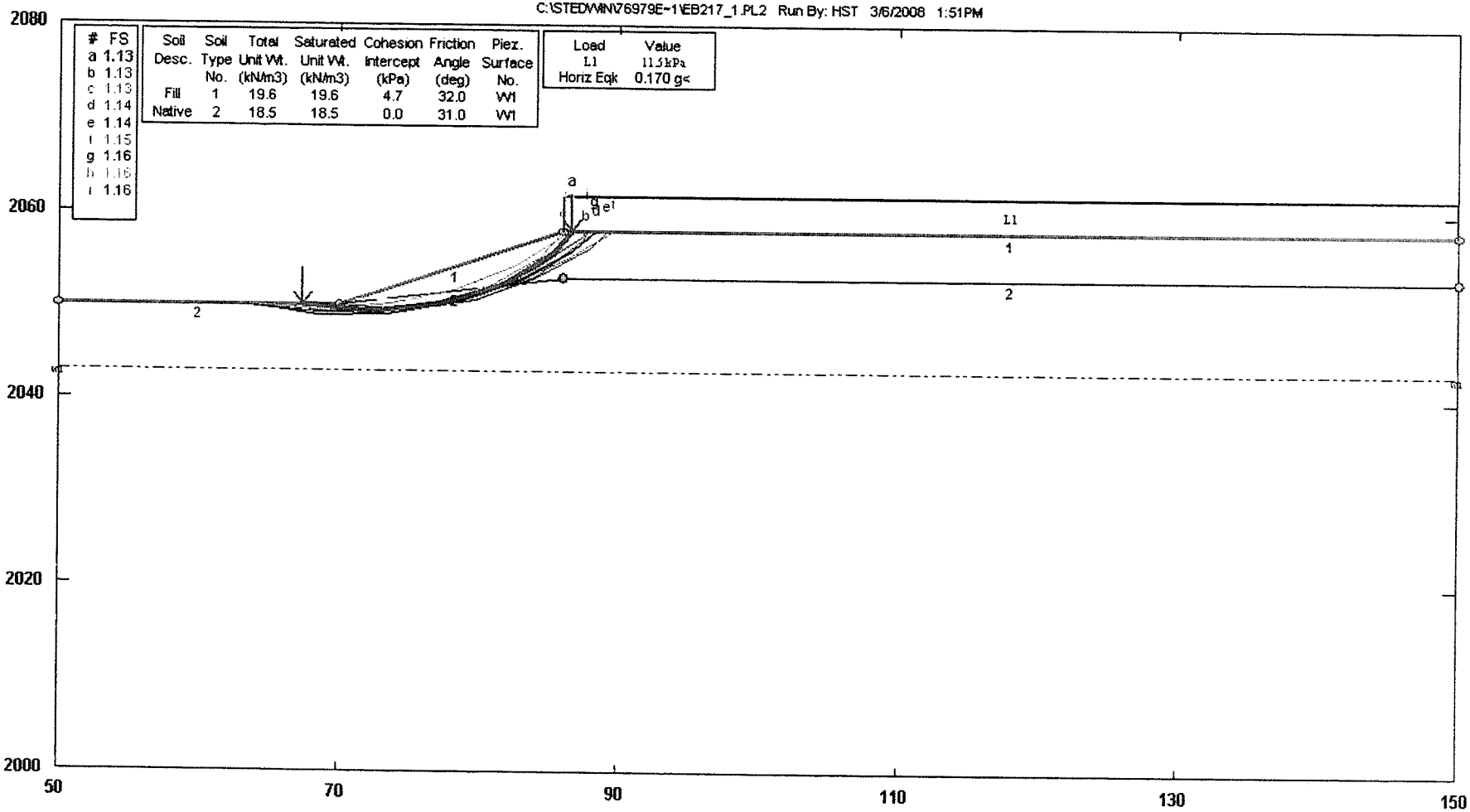
Circle Center At X = 74.0 ; Y = 65.3 and Radius, 14.9

Factor of Safety
*** 1.673 ***

**** END OF GSTABL7 OUTPUT ****

I-215/SR60 East Junction HOV Lane, EB Riverside, California

C:\STEDWIN\76979E~1\EB217_1.PL2 Run By: HST 3/6/2008 1:51PM



KLEINFELDER

GSTABL7 v.2 FSmin=1.13

Safety Factors Are Calculated By The Modified Bishop Method

eb217_1

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **

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****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 3/6/2008
Time of Run: 1:51PM
Run By: HST
Input Data Filename: C:eb217_1.in
Output Filename: C:eb217_1.OUT
Unit System: SI

Plotted Output Filename: C:eb217_1.PLT

PROBLEM DESCRIPTION: I-215/SR60 East Junction HOV Lane, EB
Riverside, California

BOUNDARY COORDINATES

3 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	50.00	50.00	70.00	50.00	2
2	70.00	50.00	86.00	58.00	1
3	86.00	58.00	150.00	58.00	1
4	70.00	50.00	86.00	53.00	2
5	86.00	53.00	150.00	53.00	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	4.7	32.0	0.00	0.0	1
2	18.5	18.5	0.0	31.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	50.00	43.00
2	150.00	43.00

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	86.00	150.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.170 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

eb217_1

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 51.00(m)
and X = 75.00(m)

Each Surface Terminates Between X = 86.00(m)
and X = 150.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

5.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 3.923 FS Min = 1.125 FS Ave = 2.233
Standard Deviation = 0.567 Coefficient of Variation = 25.39 %

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	67.42	50.00
2	72.37	49.29
3	77.31	50.07
4	81.79	52.29
5	85.42	55.73
6	86.68	58.00

Circle Center At X = 72.3 ; Y = 65.6 and Radius, 16.3

Factor of Safety
*** 1.125 ***

Individual data on the 8 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)

1	2.6	8.9	0.0	0.0	0.0	0.0	1.5	0.0	0.0
2	2.4	50.8	0.0	0.0	0.0	0.0	8.6	0.0	0.0
3	4.9	258.6	0.0	0.0	0.0	0.0	44.0	0.0	0.0
4	4.2	295.3	0.0	0.0	0.0	0.0	50.2	0.0	0.0
5	0.3	17.8	0.0	0.0	0.0	0.0	3.0	0.0	0.0
6	3.6	198.5	0.0	0.0	0.0	0.0	33.7	0.0	0.0
7	0.6	18.3	0.0	0.0	0.0	0.0	3.1	0.0	0.0
8	0.7	8.2	0.0	0.0	0.0	0.0	1.4	0.0	7.9

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.16
3	74.81	49.53
4	79.56	51.10
5	83.78	53.78
6	87.23	57.39
7	87.58	58.00

Circle Center At X = 70.8 ; Y = 69.6 and Radius, 20.5

Factor of Safety
*** 1.127 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	66.16	50.00
2	71.09	49.20
3	76.05	49.87
4	80.59	51.96
5	84.33	55.27
6	86.01	58.00

Circle Center At X = 71.3 ; Y = 65.8 and Radius, 16.7

Factor of Safety
*** 1.135 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00

2	68.56	49.13
3	73.55	49.33
4	78.39	50.58
5	82.86	52.83
6	86.75	55.97
7	88.39	58.00

Circle Center At X = 70.1 ; Y = 72.6 and Radius, 23.5

Factor of Safety
*** 1.139 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.11
3	74.81	49.33
4	79.63	50.65
5	84.05	52.99
6	87.84	56.26
7	89.13	58.00

Circle Center At X = 71.3 ; Y = 71.6 and Radius, 22.5

Factor of Safety
*** 1.140 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	62.37	50.00
2	67.31	49.22
3	72.31	49.33
4	77.21	50.33
5	81.85	52.18
6	86.09	54.83
7	89.58	58.00

Circle Center At X = 69.2 ; Y = 77.2 and Radius, 28.0

Factor of Safety
*** 1.149 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.52	48.92
3	73.51	48.99
4	78.37	50.21
5	82.81	52.49
6	86.62	55.74
7	88.28	58.00

Circle Center At X = 70.7 ; Y = 70.5 and Radius, 21.7

Factor of Safety
*** 1.158 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.61	49.53
3	73.57	50.13
4	78.30	51.76
5	82.58	54.34
6	86.22	57.77
7	86.38	58.00

Circle Center At X = 68.3 ; Y = 73.1 and Radius, 23.6

Factor of Safety
*** 1.159 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	69.95	50.00
2	74.93	49.53
3	79.80	50.65
4	84.08	53.24
5	87.33	57.04
6	87.72	58.00

Circle Center At X = 73.9 ; Y = 64.9 and Radius, 15.5

Factor of Safety
*** 1.160 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.61
2	76.21	50.52
3	80.96	52.08
4	84.92	55.13
5	86.80	58.00

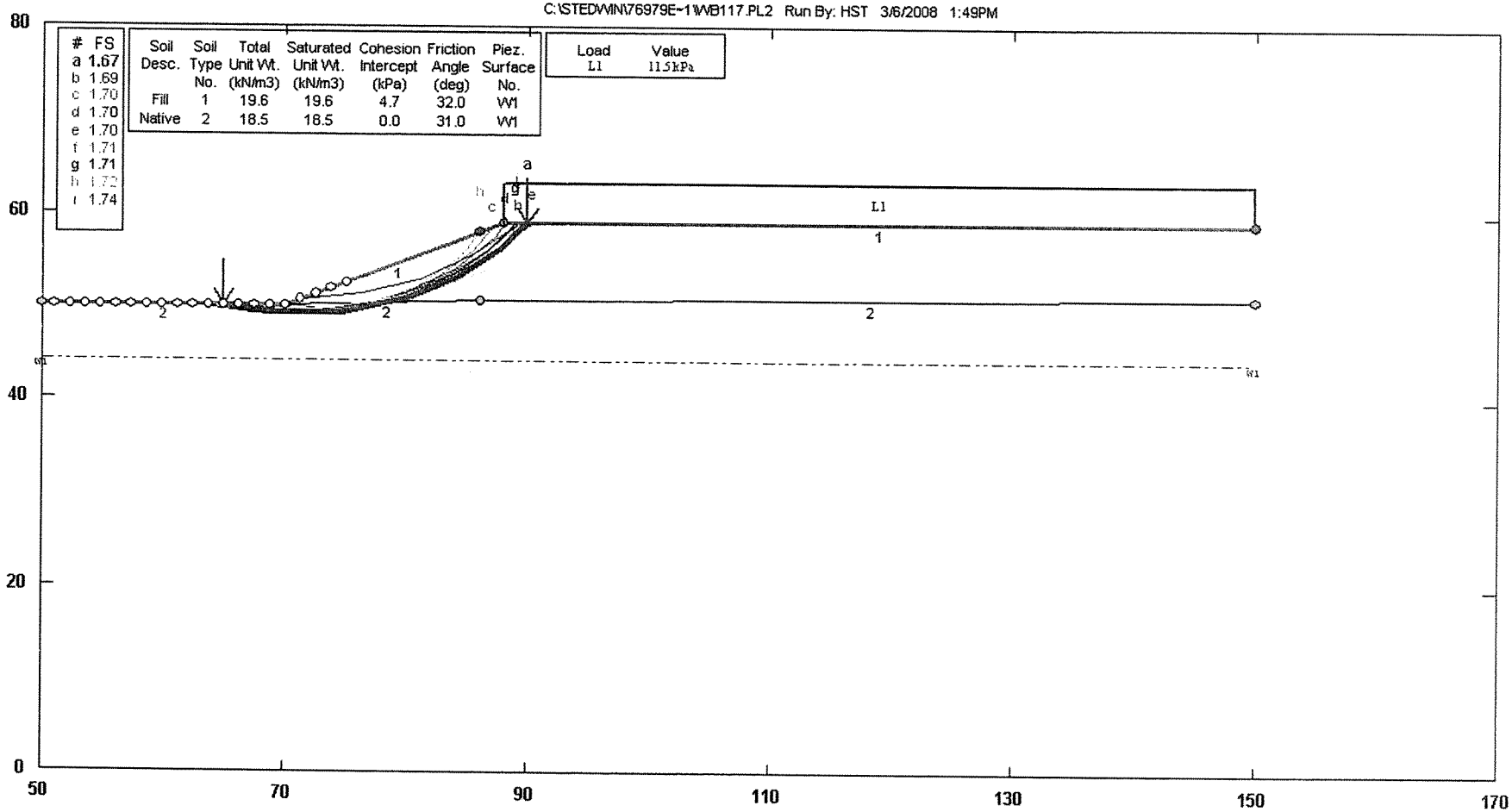
Circle Center At X = 74.0 ; Y = 65.3 and Radius, 14.9

Factor of Safety
*** 1.185 ***

**** END OF GSTABL7 OUTPUT ****

I-215/SR60 East Junction HOV Lane, WB Riverside, California

C:\STEDWIN\76979E~1\WB117.PL2 Run By: HST 3/6/2008 1:49PM



KLEINFELDER

GSTABL7 v.2 FSmin=1.67

Safety Factors Are Calculated By The Modified Bishop Method

wb117

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **

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****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 3/6/2008
Time of Run: 1:49PM
Run By: HST
Input Data Filename: C:wb117.in
Output Filename: C:wb117.OUT
Unit System: SI

Plotted Output Filename: C:wb117.PLT

PROBLEM DESCRIPTION: I-215/SR60 East Junction HOV Lane, WB
Riverside, California

BOUNDARY COORDINATES

3 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	50.00	50.00	70.00	50.00	2
2	70.00	50.00	88.00	59.00	1
3	88.00	59.00	150.00	59.00	1
4	70.00	50.00	86.00	50.50	2
5	86.00	50.50	150.00	50.80	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	4.7	32.0	0.00	0.0	1
2	18.5	18.5	0.0	31.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	50.00	44.00
2	150.00	44.00

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	88.00	150.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 51.00(m)
and X = 75.00(m)

Each Surface Terminates Between X = 86.00(m)
and X = 150.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = 0.00(m)

5.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Evaluated. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 14.878 FS Min = 1.666 FS Ave = 4.307
Standard Deviation = 2.106 Coefficient of Variation = 48.89 %

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.11
3	74.81	49.33
4	79.63	50.65
5	84.05	53.00
6	87.83	56.27
7	89.84	59.00

Circle Center At X = 71.3 ; Y = 71.6 and Radius, 22.5

Factor of Safety
*** 1.666 ***

Individual data on the 9 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	4.9	40.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.2	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4.8	182.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	3.4	227.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1.4	113.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	4.4	354.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	3.8	247.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.2	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

wb117

9 1.8 45.2 0.0 0.0 0.0 0.0 0.0 0.0 21.2

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.56	49.13
3	73.55	49.33
4	78.39	50.58
5	82.86	52.83
6	86.75	55.98
7	89.17	59.00

Circle Center At X = 70.1 ; Y = 72.5 and Radius, 23.5

Factor of Safety
*** 1.693 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	67.42	50.00
2	72.37	49.29
3	77.31	50.07
4	81.79	52.29
5	85.41	55.73
6	86.94	58.47

Circle Center At X = 72.2 ; Y = 65.6 and Radius, 16.3

Factor of Safety
*** 1.696 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.16
3	74.81	49.53
4	79.56	51.10
5	83.78	53.78
6	87.23	57.40
7	88.13	59.00

Circle Center At X = 70.8 ; Y = 69.6 and Radius, 20.5

Factor of Safety
*** 1.701 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	62.37	50.00
2	67.31	49.22
3	72.31	49.33
4	77.21	50.33
5	81.85	52.19
6	86.08	54.84
7	89.78	58.21
8	90.38	59.00

Circle Center At X = 69.2 ; Y = 76.9 and Radius, 27.7

Factor of Safety
*** 1.702 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	69.95	50.00
2	74.92	49.44
3	79.83	50.38
4	84.24	52.73
5	87.76	56.29
6	89.17	59.00

Circle Center At X = 74.3 ; Y = 65.8 and Radius, 16.3

Factor of Safety
*** 1.712 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00

2	68.52	48.92
3	73.51	49.00
4	78.37	50.21
5	82.81	52.50
6	86.61	55.75
7	89.00	59.00

Circle Center At X = 70.7 ; Y = 70.5 and Radius, 21.7

Factor of Safety
*** 1.714 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	66.16	50.00
2	71.09	49.20
3	76.05	49.87
4	80.59	51.96
5	84.33	55.27
6	86.01	58.00

Circle Center At X = 71.3 ; Y = 65.8 and Radius, 16.7

Factor of Safety
*** 1.715 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.61
2	76.18	51.17
3	80.92	52.76
4	85.22	55.31
5	88.89	58.71
6	89.09	59.00

Circle Center At X = 71.1 ; Y = 74.1 and Radius, 23.5

Factor of Safety
*** 1.742 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.61	49.48
3	73.60	49.69
4	78.51	50.62
5	83.24	52.25
6	87.68	54.55
7	91.74	57.47
8	93.33	59.00

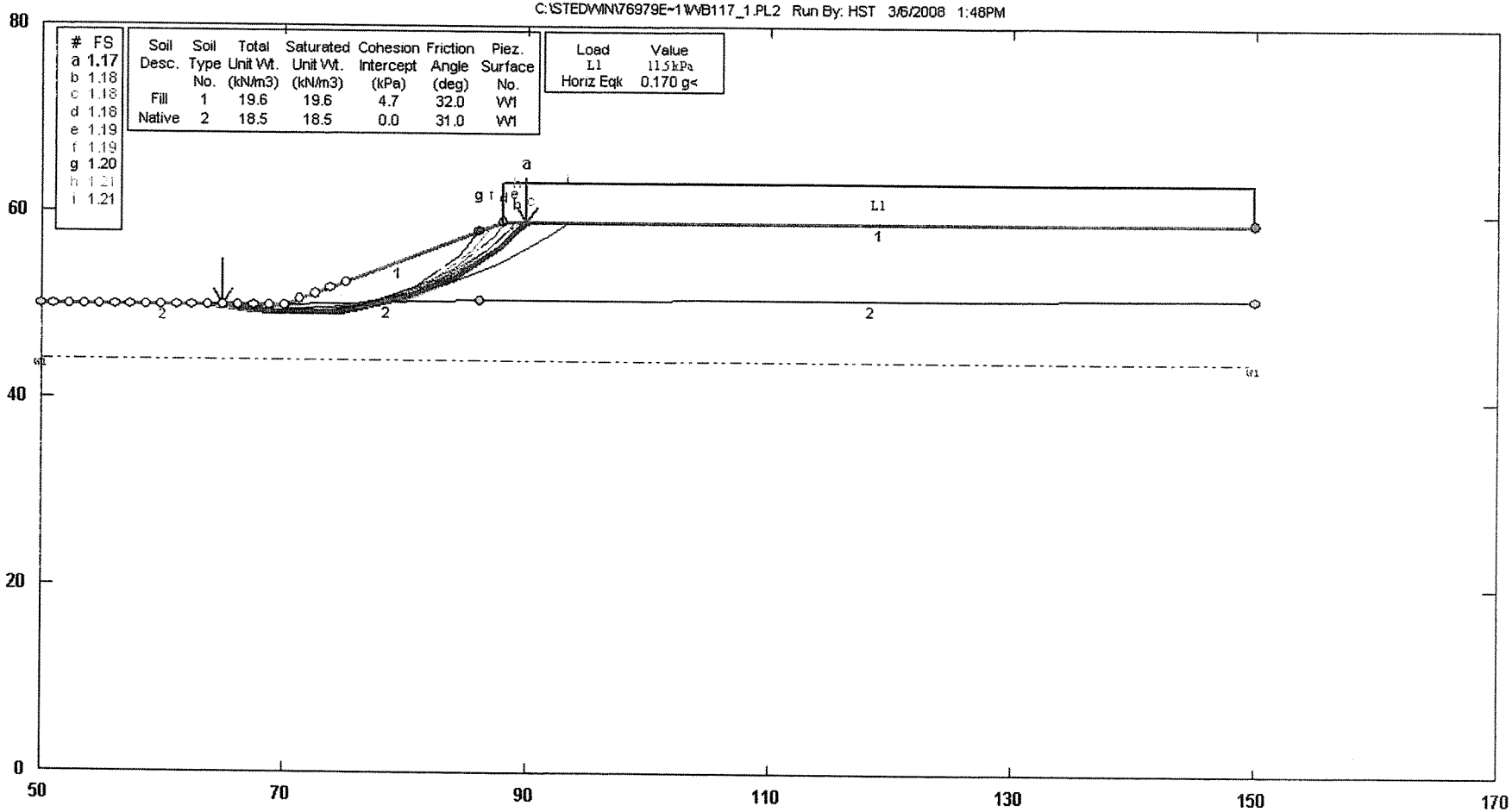
Circle Center At X = 69.7 ; Y = 83.5 and Radius, 34.1

Factor of Safety
*** 1.765 ***

**** END OF GSTABL7 OUTPUT ****

I-215/SR60 East Junction HOV Lane, WB Riverside, California

C:\STEDWIN\76979E~1\WB117_1.PL2 Run By: HST 3/6/2008 1:48PM



KLEINFELDER

GSTABL7 v.2 FSmin=1.17

Safety Factors Are Calculated By The Modified Bishop Method

wb117_1

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **

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****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 3/6/2008
Time of Run: 1:48PM
Run By: HST
Input Data Filename: C:wb117_1.in
Output Filename: C:wb117_1.OUT
Unit System: SI

Plotted Output Filename: C:wb117_1.PLT

PROBLEM DESCRIPTION: I-215/SR60 East Junction HOV Lane, WB
Riverside, California

BOUNDARY COORDINATES

3 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	50.00	50.00	70.00	50.00	2
2	70.00	50.00	88.00	59.00	1
3	88.00	59.00	150.00	59.00	1
4	70.00	50.00	86.00	50.50	2
5	86.00	50.50	150.00	50.80	2

1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	4.7	32.0	0.00	0.0	1
2	18.5	18.5	0.0	31.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	50.00	44.00
2	150.00	44.00

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	88.00	150.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.170 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

wb117_1

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 51.00(m)
and X = 75.00(m)

Each Surface Terminates Between X = 86.00(m)
and X = 150.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

5.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 3.705 FS Min = 1.167 FS Ave = 2.123
Standard Deviation = 0.507 Coefficient of Variation = 23.89 %

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.11
3	74.81	49.33
4	79.63	50.65
5	84.05	53.00
6	87.83	56.27
7	89.84	59.00

Circle Center At X = 71.3 ; Y = 71.6 and Radius, 22.5

Factor of Safety
*** 1.167 ***

Individual data on the 9 slices

Slice	Width	Weight	Water Force Top	Water Force Bot	Tie Force Norm	Tie Force Tan	Earthquake Force Hor	Earthquake Force Ver	Surcharge Load

wb117_1

No.	(m)	(kN)	(kN)	(kN)	(kN)	(kN)	(kN)	(kN)	(kN)
1	4.9	40.4	0.0	0.0	0.0	0.0	6.9	0.0	0.0
2	0.2	3.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0
3	4.8	182.0	0.0	0.0	0.0	0.0	30.9	0.0	0.0
4	3.4	227.4	0.0	0.0	0.0	0.0	38.7	0.0	0.0
5	1.4	113.5	0.0	0.0	0.0	0.0	19.3	0.0	0.0
6	4.4	354.4	0.0	0.0	0.0	0.0	60.2	0.0	0.0
7	3.8	247.4	0.0	0.0	0.0	0.0	42.1	0.0	0.0
8	0.2	8.5	0.0	0.0	0.0	0.0	1.5	0.0	0.0
9	1.8	45.2	0.0	0.0	0.0	0.0	7.7	0.0	21.2

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.56	49.13
3	73.55	49.33
4	78.39	50.58
5	82.86	52.83
6	86.75	55.98
7	89.17	59.00

Circle Center At X = 70.1 ; Y = 72.5 and Radius, 23.5

Factor of Safety
*** 1.177 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	62.37	50.00
2	67.31	49.22
3	72.31	49.33
4	77.21	50.33
5	81.85	52.19
6	86.08	54.84
7	89.78	58.21
8	90.38	59.00

Circle Center At X = 69.2 ; Y = 76.9 and Radius, 27.7

Factor of Safety
*** 1.178 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.16
3	74.81	49.53
4	79.56	51.10
5	83.78	53.78
6	87.23	57.40
7	88.13	59.00

Circle Center At X = 70.8 ; Y = 69.6 and Radius, 20.5

Factor of Safety
*** 1.184 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.52	48.92
3	73.51	49.00
4	78.37	50.21
5	82.81	52.50
6	86.61	55.75
7	89.00	59.00

Circle Center At X = 70.7 ; Y = 70.5 and Radius, 21.7

Factor of Safety
*** 1.190 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	67.42	50.00
2	72.37	49.29
3	77.31	50.07
4	81.79	52.29
5	85.41	55.73
6	86.94	58.47

Circle Center At X = 72.2 ; Y = 65.6 and Radius, 16.3

Factor of Safety
*** 1.190 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	66.16	50.00
2	71.09	49.20
3	76.05	49.87
4	80.59	51.96
5	84.33	55.27
6	86.01	58.00

Circle Center At X = 71.3 ; Y = 65.8 and Radius, 16.7

Factor of Safety
*** 1.197 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	69.95	50.00
2	74.92	49.44
3	79.83	50.38
4	84.24	52.73
5	87.76	56.29
6	89.17	59.00

Circle Center At X = 74.3 ; Y = 65.8 and Radius, 16.3

Factor of Safety
*** 1.214 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.61	49.48
3	73.60	49.69
4	78.51	50.62
5	83.24	52.25
6	87.68	54.55
7	91.74	57.47
8	93.33	59.00

Circle Center At X = 69.7 ; Y = 83.5 and Radius, 34.1

Factor of Safety
*** 1.214 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.61
2	76.18	51.17
3	80.92	52.76
4	85.22	55.31
5	88.89	58.71
6	89.09	59.00

Circle Center At X = 71.1 ; Y = 74.1 and Radius, 23.5

Factor of Safety
*** 1.240 ***

**** END OF GSTABL7 OUTPUT ****

REVISED FINAL
STRUCTURE FOUNDATION REPORT
PROPOSED WESTBOUND AND EASTBOUND
STATE ROUTE 60 HOV CONNECTORS
BRIDGE NOS. 56-0841 AND 56-0842
INTERSTATE 215/STATE ROUTE 60
EAST JUNCTION IMPROVEMENTS
CITY OF RIVERSIDE, CALIFORNIA
08-RIV-215/60-KP 61.7/62.6, 19.4/21.5
CALTRANS EA NO. 08-449311

Prepared for:

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER WEST, INC.
1220 Research Drive, Suite B
Redlands, CA 92374

Kleinfelder Project No. 76979

Revised June 12, 2009
February 16, 2009

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APPROVAL LETTER

DIVISION OF ENGINEERING SERVICES
OFFICE OF GEOTECHNICAL DESIGN – SOUTH 2

TO: **Robert Zezoff**
Office of Special Funded Projects
MS # 9 2/7G

DATE: **September 21, 2009**
FILE: **08 – RIV – 60, 215 –KP 61.7/62.6**
DIST – CO – RTE - KP/PM

FROM: **DIVISION OF ENGINEERING SERVICES**
Geotechnical Services – MS-5
Geotechnical Design – South 2, Branch C

STRUCTURE FOUNDATION REPORTS	**Prepared by Kleinfelder West, Inc for Lim & Nascimento Engr Corp**	DTD:	**Aug 19, 2009 (Br)** **Aug 19, 2009 (RW)**	**Various Structures for the 215/60 East Junction**	
				STRUCTURE NAME	
GENERAL PLAN DATED:	**8/20/09 (Br)** **8/20/09 (RWs)**	FDN PLAN DATED:	**8/20/09 (Br)** **8/20/09 (RWs)**	**08-449311**	**56-0841, 56-0842** **Various RWs**
				EA NUMBER	BR NUMBER

Submittal (Check One):
[ ] 1st [X] 2nd [ ] 3rd [ ] Other: _____

The following comments are based on the submitted:
1. Revised Final Structure Foundation Report addition for Proposed Westbound and Eastbound State Route 60 HOV Connectors, dated August 19, 2009.
2. Revised Structure Foundation Report addition for Proposed Retaining Walls RW-19 and RW-20, dated August 19, 2009.
3. PS&E plans for the Proposed Westbound and Eastbound State Route 60 HOV Connectors, dated August 20, 2009
4. PS&E plans for the Proposed Retaining Walls RW-19 and RW-20, dated August 20, 2009

Revised Final Structure Foundation Report for Proposed Westbound and Eastbound State Route 60 HOV Connectors
No further comments from our office.

Revised Structure Foundation Report for Retaining Walls RW-19 and RW-20
No further comments from our office.

PS&E plans for the Proposed Westbound and Eastbound State Route 60 HOV Connectors
Please add this Note to the following sheets: "For Bottom of Footing elevations, please see WB SR60 HOV CONNECTOR, FOUNDATION PLAN"
WB SR60 HOV CONNECTOR, RETAINING WALL #2 LAYOUT
WB SR60 HOV CONNECTOR, RETAINING WALL #3 LAYOUT
WB SR60 HOV CONNECTOR, RETAINING WALL #4 LAYOUT

Please add this Note to the following sheets: "For Bottom of Footing elevations, please see EB SR60 HOV CONNECTOR, FOUNDATION PLAN"
EB SR60 HOV CONNECTOR, RETAINING WALL #1 LAYOUT
EB SR60 HOV CONNECTOR, RETAINING WALL #2 LAYOUT
EB SR60 HOV CONNECTOR, RETAINING WALL #3 and #4 LAYOUT

PS&E plans for the Proposed Retaining Walls RW-19 and RW-20
No further comments from our office.

To: **Robert Zezoff**
Office of Special Funded Projects
MS # 9 2/7G

DATE: **September 21, 2009**

STRUCTURE FOUNDATION REPORTS	**Prepared by Kleinfelder West, Inc for Lim & Nascimento Engr Corp**	DTD:	**Aug 19, 2009 (Br) Aug 19, 2009 (RW)**	**Various Structures for the 215/60 East Junction**	
				STRUCTURE NAME	
GENERAL PLAN DATED:	**8/20/09 (Br) 8/20/09 (RWs)**	FND PLAN DATED:	**8/20/09 (Br) 8/20/09 (RWs)**	**08-449311**	**56-0841, 56-0842 Various RWs**
				EA NUMBER	BR NUMBER

Conclusion

The submitted Revised Final Structure Foundation Report additions for the Proposed Westbound and Eastbound State Route 60 HOV Connectors, and the PS&E plans are approved from the perspective of our office, The Office of Geotechnical Design, South 2, subject to verification of the changes outlined above.

The submitted Revised Structure Foundation Report additions for Retaining Walls RW-19 and RW-20 and the PS&E plans are approved from the perspective of our Office. If you have any questions, you may contact me at (916-227-4539).

NAME: Gina Pursell, R.C.E. #54512 9/21/2009
Structure Foundations Branch - C

c: SWei

REVISED LOTB SHEETS

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST 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.

RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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 (25.4 mm soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

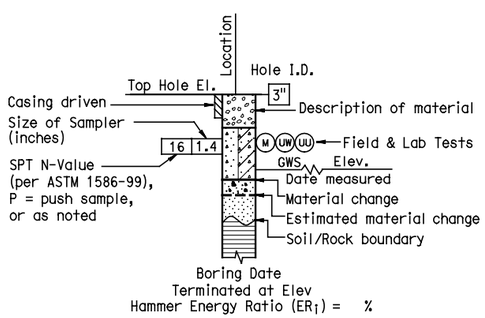
Note: Size in millimeters.

CONSISTENCY OF COHESIVE SOILS

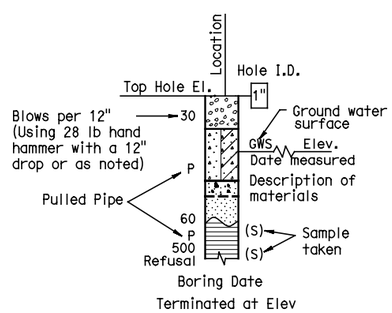
Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

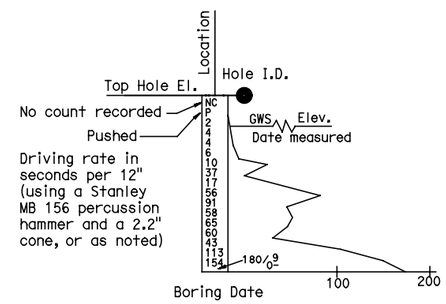
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



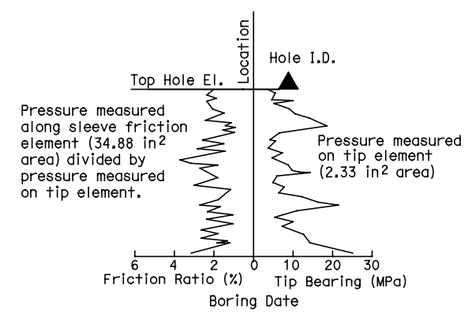
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/18/09 6/18/09 8/28/09 10/2/09

SHEET 27 OF 32

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

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DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

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SHEET 28 OF 32

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Caltrans Metric

Carlos D'Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

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1220 RESEARCH DRIVE, SUITE B
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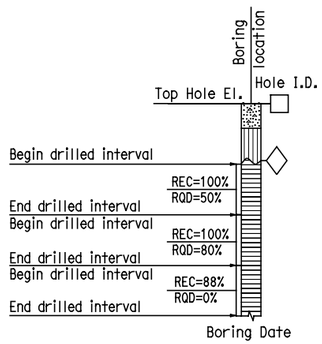
REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

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SHEET 29 OF 32

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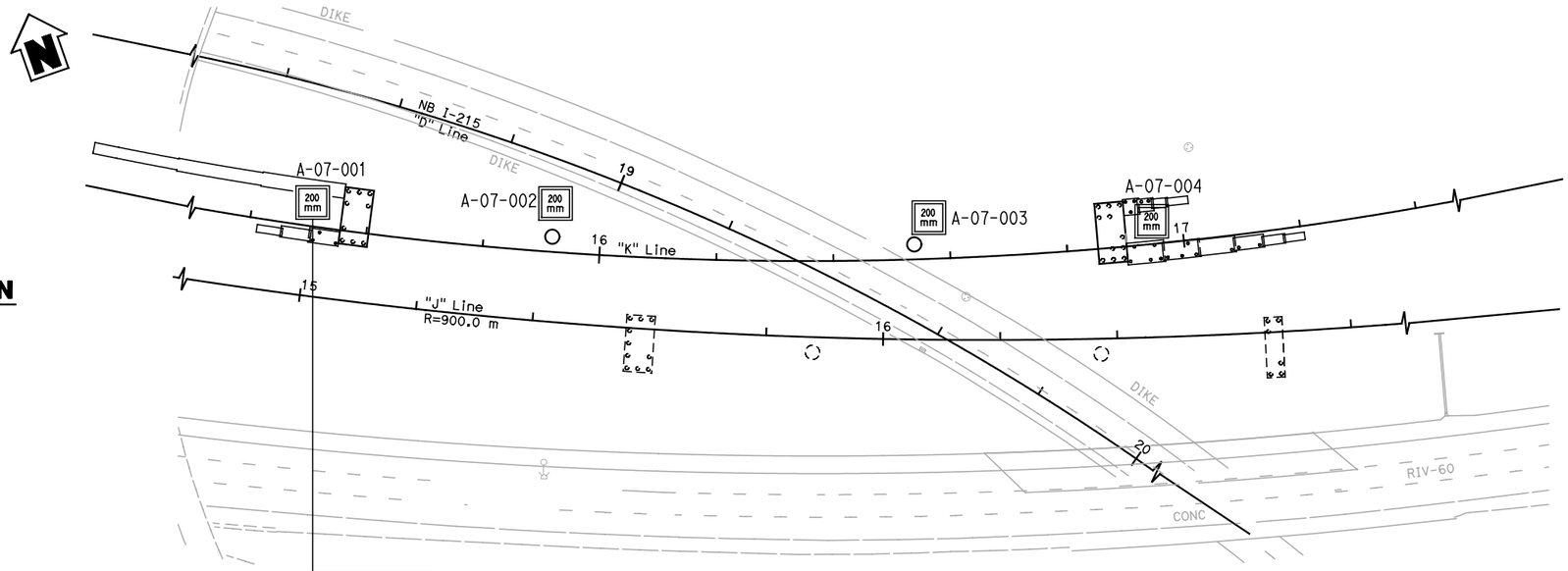
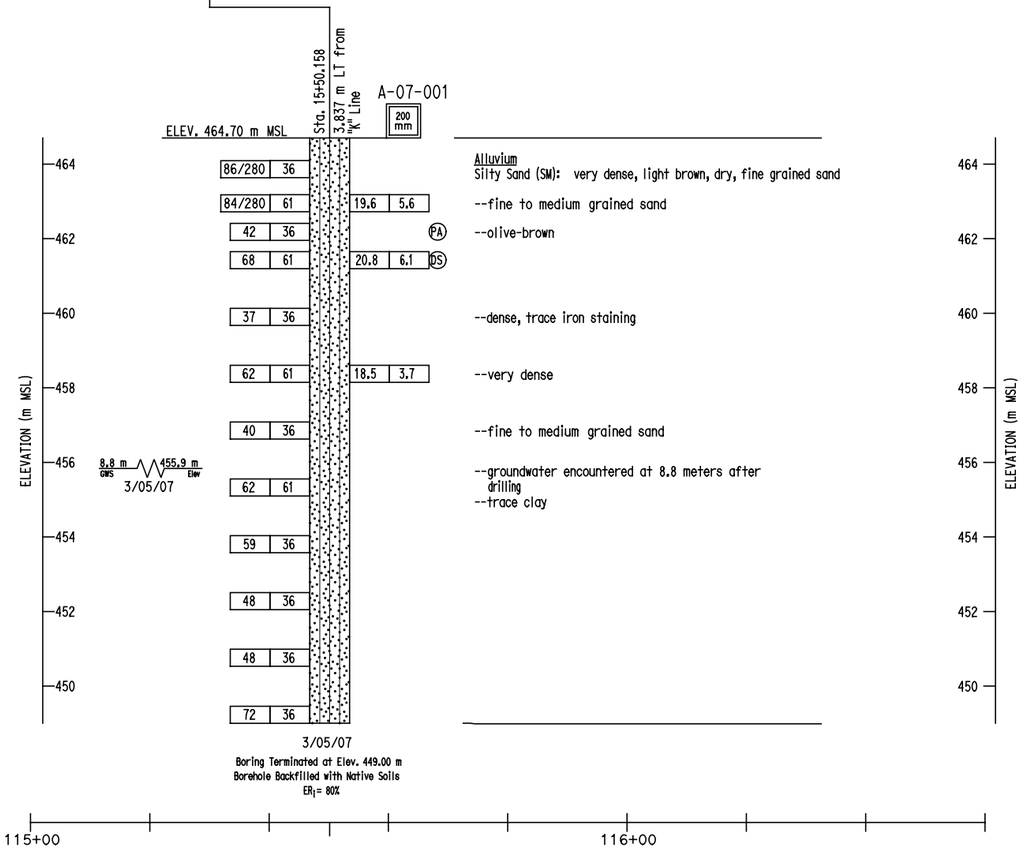
PLAN
1:500





PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.
2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.
3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.
4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

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BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 1 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
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SHEET 30 OF 32

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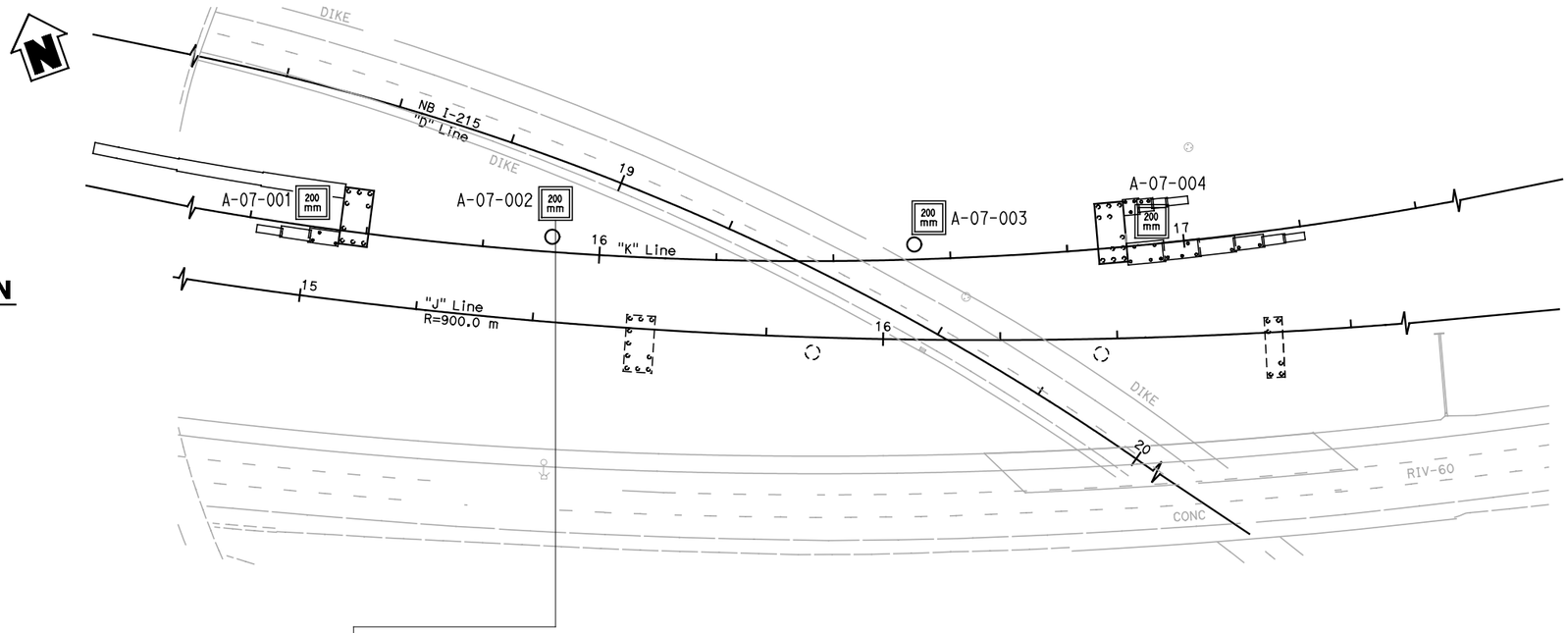
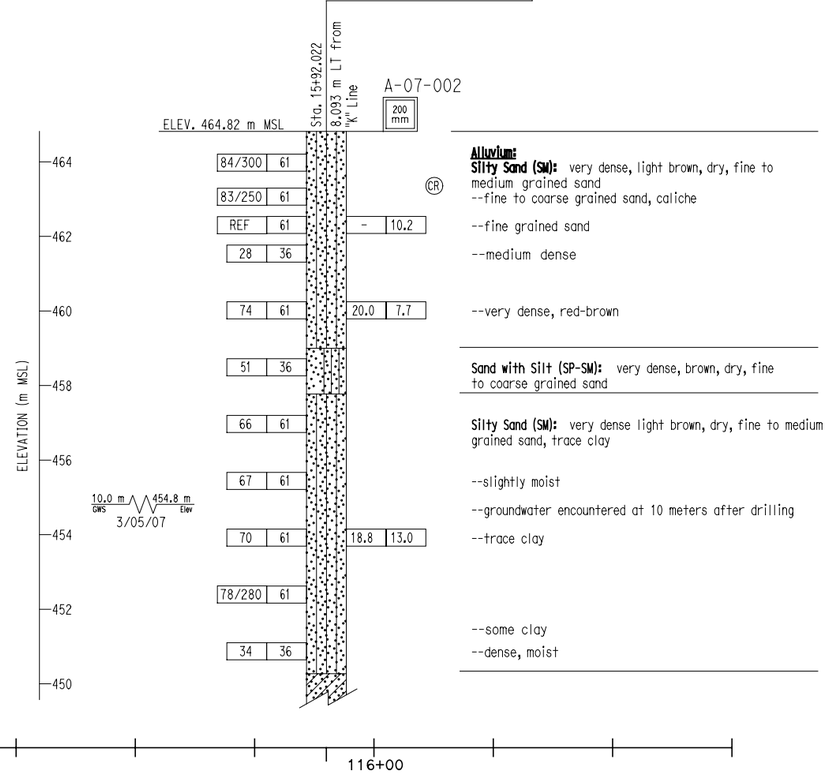
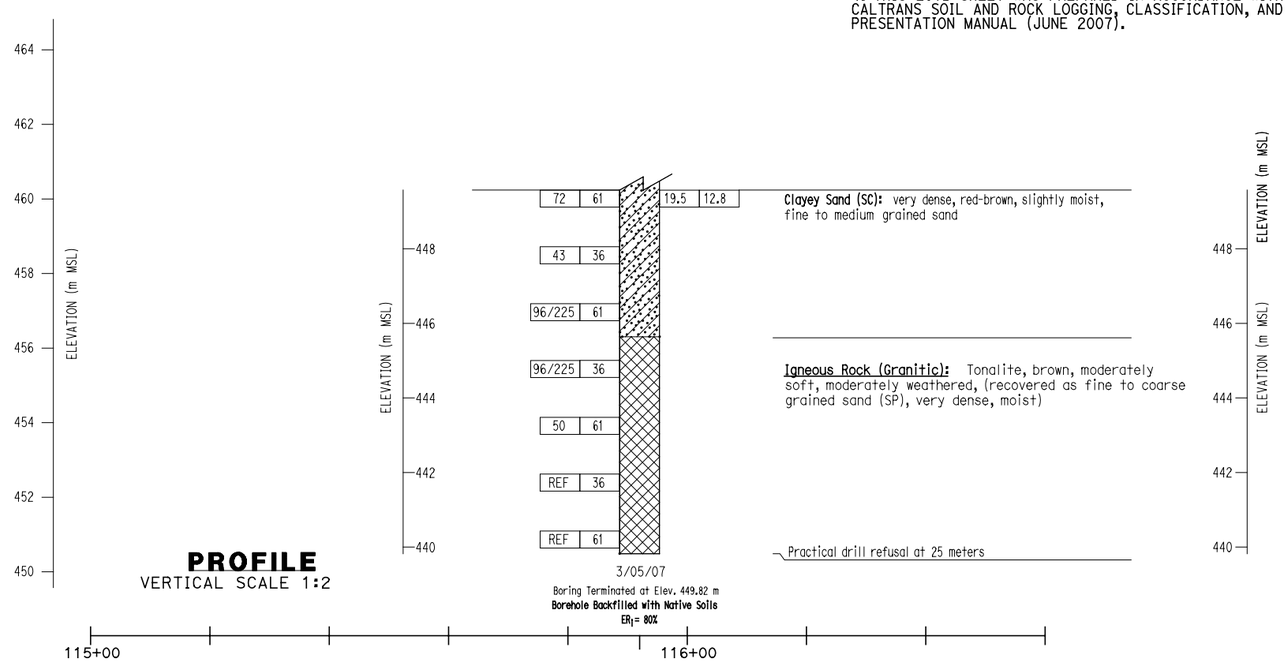
PLAN
1:500





PROFILE
VERTICAL SCALE 1:2



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PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 2 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

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08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

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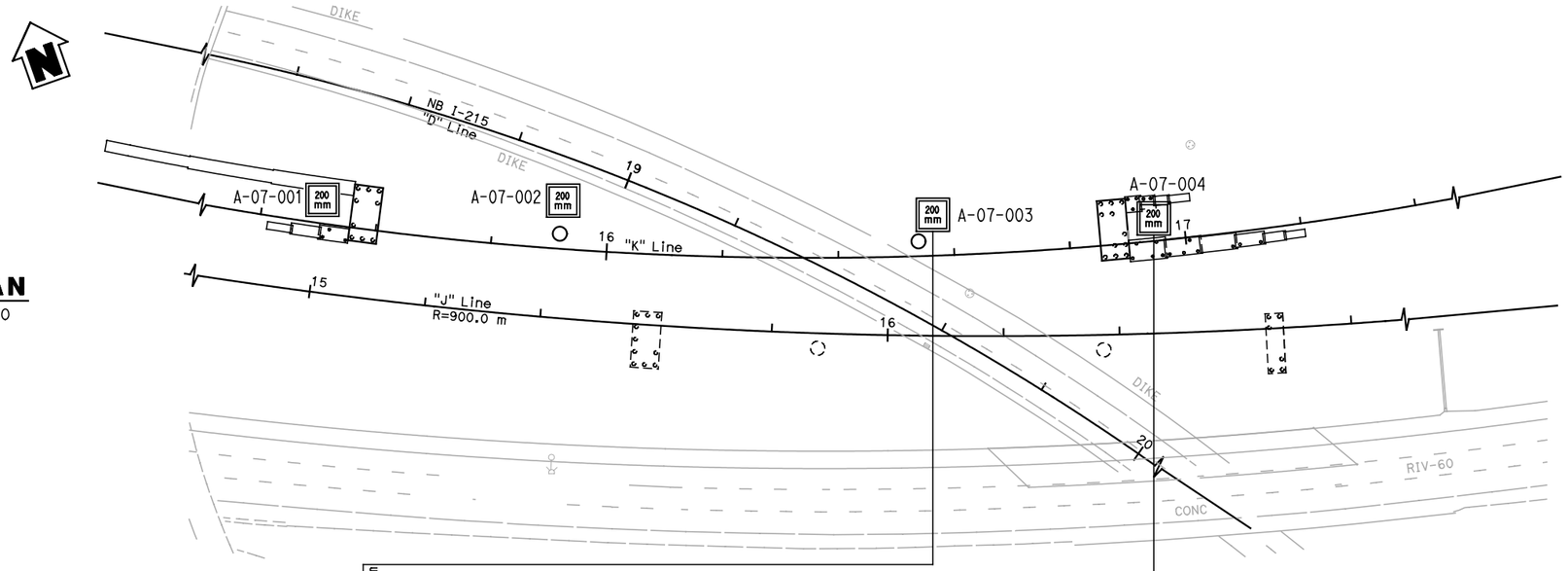
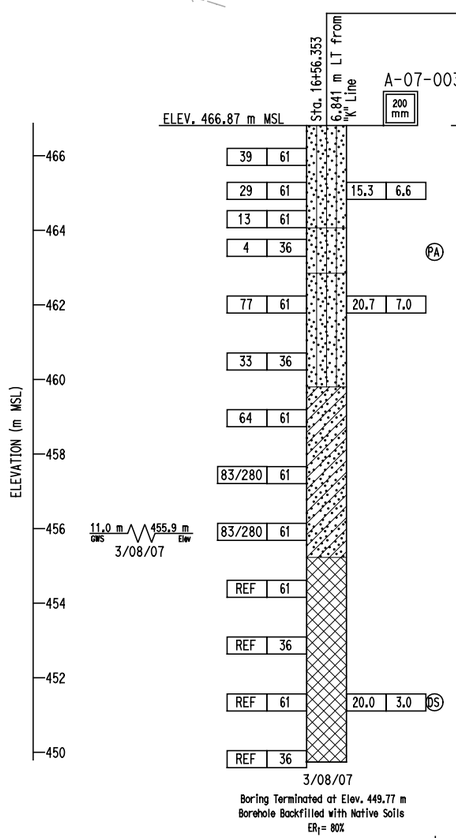
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500





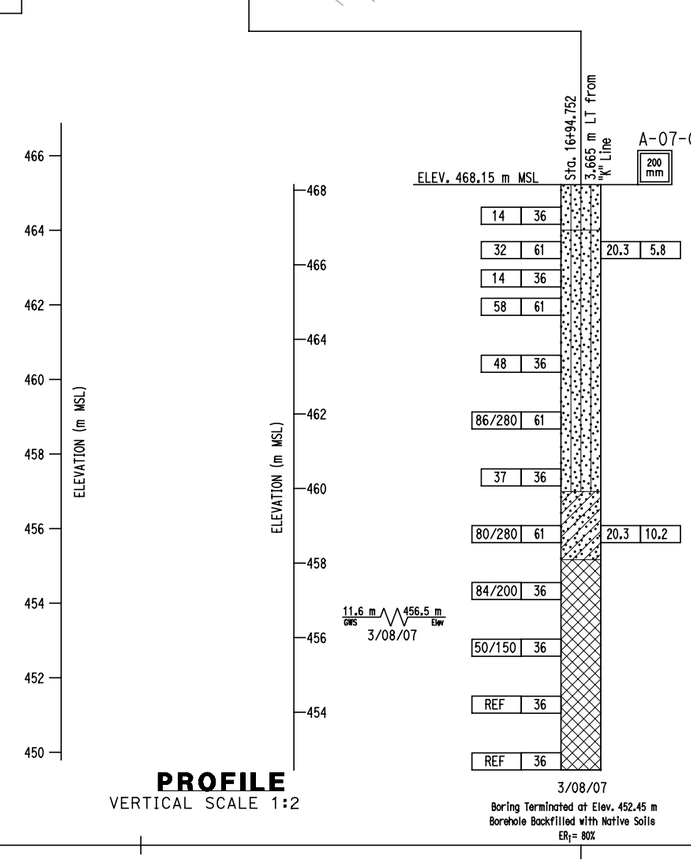
Fill:
Silty Sand (SM): dense, dark brown, fine to coarse grained sand, with fine gravel and asphalt grindings
--medium dense, asphalt grindings
--fine grained sand, trace medium sand, iron staining, gravel content decreasing

Alluvium:
Silty Sand (SM): loose, brown, slightly moist

Silty Sand (SM): very dense, red-brown, slightly moist, fine to medium grained sand, trace clay
--dense, fine grained sand

Clayey Sand (SC): very dense, brown, moist, fine grained sand
--groundwater encountered at 11 meters

Igneous Rock (Granitic): Tonalite, gray-bown, moderately soft, moderately weathered, (recovered as fine to coarse grained sand (SP), very dense, wet)
--drilling effort increases
--gray
--very difficult drilling
--slightly weathered, moist, gray-brown, fine to medium grained
--wet
Practical drill refusal at 17.1 meters



Fill:
Silty Sand (SM): medium dense, red-brown, dry, fine to medium grained sand, trace coarse sand

Alluvium:
Silty Sand (SM): medium dense, brown, slightly moist, fine to coarse grained sand
--roots
--very dense, brown, slightly moist, fine grained sand
--orange-brown, dry
--dense

Clayey Sand (SC): very dense, red-brown, moist, fine to coarse grained sand

Igneous Rock (Granitic): Tonalite, tan-brown, moderately soft, slightly weathered, (recovered as fine to medium grained sand (SP), very dense, moist)
--groundwater encountered at approximately 11.6 meters

PROFILE
VERTICAL SCALE 1:2

116+40 117+00

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.
2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.
3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.
4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 3 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 2/13/09 6/15/09 8/28/09 10/2/09

SHEET 32 OF 32

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
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Caltrans Metric

Carlos V Amante 10/02/09
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KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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 (25.4 mm soil tube) Hand Auger
●	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

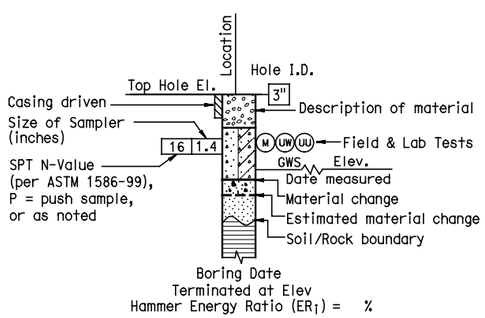
Note: Size in millimeters.

CONSISTENCY OF COHESIVE SOILS

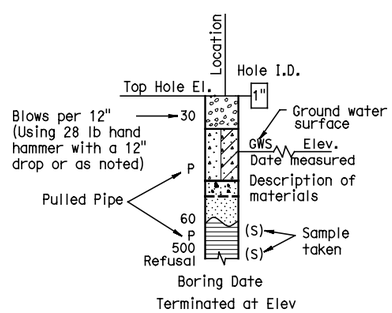
Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

PLASTICITY OF FINE-GRAINED SOILS

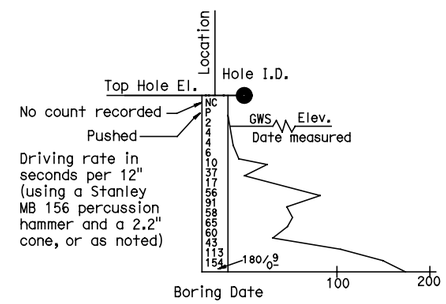
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



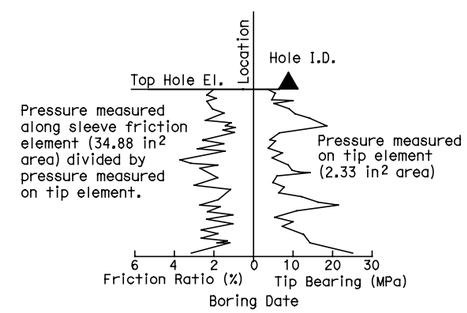
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D.FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/18/09 6/18/09 8/28/09 10/2/09

SHEET 25 OF 31

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
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Carlos V Amante 10/02/09
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LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

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SHEET 26 OF 31

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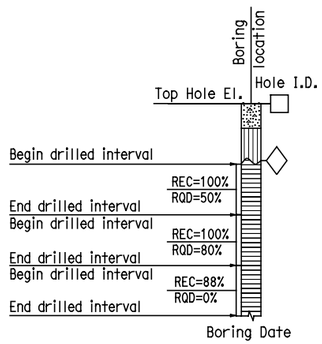
PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \geq}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 2/16/09 6/18/09 8/28/09 10/2/09

SHEET 27 OF 31

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVAL DATE

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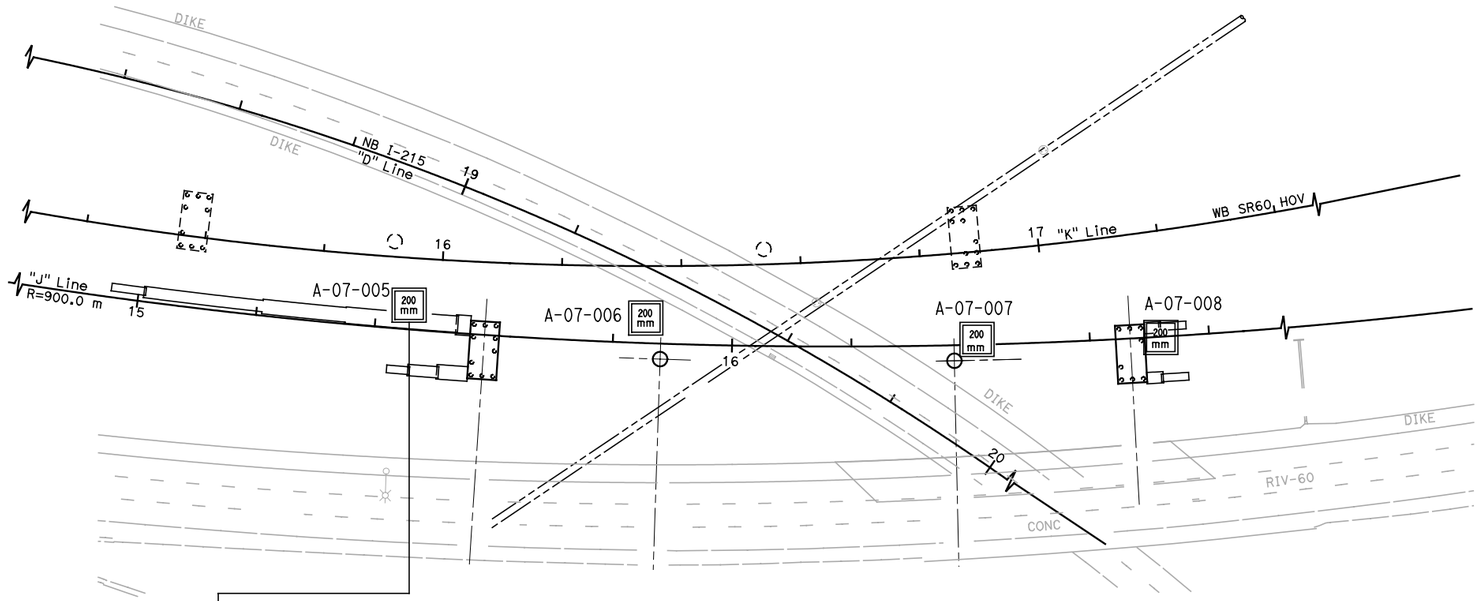
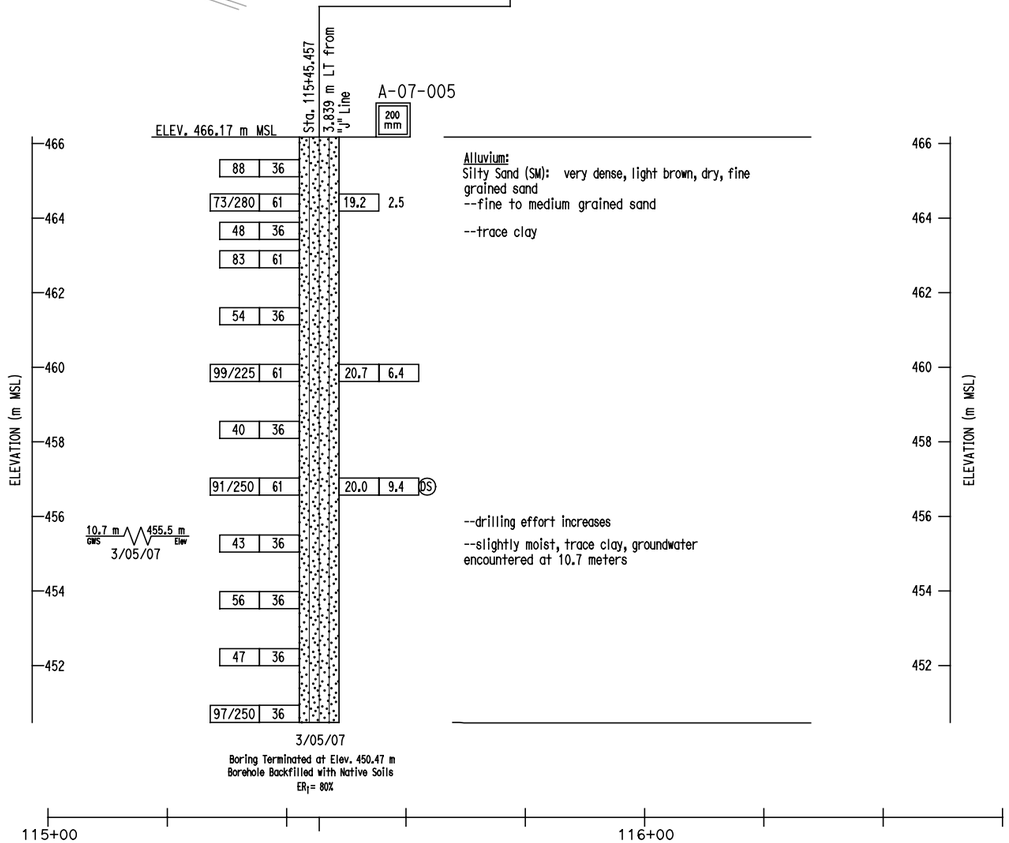
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER WEST, INC.
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500





Alluvium:
Silty Sand (SM): very dense, light brown, dry, fine grained sand
--fine to medium grained sand

--trace clay

--drilling effort increases

--slightly moist, trace clay, groundwater encountered at 10.7 meters

PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

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3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 1 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES 3/12/08 7/21/08 11/14/08 2/13/09 6/18/09 8/28/09 10/2/09

SHEET 28 OF 31

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08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Caltrans Metric

Carlos V. Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

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1220 RESEARCH DRIVE, SUITE B
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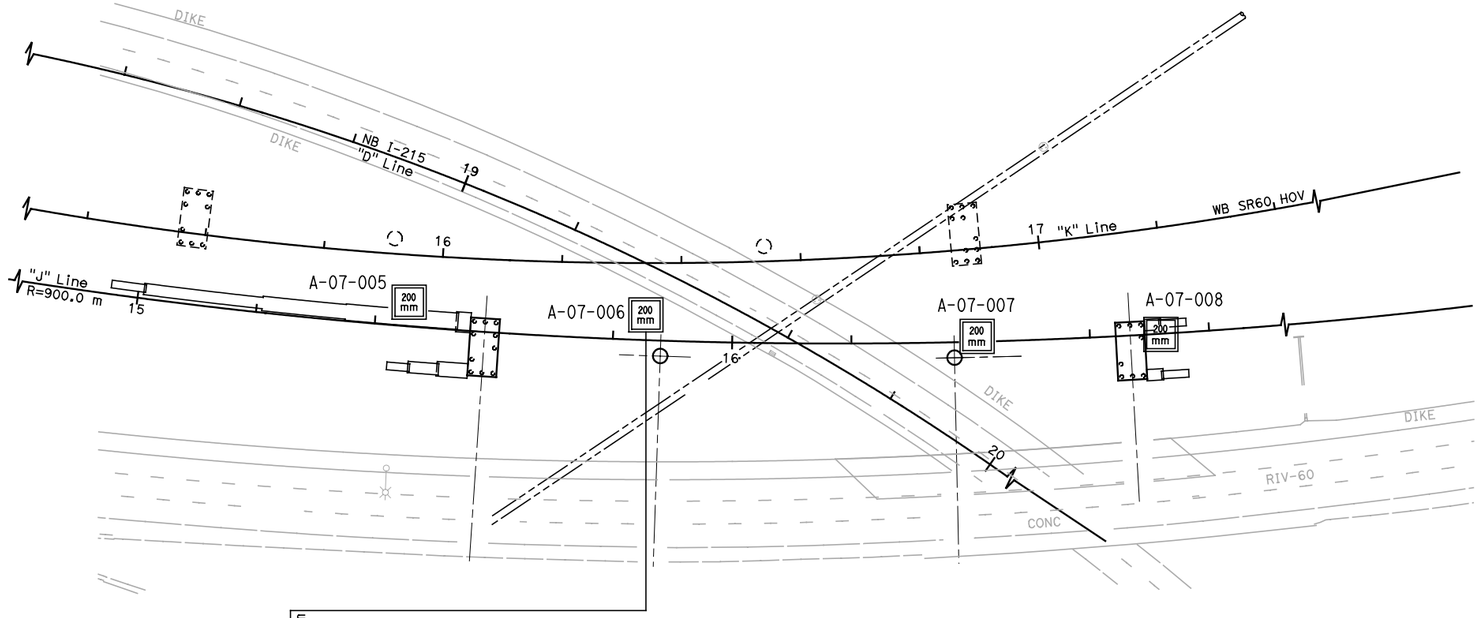
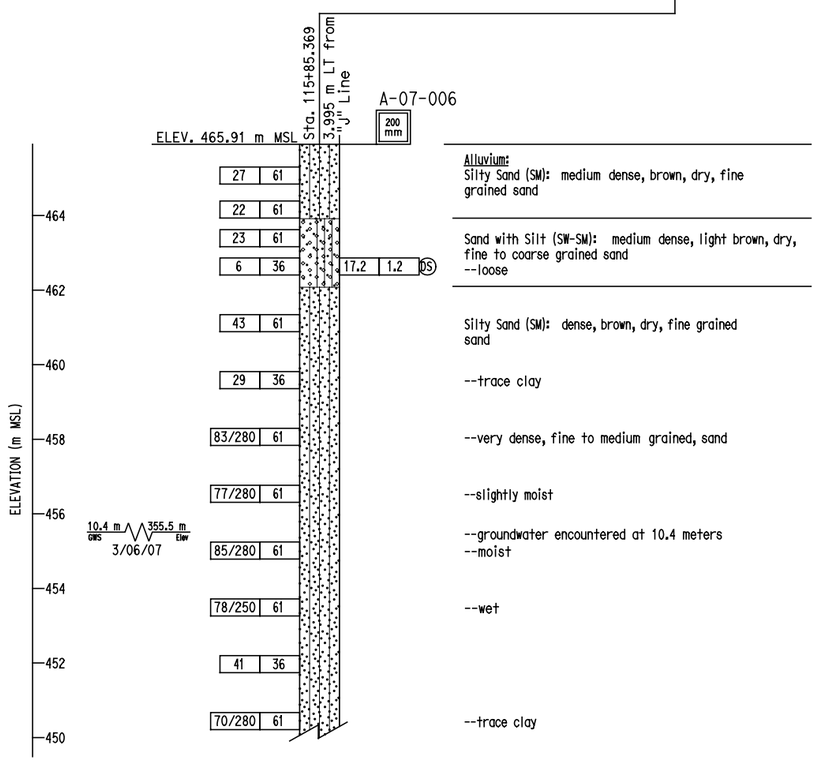
PLAN
1:500





Alluvium:
Silty Sand (SM): medium dense, brown, dry, fine grained sand

Sand with Silt (SW-SM): medium dense, light brown, dry, fine to coarse grained sand
--loose

Silty Sand (SM): dense, brown, dry, fine grained sand

--trace clay

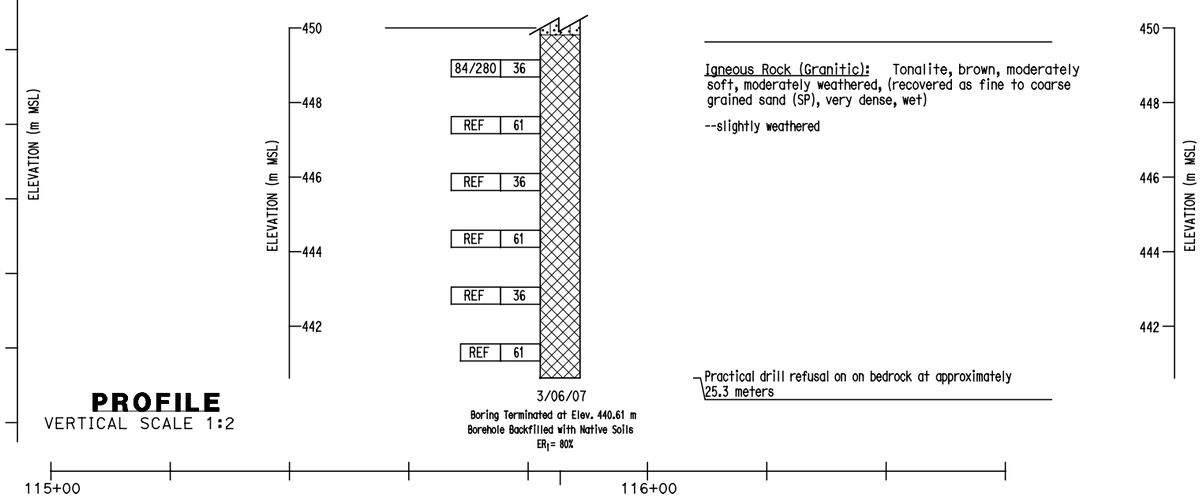
--very dense, fine to medium grained, sand

--slightly moist

--groundwater encountered at 10.4 meters
--moist

--wet

--trace clay



Igneous Rock (Granitic): Tonalite, brown, moderately soft, moderately weathered, (recovered as fine to coarse grained sand (SP), very dense, wet)

--slightly weathered

Practical drill refusal on on bedrock at approximately 25.3 meters

PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

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DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C.AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 2 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES
REVISION DATES 3/12/08 7/21/08 11/4/08 2/13/09 6/15/09 8/28/09 10/2/09

SHEET 29 OF 31

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08	Riv	60,215	R19.7/21.9, R61.3/62.7		

Carlos V. Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

PLANS APPROVAL DATE

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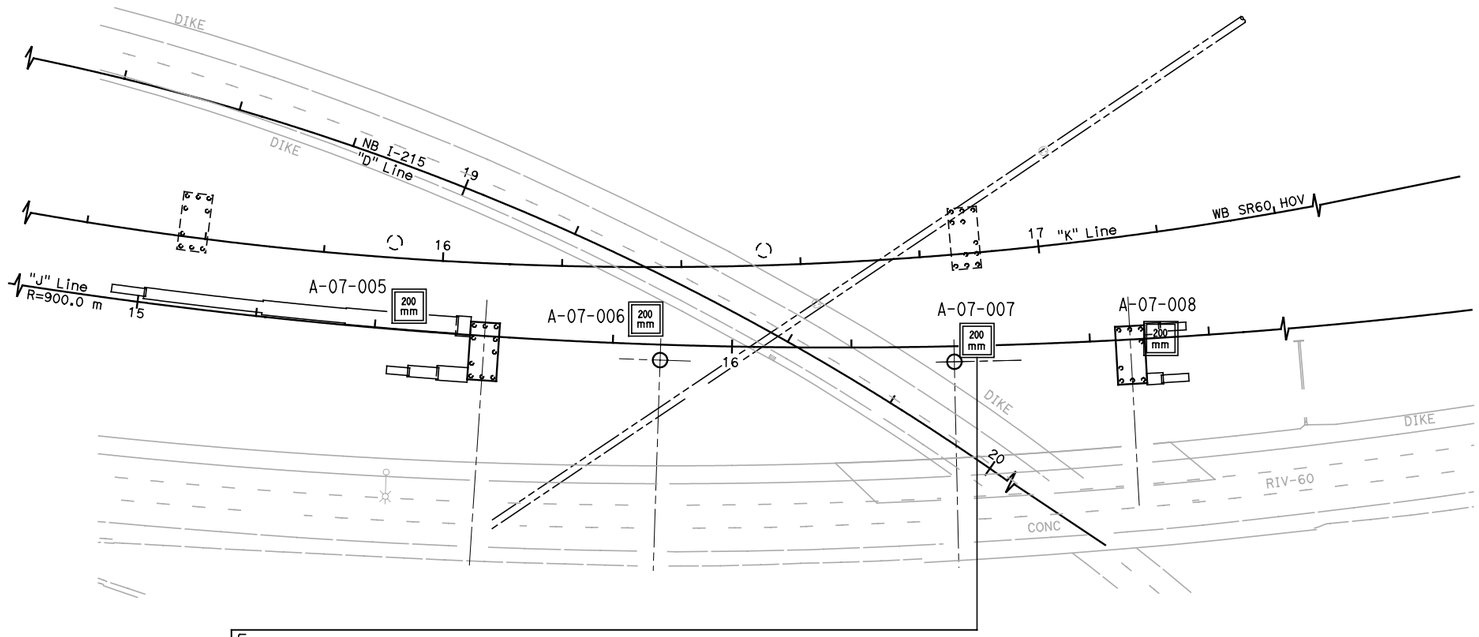

PLAN
1:500

BENCH MARK:

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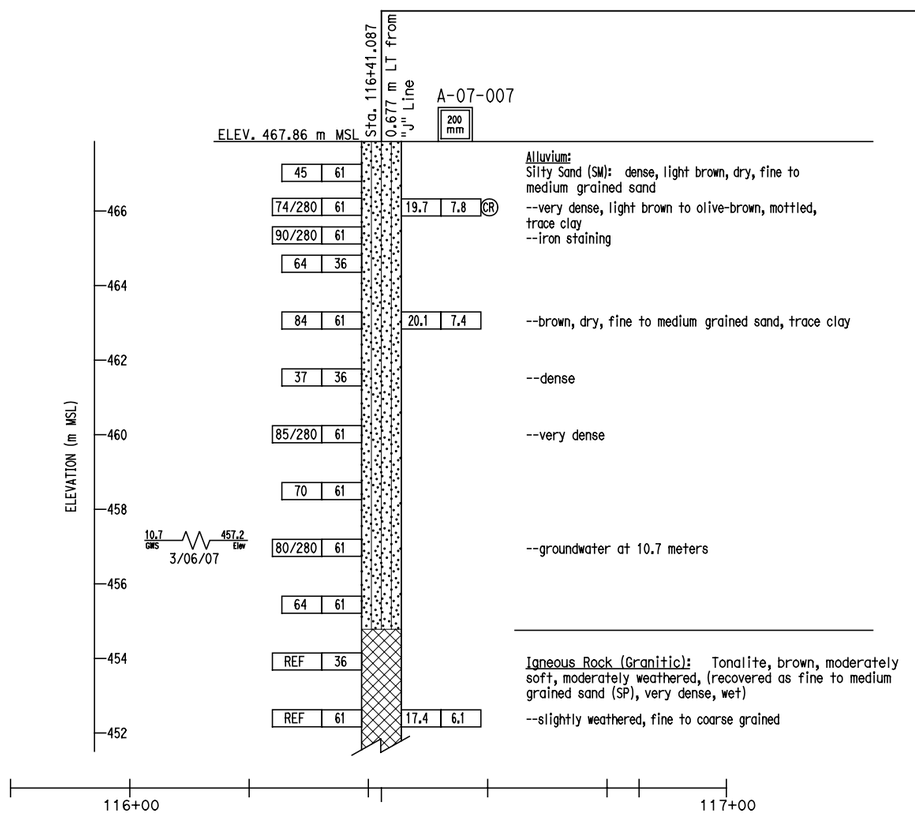

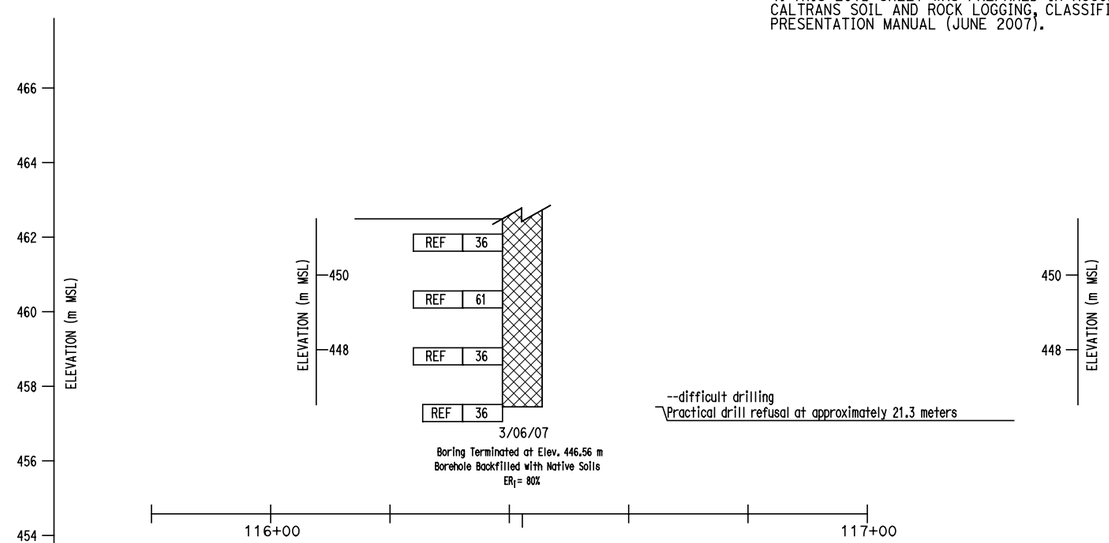

PROFILE
VERTICAL SCALE 1:2

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DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D.FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 3 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

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REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 6/18/09 8/28/09 10/2/09

SHEET 30 OF 31

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Carlos V Amante 10/02/09
CERTIFIED ENGINEERING GEOLOGIST

PLANS APPROVAL DATE

REGISTERED GEOLOGIST — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

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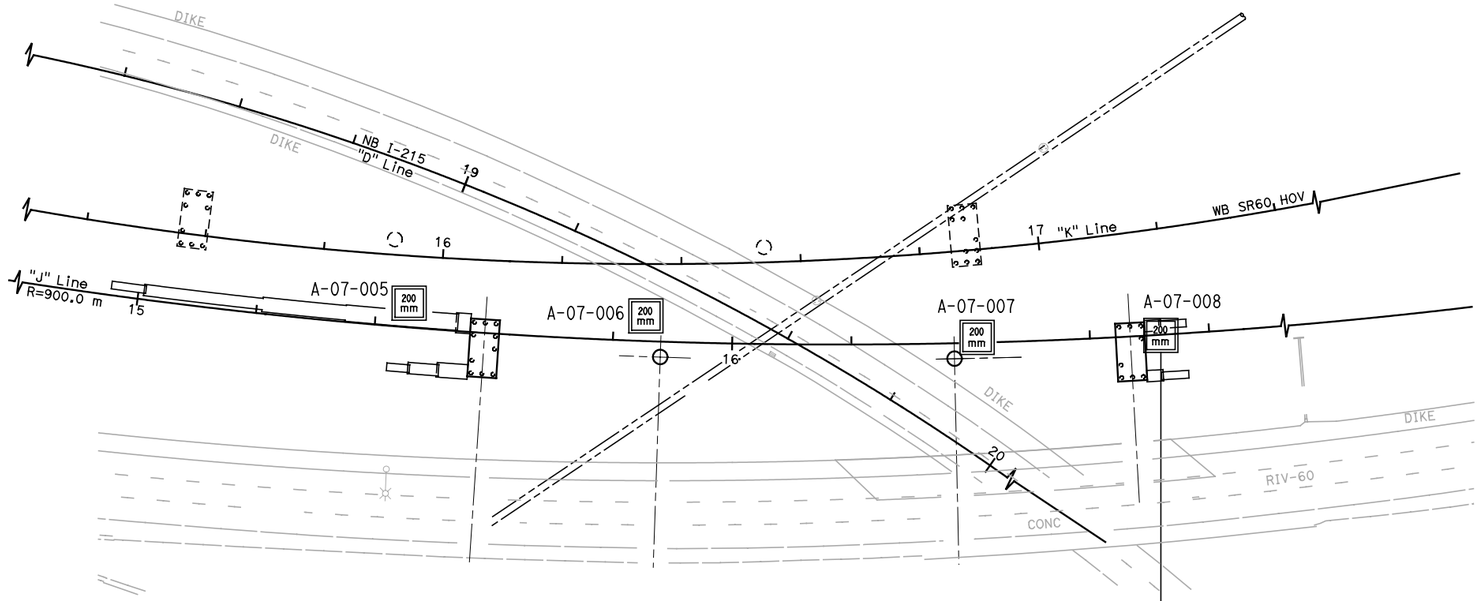

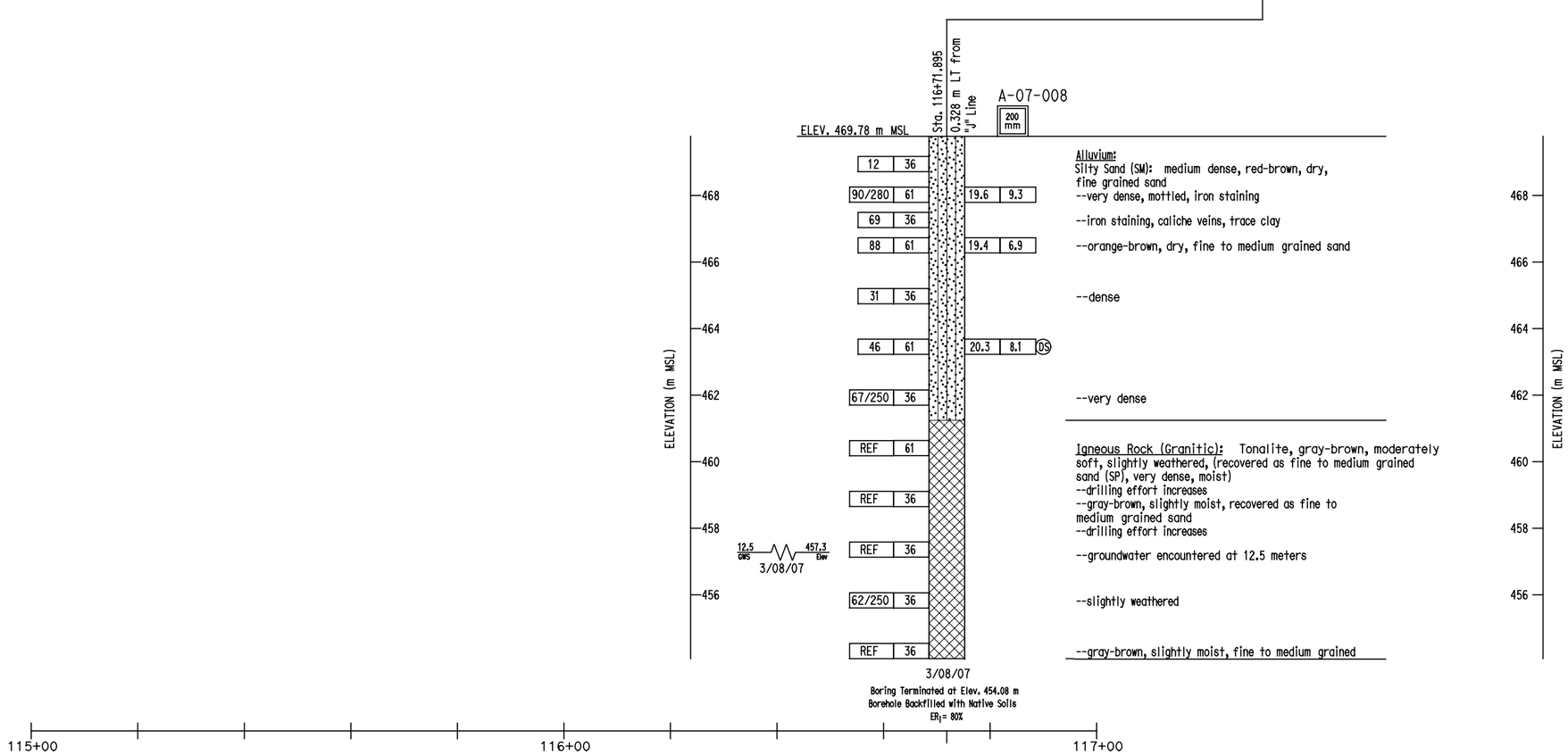

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PROFILE
VERTICAL SCALE 1:2

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 4 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

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SHEET 31 OF 31

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ADDENDUM

1220 Research Drive
Suite B
Redlands, CA 92374
p| 909.793.2691
f| 909.792.1704
kleinfelder.com

August 19, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

via Electronic Mail
Mohan.Char@lanengineering.com
Kimberly.Gee@lanengineering.com

Subject: Addendum to Revised Final Structure Foundation Report (Dated June 12, 2009)
Proposed Westbound and Eastbound
State Route 60 HOV Connectors
Bridge Nos. 56-0841 and 56-0842
Interstate 215/State Route 60 East Junction Improvements
Riverside, California
08-Riv-215/60-KP 61.7/62.6, 19.4/21.5
Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder has prepared this addendum report in response to comments provided by the California Department of Transportation (Caltrans), Division of Engineering Services, Geotechnical Services- MS #5, Office of Geotechnical Design South-2, pertaining to their review of our report entitled Revised Final Structure Foundation Report, Proposed Westbound and Eastbound State Route 60 HOV Connectors, Bridge Nos. 56-0841 and 56-0842, Interstate 215/State Route 60 East Junction, City of Riverside, California, dated June 12, 2009. The Caltrans review comments and our responses to these comments are attached.

CLOSURE

The information contained in this report/letter is subject to the conditions and limitations contained within the structure foundation report. We appreciate the opportunity to be of service on this project. If you have any questions, comments or require additional information, please do not hesitate to contact our office at your convenience.

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Respectfully submitted,

KLEINFELDER WEST, INC.

Madan Chirumalla, PE
Staff Engineer

REGISTERED PROFESSIONAL ENGINEER
MADAN CHIRUMALLA, PE
No. 74186
Exp. 6/30/2011
CIVIL
STATE OF CALIFORNIA

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

for: Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

PROFESSIONAL GEOLOGIST
MICHAEL O. COOK
CEG #1716
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

MC/CVA:lg

Attachments: Response to Comments Form
Revised Table 1, Seismic Design Parameters
Table 2C, Foundation Design Loads
Revised Log of Test Boring (LOTB) Sheets

REGISTERED PROFESSIONAL ENGINEER
CARLOS V. AMANTE
No. 2724
Exp 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

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Project Name: **I-215/SR-60 East Junction**
08-SBd-215/60 CU08 -EA449311
Review Phase: **Foundation Report Review**
WB and EB SR60 HOV Connectors Bridge No. 56-0841/56-0842
Responses by: Carlos Amante/ Madan Chirumalla

RESPONSE TO COMMENTS ON FOUNDATION REPORT REVIEW –WB AND EB SR60 HOV CONNECTORS

Comment No.	Sheet No.	Plan Comments by Gina Pursell	Response	✓
1	Pg. 11 of 28 Section 6.1	Seismic Design Criteria: Please include direction of controlling fault in Table 1.	The direction of controlling fault is shown in the revised Table 1, attached in this addendum letter.	
2	Pg. 12 of 28 Section 6.2	Bridge Foundation Design Please provide a table for both structures containing the design criteria used for LRFD: • Service I Limit State [include Total Load and Permanent Load] • Strength Limit State (Controlling Group) [include Compression and Tension per pile and per support] • Extreme Event Limit State (Controlling Group) [include Compression and Tension per pile per support]	The requested LRFD data are provided in the attached Table 4.	
3	Pg 22 of 28 Section 7.2	Pile Installation: Will dewatering the boring be a possibility? Please include an explanation of why or why not.	Dewatering will not be necessary since the pile can be constructed using wet (or slurry displacement) method, if groundwater is encountered during construction. The contractor shall also consider the use of temporary casing to prevent caving of boreholes	
4	Pg 22 of 28 Section 7.2	Pile Installation: Should the statement "…lower portion of bedrock" be written "…lowering portion of boring"? Please explain.	The statement “Hard drilling conditions should be anticipated in the lower portion of bedrock” should be modified to read “Hard drilling conditions should be anticipated at lower elevations within the bedrock materials”.	
5	Pg 22 of 28 Section 7.2	Pile Installation: Will a curing time be needed for a newly poured CIDH pile before starting construction of adjacent CIDH piles at the abutments? Please include an explanation.	The holes can be drilled in a staggered pattern and concrete pouring can be done in these holes. The adjacent holes can be drilled after the initial setting of concrete in previous holes. This is usually determined by the contractor.	

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Table 1 (Revised 8-19-09)
Seismic Design Parameters

Seismic Parameters	Design Recommendation and Reference
Controlling Fault	San Jacinto (SJO), (Mualchin, 1996a)
Direction of Controlling Fault	Right-Lateral
Type of Fault	Strike-Slip (Mualchin, 1996b)
Closest Distance to the Fault	8.8 km (northeast) (Mualchin, 1996a)
Earthquake Magnitude (MCE)	7.5 (Mualchin, 1996a,b)
Horizontal Peak Bedrock Acceleration (PBA)	0.5g
Soil Profile Type	C (Table B.1, 2006 Caltrans Seismic Design Criteria)

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TABLE 2C - FOUNDATION DESIGN LOADS

WB SR60 HOV CONNECTOR

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	1907	135	1710	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bent 2 **	2853	N/A	2180	3719	3719	0	0	2725	2725	0	0
Bent 3 **	2815	N/A	2191	3733	3733	0	0	2739	2739	0	0
Abutment 4	2346	150	2149	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

** Loads are not adjusted by pile resistance factors.

EB SR60 HOV CONNECTOR

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	1740	125	1556	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bent 2 **	2392	N/A	1702	2555	2555	0	0	2128	2128	0	0
Bent 3 **	2363	N/A	1712	2568	2568	0	0	2140	2140	0	0
Abutment 4	1781	125	1597	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

** Loads are not adjusted by pile resistance factors.

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

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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.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

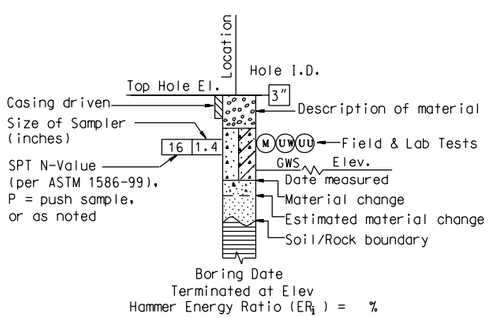
BOREHOLE IDENTIFICATION

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 (25.4 mm soil tube) Hand Auger
◎	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

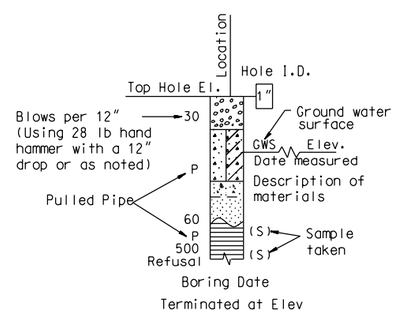
Note: Size in millimeters.

PLASTICITY OF FINE-GRAINED SOILS

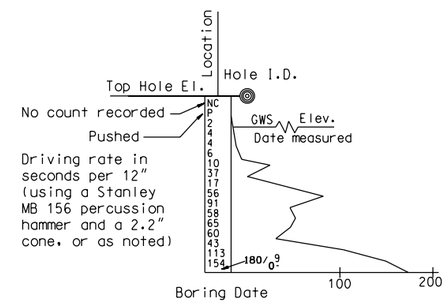
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



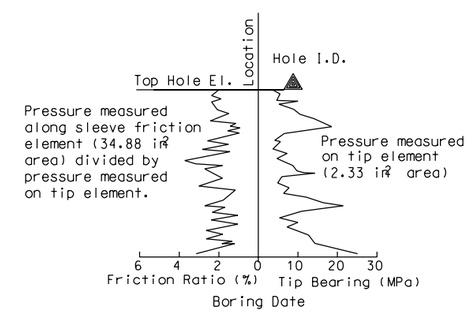
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY	C. AMANTE	C. AMANTE PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

REVISION DATES

SHEET 26 OF 31

FILE •) $REQUEST

USERNAME •)$USER DATE PLOTTED •) $DATE TIME PLOTTED •) $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER
CARLOS AMANTE
No. GE2724
Exp. 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

PLANS APPROVALDATE

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

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DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE •) $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

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SHEET 27 OF 31

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08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
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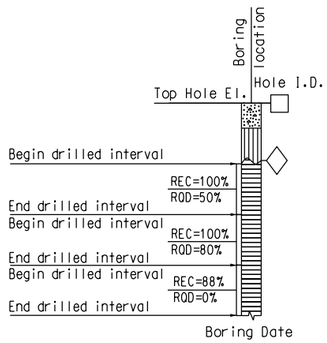
REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features: Chemical Weathering-Discoloration and/or oxidation: Body of Rock	Chemical Weathering-Discoloration and/or oxidation: Fracture Surfaces	Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning: Texture	Texture and Solutioning: Solutioning	General Characteristics
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 28 OF 31

FILE -) $REQUEST

USERNAME -*$USER DATE PLOTTED -) $DATE TIME PLOTTED -) $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

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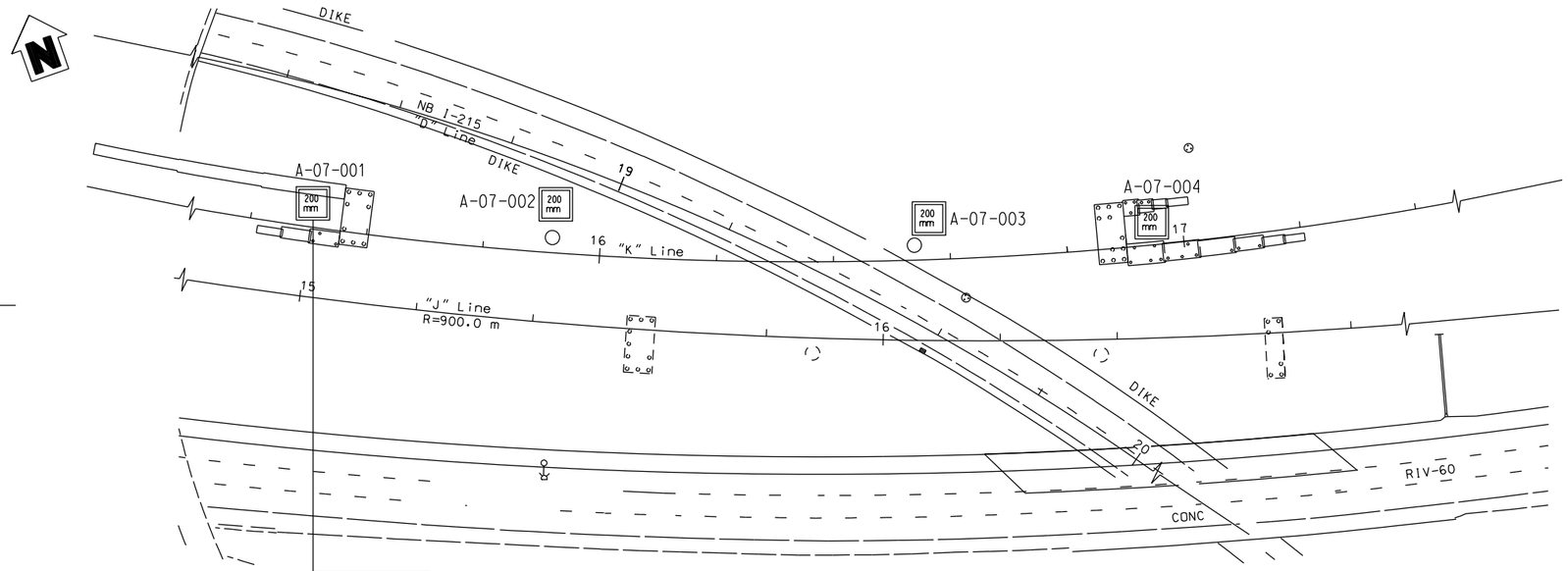
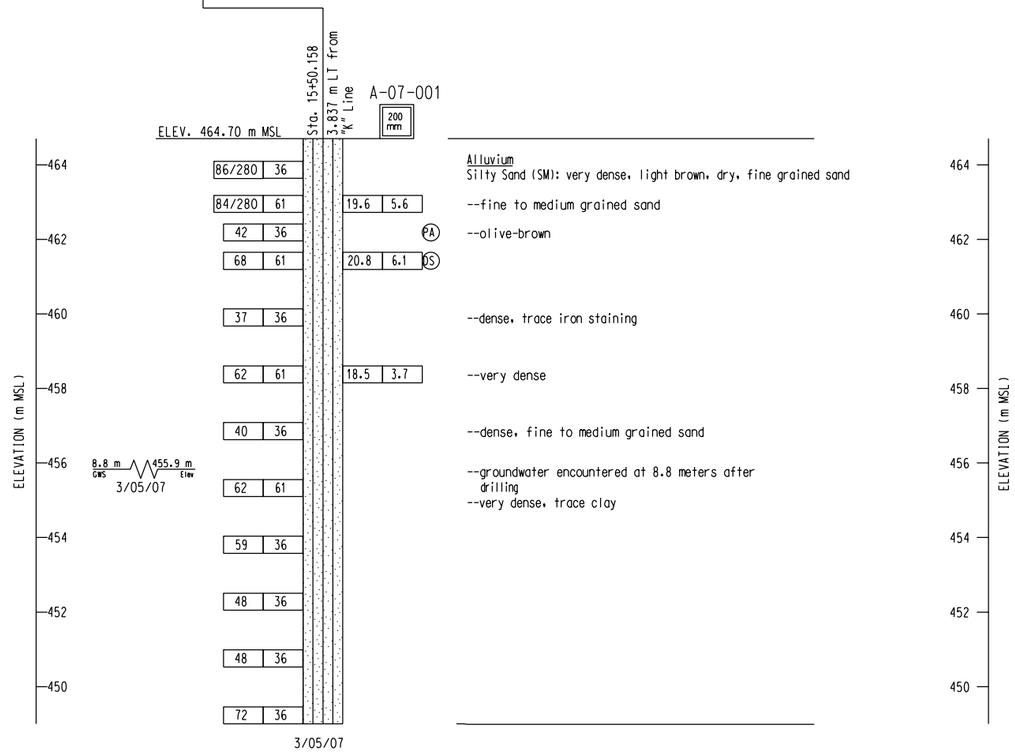
PLAN
1:500



PROFILE
VERTICAL SCALE 1:2



Alluvium
Silty Sand (SM): very dense, light brown, dry, fine grained sand

--fine to medium grained sand

--olive-brown

--dense, trace iron staining

--very dense

--dense, fine to medium grained sand

--groundwater encountered at 8.8 meters after drilling
--very dense, trace clay

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

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DESIGN OVERSIGHT

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CHECKED BY C. AMANTE

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PROJECT ENGINEER

BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 1 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

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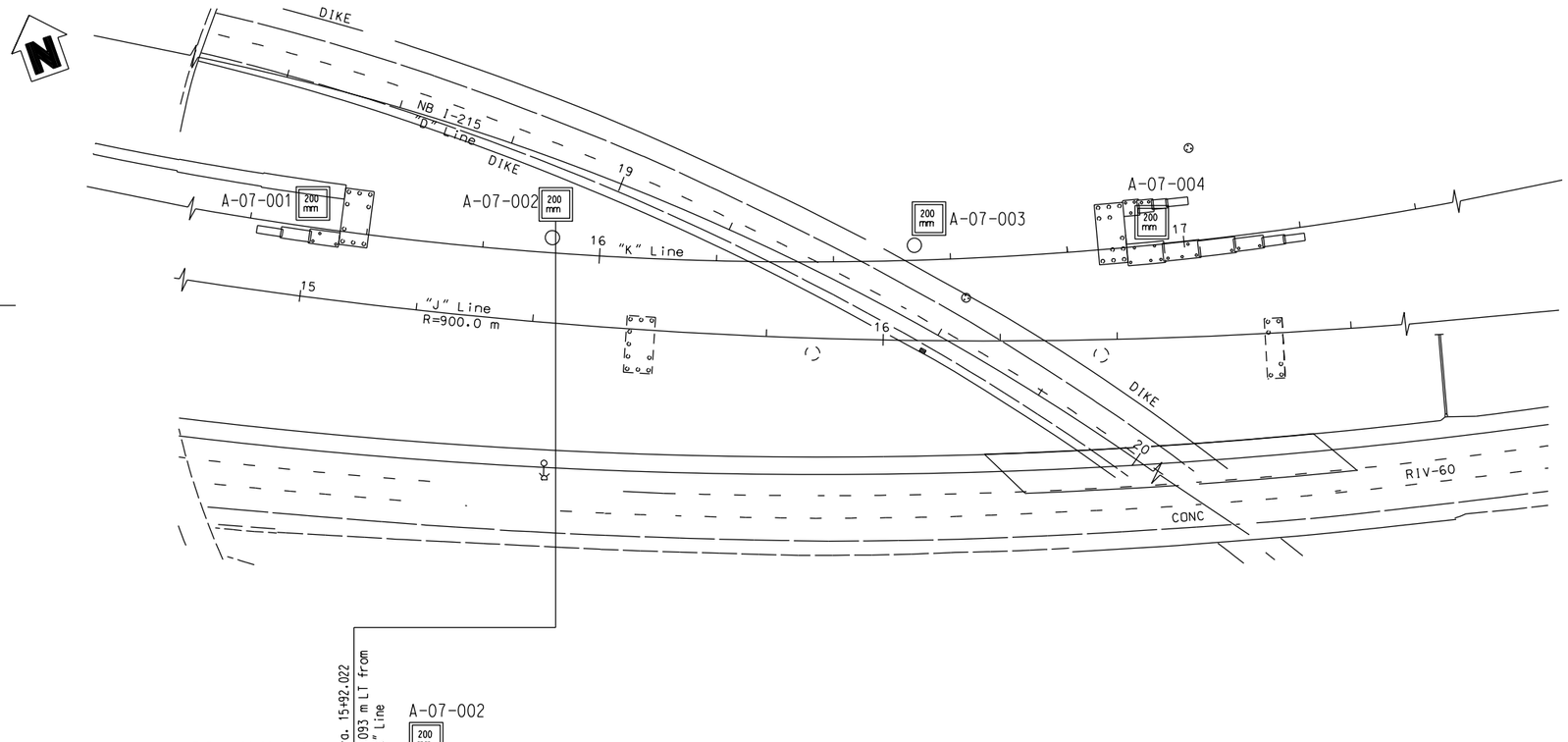
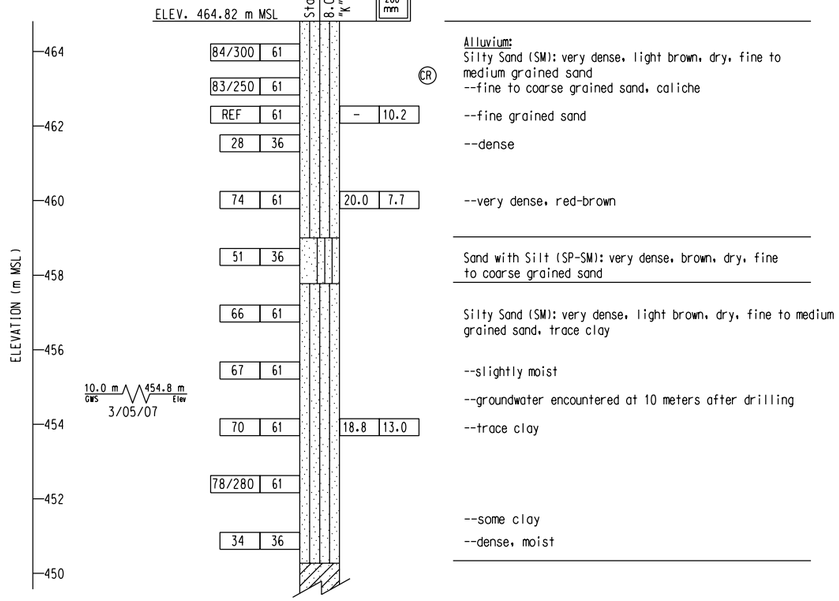
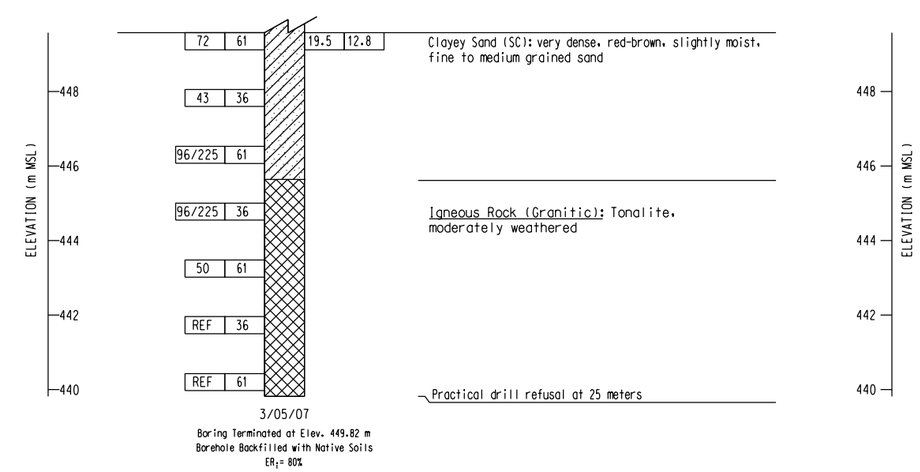
PLAN
1:500







PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
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C. AMANTE
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BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 2 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

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EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 3/12/08 7/21/08 11/4/08 2/13/09 5/20/09

SHEET 30 OF 31

FILE •) $REQUEST

USERNAME •) $USER DATE PLOTTED •) $DATE TIME PLOTTED •) $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

PLANS APPROVALDATE

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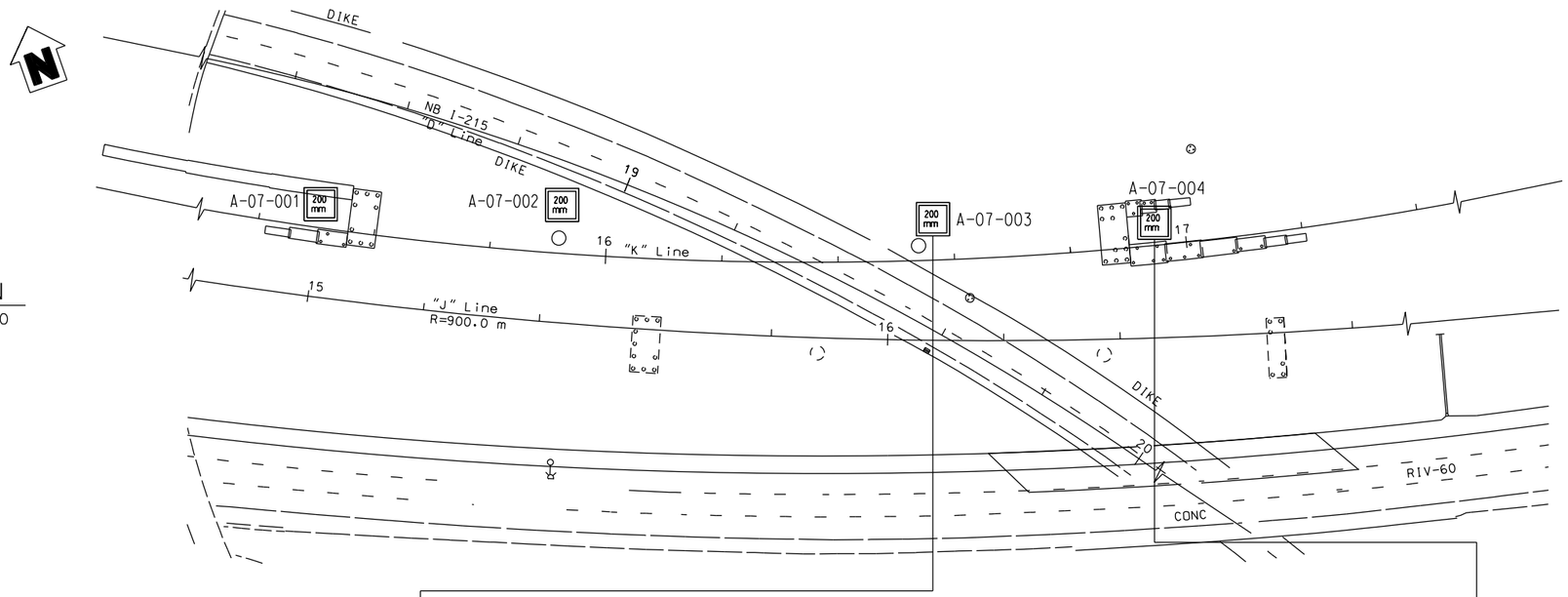
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500



BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

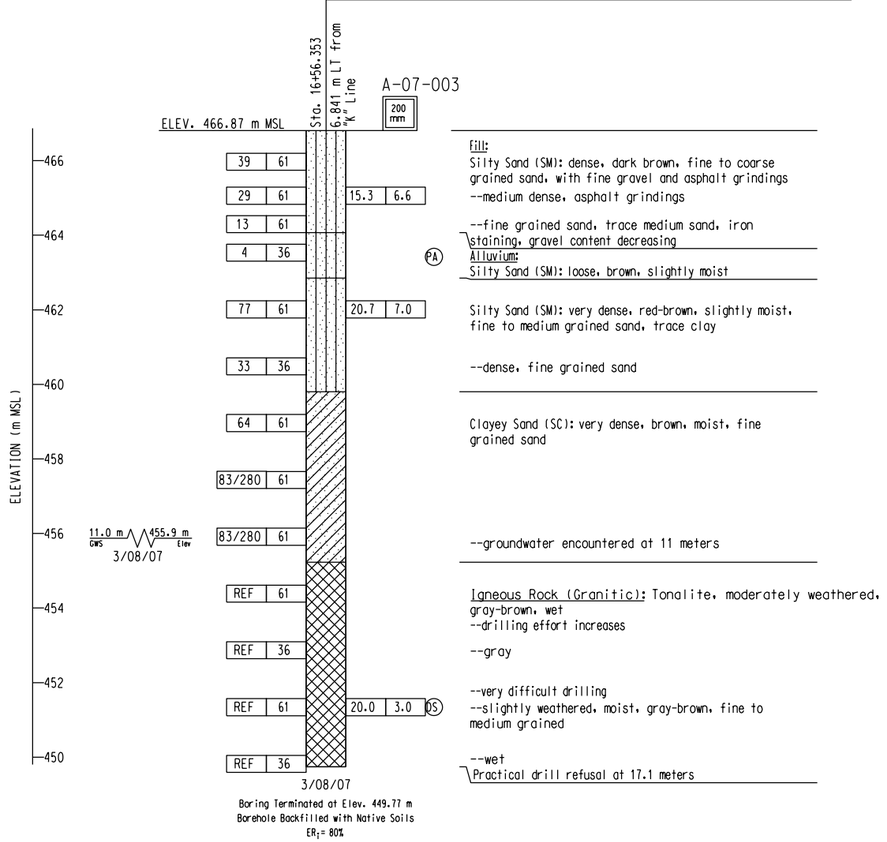
NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

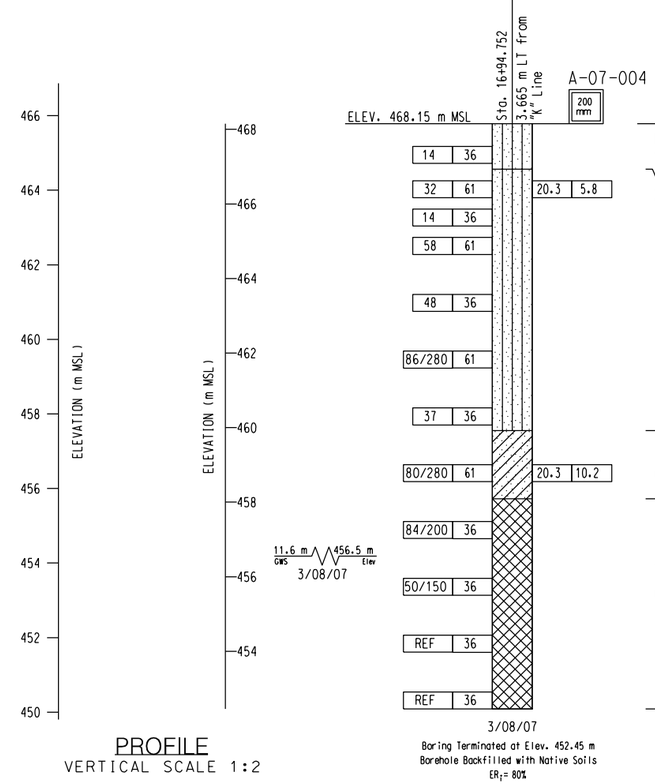
2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).



PROFILE
VERTICAL SCALE 1:2



ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY	C. AMANTE	C. AMANTE PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 3 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

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SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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.

CONSISTENCY OF COHESIVE SOILS

Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

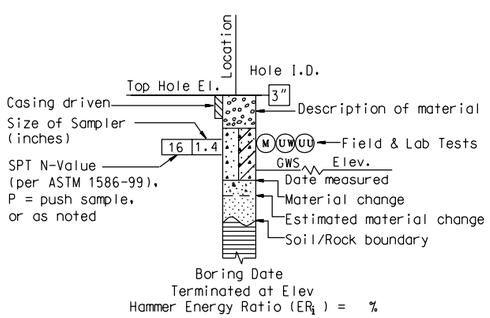
BOREHOLE IDENTIFICATION

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 (25.4 mm soil tube) Hand Auger
◎	D	Dynamic Cone Penetration Boring
▲	CPT	Cone Penetration Test (ASTM D 5778-95)
[ ]	O	Other

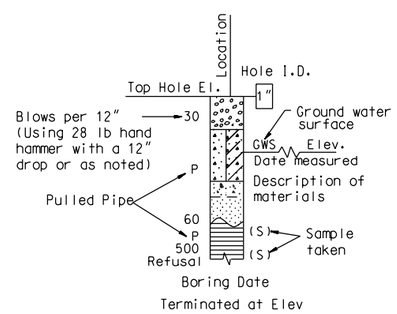
Note: Size in millimeters.

PLASTICITY OF FINE-GRAINED SOILS

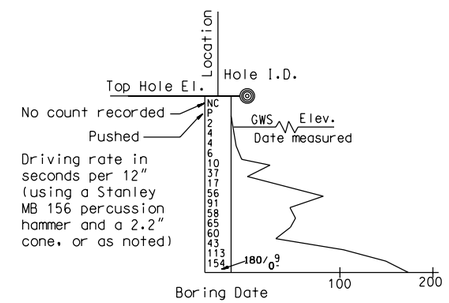
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be 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.



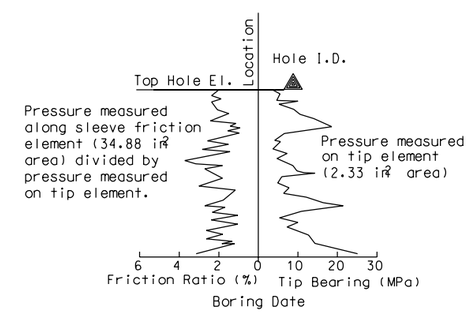
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D.FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. AMANTE PROJECT ENGINEER	BRIDGE NO. 56-0842
SIGN OFF DATE	CHECKED BY	C. AMANTE			KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

SOIL LEGEND NO.1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 24 OF 30

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Caltrans Metric

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CARLOS AMANTE
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GEOTECHNICAL
STATE OF CALIFORNIA

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KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

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SHEET 25 OF 30

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Caltrans Metric

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CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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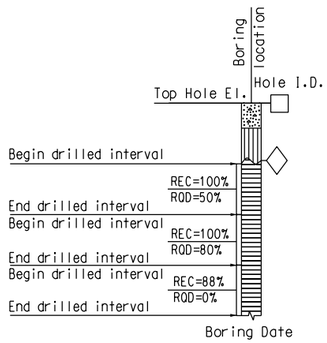
REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features: Chemical Weathering-Discoloration and/or oxidation: Body of Rock	Chemical Weathering-Discoloration and/or oxidation: Fracture Surfaces	Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning: Texture	Texture and Solutioning: Solutioning	General Characteristics
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 26 OF 30

FILE -) $REQUEST

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No. GE2724
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STATE OF CALIFORNIA

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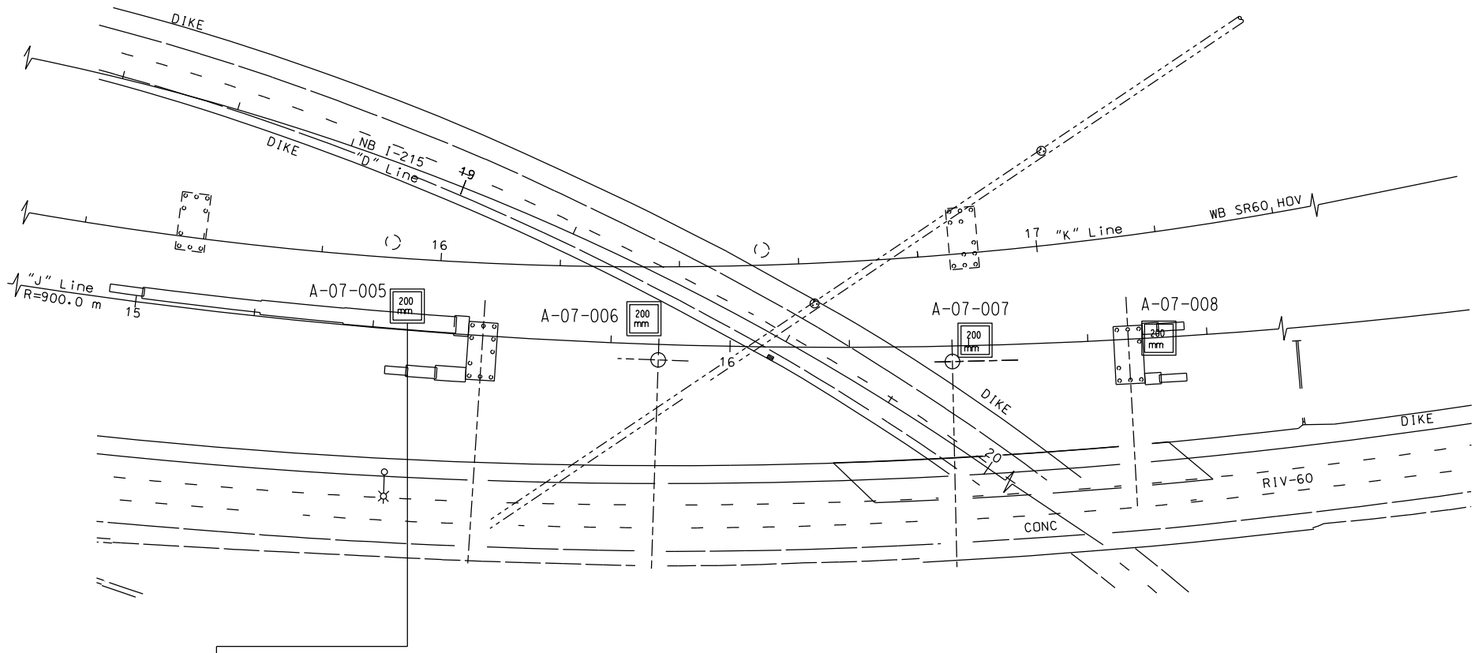
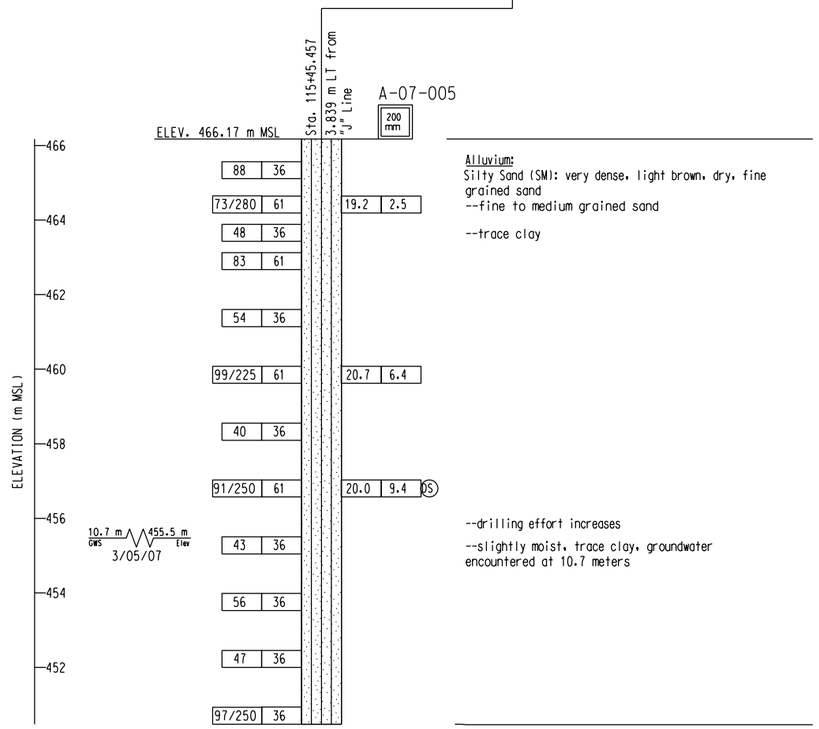
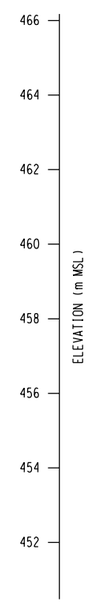
PLAN
1:500







PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

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CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 1 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

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Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

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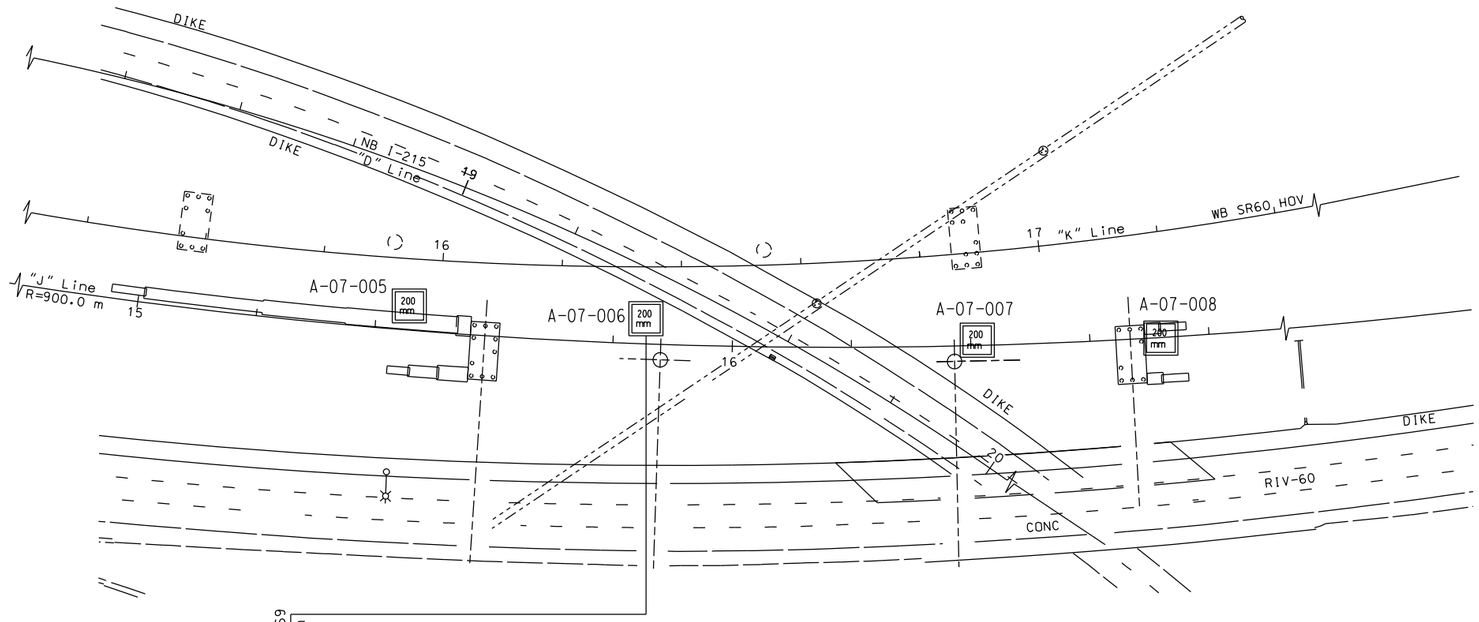
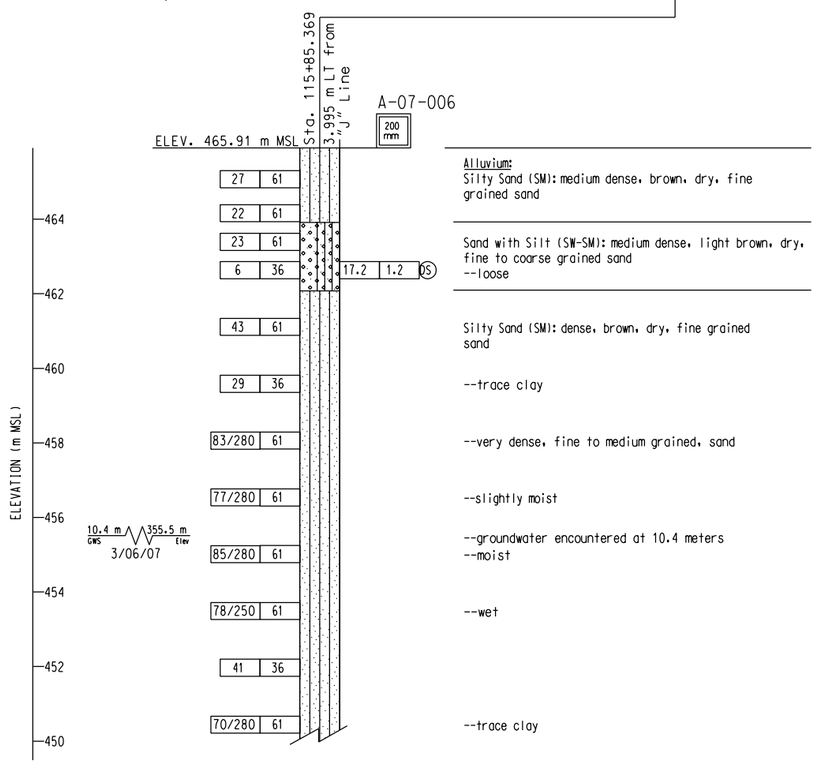




Alluvium:
Silty Sand (SM): medium dense, brown, dry, fine grained sand

Sand with Silt (SW-SM): medium dense, light brown, dry, fine to coarse grained sand
--loose

Silty Sand (SM): dense, brown, dry, fine grained sand

--trace clay

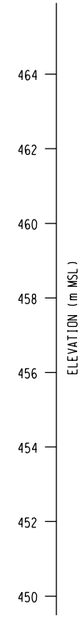
--very dense, fine to medium grained, sand

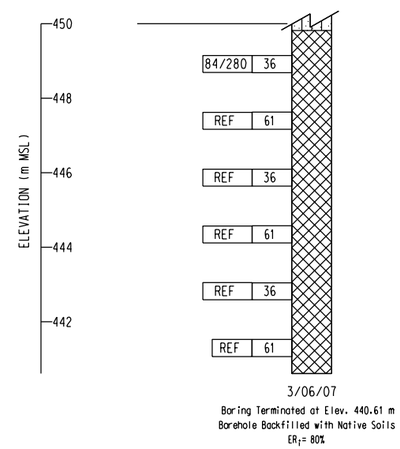
--slightly moist

--groundwater encountered at 10.4 meters
--moist

--wet

--trace clay



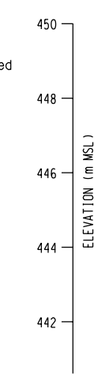


Boring Terminated at Elev. 440.61 m
Borehole Backfilled with Native Soils
ER_i= 80%

Igneous Rock (Granitic): Tonalite, moderately weathered

--slightly weathered

Practical drill refusal on on bedrock at approximately 25.3 meters



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DESIGN OVERSIGHT

SIGN OFF DATE

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CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 2 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

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Caltrans Metric

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REGISTERED PROFESSIONAL ENGINEER
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No. GE2724
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GEOTECHNICAL
STATE OF CALIFORNIA

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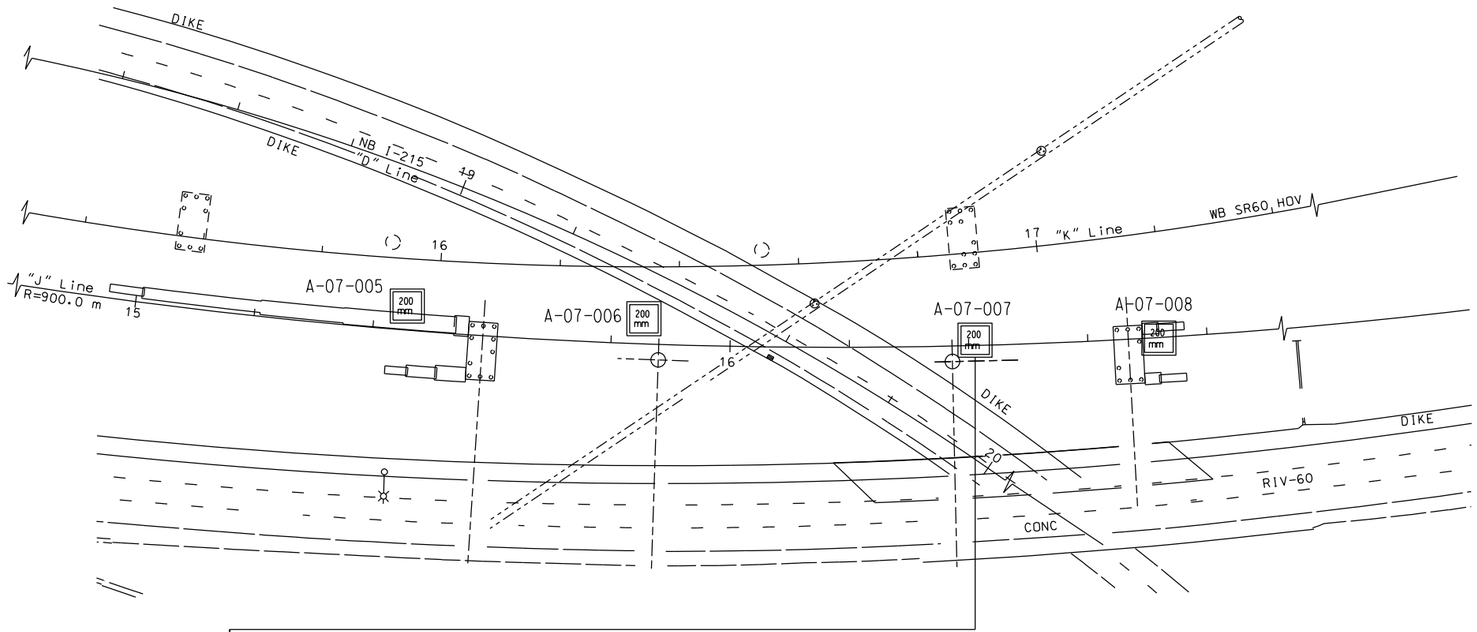

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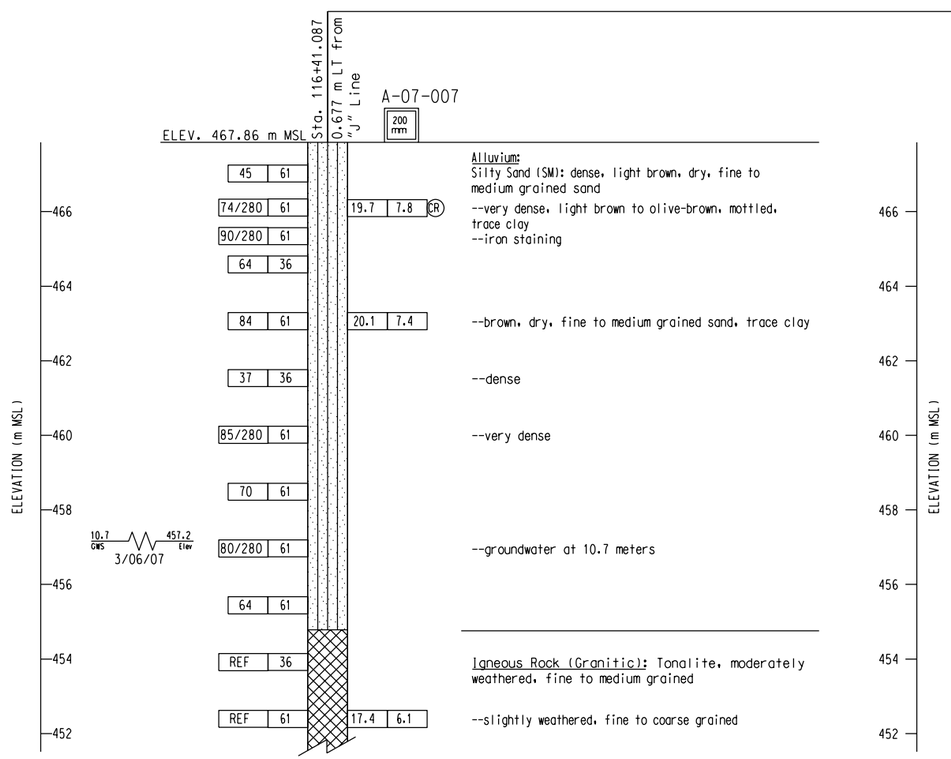

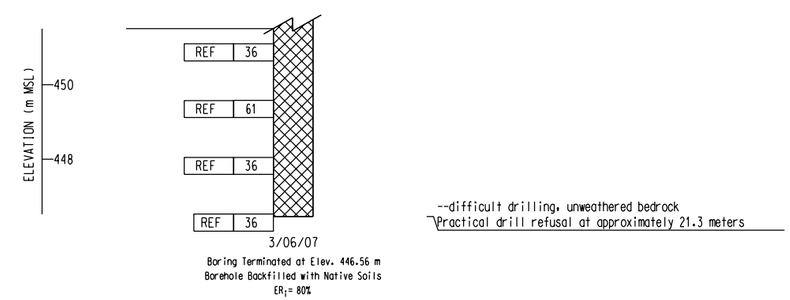

PROFILE
VERTICAL SCALE 1:2

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CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 3 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

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CERTIFIED ENGINEERING GEOLOGIST

REGISTERED PROFESSIONAL ENGINEER — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — GEOTECHNICAL — STATE OF CALIFORNIA

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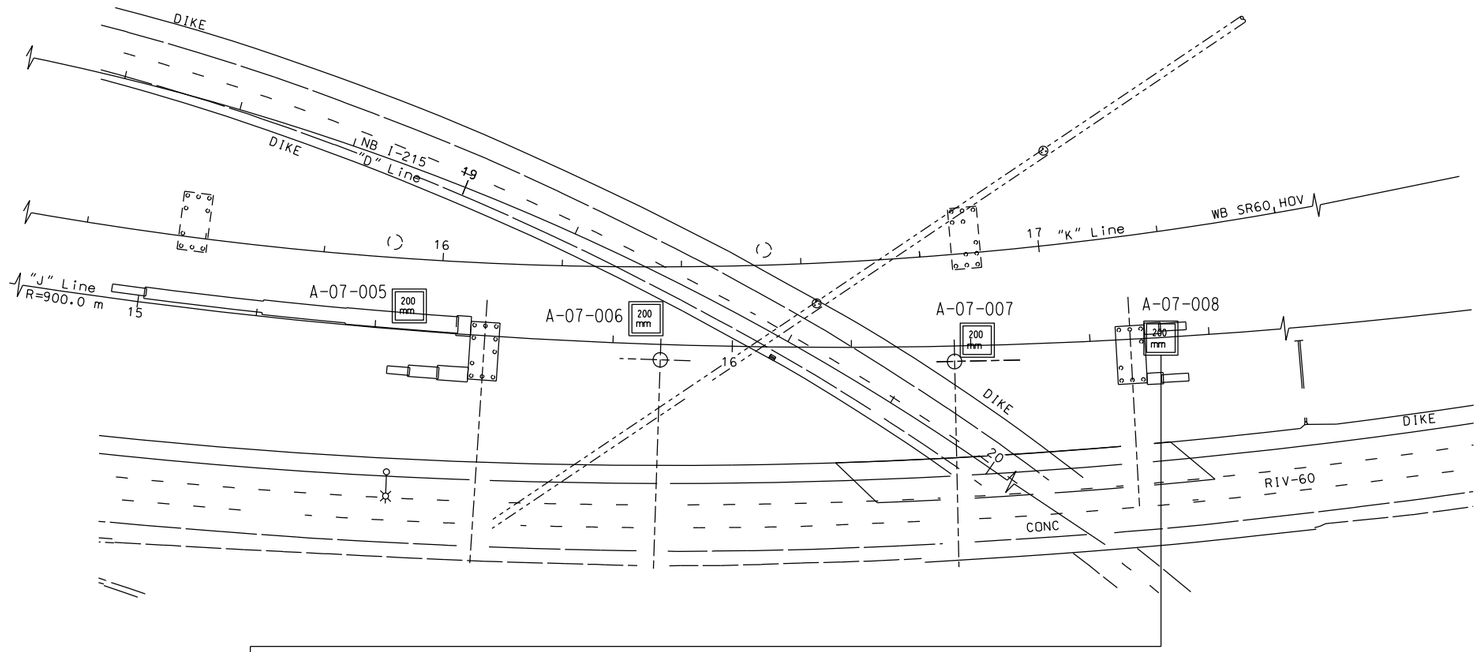

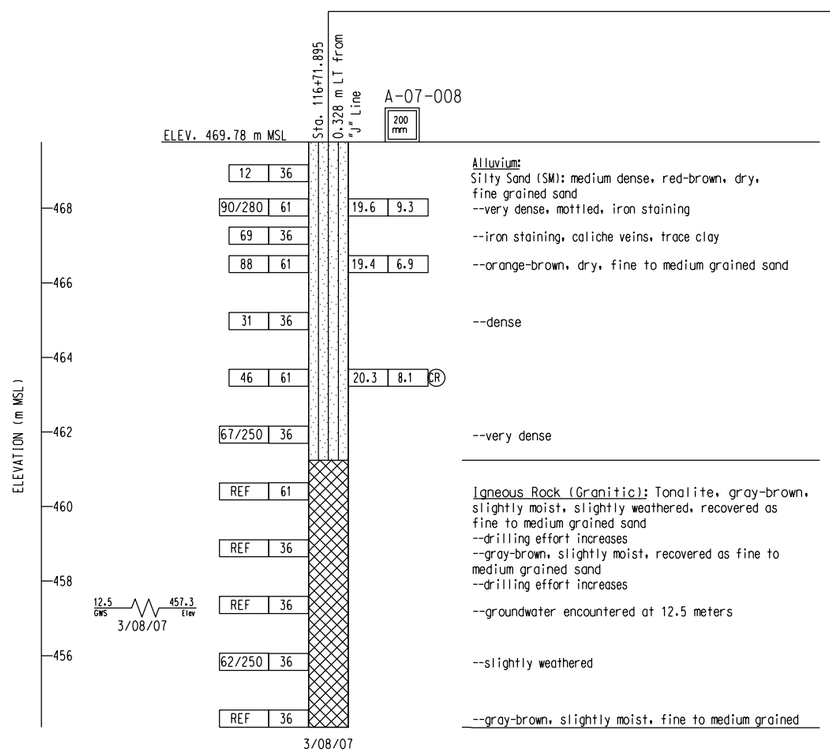

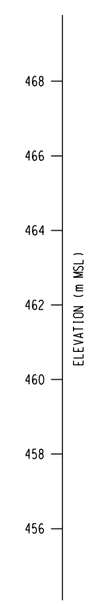

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PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 4 OF 4

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REVISED FINAL STRUCTURE FOUNDATION REPORT

REVISED FINAL
STRUCTURE FOUNDATION REPORT
PROPOSED WESTBOUND AND EASTBOUND
STATE ROUTE 60 HOV CONNECTORS
BRIDGE NOS. 56-0841 AND 56-0842
INTERSTATE 215/STATE ROUTE 60
EAST JUNCTION IMPROVEMENTS
CITY OF RIVERSIDE, CALIFORNIA
08-RIV-215/60-KP 61.7/62.6, 19.4/21.5
CALTRANS EA NO. 08-449311

Prepared for:

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Prepared by:

KLEINFELDER WEST, INC.
1220 Research Drive, Suite B
Redlands, CA 92374

Kleinfelder Project No. 76979

Revised June 12, 2009
February 16, 2009

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Revised June12, 2009
February 16, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

Subject: **Revised Final Structure Foundation Report**
Proposed Westbound and Eastbound
State Route 60 HOV Connectors
Bridge Nos. 56-0841 and 56-0842
Interstate 215/State Route 60 East Junction Improvements
Riverside, California
08-Riv-215/60-KP 61.7/62.6, 19.4/21.5
Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) is pleased to present this Revised Final Structure Foundation Report for the proposed Westbound and Eastbound State Route 60 (SR60) High-Occupancy Vehicle (HOV) Connectors, to be located at the east junction of existing Interstate 215 (I-215) and SR-60, in the City of Riverside, California. The purpose of this report is to provide geotechnical engineering recommendations for design and construction of the proposed project. This report incorporates our responses to Caltrans review comments dated December 19, 2008 and March 11, 2009 (see Appendix D).

The proposed project is geotechnically feasible provided that our recommendations in this report are properly incorporated into the design and construction of the project. Recommendations provided herein are contingent on the provisions outlined in the Additional Services and Limitations section of this report. The project Owner should become familiar with these provisions in order to assess potential impacts to the proposed project and further involvement by Kleinfelder.

We appreciate the opportunity to be of service on this project. If you have any questions and comments or require additional information, please do not hesitate to contact the undersigned.

Sincerely,
KLEINFELDER WEST, INC.

REGISTERED PROFESSIONAL ENGINEER CARLOS V. AMANTE No. 2724 Exp. 6-30-10 GEOTECHNICAL STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST RICHARD F. ESCANDON No. 1213 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

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Appendix B Laboratory Testing
Appendix C Engineering Analyses
Appendix D Response to Caltrans Review Comments

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1.0 INTRODUCTION

1.1 GENERAL

Kleinfelder West, Inc., (Kleinfelder) was retained by Lim & Nascimento Engineering Corporation (LAN Engineering) to conduct a geotechnical investigation along the proposed alignments of Westbound (WB) and Eastbound (EB) State Route 60 High Occupancy Vehicle (SR-60 HOV) Connectors at the Interstate Highway 215/State Route 60 East Junction in the City of Riverside, Riverside County, California (see Plate 1, *Site Location Map*). The scope of our services was provided in our proposal entitled *Revised Proposal for Geotechnical Support Services For Plans, Specifications, and Cost Estimates (PS&E), Two New SR 60 HOV Connectors at the I-215/SR 60 East Junction, Riverside, California, dated July 11, 2007.*

This report presents our recommendations relative to the geotechnical aspects of design and construction for the proposed project. Conclusions and recommendations presented in this report are based on the subsurface conditions encountered at the locations of our field excavations, and the provisions and requirements outlined in the Additional Services and Limitations sections of this report. Recommendations presented in this report should not be extrapolated to other areas or be used for other projects without our prior review.

1.2 PROJECT DESCRIPTION

The proposed project consists of adding two new HOV lane bridges at the east junction of I-215 and SR-60 between the Box Springs Overcrossing and the Day Street Undercrossing, and extending the existing HOV lanes to connect to the two new HOV lane bridges. The project will also include lowering and widening of the existing northbound I-215 connector ramp to the WB SR-60.

The proposed three-span WB and EB SR-60 HOV Connectors will be constructed with cast-in-place, prestressed concrete box girders with a total length of 109.2 and 130.7 meters (for the westbound and eastbound structures, respectively) and width of 9.105 meters for both structures (see *General Plans* on Plates 2a and 2b). Both connectors will be supported on two abutments (Abutments 1 and 4) and two bents (Bents 2 and 3).

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Each bent will be supported by a single 1.68-m diameter column bearing on 2.44-m diameter cast-in-drilled-hole (CIDH) piles. The bridge abutments will be built on proposed 1:2 and 1:4 (Vertical:Horizontal, V:H) fill slopes and will be supported by 600-mm diameter CIDH piles. The bottom of pile cap elevations for WB and EB SR-60 HOV Connectors are shown on the *Foundation Plans* (see Plates 3a and 3b, respectively). Retaining walls supported by 400-mm diameter CIDH piles will be required for the proposed fill embankments at both Abutments 1 and 4. Geotechnical recommendations for proposed retaining walls are provided in a separate Structure Foundation Report (SFR).

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2.0 GEOTECHNICAL INVESTIGATION

The purpose of this investigation was to evaluate subsurface conditions along the proposed bridge alignments and provide geotechnical recommendations for design and construction of the proposed development. A description of the scope of services performed is presented below.

Task 1 – Literature Review

We began our services by reviewing soils and geologic data in our files and from select public agencies (see References). We have completed a computerized search of appropriate seismic and faulting information as it relates to the site.

Task 2 – Field Exploration

Prior to conducting the field exploration, our proposed exploration locations were cleared of known existing utility lines through Underground Service Alert (USA). Our subsurface exploration program for the WB and EB SR-60 HOV Connectors consisted of drilling and logging eight exploratory soil borings A-07-001 through A-07-008 (HV-1 through HV-8) on March 5, 6 and 8, 2007. Locations of our borings are shown on the *Logs of Test Borings*. These borings were advanced to depths ranging from approximately 15.7 to 23.5 meters below the existing ground surface (bgs). The borings were advanced using a Mobile B-61, truck-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer for sample collection.

The borings were logged and sampled by a staff geologist from our office using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Each soil sample was observed and described in general accordance with the Unified Soil Classification System (USCS). Following drilling, sampling and logging, the borings were backfilled with native cuttings. The boring logs are presented in Appendix A, *Field Exploration*.

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Task 3 – Laboratory Soil Testing

Laboratory testing was performed on the samples collected during our field exploration to substantiate field classifications and to assess the physical characteristics of the subsurface soils and rocks. A laboratory testing program was developed and performed to characterize and evaluate the engineering properties of the subsurface soils. Tests performed consisted of moisture content and in situ dry unit weight (ASTM D2216 and D2937); grain size distribution (ASTM D 422); direct shear (ASTM D 3080); and corrosivity tests consisting of electrical resistivity test (CTM 532), pH (CTM 643), sulfate content (CTM 417), and chloride content (CTM 422). The laboratory test procedures and results are presented in Appendix B, *Laboratory Testing*.

Task 4 – Geotechnical Analyses and Report Preparation

Field and laboratory findings were evaluated in conjunction with the proposed use project. This report includes conclusions and recommendations regarding the following:

- Regional geologic setting, geologic features, and geologic hazards including the potential for ground rupture due to surface faulting, liquefaction potential, and other seismically induced hazards;
- Subsurface materials encountered within the exploratory borings, anticipated groundwater levels and excavation characteristics of these materials;
- Corrosion potential of the near-surface soils;
- Acceleration Response Spectra (ARS) curves, including standard Caltrans ARS curve and modified (design) ARS curve;
- Recommendations for design and construction of deep foundations including recommended pile axial and lateral capacities, maximum bending moment, and total and differential settlements;
- Guidelines for earthwork including recommendations for site preparation, fill placement, and compaction.

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3.0 PERTINENT REPORTS AND INVESTIGATIONS

The following documents were reviewed for this study:

- Foundation Plans for WB and EB SR-60 HOV Connector, prepared for the State of California, Department of Transportation, CU 08, EA 449311, by Lim & Nascimento Engineering, Revision Date May 15, 2009.
- General Plans for WB and EB SR-60 HOV Connector, prepared for the State of California, Department of Transportation, CU 08, EA 449311, by Lim & Nascimento Engineering, Revision Date May 15, 2009.
- Preliminary Foundation Report, Proposed WB & EB SR-60 HOV Connector Bridges, I-215/SR60 East Junction, Riverside, California, Kleinfelder Project No. 76979, dated June 12, 2007.
- United States Geological Survey, 7-1/2 Minute Series, Riverside East Quadrangle, California, 1967, Photorevised 1980.
- United States Geological Survey, Geologic Map of the San Bernardino and Santa Ana 30' X 60' Quadrangle, California, Version 1.0, 2006.

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4.0 GEOLOGY, FAULTING AND SEISMICITY

4.1 REGIONAL AND LOCAL GEOLOGY

The project site is situated within the northern Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are a northwest-southeast oriented complex of blocks separated by similarly trending faults which extend 200 kilometers from the Transverse Ranges south to the Mexican border and beyond another 1250 kilometers to the tip of Baja California. The province varies in width from 50 to 160 kilometers and is bounded on the east by the Colorado Desert and the Gulf of California and on the west by the Pacific Ocean.

The Peninsular Ranges contain Jurassic-age and Cretaceous-age igneous and metamorphic rocks, as well as a thick sequence of marine and non-marine sedimentary rock. The Peninsular Ranges Province is further described by sub-units, which include the Perris Block, the Santa Ana Mountains, and the San Jacinto Mountains. The Perris Block is characterized as a broad area of intermixed valleys and low mountain ranges situated between the Elsinore and San Jacinto fault zones.

The project site is located in the northern portion of the Perris Block and Perris Valley. Typical lithographic units within this area consist of Quaternary alluvial deposits overlying granitic and metamorphic bedrock. Sporadic outcrops of bedrock dot the valley floor and represent remnants of eroded hills and mountains. Bedrock consists of mostly Cretaceous-age igneous rock (tonalite) forming the bedrock hills north of the site.

4.2 FAULTING AND SEISMICITY

The project site is located in the highly seismic southern California region within the influence of several fault systems that are considered to be active or potentially active. An active fault is defined by the State of California as “a sufficiently active and well defined fault, which has exhibited surface displacement within the Holocene time (the last 11,000 years).” A potentially active fault is defined by the State as “a fault with a history of movement within Pleistocene time (between 11,000 and 1.6 million years ago).” These active and potentially active faults are capable of producing potentially damaging seismic shaking at the site. It is anticipated that the project site will

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periodically experience ground acceleration as the result of moderate to large magnitude earthquakes. Other active faults without surface expression (blind faults) that are capable of generating an earthquake, or other potentially active seismic sources may be present that are not currently zoned.

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5.0 SUBSURFACE CONDITIONS

5.1 EARTH MATERIALS

5.1.1 Undocumented Artificial Fill (Afu)

Undocumented fill soils were encountered in borings A-07-003 and A-07-004 (HV-3 and HV-4) to depths of approximately 2.8 and 1.3 meters, respectively. The fill soils were likely placed as part of the development of the existing interchange. In general, the undocumented fill soils consist of silty sand (SM). Additional areas of undocumented fill soils may be encountered during earthwork operations that were not identified during this investigation.

5.1.2 Alluvium (Qal)

Alluvial soils were encountered below the fill soils in borings A-07-003 and A-07-004 (HV-3 and HV-4) and in the remaining borings excavated for the proposed HOV Connectors. The alluvial soils extend to depths ranging from approximately 8.5 to 19.5 meters below existing grades. The alluvial soil deposits encountered during our investigation consist of silty sand (SM), poorly graded and well graded sand with silt (SP-SM and SW-SM), and clayey sand (SC). The alluvial soils encountered in the borings are generally medium dense to very dense with several interbedded layers of loose soils.

5.1.3 Granitic Bedrock (Kgr)

Tonalite granitic bedrock was encountered in six of our eight borings excavated for the proposed HOV Connectors. The bedrock was encountered at depths ranging from approximately 8.5 to 19.5 meters below existing grades and extended to the maximum depth explored of 25.3 meters below the existing grade. In general, the tonalite rock is moderately to highly weathered and decomposed near the contact with the alluvial soils and becomes less weathered with depth.

5.2 GROUNDWATER

Groundwater was encountered in all eight borings excavated for the proposed HOV Connectors at depths of 8.8 to 12.5 meters below existing grades. These depths to

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groundwater correspond to groundwater elevations of approximately 454.8 to 457.3 meters, above Mean Sea Level (MSL).

Fluctuations of the groundwater level, localized zones of perched water, and soil moisture content should be anticipated during and following the rainy season. Irrigation of landscaped areas on or immediately adjacent to the site can also cause a fluctuation of local groundwater levels.

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6.0 DISCUSSION AND RECOMMENDATIONS

6.1 SEISMIC DESIGN CRITERIA

6.1.1 Ground Surface Rupture and Deformation Potential

The site is not located within a currently delineated State of California Alquist-Priolo Earthquake Fault Zone (Hart and Bryant, 1997). No known active faults have been identified on the site, thus, the potential for future surface fault rupture at the site is considered to be "low." While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

6.1.2 Seismic Shaking

The 1996 California Seismic Hazard Map prepared by Caltrans (Mualchin, 1996a) indicates that the controlling fault for this project is the San Jacinto Fault (SJO), a strike slip fault with a maximum credible earthquake (MCE) moment magnitude of 7.5. The closest fault distance to the project site is approximately 8.8 km.

The horizontal peak bedrock acceleration (PBA) at the site based on the 1996 Caltrans Seismic Hazard Map is 0.5g, as shown on Plate 5, *Fault and PBA Map*. Caltrans Guidelines for Structures Foundation Reports (CGSFR), Version 2.0, dated March 2006 requires that the PBA determined above be verified with well-established attenuation relationships such as Sadigh et al. (1997) for controlling faults. The PBA value for the site, estimated using Sadigh et al. (1997) attenuation relationship, is 0.46g. Therefore, a PBA of 0.5g is recommended in accordance with Caltrans design practice.

Based on the results of our field exploration, our past experience, and in accordance with Table B.1 of Caltrans Seismic Design Criteria (SDC) (Version 1.4, dated June 2006), the site can be classified as Soil Profile Type C. The recommended seismic design parameters are summarized in the following Table 1.

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Table 1
Seismic Design Parameters

Seismic Parameters	Design Recommendation and Reference
Controlling Fault	San Jacinto (SJO), (Mualchin, 1996a)
Type of Fault	Strike-Slip (Mualchin, 1996b)
Closest Distance to the Fault	8.8 km (Mualchin, 1996a)
Earthquake Magnitude (MCE)	7.5 (Mualchin, 1996a,b)
Horizontal Peak Bedrock Acceleration (PBA)	0.5g
Soil Profile Type	C (Table B.1, 2006 Caltrans Seismic Design Criteria)

6.1.3 Design ARS Curve

The standard acceleration response spectra (ARS) curve presented in Figure B.5 of Caltrans SDC for PBA of 0.5g, magnitude 7.5 and Soil Profile Type C was selected for seismic design of the proposed bridges. This standard ARS curve was modified to account for near-source fault rupture directivity effect as follows:

- 20% increase in spectral values for periods equal to or greater than 1.0 second;
- No change for periods less than 0.5 seconds; and
- Spectral ordinates for periods between 0.5 and 1 second determined by linear interpolation.

The standard Caltrans SDC ARS curve, modified ARS curve and their ordinate values are presented on Plate 6, *Design ARS Curve*.

6.1.4 Liquefaction Potential

Seismically induced soil liquefaction generally occurs in loose, saturated, cohesionless soil when pore pressures within the soil increase during ground shaking. The increase in pore pressure transforms the soil from a solid to a semi-liquid state. The primary factors affecting the liquefaction potential of a soil deposit are: 1) intensity and duration of earthquake shaking, 2) soil type and relative density, 3) overburden pressures, and 4) depth to groundwater. Soils most susceptible to liquefaction are clean, loose, uniformly graded, fine-grained sands, and non-plastic silts that are saturated. Silty sands have

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also been shown to be susceptible to liquefaction. These soils typically lose a portion or all of their shear strength and regain strength sometime after shaking stops. Soil movements (both vertical and lateral) have been observed under these conditions due to consolidation of the liquefied soils and the reduced shear resistance of slopes.

According to a *Liquefaction Hazard Map* prepared by the County of Riverside (Generalized Liquefaction Figure S-3, 2002), the site is located in an area designated as having a "low" liquefaction susceptibility. Groundwater was encountered in our borings excavated for the proposed HOV Connectors at depths ranging from approximately 8.8 to 12.5 meters below existing grades. Based on the results of our liquefaction analysis (Youd and Idriss, 2001), it is our professional opinion that due to the dense nature of subsurface soils encountered on-site and the observed depth to groundwater, the site has a "low" liquefaction potential. The liquefaction potential calculations are presented in Appendix C-2.

6.1.5 Seismically Induced Settlements

Unconsolidated, loose to medium dense sandy soil deposits tend to densify or become more tightly packed during strong ground shaking, thereby causing ground settlement. Using an empirical procedure developed by Tokimatsu and Seed (1987), seismically induced settlements due to seismic compaction of dry or unsaturated soils below the foundations were estimated to be on the order of less than 13 mm. The seismically induced settlement calculations are presented in Appendix C-2.

6.2 BRIDGE FOUNDATION DESIGN

6.2.1 Foundation Type Selection

We understand that the proposed bridges will be supported on 600–mm diameter CIDH piles at the abutments and 2.44-m diameter CIDH piles at the bents. Selection of these foundation types was made by LAN Engineering after consultation with Kleinfelder during the type selection phase of this project.

6.2.2 Axial Pile Capacity

The axial capacity of the proposed piles was estimated using the computer program SHAFT Version 5.0 (Ensoft, 1989-2003). Based on CGSFR (2006a), axial capacity for

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CIDH piles with a diameter less than or equal to 600 mm will include only skin friction. Hence, we ignored end bearing of the proposed CIDH piles at the bridge abutments and retaining walls, where 600-mm and 400-mm diameter CIDH piles are proposed, respectively. However, axial capacity for the 2.44-m diameter CIDH piles proposed for the bents includes both skin friction and end bearing. Skin friction is also ignored for the portion of the piles embedded in new embankment fill. To calculate the allowable geotechnical capacity in compression, a factor of safety of 2.0 was applied to skin friction and a factor of safety of 3.0 was applied to end bearing. The axial pile capacity calculations are presented in Appendix C-3. We understand that the bridge abutment piles are designed using Working Stress Design (WSD) method and the bridge bent piles are designed using Load Resistance Factor Design (LRFD) method. The retaining wall piles are designed using Load Factor Design (LFD) method. The recommended pile tip elevations for the WB and EB SR-60 HOV Connectors are summarized in Tables 2a and 2b, respectively.

Table 2a
Pile Data Table
WB SR-60 HOV Connector

Location	Pile Type[2]	Bottom of Pile Cap Elev. (m, MSL)	Design Loading	Nominal Resistance		Design Tip Elev. (m, MSL)[1]	Specified Tip Elevation (m, MSL)
				Compression	Tension		
Abutment 1	600-mm CIDH	462.61	900 kN	1800 kN	0 kN	451.33 (1) 456.21 (2)	451.33
RW No. 1	400-mm CIDH	463.87 – 463.92	400 kN	800 kN	0 kN	455.03 (1)	455.03
RW No. 2	400-mm CIDH	464.81	400 kN	800 kN	0 kN	455.97 (1)	455.97
Bent 2	2440-mm CIDH	462.57	N/A	23800 kN	0 kN	442.14 (1) 442.75 (2)	442.14
Bent 3	2440-mm CIDH	465.11	N/A	23800 kN	0 kN	444.68 (1) 445.29 (2)	444.68
Abutment 4	600-mm CIDH	467.65	900 kN	1800 kN	0 kN	456.37 (1) 461.25 (2)	456.37
RW No. 3	400-mm CIDH	471.00 – 472.28	400 kN	800 kN	0 kN	462.16 (1)	462.16
RW No. 4	600-mm CIDH	469.60 – 470.87	900 kN	1800 kN	0 kN	458.32 (1)	458.32
RW No. 4	400-mm CIDH	472.18 – 473.45	400 kN	800 kN	0 kN	463.34 (1)	463.34

Notes:
[1] Design tip elevation is controlled by the following demands: (1) Compression and (2) Lateral.
[2] The proposed piles should be spaced at a minimum of three pile diameters (center-to-center).

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Table 2b
Pile Data Table
EB SR-60 HOV Connector

Location	Pile Type[2]	Bottom of Pile Cap Elev. (m, MSL)	Design Loading	Nominal Resistance		Design Tip Elev. (m, MSL) [1]	Specified Tip Elevation (m, MSL)
				Compression	Tension		
Abutment 1	600-mm CIDH	464.515	900 kN	1800 kN	0 kN	453.235 (1) 458.115 (2)	453.235
RW No. 1	400-mm CIDH	465.59 – 465.64	400 kN	800 kN	0 kN	456.75 (1)	456.75
RW No. 2	400-mm CIDH	466.86	400 kN	800 kN	0 kN	458.02 (1)	458.02
Bent 2	2440-mm CIDH	463.58	N/A	16400 kN	0 kN	448.34 (1) 443.76 (2)	443.76
Bent 3	2440-mm CIDH	465.58	N/A	16400 kN	0 kN	450.34 (1) 445.76 (2)	445.76
Abutment 4	600-mm CIDH	469.415	900 kN	1800 kN	0 kN	458.135 (1) 463.015 (2)	458.135
RW No. 3	400-mm CIDH	471.72	400 kN	800 kN	0 kN	462.88 (1)	462.88
RW No. 4	400-mm CIDH	471.72	400 kN	800 kN	0 kN	462.88 (1)	462.88

Notes:
[1] Design tip elevation is controlled by the following demands: (1) Compression and (2) Lateral.
[2] The proposed piles should be spaced at a minimum of three pile diameters (center-to-center).

Based on the foundation dimensions described herein and anticipated loads, we estimate the maximum total settlement of foundations designed and constructed in accordance with the preceding recommendations to be a function of the pile length and sustained loads. The differential settlement due to static loading between any adjacent bridge supports is estimated to be less than 13 mm.

Due to the granular nature of the on-site soils and relatively shallow bedrock, the settlement of foundations should be essentially completed shortly after initial application of the loads.

6.2.3 Lateral Pile Capacity

Lateral resistance and deflections of vertical pile foundations are governed primarily by the resistance-displacement characteristics of near-surface soils and the material strength of the piles. We have developed lateral load capacity estimates based on

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allowable deflections provided by the project structural engineer. We did not evaluate the structural capacity of the piles. We performed our analyses using the computer program LPILE^{PLUS} 5.0 for Windows (Reese et al., Ensoft, Inc. 2004), which solves the beam on elastic foundation problem using independent nonlinear lateral springs, commonly referred to as p-y curves, to model the relationship between soil resistance and pile deflection. At the request of LAN Engineering, we have provided the p-y curve data and depth to point of fixity for the proposed 2.44-m diameter CIDH piles at Bents 2 and 3. The p-y curve data and depth to point of fixity calculations are presented in Appendix C-5.

The bending stiffness of the piles was modeled using full-section stiffness for static conditions and a 60% reduction in stiffness due to cracking for seismic conditions. The computed lateral pile capacities and depth to point of fixity are summarized in Table 3, below.

Table 3
Lateral Pile Capacities and Depth to Point of Fixity
Eastbound and Westbound SR60 HOV Connectors

Location	Pile Type*	Horizontal Pile Head Deflection (mm)	Lateral Capacity* (kN)	Depth to Point of Fixity (m)
Abutments 1 and 4	600-mm CIDH	6	129	N/A
		25	222	N/A
Bents 2 and 3	2.44-m diameter CIDH	13	6,984	8.0
		25	7,717	8.8

Notes:
*Assumes pinned-head condition for abutment supports and fixed head condition for bent supports. The above values are per pile. Piles in groups may be considered to act individually when the center-to-center spacing is greater than three pile diameters in the direction normal to loading and eight pile widths in the direction parallel to loading.

Piles in groups may be considered to act individually when the center-to-center spacing is greater than three pile diameters in the direction normal to loading and eight pile diameters in the direction parallel to loading (Caltrans Bridge Design Specifications, 2003). To account for group action in the direction parallel to loading, the lateral

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capacities listed in Table 3 should be multiplied by an appropriate lateral group reduction factor as follows:

- For spacing of eight pile diameters or greater, no reduction in lateral capacity is necessary.
- For spacing of five pile diameters, a lateral group reduction factor of 0.9 should be applied.
- For spacing of three pile diameters, a lateral group reduction factor of 0.7 should be applied.

For spacing in between these values, a linear interpolation may be utilized to calculate the pile group reduction factor.

6.3 APPROACH EMBANKMENT FILL

The bridge General Plans (see Plates 2a and 2b) indicate that the approach embankments at the abutments will require fill with height up to approximately 4 meters at Abutment 1 and 6 meters at Abutment 4, with the slope ratios of 1:4 (V:H) and 1:2 (V:H), respectively. Fills placed within bridge approach zone should be compacted to 95 percent relative compaction per latest ASTM D1557. Our recommendations for the new embankment fill are provided in Section 7.1.2 of this report.

6.3.1 Settlement

The weight of the fill embankments will induce settlement in the underlying soils and a settlement monitoring period is recommended as discussed in Section 7.3 of this report. The proposed embankments are estimated to settle on the order of 50 to 75 mm assuming the slopes are designed and constructed as described in this report.

Since the subsurface soils at the site are generally granular, this settlement is anticipated to occur during construction or shortly thereafter. We recommend a waiting period of 30 days. The settlement magnitude and the required waiting period are dependent on the amount of removal and replacement of the existing fill and type and amount of new fill materials placed. Caltrans requires that the remaining total settlement of the bridge approach embankments should not exceed 13 mm. The embankment settlement calculations are presented in Appendix C-6.

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6.3.2 Slope Stability

The proposed 1:2 (V:H) fill slopes at Abutment 4 are analyzed for the overall (global) slope stability of both static and pseudostatic (seismic) conditions. Modified Bishop's Method for circular slip surfaces were applied using the computer program GSTABL7 with STEDWin3.0 (Van Aller and Gregory, 2001). The design criteria utilized are as follows: permanent abutment slopes are required to have a minimum factor of safety of 1.5 for the static condition; and a minimum factor of safety of 1.1 for the pseudostatic condition using the Caltrans recommended horizontal earthquake loading coefficient equal to 1/3 of the horizontal peak acceleration or 0.17g. The results of slope stability analyses for Abutment 4 embankment indicate that the required minimum static and pseudostatic factors of safety would be satisfied provided the minimum shear strength parameters for the new compacted fill are equal to or exceed the following values: (1) a friction angle of 32 degrees, and (2) a cohesion of 4.7 kPa. The slope stability analysis results are presented in Appendix C-7.

The proposed 1:4 (V:H) fill slopes at Abutment 1 are expected to be grossly stable for both static and pseudostatic (seismic) conditions, provided the fill embankments are constructed in accordance with our recommendations in this report.

Although the proposed approach abutment slopes are expected to be grossly stable, erosion and surficial instability may be a concern during periods of heavy or intense rainfall. Erosion control and highway planting should be performed in accordance with Section 20 of Caltrans Standard Specifications. Excessive irrigation of slopes should be avoided. Appropriate drainage devices should be placed at the top of all slopes such that water does not flow over slope faces in an uncontrolled manner.

6.4 CORROSION POTENTIAL

To evaluate corrosion potential of the on-site soils, one soil sample collected during our field investigation was tested for pH, resistivity, sulfate and chloride concentrations in accordance with Caltrans Standard Test Methods 532, 643, 417, and 422. Testing was performed by AP Engineering and Testing, Inc. in Pomona, California. The test results are presented in Appendix B, *Laboratory Testing*.

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To evaluate corrosion potential of the on-site soils, two of the soil samples collected from the borings were tested for pH, resistivity, sulfate and chloride concentrations in accordance with Caltrans Standard Test Methods 532, 643, 417, and 422, respectively. Testing was performed by AP Engineering and Testing, Inc. in Pomona, California. The test results are presented in Table 5, below.

Table 5
Corrosion Test Results

Boring Number	Depth of Sample (m)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
A-07-002 (HV-2)	0.9 - 2.4	1,200	7.4	7	254
A-07-007 (HV-7)	0.9 - 2.4	3,200	7.9	5	126

In accordance with Section 4.1 of Caltrans *Corrosion Guidelines* (dated September 2003), a corrosive area is defined as an area where the soil and/or water contains more than 500 ppm of chlorides, more than 2,000 ppm of sulfates, or has a pH of less than 5.5. In general, a minimum resistivity for soil and/or water less than 1,000 Ohm-cm indicates the presence of high quantities of soluble salts and a higher propensity for corrosion. Based on the laboratory test results and the above guidelines, the project site soils may generally be considered as non-corrosive.

Concrete in contact with the ground should be batched using a cement in accordance with the Caltrans Standard Specifications and Table 854.1A of the Highway Design Manual. In general, "Type IP (MS) Modified" or "Type II Modified" cement is acceptable for use along the project alignment. Adequate concrete cover over reinforcing steel should be provided in accordance with good construction practices and Caltrans design standards.

6.5 EXPANSION POTENTIAL

Expansive soils generally contain clay particles that swell considerably when wetted and shrink when dried. Foundations constructed on these soils are subjected to uplifting forces caused by the swelling. Based on our field exploration and the results of our

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laboratory testing, it is our opinion that soils within the upper portion of the project site have a low potential for expansion. Testing of the final subgrade soils after completion of grading should be conducted to evaluate their expansion potential and confirm or modify the recommendations presented herein.

6.6 SCOUR POTENTIAL

The proposed new bridges will cross over the existing northbound I-215 connector ramp to the WB SR-60 and are not located in a flood/drainage or river channel. Therefore, scour potential is not considered a design issue.

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7.0 CONSTRUCTION CONSIDERATIONS

7.1 SITE PREPARATION

All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations, and other local, state, or federal specifications. All references to maximum unit weight should be established in accordance with the current ASTM Standard Test Method D1557 and may supersede references cited herein.

7.1.1 Stripping and Grubbing

Prior to general site grading, existing pavement, vegetation, organic topsoil, existing fill soils, and debris shall be stripped and disposed of outside the construction limits. Deeper stripping or grubbing may be required where concentrations of fill debris, organic soils, existing trees, or thick root mats are encountered during site grading. Stripped topsoil (less any debris) may be stockpiled and reused for landscape purposes elsewhere on the project; however, this material should not be incorporated into any engineered fill.

In areas where existing trees will be removed, care should be taken to remove the root-ball, roots exceeding 25 mm in diameter, and remaining organics, and to backfill the excavations with compacted engineered fill. We strongly recommend having a representative of Kleinfelder present during tree removal in areas to receive fill or beneath foundations to observe removal of large roots and subsequent scarification and recompaction. Engineered fill should be placed and compacted in accordance with recommendations provided below.

7.1.2 Earthwork and Backfill

After clearing and stripping, the surface should be excavated to a minimum depth of 0.6 meter before placement of new fill. The undocumented fill soils (if encountered) shall be removed during site development and grading and replaced with structural backfill. In addition, any compressible soils encountered shall be removed and replaced with compacted structural backfill in accordance with Caltrans Standard Specifications Section 19-3.06. The exposed surface should be proof-rolled with loaded heavy equipment. Any areas of loose or yielding soils should be over-excavated and re-

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compacted. Any soils that cannot be compacted, or are otherwise unsuitable for the planned use, should be excavated and disposed of from the project site. The exposed surface should then be scarified and compacted to the specified density before placement of new fill. New fill placed on or adjacent to the existing slopes should be properly benched into the existing fill in accordance with Caltrans Standard Specifications.

All earthwork should be performed in accordance with Caltrans Standard Specification Section 19. All materials to be placed as fill should be free of vegetation, organics, debris, and other deleterious materials. All fill placed around foundations and behind walls should be placed in thin loose lifts, moisture-conditioned, and compacted to Caltrans Standard Specification.

Abutment wall backfill shall be structural backfill according to Caltrans standard specifications. In addition, we recommend that abutment backfill be well-graded soil with maximum dimension of 100 mm, essentially non-plastic (liquid limit less than 30, plasticity index less than 12, and with less than 50 percent passing the No. 200) and non-expansive. Expansive soils, defined as soils with Expansion Index (EI) greater than 50 and/or soils with Sand Equivalent (SE) less than 20, should be excluded from the bridge abutments as required by Caltrans guidelines and shown on Plate 7, *Expansive Soil Exclusion Zone in Bridge Embankment*. Expansion Index should be determined in accordance with ASTM D4829. Sand Equivalent should be determined in accordance with California Test Method (CTM) 217.

The limits of bridge approach zone are considered to extend longitudinally 46 meters measured horizontally from the bridge abutment and either parallel or concentric with the roadway centerline, and transversely the full width of embankment except the outer 1.5 meters measured horizontally from the embankment side slopes. Fills placed within 46 meters of abutments should be compacted to 95 percent relative compaction per ASTM D1557.

7.1.3 Temporary Excavations and Shoring

All excavations must comply with the current CAL-OSHA Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We

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are providing the information below solely as a service to our client. Under no circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

A shoring design and safety plan should be required from the contractor and submitted to the Engineer for review and approval. Likewise, measures to control impact of both groundwater and surface water on the stability of temporary excavations and shoring should be employed and should remain the sole responsibility of the contractor.

7.2 PILE INSTALLATION

Practical drill refusal was encountered in four of the eight borings drilled for this geotechnical investigation at depths ranging from approximately 17.1 to 25.3 meters below existing grades. Due to anticipated depth to groundwater and potential for caving, permanent or temporary casing and the slurry (wet) method may be required for installation of CIDH piles. Construction of pile foundations should be performed in accordance with Section 49 of the Caltrans Standard Specifications (2006).

Excavation and construction of the CIDH piles shall be observed by a qualified representative of the Geotechnical Engineer. Caving of soils may be encountered during construction of CIDH piles. The contractor shall consider the use of temporary casing to prevent caving of soils during construction and to ensure integrity of the CIDH piles. Hard drilling conditions should be anticipated in the lower portion of bedrock. Furthermore, groundwater may be encountered during installation of CIDH piles and wet installation method may become necessary. It is recommended that the bottoms of these shaft borings be adequately cleaned of loose or disturbed materials using a drilling bucket or an approved alternative method. When wet method is used, PVC inspection tubes should be installed in each pile in accordance with Caltrans Standard Provisions to permit gamma-gamma and/or cross-hole sonic testing of CIDH piles.

7.3 SETTLEMENT MONITORING

A settlement monitoring program is recommended to evaluate the rate and magnitude of actual settlement in the field for the proposed embankment areas. Surface monuments, constructed in accordance with Caltrans Standard Plan A74 or equivalent,

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should be installed in a timely manner upon completion of fill placement. Surface monuments should be placed at all abutment locations. The actual location of surface monuments will be determined during grading under the direction of the Geotechnical Engineer. Settlement platforms or liquid-filled settlement gauges should also be placed at the bottom of new fill placement after the site development and grading at the abutments. Settlement platform details and installation method should conform to Caltrans Test Method (CTM) 112.

Settlements should be monitored at the time of installation, on a weekly basis for at least one month following installation, and then once every two weeks thereafter until the settlement criterion is satisfied. CIDH pile construction may begin when an extrapolation of the settlement plot shows that the residual (remaining) total settlement of the foundation soil is less than or equal to 13 mm. All settlement monitoring devices should be protected from damage throughout the construction and monitoring periods

7.4 SURFACE WATER CONTROL

Ponding of water adjacent to the structure should be avoided. During and after construction, positive drainage should be provided to direct surface water away from structures and all excavations toward suitable, non-erosive drainage devices.

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8.0 ADDITIONAL SERVICES AND LIMITATIONS

8.1 ADDITIONAL SERVICES

The review of plans and specifications, and the observation and testing by Kleinfelder of earthwork and foundation related construction activities, are an integral part of the conclusions and recommendations made in this report. If Kleinfelder is not retained for these services, the client will be assuming our responsibility for any potential claims that may arise during or after construction. The recommended tests, observations, and consultation by Kleinfelder during construction include, but are not limited to:

- A review of preliminary plans and specifications;
- Observation of site clearing, undocumented fill removal, and subgrade preparation;
- Engineered fill placement and compaction;
- Construction observation and density testing of fill material placement, trench backfill, and subgrade preparation;
- Monitoring device installation;
- Observation of pile installation; and
- When any unusual conditions are encountered during construction.

These services may be performed in accordance with our current fee schedule.

8.2 LIMITATIONS

The conclusions and recommendations presented in this report are intended to provide preliminary geotechnical design data and recommendations for the proposed EB and WB SR-60 HOV Connectors, to be located at the east junction of the I-215 and SR60 in the City of Riverside, California. The findings, conclusions and recommendations were prepared in accordance with generally accepted geotechnical engineering practice. No warranty, express or implied, is made. This report was based on the proposed project information provided to Kleinfelder. If any change (i.e., structure type, location, etc.) is implemented which materially alters the project, additional geotechnical services may

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be required, which could include revisions to the geotechnical recommendations presented herein.

Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard. They are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

This report may be used only by the project designers and Caltrans and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on-site and off-site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party, and client agrees to defend, indemnify, and hold harmless Kleinfelder from any claim or liability associated with such unauthorized use or non-compliance.

Environmental site assessment for the presence or absence of hazardous/toxic materials in the soil, surface water, groundwater or atmosphere, or the presence of wetlands was not included in the scope of our services for this report.

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9.0 REFERENCES

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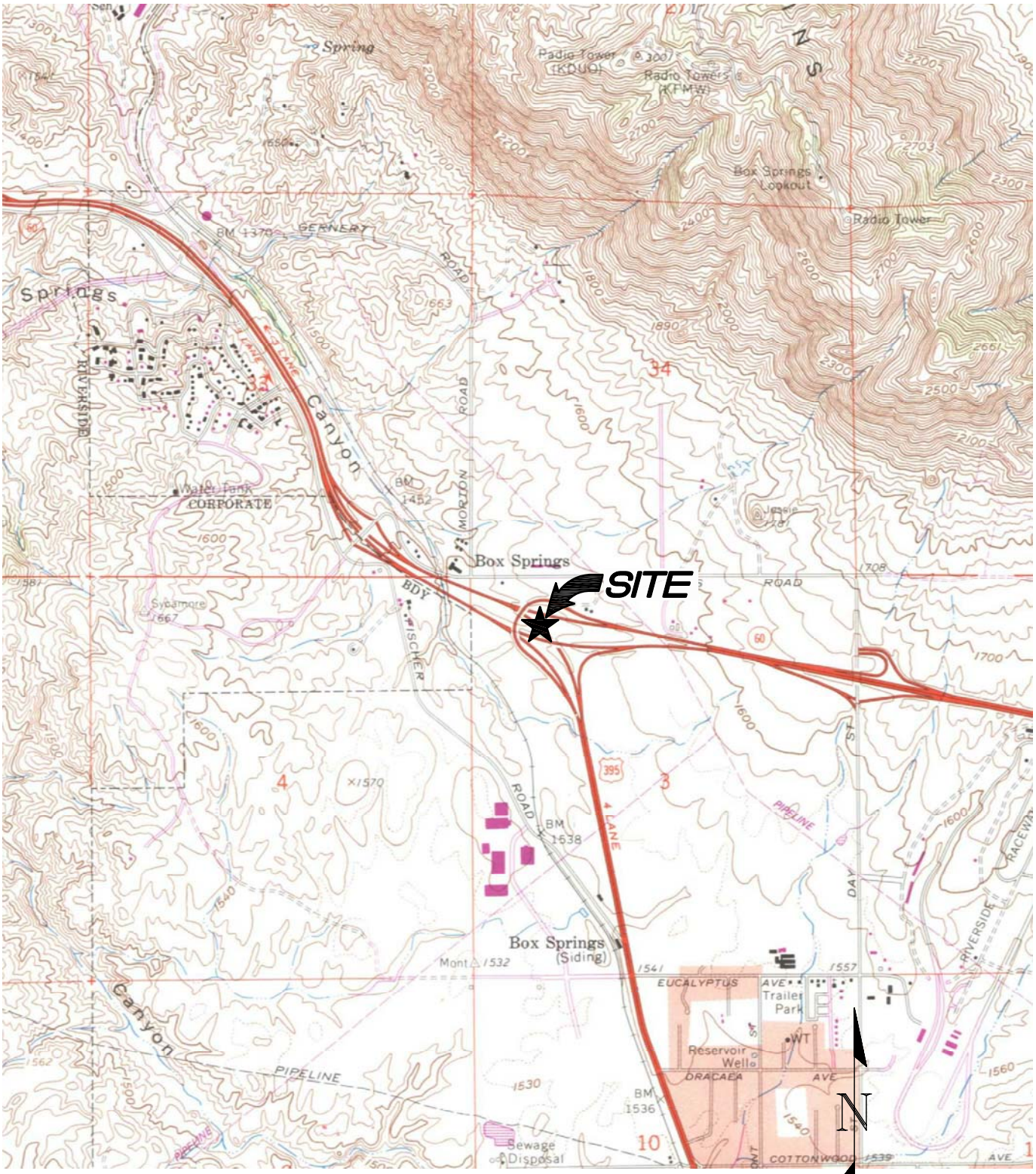
PLATES



SOURCE: U.S.G.S. 7.5' topographic series, Riverside East, California quadrangle dated 1967, photorevised 1980.

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PROJECT NO.	76979
DRAWN:	01/16/09
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p1.dwg

SITE LOCATION MAP

I-215/SR-60 EAST JUNCTION
EB & WB SR60 HOV CONNECTORS
RIVERSIDE, CALIFORNIA

PLATE **1**

PLOTTED: 16 Feb 2009, 9:35am, MGriffin
CAD FILE: L:\2009\CADD\76979\I-215_SR60\021609_EB&WB-SR60-HOV\ LAYOUT: 1
ATTACHED IMAGES: Images: 76979p1.jpg
ATTACHED XREFS:
DIAMOND BAR, CA

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

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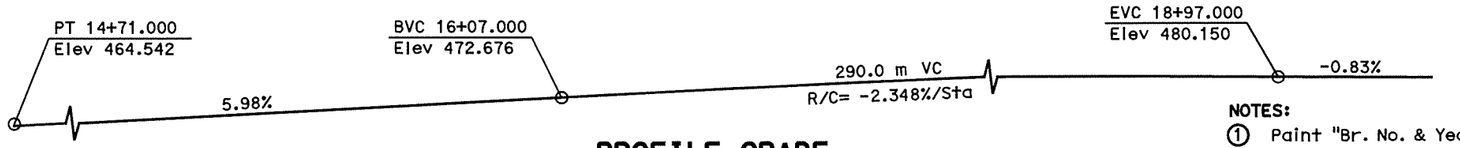
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408



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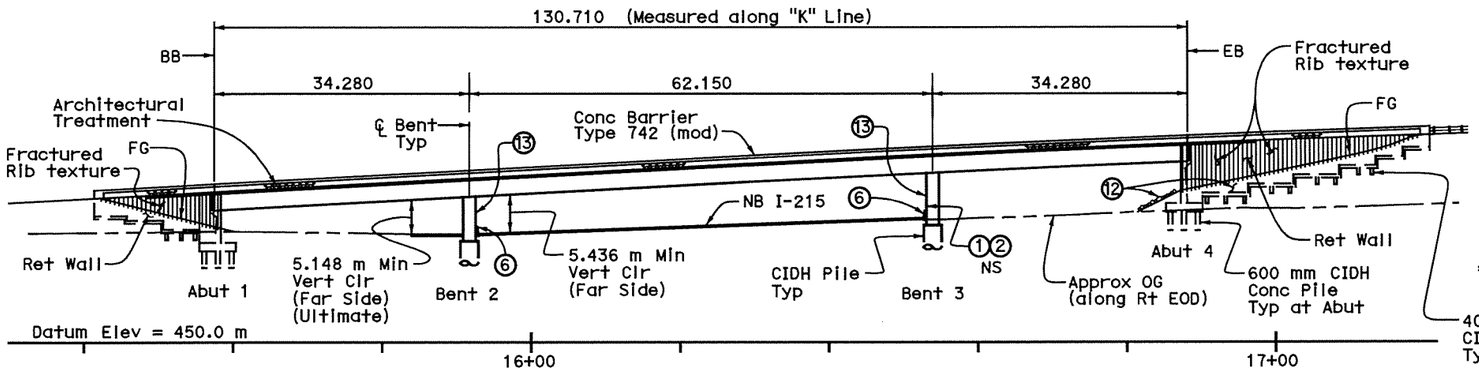


ELEVATION
1:400

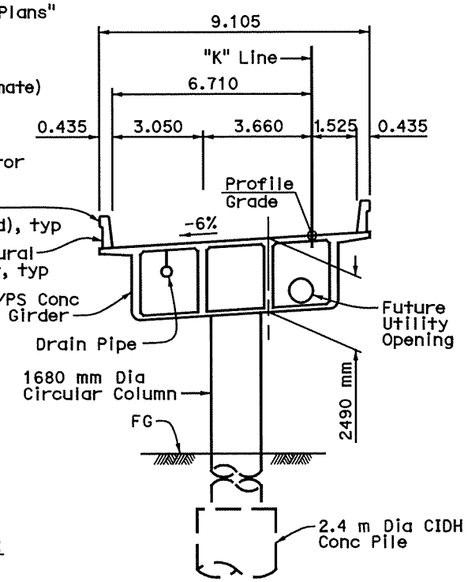
NOTES:

1. Paint "Br. No. & Year Constructed"
2. Paint "WB SR60 HOV Connector"
3. Structure Approach Type N(9S)
4. MBGR, See "Road Plans"
5. Indicates Deck Drain
6. Concrete Barrier Type 60GC see "Road Plans"
7. Concrete Barrier Type 60D see "Road Plans"
8. Welded Steel Casing for Future Utility
9. Retaining Wall Type 1
10. Concrete Barrier Type 742A, see "Road Plans"
11. Concrete Barrier Type 736B, see "Road Plans"
12. Slope Paving with Rockfacing
13. Paint "Bent No."

Ⓐ Point of minimum vertical clearance (Ultimate)
Ⓑ Point of minimum vertical clearance
→ Indicates direction of traffic
=== Indicates Proposed EB SR60 HOV Connector Br. No. 56-0842

Notes:

1. For General Notes, Index to Plans and "Standard Plans" list, see "Index to Plans" sheet.
2. For Pile Data Table, see "Foundation Plan" sheet.
3. For Stage Construction, see "Road Plans".



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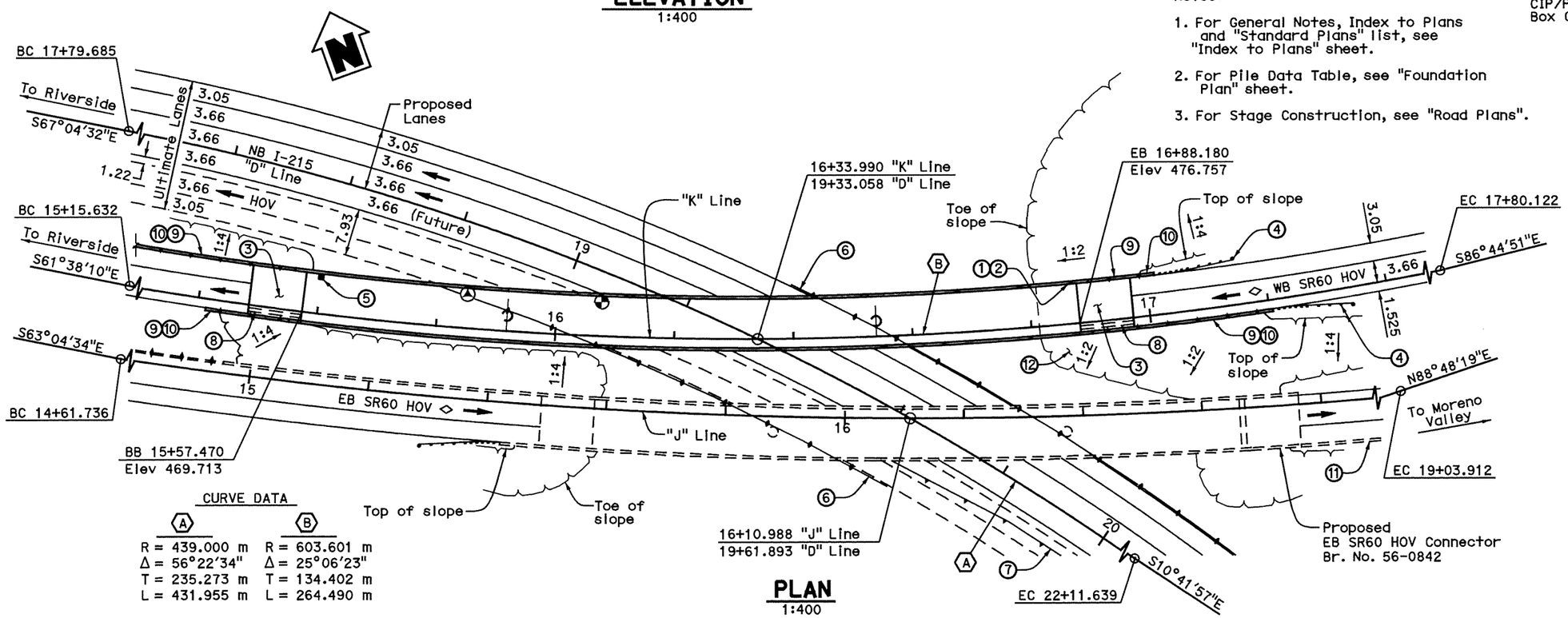

CURVE DATA

Ⓐ	Ⓑ
R = 439.000 m	R = 603.601 m
Δ = 56°22'34"	Δ = 25°06'23"
T = 235.273 m	T = 134.402 m
L = 431.955 m	L = 264.490 m

PLAN
1:400

0 - 1.5

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. KIM / D. SARETSKY	CHECKED T. DUDLEY/A. SIVATHASAN	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: HL-93 AND PERMIT DESIGN VEHICLE
	DETAILS	BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR	LAYOUT BY R. ANDRASEK	CHECKED M. CHAR
SIGN OFF DATE	QUANTITIES	BY D. SARETSKY	CHECKED K. GEE	SPECIFICATIONS BY M. CHAR	PLANS AND SPECS COMPARED M. CHAR

DESIGN GENERAL PLAN SHEET (METRIC) (REV. 10/27/06)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

MOHAN S. CHAR
PROJECT ENGINEER

CU 08
EA 449311

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
GENERAL PLAN

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 3/12/08 7/21/08 11/17/08 2/18/09 5/15/09

REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 1 OF 32

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

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1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

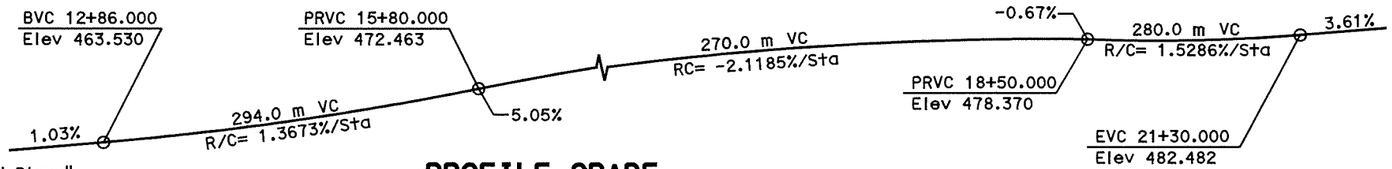
NOTES:

1. Paint "Br. No. & Year Constructed"
2. Paint "EB SR60 HOV Connector"
3. Structure Approach Type N(9S)
4. MBGR, See "Road Plans"
5. Indicates Deck Drain
6. Concrete Barrier Type 60GC, see "Road Plans"
7. Concrete Barrier Type 60D, see "Road Plans"
8. Welded Steel Casing for Future Utility
9. Retaining Wall Type 1
10. Concrete Barrier Type 742A, see "Road Plans"
11. Concrete Barrier Type 736B, see "Road Plans"
12. Slope Paving with Rockfacing
13. Paint "Bent No."

Point of minimum vertical clearance including "Ultimate"

Indicates Direction of traffic

=== Indicates WB SR60 HOV Connector Br. No. 56-0841



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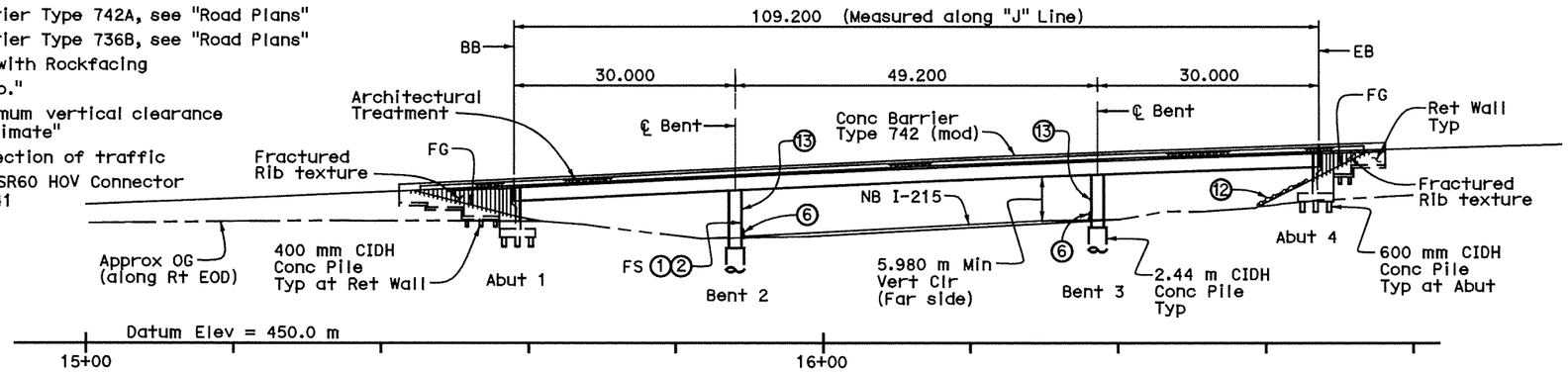
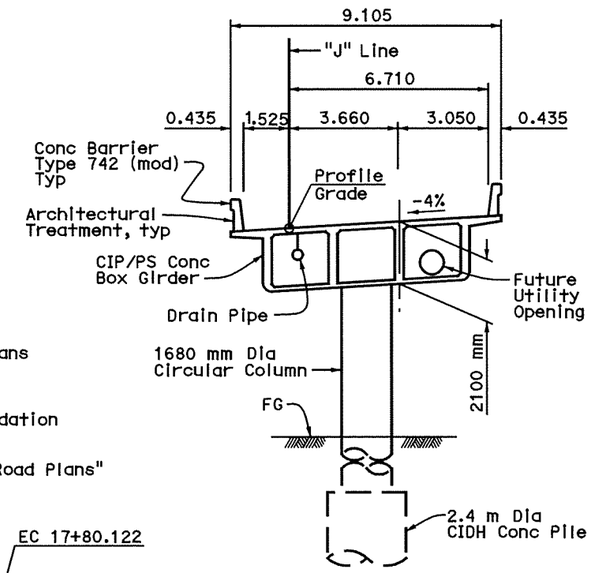


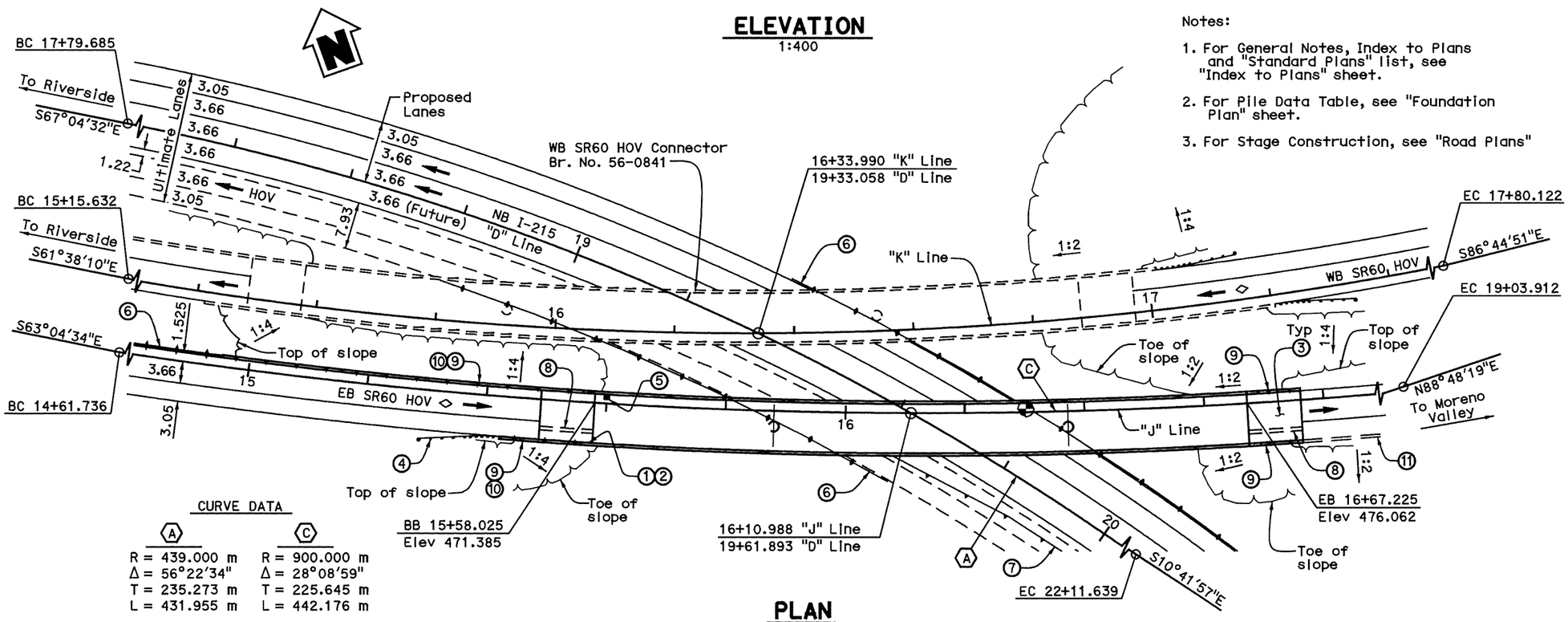
ELEVATION
1:400



TYPICAL SECTION
1:100

Notes:

1. For General Notes, Index to Plans and "Standard Plans" list, see "Index to Plans" sheet.
2. For Pile Data Table, see "Foundation Plan" sheet.
3. For Stage Construction, see "Road Plans"



CURVE DATA

A	C
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T = 235.273 m	T = 225.645 m
L = 431.955 m	L = 442.176 m

PLAN
1:400

Page 2 of 2

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT ROBERT ZEZOFF	DESIGN	BY D. KIM / K. GEE	CHECKED T. DUDLEY/A. SIVATHASAN	LOAD AND RESISTANCE FACTOR DESIGN	LIVE LOADING: HL-93 W/ "LOW-BOY" AND PERMIT DESIGN VEHICLE	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	MOHAN S. CHAR PROJECT ENGINEER
	DETAILS	BY R. ANDRASEK	CHECKED R. PRICE / M. CHAR	LAYOUT	BY R. ANDRASEK CHECKED M. CHAR		
SIGN OFF DATE	QUANTITIES	BY K. GEE	CHECKED D. SARETSKY	SPECIFICATIONS	BY M. CHAR PLANS AND SPECS COMPARED M. CHAR		

BRIDGE NO. 56-0842 — KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

GENERAL PLAN

DESIGN GENERAL PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES — REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/06 7/27/06 11/17/06 12/18/06 5/15/09

SHEET 1 OF 31

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

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SAN BERNARDINO, CALIFORNIA 92408

PLATE 3b

PILE DATA TABLE

LOCATION	PILE TYPE	DESIGN LOADING	NOMINAL RESISTANCE		DESIGN TIP ELEVATION (m)	SPECIFIED TIP ELEVATION (m)
			COMPRESSION	TENSION		
ABUT 1	600 mm CIDH	900 kN	1800 kN	0 kN	451.330 (1) 456.210 (2)	451.330
RW No. 1	400 mm CIDH	400 kN	800 kN	0 kN	455.030 (1)	455.030
RW No. 2	400 mm CIDH	400 kN	800 kN	0 kN	455.970 (1)	455.970
BENT 2	2.4 m CIDH	—	23 800 kN	0 kN	442.140 (1) 442.750 (2)	442.140
BENT 3	2.4 m CIDH	—	23 800 kN	0 kN	444.680 (1) 445.290 (2)	444.680
ABUT 4	600 mm CIDH	900 kN	1800 kN	0 kN	456.370 (1) 461.250 (2)	456.370
RW No. 3	400 mm CIDH	400 kN	800 kN	0 kN	462.160 (1)	462.160
RW No. 4	400 mm CIDH	400 kN	800 kN	0 kN	463.340 (1)	463.340
RW No. 4	600 mm CIDH	900 kN	1800 kN	0 kN	458.320 (1)	458.320

Notes: Design tip elevation is controlled by the following demands:
1. (1) Compression; (2) Lateral Loads.
2. Proposed piles spaced at minimum of 3 pile diameters (center to center).
3. The CIDH specified tip elevation shall not be raised.

BENCHMARKS

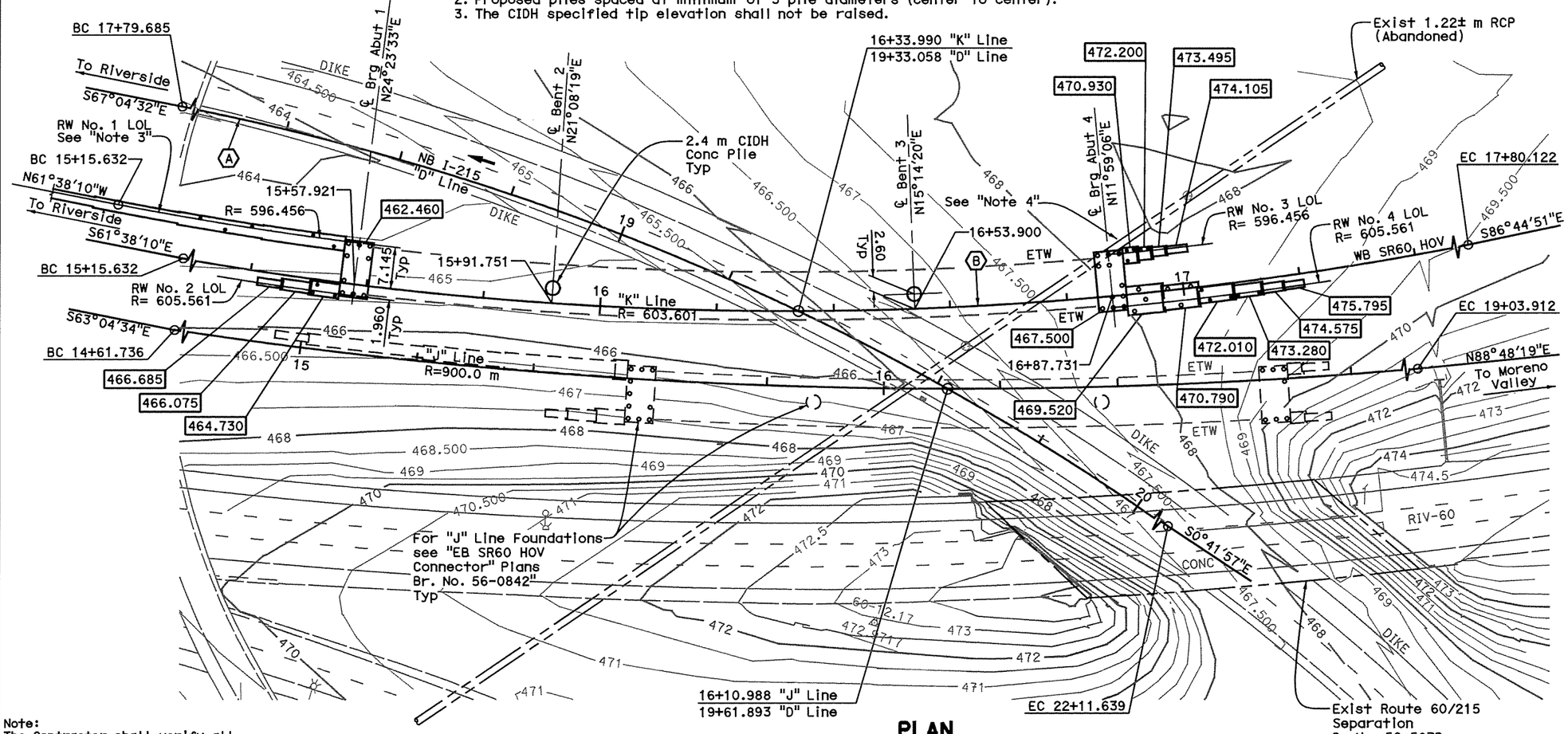
PT #865 Elevation 460.668 m

Found 25 mm iron pipe with Caltrans RP plug
North side of Box Springs Road.
N = 698034.479
E = 1903003.479

PT #3030 Elevation 472.840 m

Found 50 mm iron pipe with Brass Cap Stamped
"Dept of Trans RIV 60-12.7 1990"
34.14 m Southwesterly of bridge.
N = 697603.049
E = 1903554.738

Vertical Datum: NGVD-1929
Horizontal Datum: NAD-83, Zone 3(EPOCH 1984.0)



PLAN
1:400

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

CURVE DATA

Ⓐ	Ⓑ
R = 439.000 m	R = 603.601 m
Δ = 56°22'34"	Δ = 25°06'23"
T = 235.273 m	T = 134.402 m
L = 431.955 m	L = 264.490 m

LEGEND

- Indicates bottom of footing elevation
- ○ 400 mm or 600 mm CIDH Conc Pile
- ---- Indicates existing structure

Notes:

1. All ℄ Bents are radial to "K" Line.
2. Underground utility location as shown is approximate.
3. For Retaining Wall No. 1 layout & bottom of footing information, see Retaining Wall No.1 Layout 1 & 2 sheets.
4. Remove portion of RCP that conflicts with piles, and plug abandoned ends. For as-built RCP invert elevation, see "Abutment 4 layout" sheet.
5. For retaining wall footing pressure information, see General Notes on "Index to Plans" sheet.
6. Not all piles shown.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

GEOTECHNICAL PROFESSIONAL APPROVAL DATE 11/04/08

DESIGN OVERSIGHT ROBERT ZEZOFF	SCALE: AS SHOWN	VERT.DATUM NGVD-1929	HORZ.DATUM NAD-83, ZONE 3 (EPOCH 1984.0)	DESIGN	BY D. KIM / D. SARETSKY	CHECKED T. DUDLEY/A. SIVATHASAN	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
	PHOTOGRAMMETRY AS OF:	ALIGNMENT TIES		DETAILS	BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR	
	SURVEYED BY J. TERRY	DRAFTED BY		QUANTITIES	BY D. SARETSKY	CHECKED K. GEE	
SIGN OFF DATE	FIELD CHECKED BY M. WILSON	CHECKED BY					

MOHAN S. CHAR
PROJECT ENGINEER

CU 08
EA 449311

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
FOUNDATION PLAN

FOUNDATION PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/21/08 11/4/08 2/14/09 5/15/09

SHEET 4 OF 32

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60	19.4/21.5 61.7/62.6		

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PLANS APPROVAL DATE

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LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

PLATE 3c

PILE DATA TABLE

LOCATION	PILE TYPE	DESIGN LOADING	NOMINAL RESISTANCE		DESIGN TIP ELEVATION (m)	SPECIFIED TIP ELEVATION (m)
			COMPRESSION	TENSION		
ABUT 1	600 mm CIDH	900 kN	1800 kN	0 kN	453.235 (1) 458.115 (2)	453.235
RW No. 1	400 mm CIDH	400 kN	800 kN	0 kN	456.750 (1)	456.750
RW No. 2	400 mm CIDH	400 kN	800 kN	0 kN	458.020 (1)	458.020
BENT 2	2.4 m CIDH	—	16 400 kN	0 kN	448.340 (1) 443.760 (2)	443.760
BENT 3	2.4 m CIDH	—	16 400 kN	0 kN	450.340 (1) 445.760 (2)	445.760
ABUT 4	600 mm CIDH	900 kN	1800 kN	0 kN	458.135 (1) 463.015 (2)	458.135
RW No. 3	400 mm CIDH	400 kN	800 kN	0 kN	462.880 (1)	462.880
RW No. 4	400 mm CIDH	400 kN	800 kN	0 kN	462.880 (1)	462.880

Notes: Design tip elevation is controlled by the following demands:
1. (1) Compression; (2) Lateral Loads.
2. Proposed piles spaced at minimum of 3 pile diameters (center to center).
3. The CIDH specified tip elevation shall not be raised.

BENCHMARKS

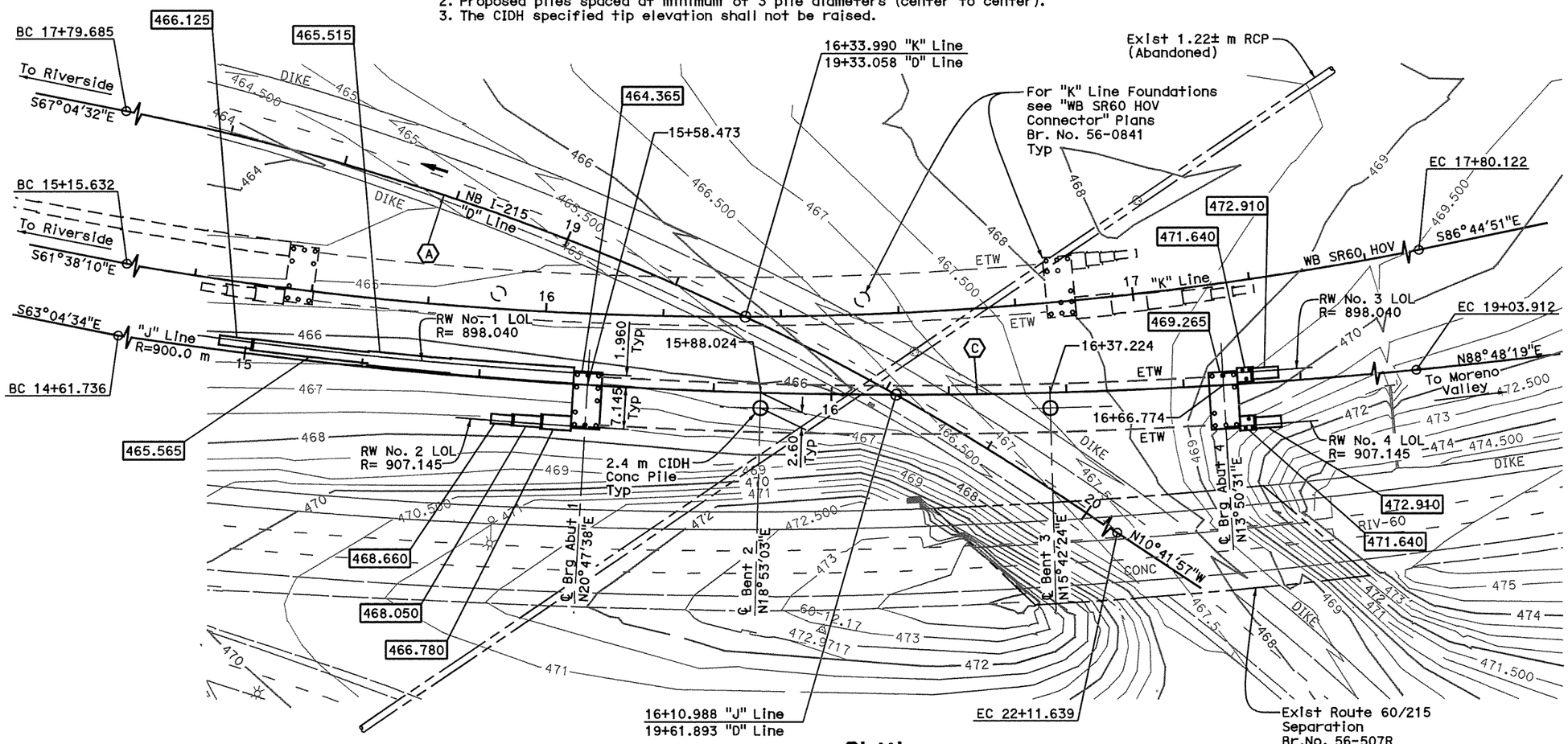
PT #865 Elevation 460.668 m

Found 25 mm iron pipe with Caltrans RP plug
North side of Box Springs Road.
N = 698034.479
E = 1903003.479

PT #3030 Elevation 472.840 m

Found 50 mm iron pipe with Brass Cap Stamped
"Dept of Trans RIV 60-12.7 1990"
34.14 m Southwesterly of bridge.
N = 697603.049
E = 1903554.738

Vertical Datum: NGVD-1929
Horizontal Datum: NAD-83, Zone 3(EPOCH 1984.0)



PLAN
1:400

CURVE DATA

Ⓐ	Ⓒ
R = 439.000 m	R = 900.000 m
Δ = 56°22'34"	Δ = 28°08'59"
T = 235.273 m	T = 225.645 m
L = 431.955 m	L = 442.176 m

LEGEND

Indicates bottom of footing elevation

400 mm or 600 mm CIDH Conc Pile

Indicates existing structure

Notes:

1. All ℄ Bents are radial to "J" Line.
2. Underground utility location as shown is approximate.
3. For retaining wall footing pressure information, see General Notes on "Index to Plans" sheet.
4. Not all piles shown.

Note:
The Contractor shall verify all controlling field dimensions before ordering or fabricating any material.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

GEOTECHNICAL PROFESSIONAL APPROVAL DATE 11/04/08

DESIGN OVERSIGHT ROBERT ZEZOFF	SCALE: AS SHOWN	VERT.DATUM NGVD-1929	HORZ.DATUM NAD-83, Zone 6 (EPOCH 1984.0)	DESIGN BY D. KIM / K. GEE	CHECKED T. DUDLEY/A. SIVATHASAN	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	MOHAN S. CHAR PROJECT ENGINEER
	PHOTOGRAMMETRY AS OF:	ALIGNMENT TIES		DETAILS BY M. / R. ANDRASEK	CHECKED R. PRICE / M. CHAR		
	SURVEYED BY J. TERRY	DRAFTED BY		QUANTITIES BY K. GEE	CHECKED K. GEE		
SIGN OFF DATE	FIELD CHECKED BY M. WILSON	CHECKED BY					

BRIDGE NO. 56-0842
KILOMETER POST R19.6

EB SR60 HOV CONNECTOR
FOUNDATION PLAN

FOUNDATION PLAN SHEET (METRIC) (REV. 10/27/05)

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90 100

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/08 7/24/08 11/4/08 12/18/09 5/15/09

SHEET 4 OF 31

FILE -> U:\BRIDGE\RCTC0601-East J2\100% 56-0842 EB\56-0842-e-fdp01.dgn

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

PLANS APPROVALDATE

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

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RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

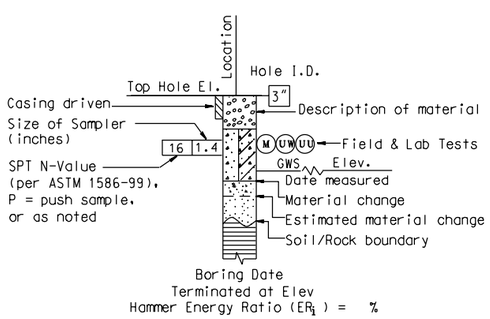
PLATE 3d

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.

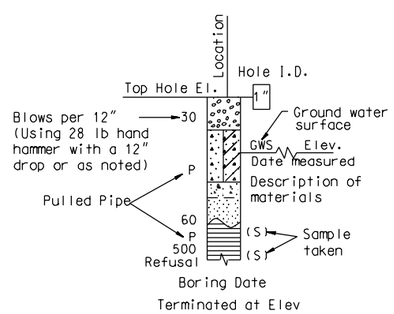
BOREHOLE IDENTIFICATION		
Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (25.4 mm soil tube) Hand Auger
	D	Dynamic Cone Penetration Boring
	CPT	Cone Penetration Test (ASTM D 5778-95)
	O	Other
Note: Size in millimeters.		

CONSISTENCY OF COHESIVE SOILS				
Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

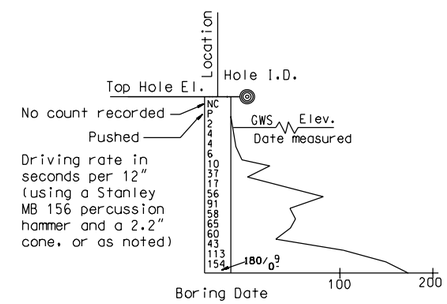
PLASTICITY OF FINE-GRAINED SOILS	
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic 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.



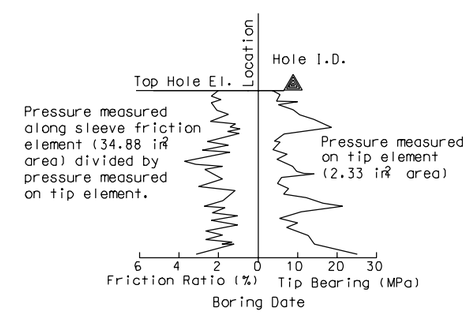
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. AMANTE PROJECT ENGINEER	BRIDGE NO. 56-0841
SIGN OFF DATE	CHECKED BY	C. AMANTE			KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE -) $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 26 OF 31

USERNAME -$USER DATE PLOTTED -) $DATE TIME PLOTTED -) $TIME

PLATE 4a

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

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1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 27 OF 31

USERNAME =>$USER DATE PLOTTED =>$DATE TIME PLOTTED =>$TIME

PLATE 4b

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

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SAN BERNARDINO, CALIFORNIA 92408

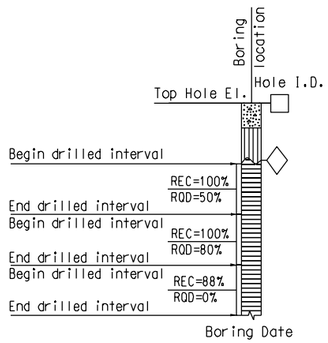
KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841

KILOMETER POST R19.6

WB SR60 HOV CONNECTOR

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 28 OF 31

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

PLATE 4c

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

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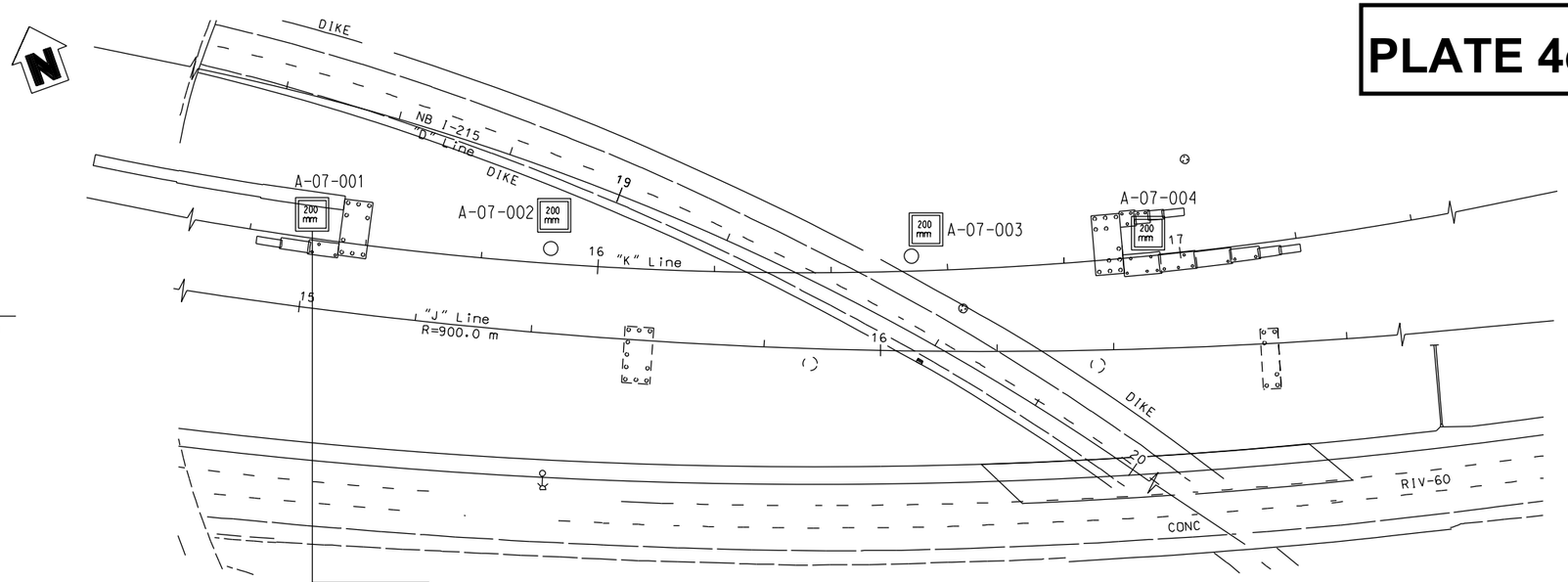
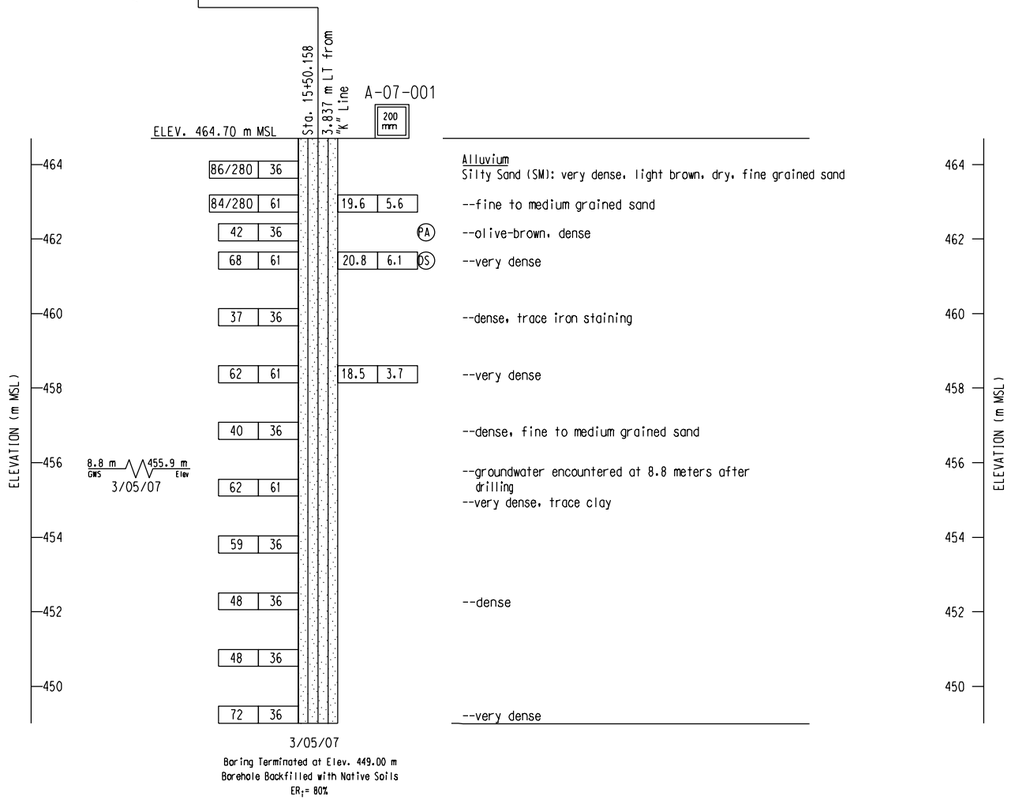
PLAN
1:500





PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT
SIGN OFF DATE

DRAWN BY D. FAHRNEY
CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 1 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 3/12/08 7/21/08 11/4/08 2/13/09 5/20/09

SHEET 29 OF 31

FILE => $REQUEST

USERNAME =>$USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

PLATE 4d

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

PLANS APPROVALDATE

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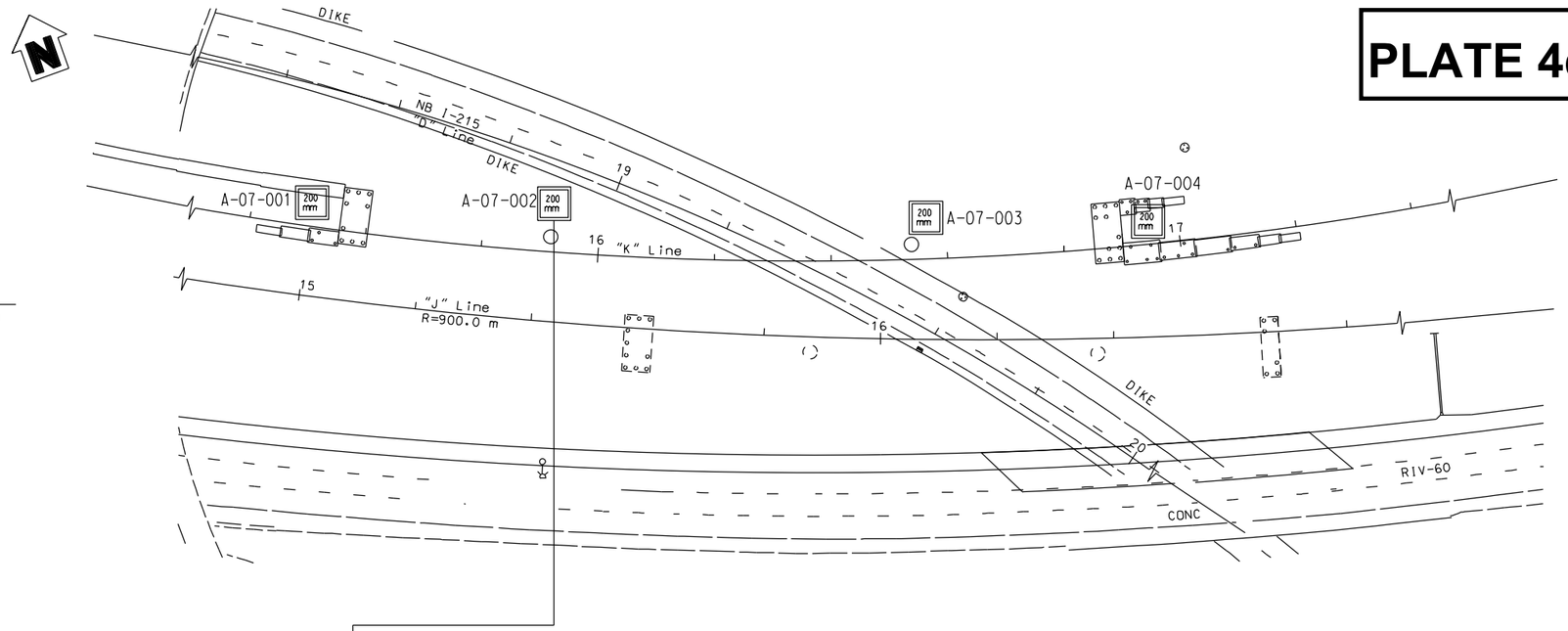
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500



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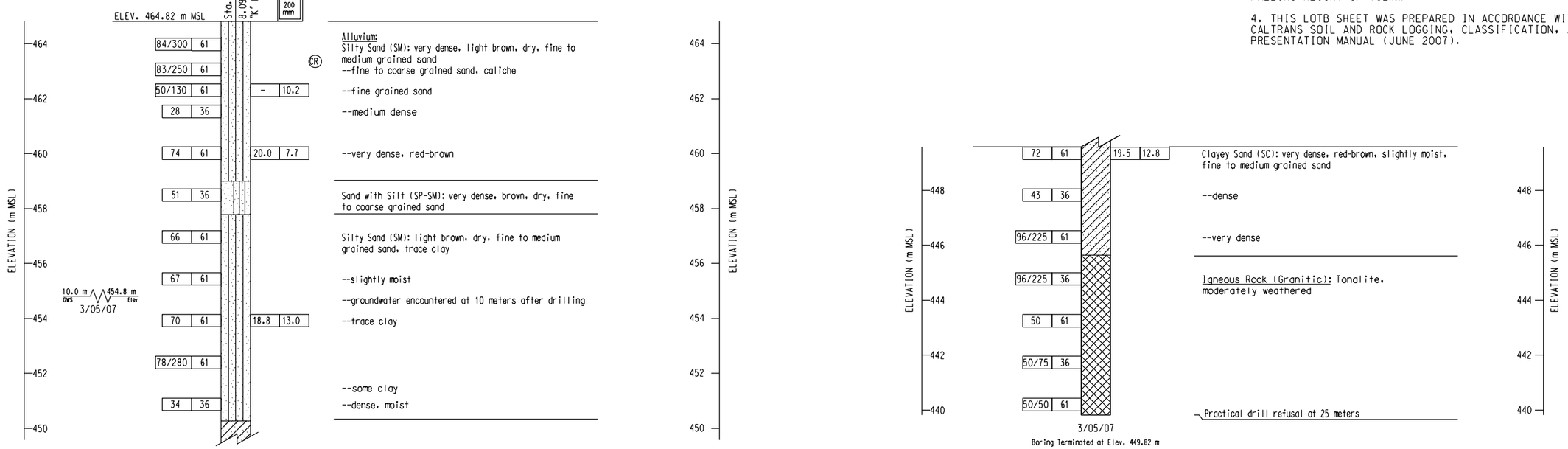

PROFILE
VERTICAL SCALE 1:2

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	C. AMANTE PROJECT ENGINEER	BRIDGE NO. 56-0841
SIGN OFF DATE	CHECKED BY	C. AMANTE			KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 2 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 2/13/09 5/20/09

SHEET 30 OF 31

FILE -> $REQUEST

USERNAME ->$USER DATE PLOTTED ->$DATE TIME PLOTTED ->$TIME

PLATE 4f

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

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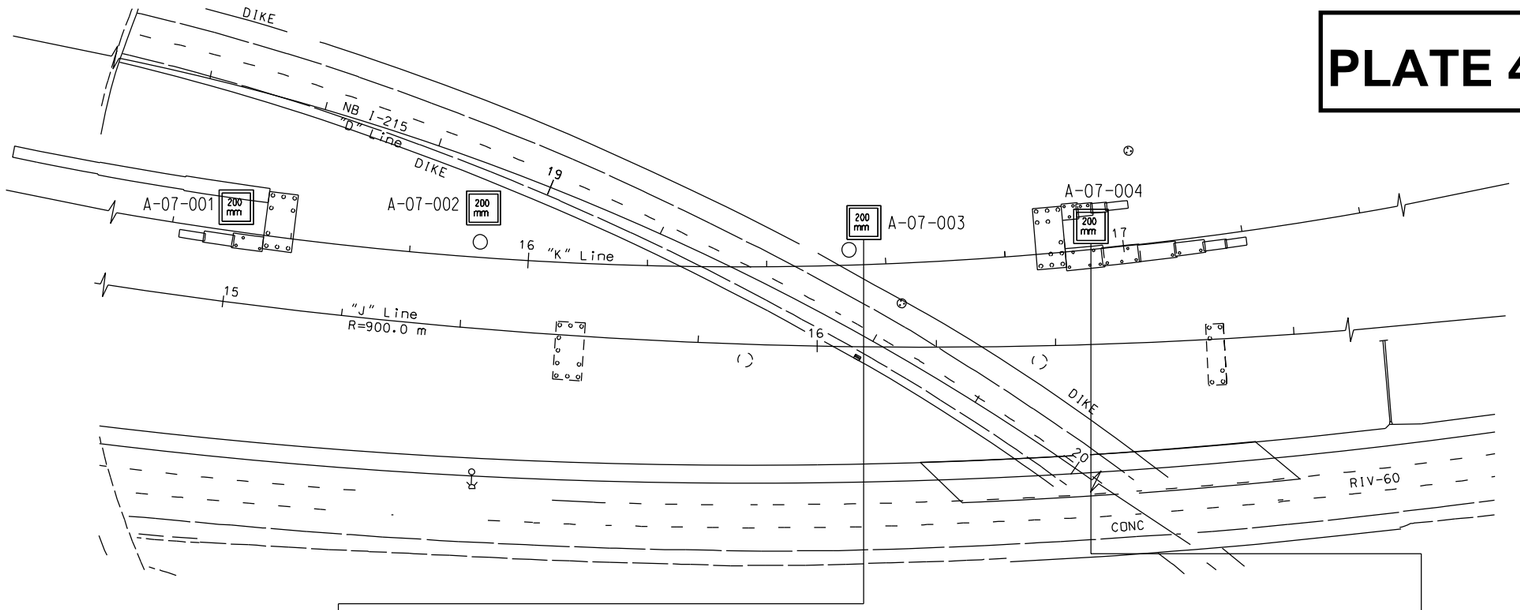
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500



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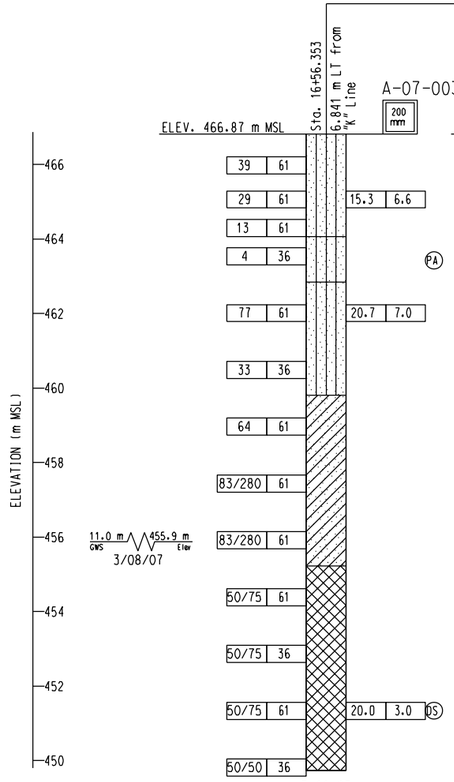


Fill:
Silty Sand (SM): dense, dark brown, fine to coarse grained sand, with fine gravel and asphalt grindings
--medium dense, asphalt grindings
--fine grained sand, trace medium sand, iron staining, gravel content decreasing

Alluvium:
Silty Sand (SM): loose, brown, slightly moist

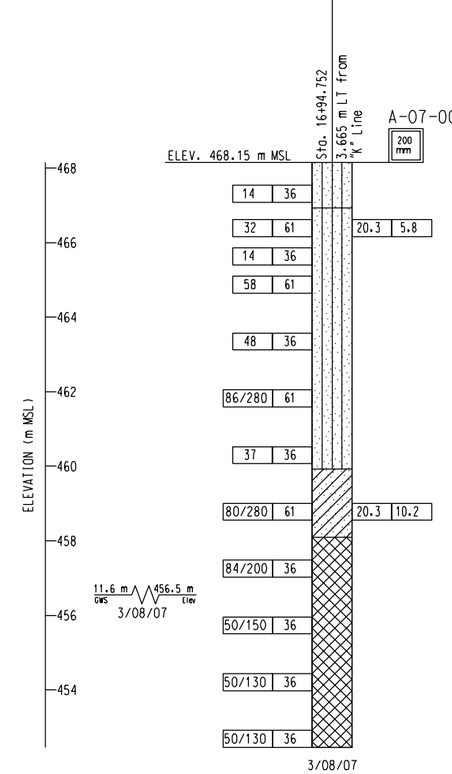
Silty Sand (SM): very dense, red-brown, slightly moist, fine to medium grained sand, trace clay
--dense, fine grained sand

Clayey Sand (SC): very dense, brown, moist, fine grained sand
--very dense
--groundwater encountered at 11 meters

Igneous Rock (Granitic): Tonalite, moderately weathered, gray-brown, wet
--drilling effort increases
--gray
--very difficult drilling
--slightly weathered, moist, gray-brown, fine to medium grained
--wet
Practical drill refusal at 17.1 meters

3/08/07
Boring Terminated at Elev. 449.77 m
Borehole Backfilled with Native Soils
ER_f= 80%

PROFILE
VERTICAL SCALE 1:2



fill:
Silty Sand (SM): medium dense, red-brown, dry, fine to medium grained sand, trace coarse sand

Alluvium:
Silty Sand (SM): medium dense, brown, slightly moist, fine to coarse grained sand
--roots
--very dense, brown, slightly moist, fine grained sand
--dense, orange-brown, dry
--dense

Clayey Sand (SC): very dense, red-brown, moist

Igneous Rock (Granitic): Tonalite, slightly weathered, tan-brown, dry, recovered as fine to medium grained sand
--groundwater encountered at approximately 11.6 meters

3/08/07
Boring Terminated at Elev. 452.45 m
Borehole Backfilled with Native Soils
ER_f= 80%

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT	DRAWN BY	D. FAHRNEY	PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION
SIGN OFF DATE	CHECKED BY	C. AMANTE	C. AMANTE PROJECT ENGINEER

BRIDGE NO. 56-0841
KILOMETER POST R19.6

WB SR60 HOV CONNECTOR
LOG OF TEST BORINGS NO. 3 OF 3

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES → 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 31 OF 31

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

PLATE 4g

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

PLANS APPROVALDATE

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

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RIVERSIDE, CALIFORNIA 92501

LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

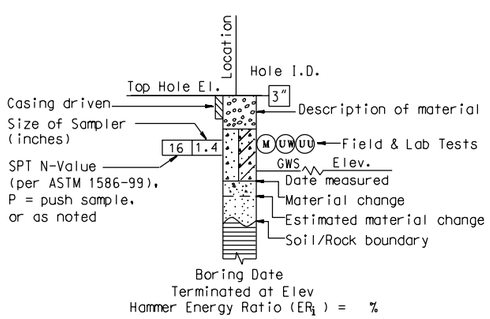
KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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.

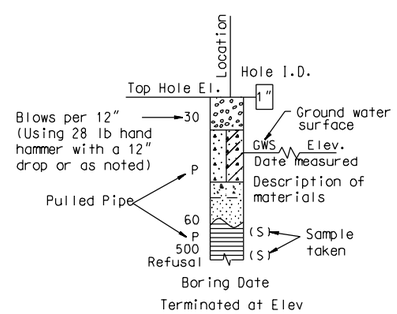
BOREHOLE IDENTIFICATION		
Symbol	Hole Type	Description
Size	A	Auger Boring
Size	R P	Rotary drilled boring Rotary percussion boring (air)
Size	R	Rotary drilled diamond core
Size	HD HA	Hand driven (25.4 mm soil tube) Hand Auger
	D	Dynamic Cone Penetration Boring
	CPT	Cone Penetration Test (ASTM D 5778-95)
	O	Other
Note: Size in millimeters.		

CONSISTENCY OF COHESIVE SOILS				
Description	Unconfined Compressive Strength (kpa)	Pocket Penetrometer Measurement (kpa)	Torvane Measurement (kpa)	Field Approximation
Very Soft	< 23.93	< 23.93	< 11.48	Easily penetrated several inches by fist
Soft	23.93 to 47.8	23.93 to 47.8	11.48 to 23.93	Easily penetrated several inches by thumb
Medium Stiff	47.85 to 95.72	47.85 to 95.72	23.93 to 47.85	Penetrated several inches by thumb with moderate effort
Stiff	95.72 to 191.44	95.72 to 191.44	47.85 to 95.72	Readily indented by thumb but penetrated only with great effort
Very Stiff	191.44 to 382.88	191.44 to 382.88	191.44 to 382.88	Readily indented by thumbnail
Hard	>765.76	>765.76	>382.88	Indented by thumbnail with difficulty

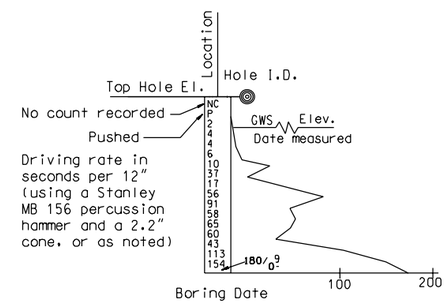
PLASTICITY OF FINE-GRAINED SOILS	
Description	Criteria
Nonplastic	A 3.18 mm thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic 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.



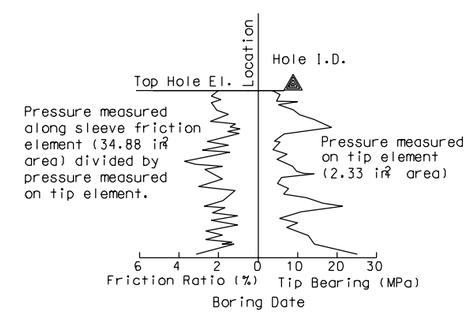
ROTARY BORING



HAND BORING



DYNAMIC CONE PENETRATION BORING



CONE PENETRATION TEST (CPT) SOUNDING

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D.FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

SOIL LEGEND NO. 1

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE -) $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 24 OF 30

USERNAME -)$USER DATE PLOTTED -)$DATE TIME PLOTTED -)$TIME

PLATE 4h

Caltrans Metric

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Carlos V Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

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SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

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)

APPARENT DENSITY OF COHESIONLESS SOILS

Description	SPT N_{60} (Blows / 304.8 mm)
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		> 304.8 mm
Cobble		76.2 mm to 304.8 mm
Gravel	Coarse	19.05 mm to 76.2 mm
	Fine	No. 4 to 19.05 mm
Sand	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40

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DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

SOIL LEGEND NO. 2

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 2/18/09 5/20/09

SHEET 25 OF 30

USERNAME -$USER DATE PLOTTED -> $DATE TIME PLOTTED -> $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

PLATE 4i

Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

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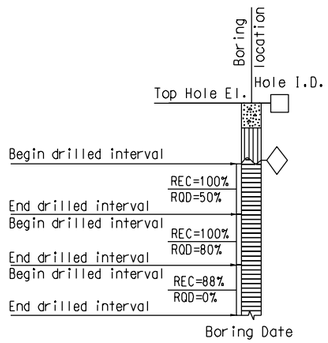
REFERENCE: CALTRANS SOIL & ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007)

PERCENT CORE RECOVERY (REC) & ROCK QUALITY DESIGNATION (RQD)

$$REC = \frac{\sum \text{Length of the recovered core pieces (mm)}}{\text{Total length of core run (mm)}} \times 100\%$$

$$RQD = \frac{\sum \text{Length of intact core pieces} \geq 101.6\text{ mm}}{\text{Total length of core run (mm)}} \times 100\%$$



RELATIVE STRENGTH OF INTACT ROCK

Term	Uniaxial Compressive Strength (kPa)
Extremely Strong	> 206842.71
Very Strong	99973.98 - 206842.71
Strong	48263.30 - 99973.98
Medium Strong	24131.65 - 48263.30
Weak	4826.33 - 24131.65
Very Weak	1034.21 - 4826.33
Extremely Weak	< 1034.21

BEDDING SPACING

Description	Thickness / Spacing
Massive	Greater than 3.05 m
Very thickly bedded	0.91 m to 3.05 m
Thickly bedded	0.30 m to 0.91 m
Moderately bedded	92.08 mm to 304.8 mm
Thinly bedded	31.75 mm to 92.08 mm
Very thinly bedded	9.53 mm to 31.75 mm
Laminated	Less than 9.53 mm

LEGEND OF ROCK MATERIALS

- IGNEOUS ROCK
- SEDIMENTARY ROCK
- METAMORPHIC ROCK

ROCK HARDNESS

Description	Criteria
Extremely Hard	Specimen cannot be scratched with a pocket knife or sharp pick; can only be chipped with repeated heavy hammer blows.
Very Hard	Specimen cannot be scratched with a pocket knife or sharp pick. Breaks with repeated heavy hammer blows.
Hard	Specimen can be scratched with a pocket knife or sharp pick with difficulty (heavy pressure). Heavy hammer blows required to break specimen.
Moderately Hard	Specimen can be scratched with pocket knife or sharp pick with light or moderate pressure. Core breaks with moderate hammer pressure.
Moderately Soft	Specimen can be grooved 1/6" deep with a pocket knife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Specimen can be grooved or gouged easily by a pocket knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Specimen can be readily indented, grooved or gouged with fingernail, or carved with a pocket knife. Breaks with light manual pressure.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures.
Very slightly fractured	Lengths greater than 0.91 m.
Slightly fractured	Lengths from 0.30 m to 0.91 m with few lengths less than 0.30 m or greater than 0.91 m.
Moderately fractured	Lengths mostly in 101.6 mm to 304.8 mm range with most lengths about 203.2 mm.
Intensely fractured	Lengths average from 25.4 mm to 101.6 mm with scattered fragmented intervals with lengths less than 101.6 mm.
Very intensely fractured	Mostly chips and fragments with a few scattered short core lengths.

Combination descriptors (such as "Very intensely to intensely fractured") are used where equal distribution of both fracture density characteristics is present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions. Only two adjacent descriptors may be combined.

WEATHERING DESCRIPTORS FOR INTACT ROCK

Description	Diagnostic features					General Characteristics
	Chemical Weathering-Discoloration and/or oxidation		Mechanical Weathering-Grain boundary conditions (disaggregation) primarily for granitics and some coarse-grained sediments	Texture and Solutioning		
	Body of Rock	Fracture Surfaces		Texture	Solutioning	
Fresh	No discoloration, not oxidized.	No discoloration or oxidation.	No separation, intact (tight).	No change.	No solutioning.	Hammer rings when crystalline rocks are struck.
Slightly Weathered	Discoloration or oxidation is limited to surface of, or short distance from, fractures; some feldspar crystals are dull.	Minor to complete discoloration or oxidation of most surfaces.	No visible separation, intact (tight).	Preserved.	Minor leaching of some soluble minerals may be noted.	Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately Weathered	Discoloration or oxidation extends from fractures usually throughout; Fe-Mg minerals are "rusty," feldspar crystals are "cloudy."	All fracture surfaces are discolored or oxidized.	Partial separation of boundaries visible.	Generally preserved.	Soluble minerals may be mostly leached.	Hammer does not ring when rock is struck. Body of rock is slightly weakened.
Intensely Weathered	Discoloration or oxidation throughout; all feldspars and Fe-Mg minerals are altered to clay to some extent; or chemical alteration produces in-situ disaggregation, see grain boundary conditions.	All fracture surfaces are discolored or oxidized, surfaces friable.	Partial separation, rock is friable; in semiarid conditions granitics are disaggregated.	Texture altered by chemical disintegration (hydration, argillation).	Leaching of soluble minerals may be complete.	Dull sound when struck with hammer, usually can be broken with moderate to heavy manual pressure or by light hammer blow without reference to planes of weakness such as incipient or hairline fractures, or veinlets. Rock is significantly weakened.
Decomposed	Discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and Fe-Mg minerals are completely altered to clay.		Complete separation of grain boundaries (disaggregated).	Resembles a soil, partial or complete remnant rock structure may be preserved; leaching of soluble minerals usually complete.		Can be granulated by hand. Resistant minerals such as quartz may be present as "stringers" or "dikes."

Combination descriptors (such as "slightly weathered to fresh") are permissible where equal distribution of both weathering characteristics is present over significant intervals or where characteristics present are "in between" the diagnostic feature. However, combination descriptors should not be used where significant, identifiable zones can be delineated. Only two adjacent descriptors may be combined. "Very intensely weathered" is the combination descriptor for "intensely weathered to decomposed."

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

ROCK LEGEND

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 26 OF 30

FILE =) $REQUEST

USERNAME =$USER DATE PLOTTED =) $DATE TIME PLOTTED =) $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

PLANS APPROVALDATE

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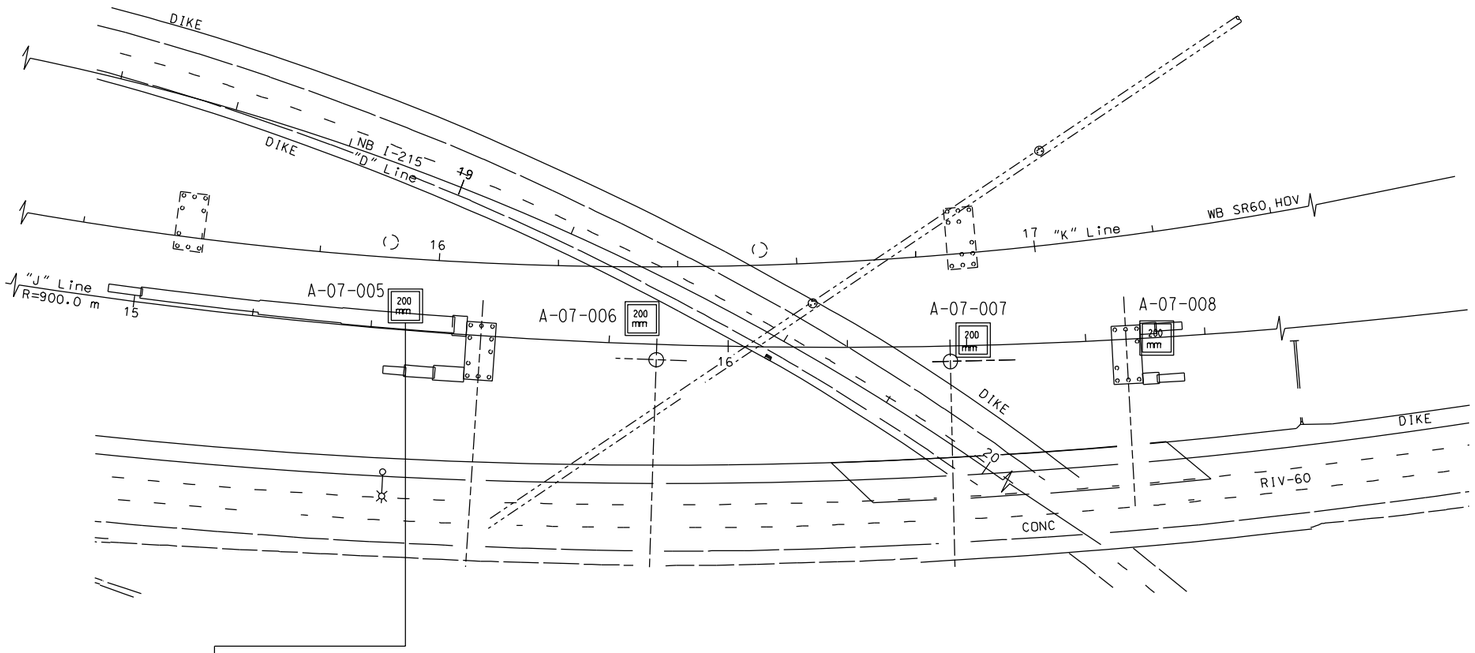
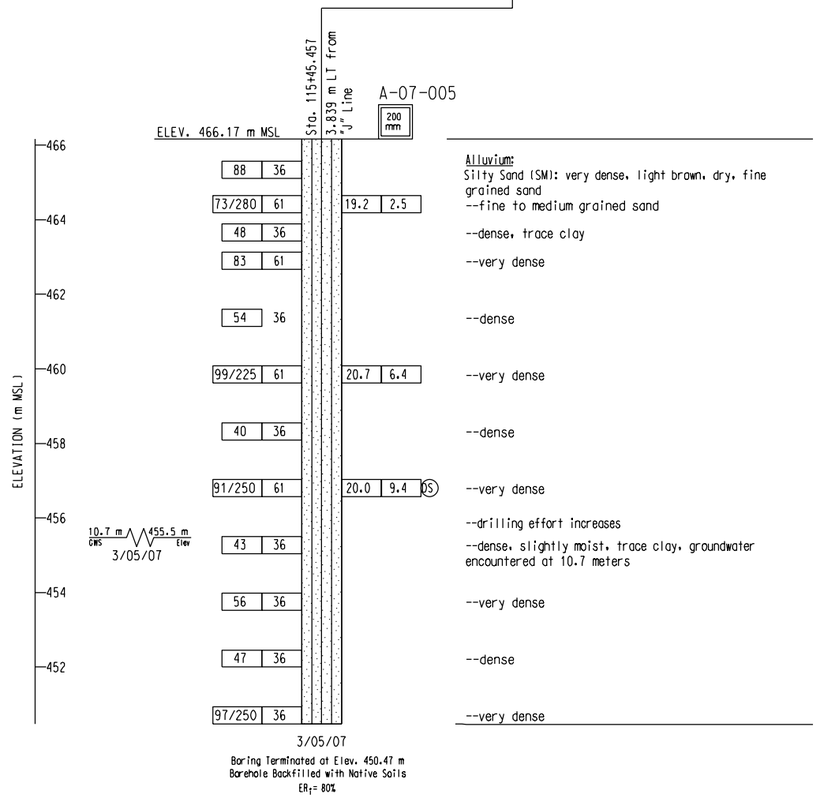
RIVERSIDE COUNTY TRANSPORTATION COMMISSION
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

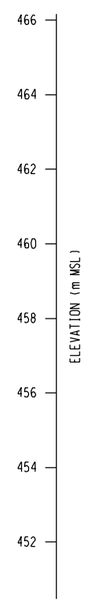
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500







PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

NOTES:

1. 36mm DIAMETER SAMPLES WERE TAKEN USING A STANDARD PENETRATION TEST (SPT) SPLIT BARREL SAMPLER WITH AN INSIDE DIAMETER (ID) OF 36mm AND AN OUTSIDE DIAMETER (OD) OF 51mm.

2. 61mm DIAMETER RING SAMPLES WERE TAKEN USING A CALIFORNIA SPLIT BARREL SAMPLER WITH AN ID OF 61mm AND AN OD OF 84mm.

3. ALL SAMPLES WERE DRIVEN WITH 64kg HAMMER WITH A FALLING HEIGHT OF 762mm.

4. THIS LOTB SHEET WAS PREPARED IN ACCORDANCE WITH THE CALTRANS SOIL AND ROCK LOGGING, CLASSIFICATION, AND PRESENTATION MANUAL (JUNE 2007).

PLATE 4j

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 1 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

FILE => $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 2/13/09 5/20/09

SHEET 27 OF 30

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

PLATE 4k

Caltrans Metric

Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST — CARLOS AMANTE — No. GE2724 — Exp. 6-30-10 — CERTIFIED ENGINEERING GEOLOGIST — STATE OF CALIFORNIA

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RIVERSIDE, CALIFORNIA 92501

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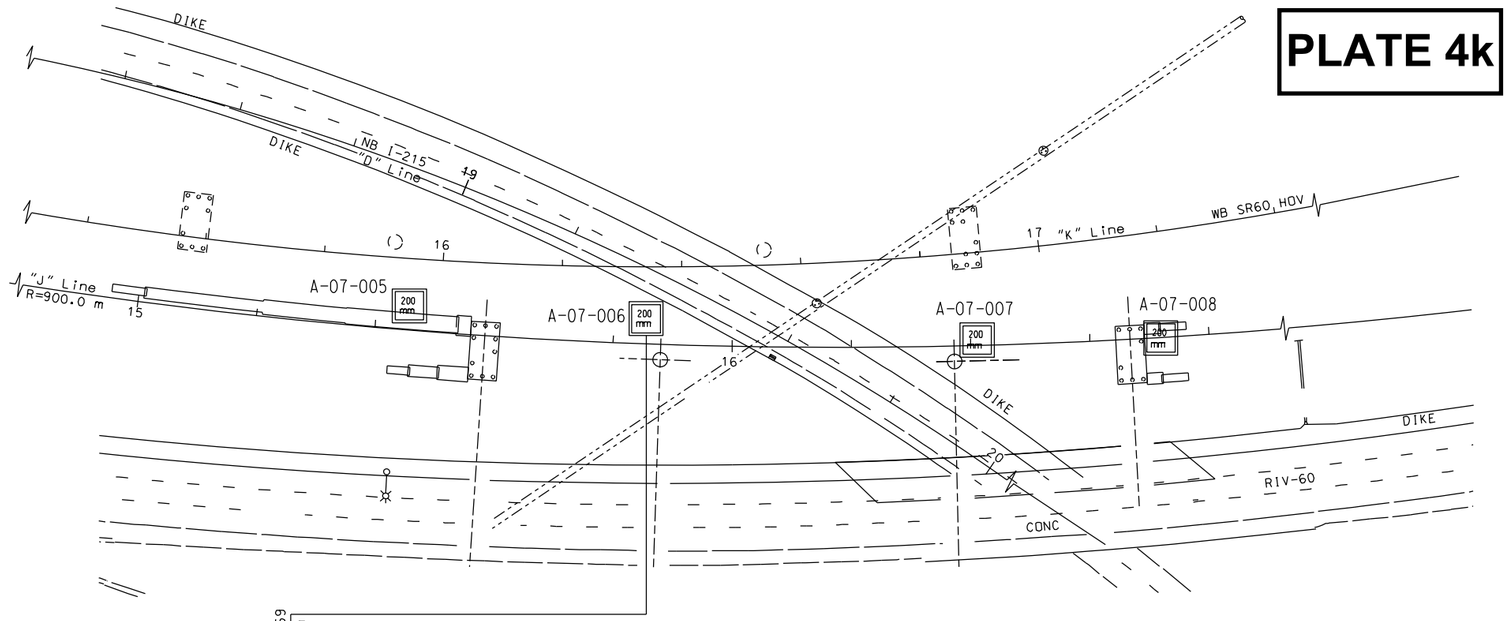
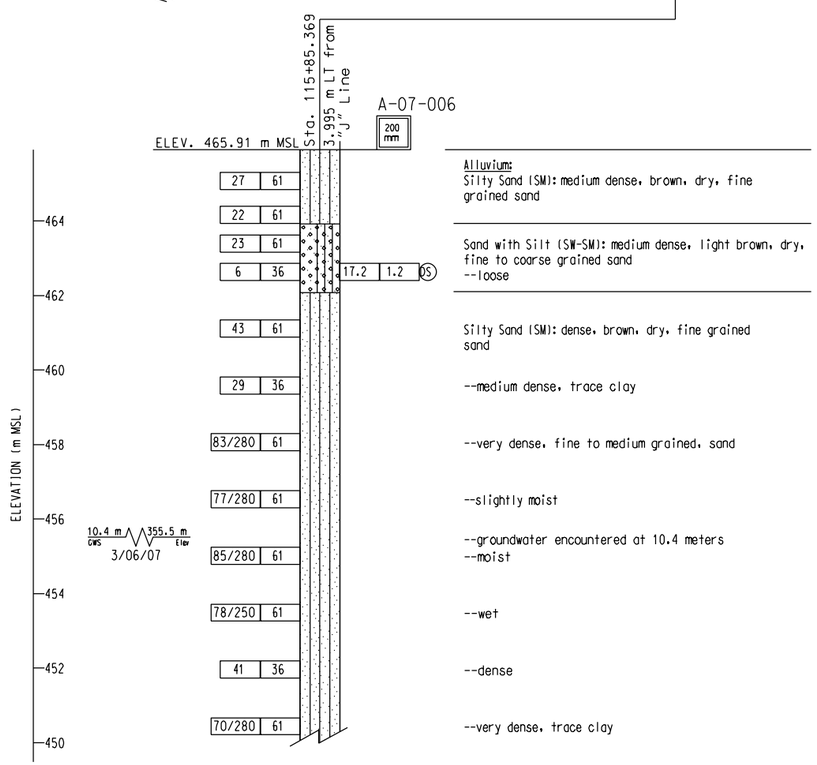
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500





Alluvium:
Silty Sand (SM): medium dense, brown, dry, fine grained sand

Sand with Silt (SW-SM): medium dense, light brown, dry, fine to coarse grained sand
--loose

Silty Sand (SM): dense, brown, dry, fine grained sand

--medium dense, trace clay

--very dense, fine to medium grained, sand

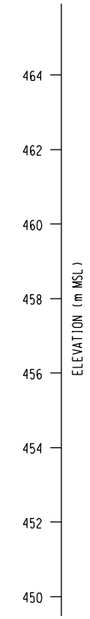
--slightly moist

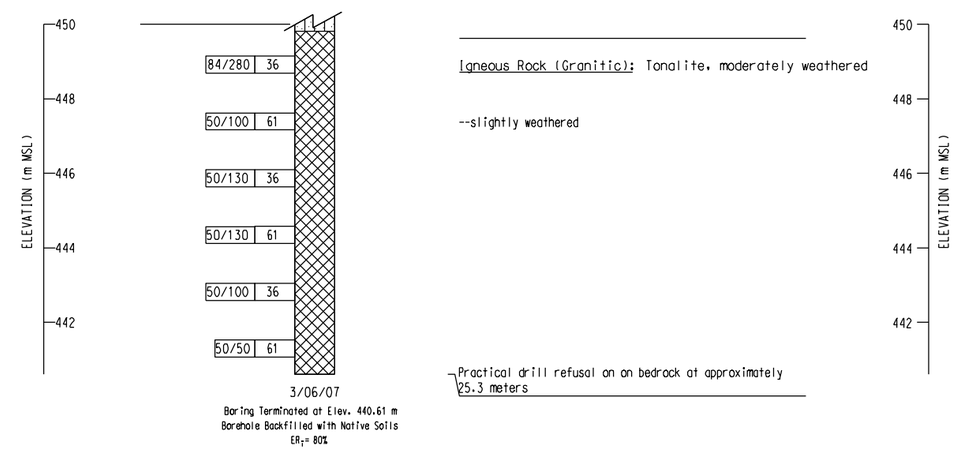
--groundwater encountered at 10.4 meters
--moist

--wet

--dense

--very dense, trace clay





PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
N = 697603.049
E = 1903554.738

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ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 2 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

REVISION DATES

SHEET 28 OF 30

FILE => $REQUEST

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

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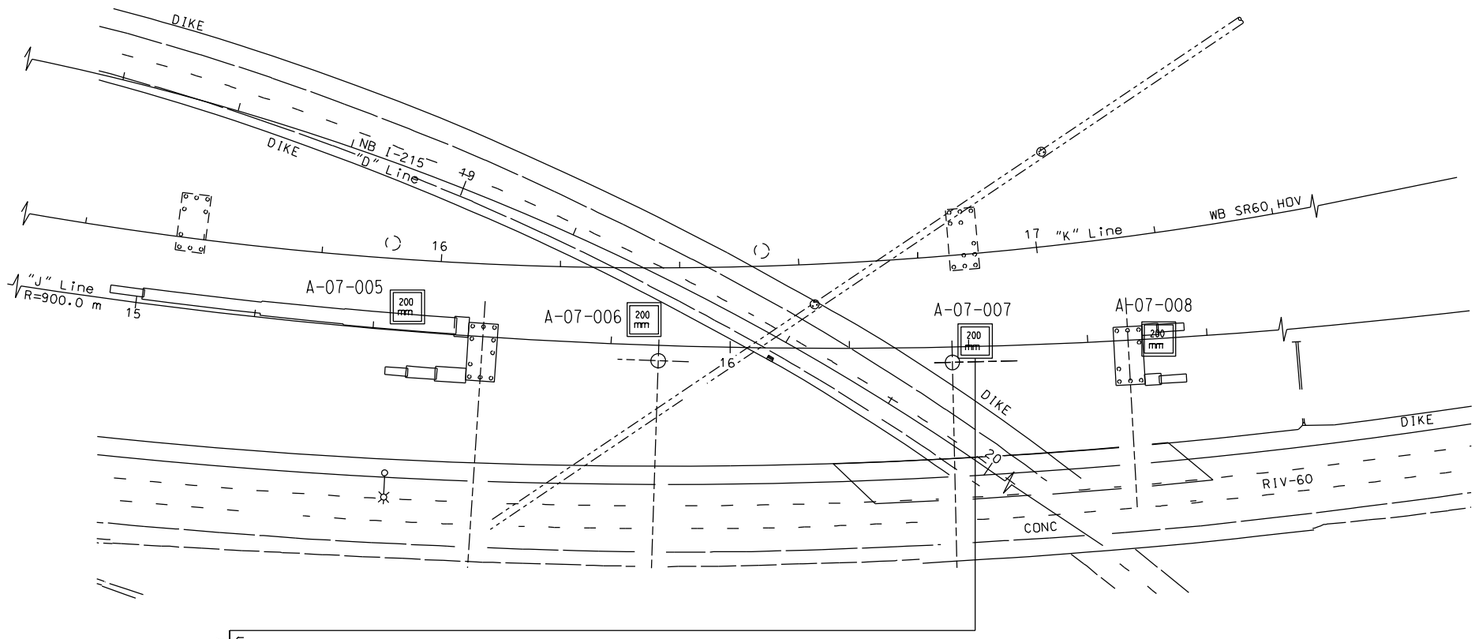

PLAN
1:500

BENCH MARK:

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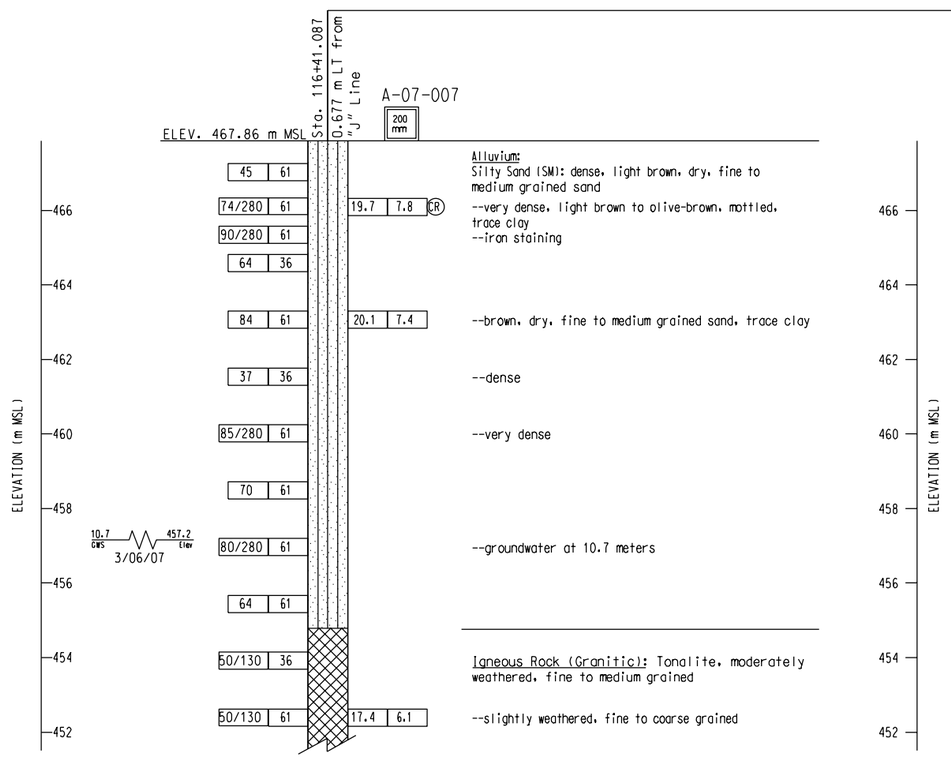

PROFILE
VERTICAL SCALE 1:2

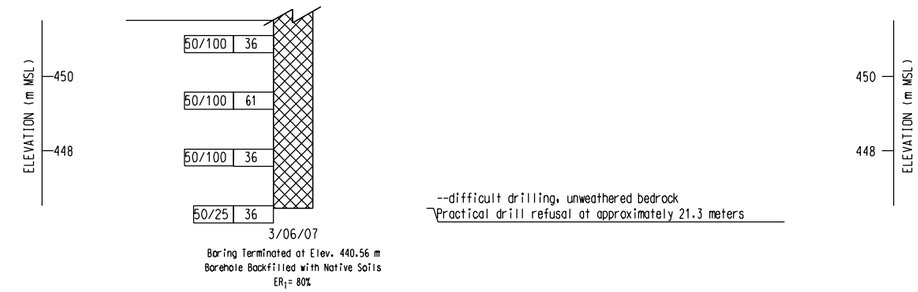

PLATE 4I

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D.FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 3 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

DISREGARD PRINTS BEARING EARLIER REVISION DATES

REVISION DATES: 3/12/08 7/21/08 11/4/08 2/13/09 5/20/09

SHEET 29 OF 30

FILE -) $REQUEST

USERNAME -%USER DATE PLOTTED -) $DATE TIME PLOTTED -) $TIME

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215/60			

Caltrans Metric

Carlos V. Amante
CERTIFIED ENGINEERING GEOLOGIST

REGISTERED GEOLOGIST CARLOS AMANTE No. GE2724 Exp. 6-30-10 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

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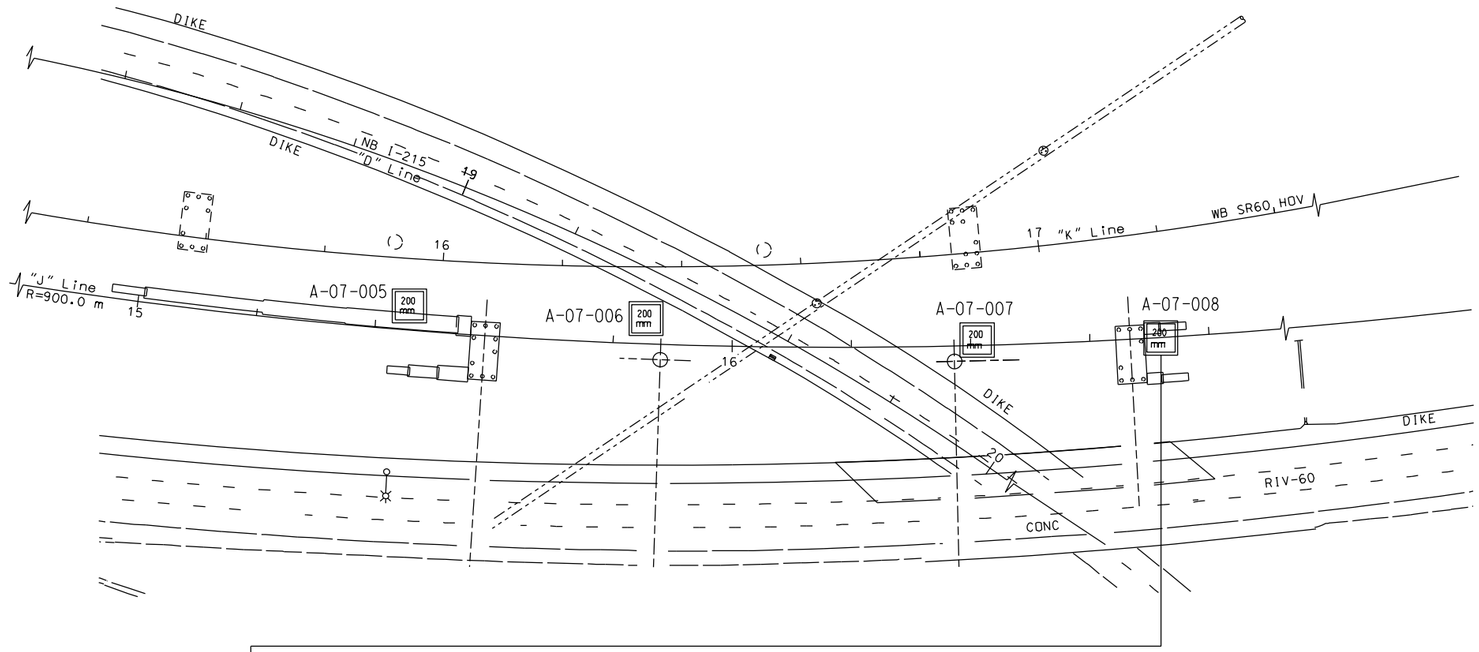
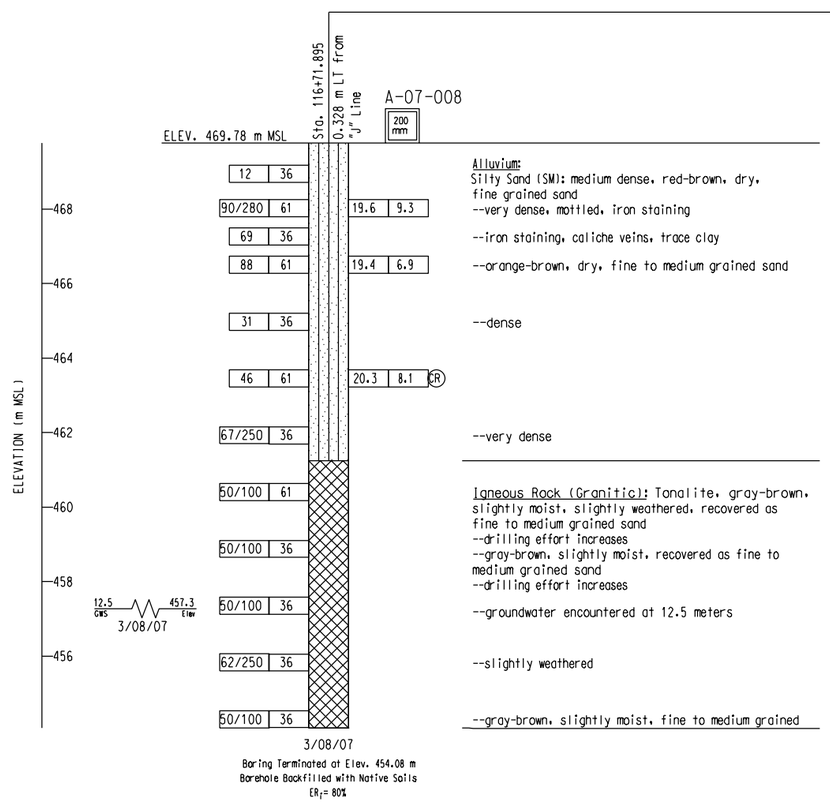
4080 LEMON STREET - THIRD FLOOR
RIVERSIDE, CALIFORNIA 92501

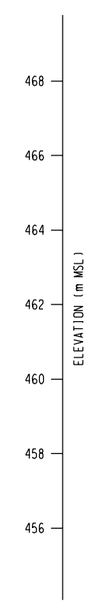
LIM & NASCIMENTO ENGINEERING
1887 BUSINESS CENTER DRIVE, SUITE 6
SAN BERNARDINO, CALIFORNIA 92408

KLEINFELDER
1220 RESEARCH DRIVE, SUITE B
REDLANDS, CALIFORNIA 92374

PLAN
1:500







PROFILE
VERTICAL SCALE 1:2

BENCH MARK:

Pt # 3030 Elevation 472.840, Found 2 iron pipe with Brass Cap Stamped Dept of Trans RIV 60-12.7 1990 112 southwesterly of bridge.
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E = 1903554.738

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PLATE 4m

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DESIGN OVERSIGHT

SIGN OFF DATE

DRAWN BY D. FAHRNEY

CHECKED BY C. AMANTE

PREPARED FOR THE STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION

C. AMANTE
PROJECT ENGINEER

BRIDGE NO. 56-0842

KILOMETER POST R19.6

EB SR60 HOV CONNECTOR

LOG OF TEST BORINGS NO. 4 OF 4

ORIGINAL SCALE IN MILLIMETERS FOR REDUCED PLANS 0 10 20 30 40 50 60 70 80 90

CU 08
EA 449311

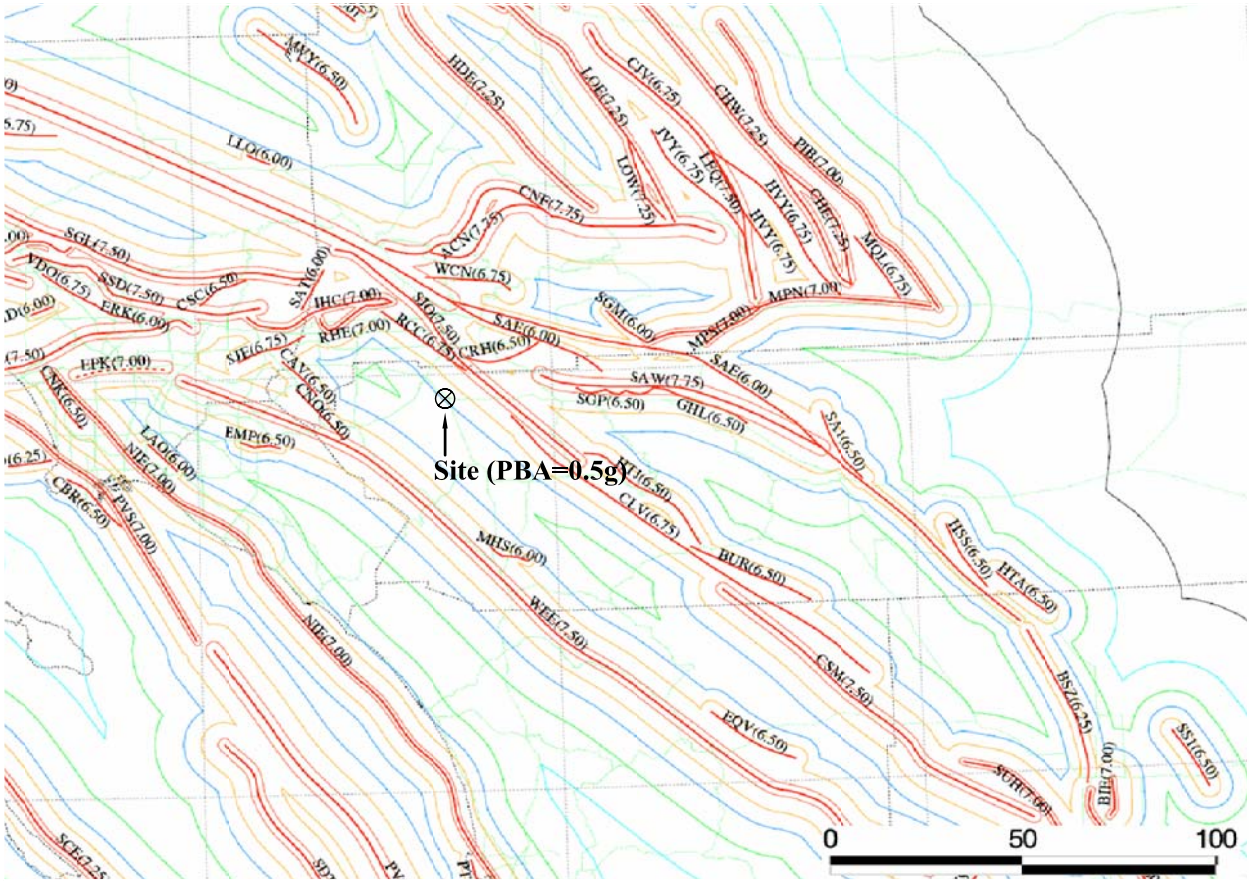
FILE -) $REQUEST

DISREGARD PRINTS BEARING EARLIER REVISION DATES 3/12/08 7/21/08 11/14/08 2/13/09 5/20/09

SHEET 30 OF 30

USERNAME -$USER DATE PLOTTED -) $DATE TIME PLOTTED -) $TIME

ATTACHED IMAGES: Images: Fault.tif Images: Fault-legend.tif
ATTACHED XREFS:
DIAMOND BAR, CA CAD FILE: L:\2009\CADD\76979\I-215_SR60\021609_EB&WB-SR60-HOV\ LAYOUT: 5 PLOTTED: 16 Feb 2009, 9:38am, MGriffin



APPROXIMATE SCALE (KILOMETERS)

LEGEND:

- 0.7g Peak Acceleration Contour
- 0.6g Peak Acceleration Contour
- 0.5g Peak Acceleration Contour
- 0.4g Peak Acceleration Contour
- 0.3g Peak Acceleration Contour
- 0.2g Peak Acceleration Contour
- 0.1g Peak Acceleration Contour
- Special Seismic Source (SSS)
- Faults with Fault Codes (MCE)
- State Highways
- County Boundary
- Latitude & Longitude

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KLEINFELDER
Bright People. Right Solutions.
www.kleinfelder.com

PROJECT NO.	76979
DRAWN:	2/16/09
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p5.dwg

FAULT AND PBA MAP

I-215/SR60 EAST JUNCTION
EB & WB SR60 HOV CONNECTORS
RIVERSIDE, CALIFORNIA

PLATE
5

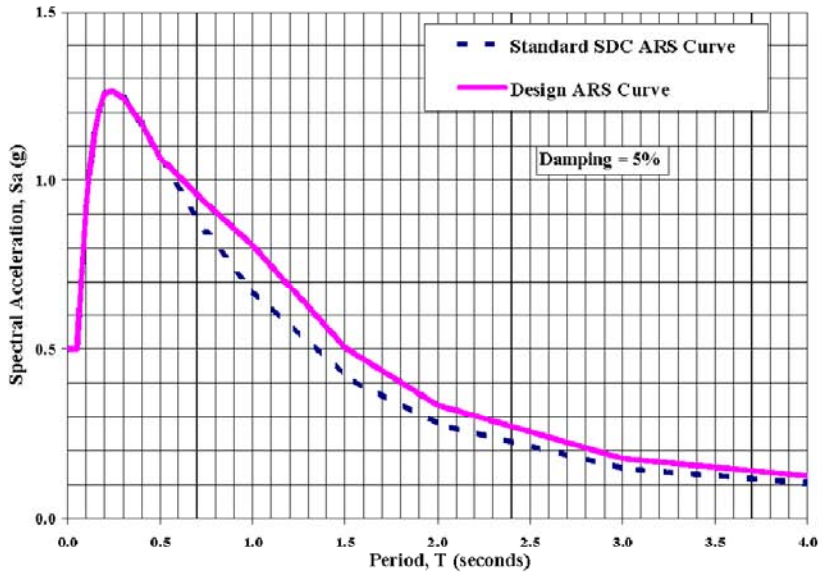
CALTRANS BRIDGE DESIGN ARS CURVE

(Version 4.0, Copyright 2007, Developed By: GeoSoftware Solutions, All Rights Reserved, http://www.geosoftwaresolutions.com)
(Licensed to: Kleinfelder West, Inc. - Redlands, California)

PROJECT INFORMATION	
Project Name	I-215/SR60 East Junction
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS	
Controlling Fault Name	San Jacinto (SJO)
Fault Type	Strike-slip (SS)
MCE Moment Magnitude	7.50
Distance to Fault	8.80 kilometers
Peak Bedrock Acceleration Based on 1996 California Seismic Hazard Map	0.5 g
Soil Profile Type	C

COMPUTED RESULTS	
Peak Bedrock Acceleration Based on Sadigh et al. (1997)[1]	0.46 g
Design Peak Bedrock Acceleration (g)	0.50 g



COMPUTED ARS CURVES

Period T (seconds)	Standard SDC ARS Curve[2] Sa (g)	Design ARS Curve[3] Sa (g)
0.010	0.500	0.500
0.020	0.500	0.500
0.030	0.500	0.500
0.050	0.500	0.500
0.075	0.719	0.719
0.100	0.919	0.919
0.120	1.037	1.037
0.150	1.155	1.155
0.170	1.207	1.207
0.200	1.256	1.256
0.240	1.264	1.264
0.300	1.244	1.244
0.400	1.168	1.168
0.500	1.067	1.067
0.750	0.847	0.932
1.000	0.674	0.808
1.500	0.419	0.503
2.000	0.278	0.334
3.000	0.147	0.177
4.000	0.104	0.125

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

NOTES:

[1]Peak Bedrock Acceleration (PBA):
Estimated using attenuation relationship by Sadigh et al. (1997) for rock site.
Sadigh et al. (1997) recommended no increase for Strike-Slip Fault, 10% increase for Oblique Fault; and 20% increase for Reverse/Thrust Fault. If type of fault is unknown, a 10% increase is assumed.

[2]Standard Seismic Design Criteria (SDC) ARS Curve:
Used Caltrans standard SDC ARS curve for the given PBA, magnitude, and soil profile type.

[3]Design ARS Curve:
When the bridge is located within 15 km of the controlling fault, the standard SDC ARS curve was modified as follows to account for fault rupture directivity effect:
- For Periods < 0.5 sec, no increase in standard SDC spectral acceleration values.
- For Periods > 1.0 sec, the standard SDC spectral acceleration values were increased by 20%.
- For Periods between 0.5 sec and 1.0 sec, spectral acceleration values were linearly interpolated.

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PRELIMINARY DESIGN ARS CURVE

I-215/SR-60 EAST JUNCTION
EB & WB SR60 HOV CONNECTORS
RIVERSIDE, CALIFORNIA

PLATE
6

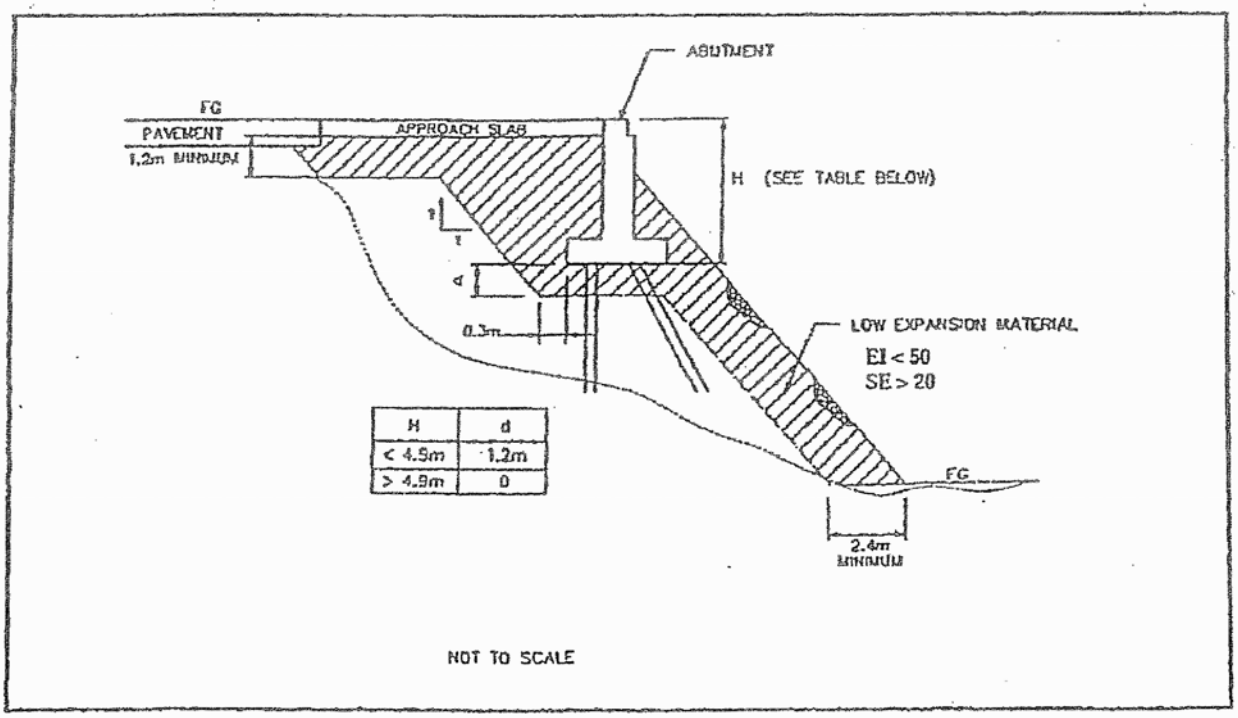
ATTACHED IMAGES: Images: Plate6-ARS Curve_1.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\021609_EB&WB-SR60-HOV\ LAYOUT: 6
PLOTTED: 16 Feb 2009, 9:31am, MGriffin

EXPANSIVE SOIL EXCLUSION ZONE

GUIDELINE FOR DEFINING EXPANSIVE SOIL AND THE ZONE AROUND BRIDGE ABUTMENTS IN WHICH EXPANSIVE SOIL IS TO BE EXCLUDED (ALSO APPLICABLE TO WINGWALLS AND RETAINING WALLS).

Expansive soil materials shall not be placed as part of the embankment within the limits of a bridge abutment as shown in Figure 7 below for the full width of the embankment. Expansive soil materials for this requirement are defined as having either an Expansion Index (EI) greater than 50, (Expansion Index to be determined in accordance with ASTM D 4829) or a Sand Equivalent (SE) less than 20 (Sand Equivalent to be determined in accordance with California Test Method 217). This requirement is exclusive of the structure backfill and pervious backfill material requirements as shown on the plans and set forth in the Standard Specifications under Sections 19-3.06 and 19-3.065 respectively.

TYPICAL SECTION - EXPANSIVE SOIL EXCLUSION ZONE IN BRIDGE EMBANKMENT



H	d
< 4.9m	1.2m
> 4.9m	0

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CHECKED BY:	MC
FILE NAME:	76979p7.dwg

EXPANSIVE SOIL EXCLUSION ZONE

I-215/SR-60 EAST JUNCTION
EB AND WB SR-60 HOV CONNECTORS
RIVERSIDE, CALIFORNIA

PLATE
7

ATTACHED IMAGES: Images: For Plate 9.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\050309_Box-Spring_OH_Widening\05-18-09\ LAYOUT: 7 PLOTTED: 18 May 2009, 10:05am, MGriffin

APPENDIX A

FIELD EXPLORATION

APPENDIX A
FIELD EXPLORATION

The subsurface exploration program for the Eastbound and Westbound SR60 HOV Connectors consisted of drilling and logging 8 exploratory soil borings HV-1 through HV-8 (LOTB Nos. A-07-001 through A-07-008) on March 5, 6 and 8, 2007. These borings were advanced to depths ranging from approximately 15.7 to 23.5 meters below the existing ground surface (bgs). The borings were advanced using a Mobile B-61, truck-mounted drill rig equipped with 200-mm diameter hollow-stem augers with an automatic hammer delivery system. The borings were logged and sampled using the modified California (ring) and Standard Penetration Test (SPT) samplers at selected intervals in accordance ASTM and Caltrans standards. The ring and SPT samplers were driven using a 63.6-kg hammer falling freely for 760 mm. The hammer efficiency was approximately 80 percent. In addition, representative bulk samples were collected from the borings. Following drilling, sampling and logging, the borings were backfilled with native cuttings.

The boring locations are shown on Plates 4d through 4g for the EB SR-60 HOV Connector and Plates 4k through 4m for the WB SR-60 HOV Connector. The boring locations, stations and offsets, and elevations were obtained from survey data provided by LAN Engineering.

The boring logs are presented on Plates A2 through A8 at the end of this appendix. The logs describe the earth materials encountered during drilling, and indicate the locations of the samples obtained and infill thickness measured in the bedrock. The excavations were logged by a staff professional from Kleinfelder using methods outlined in the Unified Soil Classification System (USCS) and general procedures established in ASTM D2488. The boundaries between soil and rock type(s) shown on the logs are approximate because the transition between different soil and rock layer(s) may be gradual.

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UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	ID	DESCRIPTION	MAJOR DIVISION		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Well-graded gravels, gravel-sand mixtures	FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands
		GP		Poorly-graded gravels, gravel-sand mixtures			CL		Inorganic clays of low to medium plasticity; gravelly clays silty clays,sandy clays, lean clays
		GM		Silty gravels, gravel-sand-silt mixtures			OL		Organic silts and organic silt-clays of low plasticity
		GC		Clayey gravels, gravel-sand-clay mixtures					
	SAND AND SANDY SOILS	SW		Well-graded sands, gravelly sands		SILTS AND CLAYS LL > 50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		SP		Poorly-graded sands and gravelly sands			CH		Inorganic clays of medium to high plasticity
		SM		Silty sands, sand-silt mixture			OH		Organic clays of medium to high plasticity
		SC		Clayey sands, sand-clay mixture		HIGHLY ORGANIC SOILS	Pt		Peat, muck and other highly organic soils

▼ Approximate water level observed in boring following drilling

SOIL SAMPLE

- Bulk Sample
- Drive Sample - California Sample
- Shelby Tube Sample
- Standard Penetration Test (SPT) Sample

ADDITIONAL TESTS

CN	- Consolidation
COR	- Corrosion
CP	- Collapse Potential
DS	- Direct Shear
EI	- Expansion Potential
MAX	- Maximum Dry Density
OC	- Organic Content
PI	- Plasticity Index
RV	- R-Value
SE	- Sand Equivalent
GS	- Grain Size Distribution

NOTES:

Blow counts represent the number of blows of a 64-kilogram hammer falling 760 mm required to drive a sampler through the last 300 mm of a 460 mm penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

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LEGEND TO LOGS

PLATE A-1

Date Drilled	3/5/07	Water Depth:	29 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/5/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	465 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
							Alluvium			
464	1	1	36, 50/130			SM	**Silty Sand:** light brown, dry, fine grained sand			
		2								
463	2	3	32, 50/130				--fine to medium grained sand	19.6	5.6	
		4	42				--olive-brown, dense			GS
462	3	5	68				--very dense	20.8	6.1	DS
461	4									
460	5	6	37				--dense, trace iron staining			
459	6	7	62				--very dense	18.5	3.7	
458	7									
457	8	8	40				--dense, fine to medium grained sand			
456	9					▼	--groundwater encountered at 8.3 meters after drilling			
		9	62				--very dense, trace clay			
455										

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV- 1

PLATE A-2a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
454	10	59							
11									
453									
12	11	48				--dense			
452									
13									
451	12	48							
14									
450									
15	13	72				--very dense			

Boring terminated at 15.7 meters.
Groundwater encountered at 8.8 meters after drilling.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV- 1

PLATE

A-2b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/5/07	Water Depth:	33 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/5/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	465 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
							Alluvium			
464	1	1	34, 50/150			SM	**Silty Sand:** light brown, dry, very dense, fine to medium grained sand			
		2								COR
463	2	3	33, 50/100				--fine to coarse grained sand, caliche			
		4	50/130				--fine grained sand		10.2	
462	3	5	28				--medium dense			
461	4									
460	5	6	74				--red-brown, very dense	20.0	7.7	
459	6	7	51			SP-SM	**Sand with Silt:** brown, dry, very dense, fine to coarse grained sand			
458	7									
457	8	8	66			SM	**Silty Sand:** light brown, dry, fine to medium grained sand, trace clay			
456	9	9	67				--slightly moist			
455										

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PLATE A-3a

PROJECT NO. 76979

LOG OF BORING HV- 2

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--groundwater encountered at 10 meters after drilling			
454 / 11	10	70				--trace clay	18.8	13.0	
453 / 12	11	28, 50/13							
452 / 13						--some clay			
451 / 14	12	34				--moist, dense			
450 / 15	13	72			SC	**Clayey Sand:** red-brown, slightly moist, very dense, fine to medium grained sand	19.5	12.8	
449 / 16									
448 / 17	14	43				--dense			
447 / 18	15	46, 50/7				--very dense			
446 / 19									
445 / 20	16	46, 50/7				**<u>Bedrock:</u>** Tonalite, moderately weathered			
444 / 21									

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV- 2

PLATE

A-3b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
	17	50							
443									
22									
442									
23	18	50/75							
441									
24									
	19	50/50							
440						Practical drill refusal at 25 meters			

Boring terminated at 25 meters due to practical refusal, lead auger sheared in half at 25 meters due to tight drilling in bedrock.
Groundwater encountered at 10 meters after drilling.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV- 2

PLATE

A-3c

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/8/07	Water Depth:	36 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	467 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1					**Fill**			
466	1	2	39			SM	**Silty Sand:** dark brown, dense, fine to coarse grained sand, with fine gravel and asphalt grindings			
465	2	3	29				--medium dense, asphalt grindings	15.3	6.6	
		4	13				--fine grained sand, trace medium sand, iron staining, gravel content decreasing			
464	3	5	4			SM	**Alluvium** **Silty Sand:** brown, slightly moist, loose			GS
463	4									
462	5	6	77				--red-brown, slightly moist, very dense, fine to medium grained sand, trace clay	20.7	7.0	
461	6	7	33				--dense, fine grained sand			
460	7									
459	8	8	64			SC	**Clayey Sand:** brown, moist, very dense, fine grained sand			
458	9									
457		9	33, 50/13				--very dense			

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-2a

PROJECT NO. 76979

LOG OF BORING HV- 3

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
456 11	10	33, 50/13				--groundwater encountered at 11 meters			
455 12	11	50/75				**Bedrock:** Tonalite, gray-brown, wet, moderately weathered --drilling effort increases			
454 13									
453 14	12	50/75				--gray			
452 15						--very difficult drilling			
	13	50/75				--slightly weathered, moist, gray-brown, fine to medium grained	20.0	3.0	DS
451 16									
450 17	14	50/50				--wet Practical drill refusal at 17.1 meters			

Boring terminated at 17.1 meters due to practical refusal.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-2b

PROJECT NO. 76979

LOG OF BORING HV- 3

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/8/07	Water Depth:	38 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	468 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
468		1					**Fill**			
	1	2	14			SM	**Silty Sand:** red-brown, dry, medium dense, fine to medium grained sand, trace coarse sand			
467							**Alluvium**			
		3	32			SM	**Silty Sand:** brown, slightly moist, medium dense, fine to coarse grained sand	20.3	5.8	
	2	4	14				--roots			
466										
	3	5	58				--brown, slightly moist, very dense, fine grained sand			
465										
	4									
464		6	48				--orange-brown, dry, dense			
	5									
463										
	6	7	36, 50/13							
462										
	7									
461		8	37				--dense			
	8									
460										
	9	9	30, 50/13			SC	**Clayey Sand:** red-brown, moist, very dense	20.3	10.2	
459										

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I-215/SR60 East Junction
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Riverside, California

PLATE
A-5a

PROJECT NO. 76979

LOG OF BORING HV- 4

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
458									
11 / 457	10	34, 50/5				**Bedrock:** Tonalite, tan-brown, dry, slightly weathered, recovered as fine to medium grained sand			
					▼	--groundwater encountered at approximately 11.6 meters			
12 / 456	11	50/150							
13 / 455									
14 / 454	12	50/130							
15 / 453									
	13	50/130							
						Boring terminated at 15.7 meters. Groundwater encountered at 11.6 meters. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
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Riverside, California

LOG OF BORING HV- 4

PLATE

A-5b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/5/07	Water Depth:	35 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/5/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	466 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
466		1					**Alluvium**			
	1	2	88			SM	**Silty Sand:** light brown, dry, very dense, fine grained sand			
465		3	23, 50/130				--fine to medium grained sand	19.2	2.5	
	2	4	48				--dense, trace clay			
464										
	3	5	83				--very dense			
463										
	4									
462		6	54				--dense			
	5									
461										
	6	7	49, 50/78				--very dense	20.7	6.4	
460										
	7									
459		8	40				--dense			
	8									
458										
	9									
457		9	41, 50/100				--very dense	20.0	9.4	DS

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV- 5

PLATE

A-6a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
456						--drilling effort increases			
	10	43			▼	--slightly moist, dense, trace clay, groundwater encountered at 10.7 meters			
11 / 455									
12 / 454	11	56				--very dense			
13 / 453									
14 / 452	12	47				--dense			
15 / 451									
	13	47, 50/100				--very dense			
						Boring terminated at 15.7 meters. Groundwater encountered at 10.7 meters. Some caving observed in borehole after removal of augers. Hole backfilled and tamped using soil from cuttings.			

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV- 5

PLATE

A-6b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/6/07	Water Depth:	34 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/6/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	466 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium** **Silty Sand:** brown, dry, medium dense, fine grained sand			
465	1	1 2	27							
		3	22							
464	2									
		4	23			SW-SM	**Sand with Silt:** light brown, dry, medium dense, fine to coarse grained sand	17.2	1.2	DS
463	3	5	6				--loose			GS
462	4									
		6	43			SM	**Silty Sand:** brown, dry, dense, fine grained sand			
461	5									
460	6	7	29				--medium dense, trace clay			
459	7									
458	8	8	33, 50/13				--very dense, fine to medium grained, sand			
457	9	9	27, 50/13				--slightly moist			
456										

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-3a

PROJECT NO. 76979

LOG OF BORING HV- 6

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--groundwater encountered at 10.4 meters			
455 11	10	35, 50/130				--moist			
454 12	11	28, 50/100				--wet			
453 13									
452 14	12	41				--dense			
451 15	13	20, 50/130				--very dense, trace clay			
450 16									
449 17	14	34, 50/130				**Bedrock:** Tonalite, moderately weathered			
448 18	15	50/100				--slightly weathered			
447 19									
446 20	16	50/130							
445 21									

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PROJECT NO. 76979

I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

LOG OF BORING HV- 6

PLATE
A-3b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
	17	50/130					18.4	20.8	
444 22									
443 23	18	50/100							
442 24									
	19	50/50							
441 25									
						Practical drill refusal on on bedrock at approximately 25.3 meters			
						Boring terminated at 25.3 meters due to practical refusal. Groundwater encountered at 10.4 meters. Hole backfilled and tamped using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

LOG OF BORING HV- 6

PLATE

A-3c

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/6/07	Water Depth:	35 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/6/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	468 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium** **Silty Sand:** light brown, dry, dense, fine to medium grained sand			
467	1	1 2	45							COR
466	2	3	24, 50/130				--very dense, light brown to olive-brown, mottled, trace clay	19.7	7.8	
		4	40, 50/130				--iron staining			
465	3	5	64							
464	4									
463	5	6	84				--brown, dry, fine to medium grained sand, trace clay	20.1	7.4	
462	6	7	37				--dense			
461	7									
460	8	8	35, 50/130				--very dense			
459	9	9	70							
458	10									

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-4a

PROJECT NO. 76979

LOG OF BORING HV- 7

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
457 / 11	10	30, 50/13				--groundwater at 10.7 meters			
456 / 12	11	64							
455 / 13									
454 / 14	12	50/130				**Bedrock:** Tonalite, moderately weathered, fine to medium grained			
453 / 15	13	50/130				--slightly weathered, fine to coarse grained	17.4	6.1	
452 / 16									
451 / 17	14	50/100							
450 / 18	15	50/100							
449 / 19									
448 / 20	16	50/100							
447 / 21	17	50/25				--difficult drilling, unweathered bedrock Practical drill refusal at approximately 21.3 meters			

Boring terminated at 21.3 meters due to practical refusal.
Groundwater encountered at 10.7 meters.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-4b

PROJECT NO. 76979

LOG OF BORING HV- 7

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Date Drilled	3/8/07	Water Depth:	41 meters (approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	470 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
469	1	2 1	12			SM	**Alluvium** **Silty Sand:** red-brown, dry, medium dense, fine grained sand			
468	2	3	40, 50/13				--very dense, mottled, iron staining	19.6	9.3	
		4	69				--iron staining, caliche veins, trace clay			
467	3	5	88				--orange-brown, dry, fine to medium grained sand	19.4	6.9	
466	4									
465	5	6	31				--dense			
464	6	7	46					20.3	8.1	DS
463	7									
462	8	8	17, 50/10				--very dense			
461	9	9	50/100				**Bedrock:** Tonalite, gray-brown, slightly moist, slightly weathered, recovered as fine to medium grained sand			
460										

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PROJECT NO. 76979

I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV- 8

PLATE
A-9a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--drilling effort increases			
459 11	10	50/100				--gray-brown, slightly moist, recovered as fine to medium grained sand			
						--drilling effort increases			
458 12									
	11	50/100			▼	--groundwater encountered at 12.5 meters			
457 13									
456 14	12	15, 50/10				--slightly weathered			
455 15									
	13	50/100				--gray-brown, slightly moist, fine to medium grained			
						Boring terminated at 15.7 meters. Groundwater encountered at 12.5 meters. Hole backfilled and tamped using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV- 8

PLATE

A-9b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-KA FORMAT.GPJ KA_RDLND.GDT 2/13/09

APPENDIX B

LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

Laboratory tests were performed on drive and bulk soil samples to estimate engineering characteristics of the various earth materials encountered. Testing was performed in general accordance with procedures outlined by the American Society for Testing and Materials, the California Department of Transportation, or other accepted procedures.

IN-SITU MOISTURE CONTENT AND DRY UNIT WEIGHT

In-situ moisture content and dry unit weight tests were performed on samples that could be recovered in a relatively undisturbed condition. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937. The test results are presented on the Logs of Borings in Appendix A, *Field Exploration*.

GRAIN SIZE DISTRIBUTION

Sieve analyses were performed on selected samples of the materials encountered at the site to evaluate the grain size distribution characteristics of the soils and to aid in their classification. The tests were performed in general accordance with ASTM Standard Test Method D 422. The results of these tests are presented on Plate B-1, *Grain Size Distribution*.

DIRECT SHEAR TEST

Five direct shear tests were performed on samples to evaluate the drained shear strength of the soils. The samples were soaked and tested in a near-saturated condition in general accordance with ASTM Test Method D 3080 (consolidated, drained). The results of these tests are presented on Plates B-2 through B-6, *Direct Shear Test*, and summarized in Table B-1, below.

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Table B-1
Direct Shear Test Results

Boring No.	Depth (m)	USCS Soil Type	Dry Unit Weight (kN/m^3)	Angle of Internal Friction (degrees)	Cohesion (kPa)
HV-1	3.0	SM	20.8	40	12.3
HV-3	15.2	Tonalite	20.0	43	0
HV-5	9.1	SM	20.0	36	0
HV-6	2.3	SW-SM	17.2	42	0
HV-8	6.1	SM	20.3	28	16.2

CORROSIVITY TESTS

Chemical analyses were performed on two samples of the sub-surface soil to estimate pH, resistivity, soluble sulfate, and chloride contents in general accordance with Caltrans Standard Test Methods 532 (pH), 643 (resistivity), 417 (sulfates), and 422 (chlorides). The test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to the construction materials. The test results are summarized in Table B-2, below.

Table B-2
Corrosion Test Results

Boring No.	Depth (m)	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
HV-2	0.9 - 2.4	1,200	7.4	7	254
HV-7	0.9 - 2.4	3,200	7.9	5	126

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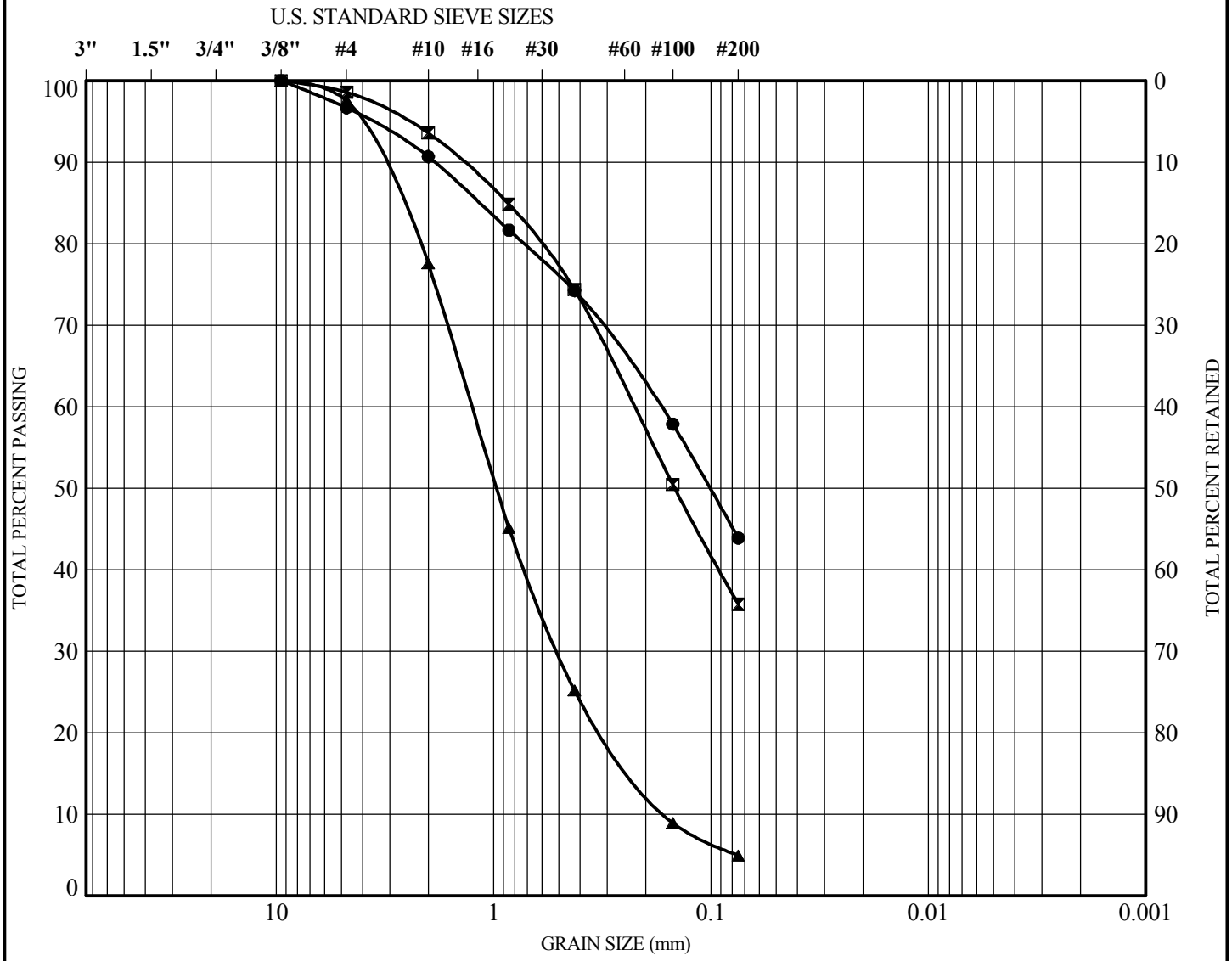
SIEVE ANALYSIS	HYDROMETER



GRAVEL	SAND					SILT	CLAY
	Very Coarse	Coarse	Medium	Fine	Very Fine		

Symbol	Test Pit	Depth (m)	USDA Description	USCS Classification
●	HV- 1	3	Silty Sand	SM
⧗	HV- 3	3	Silty Sand	SM
▲	HV- 6	3	Sand with Silt	SW-SM

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PROJECT NO. 76979

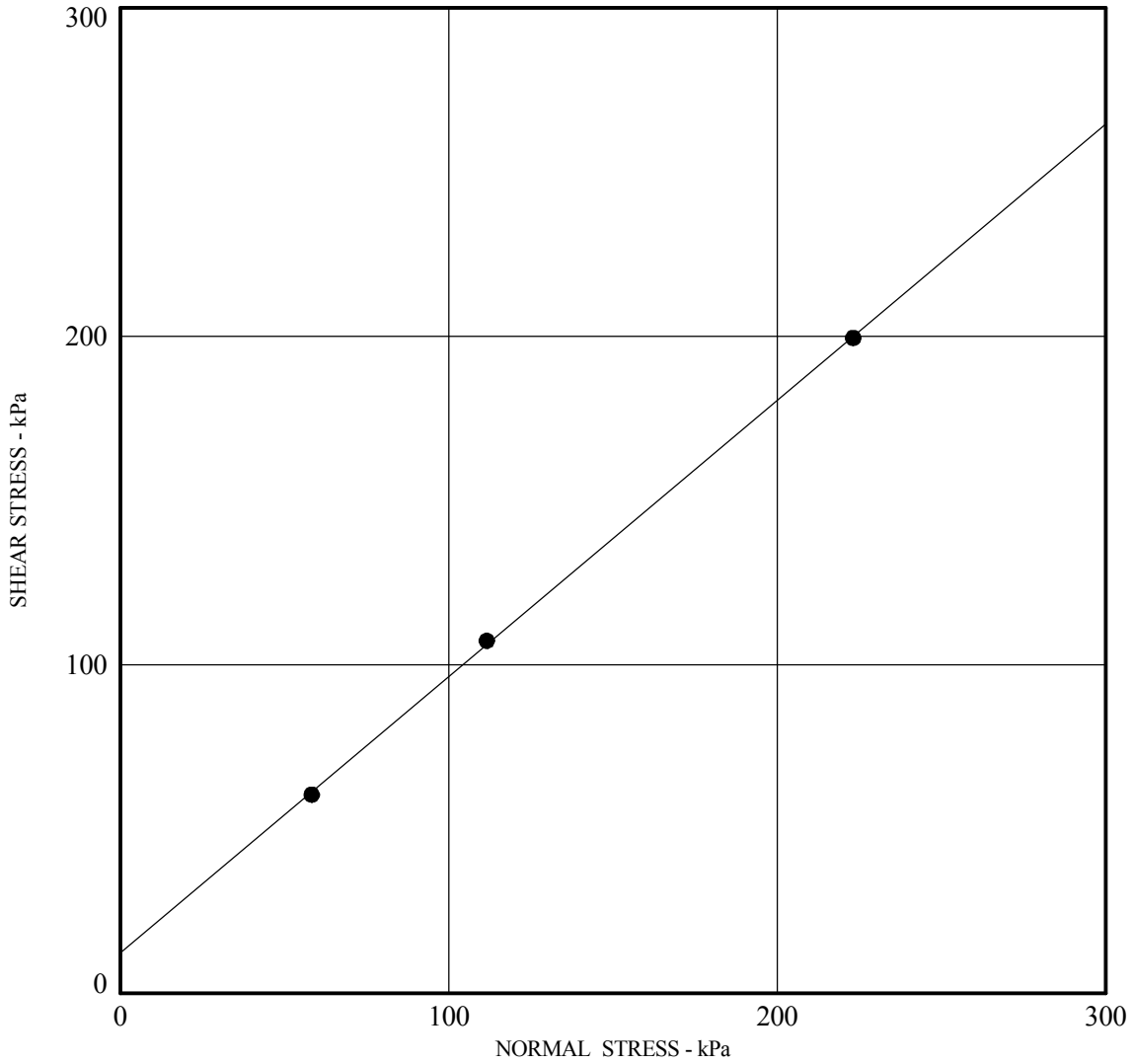
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

GRAIN SIZE DISTRIBUTION

PLATE

B-1

GRAIN SIZE USDA 76979 I-215 SR-EB&WB HOV CONNECTORS.GPJ KA_RDLND.GDT 2/16/09



Boring	**HV- 1**
Depth (m)	**3**
Friction Angle - deg	**40**
Cohesion (kPa)	**12.3**
Dry Density (kN/m^3)	**20.8**
Moisture Content (%) *	**6.1**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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PROJECT NO. 76979

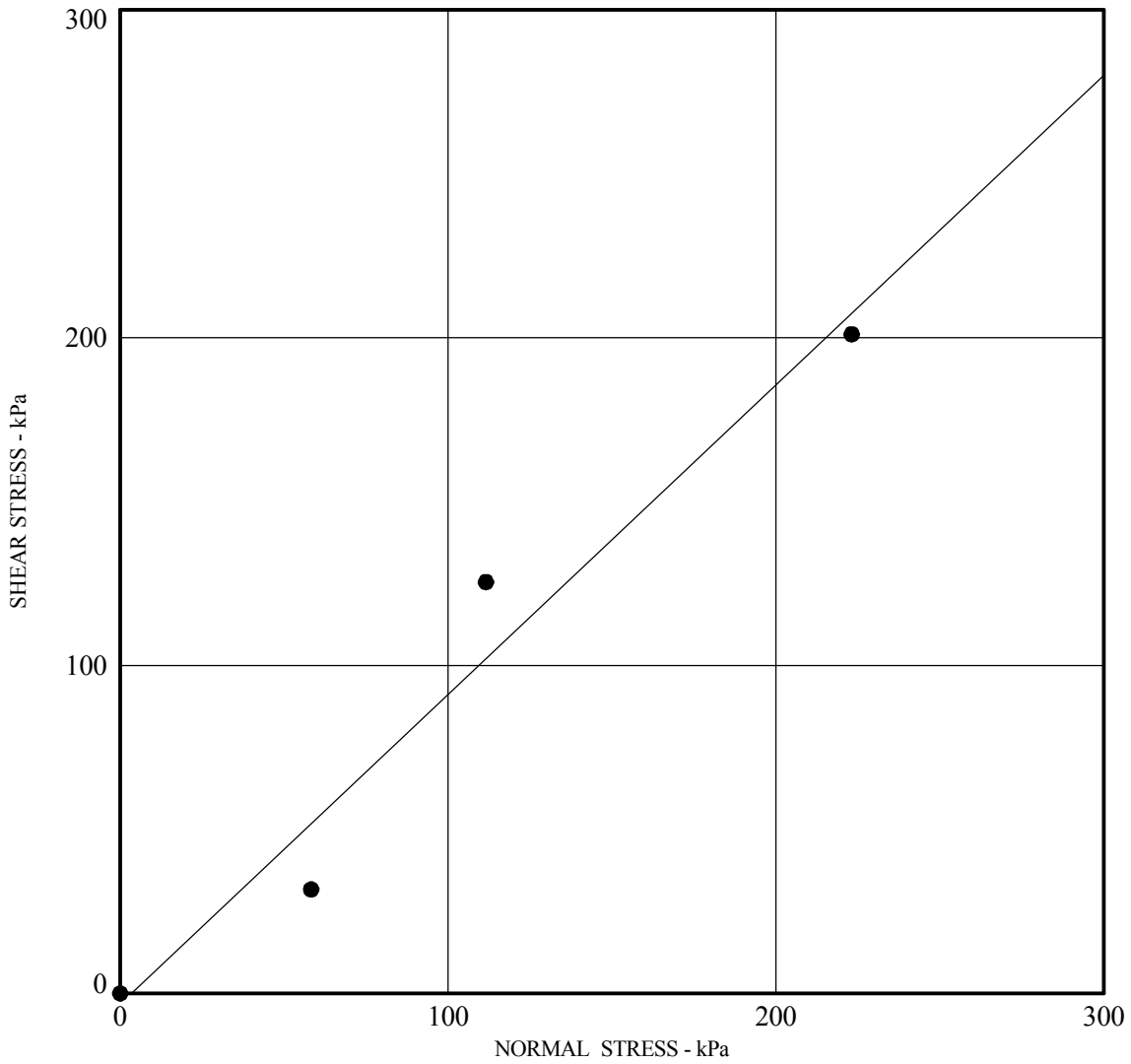
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-2

DIRECT SHEAR STATION 76979 I-215 SR-EB&WB HOV CONNECTORS.GPJ KA_RDLND.GDT 2/16/09



Boring	**HV- 3**
Depth (m)	**15**
Friction Angle - deg	**43**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**20.0**
Moisture Content (%) *	**3.0**
Description	**Tonalite**
Classification	

*** In-situ Test**

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PROJECT NO. 76979

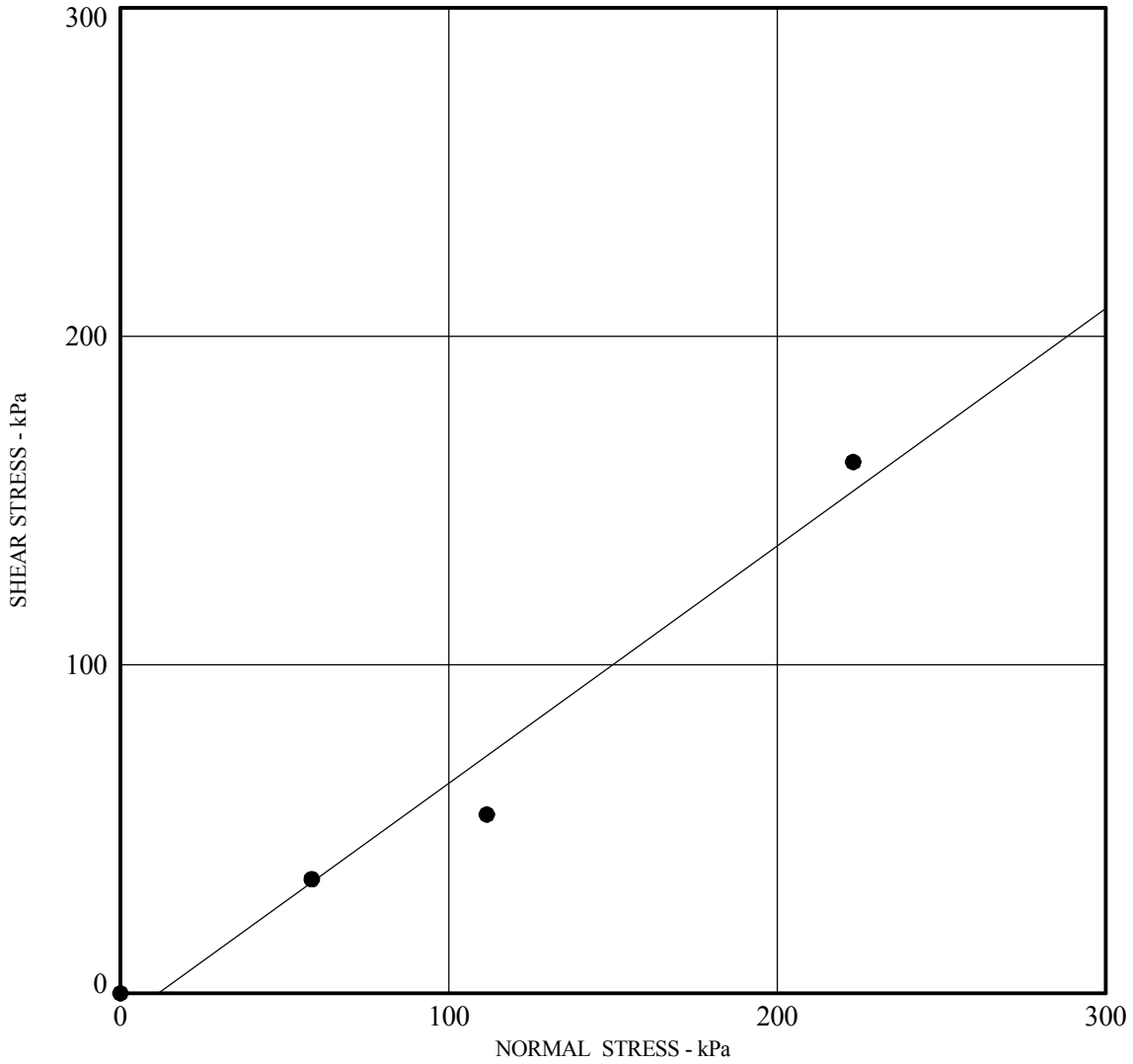
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-3

DIRECT SHEAR STATION 76979 I-215 SR-EB&WB HOV CONNECTORS.GPJ KA_RDLND.GDT 2/16/09



Boring	**HV- 5**
Depth (m)	**9**
Friction Angle - deg	**36**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**20.0**
Moisture Content (%) *	**9.4**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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PROJECT NO. 76979

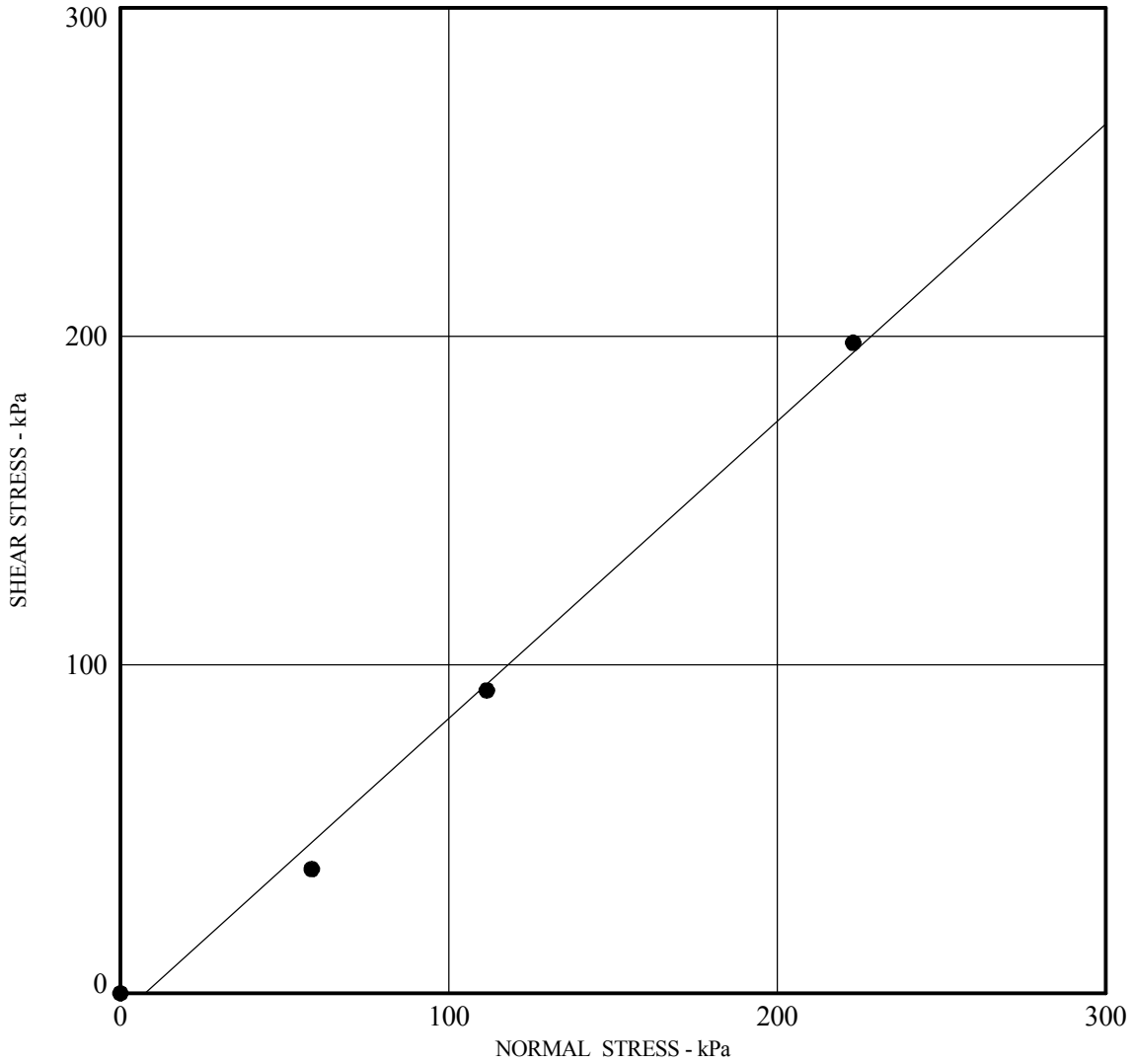
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-4

DIRECT SHEAR STATION 76979 I-215 SR-EB&WB HOV CONNECTORS.GPJ KA_RDLND.GDT 2/16/09



Boring	**HV- 6**
Depth (m)	**2**
Friction Angle - deg	**42**
Cohesion (kPa)	**0.0**
Dry Density (kN/m^3)	**17.2**
Moisture Content (%) *	**1.2**
Description	**Sand with Silt**
Classification	**SW-SM**

*** In-situ Test**

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PROJECT NO. 76979

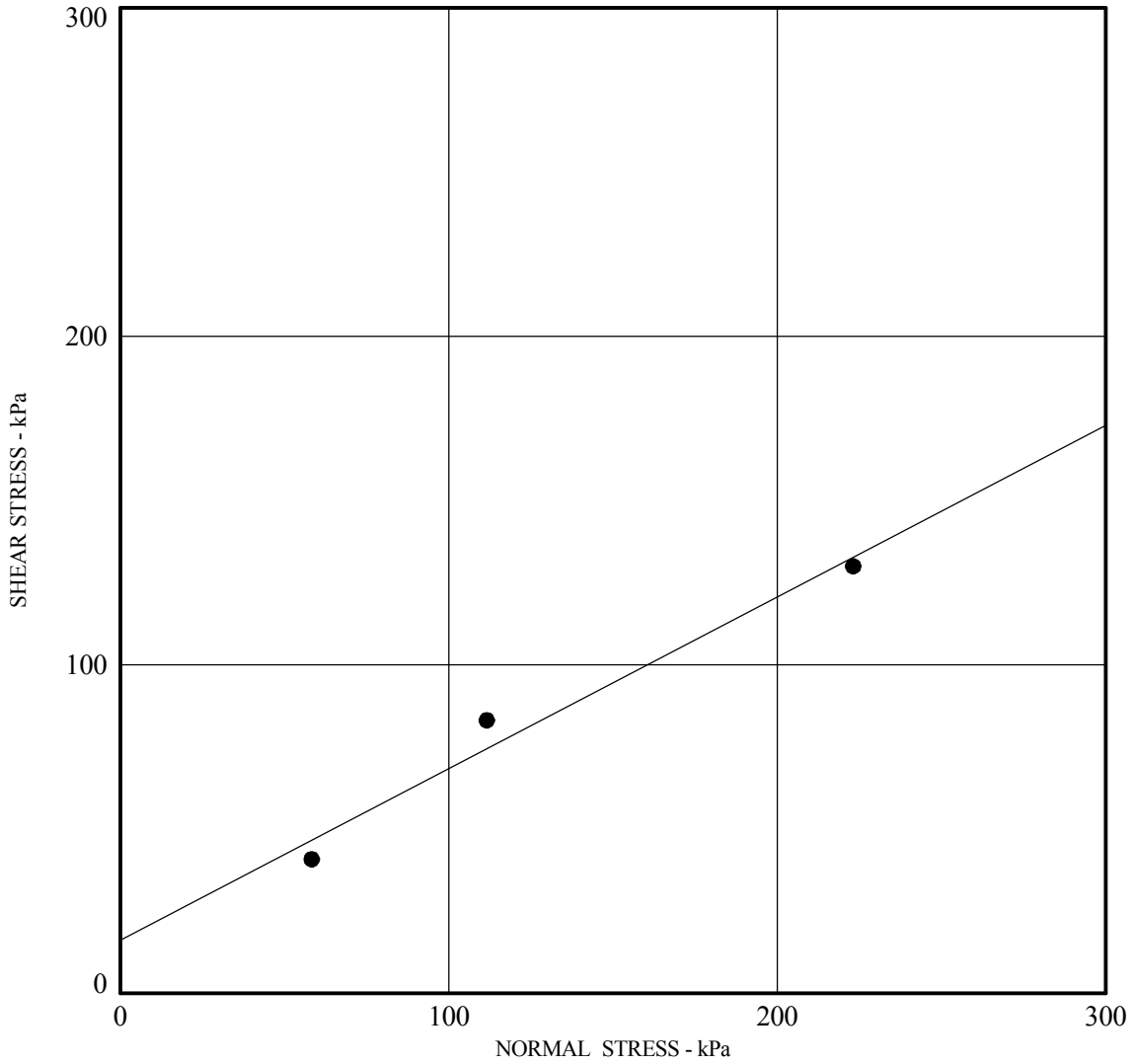
I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-5

DIRECT SHEAR STATION 76979 I-215 SR-EB&WB HOV CONNECTORS.GPJ KA_RDLND.GDT 2/16/09



Boring	**HV- 8**
Depth (m)	**6**
Friction Angle - deg	**28**
Cohesion (kPa)	**16.2**
Dry Density (kN/m^3)	**20.3**
Moisture Content (%) *	**8.1**
Description	**Silty Sand**
Classification	**SM**

*** In-situ Test**

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

DIRECT SHEAR TEST

PLATE

B-6

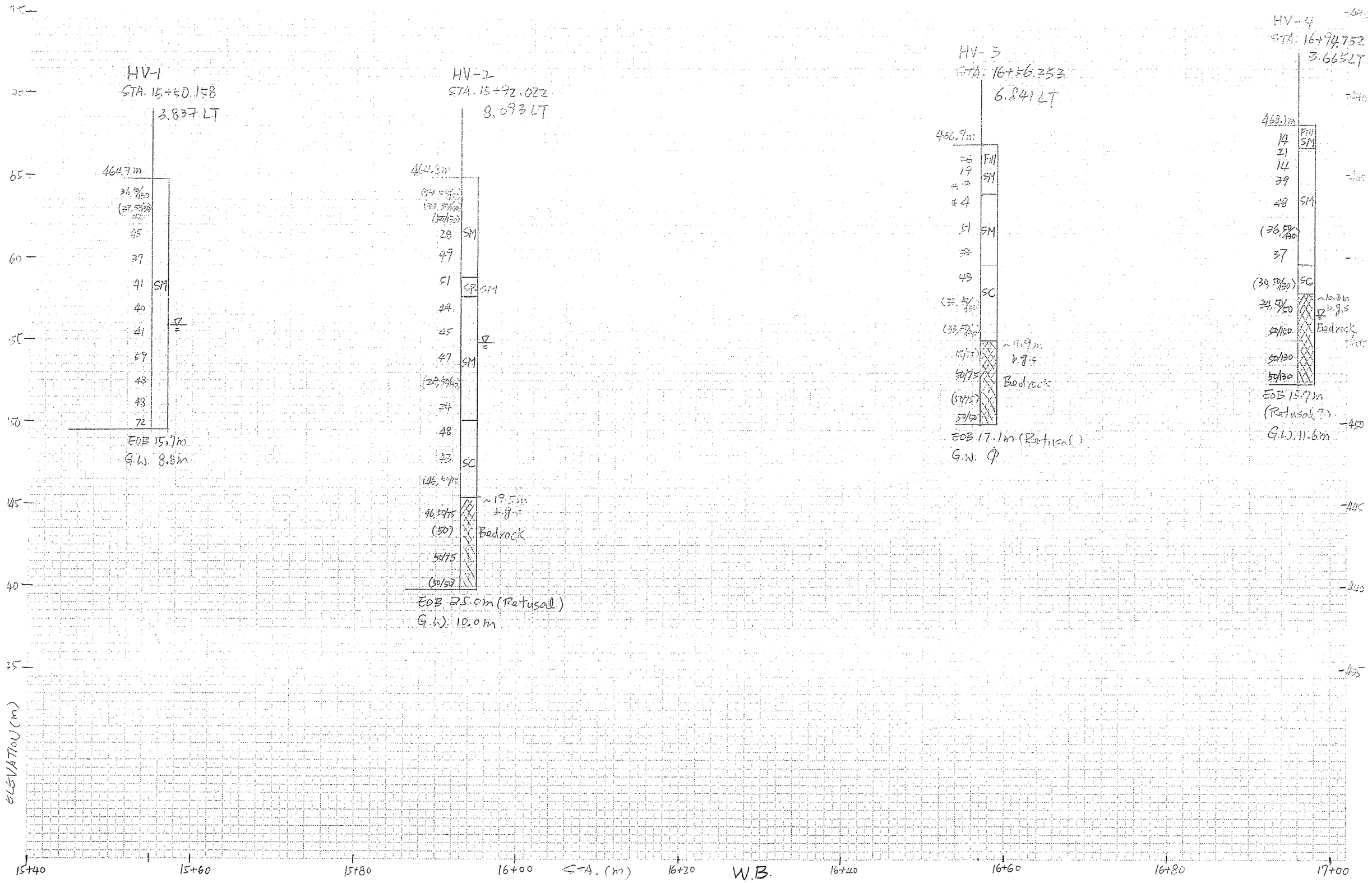
DIRECT SHEAR STATION 76979 I-215 SR-EB&WB HOV CONNECTORS.GPJ KA_RDLND.GDT 2/16/09

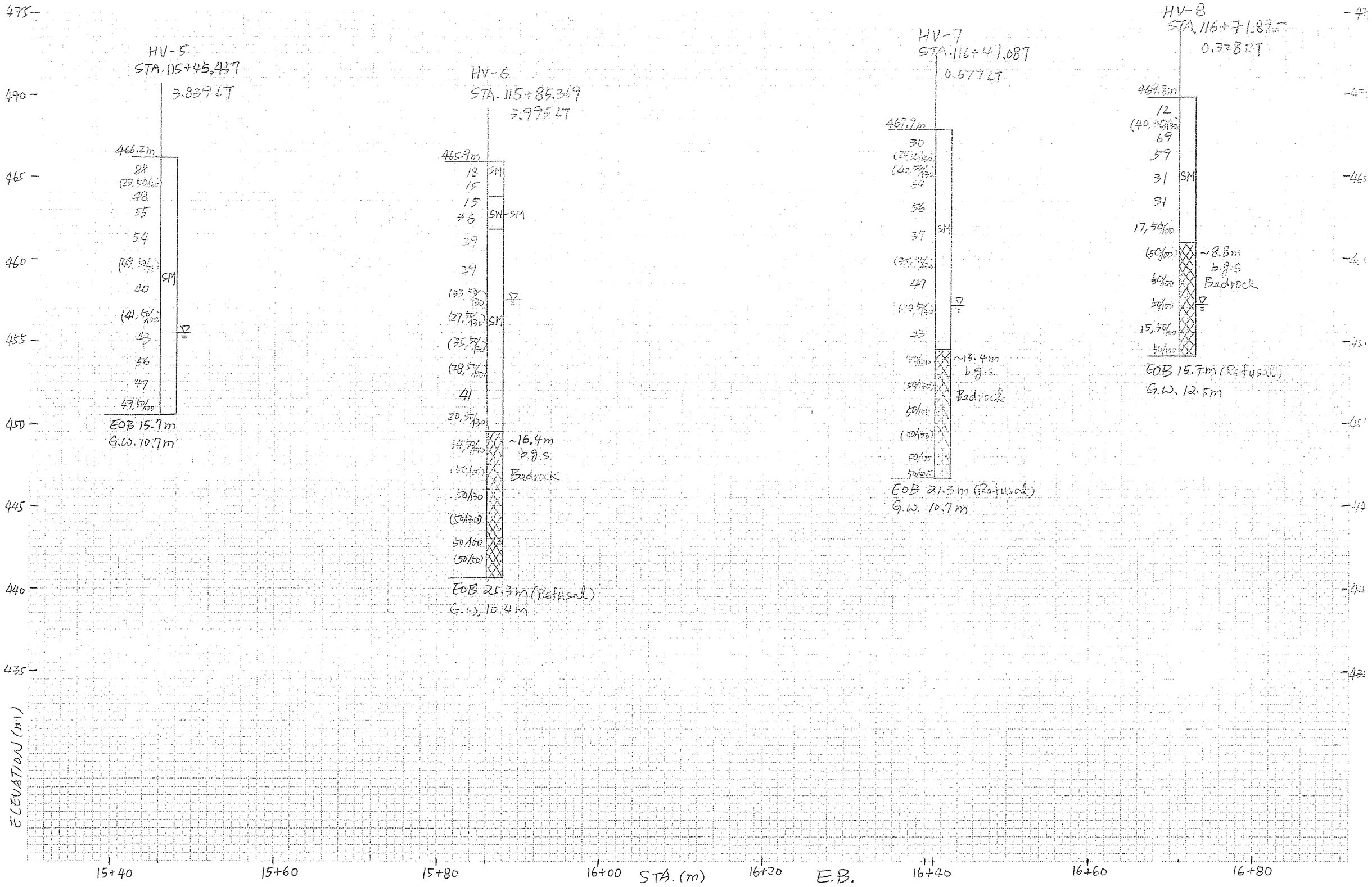
APPENDIX C

ENGINEERING ANALYSES

C-1

SOIL CROSS SECTIONS


HV-1
STA. 15+50.158
3.837 LT
464.7m
36.5/30
(32.5/30)
45
37
41
40
41
59
43
43
72
SM
EOB 15.7m
G.W. 8.8m
HV-2
STA. 15+92.022
8.093 LT
464.3m
(34.5/30)
(33.5/30)
(50/30)
28
49
51
24
25
47
(28.5/30)
34
48
43
(45.5/75)
46.5/75
(50)
50/75
(50/50)
SM
CR-SM
SM
SC
~19.5m
Bedrock
EOB 25.0m (Refusal)
G.W. 10.0m
HV-3
STA. 16+56.353
6.841 LT
466.9m
26
19
*4
*4
51
43
(32.5/30)
(33.5/30)
(50/75)
50/75
(50/75)
50/50
Fill
SM
SM
SC
~11.9m
Bedrock
EOB 17.1m (Refusal)
G.W. Φ
HV-4
STA. 16+94.752
3.665LT
468.1m
14
21
14
39
48
(36.5/30)
37
(39.5/30)
34.5/60
50/130
50/130
50/130
Fill
SM
SM
SC
~10.3m
Bedrock
EOB 15.7m
(Refusal?)
G.W. 11.6m
ELEVATION (m)
65
60
55
50
45
40
35
-460
-455
-450
-445
-440
-435
15+40
15+60
15+80
16+00
STA. (m)
16+20
W.B.
16+40
16+60
16+80
17+00


HV-5
STA. 115+45.457
3.839 LT
466.2m
88
(29.5/120)
48
55
54
(108.5/120)
40
(41.5/120)
43
56
47
47.5/120
SM
EOB 15.7m
G.W. 10.7m
HV-6
STA. 115+85.369
3.995 LT
465.9m
18
15
15
46
29
29
(33.5/120)
(27.5/120)
(35.5/120)
(30.5/120)
41
30.5/120
34.5/120
(50/120)
50/120
(50/120)
50/120
(50/120)
SM
SM-SM
SM
~16.4m
b.g.s
Bedrock
EOB 25.3m (Refusal)
G.W. 10.4m
HV-7
STA. 116+41.087
0.677 LT
467.9m
30
(24.5/120)
(42.5/120)
64
56
37
SM
(35.5/120)
47
(30.5/120)
25
7/120
50/120
50/120
(50/120)
50/120
50/120
~13.4m
b.g.s.
Bedrock
EOB 21.3m (Refusal)
G.W. 10.7m
HV-8
STA. 116+71.895
0.328 RT
468.8m
12
(40.5/120)
69
59
31
31
17.5/120
(50/120)
50/120
50/120
15.5/120
50/120
~8.8m
b.g.s
Bedrock
EOB 15.7m (Refusal)
G.W. 12.5m
475
470
465
460
455
450
445
440
435
ELEVATION (m)
15+40
15+60
15+80
16+00
STA. (m)
16+20
E.B.
16+40
16+60
16+80

C-2

LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	I-215/SR60 East Junction HOV Connector
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA	
Exploration No.	HV-3/No Soil Improv.
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1532.0 feet
Proposed Grade Elevation	1532.0 feet
Unit Weight of Proposed Fill on Surface	125.0 pcf
GWT Elevation During Test	1496.0 feet
GWT Elevation For Design	1502.0 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1532.0	1530.0	2.0	SM	Y	120.0	25.00	20.0
1530.0	1527.0	5.0	SM	Y	120.0	18.00	20.0
1527.0	1524.5	7.5	SM	Y	120.0	8.00	20.0
1524.5	1522.0	10.0	SM	Y	120.0	4.00	20.0
1522.0	1517.0	15.0	SM	Y	120.0	49.00	20.0
1517.0	1512.0	20.0	SM	Y	120.0	33.00	20.0
1512.0	1507.0	25.0	SC	Y	120.0	40.00	35.0
1507.0	1502.0	30.0	SC	Y	120.0	90.00	35.0
1502.0	1497.0	35.0	SC	Y	120.0	90.00	35.0
1497.0	1492.0	40.0	BEDROCK/FORMATION	N	135.0	90.00	10.0
1492.0	1487.0	45.0	BEDROCK/FORMATION	N	135.0	90.00	10.0
1487.0	1482.0	50.0	BEDROCK/FORMATION	N	135.0	90.00	10.0

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SH60 East Junction HOV Connector
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	HV-3(B): Soil Improv
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1532.00 feet
Proposed Grade Elevation	1532.00 feet
Unit Weight of Proposed Fill on Surface	125.00 pcf
GWT Elevation During Test	1496.00 feet
GWT Elevation For Design	1502.00 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.00

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<--- LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5 - 15 : "Moderate" liquefaction effects (usually associated with sandblows)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<--- Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.24 inches	<--- Dry or Unsaturated Soils (Above GWT)
	0.24 inches	<--- Total Earthquake-Induced Settlement

NOTES AND REFERENCES

* Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_E C_B C_R C_S \times (FC)$
** Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
*** $CSR = 0.65\, A_{max}\, (\sigma_v/\sigma_v')\, r_d$
* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_7 \times MSF \times K_\sigma \times K_\alpha$; CRR_7 is evaluated using SPT data (Youd and Idriss, 2001), K_σ =1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \sum w_i \times (FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA) / SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z_i (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio * r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (1 piece 50 ft) (inches)
1532.0	1531.0	SM	Y	120.0	25	20.0	0.5	1.700	0.750	56.2	0.999	N/A	0.325	N/A	N/A	NO	N/A	Soil above GWT	50.4	N/A	0.014	0.000	0.000	0.24
1531.0	1530.0	SM	Y	120.0	25	20.0	1.5	1.700	0.750	56.2	0.997	N/A	0.324	N/A	N/A	NO	N/A	Soil above GWT	50.4	N/A	0.021	0.000	0.000	0.24
1530.0	1529.0	SM	Y	120.0	18	20.0	2.5	1.600	0.750	39.9	0.994	N/A	0.323	N/A	N/A	NO	N/A	Soil above GWT	35.3	N/A	0.030	0.031	0.000	0.23
1529.0	1528.0	SM	Y	120.0	18	20.0	3.5	1.560	0.750	38.4	0.992	N/A	0.322	N/A	N/A	NO	N/A	Soil above GWT	33.9	N/A	0.031	0.039	0.000	0.23
1528.0	1527.0	SM	Y	120.0	18	20.0	4.5	1.497	0.750	37.0	0.990	N/A	0.322	N/A	N/A	NO	N/A	Soil above GWT	32.6	N/A	0.049	0.047	0.000	0.22
1527.0	1526.0	SM	Y	120.0	8	20.0	5.5	1.438	0.750	17.9	0.987	N/A	0.321	N/A	N/A	NO	N/A	Soil above GWT	14.9	N/A	0.076	0.174	0.002	0.20
1526.0	1525.0	SM	Y	120.0	8	20.0	6.5	1.381	0.750	17.5	0.985	N/A	0.320	N/A	N/A	NO	N/A	Soil above GWT	14.4	N/A	0.083	0.198	0.002	0.18
1525.0	1524.0	SM	Y	120.0	4	20.0	7.5	1.333	0.750	10.2	0.983	N/A	0.319	N/A	N/A	NO	N/A	Soil above GWT	7.8	N/A	0.110	0.391	0.006	0.15
1524.0	1523.0	SM	Y	120.0	4	20.0	8.5	1.287	0.850	10.8	0.980	N/A	0.319	N/A	N/A	NO	N/A	Soil above GWT	8.4	N/A	0.114	0.377	0.006	0.00
1523.0	1522.0	SM	Y	120.0	4	20.0	9.5	1.243	0.850	10.6	0.978	N/A	0.318	N/A	N/A	NO	N/A	Soil above GWT	8.1	N/A	0.121	0.520	0.006	0.00
1522.0	1521.0	SM	Y	120.0	49	20.0	10.5	1.202	0.850	86.3	0.976	N/A	0.317	N/A	N/A	NO	N/A	Soil above GWT	58.3	N/A	0.052	0.000	0.000	0.00
1521.0	1520.0	SM	Y	120.0	49	20.0	11.5	1.164	0.850	83.7	0.973	N/A	0.316	N/A	N/A	NO	N/A	Soil above GWT	55.8	N/A	0.055	0.000	0.000	0.00
1520.0	1519.0	SM	Y	120.0	49	20.0	12.5	1.128	0.850	81.2	0.971	N/A	0.316	N/A	N/A	NO	N/A	Soil above GWT	53.5	N/A	0.058	0.000	0.000	0.00
1519.0	1518.0	SM	Y	120.0	49	20.0	13.5	1.095	0.850	78.9	0.969	N/A	0.315	N/A	N/A	NO	N/A	Soil above GWT	51.4	N/A	0.061	0.000	0.000	0.00
1518.0	1517.0	SM	Y	120.0	49	20.0	14.5	1.063	0.850	76.7	0.966	N/A	0.314	N/A	N/A	NO	N/A	Soil above GWT	49.4	N/A	0.065	0.000	0.000	0.00
1517.0	1516.0	SM	Y	120.0	33	20.0	15.5	1.033	0.950	57.1	0.964	N/A	0.313	N/A	N/A	NO	N/A	Soil above GWT	51.2	N/A	0.072	0.000	0.000	0.00
1516.0	1515.0	SM	Y	120.0	33	20.0	16.5	1.005	0.950	55.6	0.962	N/A	0.312	N/A	N/A	NO	N/A	Soil above GWT	49.8	N/A	0.074	0.000	0.000	0.00
1515.0	1514.0	SM	Y	120.0	33	20.0	17.5	0.978	0.950	54.2	0.959	N/A	0.312	N/A	N/A	NO	N/A	Soil above GWT	48.6	N/A	0.077	0.000	0.000	0.00
1514.0	1513.0	SM	Y	120.0	33	20.0	18.5	0.952	0.950	52.9	0.957	N/A	0.311	N/A	N/A	NO	N/A	Soil above GWT	47.3	N/A	0.079	0.000	0.000	0.00
1513.0	1512.0	SM	Y	120.0	33	20.0	19.5	0.928	0.950	51.7	0.955	N/A	0.310	N/A	N/A	NO	N/A	Soil above GWT	46.2	N/A	0.082	0.000	0.000	0.00
1512.0	1511.0	SC	Y	120.0	40	35.0	20.5	0.905	0.950	68.1	0.952	N/A	0.309	N/A	N/A	NO	N/A	Soil above GWT	55.4	N/A	0.076	0.000	0.000	0.00
1511.0	1510.0	SC	Y	120.0	40	35.0	21.5	0.884	0.950	66.6	0.950	N/A	0.309	N/A	N/A	NO	N/A	Soil above GWT	53.2	N/A	0.078	0.000	0.000	0.00
1510.0	1509.0	SC	Y	120.0	40	35.0	22.5	0.863	0.950	65.2	0.948	N/A	0.308	N/A	N/A	NO	N/A	Soil above GWT	52.0	N/A	0.080	0.000	0.000	0.00
1509.0	1508.0	SC	Y	120.0	40	35.0	23.5	0.843	0.950	63.8	0.945	N/A	0.307	N/A	N/A	NO	N/A	Soil above GWT	50.8	N/A	0.082	0.000	0.000	0.00
1508.0	1507.0	SC	Y	120.0	40	35.0	24.5	0.824	0.950	62.5	0.943	N/A	0.306	N/A	N/A	NO	N/A	Soil above GWT	50.7	N/A	0.084	0.000	0.000	0.00
1507.0	1506.0	SC	Y	120.0	90	35.0	25.5	0.806	0.950	131.5	0.941	N/A	0.306	N/A	N/A	NO	N/A	Soil above GWT	106.2	N/A	0.067	0.000	0.000	0.00
1506.0	1505.0	SC	Y	120.0	90	35.0	26.5	0.789	0.950	128.7	0.938	N/A	0.305	N/A	N/A	NO	N/A	Soil above GWT	105.9	N/A	0.068	0.000	0.000	0.00
1505.0	1504.0	SC	Y	120.0	90	35.0	27.5	0.772	0.950	126.1	0.936	N/A	0.304	N/A	N/A	NO	N/A	Soil above GWT	103.7	N/A	0.070	0.000	0.000	0.00
1504.0	1503.0	SC	Y	120.0	90	35.0	28.5	0.756	1.000	129.9	0.934	N/A	0.303	N/A	N/A	NO	N/A	Soil above GWT	106.9	N/A	0.050	0.000	0.000	0.00
1503.0	1502.0	SC	Y	120.0	90	35.0	29.5	0.741	1.000	127.4	0.931	N/A	0.303	N/A	N/A	NO	N/A	Soil above GWT	104.8	N/A	0.052	0.000	0.000	0.00
1502.0	1501.0	SC	Y	120.0	90	35.0	30.5	0.726	1.000	154.9	0.929	0.788	0.303	N/A	N/A	NO	N/A	Dense/stiff soil	102.7	N/A	N/A	0.000	0.000	0.00
1501.0	1500.0	SC	Y	120.0	90	35.0	31.5	0.712	1.000	122.6	0.918	0.785	0.296	N/A	N/A	NO	N/A	Dense/stiff soil	100.8	N/A	N/A	0.000	0.000	0.00
1500.0	1499.0	SC	Y	120.0	90	35.0	32.5	0.698	1.000	120.4	0.929	0.778	0.308	N/A	N/A	NO	N/A	Dense/stiff soil	98.9	N/A	N/A	0.000	0.000	0.00
1499.0	1498.0	SC	Y	120.0	90	35.0	33.5	0.685	1.000	118.2	0.901	0.773	0.300	N/A	N/A	NO	N/A	Dense/stiff soil	97.1	N/A	N/A	0.000	0.000	0.00
1498.0	1497.0	SC	Y	120.0	90	35.0	34.5	0.672	1.000	116.1	0.893	0.769	0.311	N/A	N/A	NO	N/A	Dense/stiff soil	95.4	N/A	N/A	0.000	0.000	0.00
1497.0	1496.0	BEDROCK/FORMATION	N	135.0	90	100.0	35.5	0.660	1.000	N/A	0.885	N/A	0.313	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00
1496.0	1495.0	BEDROCK/FORMATION	N	135.0	90	100.0	36.5	0.648	1.000	N/A	0.877	N/A	0.314	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00
1495.0	1494.0	BEDROCK/FORMATION	N	135.0	90	100.0	37.5	0.636	1.000	N/A	0.869	N/A	0.315	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00
1494.0	1493.0	BEDROCK/FORMATION	N	135.0	90	100.0	38.5	0.626	1.000	N/A	0.861	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00
1493.0	1492.0	BEDROCK/FORMATION	N	135.0	90	100.0	39.5	0.616	1.000	N/A	0.852	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00
1492.0	1491.0	BEDROCK/FORMATION	N	135.0	90	100.0	40.5	0.623	1.000	N/A	0.844	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00
1491.0	1490.0	BEDROCK/FORMATION	N	135.0	90	100.0	41.5	0.617	1.000	N/A	0.836	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00
1490.0	1489.0	BEDROCK/FORMATION	N	135.0	90	100.0	42.5	0.611	1.000	N/A	0.828	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00
1489.0	1488.0	BEDROCK/FORMATION	N	135.0	90	100.0	43.5	0.604	1.000	N/A	0.820	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00
1488.0	1487.0	BEDROCK/FORMATION	N	135.0	90	100.0	44.5	0.598	1.000	N/A	0.812	N/A	0.316	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00
1487.0	1486.0	BEDROCK/FORMATION	N	135.0	90	100.0	45.5	0.593	1.000	N/A	0.804	N/A	0.315	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00
1486.0	1485.0	BEDROCK/FORMATION	N	135.0	90	100.0	46.5	0.587	1.000	N/A	0.795	N/A	0.315	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00
1485.0	1484.0	BEDROCK/FORMATION	N	135.0	90	100.0	47.5	0.581	1.000	N/A	0.787	N/A	0.314	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00
1484.0	1483.0	BEDROCK/FORMATION	N	135.0	90	100.0	48.5	0.576	1.000	N/A	0.779	N/A	0.313	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.000	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR60 East Junction HIV Geotecker
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	HV-3/Nx Soil Borings
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1998)
Ground Surface Elevation During Test	1532.00 feet
Proposed Grade Elevation	1532.00 feet
Unit Weight of Proposed Fill on Surface	125.00 pcf
GWT Elevation During Test	1496.00 feet
GWT Elevation For Design	1502.00 feet
Earthquake/Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<==	LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet		LPI = 5 - 15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<==	Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.24 inches	<==	Dry or Unsaturated Soils (Above GWT)
	0.24 inches	<==	Total Earthquake-Induced Settlement

NOTES AND REFERENCES

* Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ e f(FC)
** Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
*** $CSR = 0.65 A_{max} (\sigma_o/\sigma_o') r_d$
* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5} MSF K_\sigma K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), K_σ = 1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma w_i x f(FS_{liq}) x H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA) / SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) * / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ** Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio *** CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1483.0	1482.0	BEDROCK/FORMATION	N	(350)	90	10.0	49.5	0.570	1.000	N/A	0.771	N/A	0.312	N/A	N/A	No	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	I-215/SR60 East Junction HOV Connector
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA	
Exploration No.	HV-6/No Soil Improv.
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1529.0 feet
Proposed Grade Elevation	1529.0 feet
Unit Weight of Proposed Fill on Surface	125.0 pcf
GWT Elevation During Test	1495.0 feet
GWT Elevation For Design	1499.0 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1529.0	1527.0	2.0	SM	Y	120.0	17.00	20.0
1527.0	1524.0	5.0	SM	Y	120.0	14.00	20.0
1524.0	1521.5	7.5	SW-SM	Y	120.0	15.00	6.0
1521.5	1519.0	10.0	SW-SM	Y	120.0	6.00	6.0
1519.0	1514.0	15.0	SM	Y	120.0	27.00	20.0
1514.0	1509.0	20.0	SM	Y	120.0	29.00	20.0
1509.0	1504.0	25.0	SC	Y	120.0	90.00	20.0
1504.0	1499.0	30.0	SC	Y	120.0	90.00	20.0
1499.0	1494.0	35.0	SC	Y	120.0	90.00	20.0
1494.0	1489.0	40.0	SM	Y	120.0	90.00	20.0
1489.0	1484.0	45.0	SM	Y	120.0	41.00	20.0
1484.0	1479.0	50.0	SM	Y	120.0	90.00	20.0

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR60 East Junction HOV Connector
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	HV-6/Nc Soil Improve
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1529.00 feet
Proposed Grade Elevation	1529.00 feet
Unit Weight of Proposed Fill on Surface	125.00 pcf
GWT Elevation During Test	1495.00 feet
GWT Elevation For Design	1499.00 feet
Earthquake(Moment) Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.00

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<==== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet	LPI = 5-15 : "Moderate" liquefaction effects (usually associated with sandblows)
Earthquake-Induced Settlements (in the upper 50 feet):		LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.26 inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.26 inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

* Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs}$ = $N_m C_N C_E C_B C_R C_S$ x 11FC1
** Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
*** CSR = 0.65 A_{max} (σ_o/σ'_o) r_d
* FS_{liq} = (CRR/CSR), where CRR = $CRR_{7.5}$ MSF K_σ K_α; $CRR_{7.5}$ is calculated using SPT data (Youd and Idriss, 2001), K_σ = 1.0 (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. LPI = Σw_i x ((FS_{liq}) x H_i) (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ** Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1529.0	1528.0	SM	Y	120.0	17	20.0
1528.0	1527.0	SM	Y	120.0	17	20.0
1527.0	1526.0	SM	Y	120.0	14	20.0
1526.0	1525.0	SM	Y	120.0	14	20.0
1525.0	1524.0	SM	Y	120.0	14	20.0
1524.0	1523.0	SW-SM	Y	120.0	15	6.0
1523.0	1522.0	SW-SM	Y	120.0	15	6.0
1522.0	1521.0	SW-SM	Y	120.0	6	6.0
1521.0	1520.0	SW-SM	Y	120.0	6	6.0
1520.0	1519.0	SW-SM	Y	120.0	6	6.0
1519.0	1518.0	SM	Y	120.0	27	20.0
1518.0	1517.0	SM	Y	120.0	27	20.0
1517.0	1516.0	SM	Y	120.0	27	20.0
1516.0	1515.0	SM	Y	120.0	27	20.0
1515.0	1514.0	SM	Y	120.0	27	20.0
1514.0	1513.0	SM	Y	120.0	29	20.0
1513.0	1512.0	SM	Y	120.0	29	20.0
1512.0	1511.0	SM	Y	120.0	29	20.0
1511.0	1510.0	SM	Y	120.0	29	20.0
1510.0	1509.0	SM	Y	120.0	29	20.0
1509.0	1508.0	SC	Y	120.0	90	20.0
1508.0	1507.0	SC	Y	120.0	90	20.0
1507.0	1506.0	SC	Y	120.0	90	20.0
1506.0	1505.0	SC	Y	120.0	90	20.0
1505.0	1504.0	SC	Y	120.0	90	20.0
1504.0	1503.0	SC	Y	120.0	90	20.0
1503.0	1502.0	SC	Y	120.0	90	20.0
1502.0	1501.0	SC	Y	120.0	90	20.0
1501.0	1500.0	SC	Y	120.0	90	20.0
1500.0	1499.0	SC	Y	120.0	90	20.0
1499.0	1498.0	SC	Y	120.0	90	20.0
1498.0	1497.0	SC	Y	120.0	90	20.0
1497.0	1496.0	SC	Y	120.0	90	20.0
1496.0	1495.0	SC	Y	120.0	90	20.0
1495.0	1494.0	SC	Y	120.0	90	20.0
1494.0	1493.0	SM	Y	120.0	90	20.0
1493.0	1492.0	SM	Y	120.0	90	20.0
1492.0	1491.0	SM	Y	120.0	90	20.0
1491.0	1490.0	SM	Y	120.0	90	20.0
1490.0	1489.0	SM	Y	120.0	90	20.0
1489.0	1488.0	SM	Y	120.0	41	20.0
1488.0	1487.0	SM	Y	120.0	41	20.0
1487.0	1486.0	SM	Y	120.0	41	20.0
1486.0	1485.0	SM	Y	120.0	41	20.0
1485.0	1484.0	SM	Y	120.0	41	20.0
1484.0	1483.0	SM	Y	120.0	90	20.0
1483.0	1482.0	SM	Y	120.0	90	20.0
1482.0	1481.0	SM	Y	120.0	90	20.0
1481.0	1480.0	SM	Y	120.0	90	20.0

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) - / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ** CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_c (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
0.5	1.700	0.750	39.4	0.991	N/A	0.325	N/A	N/A	NO	N/A	Soil above GWT	31.8	N/A	0.016	0.014	0.000	0.26
1.5	1.700	0.750	39.4	0.997	N/A	0.324	N/A	N/A	NO	N/A	Soil above GWT	34.8	N/A	0.028	0.025	0.000	0.25
2.5	1.630	0.750	31.9	0.994	N/A	0.323	N/A	N/A	NO	N/A	Soil above GWT	27.8	N/A	0.040	0.036	0.000	0.25
3.5	1.560	0.750	30.7	0.992	N/A	0.322	N/A	N/A	NO	N/A	Soil above GWT	26.7	N/A	0.048	0.057	0.000	0.24
4.5	1.497	0.750	29.6	0.990	N/A	0.322	N/A	N/A	NO	N/A	Soil above GWT	25.7	N/A	0.055	0.069	0.000	0.23
5.5	1.438	0.750	24.9	0.987	N/A	0.321	N/A	N/A	NO	N/A	Soil above GWT	25.3	N/A	0.065	0.101	0.000	0.22
6.5	1.384	0.750	23.9	0.985	N/A	0.320	N/A	N/A	NO	N/A	Soil above GWT	24.4	N/A	0.072	0.116	0.000	0.21
7.5	1.333	0.750	9.2	0.983	N/A	0.319	N/A	N/A	NO	N/A	Soil above GWT	8.8	N/A	0.115	0.583	0.007	0.14
8.5	1.287	0.850	10.1	0.980	N/A	0.319	N/A	N/A	NO	N/A	Soil above GWT	10.6	N/A	0.117	0.533	0.006	0.07
9.5	1.243	0.850	9.8	0.978	N/A	0.318	N/A	N/A	NO	N/A	Soil above GWT	10.3	N/A	0.125	0.593	0.007	0.00
10.5	1.202	0.850	49.2	0.976	N/A	0.317	N/A	N/A	NO	N/A	Soil above GWT	43.0	N/A	0.064	0.000	0.000	0.00
11.5	1.164	0.850	47.7	0.973	N/A	0.316	N/A	N/A	NO	N/A	Soil above GWT	42.5	N/A	0.067	0.000	0.000	0.00
12.5	1.128	0.850	46.4	0.971	N/A	0.316	N/A	N/A	NO	N/A	Soil above GWT	41.2	N/A	0.071	0.000	0.000	0.00
13.5	1.095	0.850	35.1	0.969	N/A	0.315	N/A	N/A	NO	N/A	Soil above GWT	30.1	N/A	0.074	0.000	0.000	0.00
14.5	1.063	0.850	43.9	0.966	N/A	0.314	N/A	N/A	NO	N/A	Soil above GWT	39.0	N/A	0.078	0.000	0.000	0.00
15.5	1.033	0.950	50.6	0.964	N/A	0.313	N/A	N/A	NO	N/A	Soil above GWT	45.2	N/A	0.075	0.000	0.000	0.00
16.5	1.005	0.950	49.3	0.962	N/A	0.312	N/A	N/A	NO	N/A	Soil above GWT	44.0	N/A	0.078	0.000	0.000	0.00
17.5	0.978	0.950	48.1	0.959	N/A	0.312	N/A	N/A	NO	N/A	Soil above GWT	42.9	N/A	0.081	0.000	0.000	0.00
18.5	0.952	0.950	46.9	0.957	N/A	0.311	N/A	N/A	NO	N/A	Soil above GWT	41.8	N/A	0.084	0.000	0.000	0.00
19.5	0.928	0.950	45.8	0.955	N/A	0.310	N/A	N/A	NO	N/A	Soil above GWT	40.8	N/A	0.086	0.000	0.000	0.00
20.5	0.905	0.950	131.4	0.952	N/A	0.309	N/A	N/A	NO	N/A	Soil above GWT	126.1	N/A	0.061	0.000	0.000	0.00
21.5	0.884	0.950	128.3	0.950	N/A	0.309	N/A	N/A	NO	N/A	Soil above GWT	117.2	N/A	0.063	0.000	0.000	0.00
22.5	0.863	0.950	125.4	0.948	N/A	0.308	N/A	N/A	NO	N/A	Soil above GWT	114.5	N/A	0.065	0.000	0.000	0.00
23.5	0.843	0.950	122.6	0.945	N/A	0.307	N/A	N/A	NO	N/A	Soil above GWT	111.9	N/A	0.066	0.000	0.000	0.00
24.5	0.824	0.950	119.9	0.943	N/A	0.306	N/A	N/A	NO	N/A	Soil above GWT	109.4	N/A	0.068	0.000	0.000	0.00
25.5	0.806	0.950	117.4	0.941	N/A	0.306	N/A	N/A	NO	N/A	Soil above GWT	107.1	N/A	0.069	0.000	0.000	0.00
26.5	0.789	0.950	114.9	0.938	N/A	0.305	N/A	N/A	NO	N/A	Soil above GWT	104.8	N/A	0.071	0.000	0.000	0.00
27.5	0.772	0.950	112.6	0.936	N/A	0.304	N/A	N/A	NO	N/A	Soil above GWT	102.6	N/A	0.073	0.000	0.000	0.00
28.5	0.756	1.000	110.4	0.934	N/A	0.303	N/A	N/A	NO	N/A	Soil above GWT	105.7	N/A	0.073	0.000	0.000	0.00
29.5	0.741	1.000	113.7	0.931	N/A	0.303	N/A	N/A	NO	N/A	Soil above GWT	103.0	N/A	0.074	0.000	0.000	0.00
30.5	0.726	1.000	111.5	0.929	0.788	0.303	N/A	N/A	NO	N/A	Dense/stiff soil	101.0	N/A	N/A	0.000	0.000	0.00
31.5	0.712	1.000	109.4	0.918	0.783	0.306	N/A	N/A	NO	N/A	Dense/stiff soil	99.7	N/A	N/A	0.000	0.000	0.00
32.5	0.698	1.000	107.4	0.909	0.778	0.308	N/A	N/A	NO	N/A	Dense/stiff soil	97.8	N/A	N/A	0.000	0.000	0.00
33.5	0.685	1.000	105.5	0.901	0.773	0.310	N/A	N/A	NO	N/A	Dense/stiff soil	96.0	N/A	N/A	0.000	0.000	0.00
34.5	0.676	1.000	104.1	0.893	0.769	0.311	N/A	N/A	NO	N/A	Dense/stiff soil	94.7	N/A	N/A	0.000	0.000	0.00
35.5	0.670	1.000	103.2	0.885	0.764	0.313	N/A	N/A	NO	N/A	Dense/stiff soil	93.9	N/A	N/A	0.000	0.000	0.00
36.5	0.664	1.000	102.3	0.877	0.760	0.314	N/A	N/A	NO	N/A	Dense/stiff soil	93.1	N/A	N/A	0.000	0.000	0.00
37.5	0.659	1.000	101.5	0.869	0.755	0.315	N/A	N/A	NO	N/A	Dense/stiff soil	92.3	N/A	N/A	0.000	0.000	0.00
38.5	0.653	1.000	100.6	0.861	0.751	0.316	N/A	N/A	NO	N/A	Dense/stiff soil	91.5	N/A	N/A	0.000	0.000	0.00
39.5	0.647	1.000	99.8	0.852	0.747	0.317	N/A	N/A	NO	N/A	Dense/stiff soil	90.8	N/A	N/A	0.000	0.000	0.00
40.5	0.642	1.000	47.1	0.844	0.743	0.317	N/A	N/A	NO	N/A	Dense/stiff soil	41.9	N/A	N/A	0.000	0.000	0.00
41.5	0.637	1.000	46.7	0.836	0.739	0.318	N/A	N/A	NO	N/A	Dense/stiff soil	41.6	N/A	N/A	0.000	0.000	0.00
42.5	0.631	1.000	46.3	0.828	0.735	0.318	N/A	N/A	NO	N/A	Dense/stiff soil	41.3	N/A	N/A	0.000	0.000	0.00
43.5	0.626	1.000	46.0	0.820	0.731	0.318	N/A	N/A	NO	N/A	Dense/stiff soil	40.9	N/A	N/A	0.000	0.000	0.00
44.5	0.621	1.000	45.5	0.812	0.727	0.318	N/A	N/A	NO	N/A	Dense/stiff soil	40.6	N/A	N/A	0.000	0.000	0.00
45.5	0.616	1.000	95.2	0.804	0.723	0.317	N/A	N/A	NO	N/A	Dense/stiff soil	86.5	N/A	N/A	0.000	0.000	0.00
46.5	0.611	1.000	94.4	0.795	0.720	0.317	N/A	N/A	NO	N/A	Dense/stiff soil	85.8	N/A	N/A	0.000	0.000	0.00
47.5	0.606	1.000	93.7	0.787	0.716	0.317	N/A	N/A	NO	N/A	Dense/stiff soil	85.1	N/A	N/A	0.000	0.000	0.00
48.5	0.601	1.000	93.0	0.779	0.713	0.316	N/A	N/A	NO	N/A	Dense/stiff soil	84.5	N/A	N/A	0.000	0.000	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	I-215/SR60 East Junction HOV Connector
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	HV-0/Sb Soil Impact
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1529.00 feet
Proposed Grade Elevation	1529.00 feet
Unit Weight of Proposed Fill on Surface	125.00 pcf
GWT Elevation During Test	1495.00 feet
GWT Elevation For Design	1499.00 feet
Earthquake/Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.00

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<===	LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet		LPI = 5 - 15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<===	Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.26 inches	<===	Dry or Unsaturated Soils (Above GWT)
	0.26 inches	<===	Total Earthquake-Induced Settlement

NOTES AND REFERENCES

* Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S \pm f(FC)$
** Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
*** $CSR = 0.65 A_{max}/g \cdot \sigma_{vo}/\sigma'_{vo} \cdot r_d$
* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5} MSF K_\sigma K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), $K_\sigma = 1.0$ (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma w_i \times (FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ** Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_{m} (blows/ft)	Fines Content FC (%)
1420.0	1479.0	SM	Y	120.0	30	20.0

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) *

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ** CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks
49.5	0.597	1.000	92.3	0.771	0.709	0.315	N/A	N/A	NO	N/A	Dense/stiff soil

RESIDUAL STRENGTH AND GROUND SETTLEMENT

Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
83.8	N/A	N/A	0.000	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	Ret. Walls @ Abut. 4 WB (HV-4)
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA	
Exploration No.	HV-4
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1536.0 feet
Proposed Grade Elevation	1540.0 feet
Unit Weight of Proposed Fill on Surface	125.0 pcf
GWT Elevation During Test	1498.0 feet
GWT Elevation For Design	1506.0 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1536.0	1533.5	2.5	SM	Y	120.0	15.00	15.0
1533.5	1531.0	5.0	SM	Y	120.0	22.00	15.0
1531.0	1528.5	7.5	SM	Y	120.0	14.00	15.0
1528.5	1526.0	10.0	SM	Y	120.0	40.00	15.0
1526.0	1523.5	12.5	SM	Y	120.0	48.00	15.0
1523.5	1518.5	17.5	SM	Y	120.0	51.00	15.0
1518.5	1513.5	22.5	SM	Y	120.0	37.00	15.0
1513.5	1508.5	27.5	SC	Y	120.0	51.00	25.0
1508.5	1506.0	30.0	BEDROCK/FORMATION	N	135.0	60.00	
1506.0	1503.5	32.5	BEDROCK/FORMATION	N	135.0	60.00	
1503.5	1498.5	37.5	BEDROCK/FORMATION	N	135.0	60.00	
1498.5	1493.5	42.5	BEDROCK/FORMATION	N	135.0	60.00	
1493.5	1488.5	47.5	BEDROCK/FORMATION	N	135.0	70.00	
1488.5	1484.5	51.5	BEDROCK/FORMATION	N	135.0	70.00	

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	Bel Walk @ Abut. 4 WH/HV-4A
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	HV-1
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1536.00 feet
Proposed Grade Elevation	1540.00 feet
Unit Weight of Proposed Fill on Surface	125.00 pcf
GWT Elevation During Test	1498.00 feet
GWT Elevation For Design	1506.00 feet
Earthquake/Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****		<==== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0	feet	LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandblows)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00	inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.04	inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.04	inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

* Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S \times (FC)$
** Chinese Criteria: Liquefaction can only occur if all the following conditions are met. Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
*** $CSR = 0.65\, A_{max}\,(\sigma_v/\sigma_v')\, r_d$
* $FS_{liq} = (CRR/CSR)$ where $CRR = CRR_{7.5}\, MSF\, K_\sigma\, K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), $K_\sigma = 1.0$ (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \sum w_i\, x\, (FS_{liq}\, x\, H)$, (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA) / SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) * / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ** Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ** CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1536.0	1535.0	SM	Y	120.0	15	15.0	0.5	1.700	0.750	33.2	0.990	N/A	0.322	N/A	N/A	ND	N/A	Soil along GWT	N/A	N/A	0.053	0.058	0.00	0.00
1535.0	1534.0	SM	Y	120.0	15	15.0	1.5	1.700	0.750	33.2	0.987	N/A	0.321	N/A	N/A	ND	N/A	Soil along GWT	N/A	N/A	0.058	0.063	0.00	0.00
1534.0	1533.0	SM	Y	120.0	22	15.0	2.5	1.630	0.750	45.6	0.985	N/A	0.320	N/A	N/A	ND	N/A	Soil along GWT	42.5	N/A	0.053	0.058	0.00	0.00
1533.0	1532.0	SM	Y	120.0	22	15.0	3.5	1.560	0.750	43.8	0.983	N/A	0.319	N/A	N/A	ND	N/A	Soil along GWT	40.7	N/A	0.058	0.063	0.00	0.00
1532.0	1531.0	SM	Y	120.0	22	15.0	4.5	1.497	0.750	42.1	0.980	N/A	0.319	N/A	N/A	ND	N/A	Soil along GWT	39.1	N/A	0.063	0.068	0.00	0.00
1531.0	1530.0	SM	Y	120.0	14	15.0	5.5	1.438	0.750	26.7	0.978	N/A	0.318	N/A	N/A	ND	N/A	Soil along GWT	24.1	N/A	0.085	0.117	0.01	0.02
1530.0	1529.0	SM	Y	120.0	14	15.0	6.5	1.384	0.750	25.8	0.976	N/A	0.317	N/A	N/A	ND	N/A	Soil along GWT	23.2	N/A	0.088	0.129	0.02	0.03
1529.0	1528.0	SM	Y	120.0	40	15.0	7.5	1.333	0.750	66.6	0.973	N/A	0.316	N/A	N/A	ND	N/A	Soil along GWT	62.5	N/A	0.061	0.100	0.00	0.03
1528.0	1527.0	SM	Y	120.0	40	15.0	8.5	1.287	0.850	72.6	0.971	N/A	0.316	N/A	N/A	ND	N/A	Soil along GWT	68.2	N/A	0.061	0.100	0.00	0.03
1527.0	1526.0	SM	Y	120.0	40	15.0	9.5	1.243	0.850	70.2	0.969	N/A	0.315	N/A	N/A	ND	N/A	Soil along GWT	66.0	N/A	0.063	0.100	0.00	0.03
1526.0	1525.0	SM	Y	120.0	48	15.0	10.5	1.202	0.850	81.1	0.966	N/A	0.314	N/A	N/A	ND	N/A	Soil along GWT	76.1	N/A	0.062	0.100	0.00	0.03
1525.0	1524.0	SM	Y	120.0	48	15.0	11.5	1.164	0.850	78.6	0.964	N/A	0.313	N/A	N/A	ND	N/A	Soil along GWT	74.0	N/A	0.065	0.100	0.00	0.03
1524.0	1523.0	SM	Y	120.0	51	15.0	12.5	1.128	0.850	80.9	0.962	N/A	0.312	N/A	N/A	ND	N/A	Soil along GWT	76.1	N/A	0.064	0.100	0.00	0.03
1523.0	1522.0	SM	Y	120.0	51	15.0	13.5	1.095	0.850	78.6	0.959	N/A	0.312	N/A	N/A	ND	N/A	Soil along GWT	73.9	N/A	0.068	0.100	0.00	0.03
1522.0	1521.0	SM	Y	120.0	51	15.0	14.5	1.063	0.850	76.4	0.957	N/A	0.311	N/A	N/A	ND	N/A	Soil along GWT	71.8	N/A	0.071	0.100	0.00	0.03
1521.0	1520.0	SM	Y	120.0	51	15.0	15.5	1.033	0.950	82.7	0.955	N/A	0.310	N/A	N/A	ND	N/A	Soil along GWT	77.9	N/A	0.070	0.100	0.00	0.03
1520.0	1519.0	SM	Y	120.0	51	15.0	16.5	1.005	0.950	80.5	0.952	N/A	0.309	N/A	N/A	ND	N/A	Soil along GWT	75.8	N/A	0.072	0.100	0.00	0.03
1519.0	1518.0	SM	Y	120.0	37	15.0	17.5	0.978	0.950	57.6	0.950	N/A	0.309	N/A	N/A	ND	N/A	Soil along GWT	53.9	N/A	0.083	0.100	0.00	0.03
1518.0	1517.0	SM	Y	120.0	37	15.0	18.5	0.952	0.950	56.2	0.948	N/A	0.308	N/A	N/A	ND	N/A	Soil along GWT	52.5	N/A	0.085	0.100	0.00	0.03
1517.0	1516.0	SM	Y	120.0	37	15.0	19.5	0.928	0.950	54.8	0.945	N/A	0.307	N/A	N/A	ND	N/A	Soil along GWT	51.2	N/A	0.087	0.100	0.00	0.03
1516.0	1515.0	SM	Y	120.0	37	15.0	20.5	0.905	0.950	53.5	0.943	N/A	0.306	N/A	N/A	ND	N/A	Soil along GWT	50.0	N/A	0.089	0.100	0.00	0.03
1515.0	1514.0	SM	Y	120.0	37	15.0	21.5	0.884	0.950	52.3	0.941	N/A	0.306	N/A	N/A	ND	N/A	Soil along GWT	48.8	N/A	0.091	0.100	0.00	0.03
1514.0	1513.0	SC	Y	120.0	51	25.0	22.5	0.863	0.950	75.6	0.938	N/A	0.305	N/A	N/A	ND	N/A	Soil along GWT	65.7	N/A	0.082	0.100	0.00	0.03
1513.0	1512.0	SC	Y	120.0	51	25.0	23.5	0.843	0.950	73.9	0.936	N/A	0.304	N/A	N/A	ND	N/A	Soil along GWT	64.5	N/A	0.084	0.100	0.00	0.03
1512.0	1511.0	SC	Y	120.0	51	25.0	24.5	0.824	0.950	72.4	0.934	N/A	0.303	N/A	N/A	ND	N/A	Soil along GWT	63.1	N/A	0.085	0.100	0.00	0.03
1511.0	1510.0	SC	Y	120.0	51	25.0	25.5	0.806	0.950	70.9	0.931	N/A	0.303	N/A	N/A	ND	N/A	Soil along GWT	61.7	N/A	0.087	0.100	0.00	0.03
1510.0	1509.0	SC	Y	120.0	51	25.0	26.5	0.789	0.950	69.4	0.926	N/A	0.301	N/A	N/A	ND	N/A	Soil along GWT	60.4	N/A	0.088	0.100	0.00	0.03
1509.0	1508.0	BEDROCK/FORMATION	N	135.0	60		27.5	0.771	0.950	N/A	0.918	N/A	0.298	N/A	N/A	ND	N/A	Soil along GWT	N/A	N/A	N/A	N/A	0.00	0.03
1508.0	1507.0	BEDROCK/FORMATION	N	135.0	60		28.5	0.753	1.000	N/A	0.909	N/A	0.296	N/A	N/A	ND	N/A	Soil along GWT	N/A	N/A	N/A	N/A	0.00	0.03
1507.0	1506.0	BEDROCK/FORMATION	N	135.0	60		29.5	0.736	1.000	N/A	0.901	N/A	0.293	N/A	N/A	ND	N/A	Soil along GWT	N/A	N/A	N/A	N/A	0.00	0.03
1506.0	1505.0	BEDROCK/FORMATION	N	135.0	60		30.5	0.720	1.000	N/A	0.893	N/A	0.292	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1505.0	1504.0	BEDROCK/FORMATION	N	135.0	60		31.5	0.704	1.000	N/A	0.885	N/A	0.291	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1504.0	1503.0	BEDROCK/FORMATION	N	135.0	60		32.5	0.689	1.000	N/A	0.877	N/A	0.295	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1503.0	1502.0	BEDROCK/FORMATION	N	135.0	60		33.5	0.675	1.000	N/A	0.869	N/A	0.296	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1502.0	1501.0	BEDROCK/FORMATION	N	135.0	60		34.5	0.661	1.000	N/A	0.861	N/A	0.297	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1501.0	1500.0	BEDROCK/FORMATION	N	135.0	60		35.5	0.648	1.000	N/A	0.852	N/A	0.298	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1500.0	1499.0	BEDROCK/FORMATION	N	135.0	60		36.5	0.636	1.000	N/A	0.844	N/A	0.299	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1499.0	1498.0	BEDROCK/FORMATION	N	135.0	60		37.5	0.623	1.000	N/A	0.836	N/A	0.299	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1498.0	1497.0	BEDROCK/FORMATION	N	135.0	60		38.5	0.614	1.000	N/A	0.828	N/A	0.299	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1497.0	1496.0	BEDROCK/FORMATION	N	135.0	60		39.5	0.605	1.000	N/A	0.820	N/A	0.299	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1496.0	1495.0	BEDROCK/FORMATION	N	135.0	60		40.5	0.602	1.000	N/A	0.812	N/A	0.299	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1495.0	1494.0	BEDROCK/FORMATION	N	135.0	60		41.5	0.596	1.000	N/A	0.804	N/A	0.299	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1494.0	1493.0	BEDROCK/FORMATION	N	135.0	70		42.5	0.590	1.000	N/A	0.795	N/A	0.298	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1493.0	1492.0	BEDROCK/FORMATION	N	135.0	70		43.5	0.585	1.000	N/A	0.787	N/A	0.298	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1492.0	1491.0	BEDROCK/FORMATION	N	135.0	70		44.5	0.579	1.000	N/A	0.779	N/A	0.297	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1491.0	1490.0	BEDROCK/FORMATION	N	135.0	70		45.5	0.574	1.000	N/A	0.771	N/A	0.297	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1490.0	1489.0	BEDROCK/FORMATION	N	135.0	70		46.5	0.568	1.000	N/A	0.763	N/A	0.296	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1489.0	1488.0	BEDROCK/FORMATION	N	135.0	70		47.5	0.563	1.000	N/A	0.755	N/A	0.295	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03
1488.0	1487.0	BEDROCK/FORMATION	N	135.0	70		48.5	0.558	1.000	N/A	0.747	N/A	0.294	N/A	N/A	ND	N/A	Bedrock/formation	N/A	N/A	N/A	N/A	0.00	0.03

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PROJECT INFORMATION

Project Name	Rgt. Walls @ Abut. 4 WB (HV-4)
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	HV-4
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1536.00 feet
Proposed Grade Elevation	1540.00 feet
Unit Weight of Proposed Fill on Surface	125.00 pcf
GWT Elevation During Test	1498.00 feet
GWT Elevation For Design	1506.00 feet
Earthquake/Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.00

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****	<----	LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0 feet		LPI = 5 - 15 : "Moderate" liquefaction effects (usually associated with sandboils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00 inches	<----	Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.04 inches	<----	Dry or Unsaturated Soils (Above GWT)
	0.04 inches	<----	Total Earthquake-Induced Settlement

NOTES AND REFERENCES

* Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S \times f(FC)$

** Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit

*** $CSR = 0.65 A_{max} (\sigma_v/\sigma_v') r_d$

\+ $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5} MSF K_\sigma K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), $K_\sigma = 1.0$ (level ground), and MSF = magnitude scaling factor

++ Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).

*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).

**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA) / SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)	Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
1487.0	1486.0	BEDROCK/FORMATION	N	135.0	70		49.5	0.553	1.000	N/A	0.738	N/A	0.265	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.00
1486.0	1485.0	BEDROCK/FORMATION	N	135.0	70		50.5	0.548	1.000	N/A	0.730	N/A	0.291	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.00

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION	
Project Name	Ret. Walls @ Abut. 4 EB (HV-8)
Project No.	76979
Location	Riverside, California

GENERAL INPUT DATA	
Exploration No.	HV-8
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1541.5 feet
Proposed Grade Elevation	1546.0 feet
Unit Weight of Proposed Fill on Surface	125.0 pcf
GWT Elevation During Test	1500.5 feet
GWT Elevation For Design	1511.5 feet
Earthquake Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS	
For Hammer Energy Ratio, C_e	1.33
For Borehole Diameter, C_b	1.15
For Sampling Method, C_s	1.00

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Depth to Bottom of Soil Layer Below Existing Ground Surface (feet)	Soil Classification (USCS)	Chinese Criteria Screening Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N (blows/ft)	Fines Content FC (%)
1541.5	1539.5	2.0	SM	Y	120.0	12.00	15.0
1539.5	1536.5	5.0	SM	Y	120.0	50.00	15.0
1536.5	1535.5	6.0	SM	Y	120.0	69.00	15.0
1535.5	1534.0	7.5	SM	Y	120.0	69.00	15.0
1534.0	1531.5	10.0	SM	Y	120.0	55.00	15.0
1531.5	1529.0	12.5	SM	Y	120.0	31.00	15.0
1529.0	1524.0	17.5	SM	Y	120.0	31.00	15.0
1524.0	1519.0	22.5	SM	Y	120.0	55.00	15.0
1519.0	1514.0	27.5	SM	Y	120.0	60.00	15.0
1514.0	1511.5	30.0	BEDROCK/FORMATION	N	135.0	60.00	
1511.5	1509.0	32.5	BEDROCK/FORMATION	N	135.0	60.00	
1509.0	1504.0	37.5	BEDROCK/FORMATION	N	135.0	60.00	
1504.0	1499.0	42.5	BEDROCK/FORMATION	N	135.0	60.00	
1499.0	1494.0	47.5	BEDROCK/FORMATION	N	135.0	70.00	
1494.0	1490.0	51.5	BEDROCK/FORMATION	N	135.0	70.00	

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	Rel. Walls & Abut. 4 Ell(HV-8)
Project No.	76971
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	HV-8
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1541.50 feet
Proposed Grade Elevation	1546.00 feet
Unit Weight of Proposed Fill on Surface	125.00 pcf
GWT Elevation During Test	1503.50 feet
GWT Elevation For Design	1511.50 feet
Earthquake/Moment Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.00

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00 ****		<---- LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soils (in the upper 50 feet) =	0.0	feet	LPI = 5 -15 : "Moderate" liquefaction effects (usually associated with sandblows)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00	inches	<---- Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.02	inches	<---- Dry or Unsaturated Soils (Above GWT)
	0.02	inches	<---- Total Earthquake-Induced Settlement

NOTES AND REFERENCES

* Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_E C_T C_B C_R C_S x (FC)$

** Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit

*** $CSR = 0.65 A_{max} (\sigma_o/\sigma_o') r_d$

* $FS_{liq} = (CRR/CSR)$ where $CRR = CRR_{7.5} MSF K_\sigma K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), $K_\sigma = 1.0$ (level ground), and MSF = magnitude scaling factor

** Residual strength values of liquefied soils are evaluated using the extended median curve for Seed & Harder (1990).

*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).

**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \sum w_i x (1-FS_{liq}) x 1_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1541.5	1540.5	SM	Y	120.0	12	15.0
1540.5	1539.5	SM	Y	120.0	12	15.0
1539.5	1538.5	SM	Y	120.0	50	15.0
1538.5	1537.5	SM	Y	120.0	50	15.0
1537.5	1536.5	SM	Y	120.0	50	15.0
1536.5	1535.5	SM	Y	120.0	60	15.0
1535.5	1534.5	SM	Y	120.0	60	15.0
1534.5	1533.5	SM	Y	120.0	55	15.0
1533.5	1532.5	SM	Y	120.0	55	15.0
1532.5	1531.5	SM	Y	120.0	55	15.0
1531.5	1530.5	SM	Y	120.0	31	15.0
1530.5	1529.5	SM	Y	120.0	31	15.0
1529.5	1528.5	SM	Y	120.0	31	15.0
1528.5	1527.5	SM	Y	120.0	31	15.0
1527.5	1526.5	SM	Y	120.0	31	15.0
1526.5	1525.5	SM	Y	120.0	31	15.0
1525.5	1524.5	SM	Y	120.0	31	15.0
1524.5	1523.5	SM	Y	120.0	55	15.0
1523.5	1522.5	SM	Y	120.0	55	15.0
1522.5	1521.5	SM	Y	120.0	55	15.0
1521.5	1520.5	SM	Y	120.0	55	15.0
1520.5	1519.5	SM	Y	120.0	55	15.0
1519.5	1518.5	SM	Y	120.0	60	15.0
1518.5	1517.5	SM	Y	120.0	60	15.0
1517.5	1516.5	SM	Y	120.0	60	15.0
1516.5	1515.5	SM	Y	120.0	60	15.0
1515.5	1514.5	SM	Y	120.0	60	15.0
1514.5	1513.5	BEDROCK/FORMATION	N	135.0	60	
1513.5	1512.5	BEDROCK/FORMATION	N	135.0	60	
1512.5	1511.5	BEDROCK/FORMATION	N	135.0	60	
1511.5	1510.5	BEDROCK/FORMATION	N	135.0	60	
1510.5	1509.5	BEDROCK/FORMATION	N	135.0	60	
1509.5	1508.5	BEDROCK/FORMATION	N	135.0	60	
1508.5	1507.5	BEDROCK/FORMATION	N	135.0	60	
1507.5	1506.5	BEDROCK/FORMATION	N	135.0	60	
1506.5	1505.5	BEDROCK/FORMATION	N	135.0	60	
1505.5	1504.5	BEDROCK/FORMATION	N	135.0	60	
1504.5	1503.5	BEDROCK/FORMATION	N	135.0	60	
1503.5	1502.5	BEDROCK/FORMATION	N	135.0	60	
1502.5	1501.5	BEDROCK/FORMATION	N	135.0	60	
1501.5	1500.5	BEDROCK/FORMATION	N	135.0	60	
1500.5	1499.5	BEDROCK/FORMATION	N	135.0	60	
1499.5	1498.5	BEDROCK/FORMATION	N	135.0	70	
1498.5	1497.5	BEDROCK/FORMATION	N	135.0	70	
1497.5	1496.5	BEDROCK/FORMATION	N	135.0	70	
1496.5	1495.5	BEDROCK/FORMATION	N	135.0	70	
1495.5	1494.5	BEDROCK/FORMATION	N	135.0	70	
1494.5	1493.5	BEDROCK/FORMATION	N	135.0	70	
1493.5	1492.5	BEDROCK/FORMATION	N	135.0	70	

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) + / RESIDUAL STRENGTH AND GROUND SETTLEMENT

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_H	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio r_u (%)	Remarks	Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
0.5	1.700	0.750	27.4	0.988	N/A	0.321	N/A	N/A	NO	N/A	Soil above GWT	24.7	N/A	0.061	0.085	0.00	0.02
1.5	1.700	0.750	27.0	0.986	N/A	0.320	N/A	N/A	NO	N/A	Soil above GWT	24.7	N/A	0.067	0.093	0.01	0.01
2.5	1.600	0.750	100.5	0.984	N/A	0.320	N/A	N/A	NO	N/A	Soil above GWT	93.8	N/A	0.042	0.000	0.00	0.01
3.5	1.500	0.750	96.3	0.981	N/A	0.319	N/A	N/A	NO	N/A	Soil above GWT	90.8	N/A	0.045	0.000	0.00	0.01
4.5	1.497	0.750	92.5	0.979	N/A	0.318	N/A	N/A	NO	N/A	Soil above GWT	87.2	N/A	0.048	0.000	0.00	0.01
5.5	1.438	0.750	121.8	0.977	N/A	0.317	N/A	N/A	NO	N/A	Soil above GWT	115.1	N/A	0.046	0.000	0.00	0.01
6.5	1.384	0.750	117.3	0.974	N/A	0.317	N/A	N/A	NO	N/A	Soil above GWT	110.9	N/A	0.049	0.000	0.00	0.01
7.5	1.334	0.750	90.7	0.972	N/A	0.316	N/A	N/A	NO	N/A	Soil above GWT	85.5	N/A	0.055	0.000	0.00	0.01
8.5	1.287	0.850	98.9	0.970	N/A	0.315	N/A	N/A	NO	N/A	Soil above GWT	93.3	N/A	0.050	0.000	0.00	0.01
9.5	1.243	0.850	95.6	0.967	N/A	0.314	N/A	N/A	NO	N/A	Soil above GWT	90.2	N/A	0.058	0.000	0.00	0.01
10.5	1.202	0.850	53.5	0.965	N/A	0.314	N/A	N/A	NO	N/A	Soil above GWT	49.8	N/A	0.073	0.000	0.00	0.01
11.5	1.164	0.850	51.7	0.963	N/A	0.313	N/A	N/A	NO	N/A	Soil above GWT	48.2	N/A	0.076	0.000	0.00	0.01
12.5	1.128	0.850	50.2	0.960	N/A	0.312	N/A	N/A	NO	N/A	Soil above GWT	46.8	N/A	0.078	0.000	0.00	0.01
13.5	1.095	0.850	48.7	0.958	N/A	0.311	N/A	N/A	NO	N/A	Soil above GWT	45.4	N/A	0.081	0.000	0.00	0.01
14.5	1.063	0.850	47.4	0.956	N/A	0.311	N/A	N/A	NO	N/A	Soil above GWT	44.2	N/A	0.085	0.000	0.00	0.01
15.5	1.033	0.950	51.3	0.953	N/A	0.310	N/A	N/A	NO	N/A	Soil above GWT	47.9	N/A	0.083	0.000	0.00	0.01
16.5	1.005	0.950	49.9	0.951	N/A	0.309	N/A	N/A	NO	N/A	Soil above GWT	46.6	N/A	0.086	0.000	0.00	0.01
17.5	0.978	0.950	84.4	0.949	N/A	0.308	N/A	N/A	NO	N/A	Soil above GWT	79.5	N/A	0.074	0.000	0.00	0.01
18.5	0.952	0.950	82.3	0.946	N/A	0.308	N/A	N/A	NO	N/A	Soil above GWT	77.4	N/A	0.075	0.000	0.00	0.01
19.5	0.928	0.950	80.2	0.944	N/A	0.307	N/A	N/A	NO	N/A	Soil above GWT	75.5	N/A	0.077	0.000	0.00	0.01
20.5	0.905	0.950	78.3	0.942	N/A	0.306	N/A	N/A	NO	N/A	Soil above GWT	73.7	N/A	0.079	0.000	0.00	0.01
21.5	0.884	0.950	76.5	0.939	N/A	0.305	N/A	N/A	NO	N/A	Soil above GWT	71.9	N/A	0.081	0.000	0.00	0.01
22.5	0.863	0.950	81.5	0.937	N/A	0.305	N/A	N/A	NO	N/A	Soil above GWT	76.5	N/A	0.081	0.000	0.00	0.01
23.5	0.843	0.950	79.5	0.935	N/A	0.304	N/A	N/A	NO	N/A	Soil above GWT	74.8	N/A	0.082	0.000	0.00	0.01
24.5	0.824	0.950	77.8	0.932	N/A	0.303	N/A	N/A	NO	N/A	Soil above GWT	73.2	N/A	0.084	0.000	0.00	0.01
25.5	0.806	0.950	76.1	0.930	N/A	0.302	N/A	N/A	NO	N/A	Soil above GWT	71.6	N/A	0.086	0.000	0.00	0.01
26.5	0.789	0.950	74.5	0.927	N/A	0.300	N/A	N/A	NO	N/A	Soil above GWT	70.1	N/A	0.088	0.000	0.00	0.01
27.5	0.771	0.950	N/A	0.914	N/A	0.297	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.01
28.5	0.753	1.000	N/A	0.905	N/A	0.294	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.01
29.5	0.736	1.000	N/A	0.897	N/A	0.292	N/A	N/A	NO	N/A	Soil above GWT	N/A	N/A	N/A	N/A	0.00	0.01
30.5	0.720	1.000	N/A	0.889	N/A	0.291	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
31.5	0.704	1.000	N/A	0.881	N/A	0.293	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
32.5	0.689	1.000	N/A	0.873	N/A	0.294	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
33.5	0.675	1.000	N/A	0.865	N/A	0.295	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
34.5	0.661	1.000	N/A	0.857	N/A	0.296	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
35.5	0.648	1.000	N/A	0.848	N/A	0.296	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
36.5	0.636	1.000	N/A	0.840	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
37.5	0.623	1.000	N/A	0.832	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
38.5	0.612	1.000	N/A	0.824	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
39.5	0.600	1.000	N/A	0.816	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
40.5	0.590	1.000	N/A	0.808	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
41.5	0.582	1.000	N/A	0.800	N/A	0.297	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
42.5	0.536	1.000	N/A	0.791	N/A	0.296	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
43.5	0.571	1.000	N/A	0.783	N/A	0.296	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
44.5	0.565	1.000	N/A	0.775	N/A	0.295	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
45.5	0.560	1.000	N/A	0.767	N/A	0.294	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
46.5	0.555	1.000	N/A	0.759	N/A	0.294	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
47.5	0.550	1.000	N/A	0.751	N/A	0.293	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01
48.5	0.545	1.000	N/A	0.743	N/A	0.292	N/A	N/A	NO	N/A	Bedrock/Formation	N/A	N/A	N/A	N/A	0.00	0.01

EVALUATION OF LIQUEFACTION POTENTIAL AND EARTHQUAKE-INDUCED SETTLEMENTS USING SPT DATA

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PROJECT INFORMATION

Project Name	Ret. Walls @ Alta 4 Elt (HV-8)
Project No.	76939
Location	Riverside, California

GENERAL INPUT DATA

Exploration No.	HV-8
Liquefaction Analysis Method	1996-1998 NCEER/NSF Workshops
Magnitude Scaling Factor Method	Idriss (1985)
Ground Surface Elevation During Test	1541.50 feet
Proposed Grade Elevation	1546.00 feet
Unit Weight of Proposed Fill on Surface	125.00 pcf
GWT Elevation During Test	1508.50 feet
GWT Elevation For Design	1511.50 feet
Earthquake(Moment) Magnitude, M_w	7.50
Peak Ground Acceleration, A_{max}	0.50 g
Required Factor of Safety, FS	1.10

SPT CORRECTION FACTORS

For Hammer Energy Ratio, C_E	1.33
For Borehole Diameter, C_B	1.15
For Sampling Method, C_S	1.00

SUMMARY OF RESULTS

Liquefaction Potential Index (LPI) =	0.00	****	<==== LPI < 5 : "Minor" liquefaction effects (no surface manifestation of liquefaction)
Total Thickness of Liquefiable Soil (in the upper 50 feet) =	0.0	feet	LPI = 5 - 15 : "Moderate" liquefaction effects (usually associated with sand boils)
Earthquake-Induced Settlements (in the upper 50 feet):			LPI > 15 : "Major" liquefaction effects (usually associated with lateral spreading)
- Liquefaction-Induced Settlement =	0.00	inches	<==== Saturated Soils (Below GWT)
- Seismic Compaction Settlement =	0.02	inches	<==== Dry or Unsaturated Soils (Above GWT)
	0.02	inches	<==== Total Earthquake-Induced Settlement

NOTES AND REFERENCES

* Liquefaction Resistance of Soils: Summary Report From the 1996 NCEER and 1998 NCEER/NSF Workshops (Edited by: T.L. Youd and I.M. Idriss, 2001)
The method is based on observed seismic performance of level ground sites using correlation with corrected SPT blow count, $(N_1)_{60cs} = N_m C_N C_E C_B C_R C_S$ x f(FC)
** Chinese Criteria: Liquefaction can only occur if all the following conditions are met: Clay content < 15%, Liquid limit < 35%, Natural moisture content > 0.9 x Liquid limit
*** $CSR = 0.65 A_{max} (\sigma_v/\sigma_v') r_d$
* $FS_{liq} = (CRR/CSR)$, where $CRR = CRR_{7.5}$ MSF $K_\sigma K_\alpha$; $CRR_{7.5}$ is evaluated using SPT data (Youd and Idriss, 2001), $K_\sigma = 1.0$ (level ground), and MSF = magnitude scaling factor
** Residual strength values of liquefied soils are evaluated using the extended median curve by Seed & Harder (1990).
*** Ground settlements are evaluated using the method developed by Tokimatsu and Seed (1987).
**** Liquefaction Potential Index (LPI) is a measure of severity of liquefaction effects at the site. $LPI = \Sigma w_i \times f(FS_{liq}) \times H_i$ (Iwasaki et al., 1982; Toprak and Holzer, 2003)

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

INPUT SOIL PROFILE (BORING DATA)

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Classification (USCS)	Chinese Criteria Screening ++ Liquefiable? (Y/N)	Soil Unit Weight γ_t (pcf)	Field SPT Blow Count N_m (blows/ft)	Fines Content FC (%)
1492.5	1491.5	BEDROCK/FORMATION	N	135.0	70	
1491.5	1490.5	BEDROCK/FORMATION	N	135.0	70	

SOIL LIQUEFACTION POTENTIAL ANALYSIS (1996 NCEER & 1998 NCEER/NSF WORKSHOPS) *

Soil Depth During Test Z (feet)	SPT Stress Correction Factor C_N	SPT Rod Length Correction Factor C_R	Fines Corrected SPT Blow Count (For Liq.) $(N_1)_{60cs}$	Shear Stress Reduction Coeff. r_d	Correction for High Overburden Stress K_σ	Cyclic Stress Ratio ++ CSR	Cyclic Res. Ratio * CRR	Factor of Safety Against Liquefaction * FS_{liq}	Liquefy ?	Cyclic Pore Pressure Ratio e_v (%)	Remarks
49.5	0.540	1.000	N/A	0.734	N/A	0.290	N/A	N/A	NO	N/A	Bedrock/Formation
50.5	0.535	1.000	N/A	0.726	N/A	0.289	N/A	N/A	NO	N/A	Bedrock/Formation

RESIDUAL STRENGTH AND GROUND SETTLEMENT

Fines Corrected SPT Blow Count $(N_1)_{60cs}$	Residual Shear Strength ** S_r (psf)	Cyclic Shear Strain *** γ_c (%)	Vol. Strain *** ε_v (%)	Layer Settlement *** S_i (inches)	Cumulative Settlement Profile (Upper 50 ft) (inches)
N/A	N/A	N/A	N/A	0.00	0.00
N/A	N/A	N/A	N/A	0.00	N/A

C-3

AXIAL PILE CAPACITY

Prelim 16_in CIDH for Wingwalls
VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 5.0 (C) COPYRIGHT ENSOFT,INC. 1989,1995,1998,2001,2003

HOV Wingwall Piles 1.33' CIDH

PROPOSED DEPTH = 55.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 30.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 2.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 3.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.114E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
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.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04

DEPTH, FT = 0.700E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.761E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.300E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.761E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.300E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.646E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.400E+02

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.646E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.400E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.454E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+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 = 0.300E+04
DEPTH, FT = 0.600E+02

LAYER NO 5----SAND

Prelim 16_in CIDH for Wingwalls

AT THE TOP

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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.600E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.293E+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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.800E+02

DRILLED SHAFT INFORMATION

DIAMETER OF STEM	=	1.333	FT.
DIAMETER OF BASE	=	1.333	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	=	2.011	SQ.IN.
ELASTIC MODULUS, Ec	=	0.360E+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	0.05	0.26	0.00	0.26	0.26	0.13	5.10
2.0	0.10	0.79	0.00	0.79	0.79	0.40	7.65
3.0	0.16	1.58	0.00	1.58	1.58	0.79	10.21
4.0	0.21	2.64	0.00	2.64	2.64	1.32	12.76
5.0	0.26	3.96	0.00	3.96	3.96	1.98	15.30
6.0	0.31	5.50	0.49	5.99	5.66	2.91	19.29
7.0	0.36	7.26	1.09	8.35	7.62	3.99	23.07

AT THE TOP

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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.600E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.293E+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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.800E+02

DRILLED SHAFT INFORMATION

DIAMETER OF STEM	=	1.333	FT.
DIAMETER OF BASE	=	1.333	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	=	2.011	SQ.IN.
ELASTIC MODULUS, Ec	=	0.360E+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	0.05	0.26	0.00	0.26	0.26	0.13	5.10
2.0	0.10	0.79	0.00	0.79	0.79	0.40	7.65
3.0	0.16	1.58	0.00	1.58	1.58	0.79	10.21
4.0	0.21	2.64	0.00	2.64	2.64	1.32	12.76
5.0	0.26	3.96	0.00	3.96	3.96	1.98	15.30
6.0	0.31	5.50	0.49	5.99	5.66	2.91	19.29
7.0	0.36	7.26	1.09	8.35	7.62	3.99	23.07

Prelim 16_in CIDH for Wingwalls

8.0	0.41	9.24	1.82	11.06	9.85	5.23	26.74
9.0	0.47	11.43	2.67	14.11	12.33	6.61	30.31
10.0	0.52	13.84	3.64	17.48	15.05	8.13	33.80
11.0	0.57	16.44	4.74	21.18	18.02	9.80	37.23
12.0	0.62	19.24	5.67	24.91	21.13	11.51	40.14
13.0	0.67	22.23	6.48	28.71	24.39	13.27	42.70
14.0	0.72	25.41	7.29	32.69	27.83	15.13	45.15
15.0	0.78	28.76	8.10	36.85	31.46	17.08	47.51
16.0	0.83	32.29	8.91	41.19	35.26	19.11	49.78
17.0	0.88	35.98	9.72	45.70	39.22	21.23	51.98
18.0	0.93	39.84	10.52	50.37	43.35	23.43	54.11
19.0	0.98	43.87	11.33	55.20	47.64	25.71	56.18
20.0	1.03	48.04	12.14	60.19	52.09	28.07	58.19
21.0	1.09	52.37	12.95	65.32	56.69	30.50	60.14
22.0	1.14	56.84	13.76	70.60	61.43	33.01	62.05
23.0	1.19	61.45	14.57	76.03	66.31	35.58	63.91
24.0	1.24	66.21	15.38	81.59	71.33	38.23	65.73
25.0	1.29	71.09	16.19	87.28	76.49	40.94	67.51
26.0	1.34	76.10	17.00	93.10	81.77	43.72	69.24
27.0	1.40	81.24	17.81	99.05	87.18	46.56	70.94
28.0	1.45	86.50	18.62	105.12	92.71	49.46	72.59
29.0	1.50	91.88	18.62	110.50	98.08	52.14	73.67
30.0	1.55	97.36	18.62	115.98	103.57	54.89	74.75
31.0	1.60	102.86	18.62	121.48	109.07	57.64	75.77
32.0	1.65	108.37	18.62	126.99	114.58	60.39	76.73
33.0	1.71	113.88	18.62	132.50	120.09	63.15	77.64
34.0	1.76	119.40	18.62	138.02	125.61	65.91	78.49
35.0	1.81	124.92	18.62	143.54	131.13	68.67	79.30
36.0	1.86	130.44	18.62	149.06	136.65	71.43	80.06
37.0	1.91	135.96	18.62	154.58	142.17	74.19	80.78
38.0	1.97	141.48	18.62	160.10	147.69	76.95	81.47
39.0	2.02	147.00	35.75	182.74	158.91	85.41	90.60
40.0	2.07	152.51	35.75	188.25	164.42	88.17	91.00
41.0	2.12	158.01	35.75	193.76	169.93	90.92	91.38
42.0	2.17	163.50	35.75	199.25	175.42	93.67	91.73
43.0	2.22	168.99	35.75	204.74	180.90	96.41	92.06
44.0	2.28	174.46	35.75	210.21	186.38	99.15	92.38
45.0	2.33	179.92	35.75	215.67	191.83	101.88	92.67
46.0	2.38	185.36	35.75	221.11	197.28	104.60	92.94
47.0	2.43	190.79	35.75	226.53	202.70	107.31	93.20
48.0	2.48	196.20	35.75	231.94	208.11	110.01	93.43
49.0	2.53	201.58	35.75	237.33	213.50	112.71	93.65
50.0	2.59	206.95	35.75	242.70	218.86	115.39	93.85
51.0	2.64	212.29	35.75	248.04	224.21	118.06	94.04
52.0	2.69	217.61	35.75	253.36	229.53	120.72	94.21
53.0	2.74	222.90	35.75	258.65	234.82	123.37	94.36
54.0	2.79	228.17	35.75	263.91	240.08	126.00	94.50
55.0	2.84	233.40	35.75	269.15	245.32	128.62	94.62

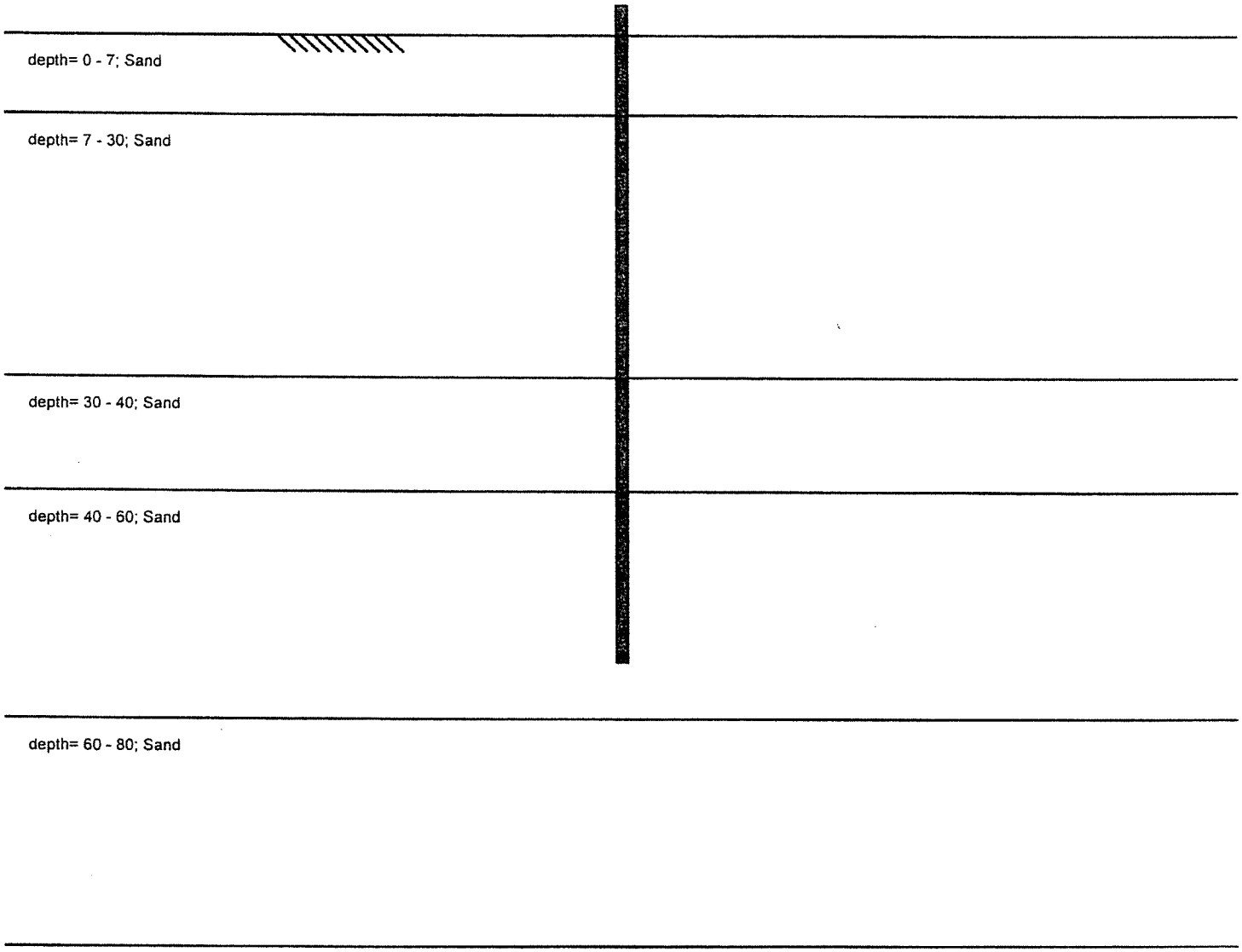
L_{min} = 20' for brk EB & HB [illegible]

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.1363E+01	0.1175E-02	0.7820E-02	0.1000E-03
0.1385E+02	0.1186E-01	0.7820E-01	0.1000E-02
0.3456E+02	0.2988E-01	0.1955E+00	0.2500E-02
0.6410E+02	0.5807E-01	0.3910E+00	0.5000E-02
0.8717E+02	0.8296E-01	0.5865E+00	0.7500E-02
0.1057E+03	0.1048E+00	0.7820E+00	0.1000E-01
0.1656E+03	0.1909E+00	0.1955E+01	0.2500E-01
0.2015E+03	0.2644E+00	0.3910E+01	0.5000E-01

Prelim 16_in CIDH for Wingwalls

0.2175E+03	0.3127E+00	0.5865E+01	0.7500E-01
0.2259E+03	0.3508E+00	0.7775E+01	0.1000E+00
0.2388E+03	0.5238E+00	0.1768E+02	0.2500E+00
0.2474E+03	0.7899E+00	0.2677E+02	0.5000E+00
0.2550E+03	0.1054E+01	0.3478E+02	0.7500E+00
0.2601E+03	0.1314E+01	0.4031E+02	0.1000E+01
0.2711E+03	0.1934E+01	0.5219E+02	0.1600E+01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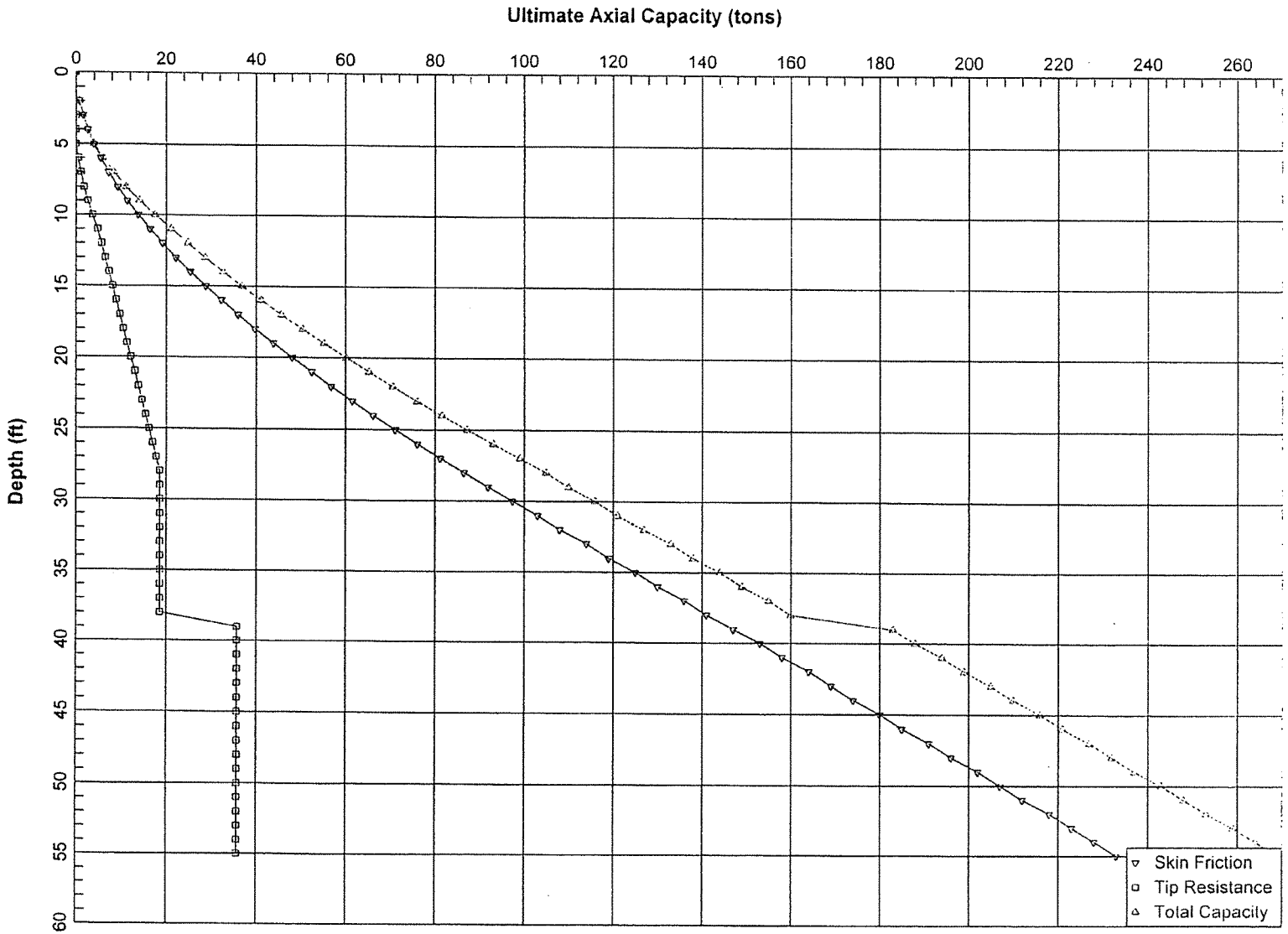
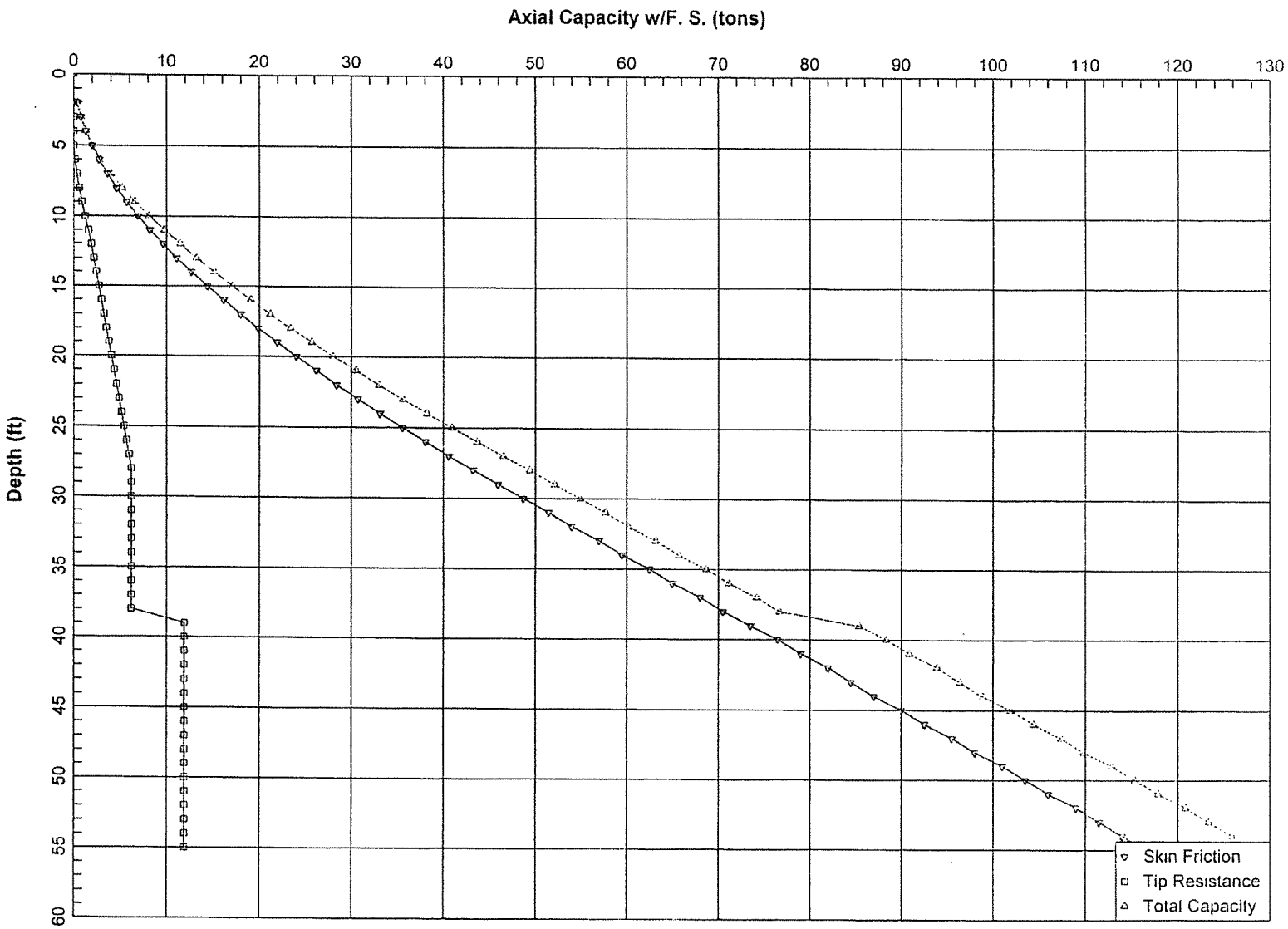
depth= 7 - 30; Sand
depth= 30 - 40; Sand
depth= 40 - 60; Sand
depth= 60 - 80; Sand


Ultimate Axial Capacity (tons)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Skin Friction
Tip Resistance
Total Capacity


Axial Capacity w/F. S. (tons)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Skin Friction
Tip Resistance
Total Capacity

Prelim 2' CIDH at Abutments
VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 5.0 (C) COPYRIGHT ENSOFT,INC. 1989,1995,1998,2001,2003

HOV Abutment Piles 2' CIDH

PROPOSED DEPTH = 55.0 FT

NUMBER OF LAYERS = 5

WATER TABLE DEPTH = 30.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 2.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 3.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.114E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
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.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04

DEPTH, FT = 0.700E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.761E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.300E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.761E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.300E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.646E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.400E+02

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.646E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.400E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.454E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+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 = 0.300E+04
DEPTH, FT = 0.600E+02

LAYER NO 5----SAND

Prelim 2' CIDH at Abutments

AT THE TOP

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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.600E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.293E+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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.800E+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	=	0.360E+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	0.40	0.00	0.40	0.40	0.20	3.40
2.0	0.23	1.19	0.00	1.19	1.19	0.59	5.10
3.0	0.35	2.38	0.00	2.38	2.38	1.19	6.80
4.0	0.47	3.96	0.26	4.22	4.05	2.07	9.06
5.0	0.58	5.94	0.90	6.83	6.23	3.27	11.74
6.0	0.70	8.25	1.83	10.08	8.86	4.74	14.44
7.0	0.81	10.89	2.95	13.84	11.87	6.43	16.99

Prelim 2' CIDH at Abutments

8.0	0.93	13.86	4.25	18.12	15.28	8.35	19.46
9.0	1.05	17.15	5.74	22.89	19.07	10.49	21.86
10.0	1.16	20.76	7.40	28.16	23.22	12.85	24.20
11.0	1.28	24.66	9.25	33.91	27.75	15.42	26.49
12.0	1.40	28.86	11.28	40.14	32.62	18.19	28.75
13.0	1.51	33.35	13.49	46.84	37.85	21.17	30.96
14.0	1.63	38.11	15.89	54.00	43.40	24.35	33.14
15.0	1.75	43.14	18.46	61.60	49.29	27.72	35.29
16.0	1.86	48.43	21.22	69.65	55.51	31.29	37.41
17.0	1.98	53.98	23.71	77.68	61.88	34.89	39.27
18.0	2.09	59.77	25.76	85.53	68.36	38.47	40.83
19.0	2.21	65.80	27.59	93.39	75.00	42.10	42.24
20.0	2.33	72.06	29.41	101.47	81.87	45.83	43.60
21.0	2.44	78.55	31.23	109.78	88.96	49.69	44.92
22.0	2.56	85.26	33.05	118.31	96.28	53.65	46.21
23.0	2.68	92.18	34.87	127.06	103.81	57.72	47.47
24.0	2.79	99.31	36.69	136.00	111.54	61.89	48.70
25.0	2.91	106.64	38.52	145.15	119.48	66.16	49.89
26.0	3.03	114.16	40.34	154.49	127.60	70.52	51.06
27.0	3.14	121.86	41.51	163.37	135.70	74.77	52.00
28.0	3.26	129.75	41.90	171.65	143.72	78.84	52.68
29.0	3.37	137.82	41.90	179.72	151.78	82.87	53.25
30.0	3.49	146.05	41.90	187.95	160.02	86.99	53.84
31.0	3.61	154.30	41.90	196.20	168.26	91.11	54.39
32.0	3.72	162.56	41.90	204.45	176.52	95.24	54.90
33.0	3.84	170.83	41.90	212.72	184.79	99.38	55.39
34.0	3.96	179.10	41.90	221.00	193.07	103.52	55.86
35.0	4.07	187.38	41.90	229.28	201.35	107.66	56.29
36.0	4.19	195.67	41.90	237.56	209.63	111.80	56.71
37.0	4.31	203.95	55.66	259.61	222.50	120.53	60.29
38.0	4.42	212.23	72.18	284.41	236.29	130.17	64.31
39.0	4.54	220.50	80.44	300.94	247.31	137.06	66.31
40.0	4.65	228.77	80.44	309.20	255.58	141.20	66.43
41.0	4.77	237.02	80.44	317.46	263.83	145.32	66.54
42.0	4.89	245.26	80.44	325.70	272.08	149.44	66.64
43.0	5.00	253.49	80.44	333.92	280.30	153.56	66.73
44.0	5.12	261.70	80.44	342.13	288.51	157.66	66.82
45.0	5.24	269.88	80.44	350.32	296.70	161.75	66.90
46.0	5.35	278.05	80.44	358.48	304.86	165.84	66.97
47.0	5.47	286.19	80.44	366.62	313.00	169.91	67.03
48.0	5.59	294.30	80.44	374.74	321.11	173.96	67.09
49.0	5.70	302.38	80.44	382.82	329.19	178.00	67.14
50.0	5.82	310.43	80.44	390.87	337.24	182.03	67.18
51.0	5.93	318.45	80.44	398.88	345.26	186.03	67.21
52.0	6.05	326.42	80.44	406.86	353.23	190.02	67.24
53.0	6.17	334.36	80.44	414.80	361.17	193.99	67.25
54.0	6.28	342.26	80.44	422.69	369.07	197.94	67.26
55.0	6.40	350.11	80.44	430.54	376.92	201.87	67.27

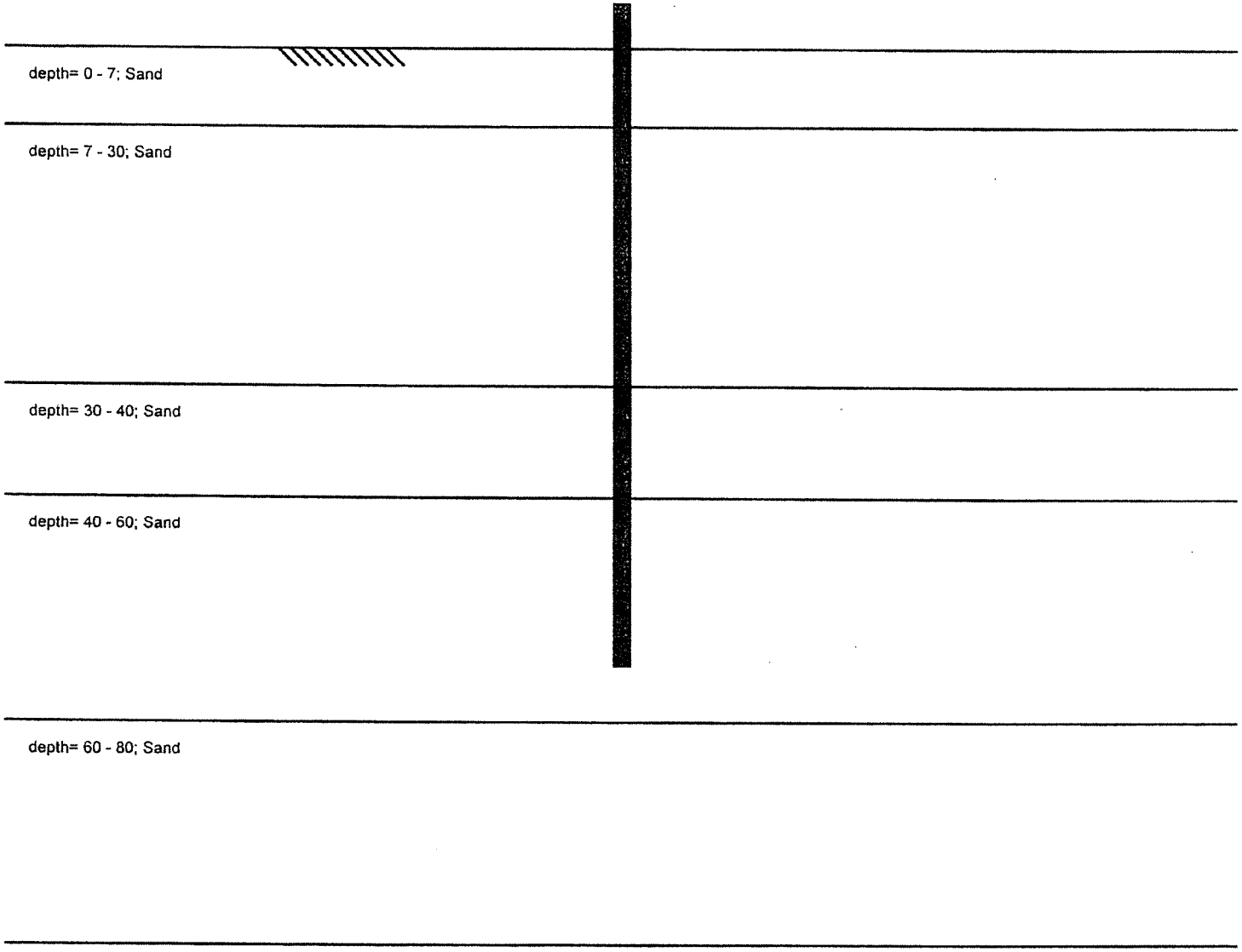
Lmin = 37' for both EB & WB Connector

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.8186E+00	0.4367E-03	0.1173E-01	0.1000E-03
0.8186E+01	0.4367E-02	0.1173E+00	0.1000E-02
0.2059E+02	0.1094E-01	0.2933E+00	0.2500E-02
0.4145E+02	0.2198E-01	0.5865E+00	0.5000E-02
0.6211E+02	0.3302E-01	0.8798E+00	0.7500E-02
0.8174E+02	0.4390E-01	0.1173E+01	0.1000E-01
0.1728E+03	0.1011E+00	0.2933E+01	0.2500E-01
0.2513E+03	0.1674E+00	0.5865E+01	0.5000E-01

Prelim 2' CIDH at Abutments

0.2896E+03	0.2137E+00	0.8798E+01	0.7500E-01
0.3138E+03	0.2527E+00	0.1173E+02	0.1000E+00
0.3612E+03	0.4346E+00	0.2869E+02	0.2500E+00
0.3778E+03	0.6985E+00	0.4628E+02	0.5000E+00
0.3913E+03	0.9596E+00	0.6023E+02	0.7500E+00
0.4033E+03	0.1219E+01	0.7259E+02	0.1000E+01
0.4458E+03	0.2655E+01	0.1174E+03	0.2400E+01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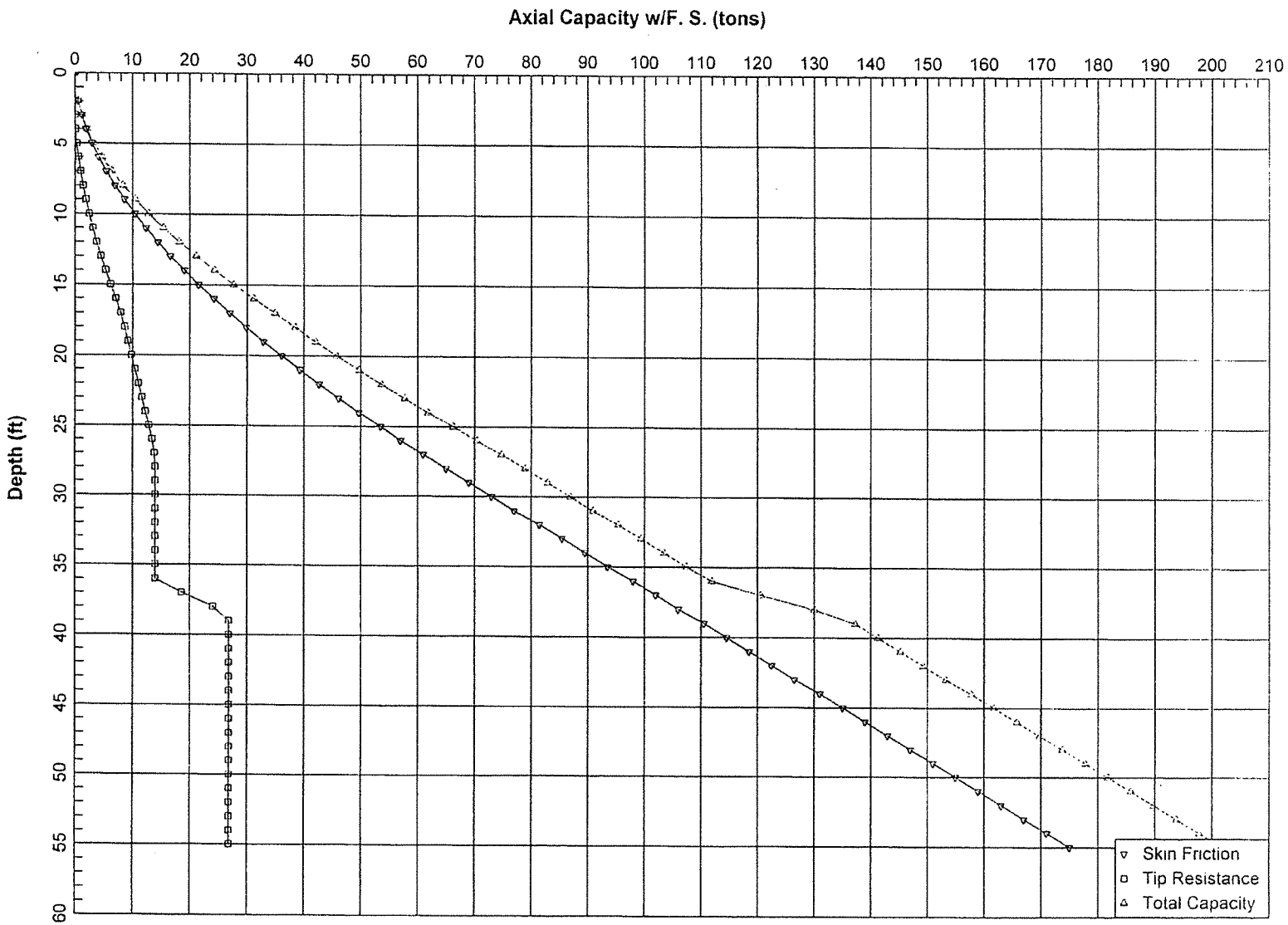
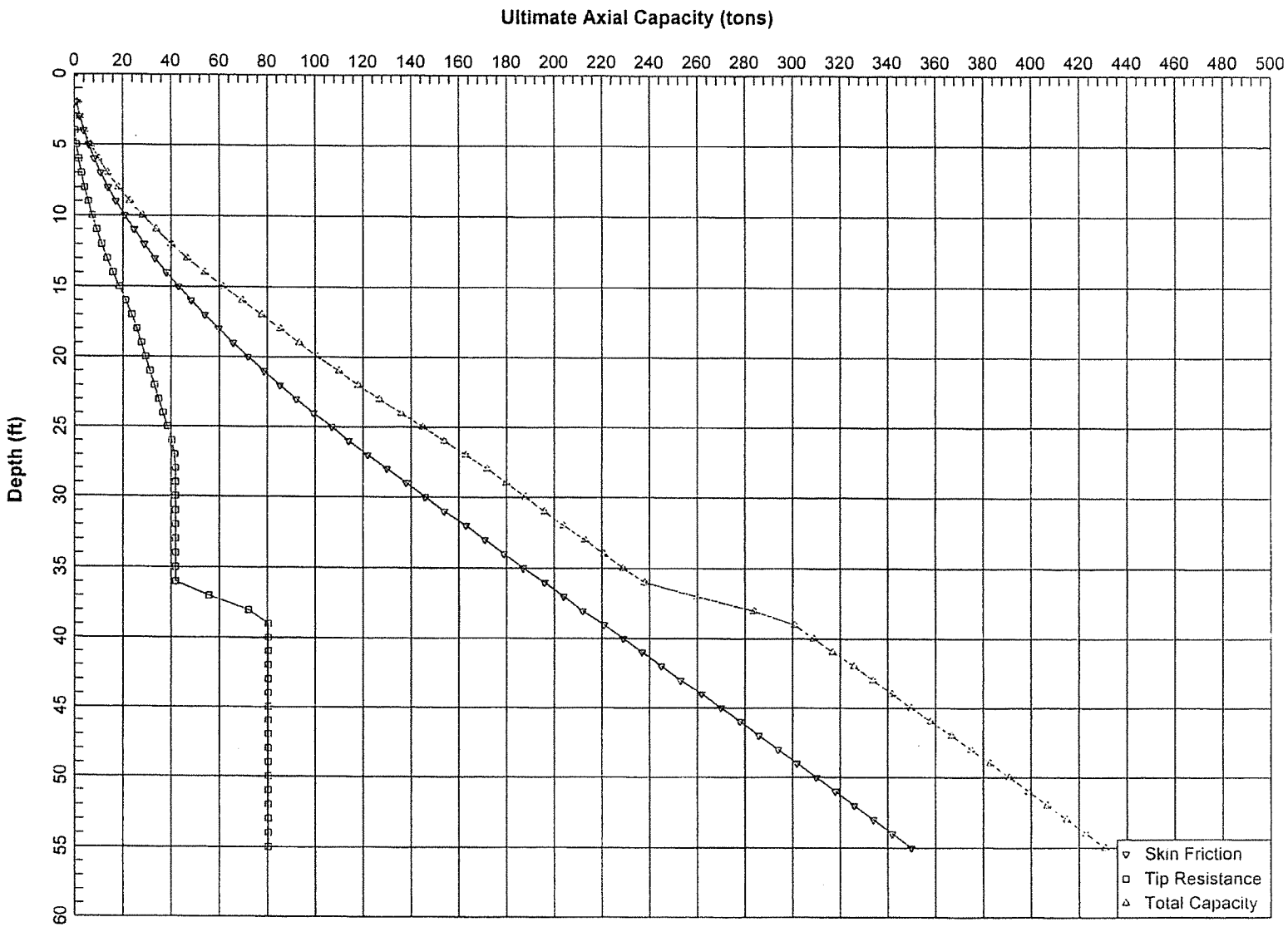
depth= 30 - 40; Sand
depth= 40 - 60; Sand
depth= 60 - 80; Sand


Axial Capacity w/F. S. (tons)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
Skin Friction
Tip Resistance
Total Capacity


Ultimate Axial Capacity (tons)
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500
Depth (ft)
0 5 10 15 20 25 30 35 40 45 50 55 60
Skin Friction
Tip Resistance
Total Capacity

Prelim depth to fixity 8' CIDH at Bents
VERTICALLY LOADED DRILLED SHAFT ANALYSIS PROGRAM SHAFT
VERSION 5.0 (C) COPYRIGHT ENSOFT,INC. 1989,1995,1998,2001,2003

depth to fixity - Bent Piles 8' CIDH

PROPOSED DEPTH = 80.0 FT

NUMBER OF LAYERS = 6

WATER TABLE DEPTH = 30.0 FT.

FACTOR OF SAFETY APPLIED TO THE TOTAL ULTIMATE CAPACITY = 2.00

FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 3.00

SOIL INFORMATION

LAYER NO 1----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.120E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.000E+00

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.114E+01
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.105E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
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.	= 0.300E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.110E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04

DEPTH, FT = 0.700E+01

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.761E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.300E+02

LAYER NO 3----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.761E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.300E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.646E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.400E+02

LAYER NO 4----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA = 0.646E+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 = 0.125E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT = 0.300E+04
DEPTH, FT = 0.400E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA = 0.454E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT = 0.000E+00
INTERNAL FRICTION ANGLE, DEG. = 0.380E+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 = 0.300E+04
DEPTH, FT = 0.600E+02

LAYER NO 5----SAND

Prelim depth to fixity 8' CIDH at Bents

AT THE TOP

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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.600E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.293E+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	= 0.130E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.300E+04
DEPTH, FT	= 0.800E+02

LAYER NO 6----SAND

AT THE TOP

SKIN FRICTION COEFFICIENT- BETA	= 0.293E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.410E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.131E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.800E+02

AT THE BOTTOM

SKIN FRICTION COEFFICIENT- BETA	= 0.250E+00
UNDRAINED SHEAR STRENGTH, LB/SQ FT	= 0.000E+00
INTERNAL FRICTION ANGLE, DEG.	= 0.410E+02
BLOWS PER FOOT FROM STANDARD PENETRATION TEST	= 0.000E+00
SOIL UNIT WEIGHT, LB/CU FT	= 0.131E+03
MAXIMUM LOAD TRANSFER FOR SOIL, LB/SQ FT	= 0.100E+11
DEPTH, FT	= 0.100E+03

DRILLED SHAFT INFORMATION

DIAMETER OF STEM	=	8.000	FT.
DIAMETER OF BASE	=	8.000	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	=	72.392	SQ.IN.
ELASTIC MODULUS, Ec	=	0.360E+07	LB/SQ IN
VOLUME OF UNDERREAM	=	0.000	CU.YDS.

Prelim depth to fixity 8' CIDH at Bents

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	1.86	1.58	11.43	13.01	5.39	4.60	6.99
2.0	3.72	4.75	14.42	19.17	9.56	7.18	5.15
3.0	5.59	9.50	17.82	27.32	15.44	10.69	4.89
4.0	7.45	15.84	21.63	37.46	23.04	15.13	5.03
5.0	9.31	23.74	25.84	49.58	32.35	20.48	5.33
6.0	11.17	33.00	30.44	63.44	43.15	26.65	5.68
7.0	13.03	43.56	35.42	78.98	55.36	33.59	6.06
8.0	14.90	55.44	40.79	96.23	69.04	41.32	6.46
9.0	16.76	68.61	46.53	115.14	84.12	49.81	6.87
10.0	18.62	83.03	52.65	135.67	100.58	59.06	7.29
11.0	20.48	98.65	59.15	157.80	118.37	69.04	7.70
12.0	22.34	115.45	66.03	181.48	137.46	79.74	8.12
13.0	24.21	133.39	73.29	206.68	157.82	91.12	8.54
14.0	26.07	152.44	80.93	233.36	179.41	103.19	8.95
15.0	27.93	172.56	88.54	261.10	202.07	115.79	9.35
16.0	29.79	193.72	96.09	289.81	225.75	128.89	9.73
17.0	31.65	215.91	103.50	319.41	250.41	142.45	10.09
18.0	33.51	239.07	110.74	349.82	275.99	156.45	10.44
19.0	35.38	263.20	117.75	380.95	302.45	170.85	10.77
20.0	37.24	288.26	124.47	412.73	329.75	185.62	11.08
21.0	39.10	314.21	130.85	445.06	357.83	200.72	11.38
22.0	40.96	341.05	136.82	477.87	386.65	216.13	11.67
23.0	42.82	368.73	142.42	511.15	416.21	231.84	11.94
24.0	44.69	397.24	147.69	544.93	446.47	247.85	12.19
25.0	46.55	426.55	163.96	590.51	481.20	267.93	12.69
26.0	48.41	456.63	180.92	637.55	516.94	288.62	13.17
27.0	50.27	487.46	198.66	686.12	553.68	309.95	13.65
28.0	52.13	519.01	217.24	736.25	591.42	331.92	14.12
29.0	54.00	551.27	236.74	788.00	630.18	354.54	14.59
30.0	55.86	584.20	257.24	841.43	669.94	377.84	15.06
31.0	57.72	617.19	278.76	895.95	710.11	401.51	15.52
32.0	59.58	650.23	301.32	951.54	750.66	425.55	15.97
33.0	61.44	683.30	322.27	1005.58	790.73	449.08	16.37
34.0	63.31	716.41	341.58	1057.99	830.27	472.06	16.71
35.0	65.17	749.53	359.18	1108.72	869.26	494.49	17.01
36.0	67.03	782.67	375.04	1157.71	907.68	516.35	17.27
37.0	68.89	815.79	389.10	1204.89	945.49	537.60	17.49
38.0	70.75	848.91	401.31	1250.23	982.68	558.23	17.67
39.0	72.62	882.01	411.64	1293.64	1019.22	578.22	17.82
40.0	74.48	915.07	420.01	1335.08	1055.07	597.54	17.93
41.0	76.34	948.09	428.39	1376.48	1090.88	616.84	18.03
42.0	78.20	981.05	436.77	1417.83	1126.64	636.12	18.13
43.0	80.06	1013.96	445.15	1459.11	1162.34	655.36	18.22
44.0	81.92	1046.79	453.53	1500.32	1197.97	674.57	18.31
45.0	83.79	1079.54	475.05	1554.58	1237.89	698.12	18.55
46.0	85.65	1112.20	497.55	1609.75	1278.05	721.95	18.79

Prelim depth to fixity 8' CIDH at Bents

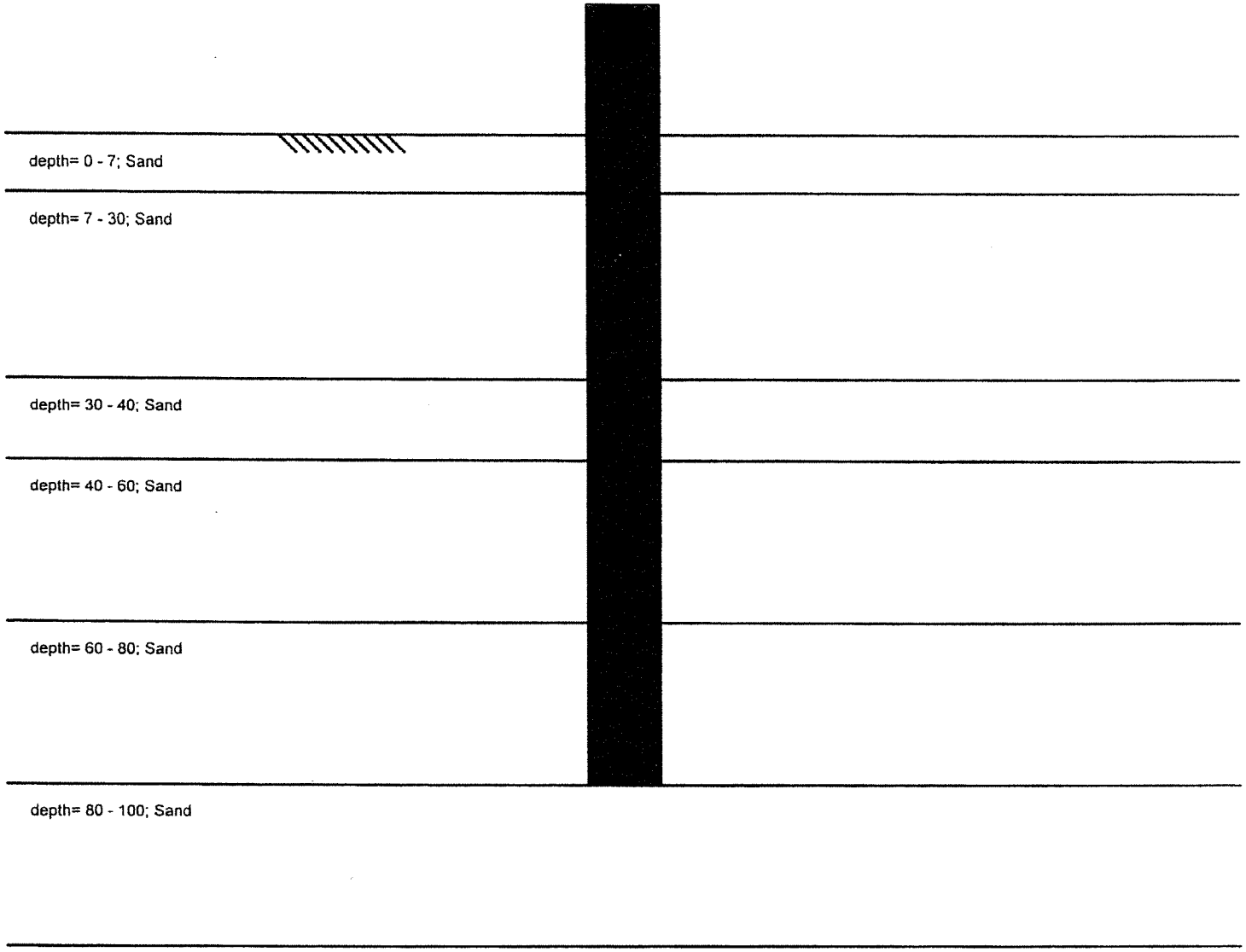
47.0	87.51	1144.75	521.06	1665.81	1318.44	746.06	19.04
48.0	89.37	1177.20	545.58	1722.78	1359.06	770.46	19.28
49.0	91.23	1209.53	571.12	1780.65	1399.90	795.14	19.52
50.0	93.10	1241.72	597.71	1839.43	1440.96	820.10	19.76
51.0	94.96	1273.78	625.34	1899.12	1482.23	845.34	20.00
52.0	96.82	1305.69	654.04	1959.73	1523.70	870.86	20.24
53.0	98.68	1337.44	680.73	2018.17	1564.35	895.63	20.45
54.0	100.54	1369.02	705.36	2074.39	1604.15	919.63	20.63
55.0	102.41	1400.43	727.91	2128.34	1643.07	942.85	20.78
56.0	104.27	1431.66	748.32	2179.98	1681.10	965.27	20.91
57.0	106.13	1462.68	766.57	2229.25	1718.21	986.86	21.00
58.0	107.99	1493.51	782.61	2276.12	1754.38	1007.63	21.08
59.0	109.85	1524.12	796.41	2320.54	1789.59	1027.53	21.12
60.0	111.72	1554.51	807.93	2362.45	1823.83	1046.57	21.15
61.0	113.58	1584.70	819.45	2404.16	1857.86	1065.50	21.17
62.0	115.44	1614.68	830.97	2445.66	1891.67	1084.33	21.19
63.0	117.30	1644.44	842.50	2486.94	1925.27	1103.05	21.20
64.0	119.16	1673.96	854.02	2527.98	1958.64	1121.65	21.21
65.0	121.03	1703.25	873.36	2576.61	1994.37	1142.75	21.29
66.0	122.89	1732.28	892.38	2624.66	2029.74	1163.60	21.36
67.0	124.75	1761.05	911.02	2672.07	2064.73	1184.20	21.42
68.0	126.61	1789.56	929.24	2718.80	2099.30	1204.52	21.47
69.0	128.47	1817.78	946.99	2764.77	2133.44	1224.55	21.52
70.0	130.33	1845.72	964.22	2809.94	2167.12	1244.27	21.56
71.0	132.20	1873.35	980.90	2854.25	2200.32	1263.64	21.59
72.0	134.06	1900.68	996.96	2897.64	2233.00	1282.66	21.61
73.0	135.92	1927.69	1010.53	2938.22	2264.54	1300.69	21.62
74.0	137.78	1954.38	1021.74	2976.12	2294.96	1317.77	21.60
75.0	139.64	1980.73	1030.74	3011.47	2324.31	1333.94	21.57
76.0	141.51	2006.74	1037.65	3044.39	2352.62	1349.25	21.51
77.0	143.37	2032.39	1042.63	3075.03	2379.94	1363.74	21.45
78.0	145.23	2057.68	1045.81	3103.50	2406.29	1377.45	21.37
79.0	147.09	2082.60	1047.33	3129.94	2431.72	1390.41	21.28
80.0	148.95	2107.14	1047.33	3154.48	2456.26	1402.68	21.18

Lmin = 56' for EB Concrete

Lmin = 67' for WB Concrete

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD ton	TOP MOVEMENT IN.	TIP LOAD ton	TIP MOVEMENT IN.
0.8341E+00	0.1344E-03	0.3818E-01	0.1000E-03
0.8341E+01	0.1344E-02	0.3818E+00	0.1000E-02
0.2085E+02	0.3360E-02	0.9546E+00	0.2500E-02
0.4171E+02	0.6720E-02	0.1909E+01	0.5000E-02
0.6256E+02	0.1008E-01	0.2864E+01	0.7500E-02
0.8341E+02	0.1344E-01	0.3818E+01	0.1000E-01
0.2085E+03	0.3360E-01	0.9546E+01	0.2500E-01
0.4176E+03	0.6721E-01	0.1909E+02	0.5000E-01
0.6264E+03	0.1008E+00	0.2864E+02	0.7500E-01
0.8088E+03	0.1336E+00	0.3818E+02	0.1000E+00
0.1539E+04	0.3154E+00	0.9546E+02	0.2500E+00
0.2040E+04	0.5894E+00	0.1907E+03	0.5000E+00
0.2271E+04	0.8522E+00	0.2834E+03	0.7500E+00
0.2383E+04	0.1110E+01	0.3735E+03	0.1000E+01
0.3517E+04	0.9794E+01	0.1529E+04	0.9600E+01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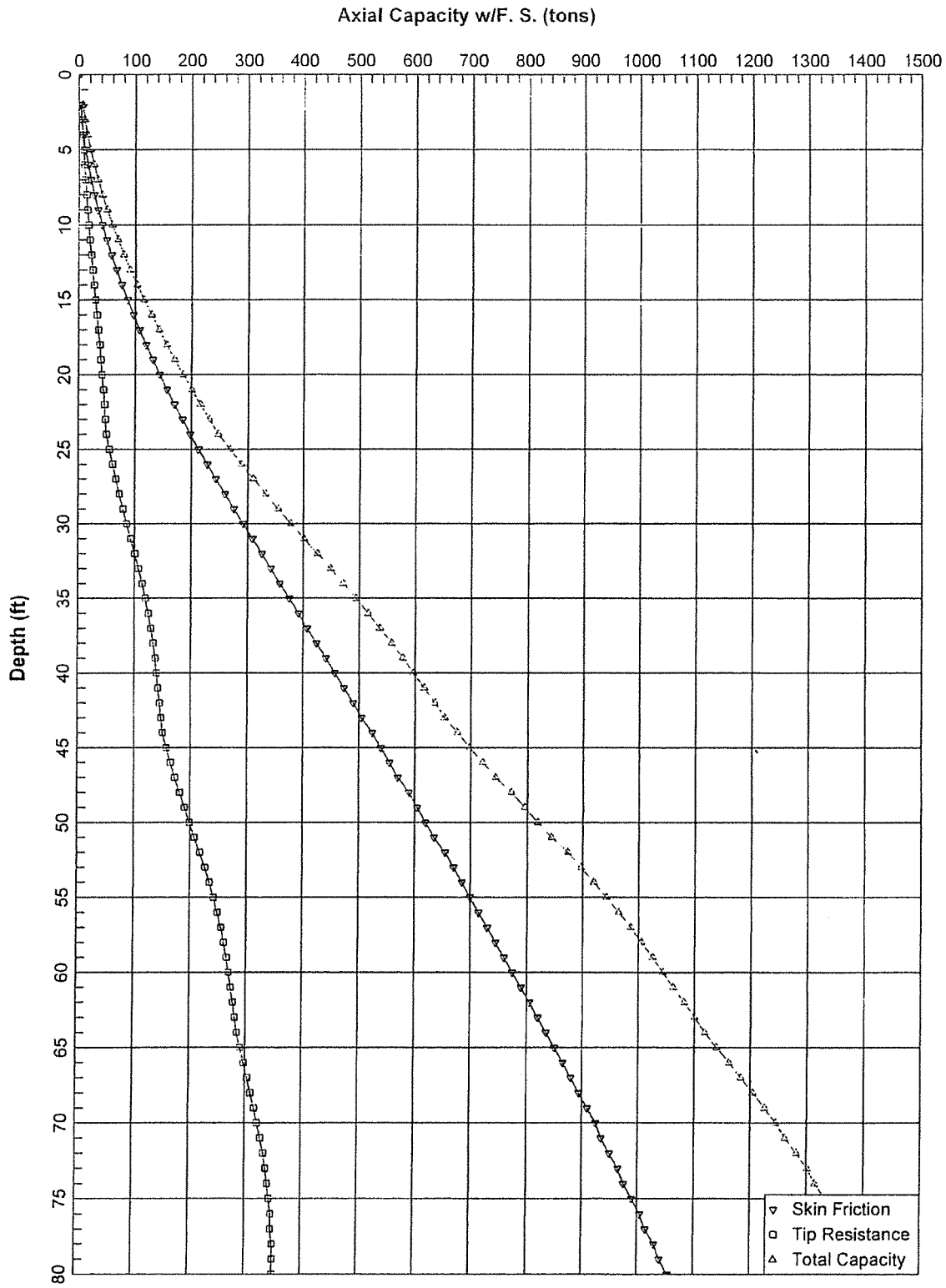
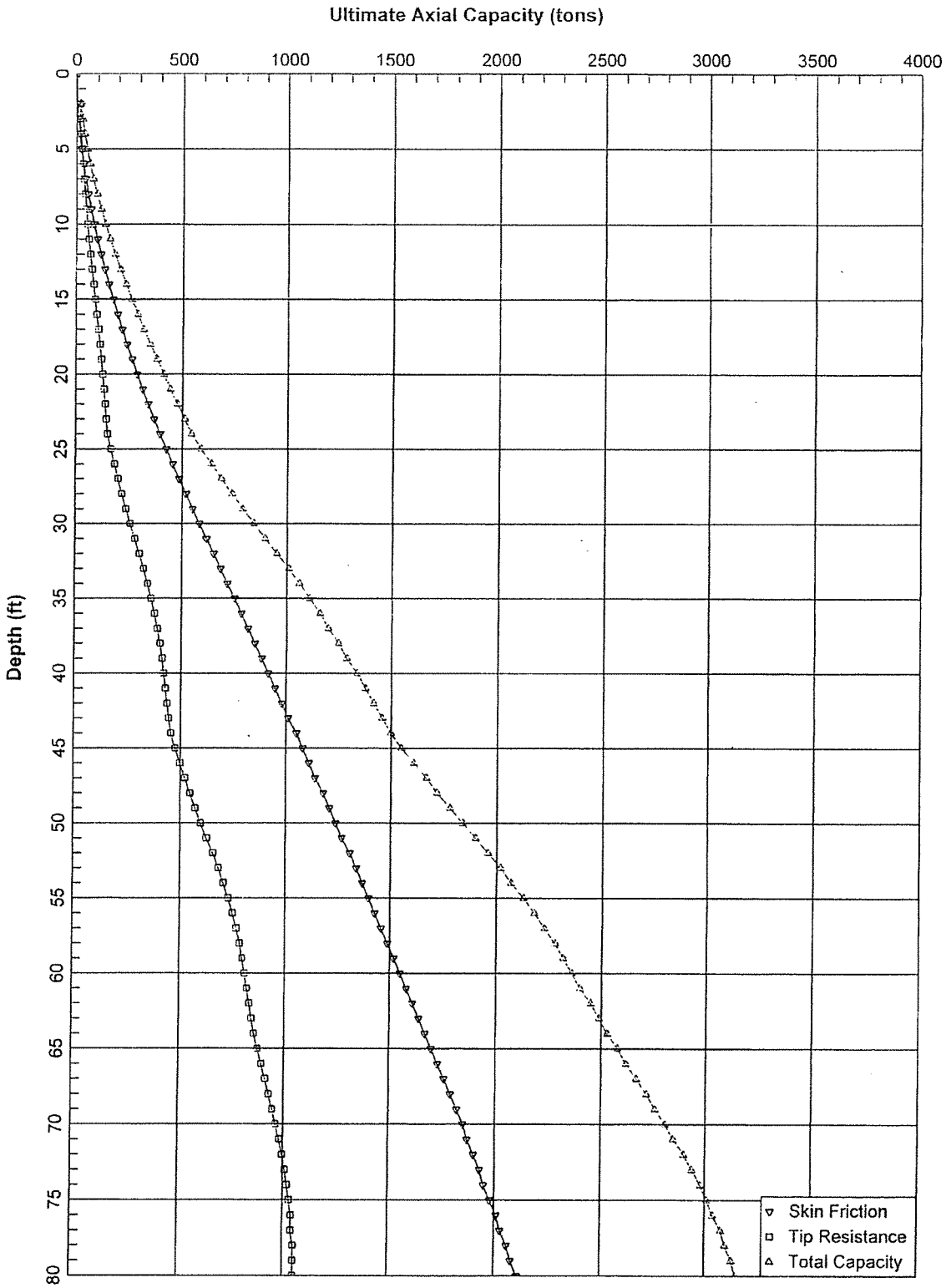
depth= 7 - 30; Sand
depth= 30 - 40; Sand
depth= 40 - 60; Sand
depth= 60 - 80; Sand
depth= 80 - 100; Sand


Axial Capacity w/F. S. (tons)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Skin Friction
Tip Resistance
Total Capacity


Ultimate Axial Capacity (tons)
0
500
1000
1500
2000
2500
3000
3500
4000
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
Skin Friction
Tip Resistance
Total Capacity

C-4

LATERAL PILE CAPACITY

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LPILE Plus for Windows, Version 5.0 (5.0.22)

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:

Kleinfelder
Kleinfelder

Path to file locations: C:\Documents and Settings\stien\My Documents\76979 related files\Engineering Analysis\Lateral Capacity\
Name of input data file: Preliminary Abut 24 inch CIDH FREE HEAD 0.25 inch.lpd
Name of output file: Preliminary Abut 24 inch CIDH FREE HEAD 0.25 inch.lpo
Name of plot output file: Preliminary Abut 24 inch CIDH FREE HEAD 0.25 inch.lpp
Name of runtime file: Preliminary Abut 24 inch CIDH FREE HEAD 0.25 inch.lpr

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Time and Date of Analysis

Date: February 26, 2008 Time: 17: 4:20

Problem Title

I215/SR60 HOV Abutments (2' CIDH) preliminary FREE HEAD 0.25" defl.

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 includes automatic computation of pile-top deflection vs. pile embedment length
- 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:

Preliminary Abut 24 inch CIDH FREE HEAD 0.25 inch.lpo

- 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 = 600.00 in
Depth of ground surface below top of pile = -24.00 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	16286.0000	452.0000	3600000.
2	600.0000	24.00000000	16286.0000	452.0000	3600000.

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -24.000 in
Distance from top of pile to bottom of layer = 84.000 in
p-y subgrade modulus k for top of soil layer = 50.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 84.000 in
Distance from top of pile to bottom of layer = 360.000 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 = 150.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 360.000 in
Distance from top of pile to bottom of layer = 480.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 480.000 in
Distance from top of pile to bottom of layer = 720.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 720.000 in
Distance from top of pile to bottom of layer = 1200.000 in
p-y subgrade modulus k for top of soil layer = 200.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 200.000 lbs/in**3

(Depth of lowest layer extends 600.00 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	-24.00	.06100
2	84.00	.06100
3	84.00	.06400
4	360.00	.07200
5	360.00	.03900
6	480.00	.03900
7	480.00	.03900
8	720.00	.03900
9	720.00	.07200
10	1200.00	.07200

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	-24.000	.00000	30.00	------	------
2	84.000	.00000	30.00	------	------
3	84.000	.00000	30.00	------	------
4	360.000	.00000	35.00	------	------
5	360.000	.00000	35.00	------	------
6	480.000	.00000	35.00	------	------
7	480.000	.00000	38.00	------	------
8	720.000	.00000	38.00	------	------
9	720.000	.00000	40.00	------	------
10	1200.000	.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.

Loading Type

Static loading criteria was used for computation of p-y curves

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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 = 29000.000 lbs
Bending moment at pile head = .000 in-lbs
Axial load at pile head = 68000.000 lbs

(Zero moment at pile head for this load indicates a free-head 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 = 29000.000 lbs
Specified moment at pile head = .000 in-lbs
Specified axial load at pile head = 68000.000 lbs

(Zero moment for this load indicates free-head conditions)

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
0.000	.247311	9.0405E-08	29000.0000	-.0027142	150.4425	-214.8641
6.000	.231026	171240.	27562.2494	-.0027054	276.6170	-264.3861
12.000	.214846	332955.	25851.7750	-.0026796	395.7731	-305.7720
18.000	.198871	483648.	23903.7603	-.0026378	506.8082	-343.5662
24.000	.183193	621952.	21760.7115	-.0025813	608.7150	-370.7834
30.000	.167896	746883.	19468.4529	-.0025112	700.7673	-393.3028
36.000	.153058	857623.	17076.1411	-.0024291	782.3640	-404.1344
42.000	.138747	953778.	14641.0383	-.0023364	853.2142	-407.5665
48.000	.125021	1035222.	12225.8592	-.0022346	913.2241	-397.4932
54.000	.111931	1102312.	9859.0946	-.0021253	962.6582	-391.4283
60.000	.099518	1155265.	7563.1306	-.0020098	1001.6755	-373.8931
66.000	.087814	1194710.	5406.3557	-.0018895	1030.7394	-345.0319
72.000	.076843	1221683.	3453.9988	-.0017659	1050.6143	-305.7537
78.000	.066623	1237599.	1627.9347	-.0016400	1062.3413	-302.9343
84.000	.057163	1242557.	-154.7694	-.0015131	1065.9945	-291.3004
90.000	.048466	1236976.	-1877.9880	-.0013862	1061.8826	-283.1058
96.000	.040528	1221152.	-3537.9052	-.0012605	1050.2229	-270.1999
102.000	.033340	1195550.	-5135.1663	-.0011368	1031.3584	-262.2205
108.000	.026886	1160458.	-6681.1977	-.0010163	1005.5016	-253.1233
114.000	.021145	1116205.	-8159.9949	-.0008998	972.8947	-239.8091
120.000	.016089	1063272.	-9545.3123	-.0007882	933.8923	-221.9634
126.000	.011686	1002304.	-10727.5975	-.0006825	888.9694	-172.1317
132.000	.007899	935098.	-11611.8920	-.0005834	839.4498	-122.6332
138.000	.004685	863438.	-12209.4319	-.0004914	786.6484	-76.5468
144.000	.002002	788986.	-12542.1683	-.0004068	731.7900	-34.3653

150.000	-.000197	713263.	-12634.6313	-.0003300	675.9958	3.5443
156.000	-.001958	637639.	-12513.1887	-.0002608	620.2736	36.9366
162.000	-.003327	563318.	-12205.3313	-.0001994	565.5116	65.6825
168.000	-.004350	491338.	-11739.0023	-.0001454	512.4746	89.7605
174.000	-.005072	422569.	-11141.9805	-9.8662E-05	461.8034	109.2467
180.000	-.005534	357715.	-10441.3297	-5.8736E-05	414.0171	124.3035
186.000	-.005777	297321.	-9662.9182	-2.5219E-05	369.5170	135.1670
192.000	-.005837	241780.	-8831.0159	2.3662E-06	328.5932	142.1338
198.000	-.005748	191347.	-7967.9692	2.4529E-05	291.4322	145.5484
204.000	-.005543	146145.	-7093.9541	4.1798E-05	258.1261	145.7899
210.000	-.005247	106185.	-6226.8061	5.4709E-05	228.6827	143.2594
216.000	-.004886	71378.2729	-5381.9216	6.3795E-05	203.0361	138.3688
222.000	-.004481	41549.8629	-4572.2263	6.9573E-05	181.0576	131.5296
228.000	-.004051	16454.7854	-3808.2048	7.2541E-05	162.5668	123.1442
234.000	-.003611	-4207.7881	-3097.9816	7.3168E-05	153.5429	113.5969
240.000	-.003173	-20780.6986	-2447.4482	7.1889E-05	165.7543	103.2476
246.000	-.002748	-33635.8283	-1860.4262	6.9105E-05	175.2263	92.4264
252.000	-.002344	-43162.2026	-1338.8585	6.5175E-05	182.2456	81.4295
258.000	-.001966	-49755.3134	-883.0211	6.0421E-05	187.1036	70.5163
264.000	-.001619	-53807.7585	-491.7464	5.5121E-05	190.0896	59.9085
270.000	-.001305	-55701.2496	-162.6530	4.9518E-05	191.4848	49.7893
276.000	-.001025	-55800.0016	107.6272	4.3813E-05	191.5575	40.3041
282.000	-.000779	-54445.4748	323.2277	3.8172E-05	190.5595	31.5627
288.000	-.000567	-51952.4169	488.8384	3.2727E-05	188.7225	23.6408
294.000	-.000386	-48606.1191	609.5115	2.7582E-05	186.2569	16.5835
300.000	-.000236	-44660.7855	690.4864	2.2810E-05	183.3498	10.4081
306.000	-.000112	-40338.8951	737.0349	1.8460E-05	180.1654	5.1081
312.000	-1.41E-05	-35831.4297	754.3288	1.4563E-05	176.8441	.6565585
318.000	6.23E-05	-31298.8321	747.3292	1.1128E-05	173.5044	-2.9898
324.000	.000119	-26872.5595	720.6987	8.1511E-06	170.2430	-5.8871
330.000	.000160	-22657.0991	678.7355	5.6168E-06	167.1369	-8.1007
336.000	.000187	-18732.3169	625.3277	3.4989E-06	164.2450	-9.7019
342.000	.000202	-15156.0216	563.9271	1.7649E-06	161.6099	-10.7650
348.000	.000208	-11966.6319	497.5401	3.7706E-07	159.2598	-11.3641
354.000	.000207	-9185.8485	428.7343	-7.0529E-07	157.2109	-11.5712
360.000	.000200	-6821.2448	367.0040	-1.5243E-06	155.4686	-9.0056
366.000	.000188	-4780.5569	314.0683	-2.1180E-06	153.9649	-8.6397
372.000	.000174	-3050.6974	263.7891	-2.5187E-06	152.6903	-8.1200
378.000	.000158	-1613.0322	216.9577	-2.7573E-06	151.6310	-7.4904
384.000	.000141	-444.9551	174.1192	-2.8627E-06	150.7703	-6.7891
390.000	.000124	478.7338	135.6055	-2.8609E-06	150.7952	-6.0488
396.000	.000107	1184.6455	101.5676	-2.7758E-06	151.3154	-5.2972
402.000	9.05E-05	1699.8096	72.0062	-2.6282E-06	151.6949	-4.5566
408.000	7.52E-05	2050.8639	46.8012	-2.4363E-06	151.9536	-3.8450
414.000	6.12E-05	2263.4118	25.7386	-2.2155E-06	152.1102	-3.1759
420.000	4.86E-05	2361.5345	8.5345	-1.9789E-06	152.1825	-2.5588
426.000	3.75E-05	2367.4404	-5.1430	-1.7369E-06	152.1869	-2.0003
432.000	2.78E-05	2301.2361	-15.6551	-1.4980E-06	152.1381	-1.5037
438.000	1.95E-05	2180.8010	-23.3768	-1.2687E-06	152.0494	-1.0702
444.000	1.26E-05	2021.7492	-28.6832	-1.0536E-06	151.9322	-.6986348
450.000	6.86E-06	1837.4620	-31.9392	-8.5618E-07	151.7964	-.3866751
456.000	2.29E-06	1639.1779	-33.4910	-6.7828E-07	151.6503	-.1306099
462.000	-1.28E-06	1436.1233	-33.6606	-5.2092E-07	151.5007	.0740681
468.000	-3.96E-06	1235.6752	-32.7412	-3.8421E-07	151.3530	.2324031
474.000	-5.89E-06	1043.5421	-30.9949	-2.6759E-07	151.2114	.3497185
480.000	-7.18E-06	863.9552	-28.6896	-1.6998E-07	151.0791	.4187132
486.000	-7.93E-06	699.4060	-26.0273	-8.9987E-08	150.9578	.4686965
492.000	-8.26E-06	551.7006	-23.1389	-2.5969E-08	150.8490	.4941080
498.000	-8.24E-06	421.7601	-20.1582	2.3841E-08	150.7532	.4994776
504.000	-7.97E-06	309.7832	-17.1929	6.1273E-08	150.6707	.4889384
510.000	-7.51E-06	215.3951	-14.3276	8.8146E-08	150.6012	.4661774
516.000	-6.91E-06	137.7804	-11.6258	1.0622E-07	150.5440	.4344096
522.000	-6.23E-06	75.7987	-9.1335	1.1715E-07	150.4983	.3963685

528.000	-5.51E-06	28.0831	-6.8814	1.2246E-07	150.4632	.3543129
534.000	-4.76E-06	-6.8785	-4.8884	1.2355E-07	150.4475	.3100454
540.000	-4.02E-06	-30.6780	-3.1634	1.2162E-07	150.4651	.2649409
546.000	-3.30E-06	-44.9385	-1.7086	1.1776E-07	150.4756	.2199823
552.000	-2.61E-06	-51.2777	-.5212768	1.1283E-07	150.4803	.1758017
558.000	-1.95E-06	-51.2859	.4043071	1.0758E-07	150.4803	.1327263
564.000	-1.32E-06	-46.5138	1.0750	1.0258E-07	150.4768	.0908271
570.000	-7.18E-07	-38.4700	1.4974	9.8232E-08	150.4708	.0499713
576.000	-1.40E-07	-28.6256	1.6769	9.4798E-08	150.4636	.0098755
582.000	4.20E-07	-18.4245	1.6170	9.2391E-08	150.4561	-.0298370
588.000	9.68E-07	-9.2968	1.3188	9.0973E-08	150.4493	-.0695765
594.000	1.51E-06	-2.6734	.7808745	9.0360E-08	150.4444	-.1097247
600.000	2.05E-06	0.0000	0.0000	9.0223E-08	150.4425	-.1505669

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection              =      .24731139 in
Computed slope at pile head       =     -.00271417
Maximum bending moment            =       1242557. lbs-in
Maximum shear force               =    29000.00000 lbs
Depth of maximum bending moment   =    84.00000000 in
Depth of maximum shear force      =        0.00000 in
Number of iterations              =             14
Number of zero deflection points  =              4
```

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= 29000.	M= 0.000	68000.0000	.2473114	1242557.	29000.0000

Pile-head Deflection vs. Pile Length

Boundary Condition Type 1, Shear and Moment

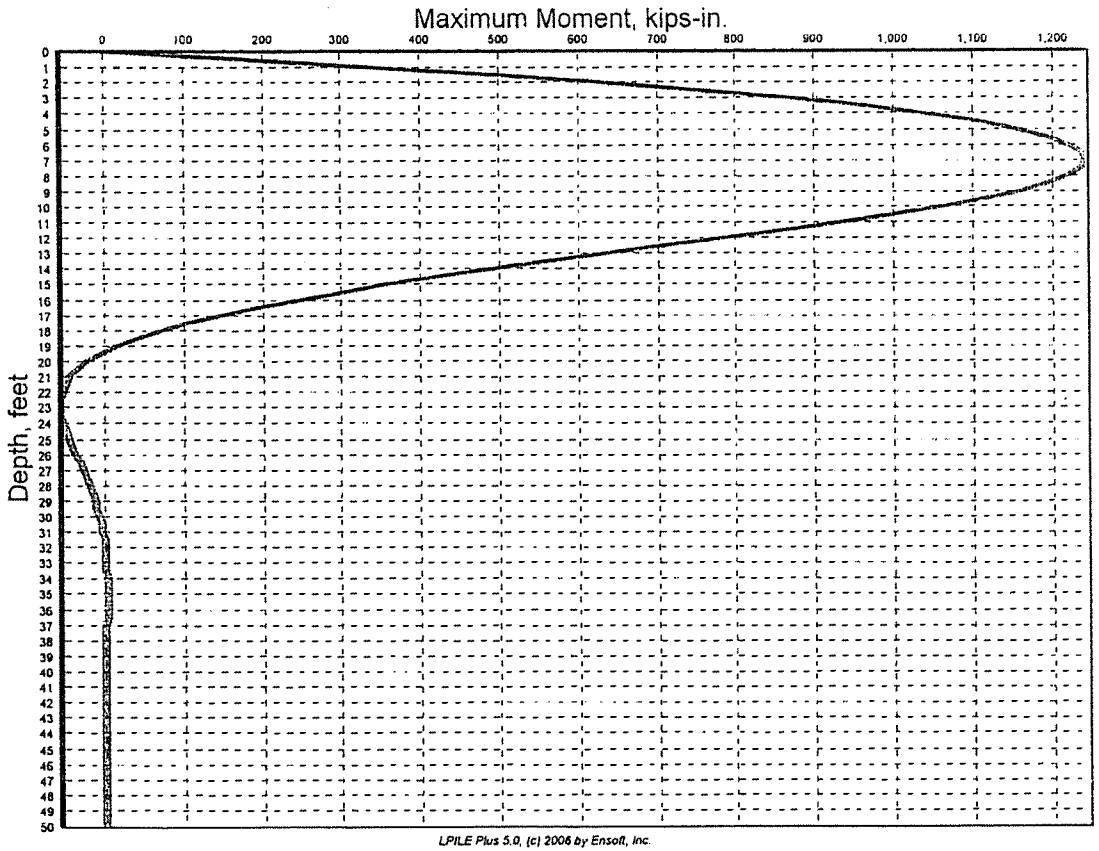
```
Shear      =          29000. lbs
Moment     =              0. in-lbs
Axial Load =          68000. lbs
```

Preliminary Abut 24 inch CIDH FREE HEAD 0.25 inch.lpo

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
600.000	.24731139	1242557.	29000.00000
570.000	.24643932	1242514.	29000.00000
540.000	.24613424	1242569.	29000.00000
510.000	.24599956	1242826.	29000.00000
480.000	.24605467	1242901.	29000.00000
450.000	.24609628	1242711.	29000.00000
420.000	.24535923	1244506.	29000.00000
390.000	.24573150	1242932.	29000.00000
360.000	.24556150	1243548.	29000.00000
330.000	.24561698	1243065.	29000.00000

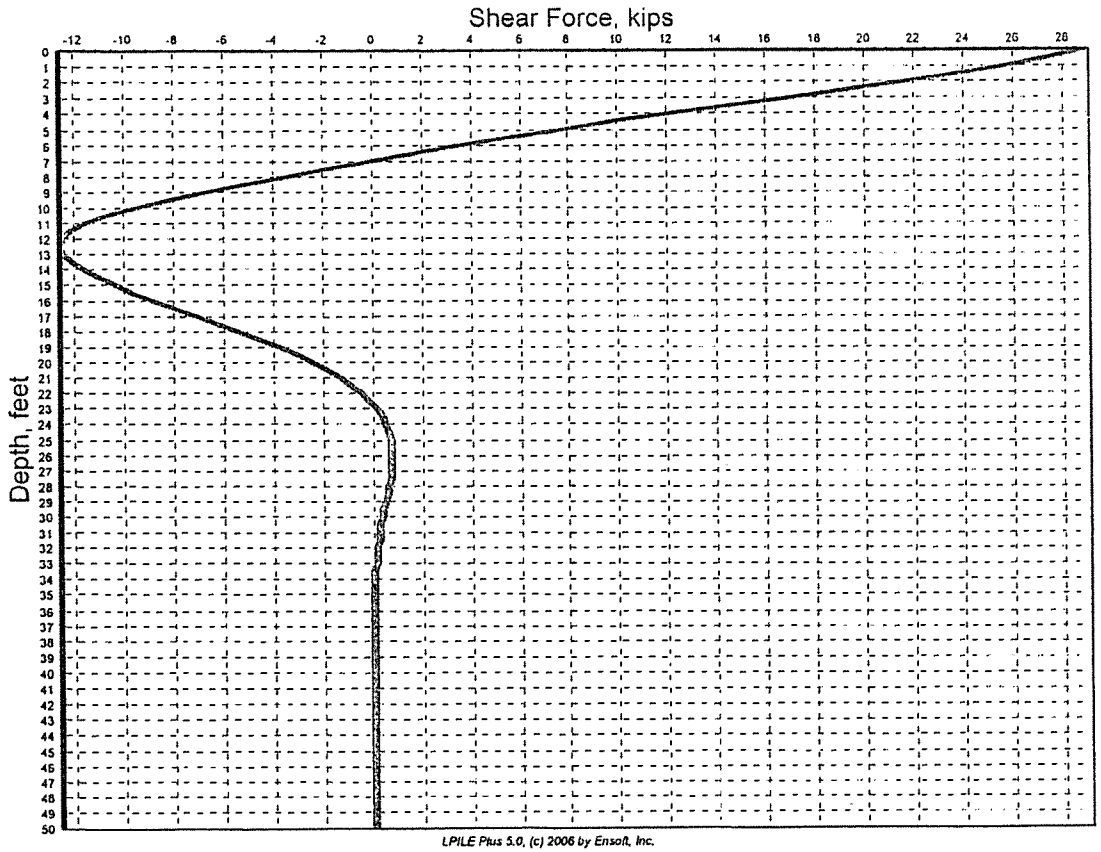
The analysis ended normally.

Bending Moment vs. Depth



LPILE Plus 5.0, (c) 2006 by Ensoft, Inc.

Shear Force vs. Depth



LPILE Plus 5.0, (c) 2006 by Ensoft, Inc.

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LPILE Plus for Windows, Version 5.0 (5.0.22)

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:

Kleinfelder
Kleinfelder

Path to file locations: C:\Documents and Settings\stien\My Documents\76979 related files\Engineering Analysis\Lateral Capacity\
Name of input data file: Preliminary Abut 24 inch CIDH 1 inch deflect.lpd
Name of output file: Preliminary Abut 24 inch CIDH 1 inch deflect.lpo
Name of plot output file: Preliminary Abut 24 inch CIDH 1 inch deflect.lpp
Name of runtime file: Preliminary Abut 24 inch CIDH 1 inch deflect.lpr

---

Time and Date of Analysis

Date: February 26, 2008 Time: 17: 5:25

Problem Title

I215/SR60 HOV Abutments (2' CIDH) preliminary 1 " defl.

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 includes automatic computation of pile-top deflection vs. pile embedment length
- 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:

Preliminary Abut 24 inch CIDH 1 inch deflect.lpo

- 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 = 600.00 in
Depth of ground surface below top of pile = -24.00 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	6514.0000	452.0000	3600000.
2	600.0000	24.00000000	6514.0000	452.0000	3600000.

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -24.000 in
Distance from top of pile to bottom of layer = 84.000 in
p-y subgrade modulus k for top of soil layer = 50.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 84.000 in
Distance from top of pile to bottom of layer = 360.000 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 = 150.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 360.000 in
Distance from top of pile to bottom of layer = 480.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 480.000 in
Distance from top of pile to bottom of layer = 720.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 720.000 in
Distance from top of pile to bottom of layer = 1200.000 in
p-y subgrade modulus k for top of soil layer = 200.000 lbs/in**3

p-y subgrade modulus k for bottom of layer = 200.000 lbs/in**3

(Depth of lowest layer extends 600.00 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	-24.00	.06100
2	84.00	.06100
3	84.00	.06400
4	360.00	.07200
5	360.00	.03900
6	480.00	.03900
7	480.00	.03900
8	720.00	.03900
9	720.00	.07200
10	1200.00	.07200

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	-24.000	.00000	30.00	------	------
2	84.000	.00000	30.00	------	------
3	84.000	.00000	30.00	------	------
4	360.000	.00000	35.00	------	------
5	360.000	.00000	35.00	------	------
6	480.000	.00000	35.00	------	------
7	480.000	.00000	38.00	------	------
8	720.000	.00000	38.00	------	------
9	720.000	.00000	40.00	------	------
10	1200.000	.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.

Loading Type

Preliminary Abut 24 inch CIDH 1 inch deflect.lpo

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 Slope (BC Type 2)
Shear force at pile head = 115000.000 lbs
Slope at pile head = .000 in/in
Axial load at pile head = 68000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Specified shear force at pile head = 115000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 68000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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
0.000	1.004	-6462754.	115000.	3.7007E-17	12056.0385	-339.4287
6.000	.999334	-5778527.	112693.	-.0015660	10795.5639	-429.7132
12.000	.985503	-5109166.	109863.	-.0029589	9562.4761	-513.3525
18.000	.963828	-4457752.	106527.	-.0041828	8362.4507	-598.8775
24.000	.935309	-3827432.	102705.	-.0052427	7201.2847	-674.9889
30.000	.900915	-3221013.	98440.8511	-.0061444	6084.1471	-746.4235
36.000	.861577	-2641128.	93843.9180	-.0068943	5015.8920	-785.8875
42.000	.818183	-2089260.	88991.5992	-.0074995	3999.2479	-831.5521
48.000	.771583	-1567109.	83919.5091	-.0079673	3037.3495	-859.1446
54.000	.722576	-1075724.	78622.4531	-.0083053	2132.1271	-906.5407
60.000	.671918	-616863.	73086.5066	-.0085219	1286.8185	-938.7748
66.000	.620314	-191733.	67409.4181	-.0086253	503.6495	-953.5881
72.000	.568414	199089.	61702.0043	-.0086244	517.2005	-948.8832
78.000	.516821	555729.	55908.6381	-.0085278	1174.1987	-982.2389
84.000	.466081	876951.	50004.4944	-.0083445	1765.9491	-985.8090
90.000	.416687	1162592.	44010.5451	-.0080836	2292.1534	-1012.1741
96.000	.369077	1411674.	37889.8841	-.0077543	2751.0080	-1028.0463
102.000	.323635	1623598.	31672.9913	-.0073660	3141.4124	-1044.2513
108.000	.280685	1797760.	25379.3897	-.0069283	3462.2512	-1053.6159
114.000	.240495	1933804.	19063.8341	-.0064509	3712.8699	-1051.5693
120.000	.203274	2031790.	12796.4885	-.0059436	3893.3780	-1037.5459
126.000	.169172	2092212.	6650.5041	-.0054160	4004.6866	-1011.1156
132.000	.138282	2116016.	701.2252	-.0048777	4048.5371	-971.9774
138.000	.110640	2104607.	-4974.5224	-.0043377	4027.5203	-919.9385
144.000	.086229	2059861.	-10298.9355	-.0038050	3945.0897	-854.8659

150.000	.064981	1984125.	-15193.3036	-.0032876	3805.5693	-776.5902
156.000	.046778	1880224.	-19577.1935	-.0027933	3614.1650	-684.7065
162.000	.031461	1751478.	-23365.7120	-.0023287	3376.9902	-578.1330
168.000	.018834	1601736.	-26265.9172	-.0018997	3101.1376	-388.6021
174.000	.008665	1437837.	-27991.6508	-.0015108	2799.2054	-186.6425
180.000	.000704	1267069.	-28599.0135	-.0011648	2484.6188	-15.8118
186.000	-.005312	1095599.	-28273.5645	-.0008625	2168.7399	124.2948
192.000	-.009646	928490.	-27195.9794	-.0006036	1860.8934	234.9002
198.000	-.012555	769740.	-25537.5930	-.0003863	1568.4466	317.8952
204.000	-.014283	622354.	-23456.8529	-.0002083	1296.9342	375.6849
210.000	-.015054	488428.	-21096.6817	-6.6149E-05	1050.2170	411.0389
216.000	-.015076	369248.	-18582.7152	4.3573E-05	830.6654	426.9500
222.000	-.014531	265399.	-16022.3514	.0001248	639.3577	426.5046
228.000	-.013579	176878.	-13504.5281	.0001813	476.2841	412.7698
234.000	-.012355	103197.	-11100.1298	.0002172	340.5508	388.6963
240.000	-.010973	43498.9047	-8862.9159	.0002359	230.5756	357.0417
246.000	-.009524	-3350.3749	-6830.8589	.0002411	156.6145	320.3107
252.000	-.008080	-38668.1201	-5027.7822	.0002357	221.6763	280.7149
258.000	-.006696	-63876.0931	-3465.1931	.0002226	268.1141	240.1481
264.000	-.005409	-80432.0646	-2144.2148	.0002041	298.6133	200.1780
270.000	-.004246	-89773.2333	-1057.5325	.0001823	315.8215	162.0495
276.000	-.003221	-93271.2502	-191.2828	.0001589	322.2655	126.7005
282.000	-.002339	-92198.3135	473.1738	.0001352	320.2889	94.7851
288.000	-.001599	-87703.4898	957.6389	.0001122	312.0086	66.7033
294.000	-.000993	-80798.1921	1285.6539	9.0632E-05	299.2878	42.6350
300.000	-.000511	-72349.5989	1481.2865	7.1040E-05	283.7239	22.5758
306.000	-.000140	-63080.7227	1568.1341	5.3714E-05	266.6489	6.3733
312.000	.000134	-53575.8210	1568.5409	3.8791E-05	249.1391	-6.2377
318.000	.000325	-44289.8846	1503.0202	2.6271E-05	232.0327	-15.6025
324.000	.000449	-35561.0149	1389.8641	1.6055E-05	215.9525	-22.1162
330.000	.000518	-27624.6165	1244.9217	7.9720E-06	201.3322	-26.1979
336.000	.000544	-20628.4597	1081.5227	1.7990E-06	188.4439	-28.2684
342.000	.000539	-14647.8118	910.5219	-2.7139E-06	177.4265	-28.7319
348.000	.000512	-9699.9828	740.4404	-5.8287E-06	168.3117	-27.9619
354.000	.000470	-5757.7712	577.6819	-7.8062E-06	161.0494	-26.2909
360.000	.000418	-2761.4299	442.1941	-8.8961E-06	155.5295	-18.8717
366.000	.000363	-444.1826	335.6596	-9.3061E-06	151.2607	-16.6398
372.000	.000307	1274.0788	242.8618	-9.2000E-06	152.7896	-14.2928
378.000	.000252	2477.6665	164.1208	-8.7200E-06	155.0068	-11.9542
384.000	.000202	3250.6445	99.1064	-7.9872E-06	156.4308	-9.7173
390.000	.000157	3673.4604	47.0085	-7.1014E-06	157.2097	-7.6486
396.000	.000117	3820.5416	6.6876	-6.1427E-06	157.4806	-5.7917
402.000	8.28E-05	3758.7235	-23.1989	-5.1731E-06	157.3667	-4.1705
408.000	5.46E-05	3546.3762	-44.0903	-4.2385E-06	156.9756	-2.7933
414.000	3.19E-05	3233.0986	-57.4395	-3.3712E-06	156.3984	-1.6564
420.000	1.42E-05	2859.8537	-64.6482	-2.5918E-06	155.7109	-.7465326
426.000	8.32E-07	2459.4350	-67.0209	-1.9113E-06	154.9732	-.0443797
432.000	-8.75E-06	2057.1620	-65.7337	-1.3335E-06	154.2322	.4734675
438.000	-1.52E-05	1671.7190	-61.8161	-8.5644E-07	153.5221	.8323993
444.000	-1.90E-05	1316.0680	-56.1442	-4.7422E-07	152.8669	1.0582
450.000	-2.09E-05	998.3755	-49.4417	-1.7813E-07	152.2817	1.1759
456.000	-2.12E-05	722.9125	-42.2873	4.2073E-08	151.7742	1.2089
462.000	-2.04E-05	490.8930	-35.1267	1.9736E-07	151.3468	1.1780
468.000	-1.88E-05	301.2306	-28.2874	2.9869E-07	150.9974	1.1018
474.000	-1.68E-05	151.2007	-21.9948	3.5657E-07	150.7210	.9957426
480.000	-1.45E-05	37.0018	-16.4664	3.8065E-07	150.5106	.8470552
486.000	-1.22E-05	-46.7070	-11.7614	3.7941E-07	150.5285	.7212800
492.000	-9.96E-06	-104.4449	-7.8086	3.6007E-07	150.6349	.5963280
498.000	-7.88E-06	-140.7041	-4.5864	3.2871E-07	150.7017	.4777321
504.000	-6.02E-06	-159.7502	-2.0454	2.9027E-07	150.7368	.3692681
510.000	-4.40E-06	-165.4860	-.1179017	2.4866E-07	150.7473	.2732379
516.000	-3.03E-06	-161.3679	1.2741	2.0685E-07	150.7397	.1907468
522.000	-1.92E-06	-150.3661	2.2122	1.6697E-07	150.7195	.1219642

Preliminary Abut 24 inch CIDH 1 inch deflect.lpo

528.000	-1.03E-06	-134.9579	2.7772	1.3047E-07	150.6911	.0663606
534.000	-3.52E-07	-117.1466	3.0450	9.8215E-08	150.6583	.0229156
540.000	1.47E-07	-98.4982	3.0846	7.0628E-08	150.6239	-.0097055
546.000	4.96E-07	-80.1889	2.9565	4.7769E-08	150.5902	-.0330046
552.000	7.21E-07	-63.0593	2.7119	2.9443E-08	150.5586	-.0485347
558.000	8.49E-07	-47.6704	2.3928	1.5277E-08	150.5303	-.0578097
564.000	9.04E-07	-34.3577	2.0327	4.7835E-09	150.5058	-.0622382
570.000	9.06E-07	-23.2820	1.6567	-2.5904E-09	150.4854	-.0630783
576.000	8.73E-07	-14.4747	1.2833	-7.4206E-09	150.4691	-.0614073
582.000	8.17E-07	-7.8765	.9247472	-1.0280E-08	150.4570	-.0581062
588.000	7.49E-07	-3.3693	.5888701	-1.1719E-08	150.4487	-.0538528
594.000	6.77E-07	-.8005043	.2799444	-1.2252E-08	150.4440	-.0491224
600.000	6.02E-07	0.0000	0.0000	-1.2354E-08	150.4425	-.0441924

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection              =     1.00429479 in
Computed slope at pile head       =   3.700743E-17
Maximum bending moment            =      -6462754. lbs-in
Maximum shear force               =   115000.00000 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  =              4
```

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
2	V= 1.15E+05	S= 0.000	68000.0000	1.0043	-6462754.	115000.

Pile-head Deflection vs. Pile Length

Boundary Condition Type 2, Shear and Slope

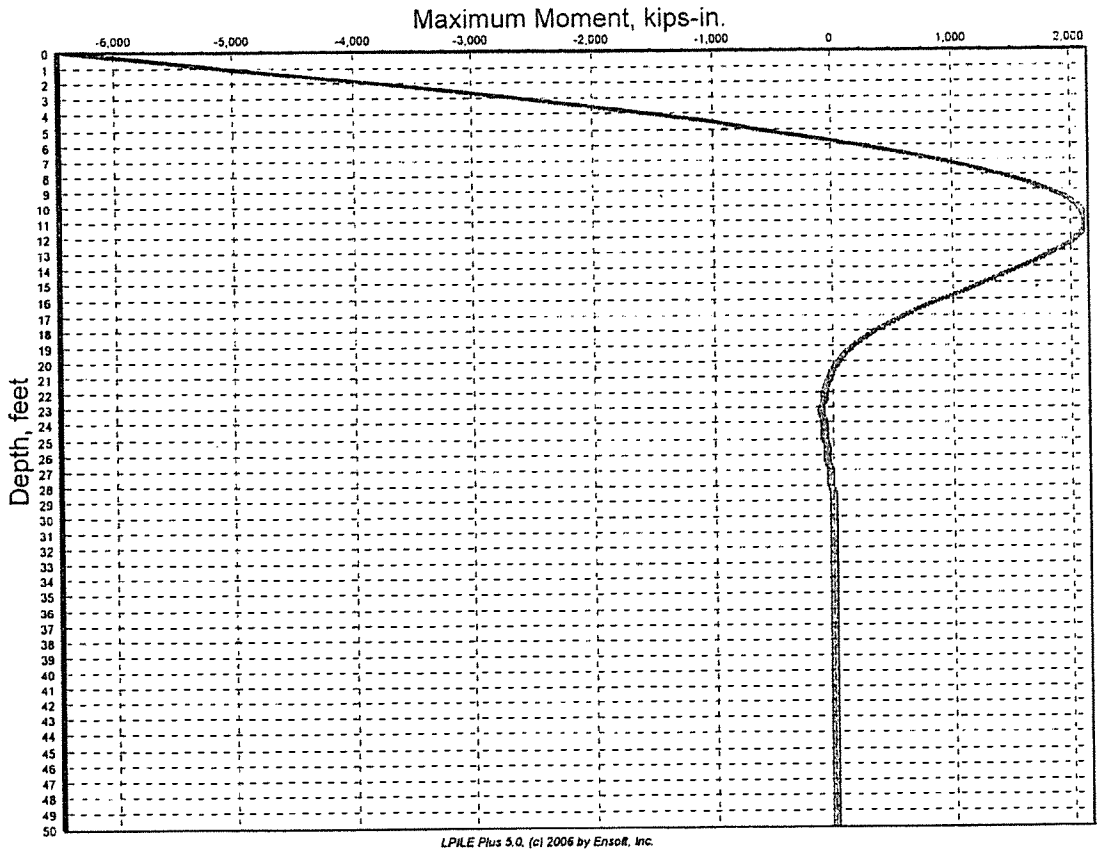
```
Shear      =        115000. lbs
Slope      =         .00000
Axial Load =         68000. lbs
```

Preliminary Abut 24 inch CIDH 1 inch deflect.lpo

Pile Length in	Pile Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
600.000	1.00429479	-6462754.	115000.00000
570.000	.99844524	-6454776.	115000.00000
540.000	.99533554	-6451710.	115000.00000
510.000	.99371553	-6450205.	115000.00000
480.000	.99351608	-6450116.	115000.00000
450.000	.99459858	-6451376.	115000.00000
420.000	.98769872	-6444001.	115000.00000
390.000	.99173284	-6448124.	115000.00000
360.000	.98963978	-6446156.	115000.00000
330.000	.98998369	-6446378.	115000.00000

The analysis ended normally.

Bending Moment vs. Depth



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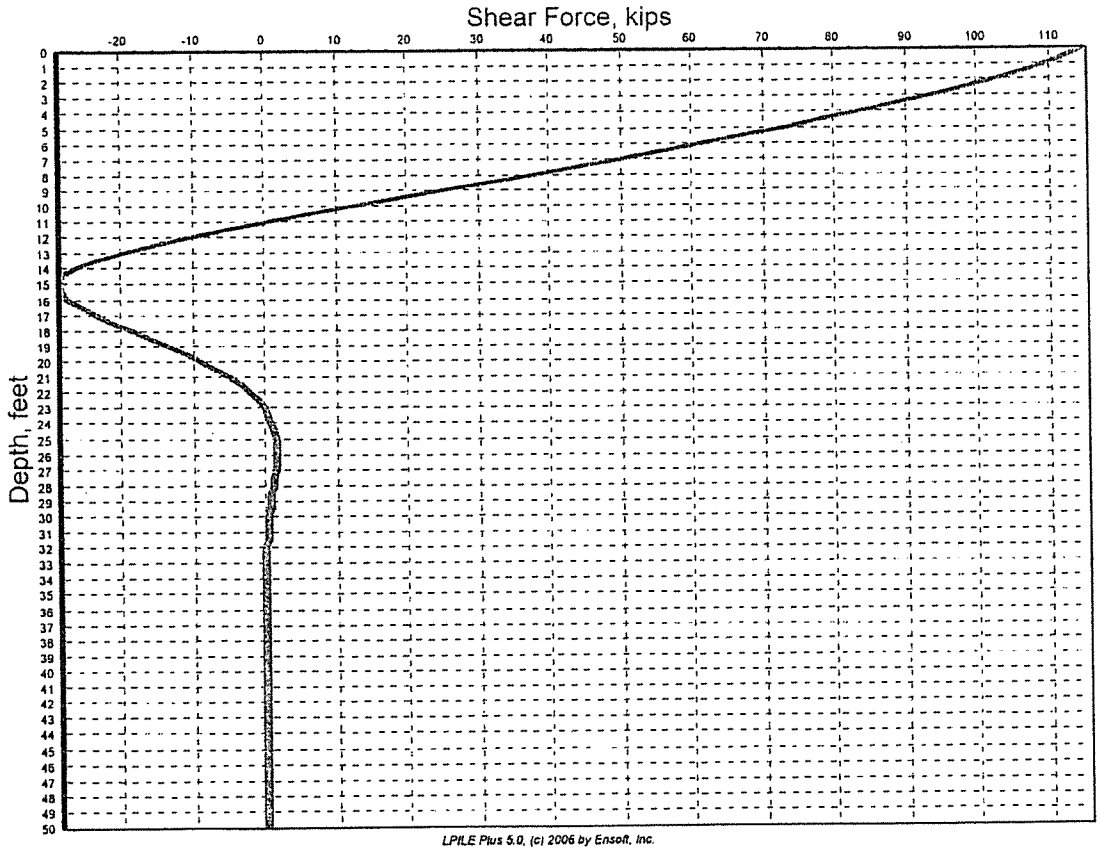
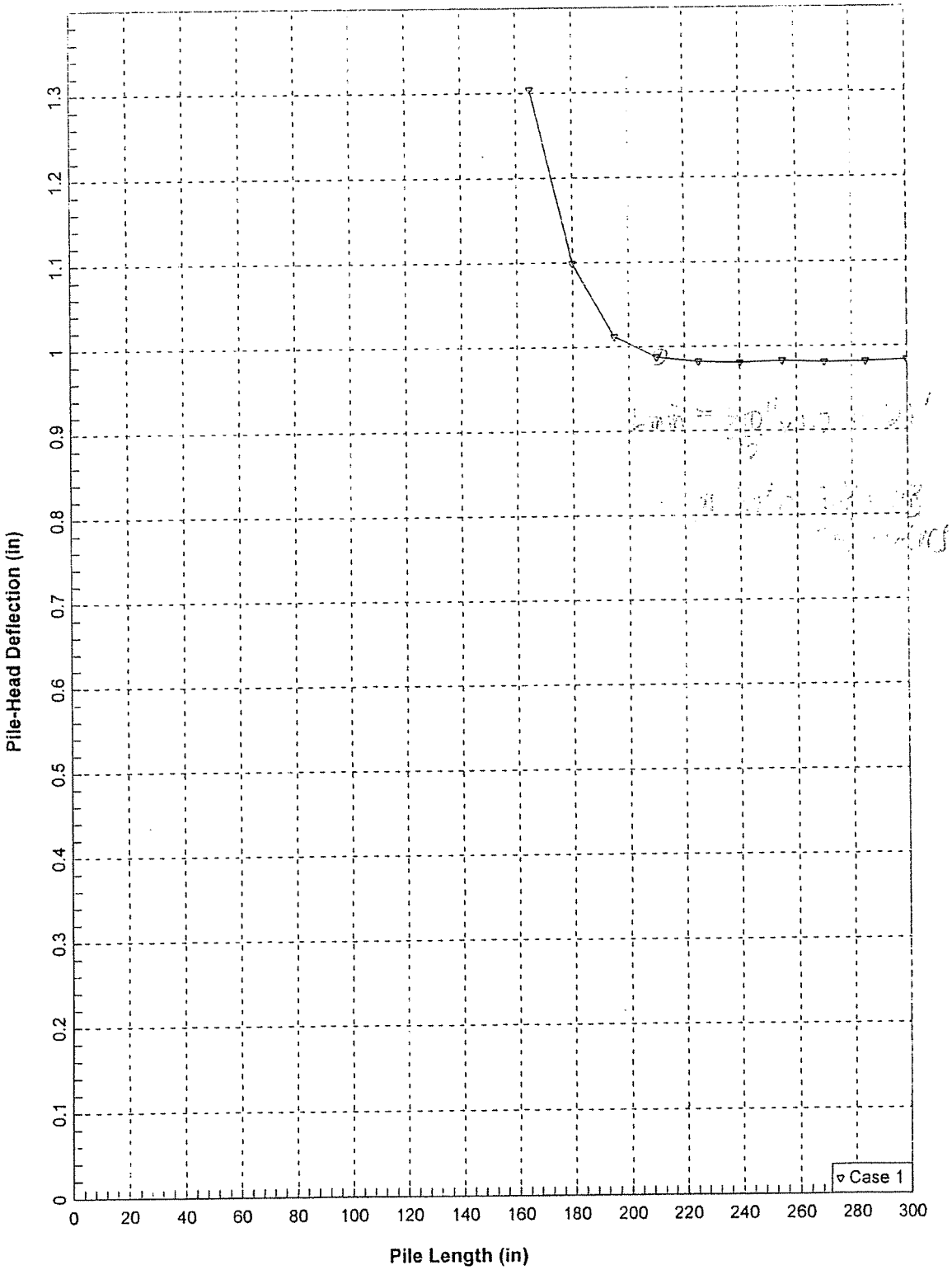
Shear Force vs. Depth



LPILE Plus 5.0, (c) 2006 by Ensoft, Inc.


Pile-Head Deflection (in)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
Pile Length (in)
Case 1

==========

LPILE Plus for Windows, Version 5.0 (5.0.22)

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:

Kleinfelder
Kleinfelder

Path to file locations: C:\Documents and Settings\stien\My Documents\76979 related files\Engineering Analysis\Lateral Capacity\
Name of input data file: Preliminary Bent depth to fixity 0.5 inch.lpd
Name of output file: Preliminary Bent depth to fixity 0.5 inch.lpo
Name of plot output file: Preliminary Bent depth to fixity 0.5 inch.lpp
Name of runtime file: Preliminary Bent depth to fixity 0.5 inch.lpr

---

Time and Date of Analysis

Date: February 26, 2008 Time: 17: 6:22

Problem Title

I215/SR60 HOV Bents (8' CIDH) preliminary fixity depth 0.5" defl.

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 = 160

Preliminary Bent depth to fixity 0.5 inch.lpo

- 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 = 960.00 in
Depth of ground surface below top of pile = -24.00 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	96.00000000	4169220.	7238.0000	3600000.
2	960.0000	96.00000000	4169220.	7238.0000	3600000.

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -24.000 in
Distance from top of pile to bottom of layer = 84.000 in
p-y subgrade modulus k for top of soil layer = 50.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 84.000 in
Distance from top of pile to bottom of layer = 360.000 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 = 150.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 360.000 in
Distance from top of pile to bottom of layer = 480.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 480.000 in
Distance from top of pile to bottom of layer = 720.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 720.000 in
Distance from top of pile to bottom of layer = 1200.000 in
p-y subgrade modulus k for top of soil layer = 200.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 200.000 lbs/in**3

Preliminary Bent depth to fixity 0.5 inch.lpo

(Depth of lowest layer extends 240.00 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	-24.00	.06100
2	84.00	.06100
3	84.00	.06400
4	360.00	.07200
5	360.00	.03900
6	480.00	.03900
7	480.00	.03900
8	720.00	.03900
9	720.00	.07200
10	1200.00	.07200

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	-24.000	.00000	30.00	------	------
2	84.000	.00000	30.00	------	------
3	84.000	.00000	30.00	------	------
4	360.000	.00000	35.00	------	------
5	360.000	.00000	35.00	------	------
6	480.000	.00000	35.00	------	------
7	480.000	.00000	38.00	------	------
8	720.000	.00000	38.00	------	------
9	720.000	.00000	40.00	------	------
10	1200.000	.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.

Loading Type

Preliminary Bent depth to fixity 0.5 inch.lpo
Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 1570000.000 lbs
Slope at pile head = .000 in/in
Axial load at pile head = 2500000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Specified shear force at pile head = 1570000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 2500000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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
0.000	.494815	-2.5477E+08	1570000.	6.4763E-17	3278.5498	-639.0240
6.000	.494509	-2.4536E+08	1565654.	-9.9965E-05	3170.2215	-809.6456
12.000	.493615	-2.3598E+08	1560277.	-.0001962	3062.2119	-982.5972
18.000	.492155	-2.2663E+08	1553859.	-.0002886	2954.5931	-1156.8616
24.000	.490152	-2.1732E+08	1546394.	-.0003774	2847.4383	-1331.4191
30.000	.487627	-2.0806E+08	1537864.	-.0004624	2740.8202	-1512.0708
36.000	.484603	-1.9886E+08	1528248.	-.0005437	2634.8145	-1692.9704
42.000	.481102	-1.8971E+08	1517550.	-.0006214	2529.4967	-1873.2493
48.000	.477146	-1.8063E+08	1505774.	-.0006954	2424.9423	-2052.0449
54.000	.472757	-1.7162E+08	1492932.	-.0007658	2321.2258	-2228.5021
60.000	.467956	-1.6269E+08	1479041.	-.0008326	2218.4212	-2401.7749
66.000	.462765	-1.5384E+08	1464123.	-.0008959	2116.6008	-2571.0275
72.000	.457205	-1.4509E+08	1448204.	-.0009557	2015.8353	-2735.4360
78.000	.451297	-1.3644E+08	1431295.	-.0010119	1916.1936	-2900.8165
84.000	.445062	-1.2789E+08	1413511.	-.0010648	1817.7448	-3027.1721
90.000	.438520	-1.1944E+08	1394787.	-.0011142	1720.5418	-3214.2009
96.000	.431691	-1.1112E+08	1374951.	-.0011603	1624.6627	-3397.8285
102.000	.424596	-1.0291E+08	1354026.	-.0012031	1530.1843	-3577.2081
108.000	.417255	-9.4831E+07	1332040.	-.0012426	1437.1813	-3751.4771
114.000	.409685	-8.6887E+07	1309026.	-.0012789	1345.7267	-3919.7591
120.000	.401908	-7.9084E+07	1285023.	-.0013121	1255.8907	-4081.1646
126.000	.393940	-7.1428E+07	1260025.	-.0013422	1167.7407	-4251.6497
132.000	.385802	-6.3924E+07	1234009.	-.0013692	1081.3480	-4420.0933
138.000	.377510	-5.6578E+07	1207004.	-.0013933	996.7828	-4581.8144
144.000	.369082	-4.9398E+07	1179050.	-.0014145	914.1128	-4736.0041
150.000	.360536	-4.2387E+07	1150197.	-.0014328	833.4022	-4881.8461

156.000	.351888	-3.5552E+07	1120496.	-.0014484	754.7121	-5018.5190
162.000	.343155	-2.8898E+07	1090004.	-.0014613	678.0995	-5145.1982
168.000	.334352	-2.2429E+07	1058786.	-.0014716	603.6174	-5261.0578
174.000	.325496	-1.6148E+07	1026835.	-.0014793	531.3144	-5389.2428
180.000	.316601	-1.0062E+07	994126.	-.0014845	461.2438	-5513.8270
186.000	.307682	-4174309.	960698.	-.0014874	393.4579	-5628.5428
192.000	.298753	1510890.	926615.	-.0014879	362.7941	-5732.7061
198.000	.289827	6989704.	891940.	-.0014862	425.8714	-5825.6388
204.000	.280919	1.2259E+07	856743.	-.0014823	486.5336	-5906.6708
210.000	.272039	1.7315E+07	821097.	-.0014764	544.7469	-5975.1423
216.000	.263201	2.2156E+07	785081.	-.0014685	600.4825	-6030.4064
222.000	.254417	2.6780E+07	748759.	-.0014588	653.7172	-6076.6791
228.000	.245696	3.1185E+07	712201.	-.0014472	704.4315	-6109.4869
234.000	.237051	3.5370E+07	675491.	-.0014339	752.6114	-6126.9870
240.000	.228490	3.9334E+07	638725.	-.0014189	798.2495	-6128.5860
246.000	.220023	4.3077E+07	601998.	-.0014025	841.3447	-6113.7353
252.000	.211660	4.6600E+07	565411.	-.0013845	881.9031	-6081.9388
258.000	.203409	4.9904E+07	529067.	-.0013653	919.9374	-6032.7611
264.000	.195277	5.2990E+07	493071.	-.0013447	955.4680	-5965.8367
270.000	.187273	5.5861E+07	457378.	-.0013229	988.5222	-5931.8826
276.000	.179402	5.8518E+07	421896.	-.0013001	1019.1141	-5895.4225
282.000	.171672	6.0963E+07	386677.	-.0012762	1047.2584	-5844.0436
288.000	.164088	6.3196E+07	351812.	-.0012514	1072.9764	-5777.5985
294.000	.156656	6.5222E+07	317392.	-.0012257	1096.2954	-5696.0202
300.000	.149380	6.7042E+07	283506.	-.0011993	1117.2491	-5599.3295
306.000	.142264	6.8660E+07	250245.	-.0011721	1135.8774	-5487.6415
312.000	.135314	7.0080E+07	217698.	-.0011444	1152.2266	-5361.1730
318.000	.128532	7.1307E+07	185954.	-.0011161	1166.3489	-5220.2490
324.000	.121920	7.2345E+07	155097.	-.0010874	1178.3026	-5065.3087
330.000	.115482	7.3200E+07	125211.	-.0010583	1188.1520	-4896.9117
336.000	.109220	7.3879E+07	96372.6330	-.0010289	1195.9667	-4715.7428
342.000	.103135	7.4388E+07	68657.5556	-.0009993	1201.8217	-4522.6163
348.000	.097228	7.4733E+07	42134.2703	-.0009695	1205.7972	-4318.4788
354.000	.091501	7.4922E+07	16865.5999	-.0009396	1207.9777	-4104.4113
360.000	.085953	7.4964E+07	-6682.7466	-.0009096	1208.4518	-3745.0375
366.000	.080585	7.4870E+07	-28632.6391	-.0008797	1207.3686	-3571.5933
372.000	.075397	7.4646E+07	-49541.9919	-.0008498	1204.7999	-3398.1910
378.000	.070388	7.4301E+07	-69412.1946	-.0008200	1200.8176	-3225.2099
384.000	.065557	7.3838E+07	-88246.8676	-.0007904	1195.4935	-3053.0144
390.000	.060903	7.3265E+07	-106052.	-.0007610	1188.8988	-2881.9529
396.000	.056424	7.2588E+07	-122835.	-.0007319	1181.1047	-2712.3579
402.000	.052120	7.1813E+07	-138605.	-.0007030	1172.1813	-2544.5455
408.000	.047988	7.0946E+07	-153375.	-.0006745	1162.1984	-2378.8152
414.000	.044027	6.9993E+07	-167158.	-.0006463	1151.2246	-2215.4500
420.000	.040233	6.8960E+07	-179969.	-.0006185	1139.3278	-2054.7160
426.000	.036604	6.7852E+07	-191824.	-.0005912	1126.5746	-1896.8625
432.000	.033139	6.6675E+07	-202740.	-.0005643	1113.0306	-1742.1219
438.000	.029833	6.5436E+07	-212739.	-.0005379	1098.7599	-1590.7100
444.000	.026684	6.4139E+07	-221840.	-.0005120	1083.8253	-1442.8258
450.000	.023689	6.2789E+07	-230064.	-.0004866	1068.2884	-1298.6519
456.000	.020845	6.1393E+07	-237435.	-.0004618	1052.2088	-1158.3546
462.000	.018148	5.9954E+07	-243976.	-.0004375	1035.6449	-1022.0841
468.000	.015594	5.8478E+07	-249713.	-.0004139	1018.6533	-889.9747
474.000	.013181	5.6970E+07	-254669.	-.0003908	1001.2888	-762.1453
480.000	.010905	5.5434E+07	-258837.	-.0003683	983.6044	-627.2230
486.000	.008761	5.3875E+07	-262250.	-.0003465	965.6563	-510.5058
492.000	.006747	5.2297E+07	-264976.	-.0003253	947.4928	-398.1998
498.000	.004858	5.0705E+07	-267042.	-.0003047	929.1607	-290.3695
504.000	.003091	4.9102E+07	-268474.	-.0002847	910.7048	-187.0661
510.000	.001442	4.7492E+07	-269300.	-.0002654	892.1679	-88.3275
516.000	-9.39E-05	4.5878E+07	-269548.	-.0002467	873.5911	5.8207
522.000	-.001519	4.4264E+07	-269244.	-.0002287	855.0136	95.3651
528.000	-.002839	4.2654E+07	-268417.	-.0002114	836.4726	180.3040

534.000	-.004056	4.1050E+07	-267095.	-.0001946	818.0033	260.6468
540.000	-.005174	3.9455E+07	-265303.	-.0001785	799.6393	336.4134
546.000	-.006198	3.7872E+07	-263071.	-.0001631	781.4119	407.6339
552.000	-.007131	3.6303E+07	-260425.	-.0001483	763.3509	474.3481
558.000	-.007977	3.4751E+07	-257392.	-.0001341	745.4840	536.6045
564.000	-.008740	3.3218E+07	-253999.	-.0001205	727.8370	594.4606
570.000	-.009423	3.1706E+07	-250272.	-.0001075	710.4342	647.9815
576.000	-.010030	3.0218E+07	-246236.	-9.5112E-05	693.2978	697.2401
582.000	-.010564	2.8754E+07	-241918.	-8.3325E-05	676.4482	742.3162
588.000	-.011030	2.7318E+07	-237341.	-7.2118E-05	659.9043	783.2958
594.000	-.011429	2.5909E+07	-232530.	-6.1479E-05	643.6832	820.2712
600.000	-.011767	2.4529E+07	-227509.	-5.1398E-05	627.8003	853.3402
606.000	-.012046	2.3180E+07	-222301.	-4.1862E-05	612.2694	882.6051
612.000	-.012270	2.1863E+07	-216929.	-3.2859E-05	597.1026	908.1733
618.000	-.012441	2.0578E+07	-211414.	-2.4376E-05	582.3108	930.1558
624.000	-.012562	1.9326E+07	-205778.	-1.6400E-05	567.9031	948.6674
630.000	-.012637	1.8109E+07	-200040.	-8.9172E-06	553.8872	963.8259
636.000	-.012669	1.6926E+07	-194221.	-1.9145E-06	540.2695	975.7520
642.000	-.012660	1.5778E+07	-188340.	4.6224E-06	527.0551	984.5686
648.000	-.012614	1.4666E+07	-182416.	1.0708E-05	514.2477	990.4004
654.000	-.012532	1.3589E+07	-176464.	1.6355E-05	501.8497	993.3738
660.000	-.012417	1.2548E+07	-170503.	2.1579E-05	489.8626	993.6163
666.000	-.012273	1.1542E+07	-164549.	2.6394E-05	478.2864	991.2564
672.000	-.012101	1.0573E+07	-158616.	3.0815E-05	467.1202	986.4229
678.000	-.011903	9638094.	-152719.	3.4854E-05	456.3621	979.2449
684.000	-.011682	8738858.	-146871.	3.8527E-05	446.0093	969.8513
690.000	-.011441	7874483.	-141087.	4.1848E-05	436.0578	958.3709
696.000	-.011180	7044563.	-135377.	4.4830E-05	426.5029	944.9318
702.000	-.010903	6248618.	-129753.	4.7487E-05	417.3393	929.6610
708.000	-.010610	5486103.	-124226.	4.9833E-05	408.5605	912.6850
714.000	-.010305	4756412.	-118805.	5.1880E-05	400.1596	894.1286
720.000	-.009988	4058881.	-112013.	5.3642E-05	392.1290	1370.1597
726.000	-.009661	3410651.	-103891.	5.5135E-05	384.6659	1336.9327
732.000	-.009326	2810531.	-95975.1777	5.6378E-05	377.7568	1301.7797
738.000	-.008985	2257258.	-88275.2171	5.7391E-05	371.3870	1264.8739
744.000	-.008637	1749507.	-80801.4574	5.8192E-05	365.5413	1226.3794
750.000	-.008286	1285895.	-73562.9656	5.8799E-05	360.2037	1186.4512
756.000	-.007932	864987.	-66567.9080	5.9229E-05	355.3578	1145.2347
762.000	-.007575	485303.	-59823.6070	5.9499E-05	350.9865	1102.8657
768.000	-.007218	145319.	-53336.5985	5.9625E-05	347.0723	1059.4705
774.000	-.006860	-156525.	-47112.6906	5.9622E-05	347.2013	1015.1655
780.000	-.006502	-421822.	-41157.0216	5.9507E-05	350.2557	970.0575
786.000	-.006146	-652194.	-35474.1183	5.9292E-05	352.9080	924.2436
792.000	-.005791	-849290.	-30067.9544	5.8992E-05	355.1771	877.8111
798.000	-.005438	-1014780.	-24942.0075	5.8619E-05	357.0824	830.8379
804.000	-.005088	-1150353.	-20099.3166	5.8187E-05	358.6432	783.3924
810.000	-.004740	-1257717.	-15542.5375	5.7705E-05	359.8793	735.5339
816.000	-.004395	-1338594.	-11273.9978	5.7186E-05	360.8104	687.3126
822.000	-.004054	-1394721.	-7295.7500	5.6640E-05	361.4566	638.7700
828.000	-.003715	-1427843.	-3609.6237	5.6076E-05	361.8380	589.9388
834.000	-.003381	-1439718.	-217.2754	5.5503E-05	361.9747	540.8440
840.000	-.003049	-1432115.	2879.7634	5.4929E-05	361.8871	491.5023
846.000	-.002721	-1406809.	5680.0405	5.4361E-05	361.5958	441.9234
852.000	-.002397	-1365585.	8182.1392	5.3807E-05	361.1212	392.1095
858.000	-.002076	-1310238.	10384.6379	5.3272E-05	360.4840	342.0567
864.000	-.001758	-1242568.	12286.0717	5.2762E-05	359.7049	291.7546
870.000	-.001443	-1164388.	13884.8976	5.2281E-05	358.8048	241.1874
876.000	-.001130	-1077518.	15179.4623	5.1833E-05	357.8047	190.3342
882.000	-.000821	-983789.	16167.9747	5.1421E-05	356.7256	139.1699
888.000	-.000513	-885045.	16848.4799	5.1047E-05	355.5888	87.6652
894.000	-.000208	-783139.	17218.8396	5.0714E-05	354.4155	35.7880
900.000	9.53E-05	-679940.	17276.7144	5.0421E-05	353.2274	-16.4964
906.000	.000397	-577331.	17019.5518	5.0170E-05	352.0461	-69.2245

Preliminary Bent depth to fixity 0.5 inch.lpo

912.000	.000697	-477210.	16444.5778	4.9959E-05	350.8934	-122.4335
918.000	.000996	-381495.	15548.7943	4.9788E-05	349.7914	-176.1610
924.000	.001295	-292118.	14328.9803	4.9653E-05	348.7624	-230.4437
930.000	.001592	-211036.	12781.6995	4.9553E-05	347.8289	-285.3166
936.000	.001889	-140225.	10903.3124	4.9482E-05	347.0137	-340.8124
942.000	.002186	-81681.2086	8689.9947	4.9438E-05	346.3397	-396.9601
948.000	.002483	-37427.8478	6137.7618	4.9414E-05	345.8302	-453.7842
954.000	.002779	-9510.4922	3242.4993	4.9405E-05	345.5088	-511.3033
960.000	.003075	0.0000	0.0000	4.9403E-05	345.3993	-569.5298

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

Pile-head deflection	=	.49481485	in
Computed slope at pile head	=	6.476301E-17	
Maximum bending moment	=	-2.547698E+08	lbs-in
Maximum shear force	=	1570000.	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	=	2	

Summary of Pile Response(s)

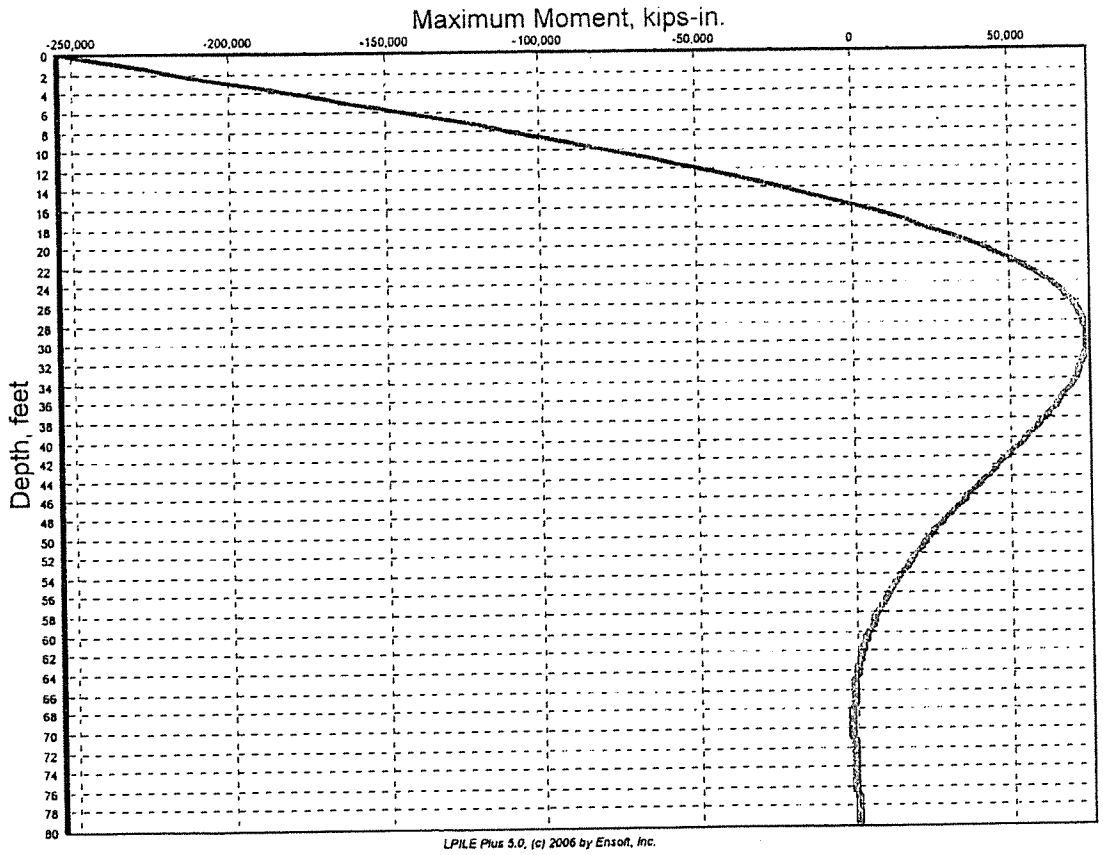
Definition of Symbols for Pile-Head Loading Conditions:

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

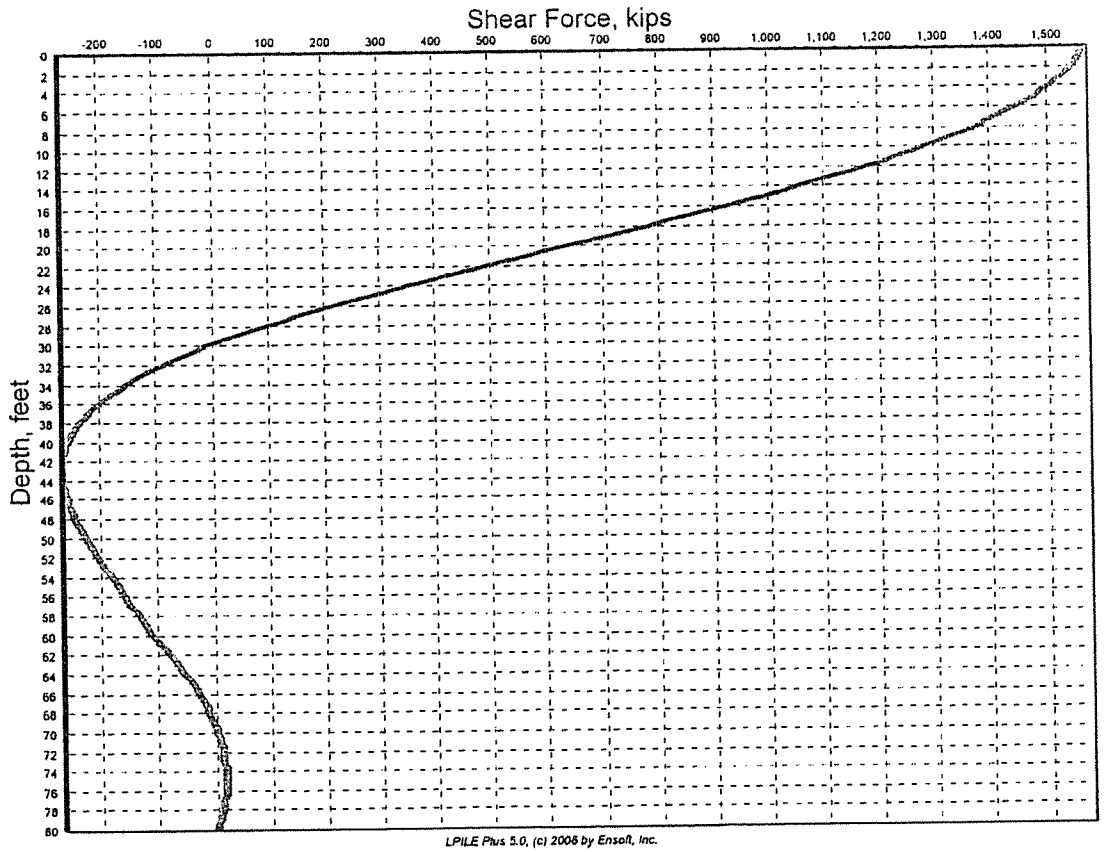
Load Type	Pile-Head Condition 1	Pile-Head Condition 2	Axial Load lbs	Pile-Head Deflection in	Maximum Moment in-lbs	Maximum Shear lbs
2	V= 1.57E+06	S= 0.000	2500000.	.4948148	-2.5477E+08	1570000.

The analysis ended normally.

Bending Moment vs. Depth



Shear Force vs. Depth



LPILE Plus 5.0, (c) 2006 by Ensoft, Inc.

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LPILE Plus for Windows, Version 5.0 (5.0.22)

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:

Kleinfelder
Kleinfelder

Path to file locations: C:\Documents and Settings\stien\My Documents\76979 related files\Engineering Analysis\Lateral Capacity\
Name of input data file: Preliminary Bent depth to fixity 1.0 inch.lpd
Name of output file: Preliminary Bent depth to fixity 1.0 inch.lpo
Name of plot output file: Preliminary Bent depth to fixity 1.0 inch.lpp
Name of runtime file: Preliminary Bent depth to fixity 1.0 inch.lpr

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Time and Date of Analysis

Date: February 26, 2008 Time: 17: 7:11

Problem Title

I215/SR60 HOV Bents (8' CIDH) preliminary fixity depth 1.0" defl.

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 includes automatic computation of pile-top deflection vs. pile embedment length
- 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:

Preliminary Bent depth to fixity 1.0 inch.lpo

- Number of pile increments = 160
- 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 = 960.00 in
Depth of ground surface below top of pile = -24.00 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	96.00000000	1667688.	7238.0000	3600000.
2	960.0000	96.00000000	1667688.	7238.0000	3600000.

Soil and Rock Layering Information

The soil profile is modelled using 5 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = -24.000 in
Distance from top of pile to bottom of layer = 84.000 in
p-y subgrade modulus k for top of soil layer = 50.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 90.000 lbs/in**3

Layer 2 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 84.000 in
Distance from top of pile to bottom of layer = 360.000 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 = 150.000 lbs/in**3

Layer 3 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 360.000 in
Distance from top of pile to bottom of layer = 480.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 4 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 480.000 in
Distance from top of pile to bottom of layer = 720.000 in
p-y subgrade modulus k for top of soil layer = 125.000 lbs/in**3
p-y subgrade modulus k for bottom of layer = 125.000 lbs/in**3

Layer 5 is sand, p-y criteria by Reese et al., 1974
Distance from top of pile to top of layer = 720.000 in
Distance from top of pile to bottom of layer = 1200.000 in
p-y subgrade modulus k for top of soil layer = 200.000 lbs/in**3

Preliminary Bent depth to fixity 1.0 inch.lpo
p-y subgrade modulus k for bottom of layer = 200.000 lbs/in**3

(Depth of lowest layer extends 240.00 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	-24.00	.06100
2	84.00	.06100
3	84.00	.06400
4	360.00	.07200
5	360.00	.03900
6	480.00	.03900
7	480.00	.03900
8	720.00	.03900
9	720.00	.07200
10	1200.00	.07200

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	-24.000	.00000	30.00	------	------
2	84.000	.00000	30.00	------	------
3	84.000	.00000	30.00	------	------
4	360.000	.00000	35.00	------	------
5	360.000	.00000	35.00	------	------
6	480.000	.00000	35.00	------	------
7	480.000	.00000	38.00	------	------
8	720.000	.00000	38.00	------	------
9	720.000	.00000	40.00	------	------
10	1200.000	.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.

Loading Type

Preliminary Bent depth to fixity 1.0 inch.lpo

Static loading criteria was used for computation of p-y curves

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Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Case Number 1

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Shear force at pile head = 1710000.000 lbs
Slope at pile head = .000 in/in
Axial load at pile head = 2500000.000 lbs

(Zero slope for this load indicates fixed-head condition)

Computed Values of Load Distribution and Deflection
for Lateral Loading for Load Case Number 1

Pile-head boundary conditions are Shear and Slope (BC Type 2)
Specified shear force at pile head = 1710000.000 lbs
Specified slope at pile head = 0.000E+00 in/in
Specified axial load at pile head = 2500000.000 lbs

(Zero slope for this load indicates fixed-head conditions)

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
0.000	.996661	-2.5440E+08	1710000.	1.1102E-16	7667.6523	-772.0232
6.000	.995899	-2.4415E+08	1704743.	-.0002491	7372.6904	-980.3937
12.000	.993672	-2.3394E+08	1698224.	-.0004880	7078.6389	-1192.5602
18.000	.990042	-2.2376E+08	1690424.	-.0007167	6785.7222	-1407.3268
24.000	.985071	-2.1363E+08	1681332.	-.0009353	6494.1672	-1623.4890
30.000	.978819	-2.0356E+08	1670927.	-.0011438	6204.2022	-1844.7878
36.000	.971346	-1.9354E+08	1659193.	-.0013422	5916.0609	-2066.5600
42.000	.962713	-1.8360E+08	1646130.	-.0015306	5629.9774	-2287.7291
48.000	.952978	-1.7374E+08	1631745.	-.0017092	5346.1851	-2507.2256
54.000	.942202	-1.6397E+08	1616052.	-.0018780	5064.9158	-2723.9896
60.000	.930443	-1.5430E+08	1599069.	-.0020370	4786.3982	-2936.9726
66.000	.917758	-1.4472E+08	1580822.	-.0021864	4510.8572	-3145.1396
72.000	.904206	-1.3526E+08	1561344.	-.0023263	4238.5127	-3347.4707
78.000	.889842	-1.2592E+08	1540652.	-.0024568	3969.5783	-3549.8833
84.000	.874724	-1.1670E+08	1518892.	-.0025781	3704.2679	-3703.7279
90.000	.858905	-1.0761E+08	1495983.	-.0026902	3442.7448	-3932.3127
96.000	.842442	-9.8666E+07	1471717.	-.0027932	3185.2498	-4156.5839
102.000	.825387	-8.9868E+07	1446121.	-.0028874	2932.0191	-4375.4910
108.000	.807793	-8.1226E+07	1419230.	-.0029729	2683.2834	-4587.9669
114.000	.789711	-7.2748E+07	1391087.	-.0030499	2439.2665	-4792.9294
120.000	.771194	-6.4442E+07	1361741.	-.0031184	2200.1845	-4989.2837
126.000	.752290	-5.6314E+07	1331183.	-.0031788	1966.2444	-5196.6588
132.000	.733049	-4.8372E+07	1299389.	-.0032311	1737.6646	-5401.2996
138.000	.713517	-4.0624E+07	1266393.	-.0032755	1514.6606	-5597.4268
144.000	.693742	-3.3077E+07	1232249.	-.0033124	1297.4389	-5784.0331

150.000	.673769	-2.5738E+07	1197016.	-.0033418	1086.1962	-5960.1042
156.000	.653641	-1.8613E+07	1160762.	-.0033639	881.1180	-6124.6217
162.000	.633402	-1.1708E+07	1123558.	-.0033791	682.3779	-6276.5654
168.000	.613092	-5028669.	1085484.	-.0033874	490.1363	-6414.9169
174.000	.592752	1419616.	1046547.	-.0033892	386.2592	-6564.0824
180.000	.572421	7631572.	1006733.	-.0033847	565.0540	-6707.0987
186.000	.552136	1.3602E+07	966101.	-.0033741	736.8958	-6837.2062
192.000	.531932	1.9326E+07	924728.	-.0033577	901.6473	-6953.5673
198.000	.511844	2.4799E+07	882701.	-.0033356	1059.1854	-7055.3580
204.000	.491905	3.0018E+07	840110.	-.0033082	1209.4023	-7141.7706
210.000	.472145	3.4980E+07	797049.	-.0032757	1352.2061	-7212.0176
216.000	.452596	3.9681E+07	753617.	-.0032384	1487.5221	-7265.3351
222.000	.433284	4.4121E+07	709875.	-.0031966	1615.2928	-7315.2040
228.000	.414237	4.8296E+07	665880.	-.0031504	1735.4648	-7349.9522
234.000	.395480	5.2206E+07	621734.	-.0031002	1848.0001	-7365.2325
240.000	.377035	5.5850E+07	577558.	-.0030462	1952.8813	-7360.2601
246.000	.358926	5.9228E+07	533474.	-.0029887	2050.1120	-7334.3097
252.000	.341171	6.2341E+07	489611.	-.0029279	2139.7176	-7286.7261
258.000	.323791	6.5191E+07	446100.	-.0028642	2221.7460	-7216.9363
264.000	.306801	6.7780E+07	403075.	-.0027977	2296.2684	-7124.4637
270.000	.290218	7.0112E+07	360493.	-.0027288	2363.3793	-7069.7121
276.000	.274055	7.2188E+07	318255.	-.0026577	2423.1347	-7009.6089
282.000	.258325	7.4010E+07	276439.	-.0025847	2475.5958	-6929.1976
288.000	.243039	7.5583E+07	235166.	-.0025099	2520.8452	-6828.2399
294.000	.228206	7.6908E+07	194562.	-.0024337	2558.9867	-6706.6210
300.000	.213834	7.7990E+07	154749.	-.0023563	2590.1459	-6564.3623
306.000	.199930	7.8835E+07	115851.	-.0022780	2614.4698	-6401.6344
312.000	.186499	7.9449E+07	77989.5420	-.0021989	2632.1264	-6218.7692
318.000	.173544	7.9837E+07	41284.4146	-.0021193	2643.3051	-6016.2732
324.000	.161068	8.0008E+07	5851.0796	-.0020394	2648.2155	-5794.8385
330.000	.149071	7.9969E+07	-28199.4982	-.0019595	2647.0869	-5555.3542
336.000	.137554	7.9728E+07	-60762.3103	-.0018797	2640.1676	-5298.9165
342.000	.126515	7.9296E+07	-91739.5704	-.0018002	2627.7234	-5026.8368
348.000	.115952	7.8681E+07	-121042.	-.0017213	2610.0363	-4740.6480
354.000	.105860	7.7895E+07	-148590.	-.0016430	2587.4031	-4442.1077
360.000	.096236	7.6948E+07	-174496.	-.0015656	2560.1336	-4193.0475
366.000	.087072	7.5848E+07	-198652.	-.0014893	2528.4862	-3859.1075
372.000	.078364	7.4608E+07	-220825.	-.0014141	2492.8074	-3531.9214
378.000	.070103	7.3241E+07	-241058.	-.0013402	2453.4368	-3212.1720
384.000	.062281	7.1756E+07	-259396.	-.0012678	2410.7062	-2900.4837
390.000	.054890	7.0166E+07	-275889.	-.0011969	2364.9393	-2597.4236
396.000	.047919	6.8481E+07	-290592.	-.0011276	2316.4507	-2303.5013
402.000	.041359	6.6713E+07	-303560.	-.0010600	2265.5458	-2019.1704
408.000	.035199	6.4870E+07	-314852.	-.0009943	2212.5199	-1744.8291
414.000	.029428	6.2964E+07	-324529.	-.0009304	2157.6581	-1480.8215
420.000	.024034	6.1004E+07	-332654.	-.0008684	2101.2347	-1227.4392
426.000	.019006	5.8998E+07	-339291.	-.0008085	2043.5132	-984.9225
432.000	.014332	5.6957E+07	-344506.	-.0007505	1984.7457	-753.4623
438.000	.010000	5.4887E+07	-348366.	-.0006947	1925.1729	-533.2017
444.000	.005997	5.2797E+07	-350938.	-.0006408	1865.0239	-324.2382
450.000	.002310	5.0695E+07	-352291.	-.0005891	1804.5162	-126.6252
456.000	-.001073	4.8587E+07	-352492.	-.0005395	1743.8554	59.6254
462.000	-.004164	4.6481E+07	-351609.	-.0004920	1683.2355	234.5414
468.000	-.006977	4.4383E+07	-349711.	-.0004466	1622.8385	398.1880
474.000	-.009524	4.2298E+07	-346865.	-.0004033	1562.8349	550.6657
480.000	-.011817	4.0232E+07	-343174.	-.0003621	1503.3837	679.6715
486.000	-.013868	3.8191E+07	-338710.	-.0003229	1444.6193	808.0828
492.000	-.015691	3.6178E+07	-333508.	-.0002857	1386.6758	926.0563
498.000	-.017297	3.4197E+07	-327628.	-.0002505	1329.6763	1033.7981
504.000	-.018697	3.2254E+07	-321132.	-.0002173	1273.7331	1131.5388
510.000	-.019905	3.0350E+07	-314079.	-.0001861	1218.9485	1219.5312
516.000	-.020930	2.8490E+07	-306526.	-.0001566	1165.4145	1298.0478
522.000	-.021785	2.6677E+07	-298530.	-.0001291	1113.2131	1367.3793

528.000	-.022479	2.4912E+07	-290145.	-.0001033	1062.4171	1427.8320
534.000	-.023024	2.3198E+07	-281422.	-7.9264E-05	1013.0898	1479.7262
540.000	-.023430	2.1537E+07	-272413.	-5.6910E-05	965.2857	1523.3940
546.000	-.023707	1.9931E+07	-263165.	-3.6189E-05	919.0508	1559.1773
552.000	-.023865	1.8380E+07	-253725.	-1.7045E-05	874.4229	1587.4262
558.000	-.023912	1.6886E+07	-244137.	5.7701E-07	831.4318	1608.4974
564.000	-.023858	1.5450E+07	-234443.	1.6736E-05	790.1002	1622.7521
570.000	-.023711	1.4073E+07	-224684.	3.1488E-05	750.4433	1630.5544
576.000	-.023480	1.2753E+07	-214895.	4.4893E-05	712.4699	1632.2705
582.000	-.023172	1.1493E+07	-205113.	5.7008E-05	676.1823	1628.2662
588.000	-.022796	1.0290E+07	-195372.	6.7893E-05	641.5769	1618.9065
594.000	-.022357	9146060.	-185702.	7.7605E-05	608.6445	1604.5536
600.000	-.021864	8059500.	-176131.	8.6203E-05	577.3707	1585.5663
606.000	-.021323	7029900.	-166688.	9.3743E-05	547.7364	1562.2986
612.000	-.020739	6056436.	-157395.	.0001003	519.7178	1535.0987
618.000	-.020120	5138146.	-148277.	.0001059	493.2873	1504.3082
624.000	-.019469	4273934.	-139354.	.0001106	468.4132	1470.2611
630.000	-.018793	3462586.	-130643.	.0001144	445.0607	1433.2835
636.000	-.018096	2702786.	-122162.	.0001175	423.1918	1393.6924
642.000	-.017382	1993117.	-113925.	.0001199	402.7659	1351.7952
648.000	-.016657	1332084.	-105946.	.0001215	383.7398	1307.8898
654.000	-.015924	718114.	-98235.9668	.0001226	366.0683	1262.2635
660.000	-.015186	149575.	-90803.5982	.0001230	349.7044	1215.1927
666.000	-.014448	-375219.	-83657.1901	.0001229	356.1990	1166.9433
672.000	-.013712	-857997.	-76803.0512	.0001223	370.0945	1117.7697
678.000	-.012981	-1300523.	-70245.9969	.0001212	382.8314	1067.9151
684.000	-.012258	-1704585.	-63989.4174	.0001197	394.4613	1017.6114
690.000	-.011545	-2071987.	-58035.3459	.0001178	405.0360	967.0791
696.000	-.010844	-2404543.	-52384.5262	.0001156	414.6077	916.5274
702.000	-.010158	-2704068.	-47036.4810	.0001130	423.2287	866.1543
708.000	-.009488	-2972371.	-41989.5776	.0001102	430.9511	816.1468
714.000	-.008836	-3211248.	-37241.0949	.0001071	437.8266	766.6808
720.000	-.008203	-3422476.	-31565.0645	.0001038	443.9062	1125.3293
726.000	-.007591	-3593141.	-25037.7646	.0001003	448.8184	1050.4373
732.000	-.007000	-3725937.	-18955.2037	9.6602E-05	452.6406	977.0830
738.000	-.006432	-3823502.	-13307.5858	9.2829E-05	455.4487	905.4563
744.000	-.005886	-3888413.	-8084.0555	8.8976E-05	457.3170	835.7205
750.000	-.005364	-3923180.	-3272.8520	8.5072E-05	458.3177	768.0140
756.000	-.004865	-3930239.	1138.5424	8.1148E-05	458.5209	702.4508
762.000	-.004390	-3911952.	5163.2599	7.7229E-05	457.9945	639.1217
768.000	-.003938	-3870597.	8814.9117	7.3340E-05	456.8042	578.0955
774.000	-.003510	-3808373.	12107.4583	6.9503E-05	455.0133	519.4200
780.000	-.003104	-3727393.	15055.0874	6.5738E-05	452.6825	463.1230
786.000	-.002721	-3629684.	17672.0977	6.2061E-05	449.8702	409.2137
792.000	-.002360	-3517190.	19972.7904	5.8490E-05	446.6323	357.6838
798.000	-.002019	-3391765.	21971.3676	5.5038E-05	443.0223	308.5086
804.000	-.001699	-3255184.	23681.8377	5.1716E-05	439.0912	261.6481
810.000	-.001399	-3109135.	25117.9277	4.8536E-05	434.8875	217.0486
816.000	-.001117	-2955225.	26293.0030	4.5506E-05	430.4576	174.6432
822.000	-.000853	-2794984.	27219.9940	4.2633E-05	425.8455	134.3538
828.000	-.000605	-2629864.	27911.3297	3.9922E-05	421.0930	96.0915
834.000	-.000374	-2461246.	28378.8787	3.7378E-05	416.2397	59.7582
840.000	-.000157	-2290439.	28633.8968	3.5003E-05	411.3235	25.2478
846.000	4.65E-05	-2118689.	28686.9817	3.2800E-05	406.3802	-7.5529
852.000	.000237	-1947179.	28548.0342	3.0768E-05	401.4437	-38.7629
858.000	.000416	-1777036.	28226.2271	2.8908E-05	396.5466	-68.5061
864.000	.000584	-1609332.	27729.9800	2.7215E-05	391.7197	-96.9096
870.000	.000742	-1445092.	27066.9412	2.5689E-05	386.9925	-124.1033
876.000	.000892	-1285299.	26243.9766	2.4325E-05	382.3932	-150.2182
882.000	.001034	-1130894.	25267.1649	2.3117E-05	377.9491	-175.3857
888.000	.001170	-982787.	24141.7997	2.2061E-05	373.6862	-199.7360
894.000	.001299	-841855.	22872.3986	2.1149E-05	369.6298	-223.3977
900.000	.001423	-708952.	21462.7188	2.0374E-05	365.8046	-246.4956

Preliminary Bent depth to fixity 1.0 inch.lpo

906.000	.001543	-584913.	19915.7795	1.9728E-05	362.2345	-269.1508
912.000	.001660	-470555.	18233.8919	1.9201E-05	358.9430	-291.4784
918.000	.001774	-366683.	16418.6955	1.8782E-05	355.9533	-313.5871
924.000	.001885	-274094.	14471.2017	1.8462E-05	353.2884	-335.5775
930.000	.001995	-193582.	12391.8453	1.8228E-05	350.9710	-357.5413
936.000	.002104	-125939.	10180.5429	1.8069E-05	349.0241	-379.5595
942.000	.002212	-71957.5785	7836.7589	1.7970E-05	347.4704	-401.7018
948.000	.002320	-32436.6638	5359.5804	1.7918E-05	346.3329	-424.0244
954.000	.002427	-8180.1418	2747.7985	1.7897E-05	345.6347	-446.5695
960.000	.002535	0.0000	0.0000	1.7893E-05	345.3993	-469.3633

Output Verification:

Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection              =      .99666124 in
Computed slope at pile head       =   1.110223E-16
Maximum bending moment            =  -2.544007E+08 lbs-in
Maximum shear force               =       1710000. lbs
Depth of maximum bending moment   =        0.00000 in
Depth of maximum shear force      =        0.00000 in
Number of iterations              =             17
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
2	V= 1.71E+06	S= 0.000	2500000.	.9966612	-2.5440E+08	1710000.

Pile-head Deflection vs. Pile Length

Boundary Condition Type 2, Shear and Slope

```
Shear      =        1710000. lbs
Slope      =          .00000
Axial Load =        2500000. lbs
```

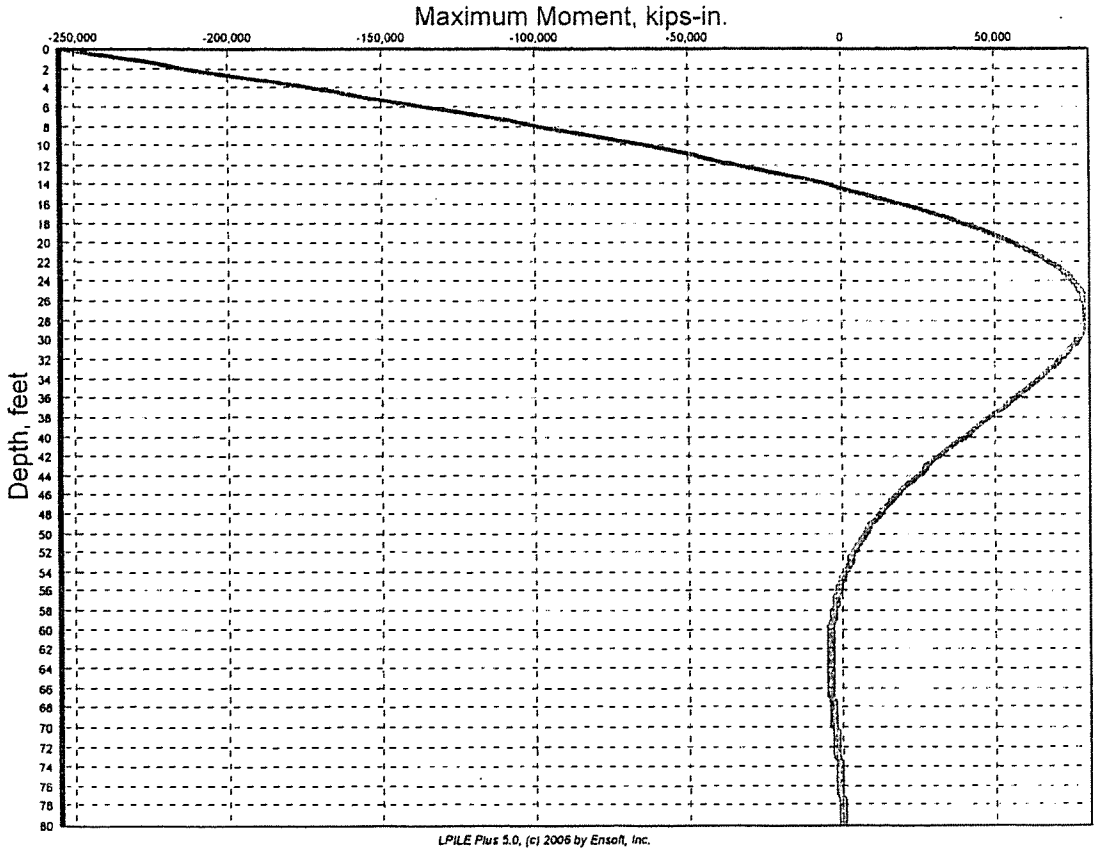
Pile Pile Head Maximum Maximum

Preliminary Bent depth to fixity 1.0 inch.lpo

Length in	Deflection in	Moment in-lbs	Shear lbs
960.000	.99666124	-2.544007E+08	1710000.
912.000	.99475609	-2.542190E+08	1710000.
864.000	.99348202	-2.540924E+08	1710000.
816.000	.99288229	-2.540464E+08	1710000.
768.000	.99282460	-2.540651E+08	1710000.
720.000	.99376079	-2.541106E+08	1710000.
672.000	.99306142	-2.537843E+08	1710000.
624.000	1.00532479	-2.542977E+08	1710000.
576.000	1.03151029	-2.555665E+08	1710000.
528.000	1.09552955	-2.602642E+08	1710000.

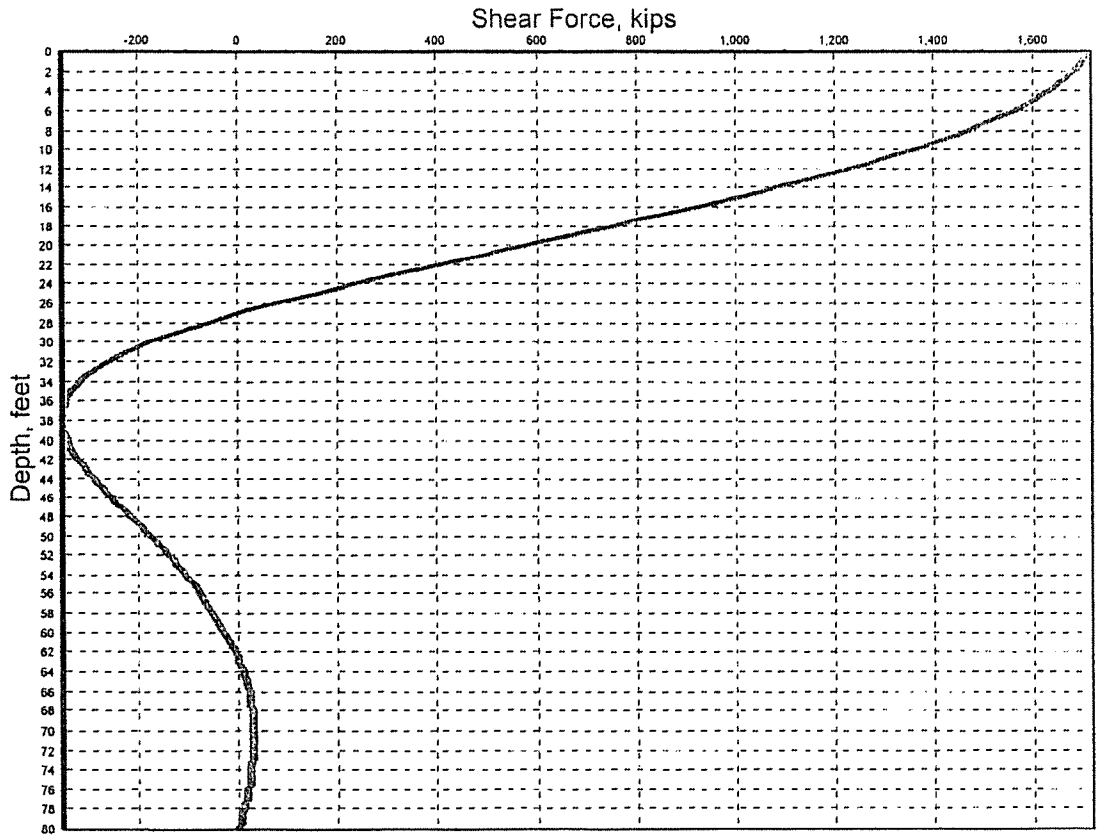
The analysis ended normally.

Bending Moment vs. Depth



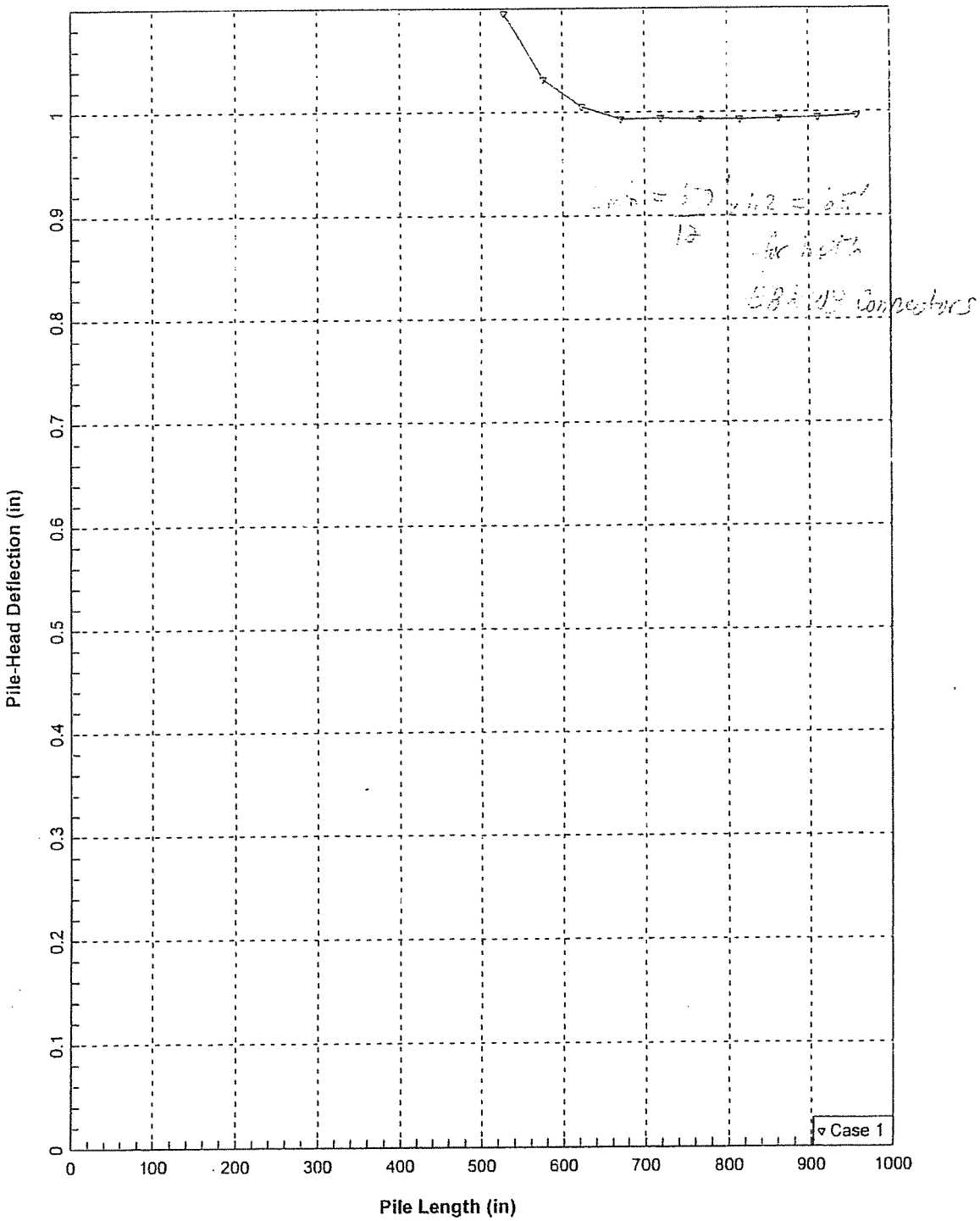
LPILE Plus 5.0, (c) 2006 by Ensoft, Inc.

Shear Force vs. Depth



LPILE Plus 5.0, (c) 2006 by Ensoft, Inc.

8' CIDH 1.0" deflection at pile head



C-5

P-Y CURVE DATA AND DEPTH TO POINT OF FIXITY FOR PILES AT BENTS 2 AND 3

ANALYSIS OF LATERAL STIFFNESS (P-Y CURVES) OF A SINGLE PILE

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(Licensed to: Kleinfelder West, Inc. - Redlands, California)

PROJECT INFORMATION

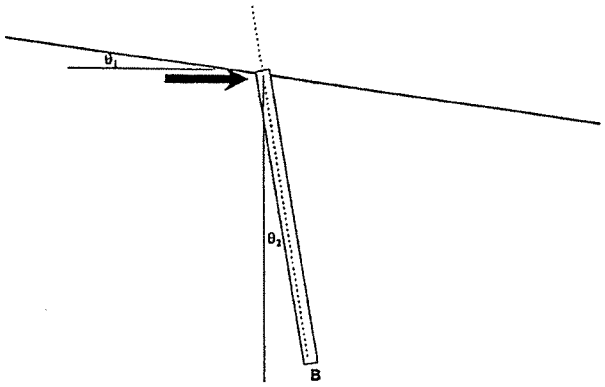
Project Name	I-215/SR60 East Junction
Project No.	76979
Location	Riverside, California

GENERAL INPUT PARAMETERS

Pile Location	Bents 2 & 3
Pile Description	96-inch diameter CIDH Pile
Ground Surface Elevation (feet)	1,524.90
Design GWT Elevation (feet)	1,494.90
Ground Slope Angle, θ_1 (degrees)	0.00
Pile Batter Angle, θ_2 (degrees)	0.00
Number of Load Cycles, N_c	0

SOIL INPUT PARAMETERS

Soil Depth (feet)	0.00	7.00	7.10	30.00	30.10	40.00	40.10	60.00	60.10	100.00				
Pile Diameter or Width, B (inches)	96.00	96.00	96.00	96.00	96.00	96.00	96.00	96.00	96.00	96.00				
Soil Type Code for p-y Curve Criteria: 1 = Sand/Gravel (Reese et al., 1974) 2 = Sand/Gravel (API RP2A Criteria, 1987) 3 = Stiff Clay w/o Free Water (Reese and Wang, 1997) 4 = Stiff Clay w/ Free Water (Reese and Wang, 1997) 5 = Soft Clay (Matlock, 1970) 6 = Liquefied Soil	1	1	1	1	1	1	1	1	1	1				
Soil Modulus, k (pci)	50.00	50.00	90.00	90.00	125.00	125.00	125.00	125.00	200.00	200.00				
Total Soil Unit Weight, γ_t (pcf)	105.00	105.00	110.00	110.00	128.00	128.00	128.00	128.00	130.00	130.00				
Saturated Soil Unit Weight, γ_{sat} (pcf)	115.00	115.00	120.00	120.00	128.00	128.00	128.00	128.00	130.00	130.00				
Soil Cohesion, c (psf)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Soil Friction Angle, ϕ (degrees)	30.00	30.00	30.00	30.00	35.00	35.00	38.00	38.00	40.00	40.00				



REFERENCES:

1. Reese, L.C. and Wang, S.T., Computer Program LPILE Plus 3.0, Version 3.0, A Program for the Analysis of Piles and Drilled Shafts Under Lateral Loads, Ensoft, Inc., 1997.
2. US Army Corps of Engineers, Technical Instructions, Design of Deep Foundations, Chapter 4, Lateral Loads, TI 818-02, August 3, 1998.
3. American Petroleum Institute, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms, API Recommended Practice 2A (RP 2A), 19th Edition, August 1, 1991.

ANALYSIS OF LATERAL STIFFNESS (P-Y CURVES) OF A SINGLE PILE

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(Licensed to: Kleinfelder West, Inc. - Redlands, California)

PROJECT INFORMATION

Project Name	I-215/SR60 East Junction
Project No.	76979
Location	Riverside, California

Prepared By: _____ Date: _____
Reviewed By: _____ Date: _____

GENERAL INPUT PARAMETERS

Pile Location	Bents 2 & 3
Pile Description	96-inch diameter CIDH Pile
Ground Surface Elevation (feet)	1524.90
Design GWT Elevation (feet)	1494.90
Ground Slope Angle, θ_1 (degrees)	0.00
Pile Batter Angle, θ_2 (degrees)	0.00
Number of Load Cycles, N_c	0.00

SOIL INPUT PARAMETERS

Soil Depth (feet)	0.00	7.00	7.10	30.00	30.10	40.00	40.10	60.00	60.10	100.00				
Pile Diameter or Width, B (inches)	96.00	96.00	96.00	96.00	96.00	96.00	96.00	96.00	96.00	96.00				
Soil Type Code for p-y Curve Criteria: 1 = Sand/Gravel (Reese et al., 1974) 2 = Sand/Gravel (API RP2A Criteria, 1987) 3 = Stiff Clay w/o Free Water (Reese and Wang, 1997) 4 = Stiff Clay w/ Free Water (Reese and Wang, 1997) 5 = Soft Clay (Matlock, 1970) 6 = Liquefied Soil	1	1	1	1	1	1	1	1	1	1				
Soil Modulus, k (pci)	50.00	50.00	90.00	90.00	125.00	125.00	125.00	125.00	200.00	200.00				
Total Soil Unit Weight, γ_t (pcf)	105.00	105.00	110.00	110.00	128.00	128.00	128.00	128.00	130.00	130.00				
Saturated Soil Unit Weight, γ_{sat} (pcf)	115.00	115.00	120.00	120.00	128.00	128.00	128.00	128.00	130.00	130.00				
Soil Cohesion, c (psf)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
Soil Friction Angle, ϕ (degrees)	30.00	30.00	30.00	30.00	35.00	35.00	38.00	38.00	40.00	40.00				

SUMMARY OF RESULTS

Soil Depth, z (feet) ==>	0.00	7.00	7.10	30.00	30.10	40.00	40.10	60.00	60.10	100.00				
Elevation (feet) ==>	1,524.90	1,517.90	1,517.80	1,494.90	1,494.80	1,484.90	1,484.80	1,464.90	1,464.80	1,424.90				
Deflection, y (inches)	Lateral Soil Resistance, p (pounds/inch)													
0.000	0	0	0	0	0	0	0	0	0	0				
0.050	0	210	383	1,041	1,742	1,943	2,491	4,500	6,441	12,000				
0.100	0	420	767	1,495	2,505	2,961	3,797	8,022	9,817	24,000				
0.250	0	1,050	1,917	2,410	4,050	5,170	6,628	14,002	17,137	45,324				
0.500	0	2,100	2,542	3,460	5,826	7,879	10,101	21,342	26,119	69,080				
0.750	0	2,700	2,870	4,274	7,206	10,082	12,925	27,308	33,421	88,392				
1.000	0	2,942	3,129	4,966	8,379	12,009	15,396	32,528	39,809	105,288				
2.000	0	3,639	3,871	7,172	12,126	18,411	23,603	49,867	61,029	161,412				
3.000	0	4,272	4,545	9,240	15,640	24,484	31,388	66,316	81,161	214,655				
4.000	0	4,651	4,950	10,481	17,748	28,127	36,060	76,186	93,239	246,601				

CALCULATION OF DEPTH TO POINT OF FIXITY:

I-95/SR 60 East Junction Project
Proposed SR 60 HOV Connectors

- Based on the results of LPILE analysis for proposed 8-ft diameter CIDH piles and using Beam Column Formula for fixed and Cantilever:

$$\delta_{max} = \frac{PL^3}{12EI} = \text{deflection}$$

$$\text{Solving for } L = \sqrt[3]{\frac{\delta_{max}(12EI)}{P}}$$

For $\delta_{max} = 0.5''$: $P = 1130$ kips, $E = 3{,}600$ ksi
$I = 1{,}667{,}688$ in^4 (40% I_{gross}) - Cracked Section

$$L = \sqrt[3]{\frac{0.5(12 \times 3{,}600 \times 1{,}667{,}688)}{1130}} \approx 317'' \approx 26.4 \ (8.0\text{ m})$$

For $\delta_{max} = 1.0''$: $P = 1710$ kips, $E = 3{,}600$ ksi
$I = 1{,}667{,}688$ in^4 (40% I_{gross}) - Cracked Section

$$L = \sqrt[3]{\frac{1.0(12 \times 3{,}600 \times 1{,}667{,}688)}{1710}} \approx 348'' \approx 29.0 \ (8.8\text{ m})$$

C-6

EMBANKMENT SETTLEMENT

ANALYSIS OF SETTLEMENTS BENEATH A TRAPEZOIDAL EMBANKMENT

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PROJECT INFORMATION

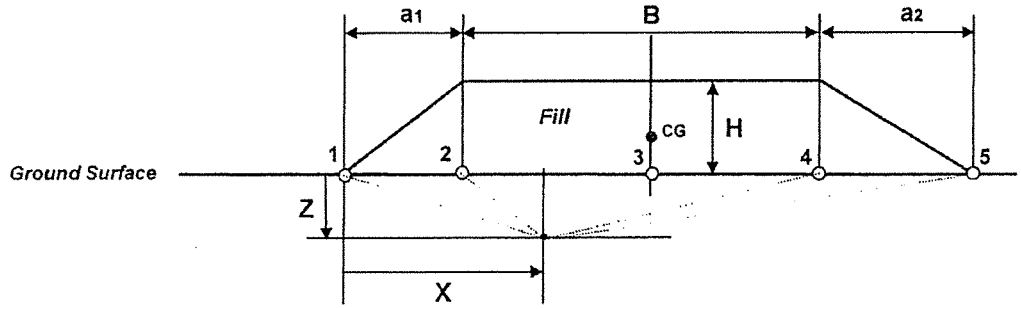
Project Name	I-215/SR60 East Junction HOV Connectors
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Analysis Description	Approach Embankment at Abutment 1 (Boring HV-1)
Stress Analysis Method	Boussinesq Method
Embankment Height, H	19.00 feet
Top Width of Embankment, B	90.00 feet
Left Side Slope Width, a_1	38.00 feet
Right Side Slope Width, a_2	38.00 feet
Ground Surface Elevation	1,524.00 feet
GWT Elevation for Design	1,497.00 feet
Unit Weight of Fill, $\gamma_{f,DR}$	125.00 pcf

INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Soil Modulus E_s (ksf)	Poisson's Ratio ν	Compression Ratio $C_c / (1 + e_0)$	Recompression Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,524.00	1,519.00	Cohesionless Soil	120.0	1,350.0	0.25			1.0
1,519.00	1,514.00	Cohesionless Soil	125.0	570.0	0.25			1.0
1,514.00	1,509.00	Cohesionless Soil	125.0	600.0	0.25			1.0
1,509.00	1,504.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,504.00	1,499.00	Cohesionless Soil	125.0	560.0	0.25			1.0
1,499.00	1,494.00	Cohesionless Soil	125.0	550.0	0.25			1.0
1,494.00	1,489.00	Cohesionless Soil	125.0	560.0	0.25			1.0
1,489.00	1,484.00	Cohesionless Soil	125.0	740.0	0.25			1.0
1,484.00	1,479.00	Cohesionless Soil	125.0	630.0	0.25			1.0
1,479.00	1,474.00	Cohesionless Soil	125.0	630.0	0.25			1.0



ANALYSIS OF SETTLEMENTS BENEATH A TRAPEZOIDAL EMBANKMENT

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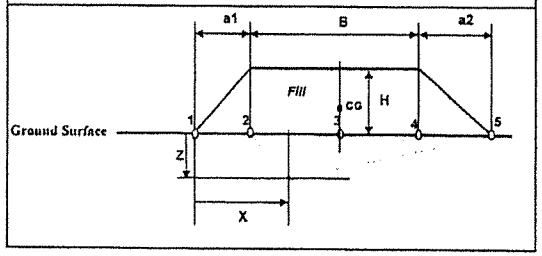
PROJECT INFORMATION

Project Name	I-215/SR60 East Junction HOV Connectors
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Analysis Description	Approach Embankment at Abutment 1 (Boring HV-1)
Stress Analysis Method	Boussinesq Method
Embankment Height, H	19.00 feet
Top Width of Embankment, B	90.00 feet
Left Side Slope Width, a_1	38.00 feet
Right Side Slope Width, a_2	38.00 feet
Ground Surface Elevation at Toe	1,524.00 feet
GWT Elevation for Design	1,497.00 feet
Unit Weight of Fill, $\gamma_{t,fill}$	125.00 pcf

** SUMMARY OF RESULTS **	Station 1	Station 2	Station 3	Station 4	Station 5
Distance, X (feet)	0.00	38.00	83.00	128.00	166.00
Total Elastic Settlement (inches)	0.33	1.64	1.93	1.64	0.33
Total Consol. Settlement (inches)	0.00	0.00	0.00	0.00	0.00
Total Settlement (inches)	0.33	1.64	1.93	1.64	0.33



Prepared By: _____ Date: _____

Reviewed By: _____ Date: _____

INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Soil Modulus E_s (ksf)	Soil Poisson's Ratio ν	Compression Ratio (For Clay) $C_c/(1+e_o)$	Recompression Ratio (For Clay) $C_r/(1+e_o)$	Overconsol. Ratio (For Clay) OCR
1,524.00	1,519.00	Cohesionless Soil	120.0	1,350.0	0.25			1.0
1,519.00	1,514.00	Cohesionless Soil	125.0	570.0	0.25			1.0
1,514.00	1,509.00	Cohesionless Soil	125.0	600.0	0.25			1.0
1,509.00	1,504.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,504.00	1,499.00	Cohesionless Soil	125.0	560.0	0.25			1.0
1,499.00	1,494.00	Cohesionless Soil	125.0	550.0	0.25			1.0
1,494.00	1,489.00	Cohesionless Soil	125.0	560.0	0.25			1.0
1,489.00	1,484.00	Cohesionless Soil	125.0	740.0	0.25			1.0
1,484.00	1,479.00	Cohesionless Soil	125.0	630.0	0.25			1.0
1,479.00	1,474.00	Cohesionless Soil	125.0	630.0	0.25			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

Soil Depth Z (feet)	Layer Thickness H_i (feet)	Load-Induced Stress Change Δp (ksf)					Elastic Settlement S_e (inches)					Consolidation Settlement S_c (inches)				
		Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5
2.50	5.00	0.05	2.33	2.37	2.33	0.05	0.002	0.117	0.120	0.117	0.002	0.000	0.000	0.000	0.000	0.000
7.50	5.00	0.15	2.23	2.37	2.23	0.15	0.013	0.219	0.236	0.219	0.013	0.000	0.000	0.000	0.000	0.000
12.50	5.00	0.24	2.13	2.37	2.13	0.24	0.020	0.189	0.211	0.189	0.020	0.000	0.000	0.000	0.000	0.000
17.50	5.00	0.33	2.05	2.35	2.05	0.33	0.031	0.204	0.236	0.204	0.031	0.000	0.000	0.000	0.000	0.000
22.50	5.00	0.40	1.97	2.33	1.97	0.40	0.036	0.180	0.214	0.180	0.036	0.000	0.000	0.000	0.000	0.000
27.50	5.00	0.47	1.89	2.30	1.89	0.47	0.043	0.175	0.214	0.175	0.043	0.000	0.000	0.000	0.000	0.000
32.50	5.00	0.53	1.83	2.26	1.83	0.53	0.047	0.165	0.205	0.165	0.047	0.000	0.000	0.000	0.000	0.000
37.50	5.00	0.58	1.77	2.22	1.77	0.58	0.039	0.121	0.152	0.121	0.039	0.000	0.000	0.000	0.000	0.000
42.50	5.00	0.62	1.71	2.17	1.71	0.62	0.050	0.137	0.174	0.137	0.050	0.000	0.000	0.000	0.000	0.000
47.50	5.00	0.66	1.66	2.11	1.66	0.66	0.053	0.133	0.169	0.133	0.053	0.000	0.000	0.000	0.000	0.000

ANALYSIS OF SETTLEMENTS BENEATH A TRAPEZOIDAL EMBANKMENT

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PROJECT INFORMATION

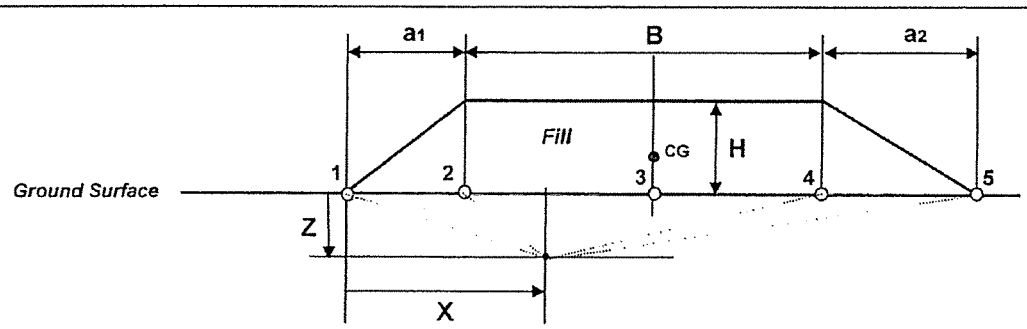
Project Name	I-215/SR60 East Junction HOV Connectors
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Analysis Description	Approach Embankment at Abutment 4 (Boring HV-4)
Stress Analysis Method	Boussinesq Method
Embankment Height, H	29.00 feet
Top Width of Embankment, B	104.00 feet
Left Side Slope Width, a_1	58.00 feet
Right Side Slope Width, a_2	58.00 feet
Ground Surface Elevation	1,536.00 feet
GWT Elevation for Design	1,506.00 feet
Unit Weight of Fill, $\gamma_{t,fill}$	125.00 pcf

INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Soil Modulus E_s (ksf)	Poisson's Ratio ν	Compression Ratio $C_c / (1 + e_0)$	Recompression Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,536.00	1,532.00	Cohesionless Soil	120.0	290.0	0.25			1.0
1,532.00	1,527.00	Cohesionless Soil	125.0	320.0	0.25			1.0
1,527.00	1,523.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,523.00	1,518.00	Cohesionless Soil	125.0	630.0	0.25			1.0
1,518.00	1,513.00	Cohesionless Soil	125.0	1,050.0	0.25			1.0
1,513.00	1,508.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,508.00	1,502.00	Cohesionless Soil	125.0	1,050.0	0.25			1.0
1,502.00	1,492.00	Incompressible Soil	130.0	2,000.0	0.25			1.0
1,492.00	1,482.00	Incompressible Soil	130.0	2,000.0	0.25			1.0



ANALYSIS OF SETTLEMENTS BENEATH A TRAPEZOIDAL EMBANKMENT

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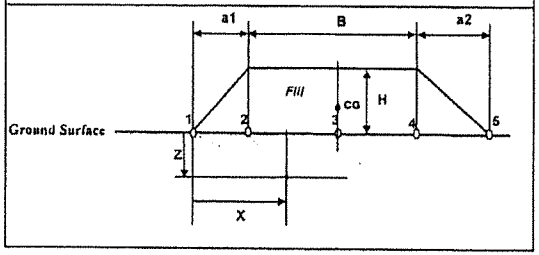
PROJECT INFORMATION

Project Name	I-215/SR60 East Junction HOV Connectors
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Analysis Description	Approach Embankment at Abutment 4 (Boring HV-4)
Stress Analysis Method	Boussinesq Method
Embankment Height, H	29.00 feet
Top Width of Embankment, B	104.00 feet
Left Side Slope Width, a_1	58.00 feet
Right Side Slope Width, a_2	58.00 feet
Ground Surface Elevation at Toe	1,536.00 feet
GWT Elevation for Design	1,506.00 feet
Unit Weight of Fill, γ_{fill}	125.00 pcf

** SUMMARY OF RESULTS **	Station 1	Station 2	Station 3	Station 4	Station 5
Distance, X (feet)	0.00	58.00	110.00	162.00	220.00
Total Elastic Settlement (inches)	0.16	2.68	2.86	2.68	0.16
Total Consol. Settlement (inches)	0.00	0.00	0.00	0.00	0.00
Total Settlement (inches)	0.16	2.68	2.86	2.68	0.16



Prepared By: _____ Date: _____

Reviewed By: _____ Date: _____

INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Soil Modulus E_s (ksf)	Soil Poisson's Ratio ν	Compression Ratio (For Clay) $C_c / (1 + e_o)$	Recompression Ratio (For Clay) $C_r / (1 + e_o)$	Overconsol. Ratio (For Clay) OCR
1,536.00	1,532.00	Cohesionless Soil	120.0	290.0	0.25			1.0
1,532.00	1,527.00	Cohesionless Soil	125.0	320.0	0.25			1.0
1,527.00	1,523.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,523.00	1,518.00	Cohesionless Soil	125.0	630.0	0.25			1.0
1,518.00	1,513.00	Cohesionless Soil	125.0	1,050.0	0.25			1.0
1,513.00	1,508.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,508.00	1,502.00	Cohesionless Soil	125.0	1,050.0	0.25			1.0
1,502.00	1,492.00	Incompressible Soil	130.0	2,000.0	0.25			1.0
1,492.00	1,482.00	Incompressible Soil	130.0	2,000.0	0.25			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

Soil Depth Z (feet)	Layer Thickness H_i (feet)	Load-Induced Stress Change Δp (ksf)					Elastic Settlement S_e (inches)					Consolidation Settlement S_c (inches)				
		Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5
2.00	4.00	0.04	3.59	3.62	3.59	0.04	0.005	0.775	0.786	0.775	0.005	0.000	0.000	0.000	0.000	0.000
6.50	5.00	0.13	3.50	3.62	3.50	0.13	0.020	0.670	0.698	0.670	0.020	0.000	0.000	0.000	0.000	0.000
11.00	4.00	0.22	3.41	3.62	3.41	0.22	0.017	0.295	0.316	0.295	0.017	0.000	0.000	0.000	0.000	0.000
15.50	5.00	0.30	3.32	3.61	3.32	0.30	0.024	0.285	0.313	0.285	0.024	0.000	0.000	0.000	0.000	0.000
20.50	5.00	0.39	3.23	3.60	3.23	0.39	0.019	0.162	0.182	0.162	0.019	0.000	0.000	0.000	0.000	0.000
25.50	5.00	0.48	3.14	3.57	3.14	0.48	0.046	0.314	0.359	0.314	0.046	0.000	0.000	0.000	0.000	0.000
31.00	6.00	0.56	3.05	3.54	3.05	0.56	0.032	0.179	0.209	0.179	0.032	0.000	0.000	0.000	0.000	0.000
39.00	10.00	0.68	2.92	3.47	2.92	0.68	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49.00	10.00	0.80	2.78	3.35	2.78	0.80	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ANALYSIS OF SETTLEMENTS BENEATH A TRAPEZOIDAL EMBANKMENT

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PROJECT INFORMATION

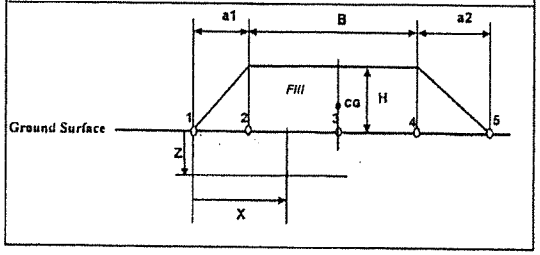
Project Name	I-215/SR60 East Junction HOV Connectors
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Analysis Description	Approach Embankment at Abutment 4 (Bonne HV-4)
Stress Analysis Method	Boussinesq Method
Embankment Height, H	29.00 feet
Top Width of Embankment, B	104.00 feet
Left Side Slope Width, a_1	58.00 feet
Right Side Slope Width, a_2	58.00 feet
Ground Surface Elevation at Toe	1,536.00 feet
GWT Elevation for Design	1,506.00 feet
Unit Weight of Fill, γ_{fill}	125.00 pcf

** SUMMARY OF RESULTS **

	Station 1	Station 2	Station 3	Station 4	Station 5
Distance, X (feet)	0.00	58.00	110.00	162.00	220.00
Total Elastic Settlement (inches)	0.16	2.68	2.86	2.68	0.16
Total Consol. Settlement (inches)	0.00	0.00	0.00	0.00	0.00
Total Settlement (inches)	0.16	2.68	2.86	2.68	0.16



Prepared By: _____ Date: _____

Reviewed By: _____ Date: _____

INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Soil Modulus E_s (ksf)	Soil Poisson's Ratio ν	Compression Ratio (For Clay) $C_c/(1+e_o)$	Recompression Ratio (For Clay) $C_r/(1+e_o)$	Overconsol. Ratio (For Clay) OCR
1,536.00	1,532.00	Cohesionless Soil	120.0	290.0	0.25			1.0
1,532.00	1,527.00	Cohesionless Soil	125.0	320.0	0.25			1.0
1,527.00	1,523.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,523.00	1,518.00	Cohesionless Soil	125.0	630.0	0.25			1.0
1,518.00	1,513.00	Cohesionless Soil	125.0	1,050.0	0.25			1.0
1,513.00	1,508.00	Cohesionless Soil	125.0	520.0	0.25			1.0
1,508.00	1,502.00	Cohesionless Soil	125.0	1,050.0	0.25			1.0
1,502.00	1,492.00	Incompressible Soil	130.0	2,000.0	0.25			1.0
1,492.00	1,482.00	Incompressible Soil	130.0	2,000.0	0.25			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

Soil Depth Z (feet)	Layer Thickness H_i (feet)	Load-Induced Stress Change Δp (ksf)					Elastic Settlement S_e (inches)					Consolidation Settlement S_c (inches)				
		Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5
2.00	4.00	0.04	3.59	3.62	3.59	0.04	0.005	0.775	0.786	0.775	0.005	0.000	0.000	0.000	0.000	0.000
6.50	5.00	0.13	3.50	3.62	3.50	0.13	0.020	0.670	0.698	0.670	0.020	0.000	0.000	0.000	0.000	0.000
11.00	4.00	0.22	3.41	3.62	3.41	0.22	0.017	0.295	0.316	0.295	0.017	0.000	0.000	0.000	0.000	0.000
15.50	5.00	0.30	3.32	3.61	3.32	0.30	0.024	0.285	0.313	0.285	0.024	0.000	0.000	0.000	0.000	0.000
20.50	5.00	0.39	3.23	3.60	3.23	0.39	0.019	0.162	0.182	0.162	0.019	0.000	0.000	0.000	0.000	0.000
25.50	5.00	0.48	3.14	3.57	3.14	0.48	0.046	0.314	0.359	0.314	0.046	0.000	0.000	0.000	0.000	0.000
31.00	6.00	0.56	3.05	3.54	3.05	0.56	0.032	0.179	0.209	0.179	0.032	0.000	0.000	0.000	0.000	0.000
39.00	10.00	0.68	2.92	3.47	2.92	0.68	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49.00	10.00	0.80	2.78	3.35	2.78	0.80	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ANALYSIS OF SETTLEMENTS BENEATH A TRAPEZOIDAL EMBANKMENT

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PROJECT INFORMATION

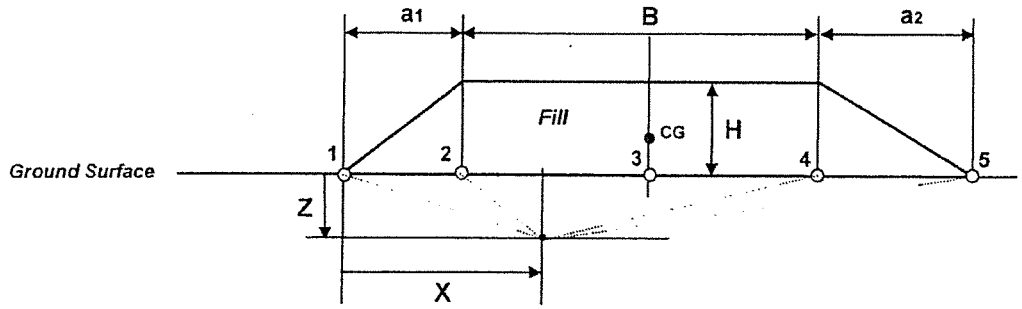
Project Name	I-215/SR60 East Junction HOV Connectors
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

Analysis Description	Approach Embankment at Abutment 4 (Boring HV-8)
Stress Analysis Method	Boussinesq Method
Embankment Height, H	29.00 feet
Top Width of Embankment, B	104.00 feet
Left Side Slope Width, a_1	58.00 feet
Right Side Slope Width, a_2	58.00 feet
Ground Surface Elevation	1,541.00 feet
GWT Elevation for Design	1,511.00 feet
Unit Weight of Fill, $\gamma_{t,fill}$	125.00 pcf

INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Soil Modulus E_s (ksf)	Poisson's Ratio ν	Compression Ratio $C_c / (1 + e_0)$	Recompression Ratio $C_r / (1 + e_0)$	Overconsol. Ratio OCR
1,541.00	1,537.00	Cohesionless Soil	120.0	270.0	0.25			1.0
1,537.00	1,532.00	Cohesionless Soil	125.0	850.0	0.25			1.0
1,532.00	1,528.00	Cohesionless Soil	125.0	700.0	0.25			1.0
1,528.00	1,523.00	Cohesionless Soil	125.0	460.0	0.25			1.0
1,523.00	1,518.00	Cohesionless Soil	130.0	440.0	0.25			1.0
1,518.00	1,513.00	Cohesionless Soil	130.0	1,050.0	0.25			1.0
1,513.00	1,503.00	Incompressible Soil	130.0	2,000.0	0.25			1.0
1,503.00	1,493.00	Incompressible Soil	130.0	2,000.0	0.25			1.0



ANALYSIS OF SETTLEMENTS BENEATH A TRAPEZOIDAL EMBANKMENT

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PROJECT INFORMATION

Project Name	I-215/SR60 East Junction HOV Connectors
Project No.	76979
Location	Riverside, California

INPUT PARAMETERS

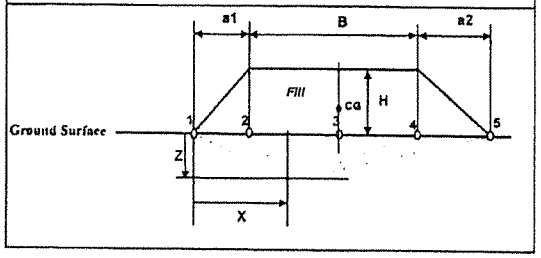
Analysis Description	Approach Embankment at Abutment 4 (Boring HV-8)
Stress Analysis Method	Boussinesq Method
Embankment Height, H	29.00 feet
Top Width of Embankment, B	104.00 feet
Left Side Slope Width, a_1	58.00 feet
Right Side Slope Width, a_2	58.00 feet
Ground Surface Elevation at Toe	1,541.00 feet
GWT Elevation for Design	1,511.00 feet
Unit Weight of Fill, $\gamma_{f,ow}$	125.00 pcf

** SUMMARY OF RESULTS **

	Station 1	Station 2	Station 3	Station 4	Station 5
Distance, X (feet)	0.00	58.00	110.00	162.00	220.00
Total Elastic Settlement (inches)	0.13	2.24	2.38	2.24	0.13
Total Consol. Settlement (inches)	0.00	0.00	0.00	0.00	0.00
Total Settlement (inches)	0.13	2.24	2.38	2.24	0.13

Prepared By: _____ Date: _____

Reviewed By: _____ Date: _____



INPUT SOIL PROFILE DATA

Top of Soil Layer Elevation (feet)	Bottom of Soil Layer Elevation (feet)	Soil Type Model	Total Soil Unit Weight γ_t (pcf)	Elastic Soil Modulus E_s (ksf)	Soil Poisson's Ratio ν	Compression Ratio (For Clay) $C_c / (1 + e_o)$	Recompression Ratio (For Clay) $C_r / (1 + e_o)$	Overconsol. Ratio (For Clay) OCR
1,541.00	1,537.00	Cohesionless Soil	120.0	270.0	0.25			1.0
1,537.00	1,532.00	Cohesionless Soil	125.0	850.0	0.25			1.0
1,532.00	1,528.00	Cohesionless Soil	125.0	700.0	0.25			1.0
1,528.00	1,523.00	Cohesionless Soil	125.0	460.0	0.25			1.0
1,523.00	1,518.00	Cohesionless Soil	130.0	440.0	0.25			1.0
1,518.00	1,513.00	Cohesionless Soil	130.0	1,050.0	0.25			1.0
1,513.00	1,503.00	Incompressible Soil	130.0	2,000.0	0.25			1.0
1,503.00	1,493.00	Incompressible Soil	130.0	2,000.0	0.25			1.0

SOIL STRESS AND SETTLEMENT ANALYSIS RESULTS

Soil Depth Z (feet)	Layer Thickness H_i (feet)	Load-Induced Stress Change Δp (ksf)					Elastic Settlement S_e (inches)					Consolidation Settlement S_c (inches)				
		Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5	Station 1	Station 2	Station 3	Station 4	Station 5
2.00	4.00	0.04	3.59	3.62	3.59	0.04	0.006	0.833	0.844	0.833	0.006	0.000	0.000	0.000	0.000	0.000
6.50	5.00	0.13	3.50	3.62	3.50	0.13	0.008	0.252	0.263	0.252	0.008	0.000	0.000	0.000	0.000	0.000
11.00	4.00	0.22	3.41	3.62	3.41	0.22	0.012	0.220	0.235	0.220	0.012	0.000	0.000	0.000	0.000	0.000
15.50	5.00	0.30	3.32	3.61	3.32	0.30	0.033	0.391	0.428	0.391	0.033	0.000	0.000	0.000	0.000	0.000
20.50	5.00	0.39	3.23	3.60	3.23	0.39	0.044	0.387	0.434	0.387	0.044	0.000	0.000	0.000	0.000	0.000
25.50	5.00	0.48	3.14	3.57	3.14	0.48	0.023	0.155	0.178	0.155	0.023	0.000	0.000	0.000	0.000	0.000
33.00	10.00	0.59	3.02	3.52	3.02	0.59	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43.00	10.00	0.73	2.86	3.42	2.86	0.73	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

C-7

SLOPE STABILITY ANALYSES

I-215/SR60 East Junction HOV Lane, EB Riverside, California

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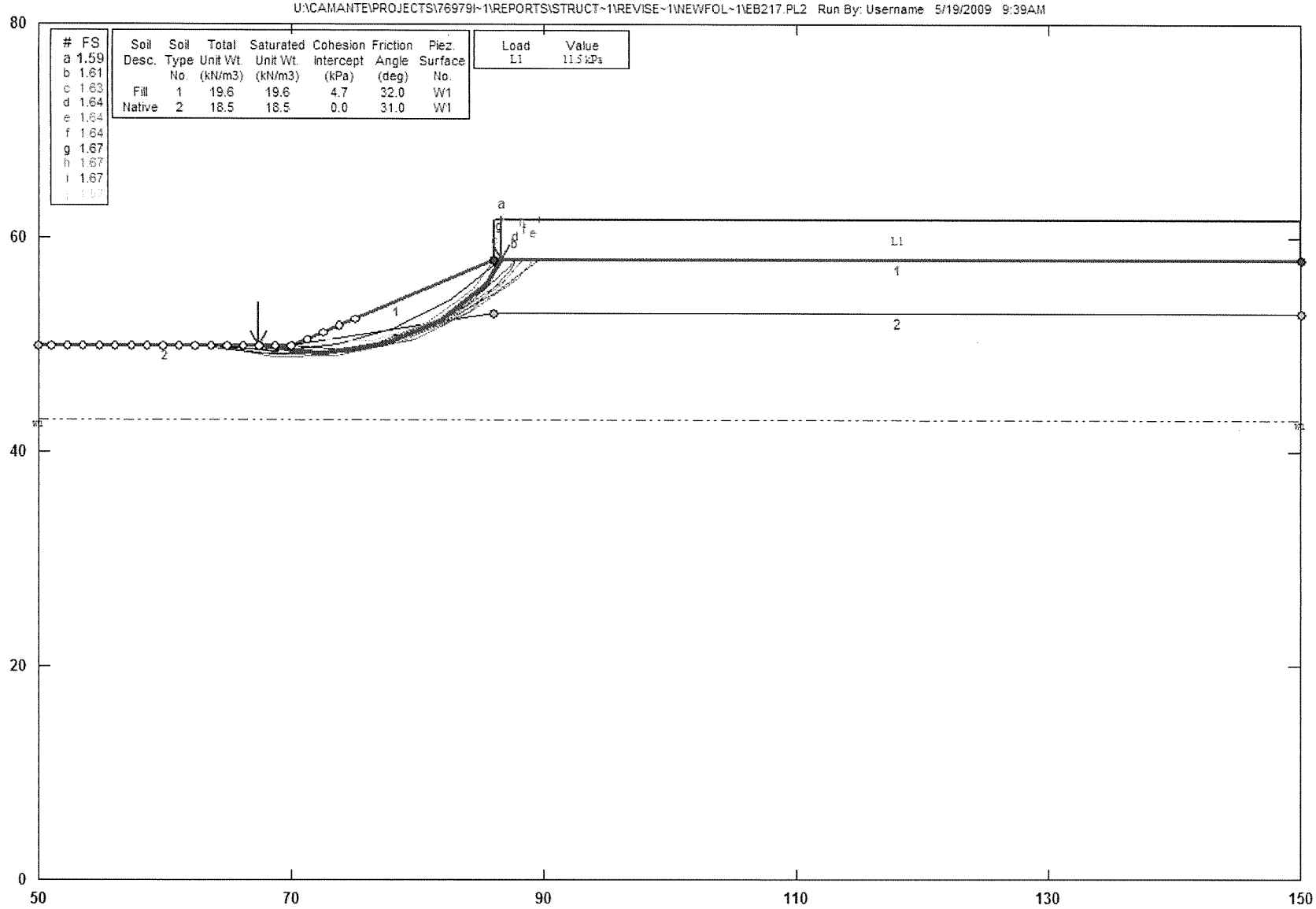

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b	1.61
c	1.63
d	1.64
e	1.64
f	1.64
g	1.67
h	1.67
i	1.67
j	1.67

Soil Desc.	Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Piez. Surface No.
Fill	1	19.6	19.6	4.7	32.0	W1
Native	2	18.5	18.5	0.0	31.0	W1

Load	Value
L1	11.5 kPa

GSTABL7 v.2 FSmin=1.59

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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*

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****
*

Analysis Run Date: 5/19/2009
Time of Run: 9:39AM
Run By: Username
Input Data Filename: U:eb217.in
Output Filename: U:eb217.OUT
Unit System: SI

Plotted Output Filename: U:eb217.PLT

PROBLEM DESCRIPTION: I-215/SR60 East Junction HOV Lane, EB
Riverside, California

BOUNDARY COORDINATES

3 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	50.00	50.00	70.00	50.00	2
2	70.00	50.00	86.00	58.00	1
3	86.00	58.00	150.00	58.00	1
4	70.00	50.00	86.00	53.00	2
5	86.00	53.00	150.00	53.00	2

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	4.7	32.0	0.00	0.0	1
2	18.5	18.5	0.0	31.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	50.00	43.00
2	150.00	43.00

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	86.00	150.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 51.00(m)
and X = 75.00(m)

Each Surface Terminates Between X = 86.00(m)
and X = 150.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

5.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 19.248 FS Min = 1.594 FS Ave = 4.863
Standard Deviation = 2.696 Coefficient of Variation = 55.44
%

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	67.42	50.00
2	72.37	49.29
3	77.31	50.07
4	81.79	52.29
5	85.42	55.73
6	86.68	58.00

Circle Center At X = 72.3 ; Y = 65.6 and Radius, 16.3

Factor of Safety
*** 1.594 ***

Individual data on the 8 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	2.6	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	2.4	50.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4.9	258.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	4.2	295.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.3	17.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	3.6	198.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.6	18.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.7	8.2	0.0	0.0	0.0	0.0	0.0	0.0	7.9

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.16
3	74.81	49.53
4	79.56	51.10
5	83.78	53.78
6	87.23	57.39
7	87.58	58.00

Circle Center At X = 70.8 ; Y = 69.6 and Radius, 20.5

Factor of Safety
*** 1.613 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)

1	66.16	50.00
2	71.09	49.20
3	76.05	49.87
4	80.59	51.96
5	84.33	55.27
6	86.01	58.00

Circle Center At X = 71.3 ; Y = 65.8 and Radius, 16.7

Factor of Safety
*** 1.625 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	69.95	50.00
2	74.93	49.53
3	79.80	50.65
4	84.08	53.24
5	87.33	57.04
6	87.72	58.00

Circle Center At X = 73.9 ; Y = 64.9 and Radius, 15.5

Factor of Safety
*** 1.637 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.11
3	74.81	49.33
4	79.63	50.65
5	84.05	52.99
6	87.84	56.26
7	89.13	58.00

Circle Center At X = 71.3 ; Y = 71.6 and Radius, 22.5

Factor of Safety
*** 1.639 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.56	49.13
3	73.55	49.33
4	78.39	50.58
5	82.86	52.83
6	86.75	55.97
7	88.39	58.00

Circle Center At X = 70.1 ; Y = 72.6 and Radius, 23.5

Factor of Safety
*** 1.642 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.61	49.53
3	73.57	50.13
4	78.30	51.76
5	82.58	54.34
6	86.22	57.77
7	86.38	58.00

Circle Center At X = 68.3 ; Y = 73.1 and Radius, 23.6

Factor of Safety
*** 1.669 ***

Failure Surface Specified By 7 Coordinate Points

Point	X-Surf	Y-Surf

No.	(m)	(m)
1	63.63	50.00
2	68.52	48.92
3	73.51	48.99
4	78.37	50.21
5	82.81	52.49
6	86.62	55.74
7	88.28	58.00

Circle Center At X = 70.7 ; Y = 70.5 and Radius, 21.7

Factor of Safety
*** 1.670 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	62.37	50.00
2	67.31	49.22
3	72.31	49.33
4	77.21	50.33
5	81.85	52.18
6	86.09	54.83
7	89.58	58.00

Circle Center At X = 69.2 ; Y = 77.2 and Radius, 28.0

Factor of Safety
*** 1.671 ***

Failure Surface Specified By 5 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.61
2	76.21	50.52
3	80.96	52.08
4	84.92	55.13
5	86.80	58.00

Circle Center At X = 74.0 ; Y = 65.3 and Radius, 14.9

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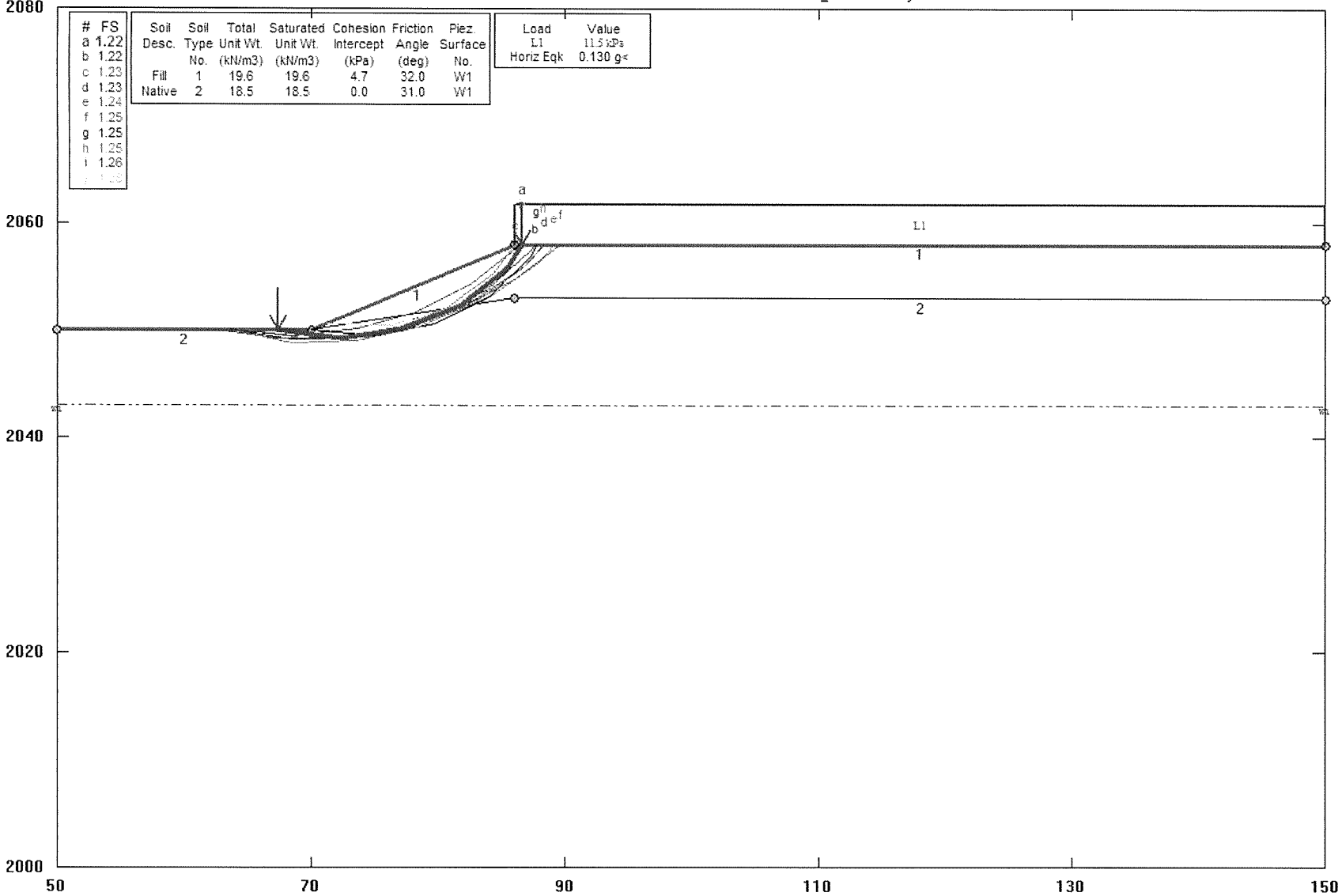
 Factor of Safety
***     1.673    ***


    **** END OF GSTABL7 OUTPUT ****
```

I-215/SR60 East Junction HOV Lane, EB Riverside, California

U:\CAMANTE\PROJECTS\76979I~1\REPORTS\STRUCT~1\REVISE~1\NEWFOL~1\EB217_1.PL2 Run By: Username 5/19/2009 9:39AM



#	FS
a	1.22
b	1.22
c	1.23
d	1.23
e	1.24
f	1.25
g	1.25
h	1.25
i	1.26

Soil Desc.	Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Piez. Surface No.
Fill	1	19.6	19.6	4.7	32.0	W1
Native	2	18.5	18.5	0.0	31.0	W1

Load	Value
L1	11.5 kPa
Horiz Eqk	0.130 g<

GSTABL7 v.2 FSmin=1.22

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****
*

Analysis Run Date: 5/19/2009
Time of Run: 9:39AM
Run By: Username
Input Data Filename: U:eb217_1.in
Output Filename: U:eb217_1.OUT
Unit System: SI

Plotted Output Filename: U:eb217_1.PLT

PROBLEM DESCRIPTION: I-215/SR60 East Junction HOV Lane, EB
Riverside, California

BOUNDARY COORDINATES

3 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	50.00	50.00	70.00	50.00	2
2	70.00	50.00	86.00	58.00	1
3	86.00	58.00	150.00	58.00	1
4	70.00	50.00	86.00	53.00	2
5	86.00	53.00	150.00	53.00	2

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	4.7	32.0	0.00	0.0	1
2	18.5	18.5	0.0	31.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	50.00	43.00
2	150.00	43.00

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	86.00	150.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.130 Has Been Assigned

A Vertical Earthquake Loading Coefficient

Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 51.00(m)
and X = 75.00(m)

Each Surface Terminates Between X = 86.00(m)
and X = 150.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

5.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 4.829 FS Min = 1.216 FS Ave = 2.539
Standard Deviation = 0.722 Coefficient of Variation = 28.42

%

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	67.42	50.00
2	72.37	49.29
3	77.31	50.07

4	81.79	52.29
5	85.42	55.73
6	86.68	58.00

Circle Center At X = 72.3 ; Y = 65.6 and Radius, 16.3

Factor of Safety
*** 1.216 ***

Individual data on the 8 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	2.6	8.9	0.0	0.0	0.0	0.0	1.2	0.0	0.0
2	2.4	50.8	0.0	0.0	0.0	0.0	6.6	0.0	0.0
3	4.9	258.6	0.0	0.0	0.0	0.0	33.6	0.0	0.0
4	4.2	295.3	0.0	0.0	0.0	0.0	38.4	0.0	0.0
5	0.3	17.8	0.0	0.0	0.0	0.0	2.3	0.0	0.0
6	3.6	198.5	0.0	0.0	0.0	0.0	25.8	0.0	0.0
7	0.6	18.3	0.0	0.0	0.0	0.0	2.4	0.0	0.0
8	0.7	8.2	0.0	0.0	0.0	0.0	1.1	0.0	7.9

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.16
3	74.81	49.53
4	79.56	51.10
5	83.78	53.78
6	87.23	57.39
7	87.58	58.00

Circle Center At X = 70.8 ; Y = 69.6 and Radius, 20.5

Factor of Safety
*** 1.219 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	66.16	50.00
2	71.09	49.20
3	76.05	49.87
4	80.59	51.96
5	84.33	55.27
6	86.01	58.00

Circle Center At X = 71.3 ; Y = 65.8 and Radius, 16.7

Factor of Safety
*** 1.228 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.56	49.13
3	73.55	49.33
4	78.39	50.58
5	82.86	52.83
6	86.75	55.97
7	88.39	58.00

Circle Center At X = 70.1 ; Y = 72.6 and Radius, 23.5

Factor of Safety
*** 1.234 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)

1	64.90	50.00
2	69.82	49.11
3	74.81	49.33
4	79.63	50.65
5	84.05	52.99
6	87.84	56.26
7	89.13	58.00

Circle Center At X = 71.3 ; Y = 71.6 and Radius, 22.5

Factor of Safety
*** 1.235 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	62.37	50.00
2	67.31	49.22
3	72.31	49.33
4	77.21	50.33
5	81.85	52.18
6	86.09	54.83
7	89.58	58.00

Circle Center At X = 69.2 ; Y = 77.2 and Radius, 28.0

Factor of Safety
*** 1.247 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	69.95	50.00
2	74.93	49.53
3	79.80	50.65
4	84.08	53.24
5	87.33	57.04
6	87.72	58.00

Circle Center At X = 73.9 ; Y = 64.9 and Radius, 15.5

Factor of Safety
*** 1.251 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.52	48.92
3	73.51	48.99
4	78.37	50.21
5	82.81	52.49
6	86.62	55.74
7	88.28	58.00

Circle Center At X = 70.7 ; Y = 70.5 and Radius, 21.7

Factor of Safety
*** 1.254 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.61	49.53
3	73.57	50.13
4	78.30	51.76
5	82.58	54.34
6	86.22	57.77
7	86.38	58.00

Circle Center At X = 68.3 ; Y = 73.1 and Radius, 23.6

Factor of Safety
*** 1.256 ***

Failure Surface Specified By 5 Coordinate Points

Point	X-Surf	Y-Surf

No.	(m)	(m)
1	71.21	50.61
2	76.21	50.52
3	80.96	52.08
4	84.92	55.13
5	86.80	58.00

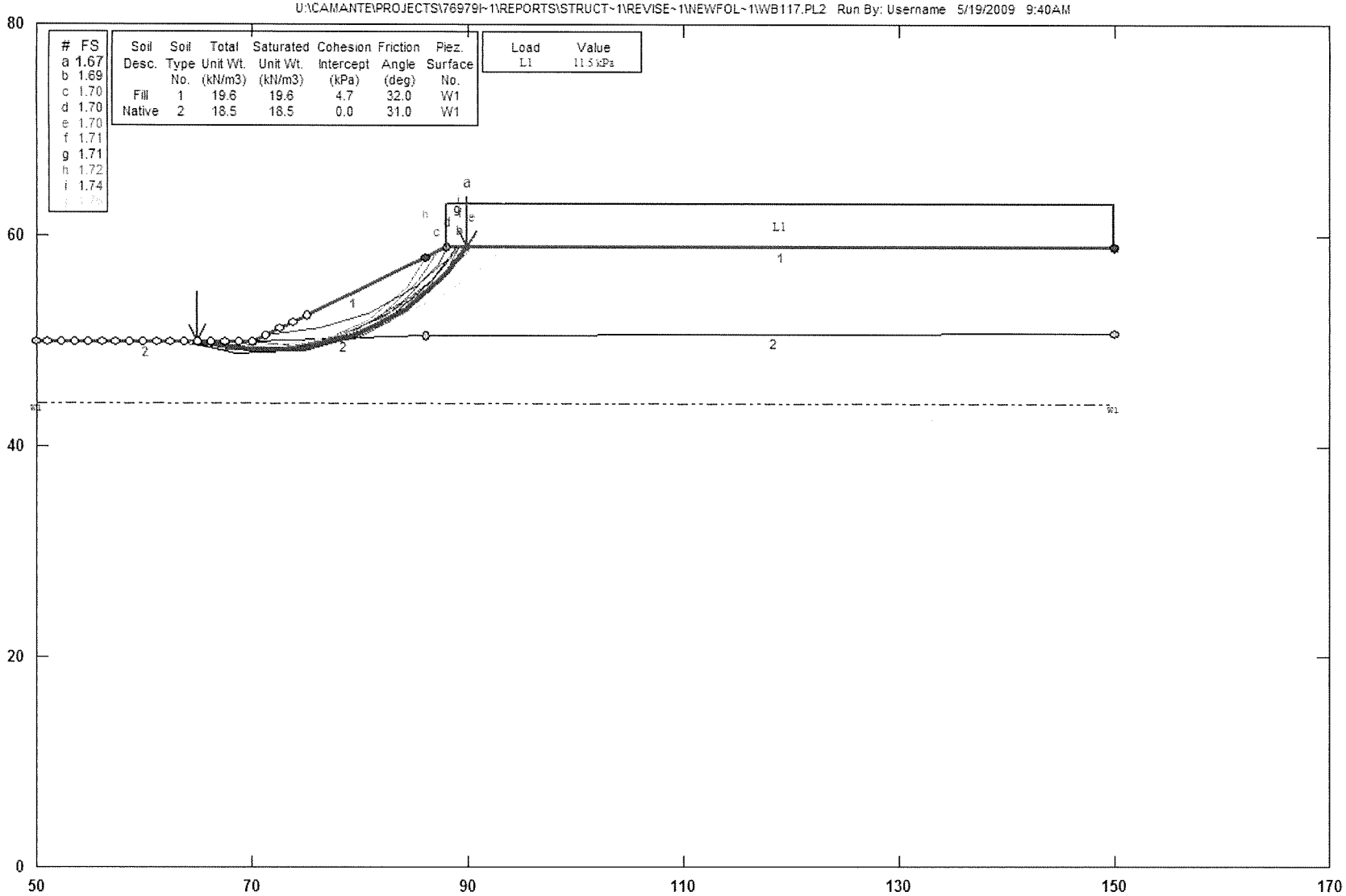
Circle Center At X = 74.0 ; Y = 65.3 and Radius, 14.9

Factor of Safety
*** 1.279 ***

**** END OF GSTABL7 OUTPUT ****

I-215/SR60 East Junction HOV Lane, WB Riverside, California

U:\CAMANTE\PROJECTS\76979I~1\REPORTS\STRUCT~1\REVISE~1\NEWFOL~1\WB117.PL2 Run By: Username 5/19/2009 9:40AM



GSTABL7 v.2 FSmin=1.67

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
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SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****
*

Analysis Run Date: 5/19/2009
Time of Run: 9:40AM
Run By: Username
Input Data Filename: U:wb117.in
Output Filename: U:wb117.OUT
Unit System: SI

Plotted Output Filename: U:wb117.PLT

PROBLEM DESCRIPTION: I-215/SR60 East Junction HOV Lane, WB
Riverside, California

BOUNDARY COORDINATES

3 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	50.00	50.00	70.00	50.00	2
2	70.00	50.00	88.00	59.00	1
3	88.00	59.00	150.00	59.00	1
4	70.00	50.00	86.00	50.50	2
5	86.00	50.50	150.00	50.80	2

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	4.7	32.0	0.00	0.0	1
2	18.5	18.5	0.0	31.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	50.00	44.00
2	150.00	44.00

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	88.00	150.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 51.00(m)
and X = 75.00(m)

Each Surface Terminates Between X = 86.00(m)
and X = 150.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

5.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 14.878 FS Min = 1.666 FS Ave = 4.307
Standard Deviation = 2.106 Coefficient of Variation = 48.89

%

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.11
3	74.81	49.33
4	79.63	50.65
5	84.05	53.00
6	87.83	56.27
7	89.84	59.00

Circle Center At X = 71.3 ; Y = 71.6 and Radius, 22.5

Factor of Safety
*** 1.666 ***

Individual data on the 9 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	4.9	40.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.2	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	4.8	182.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	3.4	227.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1.4	113.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	4.4	354.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	3.8	247.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.2	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	1.8	45.2	0.0	0.0	0.0	0.0	0.0	0.0	21.2

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.56	49.13
3	73.55	49.33
4	78.39	50.58
5	82.86	52.83
6	86.75	55.98
7	89.17	59.00

Circle Center At X = 70.1 ; Y = 72.5 and Radius, 23.5

Factor of Safety
*** 1.693 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	67.42	50.00
2	72.37	49.29
3	77.31	50.07
4	81.79	52.29
5	85.41	55.73
6	86.94	58.47

Circle Center At X = 72.2 ; Y = 65.6 and Radius, 16.3

Factor of Safety
*** 1.696 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.16
3	74.81	49.53
4	79.56	51.10
5	83.78	53.78
6	87.23	57.40
7	88.13	59.00

Circle Center At X = 70.8 ; Y = 69.6 and Radius, 20.5

Factor of Safety
*** 1.701 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	62.37	50.00
2	67.31	49.22
3	72.31	49.33
4	77.21	50.33
5	81.85	52.19
6	86.08	54.84
7	89.78	58.21

8	90.38	59.00

Circle Center At X = 69.2 ; Y = 76.9 and Radius, 27.7

Factor of Safety
*** 1.702 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	69.95	50.00
2	74.92	49.44
3	79.83	50.38
4	84.24	52.73
5	87.76	56.29
6	89.17	59.00

Circle Center At X = 74.3 ; Y = 65.8 and Radius, 16.3

Factor of Safety
*** 1.712 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.52	48.92
3	73.51	49.00
4	78.37	50.21
5	82.81	52.50
6	86.61	55.75
7	89.00	59.00

Circle Center At X = 70.7 ; Y = 70.5 and Radius, 21.7

Factor of Safety
*** 1.714 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	66.16	50.00
2	71.09	49.20
3	76.05	49.87
4	80.59	51.96
5	84.33	55.27
6	86.01	58.00

Circle Center At X = 71.3 ; Y = 65.8 and Radius, 16.7

Factor of Safety
*** 1.715 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.61
2	76.18	51.17
3	80.92	52.76
4	85.22	55.31
5	88.89	58.71
6	89.09	59.00

Circle Center At X = 71.1 ; Y = 74.1 and Radius, 23.5

Factor of Safety
*** 1.742 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.61	49.48
3	73.60	49.69
4	78.51	50.62
5	83.24	52.25
6	87.68	54.55

7	91.74	57.47
8	93.33	59.00

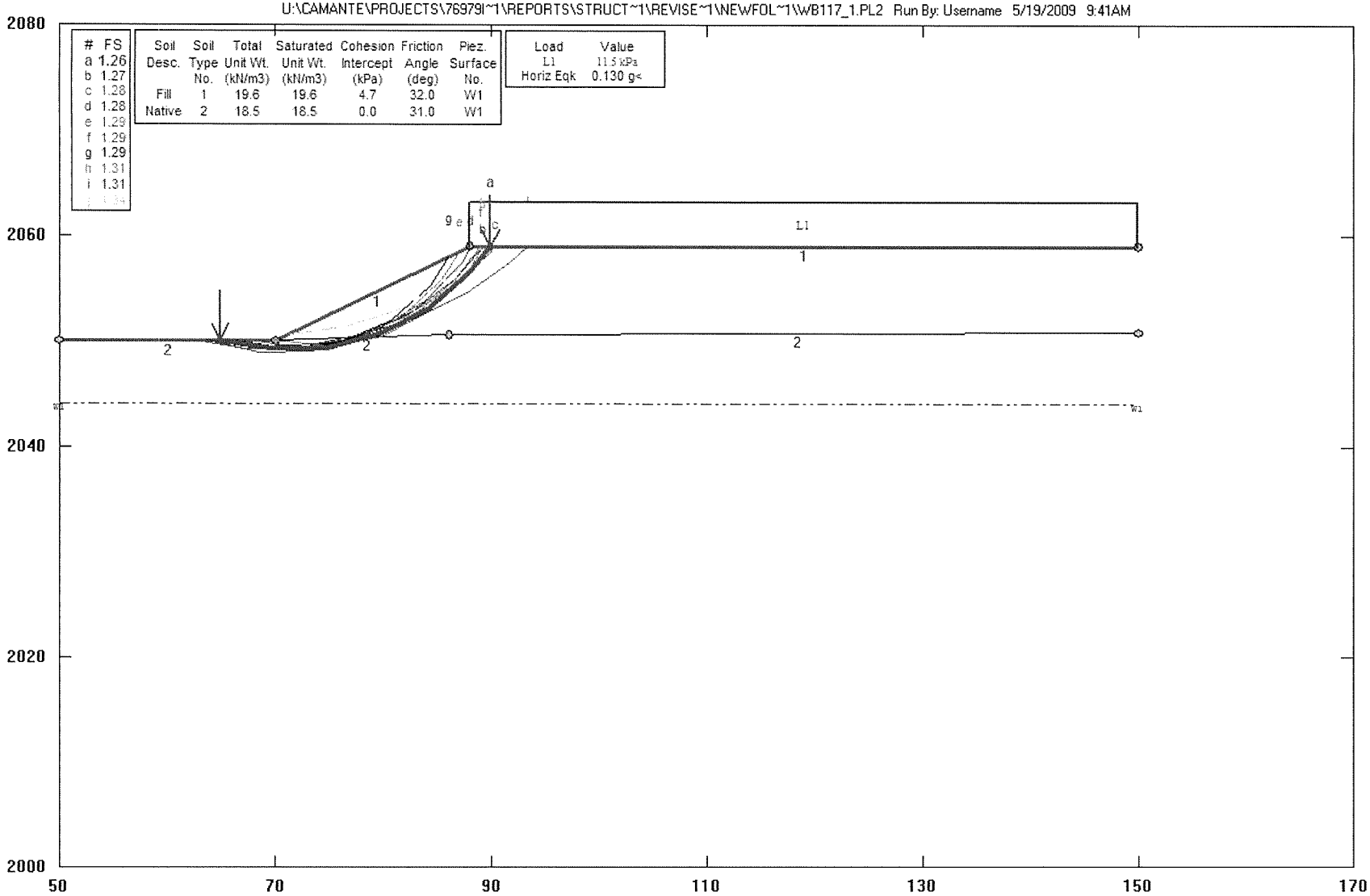
Circle Center At X = 69.7 ; Y = 83.5 and Radius, 34.1

Factor of Safety
*** 1.765 ***

**** END OF GSTABL7 OUTPUT ****

I-215/SR60 East Junction HOV Lane, WB Riverside, California

U:\CAMANTE\PROJECTS\76979I~1\REPORTS\STRUCT~1\REVISE~1\NEWFOL~1\WB117_1.PL2 Run By: Username 5/19/2009 9:41AM



GSTABL7 v.2 FSmin=1.26

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **
(All Rights Reserved-Unauthorized Use Prohibited)

****
*

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****
*

Analysis Run Date: 5/19/2009
Time of Run: 9:41AM
Run By: Username
Input Data Filename: U:wb117_1.in
Output Filename: U:wb117_1.OUT
Unit System: SI

Plotted Output Filename: U:wb117_1.PLT

PROBLEM DESCRIPTION: I-215/SR60 East Junction HOV Lane, WB
Riverside, California

BOUNDARY COORDINATES

3 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	50.00	50.00	70.00	50.00	2
2	70.00	50.00	88.00	59.00	1
3	88.00	59.00	150.00	59.00	1
4	70.00	50.00	86.00	50.50	2
5	86.00	50.50	150.00	50.80	2

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	19.6	19.6	4.7	32.0	0.00	0.0	1
2	18.5	18.5	0.0	31.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 2 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	50.00	44.00
2	150.00	44.00

1

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	88.00	150.00	11.5	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.130 Has Been Assigned

A Vertical Earthquake Loading Coefficient

Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 51.00(m)
and X = 75.00(m)

Each Surface Terminates Between X = 86.00(m)
and X = 150.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

5.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 4.503 FS Min = 1.262 FS Ave = 2.398
Standard Deviation = 0.638 Coefficient of Variation = 26.61

%

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.11
3	74.81	49.33

4	79.63	50.65
5	84.05	53.00
6	87.83	56.27
7	89.84	59.00

Circle Center At X = 71.3 ; Y = 71.6 and Radius, 22.5

Factor of Safety
*** 1.262 ***

Individual data on the 9 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	4.9	40.4	0.0	0.0	0.0	0.0	5.3	0.0	0.0
2	0.2	3.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0
3	4.8	182.0	0.0	0.0	0.0	0.0	23.7	0.0	0.0
4	3.4	227.4	0.0	0.0	0.0	0.0	29.6	0.0	0.0
5	1.4	113.5	0.0	0.0	0.0	0.0	14.8	0.0	0.0
6	4.4	354.4	0.0	0.0	0.0	0.0	46.1	0.0	0.0
7	3.8	247.4	0.0	0.0	0.0	0.0	32.2	0.0	0.0
8	0.2	8.5	0.0	0.0	0.0	0.0	1.1	0.0	0.0
9	1.8	45.2	0.0	0.0	0.0	0.0	5.9	0.0	21.2

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.56	49.13
3	73.55	49.33
4	78.39	50.58
5	82.86	52.83
6	86.75	55.98
7	89.17	59.00

Circle Center At X = 70.1 ; Y = 72.5 and Radius, 23.5

Factor of Safety
*** 1.274 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	62.37	50.00
2	67.31	49.22
3	72.31	49.33
4	77.21	50.33
5	81.85	52.19
6	86.08	54.84
7	89.78	58.21
8	90.38	59.00

Circle Center At X = 69.2 ; Y = 76.9 and Radius, 27.7

Factor of Safety
*** 1.276 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	64.90	50.00
2	69.82	49.16
3	74.81	49.53
4	79.56	51.10
5	83.78	53.78
6	87.23	57.40
7	88.13	59.00

Circle Center At X = 70.8 ; Y = 69.6 and Radius, 20.5

Factor of Safety
*** 1.281 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	67.42	50.00
2	72.37	49.29
3	77.31	50.07
4	81.79	52.29
5	85.41	55.73
6	86.94	58.47

Circle Center At X = 72.2 ; Y = 65.6 and Radius, 16.3

Factor of Safety
*** 1.286 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.52	48.92
3	73.51	49.00
4	78.37	50.21
5	82.81	52.50
6	86.61	55.75
7	89.00	59.00

Circle Center At X = 70.7 ; Y = 70.5 and Radius, 21.7

Factor of Safety
*** 1.288 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	66.16	50.00
2	71.09	49.20
3	76.05	49.87
4	80.59	51.96
5	84.33	55.27
6	86.01	58.00

Circle Center At X = 71.3 ; Y = 65.8 and Radius, 16.7

Factor of Safety
*** 1.295 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	69.95	50.00
2	74.92	49.44
3	79.83	50.38
4	84.24	52.73
5	87.76	56.29
6	89.17	59.00

Circle Center At X = 74.3 ; Y = 65.8 and Radius, 16.3

Factor of Safety
*** 1.306 ***

1

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	63.63	50.00
2	68.61	49.48
3	73.60	49.69
4	78.51	50.62
5	83.24	52.25
6	87.68	54.55
7	91.74	57.47
8	93.33	59.00

Circle Center At X = 69.7 ; Y = 83.5 and Radius, 34.1

Factor of Safety
*** 1.314 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	71.21	50.61
2	76.18	51.17
3	80.92	52.76
4	85.22	55.31
5	88.89	58.71
6	89.09	59.00

Circle Center At X = 71.1 ; Y = 74.1 and Radius, 23.5

Factor of Safety
*** 1.336 ***

**** END OF GSTABL7 OUTPUT ****

APPENDIX D

RESPONSE TO CALTRANS REVIEW COMMENTS

1220 Research Drive
Suite B
Redlands, CA 92374
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f| 909.792.1704
kleinfelder.com

June 12, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, California 92408

Subject: Response to Caltrans Review Comments (Dated March 11, 2009)
Final Structural Foundation Report (Dated February 16, 2009)
Proposed Westbound and Eastbound SR-60 HOV Connectors
Bridge Nos. 56-0841 and 56-0842
I-215/SR-60 East Junction Improvement Project
Riverside County, California
08-Riv-60/215, KP 19.4/21.5, 61.7/62.6
Caltrans EA No. 08-449311

Dear Mr. Suydam:

Kleinfelder has prepared this letter in response to comments provided by the California Department of Transportation (Caltrans), Division of Engineering Services, Office of Geotechnical Design South-2, pertaining to their review of our report entitled Final *Structural Foundation Report, Proposed Eastbound and Westbound SR60 HOV Connectors, I-215/SR-60 East Junction Improvement Project, Riverside County, California,* dated February 16, 2009. Caltrans has requested responses and resolutions on fourteen comments (Comments 1 through 14). The Caltrans review comments and our responses to these comments are presented below:

Comment No. 1. *Response to comment #10: Last sentence states that "For design purposes, the soil parameters used for the bedrock within our exploratory depths are assumed for materials beneath our exploratory boring depths."*

Evidently the choice of drilling equipment did not allow for the needed penetration into rock. Since some borings were not sufficiently deep, assumptions had to be made about deeper layers favoring a conservative design. This may result in a higher potential for assertion of differing site conditions by the contractor, not to mention substantially higher cost for deeper piles. The cost of having deeper borings may significantly lower. The contractor must be warned of the possibility that the layers below the bottom of the boring may be more difficult to drill than what is shown on the LOTB's.

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Also since the borings are not deep enough, can any additional nearby boring be included, to provide more clarification about the subsurface conditions close to the proposed foundations.

Response to Comment No. 1. The deepest boring performed near the proposed bents is A-07-006 was drilled to elevation 440.61 meters which is lower than the specified tip elevations. In our opinion, drilling additional borings is not necessary.

Comment No. 2. *The report expresses that end bearing is calculated in determining the axial capacity of the CIDH piles at the bents. The potential for anomalies are much higher at CIDH pile tips, located below the ground water. Also skin friction and end bearing resistances develop at different rates in relation to the extent of the pile movement. Therefore, Caltrans often does not count on the resistance from the pile's tip or the sides up to a pile diameter near the tip, in determining its axial capacities in similar circumstances. Please consider if inclusion of the pile tip resistance is appropriate in this case.*

Response to Comment No. 2. According to chart of "Load Transfer in End Bearing Versus Settlement for Drilled Shafts in Cohesionless Soil developed by Reese and O-Neill (1988), inclusion of a fraction of ultimate pile end bearing resistance on bedrock is appropriate in the evaluation of axial pile capacity of proposed 2.44-m diameter CIDH pile proportional to pile tip settlement.

Comment No. 3. *Sand layers are assumed for calculations; even where slightly to moderately weathered rock is encountered. Please specify your reasons, as this can result in a conservative design with lower pile tip elevations and higher costs. Design methods using intermediate geomaterial (IGM) properties may be more appropriate.*

Response to Comment No. 3. The underlying bedrock material was modeled as very dense sand with a friction angle of 40 degrees. In our opinion, this assumed strength parameter for the granitic bedrock is reasonable and appropriate for design.

Comment No. 4. *Minor comments: Title refers to EB & then WB but uses the reverse order for the bridge numbers, and the opening is too small for the title.*

Response to Comment No. 4. The comment is acknowledged. The order of the bridge numbers has been corrected in the final report.

Comment No. 5. *KP is shown, which indicates this project is using metric exception. To help the reader, it would be helpful to include info & approval regarding this issue in the report.*

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Response to Comment No. 5. The comment is acknowledged. The metric exception approval information is attached herein.

Comment No. 6. *Minor: The memo refers to Caltrans' comments dated 4/17/08, but appendix B shows the date of comments as 12/19/08. However, the 4/17/08 date seems to be a typo.*

Response to Comment No. 6. The comment is acknowledged. The typo has been corrected in the final report.

Comment No. 7. *The report format includes some variations from the format provided in Caltrans' 'Guidelines for Structures Foundation Reports' (GSFR) dated March 2006. Following that format may allow for easier verification that all subjects/issues have been properly considered (please also see comments about the plates and appendices).*

Response to Comment No. 7. The comment is acknowledged. We believe that our report was prepared in general accordance with the Caltrans GSFR dated March 2006.

Comment No. 8. *Please include info about soil density.*

Response to Comment No. 8. The alluvial soils encountered in the borings are generally medium dense to very dense with several interbedded layers of loose soils (see Section 5.1.2 of our final report).

Comment No. 9. *Last sentence mentions that the rock becomes less weathered with depth. Can you please elaborate/be more specific.*

Response to Comment No. 9. Weathering is the process of decomposition that takes place in rocks and minerals at or near the surface of the earth in response to physical, chemical, and biological changes, and therefore, generally decreases with depth.

Comment No. 10. *Last paragraph refers to soil type C. Since your borings identify the density of some of the soil as medium dense to even very loose, please include your reasons for reaching this conclusion in the report.*

Response to Comment No. 10. A Soil Profile Type C is evaluated for the bridge site considering all the earth materials encountered in the borings in the upper 30 meters, including the igneous granitic rock.

Comment No. 11. *Is the LRFD procedure being used? Please specify in the report. The info provided in the report and attached plans do not seem to conform to the ASSHTO & Caltrans procedures for LRFD.*

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Response to Comment No. 11. We understand that the bridge abutment piles are designed using Working Stress Design (WSD) method and the bridge bent piles are designed using Load Resistance Factor Design (LRFD) method. The retaining wall piles are designed using Load Factor Design (LFD) method.

Comment No. 12. *400-mm diameter CIDH piles are mentioned for the retaining walls. The retaining walls will be in a separate report, but we like to use this opportunity as a reminder of Caltrans' policy of avoiding CIDH piles smaller than 600-mm, if groundwater is anticipated.*

Response to Comment No. 12. Pile end bearing is ignored in the evaluation of axial pile capacities of 400-mm and 600-mm CIDH piles due to groundwater.

Comment No. 13. *Minor. The first sentence in the last paragraph refers to plates A2-A8 at the end of this appendix. However; in the FR copy being reviewed the plates are included in Appendix B, titled 'Laboratory Testing' in the table of contents.*

Response to Comment No. 13. The comment is acknowledged. The missing plates were misplaced accidentally in the copy reviewed by Caltrans.

Comment No. 14. *Some of the Legend sheets refer to the Soil & Rock Logging, Classification, and Presentation Manual (SRLCPM) dated June 2007. However, the LOTB sheets seem to include numerous deviations from the 6/07 Manual, and a few errors. Some of the many examples include soil and rock descriptors (i.e.-rock recovery and RQD), borehole ID, hammer efficiency, notes, vertical datum, nearest cities, data that is not described in the legend, termination elevation for boring HV-7 & HV-2,…etc.*

Please perform a thorough quality control. Please also refer to comment #9 from Caltrans' dated 12/19/08. The response states that the report will be revised accordingly and a hand written reference is made to an e-mail regarding Caltrans' CADD standards. The requested revisions are not reflected in the re-submitted report, and the original comments were not intended to be about the CADD standards but the SRLCPM.

Response to Comment No. 14. We agree with Caltrans on this comment. We revised our LOTB sheet based on Caltrans Soil and Rock Logging, Classification, and Presentation Manual (CSRLCPM), dated June 2007. Some of the changes made to LOTB sheet include:

- Borehole ID's.
- Names of nearest cities on plan.
- Vertical scale for profile.
- Soil descriptions.
- Rock descriptions.

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- Representation of groundwater surface elevation.
- Hammer energy ratio.
- Note indicating the LOTB sheet is prepared in accordance with CSRLCPM.

However, Bedding Spacing, Fracture Density, Core Recovery (REC), and Rock Quality Designation (RQD) are not shown on the logs. These descriptions are only possible when rock coring is performed. Rock coring was not performed for the current project. Subsurface exploration only consisted of California (Modified) and Standard Penetration Test (SPT) samples in soil and bedrock materials.

CLOSURE

The information contained in this letter/report is subject to the conditions and limitations contained within the structures foundation report. We appreciate the opportunity to be of service on this project. If you have any questions, comments or require additional information, please do not hesitate to contact our office at your convenience.

Respectfully submitted,

KLEINFELDER WEST, INC.

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

Richard F. Escandon, PG, CEG
Principal Geologist/Project Manager

MC/CVA:lg

Attachment: OSFP Review Comment & Response Form

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I215/SR 60 East Junction
Eastbound and Westbound SR60 HOV Connectors
Bridge No. 56-0842
Bridge No. 56-0841

REVIEWER: Asef Wardak
DATE: December 19, 2008

COMMENTS RESOLUTION FORM

RESPONDER:_____
DATE: _____

DOCUMENT NAME AND DATE: Foundation Report, November 12, 2008, General Plan (November 4, 2008), Foundation plan (November 4, 2008), details sheets (July 21 through November 4, 2008), and Log of Test Boring (November 4, 2008).

COMMENT NUMBER	PAGE NO.	CRITERIA / REPORT /DRAWING NO./ SPECIFICATION	COMMENT (Do not address more than one discipline per sheet)	RESPONSE	ACTION CODE
1	Cover Sheet	Plans and Foundation Report, (FR)	Please review and revise as necessary the project Expenditure Authorization (EA) number. The EA number generally consists of the district's 2-digit number in which the bridge is located, and then followed by the projects six digit numbers (or combination of numbers and alphabet characters). Please provide structure (Bridge) number on cover sheet.		
2	3	FR 3 Appendix A A-1	Five (HV-1 through HV-5) drilled and logged exploratory soil borings are attached to the submitted foundation report instead of 8 (HV-1 through HV-8), three (3) of the drilled and logging exploratory soil borings are missing. Please include all the of the drilled and logged exploratory soil borings to the foundation report.		
3	11	Table 1 FR	The attached Log of Test Borings (LOTB) are drilled shallow than 30 meter (100 feet) to determine the soil profile type. The soil profile types shall be established through properly substantiated geotechnical data for the upper 30 meters (100 feet) of subsurface investigations. Therefore, please revise or explain the provincial geology at the jobsite.		

ACTION CODES: A – Designer agrees and will comply/take action.
B – Designer will investigate and comment.
C – Disagree for reasons noted, discussion may be required.

NOTES: ( ) Indicates paraphrasing of original comment.
.... Indicates unreadable comment

I215/SR 60 East Junction
Eastbound and Westbound SR60 HOV Connectors
Bridge No. 56-0842
Bridge No. 56-0841

REVIEWER: Asef Wardak
DATE: December 19, 2008

COMMENTS RESOLUTION FORM

RESPONDER:_____
DATE: _____

DOCUMENT NAME AND DATE: Foundation Report, November 12, 2008, General Plan (November 4, 2008), Foundation plan (November 4, 2008), details sheets (July 21 through November 4, 2008), and Log of Test Boring (November 4, 2008).

4	11	FR General (SP) or Foundation Plan (GP)	The standard acceleration response spectra (ARS) curve should be placed on one of the General, Foundation plans or other details sheets.		
5	16	FR 6.3	Per Caltrans' policy retaining wall(s) should have a separate foundation report. Please submit a separate foundation report for the proposed retaining wall(s).		
6	17	FR 6.4	Please provide calculation and soil parameters used for the evaluation of Lateral Earth Pressures.		
7	24	FR 7.2, 7.3	Please explain in the foundation report the installation effects of the recommended Cast-IN-Drilled-Hold (CIDH) on the existing structures.		
8	Appe-ndix.B Appe-ndix. C-2	Table B-1	Laboratory testing (Appendix B), the soil strength parameters (Table B-1) have not used in engineering analyses shows (Appendix C-2). However, the soil strength parameters used in engineering analyses are reasonable values in geotechnical practice, but the differences should be stated and explained in the geotechnical design report.		
9	LOTB	Log of Test Borings (LOTB)	The attached LOTBs do not meet Caltrans' requirements for Soil & Rock Logging Classification and Presentation Manual (June 2007). Caltrans LOTB shall be consistent with Caltrans Guidelines for Structures		

ACTION CODES: A – Designer agrees and will comply/take action.
B – Designer will investigate and comment.
C – Disagree for reasons noted, discussion may be required.

NOTES: ( ) Indicates paraphrasing of original comment.
.... Indicates unreadable comment

I215/SR 60 East Junction
Eastbound and Westbound SR60 HOV Connectors
Bridge No. 56-0842
Bridge No. 56-0841

REVIEWER: Asef Wardak
DATE: December 19, 2008

COMMENTS RESOLUTION FORM

RESPONDER:_____
DATE: _____

DOCUMENT NAME AND DATE: Foundation Report, November 12, 2008, General Plan (November 4, 2008), Foundation plan (November 4, 2008), details sheets (July 21 through November 4, 2008), and Log of Test Boring (November 4, 2008).

			Foundation Reports, and can be found at following website. http://www.dot.ca.gov/hq/esc/geotech/requests/logging_manual/logging_manual.html		
10	Foun-dation Plan	Pile Data Table East Bound	The attached Log of Test Boring drilled in March, 2007 are shallow than design specified tip elevations shown in pile data tables for East and West bounds connectors, except boring HV-2, which is far away from the proposed support locations. Please revised the design specified tip elevations or explain and clarify.		
11	11	Additional	It is our recommendations to provide one complete foundation report per each structure.		

ACTION CODES: A – Designer agrees and will comply/take action.
B – Designer will investigate and comment.
C – Disagree for reasons noted, discussion may be required.

NOTES: ( ) Indicates paraphrasing of original comment.
.... Indicates unreadable comment

OSFP Review Comment & Response Form

General Project Information	Review Phase		Reviewer Information
Dist: 08 EA: 449311 08-RIV- 215 / 60 KP 61.7/62.6, 19.4/21.5 215/60 E. Junction Improv. Proj. OSFP Liaison: Robert Zezoff Phone: 916-227-8892 e-mail: Robert_Zezoff@dot.ca.gov	☐ PSR/PDS (Review No. _) ☐ APS/PSR (Review No. 1) ☐ APS/PR (Review No. 2) ☐ Type Selection	☐ 65% PS&E Unchecked Details ☐ PS&E (Review No. _) ☐ Construction Support ☐ Other: FR Review	Reviewer Names: Farzad Qmehr & Asef Wardak Functional Unit: Geotech. Design South-2 Phone Number: 227-4519 & 227-1219 e-mail: Farzad_Qmehr@dot.ca.gov & Asef_Wardak@dot.ca.gov Date of Review: 3/11/09
	Structure Information (Use when necessary to document comments by individual structure) Structure Name: WB/EB SR 60 HOV Connectors (New) Br No: Br. 56-0841 & 56-0842		

Consultant Information (to be filled in by Consultant)				
Consultant Structure Lead (First and Last Name)	Structure Consultant Firm	Phone Number	e-mail	Response Date

#	Doc. See Note 1	Section #	Section Name	Review Comments	Consultant Responses	✓
1 fq	FR	Appndx D	Response to Comments	**The first three comments are placed out of order, for the purpose of emphasis.** Response to comment #10: Last sentence states that "For design purposes, the soil parameters used for the bedrock within our exploratory depths are assumed for materials beneath our exploratory boring depths." **Evidently the choice of drilling equipment did not allow for the needed penetration into rock. Since some borings were not sufficiently deep, assumptions had to be made about deeper layers favoring a conservative design. This may result in a higher potential for assertion of differing site conditions by the contractor, not to mention substantially higher cost for deeper piles. The cost of having deeper borings may be significantly lower. The contractor must be warned of the possibility that the layers below the bottom of the boring may be more difficult to drill than what is shown on the LOTBs.** Also since the borings are not deep enough, can any additional		

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
P=Structure Plans	SP=Special Provisions	FR=Foundation Rpt	DC=Design Calcs	TS=Type Sel. Report	QCC=Quant. Check Calcs
RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	PFR= Preliminary Foundation Report

✓= Comment Resolved (for Reviewer's use)

				nearby borings be included, to provide more clarification about the subsurface conditions close to the proposed foundations?		
2 fq	FR	6.2.2	Axial Pile Capacity	The report expresses that end bearing is included in determining the axial capacity of the CIDH piles at the bents. The potential for anomalies are much higher at CIDH pile tips, located below the ground water. Also skin friction and end bearing resistances develop at different rates in relation to the extent of the pile movement. Therefore, Caltrans often does not count on the resistance from the pile's tip or the sides up to a pile diameter near the tip, in determining its axial capacities in similar circumstances. Please consider if inclusion of the pile tip resistance is appropriate in this case.		
3 fq	FR	Appndx C	Engineering Analysis	Sand layers are assumed for calculations; even where slightly to moderately weathered rock is encountered. Please specify your reasons, as this can result in a conservative design with lower pile tip elevations and higher costs. Design methods using intermediate geomaterial (IGM) properties may be more appropriate.		
4 fq	FR	N/A	Cover sheet	Minor comments: Title refers to EB & then WB but uses the reverse order for the bridge numbers, and the opening is too small for the title.		
5 fq	FR	N/A	Cover sheet	KP is shown, which indicates this project is using a metric exception. To help the reader, it would be helpful to include info & approval regarding this issue in the report.		
6 fq	FR	N/A	Transmittal Memo	Minor: The memo refers to Caltrans' comments dated 4/17/08, but appendix B shows the date of comments as 12/19/08. However, the 4/17/08 date seems to only be a typo.		
7 fq	FR	N/A	N/A	The report format includes some variations from the format provided in Caltrans' 'Guidelines for Structures Foundation Reports' (GSFR) dated March 20063. Following that format may allow for easier verification that all subjects/issues have been properly considered (please also see comments about the plates and appendices).		
8 fq	FR	5.1.1	Undoc. Artificial Fill	Please include info about soil density.		

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
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RP=Road Plans	E=Estimate	H=Hydraulics Rpt	CC=Check Calcs	QC=Quant. Calcs	PFR= Preliminary Foundation Report

✓= Comment Resolved (for Reviewer's use)

9 fq	FR	5.1.3	Granitic Bedrock	Last sentence mentions that the rock becomes less weathered with depth. Can you please elaborate / be more specific.		
10 fq	FR	6.1.2	Seismic Shaking	Last paragraph refers to soil type C. Since your borings identify the density of some of the soil as medium dense to even very loose, please include your reasons for reaching this conclusion in the report.		
11 fq	FR	6.2	Bridge Foundation Design	Is the LRFD procedure being used? Please specify in the report. The info provided in the report and attached plans do not seem to conform to the ASSHTO & Caltrans procedures for LRFD.		
12 fq	FR	6.2.2	Axial Pile Capacity	400-mm CIDH piles are mentioned for the proposed retaining walls. The retaining walls will be in a separate report, but we like to use this opportunity as a reminder of Caltrans' policy of avoiding CIDH piles smaller than 600-mm, if groundwater is anticipated.		
13 fq	FR	N/A	Appendix A – Field Exploration	Minor, The first sentence in the last paragraph refers to plates A2-A8 at the end of this appendix. However; in the FR copy being reviewed the plates are included in Appendix B, titled 'Laboratory Testing' in the table of contents.		
14 fq	FR	Plates 4a-4m	LOTB Sheets	Some of the Legend sheets refer to the Soil & Rock Logging, Classification, and Presentation Manual (SRLCPM) dated June 2007. However The LOTB sheets seem to include numerous deviations from the 6/07 Manual, and a few errors. Some of the many examples include soil and rock descriptors (i.e.- rock recovery and RQD), borehole ID, hammer efficiency, notes, vertical datum, nearest cities, data that is not described in the legend, termination elevation for boring HV-7 & HV-2, … etc. Please perform a thorough quality control. Please also refer to comment #9 from Caltrans' dated 12/19/08. The response states that the report will be revised accordingly and a hand written reference is made to an email regarding Caltrans' CADD standards. The requested revisions are not reflected in the re-submitted report, and the original comments were not intended to be about the CADD standards but the SRLCPM.		

Note 1: Abbreviations for Typical Documents (if Abbr. is not below, type in the document type)					
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✓= Comment Resolved (for Reviewer's use)

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May 12, 2009
Project No. 76979

Mr. Norman Suydam, PE
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

via Electronic Mail
Norm.Suydam@lanengineering.com
Nisa.Hester@lanengineering.com
Robert.Wong@lanengineering.com
Ed.ng@lanengineering.com

Subject: Addendum No. 3 to Final Geotechnical Design Report
Proposed 1350-mm and 450-mm Diameter Jacked Drainage Pipes
Interstate 215/State Route 60 East Junction Improvements
Riverside and Moreno Valley, California
08-RIV-215/60, KP 60.7/70.6, 22.0/18.5
Caltrans EA No. 449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) is pleased to submit this addendum report to provide supplemental geotechnical design recommendations pertaining to the proposed 1350-mm and 450-mm diameter jacked reinforced concrete pipes, to be located across Interstate 215 northbound (I-215) and State Route 60 (SR-60) westbound, in the City of Moreno Valley, California.

Our understanding of this project is based on discussions with you and review of draft cross-section drawings you provided to us and previous Final Geotechnical Design Report (GDR) prepared by Kleinfelder for this project, dated January 9, 2009. The Final GDR has been reviewed and approved by Caltrans.

1.0 PROJECT DESCRIPTION

Two 450-mm diameter and one 1350-mm diameter reinforced concrete drainage pipes will be installed across the existing I-215 northbound and SR-60 westbound (depicted on Plates 1a and 1b, *Exploration Location Map)*.

Based on our discussions with LAN Engineering, the reinforced concrete drainage pipes are proposed to be constructed using pipe jacking methods (see summary in Table 1).

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Table 1
Summary of Jacked Reinforced Concrete Pipes

Drainage System Number	Reinforced Concrete Pipe Dimensions		Approximate Flow Line (FL) Elevations (meters)
	Diameter (mm)	Length (meters)	
12 (Element 'c')	450	17.1	458.2 to 457.9
16 (Elements 'a' and 'c')	450	20.4 (Element 'a') 33.5 (Element 'c')	456.1 to 455.7 (Element 'a') 456.8 to 456.1 (Element 'c')
23 (Element 'c')	1350	34.4	458.9 to 458.1

Ground cover ranges from approximately 1.5 to 2 meters over the top of the proposed jacked pipes at Drainage System No. 12 (Element 'c') and Drainage System No. 23 (Element 'c'). Ground cover over the top of the proposed jacked pipe at Drainage System No. 16 (Elements 'a' and 'c') is approximately 3 meters.

2.0 DESIGN AND CONSTRUCTION OF THE JACKED PIPE/TUNNEL SECTION

The following section provides our recommendations for design and construction of the proposed jacked drainage pipes. The selection of the method of construction for the drainage pipe should be provided by the contractor. We recommend that the contractor's actual method of construction be reviewed by the geotechnical engineer prior to construction to evaluate if the installation method is consistent with the design assumptions. The method of excavation and support is ultimately left to the contractor with guidance and specifications provided by the designer and owner. The pipe jacking operations should be performed only by contractors who are highly experienced in this type of construction under the anticipated conditions, and under strict construction monitoring and quality control.

2.1 Anticipated Ground Conditions

We reviewed the subsurface data from previously drilled Kleinfelder borings BS-2, BD-3, BD-4, HV-11, HV-12, and HV-13 (see Plates 1a and 1b). These borings are located in the vicinity of the proposed pipeline alignment. The relevant boring data, obtained from the Final GDR, are provided in Appendix A of this report for reference purposes.

All the above mentioned borings, except HV-13, encountered fill material to the depths ranging from approximately 1 to 5 meters below ground surface, corresponding to elevations ranging from 464 meters to 450 meters above Mean Sea Level (MSL). All the borings in the vicinity of the proposed jacked pipes encountered alluvial soils at elevations ranging from approximately 466 meters to 446 meters above MSL. Borings BS-2 and BD-4 encountered granitic bedrock at elevations ranging from 451 to 442

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meters above MSL. Based on the boring data and the flow line elevations of the proposed borings, medium dense to very dense granular alluvial and fill soils are anticipated at the tunnel depths. Based on the depth to bedrock in the borings drilled, bedrock is not anticipated to be encountered within the invert elevations of the pipe.

Groundwater was also encountered in boring BD-4 at a depth of 448 meters above MSL. In our opinion, groundwater is not anticipated to be encountered within the invert elevations of the pipe. Groundwater levels may fluctuate due to seasonal variation, nearby construction, and numerous other man-made and natural influences.

2.2 Anticipated Ground Construction and Behavior

This section presents the anticipated ground behavior for the ground conditions anticipated along the alignments. We anticipate the reinforced concrete pipes will be constructed using jack and bore or micro tunneling methods. Due to the low ground cover and the relatively small diameter of the pipes, we do not anticipate other tunneling methods such as digger tunneling shields or hand mining will be used. However, as stated in the preceding sections, the method of construction for the drainage pipe is ultimately the responsibility of the contractor.

2.3 Soft-Ground Conditions

Based on the anticipated alluvial soils within the pipe zone, “soft ground” conditions are anticipated for the majority of the pipe excavation. Soft-ground behavior is described in terms of the “Tunnelman’s Ground Classification System”, first described by Terzaghi (1950) and later modified by Heuer (1974). The Tunnelman’s ground classification for soft ground is presented in Table 2, below.

Table 2
Tunnelman’s Ground Classification System for Soft Ground

CLASSIFICATION	BEHAVIOR	TYPICAL SOIL TYPES
Firm	Heading can be advanced without initial support. Final lining can be constructed before ground starts to move.	Loess above the water table, hard clay, marl, cemented sand and gravel when not highly overstressed.
Raveling - Slow Raveling - Fast Raveling	Chunks or flakes of materials begin to drop out of the arch or walls sometime after the ground has been exposed due to loosening, over-stress and "brittle" fracture. In fast raveling ground, the process starts within a few minutes, otherwise the ground is slow raveling.	Residual soils or sand with small amounts of binder may be fast raveling below the water table, slow raveling above. Stiff fissured clay may be slow or fast raveling depending upon degree of overstress.

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CLASSIFICATION	BEHAVIOR	TYPICAL SOIL TYPES
Squeezing	Ground squeezes or extrudes plastically into tunnel, without visible fracturing or loss of continuity, and without perceptible increases in water content. Ductile, plastic yield and flow due to overstress.	Ground with low frictional strength. Rate of squeeze depends on degree of overstress. Occurs at shallow to medium depth in clay of very soft to medium consistency. Stiff to hard clay under high cover may move in combination with raveling at execution surface and squeezing at depth behind face.
Running	Granular materials without cohesion are unstable at a slope greater than their angle of repose (approx. 30 - 35 degrees). When exposed at steep slopes they run like granulated sugar or dune sand until the slope flattens to the angle of repose.	Clean, dry granular materials, apparent cohesion in moist sand, or weak cementation in any granular soil, may allow the material to stand for a brief period of raveling before it breaks down and runs. Such behavior is cohesive running.
Flowing	A mixture of soil and water flows into the tunnel like a viscous fluid. The material can enter the tunnel from the invert as well as from the face, crown, and wall, and can flow for great distances, completely filling the tunnel in some cases.	Below the water table in silt, sand, or gravel without enough clay content to give significant cohesion and plasticity and may also occur in highly sensitive clay when such material is disturbed.
Swelling	Ground absorbs water, increases in volume, and expands slowly into the tunnel.	Highly preconsolidated clay with plasticity index in excess of about 30, generally containing significant percentages of montmorillonite.

Along most portions of the jacked pipes, we anticipate slow to fast raveling ground conditions for the granular soils in the tunnel crown, with slow raveling anticipated where medium dense to very dense soils are encountered, and fast raveling, locally, where loose sands and/or gravels are encountered. Local running ground conditions could occur where isolated lenses or pockets of clean, dry, cohesionless sands and gravels are encountered. Firm ground conditions are anticipated locally where stiff to very stiff fine-grained soils are encountered.

2.4 Initial Ground Support Systems and Anticipated Excavation Method

The anticipated systems for jacked pipe support include steel casing, or reinforced concrete pipe, which is jacked or advanced directly into place. The support systems for tunneling should be designed to withstand jacking forces and the applicable ground and surcharge loads at depth.

Based on the anticipated soil conditions, we anticipate excavation methods may employ jack and bore hole or micro tunneling excavation methods for the proposed trenchless alignment. Although, we anticipate the contactor may choose one of these methods, the method of excavation and tunnel support is left to the contractor.

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2.5 Pipe Jacking and Pipe Jacking Forces

Frictional resistance should be considered for jacked, pit-launched methods of trenchless installations. The actual jacking friction will depend on several factors including, but not limited to soil properties, overcut, lubrication, misalignment, steering correction. The contractor should consider these factors when assessing jacking forces. Jacking forces can be resisted by passive earth pressures from the shaft wall as determined by the contractor's engineer.

2.6 Muck Disposal

Muck (excavated soil) disposal from tunnel and launching pit excavations should be removed from the site and properly disposed of at an acceptable location. Muck, either processed or unprocessed, may also be used as backfill provided it meets the specification requirements. Bentonite slurry, if used, should be disposed of in accordance with local and state regulations. Muck and slurry disposal are the responsibility of the contractor.

2.7 Pressure Grouting of Annular Space

After installation of the pipe, the annular space around the pipe should be pressure grouted under the observation of the geotechnical engineer. The volume of the required grout should be checked during placement. In addition, the portion of the launching pit below the invert level of the pipeline should be backfilled with structural concrete prior to installation of the remainder of the pipe.

2.8 Launching Pit Construction

2.8.1 Geometry

The launching pits should accommodate all ancillary tunneling equipment such as the jacking frame, the jacking unit, at least one length of steel casing, and/or carrier pipe, and the thrust block. With some construction techniques, the launching pit need only accommodate the tunneling equipment and/or ancillary tunnel support equipment.

2.8.2 Design of Lateral Support Systems for the Launching and Receiving Pits

Design of the temporary support system for the launching and receiving pits is the responsibility of the contractor. The design should be performed by a California Registered Civil Engineer who is retained by the contractor. Furthermore, the contractor, through his or her engineer is responsible for defining the final design parameters used for temporary shoring. The excavation should be designed and constructed in accordance with OSHA and other applicable federal, state, and local requirements.

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2.8.3 Anticipated Shoring Types

The following construction methods may be suitable for the launching and receiving pits:

- Soldier Piles and Steel Plate Lagging. A soldier-pile-and-steel-plate system is considered suitable for the anticipated ground conditions. Pre-drilled auger holes within the alluvial soils may have to be cased to prevent caving during drilling. Voids created behind the walls during construction should be backfilled with granular material to prevent surface settlement and damage to utilities and structures in the immediate vicinity.

- Liner Plate. Liner plate shoring systems might be used for the launching pit construction. The excavation should proceed only in a "top-down" construction sequence. Excavation of the shaft should only slightly exceed the width of the liner plate, followed closely by the liner plate installation. The space between the liner plate and the ground should be grouted or backfilled with lean concrete at the end of the day, or more frequently, if necessary, for shaft stability.

2.9 Shaft Breakout

Alluvial soils will be encountered at the tunnel elevation and ground reinforcement may be necessary at the tunnel breakout. Depending of the type of shaft lining chosen by the contractor, pre-support prior to breakout may be required immediately outside of the shaft for stabilization. Ground reinforcement may include, but are not limited to, grouting, drilled spiling, or other suitable methods designed by the contractor. Additional structural members will likely be required in the shoring system at the breakout area.

2.10 Ground Settlement Monitoring

Ground losses (settlement) may occur as a result of soil movement in front of the excavation by means of raveling, caving, loose running, or flowing ground, or may also occur as a result of soil movement around the tunneling equipment. Ground losses may also occur as the result of soil movement downward toward the support system (casing). We recommend that the ground surface and other vital structures (utilities, roadways, etc.) be monitored for settlement and signs of distress prior to, during and following tunnel operations.

The contractor should have an onsite means of immediately controlling potential caving or other ground loss conditions that may occur in order to prevent any damage to utilities or roadway above the tunneling operations. Additionally, the contractor should provide for construction techniques to control raveling, and loose running conditions through proper equipment and installation selection and ground improvement techniques, such as pressure grouting, if required.

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2.11 Cal-OSHA Gas Classification

Prior to initiating construction of a tunnel in the State of California, the Division of Occupational Safety and Health (OSH), Mining and Tunneling Unit of the Department of Industrial Relations is required to make a review and classification of the proposed tunnel ground conditions with respect to the presence of flammable gas or vapors. This classification should be included in the contract documents.

2.12 Construction Monitoring/Resident Engineering

Variation in the subsurface conditions may likely be encountered during construction. To proactively manage the construction risk associated with the difference that may exist between the geotechnical data contained in this report and the actual conditions encountered during tunnel excavation, and to provide periodic observation for the purpose of conformance with the plans and specifications, it is recommended that a tunneling consultant be retained to provide technical monitoring of the construction operations.

3.0 LIMITATIONS

This addendum report has been prepared for the exclusive use of Lim & Nascimento Engineering Corporation, Riverside County Transportation Commission (RCTC), and Caltrans for specific application to the project. The findings, conclusions, and recommendations presented in this report were prepared in a manner consistent with the standards of care and skill ordinarily exercised by members of its profession practicing under similar conditions in the geographic vicinity and at the time the services will be performed. No warranty or guarantee, express or implied, is made.

The client has the responsibility to see that all parties to the project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. This report contains information, which may be useful in the preparation of contract specifications. However, the report is not designed as a specification document and may not contain sufficient information for this use without proper modification.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on-site and off-site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report for an adjacent or nearby project shall notify Kleinfelder of such intended use. Based on the intended use of this report and the nature of the new project, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

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The scope of our geotechnical services did not include any environmental site assessment for the presence or absence of hazardous/toxic materials. Kleinfelder will assume no responsibility or liability whatsoever for any claim, loss of value, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project sites, or from the discovery of such hazardous materials.

We appreciate the opportunity to be of service on this project. Should you have any questions or comments concerning this letter please do not hesitate to contact the undersigned at your earliest convenience.

Respectfully submitted,
KLEINFELDER WEST, INC.

Carlos V. Amante, PE, GE
Principal Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
CARLOS V. AMANTE
No. 2724
Exp 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

Richard F. Escandon, PG, CEG
Principal Geologist

PROFESSIONAL GEOLOGIST
RICHARD F. ESCANDON
No. 1213
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Attachments: Plates 1a and 1b – Exploration Location Map
Appendix A – Previous Boring Data

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PLATES

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

REGISTERED CIVIL ENGINEER

DATE APPROVED

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 BUSINESS CENTER DR, STE 6
SAN BERNARDINO, CA 92408

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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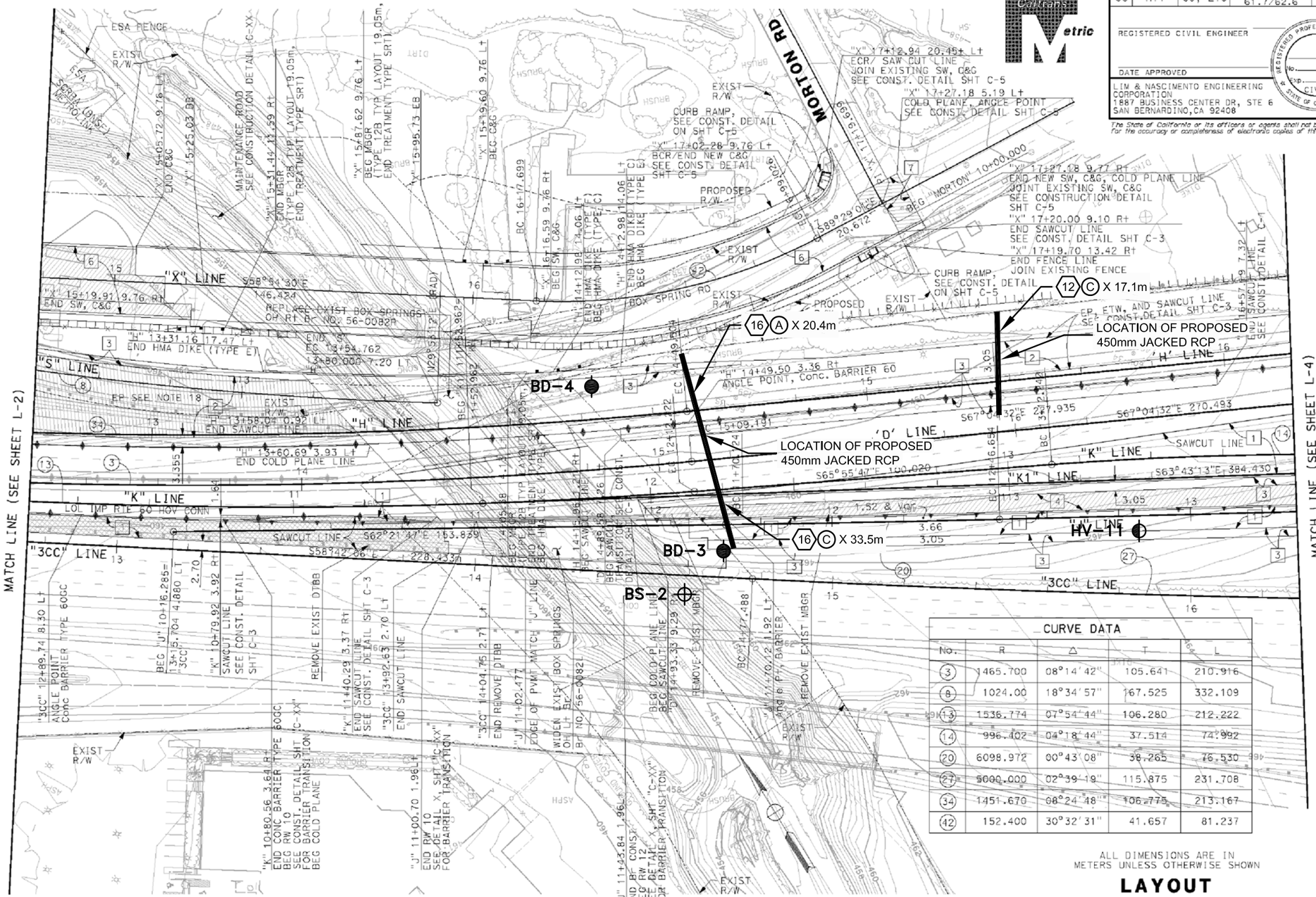
Caltrans Metric



CURVE DATA				
No.	R	Δ	T	L
3	1465.700	08°14'42"	105.641	210.916
8	1024.00	18°34'57"	167.525	332.109
13	1536.774	07°54'44"	106.280	212.222
14	996.402	04°18'44"	37.514	74.992
20	6098.972	00°43'08"	38.265	76.530
27	5000.000	02°39'19"	115.875	231.708
34	1451.670	08°24'48"	106.775	213.167
42	152.400	30°32'31"	41.657	81.237

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

LAYOUT

SCALE: 1:500

L-3

REFERENCE:

BASE MAP PROVIDED BY LAN ENIGINEERING, DATED 8/20/2008.

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EXPLANATION

HV-11	APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.
BS-2	APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.
BD-4	APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

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PROJECT NO.	76979
DRAWN:	5/08/09
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p1a.dwg

EXPLORATION LOCATION MAP

PROPOSED JACKED REINFORCED CONCRETE PIPES
I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE COUNTY, CALIFORNIA

PLATE **1a**

PLOTTED: 08 May 2009, 4:57pm, MGriffin
CAD FILE: L:\2009\CADD\76979\I-215_SR60\050809_I-215_SR60\ LAYOUT: 2a
ATTACHED IMAGES: Images: for plate 2a.tif
ATTACHED XREFS:
DIAMOND BAR, CA

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

REGISTERED CIVIL ENGINEER

DATE APPROVED

LIM & NASCIMENTO ENGINEERING CORPORATION
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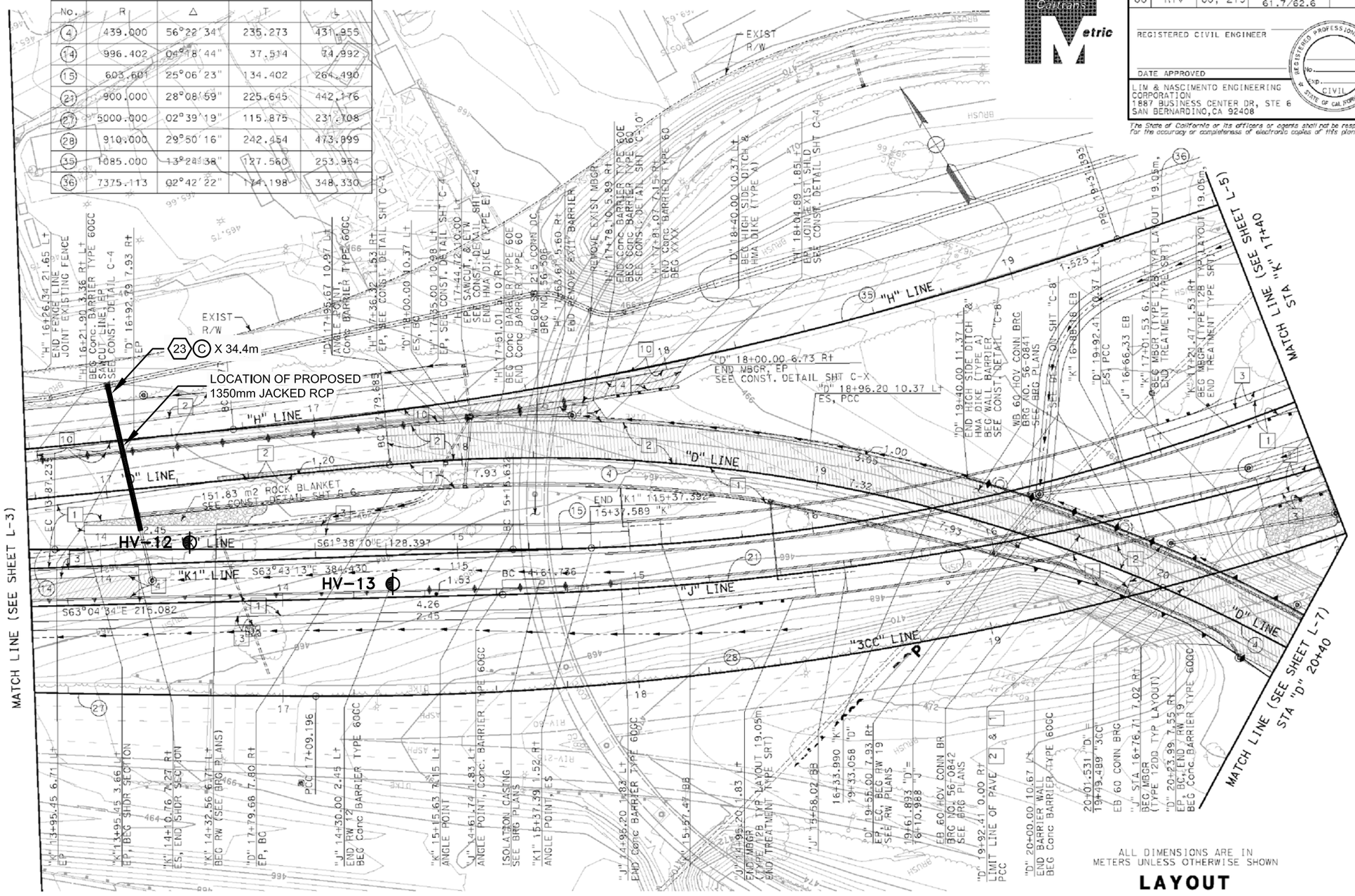
Caltrans **Metric**

CURVE DATA				
No.	R	Δ	T	L
4	439.000	56°22'34"	235.273	431.955
14	996.402	04°18'44"	37.514	74.992
15	603.601	25°06'23"	134.402	264.490
21	900.000	28°08'59"	225.645	442.176
27	5000.000	02°39'19"	115.875	231.708
28	910.000	29°50'16"	242.454	473.999
35	1085.000	13°24'38"	127.560	253.954
36	7375.113	02°42'22"	174.198	348.330



LAYOUT

SCALE: 1:500

L-4

EXPLANATION

HV-12 APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

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REFERENCE: BASE MAP PROVIDED BY LAN ENGINEERING, DATED 8/20/2008.

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PROJECT NO.	76979
DRAWN:	5/08/09
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p1b.dwg

EXPLORATION LOCATION MAP

PROPOSED JACKED REINFORCED CONCRETE PIPES
I-215/SR-60 EAST JUNCTION
RIVERSIDE, CALIFORNIA

PLATE **1b**

PLOTTED: 08 May 2009, 4:58pm, MGriffin
CAD FILE: L:\2009\CADD\76979\I-215_SR60\050809_I-215_SR60\ LAYOUT: 1b
ATTACHED IMAGES: Images: For plate 2b.tif
ATTACHED XREFS:
DIAMOND BAR, CA

APPENDIX A

PREVIOUS BORING DATA

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	ID	DESCRIPTION	MAJOR DIVISION		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Well-graded gravels, gravel-sand mixtures	FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands
		GP		Poorly-graded gravels, gravel-sand mixtures			CL		Inorganic clays of low to medium plasticity; gravelly clays silty clays,sandy clays, lean clays
		GM		Silty gravels, gravel-sand-silt mixtures			OL		Organic silts and organic silt-clays of low plasticity
		GC		Clayey gravels, gravel-sand-clay mixtures					
	SAND AND SANDY SOILS	SW		Well-graded sands, gravelly sands		SILTS AND CLAYS LL > 50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		SP		Poorly-graded sands and gravelly sands			CH		Inorganic clays of medium to high plasticity
		SM		Silty sands, sand-silt mixture			OH		Organic clays of medium to high plasticity
		SC		Clayey sands, sand-clay mixture		HIGHLY ORGANIC SOILS	Pt		Peat, muck and other highly organic soils

▼ Approximate water level observed in boring following drilling

SOIL SAMPLE

- Bulk Sample
- Drive Sample - California Sample
- Shelby Tube Sample
- Standard Penetration Test (SPT) Sample

ADDITIONAL TESTS

CN	- Consolidation
COR	- Corrosion
CP	- Collapse Potential
DS	- Direct Shear
EI	- Expansion Potential
MAX	- Maximum Dry Density
OC	- Organic Content
PI	- Plasticity Index
RV	- R-Value
SE	- Sand Equivalent
GS	- Grain Size Distribution

NOTES:

Blow counts represent the number of blows of a 64-kilogram hammer falling 760 mm required to drive a sampler through the last 300 mm of a 460 mm penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

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LEGEND TO LOGS

PLATE A-1

Date Drilled	3/7/07	Water Depth:	Not Encountered(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	453 meters
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
							Undocumented Fill			
452	1	1	6			SM	**Silty Sand:** brown, slightly moist, loose, fine to medium grained sand			
							--dark brown			
451	2	2	5				--moist	15.4	9.6	
		3								GS, COR
		4	16				--medium dense, trace clay	18.8	9.9	CN
450	3						**Alluvium**			
		5	53			SM	**Silty Sand:** olive, moist, dense, fine to medium grained sand	18.8	13.5	
449	4						--some clay			
448	5	6	78				--orange-brown, very dense, fine to coarse grained sand, coarse gravel in upper 0.3 meters of sample			
							--trace to some clay			
447	6									
		7	22, 50/10							
446	7									
							--auger bit chatter			
445	8	8	50/100				**Bedrock**: Tonalite, brown, moderately weathered, recovered as fine to coarse grained sand	16.9	7.5	
444	9									
		9	50/130				--brown, moderately to highly weathered, recovered as fine to medium grained sand			
443										

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PROJECT NO. 76979

I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

LOG OF BORING BS-2

PLATE A-3a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-CALTRANS FORMAT.GPJ KA_RDLND.GDT 5/8/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
442 11	10	26, 50/5				--light brown, slightly weathered Practical drill refusal on on bedrock at approximately 11.3 meters Boring terminated at 11.3 meters due to practical refusal. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
Box Springs Overhead Widening
Riverside, California

LOG OF BORING BS-2

PLATE A-3b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-CALTRANS FORMAT.GPJ KA_RDLND.GDT 5/8/09

Date Drilled	10/21/08	Water Depth:	Not Encountered(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	10/21/08
Drilling Method:	Mobile L-10T, 200mm HSA	Elevation:	461 meters (approx.)
Logged By:	L.Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Olive-brown, dry to slightly moist, very fine to fine grained sand, with trace fine gravel to 12.5 mm			
460	1	2	77				--slightly moist, very dense, weakly cemented, with trace fractured rock to 6 mm			
		3	27				--olive-brown to gray-brown, medium dense, weakly cemented, with trace gravel to 6 mm			
459	2						--increase in silt content			
458	3	4	42 50/75			SM	**Alluvium (Qal): Silty Sand:** Light brown to white-gray, dry to slightly moist, very dense, with trace coarse grained sand, with trace fine gravel to 6 mm	17.6	4.1	
457	4						--more coarse grained sand appeared			
		5	28			SM-SP	**Sand with Silt:** Brown, slightly moist, medium dense, fine to medium grained sand, with trace gravel to 6 mm			
456	5									
455	6	6	88			SM / ML	**Silty Sand to Sandy Silt:** Olive-brown, moist, very dense, moderately cemented, very fine to fine grained sand, with trace fine gravel to 6 mm			
454	7	13					--with trace fine gravel to 19 mm			
							--decrease in silt content			
		7	41			SM	**Silty Sand** Dark brown with mottled white and black, moist, dense, weakly to moderately cemented, with trace fractured rock to 12.5 mm, with trace fine gravel to 12.5 mm, with trace calcium carbonate			GS
453	8						--with trace coarse gravel to 25 mm, decrease in silt content			
452	9	8	46 50/75				--difficult drilling, rig chatter	19.2	11.6	DS
451							--olive-brown, very dense, fine to medium grained sand, with trace fine gravel to 6 mm, with trace clay, with			

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I-215/SR60 East Junction
Riverside, California

PLATE
A-27a

PROJECT NO. 76979

LOG OF BORING BD-3

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						weathered rock to 30 mm --difficult drilling, rig chatter --with trace gravel to 25 mm			
450 11	9	17 50/130			SP	**Sand:** Mottled brown, gray, and white, moist, very dense, fine to medium grained sand, moderately cemented, with trace fine gravel to 19 mm, with trace calcium carbonate, with trace crushed rock to 10 mm at 35 m			
449 12	10	27 50/100				--water was added due to difficult drilling, rig chatter -- red-brown with mottled black and white, fine to medium grained sand, strongly cemented, with trace calcium carbonate, with trace clay			
448 13									
447 14	11	55			SM	**Silty Sand:** Dark olive-brown, moist, very dense, fine grained sand, weakly to moderately cemented --very difficult drilling, rig chatter excessively			
						Borehole terminated at approximately 14.6 meters Refusal was encountered at approximately 14.6 meters No groundwater encountered Borehole backfilled with soil cuttings			

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PROJECT NO. 76979

I-215/SR60 East Junction
Riverside, California

LOG OF BORING BD-3

PLATE

A-27b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Date Drilled	10/21/08	Water Depth:	12 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	10/21/08
Drilling Method:	Mobile L-10T, 200mm HSA	Elevation:	460 meters (approx.)
Logged By:	L.Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Brown, dry to slightly moist, medium dense to dense, very fine to fine grained sand, with trace fine gravel to 12.5 mm			COR
459	1	2	39				--dense, very fine to fine grained sand, with fractured rock to 6 mm, with trace calcium carbonate --with trace coarse gravel to 27 mm			
458	2	3	56				--mottled black, white, and brown, slightly moist to moist, with trace calcium carbonate, with fractured rock to 60 mm in sampler with trace fine gravel to 12.5 mm	20.5	4.4	
457	3	4	13				--brown, moist, medium dense, fine grained sand, with trace fine gravel to 6 mm, with a thin layer of moderately cemented sand at approximately 3.3 meters			
456	4						--with trace fine gravel to 12.5 mm			
455	5	5	36 50/100			SM	**Alluvium (Qal): Silty Sand:** Light brwon-olive, slightly moist, very dense, moderately to strongly cemented, fine grained sand, with trace fine gravel to 6 mm, increase in silt content			
454	6	6	48				--dense, weakly cemented, very fine to fine grained sand, with trace coarse grained sand			
453	7						--decrease in silt content, increase in coarse grained sand content			
452	8	7	30 50/150			SP	**Sand:** Mottled white, dark brown, and dark gray, moist, very dense, with fractured rock on the top portion of the sampler to 25 mm, with 45 mm rock in the tip of the sampler, with trace of silt	19.2	8.0	
451	9						--encountered difficult drilling			
450		8	40 50/50				**Bedrock (Kt):** Tonalite, mottled white, orange brown, and gray, moist, moderately weathered, recovered as very fine to fine grained silty sand, with trace clay			

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I-215/SR60 East Junction
Riverside, California

PLATE
A-28a

PROJECT NO. 76979

LOG OF BORING BD-4

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
449 11	9	50/75				--orange-brown, moist, slightly weathered, recovered as fine grained silty sand			
448 12	10	42 50/100				--encountered groundwater at 11.9 meters --mottled white, black and brown, slightly to moderately weathered, recovered as fine to medium grained sand			
447 13									
446 14	11	50/100							
445 15	12	50/100							
						Borehole terminated at approximately 15.7 meters with refusal Groundwater was encountered at approximately 11.9 meters Borehole backfilled with soil cuttings			

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I-215/SR60 East Junction
Riverside, California

PLATE
A-28b

PROJECT NO. 76979

LOG OF BORING BD-4

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215_SR60 EAST JUNCTION_JACKED DRAINAGE PIPE.GPJ KA_RDLND.GDT 11/13/08

Date Drilled	3/7/07	Water Depth:	Not Encountered(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	463 meters
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
462	1	1, 2	73			SM	**Fill** **Silty Sand:** light brown, dry, very dense, fine to medium grained sand	20.3	6.5	
461	2	3	58			SM	**Alluvium** **Silty Sand:** light brown, dry, very dense, iron staining, trace clay and caliche			
460	3	4	38			CL-ML	**Sandy Silty Clay:** mottled olive-brown, dry, very stiff, fine grained sand, iron staining	17.6	16.8	
459	4									
458	5	5	18			SM	**Silty Sand:** gray, dry, medium dense, fine graine sand, trace clay and iron staining			
457	6	6	33				--olive, slightly moist, increased percentage of fines			

Boring terminated at 6.6 meters.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV-11

PLATE A-17

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-CALTRANS FORMAT.GPJ KA_RDLND.GDT 5/8/09

Date Drilled	3/7/07	Water Depth:	Not Encountered(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	464 meters
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
							Fill			
463	1	1, 2	43			SM	**Silty Sand:** brown, dry, dense, fine to medium grained sand, trace caliche			
462	2	3	64				--brown to dark brown, very dense	19.4	1.9	
						GP	Interbedded layer of Sandy Gravel			
							Alluvium			
461	3	4	51			SM	**Silty Sand:** brown, dry, very dense, fine to medium grained sand, trace clay and caliche			
460	4									
459	5	5	54			SP	**Sand:** light brown, slightly moist, dense, fine to medium grained, trace silt	18.0	3.2	
		7				SM	**Silty Sand:** dark brown, slightly moist, fine to medium grained sand			
458	6	6	48, 50/1[illegible]				--light brown, dry, very dense			

Boring terminated at 6.6 meters.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

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I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

PLATE A-18

PROJECT NO. 76979

LOG OF BORING HV-12

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-CALTRANS FORMAT.GPJ KA_RDLND.GDT 5/8/09

Date Drilled	3/7/07	Water Depth:	Not Encountered(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	466 meters
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
465		1 2	27			SM	**Alluvium** **Silty Sand:** brown, dry, medium dense, fine to medium grained	18.8	5.5	
464	1	3	33				--dense			
463	2									
462	3	4	77			SC-SM	**Silty Clayey Sand:** brown, slightly moist, very dense, fine to medium grained sand	20.3	5.7	
461	4	5	36			SM	**Silty Sand:**brown, dry, dense, fine to medium grained sand, trace caliche and iron staining			
460	5									
459	6	6	79				--red-brown, very dense, less silt			
							Boring terminated at 6.6 meters. Groundwater was not encountered. Hole backfilled and tamped using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR60 East Junction
WB & EB SR60 HOV Connectors
Riverside, California

LOG OF BORING HV-13

PLATE A-19

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-CALTRANS FORMAT.GPJ KA_RDLND.GDT 5/8/09

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March 23, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

via Electronic Mail
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Ed.ng@lanengineering.com

Subject: Addendum No. 1 to Final Geotechnical Design Report
Proposed Rock Slope Protection Lined Trap Channel
Interstate 215/State Route 60 East Junction Improvements
Riverside and Moreno Valley, California
08-RIV-215/60, KP 60.7/70.6, 22.0/18.5
Caltrans EA No. 449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) is pleased to submit this addendum report to provide supplemental geotechnical design recommendations pertaining to the proposed rock slope protection (rip-rap) lined trap channel at the location of the proposed Frontage Road Overhead bridge, east of the existing Metrolink railroad, in the City of Moreno Valley, California.

Our understanding of this project is based on discussions with you and review of draft cross-section drawings you provided to us and previous Final Geotechnical Design Report (GDR) prepared by Kleinfelder for this project, dated January 9, 2009. The Final GDR has been reviewed and approved by Caltrans.

1.0 PROJECT DESCRIPTION

An existing wash, located approximately 7 meters east of the existing Metrolink railroad tracks, will be reconstructed with a trap channel. The draft cross-section plans indicate the proposed open channel is trapezoidal in shape with bottom and top widths of 4.89 meters and 10.4 meters, respectively. The depth of the channel will be approximately

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1.8 meters with maximum water height of 1.5 meters. The sides of the channel are planned to have a maximum slope of 1:1.5 (Vertical:Horizontal, V:H). The side slopes and bottom of the channel will be protected with rip-rap lining.

2.0 ANTICIPATED SUBSURFACE CONDITIONS

We reviewed the subsurface data from previously drilled Kleinfelder borings KB-1, KB-2, and KB-3 for the proposed Frontage Road Overhead (see Plate 1, Exploration Location Map). All three borings were located in the vicinity of the proposed channel. The relevant boring data, obtained from the Final GDR, are provided in Appendix A of this report for reference purposes.

We anticipate that the subsurface conditions along the alignment of the proposed channel consists of loose to very dense silty sand fill (Qaf) and native alluvium (Qal) deposits underlain by Tonalite bedrock formation (Kt). Bedrock was encountered at elevations ranging from approximately 450 meters to 446 meters above Mean Sea Level (MSL). The existing ground surface elevation in the proposed channel area is approximately 450 meters above MSL. Considering the shallow bedrock depths encountered in the borings in the subject area, bedrock may be encountered within the excavation depths of the proposed channel.

Groundwater was encountered in all three borings drilled, at elevations ranging from approximately 446.5 meters to 439.5 meters above MSL. The plans also indicate that the elevation of the bottom of the channel will be approximately 446 meters above MSL. Therefore, groundwater may be encountered within the excavation depths of the proposed channel. Groundwater levels may fluctuate due to seasonal variation, nearby construction, and numerous other man-made and natural influences.

3.0 CONCLUSIONS AND RECOMMENDATIONS

3.1 General

Based on our review of existing field exploration and laboratory test data, it is our opinion that, it is geotechnically feasible to construct the proposed project as planned and described in this report, provided the recommendations presented herein are incorporated into the project design and construction.

The following sections provide our conclusions and recommendations, from a

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geotechnical engineering standpoint, for the proposed channel design and construction.

3.2 Excavations

Previously drilled Kleinfelder borings were able to advance through the required depths of excavation including the bedrock with a hollow-stem auger drill rig and with moderate effort. No overexcavation is required for the proposed channel as the channel bottom will be covered with rip-rap. In our opinion, the trench excavations for the proposed channel may be performed using conventional earth-moving equipment. However, it should be noted that during our previous field investigation, we observed boulders that are used as rip-rap for the existing wash in the project area, which may require special handling during reconstruction of the channel.

All vegetation, roots, organics, wet or soft soil, Portland Cement concrete, asphalt concrete, oversize material, etc., and deleterious materials should be removed from the excavation bottom and any material designated to be used as backfill. Stripped topsoil (less any debris) may be stockpiled and reused for landscape purposes; however, this material should not be incorporated into any engineered backfill.

Voids created by the removal of subsurface obstructions (such as oversize material, underground utilities, etc.) should have all loose (soft) soil, organic matter, and other deleterious materials removed, and be backfilled with material placed, and compacted as engineered fill in accordance with the recommendations presented in previously submitted geotechnical report. Pipes or utilities identified for removal or abandonment should be capped and reinforced by cement slurry injection, grouting, etc., as required to prevent the migration of water and potential collapse due to decay or other forces, which could cause settlement of overlying soils, pipelines, or structures.

3.3 Temporary Dewatering

A dewatering plan should be prepared for excavation and construction in the event that dewatering is required. The goal of the plan should be to identify an effective means of temporarily removing water from the trench excavation. As such, the plan should include identifying groundwater elevations relative to excavation or construction elevations, the horizontal and vertical permeability of soils needing to be dewatered, the area and volume of material needing to be dewatered, and the appropriate means to do so. Since temporary dewatering will impact and be dependent on construction methods

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and scheduling, we recommend the contractor be solely responsible for the design, installation, maintenance and performance of all temporary dewatering systems. The following suggestions are designed to aid the contractor in preparing an acceptable dewatering plan.

Prior to initiating any dewatering operations, the contractor should conduct at least the following assessments.

- Identify groundwater elevations based on information provided by local water agencies, and other information obtained independently by the contractor. Groundwater levels can fluctuate depending on rainfall, runoff conditions, or other factors. Therefore, water levels presented in this report may not be representative of those encountered at the time of construction.
- Identify specific soil types and their associated vertical and horizontal permeability.
- Identify depth of dewatering based on soil types and depth of construction.
- Identify dewatering methods suitable to soil types and excavation type and depth.

Given the type and setting of the project, the contractor may also need to accommodate for the following logistical issues.

- Discharge: Water removed from the excavations needs to be discharged remotely to avoid reinfiltration into the excavation. Water discharge should follow all local, state, and federal regulatory laws.
- Operations: Active construction and excavation sites often damage dewatering well heads, power lines, discharge lines and collection lines. As such, the final dewatering system needs to be designed and operated for this type of environment.

Depending on the depth of excavation below groundwater, soil conditions encountered along the excavation face and slope inclination, caving or sloughing of excavation slopes is possible within the vicinity of a dewatering system. Sloughing or caving of excavation slopes could endanger personnel working within or adjacent to the excavation as well as nearby equipment, structures, or other existing improvements. The contractor should be aware of the potential for caving and take appropriate precautions to ensure the safety of site personnel as well as the integrity of the excavation slopes and any existing nearby structures or other improvements.

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3.3.1 Slope Stability Analysis

Global slope stability analyses for the proposed channel slopes, with the inclination of 1.5:1 (H:V), was performed. Surficial slope stability is not a concern as the channel slopes will be lined with rip-rap. The draft cross section plans indicate the maximum height of the slopes will be approximately 1.8 meters.

Slope stability was calculated using the Modified Bishop's Method for circular slip surfaces implemented in the computer program GSTABL7 with STEDWin3.0 (Van Aller and Gregory, 2001). Our analysis shows that the proposed slopes are grossly stable with computed factors of safety exceeding 1.5 for static condition, and 1.1 for pseudostatic (seismic) loading conditions. The results of our slope stability analysis are based upon the strength parameters evaluated by laboratory testing of the representative soils encountered during our previous field exploration in the project area. The results of slope stability analysis are presented in Appendix B. We recommend a maximum gradient of 1.5:1 (H:V) be used for the proposed excavation slopes.

Appropriate slope setbacks for foundations and structures should be provided in accordance with the local, CBC or AREMA requirements. We recommend that all slopes be observed by a geologist from Kleinfelder during grading to assess the in-situ soil conditions encountered and evaluate, if any changes are necessary to the recommendations presented above.

4.0 LIMITATIONS

This addendum report has been prepared for the exclusive use of Lim & Nascimento Engineering Corporation, City of San Bernardino, and Caltrans for specific application to the project. The findings, conclusions, and recommendations presented in this report were prepared in a manner consistent with the standards of care and skill ordinarily exercised by members of its profession practicing under similar conditions in the geographic vicinity and at the time the services will be performed. No warranty or guarantee, express or implied, is made.

The client has the responsibility to see that all parties to the project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety.

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This report contains information, which may be useful in the preparation of contract specifications. However, the report is not designed as a specification document and may not contain sufficient information for this use without proper modification.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on-site and off-site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report for an adjacent or nearby project shall notify Kleinfelder of such intended use. Based on the intended use of this report and the nature of the new project, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

The scope of our geotechnical services did not include any environmental site assessment for the presence or absence of hazardous/toxic materials. Kleinfelder will assume no responsibility or liability whatsoever for any claim, loss of value, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project sites, or from the discovery of such hazardous materials.

We appreciate the opportunity to be of service on this project. Should you have any questions or comments concerning this letter please do not hesitate to contact the undersigned at your earliest convenience.

Respectfully submitted,
KLEINFELDER WEST, INC.

Carlos V. Amante, PE, GE
Geotechnical Group Manager

REGISTERED PROFESSIONAL ENGINEER
CARLOS V. AMANTE
No. 2724
Exp 6-30-10
GEOTECHNICAL
STATE OF CALIFORNIA

Richard F. Escandon, PG, CEG
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PROFESSIONAL GEOLOGIST
RICHARD F. ESCANDON
No. 1213
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Attachments: Plate 1 – Exploration Location Map
Appendix A – Previous Boring Data
Appendix B – Slope Stability Analysis

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PLATE

Exploration Location Map

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

REGISTERED CIVIL ENGINEER

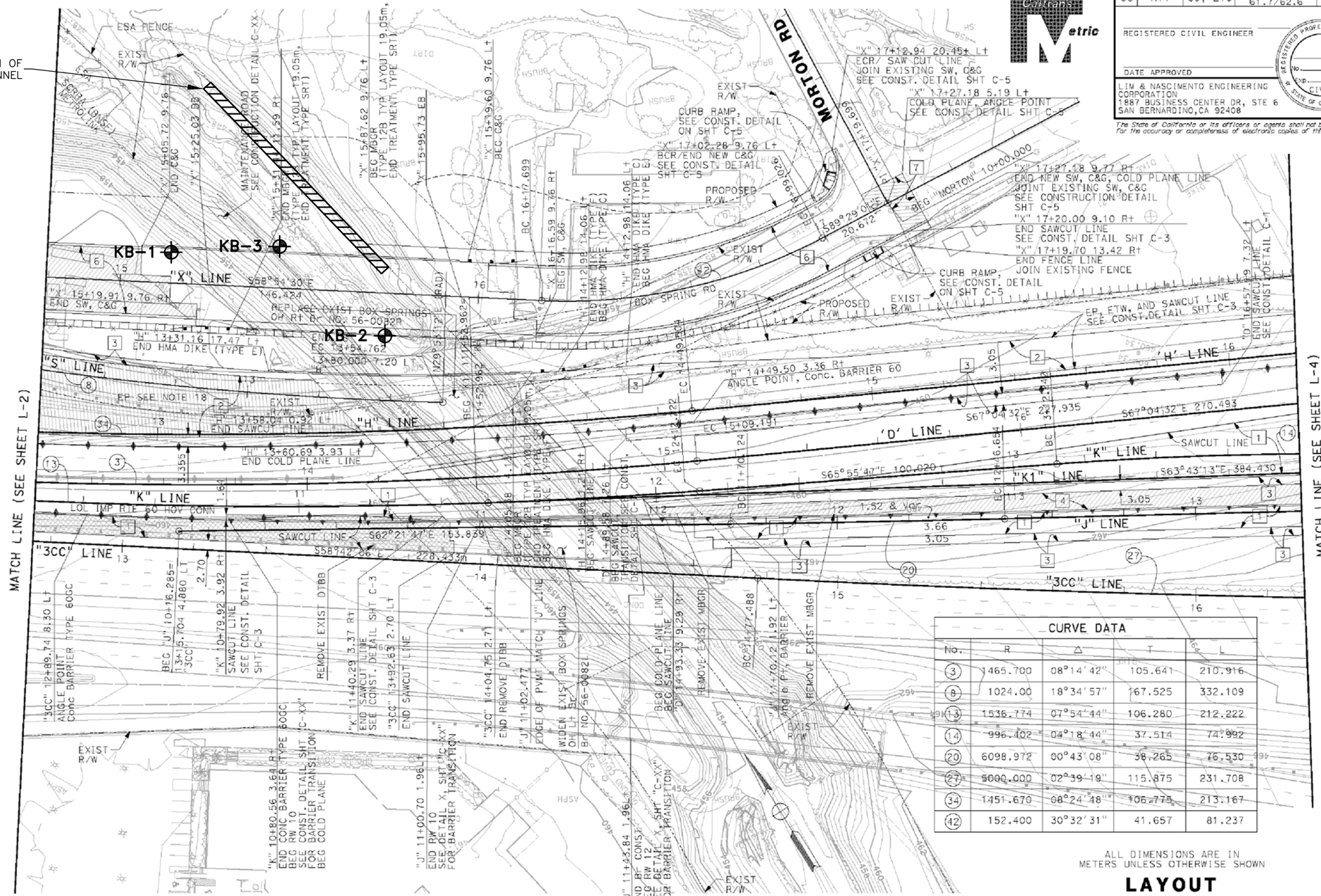
DATE APPROVED

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 BUSINESS CENTER DR, STE 6
SAN BERNARDINO, CA 92408

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — 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.

Caltrans Metric



CURVE DATA				
No.	R	Δ	T	L
3	1465.700	08°14'42"	105.641	210.916
8	1024.00	18°34'57"	167.525	332.109
13	1536.774	07°54'44"	106.280	212.222
14	996.402	04°18'44"	37.514	74.992
20	6098.972	00°43'08"	38.265	76.530
27	5000.000	02°39'19"	115.875	231.708
34	1451.670	08°24'48"	106.775	213.167
42	152.400	30°32'31"	41.657	81.237

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

LAYOUT

SCALE: 1:500

L-3

REFERENCE:

BASE MAP PROVIDED BY LAN ENIGINEERING, DATED 8/20/2008.

The Information included on this graphic representation has been compiled from a variety of sources and is subject to change without notice. Kleinfelder makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a land survey product nor is it designed or intended as a construction design document. The use or misuse of the information contained on this graphic representation is at the sole risk of the party using or misusing the information.

EXPLANATION

KB-3 — APPROXIMATE KLEINFELDER BORING LOCATION, SEPTEMBER 2008.

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PROJECT NO.	76979
DRAWN:	11/11/08
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p1_RSP.dwg

EXPLORATION LOCATION MAP

PROPOSED RSP LINED CHANNEL
I-215/SR-60 EAST JUNCTION IMPROVEMENTS
RIVERSIDE, CALIFORNIA

PLATE **1**

ATTACHED IMAGES: Images: for plate 2a.tif
ATTACHED XREFS:
DIAMOND BAR, CA

CAD FILE: L:\2009\CADD\76979\I-215_SR60\102208_I-215_SR60\ LAYOUT: 2a PLOTTED: 17 Mar 2009, 4:13pm, MGriffin

APPENDIX A

Previous Boring Data

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	ID	DESCRIPTION	MAJOR DIVISION		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Well-graded gravels, gravel-sand mixtures	FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands
		GP		Poorly-graded gravels, gravel-sand mixtures			CL		Inorganic clays of low to medium plasticity; gravelly clays silty clays,sandy clays, lean clays
		GM		Silty gravels, gravel-sand-silt mixtures			OL		Organic silts and organic silt-clays of low plasticity
		GC		Clayey gravels, gravel-sand-clay mixtures		SILTS AND CLAYS LL > 50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
	SAND AND SANDY SOILS	SW		Well-graded sands, gravelly sands			CH		Inorganic clays of medium to high plasticity
		SP		Poorly-graded sands and gravelly sands			OH		Organic clays of medium to high plasticity
		SM		Silty sands, sand-silt mixture		HIGHLY ORGANIC SOILS	Pt		Peat, muck and other highly organic soils
		SC		Clayey sands, sand-clay mixture					

▼ Approximate water level observed in boring following drilling

SOIL SAMPLE

- Bulk Sample
- Drive Sample - California Sample
- Shelby Tube Sample
- Standard Penetration Test (SPT) Sample

ADDITIONAL TESTS

CN	- Consolidation
COR	- Corrosion
CP	- Collapse Potential
DS	- Direct Shear
EI	- Expansion Potential
MAX	- Maximum Dry Density
OC	- Organic Content
PI	- Plasticity Index
RV	- R-Value
SE	- Sand Equivalent
GS	- Grain Size Distribution

NOTES:

Blow counts represent the number of blows of a 140-pound hammer falling 30 inches required to drive a sampler through the last 12 inches of an 18-inch penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

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Bright People. Right Solutions.
1220 Research Drive, Suite B, Redlands, CA 92374
PH. (909) 793-2691 • FAX (909) 792-1704

LEGEND TO LOGS

PLATE A-1

Date Drilled	9/15/08	Water Depth:	20 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	9/15/08
Drilling Method:	200mm Hollow-stem auger	Elevation:	460 meters (approx.)
Logged By:	L. Hong	Datum:	MSL

Elevation (approx.) (meters)	Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Brown, moist, fine to coarse grained sand, with trace fine gravel to 6.4 mm, with some clay			GS, DS, COR, MAX
459		2	32				--olive, medium dense, fine to coarse grained sand with trace fine gravel to 12.7 mm, with trace calcium carbonate, with clay	19.6	7.0	
	1									
458		3	7				--dark brown, loose, fine to medium grained sand, with trace clay, with trace fine gravel to 6.4 mm			
	2									
457										
	3	4	30				--brown, medium dense, medium grained sand, weakly cemented, with trace calcium carbonate, with trace fine gravel to 12.7 mm			CP
456										
	4					SM	**Alluvium (Qal): Silty Sand:** Gray-brown, moist, very dense, fine to coarse grained sand, with trace fine gravel to 12.7 mm			
455		5	26 50/130				--very dense, with trace fine gravel to 12.7 mm, fractured coarse gravel to 19.1 mm in sampler			GS
	5									
454										
	6	6	52/170				--medium grained sand			
453							--interbedded a thin layer of Poorly-graded Sand, medium to coarse grained sand			
	7						--red-brown			
452		7	22 50/130				--fine to medium grained sand, weakly cemented, with trace calcium carbonate			
	8									
451										
	9	8	10 50/130				**Bedrock (Kt):** Tonalite, mottled black, white, and olive-brown, moist, hard, slightly weathered, recovered as	18.2	6.2	
450										

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PROJECT NO. 76979

I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

LOG OF BORING KB-1

PLATE A-2a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 10/3/08

Elevation (approx.) (meters)	Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
							fine to coarse grained sand, with trace mica			
449	11	9	26 50/100				--slightly weathered			
448	12	10	50/80				--slightly to moderately weathered	18.3	2.8	
447	13									
446	14	11	50/100				--increase in moisture content, slightly to moderately weathered			
445	15	12	50/130				--slightly to moderately weathered	19.0	5.1	
444	16									
443	17	13	50/100							
442	18	14	50/80				--moist to wet, slightly weathered			
441	19									
440	20	15	50/100			▼	--wet, moderately weathered			
439	21									

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I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

LOG OF BORING KB-1

PLATE
A-2b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 10/3/08

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
438	16	50/130				Boring terminated at 21.5 meters. Groundwater was encountered at 20.0 meters. Hole backfilled using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

LOG OF BORING KB-1

PLATE

A-2c

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 10/3/08

Date Drilled	9/15/08	Water Depth:	3 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	9/15/08
Drilling Method:	200mm Hollow-stem auger	Elevation:	451 meters (approx.)
Logged By:	L. Hong	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1				SM	**Fill (Qaf): Silty Sand:** Dark brown, moist, fine to medium grained sand			
450		2	9				--loose, fine grained sand			
	1									
449		3	1				--very dark gray-brown, moist to wet, very loose, fine to medium grained sand			
	2									
448										
	3	4	4				--wet, fine to medium grained sand, with trace mica	16.8	20.0	COR
447										
	4									
446		5	58				**Bedrock (Kt):** Tonalite, mottled olive, white, and brown, wet, hard, slightly weathered, recovered as fine to coarse grained sand, with trace mica			GS
	5									
445										
	6	6	25 50/80				--moderately weathered	17.6	15.8	
444										
	7									
443		7	16 50/80				--moderately weathered, with trace calcium carbonate, with some fine sand, with trace silt			
	8									
442										
	9	8	50/100				--increase in silt content, with trace calcium carbonate			
441										

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I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

LOG OF BORING KB-2

PLATE A-3a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 10/3/08

Elevation (approx.) (meters)	Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
440		9	50/130							
	11									
439										
	12	10	50/130				--mottled white, black, and gray, moderately weathered, with some silt			
438										
	13									
437		11	50/130							
	14									
436										
	15	12	50/100							
							Boring terminated at 15.1 meters. Groundwater was encountered at 3.0 meters. Hole backfilled using soil from cuttings.			

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I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

LOG OF BORING KB-2

PLATE

A-3b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 10/3/08

Date Drilled	9/15/08	Water Depth:	4 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	9/15/08
Drilling Method:	200mm Hollow-stem auger	Elevation:	450 meters (approx.)
Logged By:	L. Hong	Datum:	MSL

Elevation (approx.) (meters)	Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
450		1					A layer of 101.6 mm riprap consists of rocks to 38.1 mm			
	1	2	36				**Alluvium (Qal): Silty Sand:** Olive, moist, fine grained sand, with trace mica --medium dense, with trace clay			
449		3	33 50/130				**Bedrock (Kt):** Tonalite, mottled black, white, and olive-brown, moist, hard, slightly weathered, recovered as fine to coarse grained sand, with trace mica, with trace clay --very dense, slightly weathered	21.0	4.5	DS, CP
	2									
448										
	3	4	12 50/130				--increase in quartz content, with trace calcium carbonate, with trace mica			
447										
	4					▼				
446		5	50/150				--wet, slightly weathered, with trace mica	17.4	21.7	
	5									
445										
	6	6	50/130				--with trace silt			
444										
	7									
443		7	50/100				--moderately weathered			
	8									
442										
	9	8	50/100							
441										

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PROJECT NO. 76979

I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

LOG OF BORING KB-3

PLATE
A-4a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 10/3/08

Elevation (approx.) (meters)	Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
440										
		9	50/80							
	11									
439										
							--increase in silt content			
	12									
438		10	50/100							
							--mottled white, black, and, dark gray, with trace mica			
	13									
437										
		11	50/100							
	14									
436										
	15									
435		12	50/100							
							Boring terminated at 15.4 meters. Groundwater was encountered at 4.0 meters. Hole backfilled using soil from cuttings.			

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PROJECT NO. 76979

I-215/SR-60 East Junction
Frontage Road OH Replacement
Riverside, California

LOG OF BORING KB-3

PLATE

A-4b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

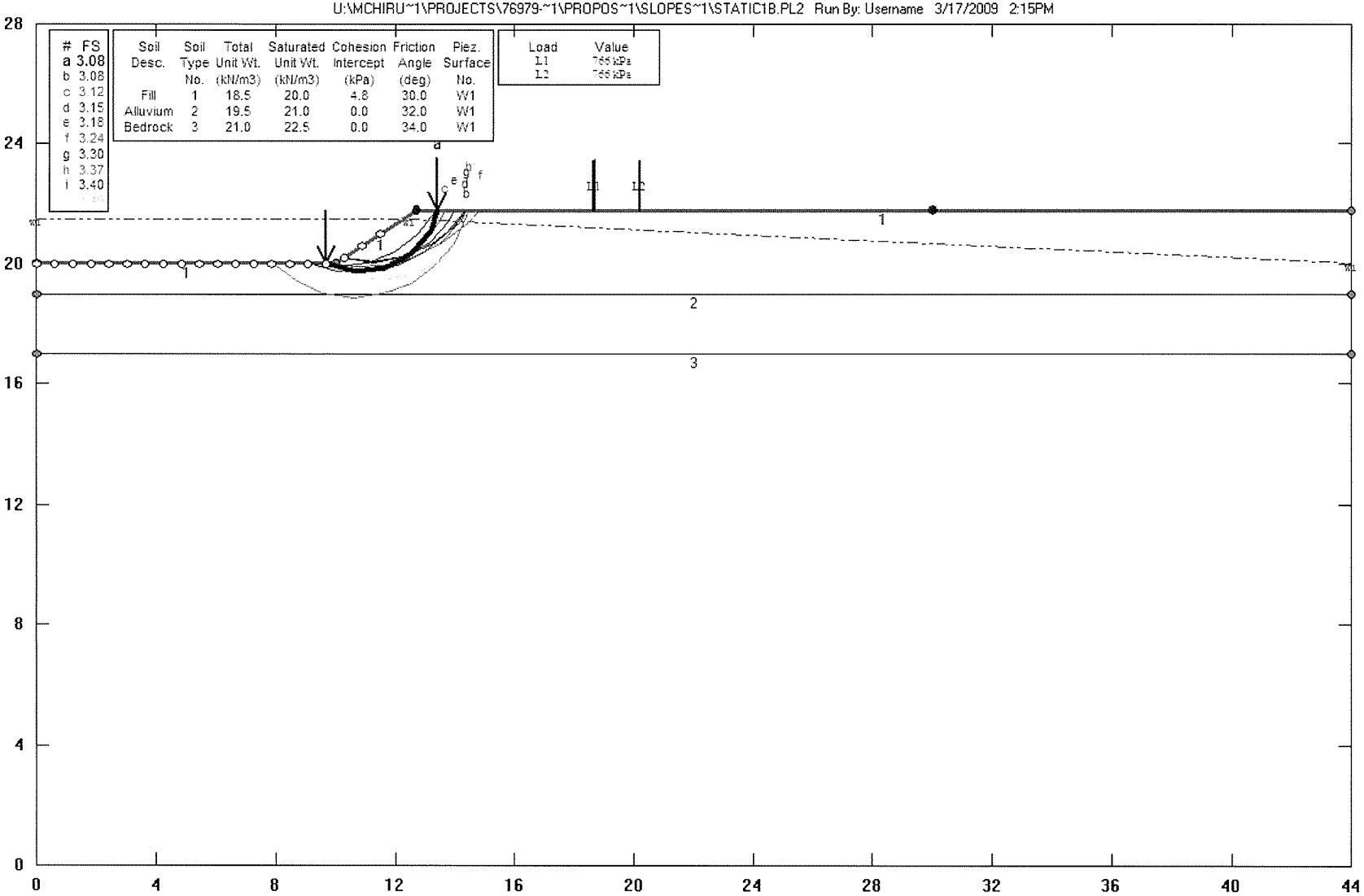
GEOTECH TEMECULA 76979 I-215 SR-60 FRONTAGE ROAD-KLEINFELDER FORMAT-METRIC.GPJ KA_RDLND.GDT 10/3/08

APPENDIX B

Slope Stability Analysis

Proposed Trap Channel- I-215/SR-60 static- with 1:1.5 slope

U:\MCHIRU~1\PROJECTS\76979-~1\PROPOS~1\SLOPES~1\STATIC1B.PL2 Run By: Username 3/17/2009 2:15PM



GSTABL7 v.2 FSmin=3.08

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

static1b
*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **

(All Rights Reserved-Unauthorized Use Prohibited)

****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.
****

Analysis Run Date: 3/17/2009
Time of Run: 2:15PM
Run By: Username
Input Data Filename: U:static1b.in
Output Filename: U:static1b.OUT
Unit System: SI

Plotted Output Filename: U:static1b.PLT

PROBLEM DESCRIPTION: Proposed Trap Channel- I-215/SR-60
static- with 1:1.5 slope

BOUNDARY COORDINATES

3 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	20.00	10.00	20.00	1
2	10.00	20.00	12.70	21.80	1
3	12.70	21.80	44.00	21.80	1
4	0.00	19.00	44.00	19.00	2
5	0.00	17.00	44.00	17.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	18.5	20.0	4.8	30.0	0.00	0.0	1
2	19.5	21.0	0.0	32.0	0.00	0.0	1
3	21.0	22.5	0.0	34.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 3 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	0.00	21.50
2	12.50	21.50
3	44.00	20.00

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	18.66	18.68	766.0	0.0
2	20.16	20.18	766.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 11.50(m)

Each Surface Terminates Between X = 12.70(m)
and X = 30.00(m)

static1b

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

1.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 175.546 FS Min = 3.079 FS Ave = 7.911
Standard Deviation = 9.318 Coefficient of Variation = 117.78 %

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	9.68	20.00
2	10.65	19.76
3	11.65	19.88
4	12.53	20.36
5	13.17	21.12
6	13.41	21.80

Circle Center At X = 10.8 ; Y = 22.4 and Radius, 2.7

Factor of Safety
*** 3.079 ***

Individual data on the 9 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.3	0.2	4.6	4.9	0.0	0.0	0.0	0.0	0.0
2	0.7	5.0	9.9	11.0	0.0	0.0	0.0	0.0	0.0
3	1.0	18.8	8.6	16.5	0.0	0.0	0.0	0.0	0.0
4	0.9	21.7	1.2	13.2	0.0	0.0	0.0	0.0	0.0
5	0.0	0.7	0.0	0.3	0.0	0.0	0.0	0.0	0.0
6	0.2	4.4	0.0	2.7	0.0	0.0	0.0	0.0	0.0

				static1b					
7	0.5	8.9	0.0	4.6	0.0	0.0	0.0	0.0	0.0
8	0.1	1.2	0.0	0.6	0.0	0.0	0.0	0.0	0.0
9	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	9.68	20.00
2	10.67	19.82
3	11.67	19.88
4	12.62	20.18
5	13.47	20.70
6	14.17	21.41
7	14.40	21.80

Circle Center At X = 10.9 ; Y = 23.9 and Radius, 4.1

Factor of Safety
*** 3.084 ***

1

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	9.08	20.00
2	10.05	19.75
3	11.05	19.78
4	12.00	20.08
5	12.83	20.64
6	13.48	21.40
7	13.67	21.80

Circle Center At X = 10.4 ; Y = 23.3 and Radius, 3.6

Factor of Safety
*** 3.119 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	9.08	20.00
2	10.05	19.76
3	11.05	19.74
4	12.03	19.95
5	12.93	20.38
6	13.72	20.99

7	14.35	21.77
8	14.36	21.80

Circle Center At X = 10.6 ; Y = 24.1 and Radius, 4.4

Factor of Safety
*** 3.154 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	10.29	20.19
2	11.28	20.04
3	12.26	20.22
4	13.14	20.71
5	13.80	21.45
6	13.95	21.80

Circle Center At X = 11.2 ; Y = 23.0 and Radius, 3.0

Factor of Safety
*** 3.185 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	9.68	20.00
2	10.68	19.90
3	11.68	19.98
4	12.64	20.24
5	13.54	20.68
6	14.35	21.27
7	14.84	21.80

Circle Center At X = 10.7 ; Y = 25.3 and Radius, 5.4

Factor of Safety
*** 3.240 ***

1

Failure Surface Specified By 6 Coordinate Points

Point	X-Surf	Y-Surf

No.	(m)	(m)
1	10.29	20.19
2	11.28	20.07
3	12.27	20.21
4	13.19	20.60
5	13.98	21.22
6	14.42	21.80

Circle Center At X = 11.2 ; Y = 23.8 and Radius, 3.8

Factor of Safety
*** 3.303 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	7.87	20.00
2	8.67	19.40
3	9.60	19.02
4	10.59	18.89
5	11.58	19.00
6	12.51	19.36
7	13.33	19.94
8	13.97	20.71
9	14.41	21.61
10	14.45	21.80

Circle Center At X = 10.6 ; Y = 22.9 and Radius, 4.0

Factor of Safety
*** 3.371 ***

1

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	9.08	20.00
2	10.07	19.89
3	11.06	20.03
4	11.98	20.42
5	12.77	21.04
6	13.36	21.80

Circle Center At X = 10.0 ; Y = 23.8 and Radius, 3.9

Factor of Safety
*** 3.398 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	9.68	20.00
2	10.60	19.59
3	11.59	19.47
4	12.58	19.65
5	13.47	20.10
6	14.19	20.79
7	14.68	21.66
8	14.71	21.80

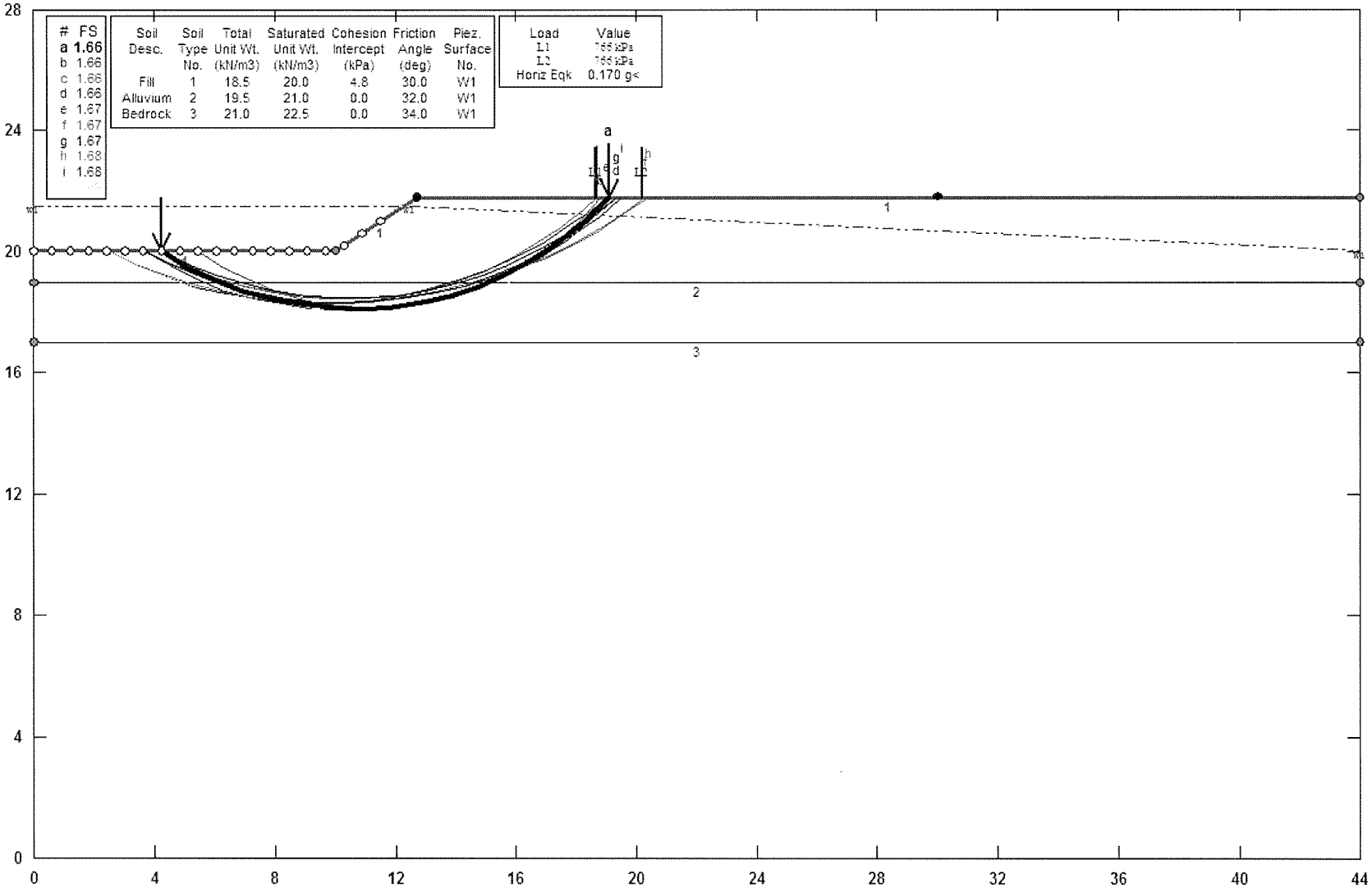
Circle Center At X = 11.5 ; Y = 22.8 and Radius, 3.4

Factor of Safety
*** 3.400 ***

**** END OF GSTABL7 OUTPUT ****

Proposed Trap Channel- I-215/SR-60 Pseudostatic- with 1:1.5 slope

U:\MCHIRU~1\PROJECTS\76979-~1\PROPOS~1\SLOPES~1\SEIS1B.PL2 Run By: Username 3/17/2009 2:20PM



GSTABL7 v.2 FSmin=1.66

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

seis1b
*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.0, September 2001 **

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****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 3/17/2009
Time of Run: 2:20PM
Run By: Username
Input Data Filename: U:seis1b.in
Output Filename: U:seis1b.OUT
Unit System: SI

Plotted Output Filename: U:seis1b.PLT

PROBLEM DESCRIPTION: Proposed Trap Channel- I-215/SR-60
Pseudostatic- with 1:1.5 slope

BOUNDARY COORDINATES

3 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (m)	Y-Left (m)	X-Right (m)	Y-Right (m)	Soil Type Below Bnd
1	0.00	20.00	10.00	20.00	1
2	10.00	20.00	12.70	21.80	1
3	12.70	21.80	44.00	21.80	1
4	0.00	19.00	44.00	19.00	2
5	0.00	17.00	44.00	17.00	3

1

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (kN/m3)	Saturated Unit Wt. (kN/m3)	Cohesion Intercept (kPa)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (kPa)	Piez. Surface No.
1	18.5	20.0	4.8	30.0	0.00	0.0	1
2	19.5	21.0	0.0	32.0	0.00	0.0	1
3	21.0	22.5	0.0	34.0	0.00	0.0	1

1

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 9.81

Piezometric Surface No. 1 Specified by 3 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (m)	Y-Water (m)
1	0.00	21.50
2	12.50	21.50
3	44.00	20.00

1

BOUNDARY LOAD(S)

2 Load(s) Specified

Load No.	X-Left (m)	X-Right (m)	Intensity (kPa)	Deflection (deg)
1	18.66	18.68	766.0	0.0
2	20.16	20.18	766.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed
Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.170 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(kPa)

1

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.

seis1b

1000 Trial Surfaces Have Been Generated.

50 Surfaces Initiate From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 0.00(m)
and X = 11.50(m)

Each Surface Terminates Between X = 12.70(m)
and X = 30.00(m)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(m)

1.00(m) Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 1000

Statistical Data On All Valid FS Values:
FS Max = 7.778 FS Min = 1.659 FS Ave = 2.276
Standard Deviation = 0.581 Coefficient of Variation = 25.55 %

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	4.24	20.00
2	5.10	19.49
3	6.00	19.06
4	6.93	18.70
5	7.89	18.43
6	8.88	18.24
7	9.87	18.13
8	10.87	18.11
9	11.87	18.18
10	12.86	18.33
11	13.83	18.56
12	14.78	18.88
13	15.70	19.27
14	16.58	19.75
15	17.41	20.30
16	18.20	20.91
17	18.93	21.60
18	19.11	21.80

Circle Center At X = 10.6 ; Y = 29.8 and Radius, 11.6

Factor of Safety
*** 1.659 ***

Individual data on the 25 slices

Slice No.	Width (m)	Weight (kN)	Water Force Top (kN)	Water Force Bot (kN)	Tie Force Norm (kN)	Tie Force Tan (kN)	Earthquake Force Hor (kN)	Earthquake Force Ver (kN)	Surcharge Load (kN)
1	0.9	4.4	12.7	17.2	0.0	0.0	0.7	0.0	0.0
2	0.9	13.1	13.3	21.8	0.0	0.0	2.2	0.0	0.0
3	0.1	2.9	2.2	3.8	0.0	0.0	0.5	0.0	0.0
4	0.8	18.2	11.6	21.9	0.0	0.0	3.1	0.0	0.0
5	1.0	28.0	14.2	28.8	0.0	0.0	4.8	0.0	0.0
6	1.0	33.4	14.4	31.1	0.0	0.0	5.7	0.0	0.0
7	1.0	36.9	14.6	32.5	0.0	0.0	6.3	0.0	0.0
8	0.1	4.9	1.9	4.3	0.0	0.0	0.8	0.0	0.0
9	0.9	38.6	12.4	28.9	0.0	0.0	6.6	0.0	0.0
10	1.0	56.1	6.9	32.9	0.0	0.0	9.5	0.0	0.0
11	0.6	41.3	0.3	20.5	0.0	0.0	7.0	0.0	0.0
12	0.2	13.9	0.0	6.4	0.0	0.0	2.4	0.0	0.0
13	0.2	11.0	0.0	4.9	0.0	0.0	1.9	0.0	0.0
14	1.0	65.3	0.0	29.6	0.0	0.0	11.1	0.0	0.0
15	0.9	58.2	0.0	26.4	0.0	0.0	9.9	0.0	0.0
16	0.3	16.0	0.0	7.4	0.0	0.0	2.7	0.0	0.0
17	0.6	33.4	0.0	15.1	0.0	0.0	5.7	0.0	0.0
18	0.9	39.7	0.0	17.8	0.0	0.0	6.7	0.0	0.0
19	0.8	29.1	0.0	12.4	0.0	0.0	4.9	0.0	0.0
20	0.8	18.1	0.0	6.3	0.0	0.0	3.1	0.0	0.0
21	0.3	4.4	0.0	0.7	0.0	0.0	0.8	0.0	0.0
22	0.1	1.4	0.0	0.0	0.0	0.0	0.2	0.0	0.0
23	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	15.3
24	0.2	1.5	0.0	0.0	0.0	0.0	0.3	0.0	0.0
25	0.2	0.3	0.0	0.0	0.0	0.0	0.1	0.0	0.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	5.45	20.00
2	6.29	19.46
3	7.18	19.01
4	8.12	18.65
5	9.08	18.39
6	10.07	18.23
7	11.07	18.16
8	12.06	18.20
9	13.05	18.34
10	14.03	18.58
11	14.97	18.92
12	15.87	19.35
13	16.72	19.87
14	17.52	20.47
15	18.25	21.15

16	18.82	21.80

Circle Center At X = 11.2 ; Y = 28.0 and Radius, 9.9

Factor of Safety
*** 1.659 ***

1

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	4.24	20.00
2	5.13	19.54
3	6.05	19.16
4	7.00	18.86
5	7.98	18.63
6	8.97	18.49
7	9.97	18.42
8	10.97	18.44
9	11.96	18.54
10	12.94	18.72
11	13.91	18.98
12	14.85	19.32
13	15.76	19.73
14	16.63	20.22
15	17.47	20.78
16	18.25	21.40
17	18.67	21.80

Circle Center At X = 10.2 ; Y = 30.6 and Radius, 12.2

Factor of Safety
*** 1.659 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	3.63	20.00
2	4.50	19.50
3	5.40	19.07
4	6.34	18.72
5	7.30	18.44
6	8.28	18.23
7	9.27	18.11
8	10.27	18.06
9	11.27	18.09
10	12.26	18.20
11	13.24	18.38
12	14.21	18.65

13	15.15	18.99
14	16.06	19.40
15	16.94	19.88
16	17.77	20.43
17	18.56	21.04
18	19.30	21.72
19	19.38	21.80

Circle Center At X = 10.4 ; Y = 30.8 and Radius, 12.7

Factor of Safety
*** 1.665 ***

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.42	20.00
2	3.32	19.57
3	4.25	19.19
4	5.20	18.89
5	6.17	18.64
6	7.15	18.46
7	8.15	18.34
8	9.15	18.29
9	10.15	18.31
10	11.14	18.39
11	12.13	18.54
12	13.11	18.76
13	14.07	19.03
14	15.01	19.38
15	15.92	19.78
16	16.81	20.24
17	17.66	20.76
18	18.48	21.34
19	19.05	21.80

Circle Center At X = 9.4 ; Y = 33.4 and Radius, 15.1

Factor of Safety
*** 1.667 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	3.63	20.00
2	4.55	19.60
3	5.49	19.25
4	6.44	18.97

5	7.42	18.74
6	8.41	18.58
7	9.40	18.48
8	10.40	18.44
9	11.40	18.46
10	12.40	18.55
11	13.38	18.70
12	14.36	18.91
13	15.32	19.18
14	16.27	19.51
15	17.19	19.91
16	18.08	20.35
17	18.95	20.85
18	19.78	21.41
19	20.29	21.80

Circle Center At X = 10.5 ; Y = 34.4 and Radius, 15.9

Factor of Safety
*** 1.672 ***

1

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	4.24	20.00
2	5.14	19.57
3	6.07	19.21
4	7.03	18.92
5	8.00	18.70
6	8.99	18.55
7	9.99	18.47
8	10.99	18.48
9	11.99	18.55
10	12.98	18.70
11	13.95	18.92
12	14.91	19.21
13	15.84	19.58
14	16.74	20.01
15	17.61	20.50
16	18.44	21.06
17	19.22	21.68
18	19.35	21.80

Circle Center At X = 10.5 ; Y = 31.9 and Radius, 13.5

Factor of Safety
*** 1.674 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.42	20.00
2	3.33	19.59
3	4.27	19.24
4	5.22	18.93
5	6.19	18.69
6	7.17	18.50
7	8.17	18.37
8	9.16	18.29
9	10.16	18.28
10	11.16	18.32
11	12.16	18.42
12	13.14	18.58
13	14.12	18.79
14	15.08	19.06
15	16.03	19.39
16	16.95	19.77
17	17.86	20.20
18	18.73	20.68
19	19.58	21.22
20	20.39	21.80

Circle Center At X = 9.9 ; Y = 35.5 and Radius, 17.3

Factor of Safety
*** 1.676 ***

1

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	3.63	20.00
2	4.53	19.56
3	5.45	19.18
4	6.40	18.86
5	7.37	18.62
6	8.36	18.45
7	9.35	18.34
8	10.35	18.31
9	11.35	18.35
10	12.34	18.46
11	13.33	18.64
12	14.30	18.89
13	15.24	19.21
14	16.17	19.60
15	17.06	20.05
16	17.92	20.56
17	18.74	21.14
18	19.51	21.77
19	19.55	21.80

Circle Center At X = 10.3 ; Y = 32.3 and Radius, 14.0

Factor of Safety
*** 1.681 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (m)	Y-Surf (m)
1	2.42	20.00
2	3.32	19.56
3	4.24	19.17
4	5.18	18.84
5	6.14	18.56
6	7.12	18.34
7	8.11	18.18
8	9.10	18.08
9	10.10	18.04
10	11.10	18.05
11	12.10	18.13
12	13.09	18.26
13	14.07	18.46
14	15.04	18.71
15	15.99	19.01
16	16.92	19.38
17	17.83	19.79
18	18.71	20.27
19	19.57	20.79
20	20.39	21.36
21	20.94	21.80

Circle Center At X = 10.3 ; Y = 34.9 and Radius, 16.9

Factor of Safety
*** 1.687 ***

**** END OF GSTABL7 OUTPUT ****

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March 24, 2009
Project No. 76979

Mr. Norman Suydam
Lim & Nascimento Engineering Corporation
1887 Business Center Drive, Suite 6
San Bernardino, CA 92408

via Electronic Mail
Norm.Suydam@lanengineering.com
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Subject: Addendum No. 2 to Final Geotechnical Design Report
Proposed 900-mm Diameter Jacked Reinforced Concrete Pipe (RCP)
Interstate 215/State Route 60 East Junction Improvements
Riverside and Moreno Valley, California
08-RIV-215/60, KP 60.7/70.6, 22.0/18.5
Caltrans EA No. 449311

Dear Mr. Suydam:

Kleinfelder West, Inc. (Kleinfelder) is pleased to submit this addendum report to provide supplemental geotechnical design recommendations pertaining to the proposed 900-mm diameter jacked Reinforced Concrete Pipe (RCP) at the location of the proposed Retaining Wall Number 19, in the City of Moreno Valley, California.

Our understanding of this project is based on discussions with you and review of draft cross-section drawings you provided to us and previous Final Geotechnical Design Report (GDR) prepared by Kleinfelder for this project, dated January 9, 2009. The Final GDR has been reviewed and approved by Caltrans.

1.0 PROJECT DESCRIPTION

The proposed 900-mm diameter jacked Reinforced Concrete Pipe (RCP) will be located west of the Retaining Wall Number 19, located beneath the existing Route 60/215 Separation Bridge (previously called Route 60/395 Separation) and west of northbound I-215 ('D' Line). The approximate location of the pipe is shown on Plate 1, Exploration Location Map.

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Based on our discussions with LAN Engineering, the 900-mm diameter drainage pipe is proposed to be constructed with pipe jacking methods in the soil. The total length of the pipe will be approximately 67.4 meters. The jacked pipe will be located approximately 1.5 meters to 5 meters below the existing ground surface with invert elevations ranging from approximately 465 to 459 meters above MSL.

2.0 DESIGN AND CONSTRUCTION OF THE JACKED PIPE/TUNNEL SECTION

The following section provides our recommendations for design and construction of the proposed jacked drainage pipe. The selection of the method of construction for the drainage pipe should be provided by the contractor. We recommend that the contractor's actual method of construction be reviewed by the geotechnical engineer prior to construction to evaluate if the installation method is consistent with the design assumptions. The method of excavation and support is ultimately left to the contractor with guidance and specifications provided by the designer and owner. The tunneling operations should be performed only by contractors highly experienced in this type of construction under the anticipated conditions, and under strict construction monitoring and quality control.

2.1 Anticipated Ground Conditions

We reviewed the subsurface data from previously drilled Kleinfelder borings HV-3, HV-6, HV-7, and HV-9 (see Plates 1a and 1b, Exploration Location Map). These borings are located in the vicinity of the proposed pipeline alignment. The relevant boring data, obtained from the Final GDR, are provided in Appendix A of this report for reference purposes.

Borings HV-3, HV-6, HV-7 encountered alluvial soils to depths ranging from approximately 455 to 450 meters above Mean Sea Level (MSL) overlying the granitic bedrock. Boring HV-3 consisted of fill in the upper portion to a depth of 464 meters above MSL. Boring HV-9 was drilled to a shallow depth of approximately 5 meters corresponding to an elevation of 463 meters above MSL and encountered alluvial soils. In general, medium dense to very dense granular alluvial and fill soils are anticipated at the tunnel depth. Draft preliminary design drawings provided by LAN Engineering indicate the jacked pipe will have invert elevations ranging from approximately 465 to

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459 meters above MSL. Based on the depth to bedrock in the borings drilled, bedrock is not anticipated to be encountered within the invert elevations of the pipe.

Groundwater was also encountered in borings HV-3, HV-6, HV-7 drilled, at depths ranging from 456 to 457 meters above MSL. Based on the depth to groundwater encountered in the borings drilled, groundwater is also not anticipated to be encountered within the invert elevations of the pipe. However, groundwater levels may fluctuate due to seasonal variation, nearby construction, and numerous other man-made and natural influences.

2.2 Anticipated Ground Construction and Behaviour

This section presents the anticipated ground behavior for the various soil, rock and mixed-face conditions anticipated along the tunnel alignment. We anticipate the pipeline will be constructed by tunneling, micro tunneling, or jack-and-bore operations. Soft-ground tunneling by means of a tunneling shield, tunnel boring machine, microtunneling, hand mining, jacking-and-boring, or other similar means has been assumed for describing ground behavior during construction.

2.3 Soft-Ground Conditions

Based on the anticipated alluvial soils within the tunnel zone, “soft ground” conditions are anticipated for the majority of the pipe excavation. Soft-ground behavior is described in terms of the “Tunnelman’s Ground Classification System”, first described by Terzaghi (1950) and later modified by Heuer (1974). The Tunnelman’s ground classification for soft ground is presented in the table below.

Table 1
Tunnelman’s Ground Classification System for Soft Ground

CLASSIFICATION	BEHAVIOR	TYPICAL SOIL TYPES
Firm	Heading can be advanced without initial support, final lining can be constructed before ground starts to move.	Loess above the water table, hard clay, marl, cemented sand and gravel when not highly overstressed.
Raveling - Slow Raveling - Fast Raveling	Chunks or flakes of materials begin to drop out of the arch or walls sometime after the ground has been exposed, due to loosening, over-stress and "brittle" fracture. In fast raveling ground, the process starts within a few minutes, otherwise the ground is slow raveling.	Residual soils or sand with small amounts of binder may be fast raveling below the water table, slow raveling above. Stiff fissured clay may be slow or fast raveling depending upon degree of overstress.

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Table 1 (Continued)
Tunnelman's Ground Classification System for Soft Ground

CLASSIFICATION	BEHAVIOR	TYPICAL SOIL TYPES
Squeezing	Ground squeezes or extrudes plastically into tunnel, without visible fracturing or loss of continuity, and without perceptible increases in water content. Ductile, plastic yield and flow due to overstress.	Ground with low frictional strength. Rate of squeeze depends on degree of overstress. Occurs at shallow to medium depth in clay of very soft to medium consistency. Stiff to hard clay under high cover may move in combination with raveling at execution surface and squeezing at depth behind face.
Running	Granular materials without cohesion are unstable at a slope greater than their angle of repose (approx. 30 - 35 degrees). When exposed at steep slopes they run like granulated sugar or dune sand until the slope flattens to the angle of repose.	Clean, dry granular materials. Apparent cohesion in moist sand, or weak cementation in any granular soil, may allow the material to stand for a brief period of raveling before it breaks down and runs. Such behavior is cohesive running.
Flowing	A mixture of soil and water flows into the tunnel like a viscous fluid. The material can enter the tunnel from the invert as well as from the face, crown, and wall, and can flow for great distances, completely filling the tunnel in some cases.	Below the water table in silt, sand, or gravel without enough clay content to give significant cohesion and plasticity. May also occur in highly sensitive clay when such material is disturbed.
Swelling	Ground absorbs water, increases in volume, and expands slowly into the tunnel.	Highly preconsolidated clay with plasticity index in excess of about 30, generally containing significant percentages of montmorillonite.

Along most portions of the tunnel, we anticipate slow to fast raveling ground conditions for the granular soils in the tunnel crown, with slow raveling anticipated where medium dense to very dense soils are encountered, and fast raveling, locally, where loose sands and/or gravels are encountered. Local running ground conditions could occur where isolated lenses or pockets of clean, dry, cohesionless sands and gravels are encountered. Firm ground conditions are anticipated locally where stiff to very stiff fine-grained soils are encountered.

2.4 Initial Ground Support Systems and Anticipated Tunnel Excavation Method

The anticipated systems for tunnel support include steel casing, which is jacked or advanced directly into place, liner plates, and horseshoe or circular steel ribs with lagging or shotcrete, if applicable. The support systems for tunneling should be designed to withstand jacking forces and the applicable ground and surcharge loads at depth.

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Based on the soil conditions encountered during our field explorations, we anticipate excavation methods may employ open face digger shield, conventional mining, or tunnel boring machine excavation methods for the proposed trenchless alignment. Although, we anticipate the contactor may choose one of these methods, the method of excavation and tunnel support is left to the contractor.

2.4.1 Open Face Digger Shield with Breasting Capabilities

The open face digger shield generally consists of a steel shell with a projecting hood that provides support of the ground prior to the installation of the initial support system. The excavation of the tunnel face is typically performed with various methods including, but are not limited to, a hydraulic excavator arm, roadheader, Load/Haul/Dump (LHD) excavator, and hand mining. The shield has steering jacks to maintain line and grade and breasting capabilities to support the face if the ground becomes unstable. Full breasting is required during shutdown periods, such as weekends, off shifts, and mechanical breakdowns. The open face configuration allows access for removal of over-sized materials if encountered. Advancement of the shield is accomplished by erecting steel ribs and lagging support or liner plates within the tail shield and pushing off the last set installed, or by jacking a casing from a jacking pit or shaft.

2.4.2 Conventional Mining with Horseshoe Steel and Lagging

A horseshoe shaped steel rib and lagging tunnel is a conventional technique that is applied to ground conditions with good stand-up time. This method consists of mining forward, erecting the steel rib and lagging, and blocking the ground prior to large ground movements. The newly excavated portion of the tunnel is supported by ground arching, which spans the gap between the last steel set installed and the face of the tunnel. The length of time before raveling starts varies directly with the cohesion of the soil and inversely with the span of the ground arch. If the ground conditions become unstable, pre-support spiling may be required to stabilize the ground ahead of the excavation. The excavation of the tunnel face is typically performed with methods including, but are not limited to, roadheader, Load/Haul/Dump (LHD) excavator, and hand mining.

2.4.3 Mechanized Tunnel Boring Machines

Mechanized tunnel boring machines (TBMs) may also be used for tunnel excavation. TBM tunnels are generally circular shaped and come in a variety of sizes and designs.

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Numerous TBMs are generally available for soft ground or hard rock conditions employing full face rotating cutter heads with picks or disc cutters for soil or rock conditions, respectively. For this project a fully shielded TBM will be required due to the soft-ground soils in the tunnel crown.

2.5 Pipe Jacking and Pipe Jacking Forces

Frictional resistance should be considered for jacked, pit-launched methods of trenchless installations. The actual jacking friction will depend on several factors including, but not limited to soil properties, overcut, lubrication, misalignment, steering correction. The contractor should consider these factors when assessing jacking forces. Jacking forces can be resisted by passive earth pressures from the shaft wall as determined by the contractor's engineer.

2.6 Muck Disposal

Muck (excavated soil) disposal from tunnel and launching pit excavations should be removed from the site and properly disposed of at an acceptable location. Muck, either processed or unprocessed, may also be used as backfill provided it meets the specification requirements. Bentonite slurry, if used, should be disposed of in accordance with local and state regulations. Muck and slurry disposal are the responsibility of the contractor.

2.7 Pressure Grouting of Annular Space

After installation of the pipe, the annular space around the pipe should be pressure grouted under the observation of the geotechnical engineer. The volume of the required grout should be checked during placement. In addition, the portion of the launching pit below the invert level of the pipeline should be backfilled with structural concrete prior to installation of the remainder of the pipe.

2.8 Launching Pit Construction

Geometry

The launching pits should accommodate all ancillary tunneling equipment such as the jacking frame, the jacking unit, at least one length of steel casing, and/or carrier pipe, and the trust block. With some construction techniques, the launching pits need only accommodate the tunneling equipment and/or ancillary tunnel support equipment.

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Launching pit excavations are generally on the order of 4.6 meters by 10.7 meters in plan dimension, although smaller pits could be specified, if required.

Design of Lateral Support Systems for the Launching and Receiving Pits

Design of the temporary support system for the launching and receiving pits is the responsibility of the contractor. The design should be performed by a California Registered Civil Engineer who is retained by the contractor. Furthermore, the contractor, through his or her engineer is responsible for defining the final design parameters used for temporary shoring. The excavation should be designed and constructed in accordance with OSHA and other applicable federal, state, and local requirements.

Anticipated Shoring Types

The following construction methods may be suitable for the launching and receiving pits:

Soldier Piles and Steel Plate Lagging. A soldier-pile-and-steel-plate system is considered suitable for the anticipated ground conditions. Pre-drilled auger holes within the alluvial soils may have to be cased to prevent caving during drilling. Voids created behind the walls during construction should be backfilled with granular material to prevent surface settlement and damage to utilities and structures in the immediate vicinity.

Liner Plate. Liner plate shoring systems might be used for the launching pit construction. The excavation should proceed only in a “top-down” construction sequence. Excavation of the shaft should only slightly exceed the width of the liner plate, followed closely by the liner plate installation. The space between the liner plate and the ground should be grouted or backfilled with lean concrete at the end of the day, or more frequently, if necessary, for shaft stability.

2.9 Shaft Breakout

Alluvial soils will be encountered at the tunnel elevation and ground reinforcement may be necessary at the tunnel breakout. Depending of the type of shaft lining chosen by the contractor, pre-support prior to breakout may be required immediately outside of the shaft for stabilization. Ground reinforcement may include, but are not limited to, grouting, drilled spiling, or other suitable methods designed by the contractor.

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Additional structural members will likely be required in the shoring system at the breakout area.

2.10 Ground Settlement Monitoring

Ground losses (settlement) may occur as the result of soil movement in front of the excavation by means of raveling, caving, loose running, or flowing ground, or may also occur as a result of soil movement around the tunneling equipment. Ground losses may also occur as the result of soil movement downward toward the support system (casing). We recommend that the ground surface and other vital structures (utilities, roadways, etc.) be monitored for settlement and signs of distress prior to, during and following tunnel operations.

The contractor should have an onsite means of immediately controlling potential caving or other ground loss conditions that may occur in order to prevent any damage to utilities or roadway above the tunneling operations. Additionally, the contractor should provide for construction techniques to control raveling, and loose running conditions through proper equipment and installation selection and ground improvement techniques, such as pressure grouting, if required.

2.11 Cal-OSHA Gas Classification

Prior to initiating construction of a tunnel in the State of California, the Division of Occupational Safety and Health (OSH), Mining and Tunneling Unit of the Department of Industrial Relations is required to make a review and classification of the proposed tunnel ground conditions with respect to the presence of flammable gas or vapors. This classification should be included in the contract documents.

2.12 Construction Monitoring/Resident Engineering

Variation in the subsurface conditions may likely be encountered during construction. To proactively manage the construction risk associated with the difference that may exist between the geotechnical data contained in this report and the actual conditions encountered during tunnel excavation, and to provide periodic observation for the purpose of conformance with the plans and specifications, it is recommended that a tunneling consultant be retained to provide technical monitoring of the construction operations.

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3.0 LIMITATIONS

This addendum report has been prepared for the exclusive use of Lim & Nascimento Engineering Corporation, Riverside County Transportation Commission (RCTC), and Caltrans for specific application to the project. The findings, conclusions, and recommendations presented in this report were prepared in a manner consistent with the standards of care and skill ordinarily exercised by members of its profession practicing under similar conditions in the geographic vicinity and at the time the services will be performed. No warranty or guarantee, express or implied, is made.

The client has the responsibility to see that all parties to the project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. This report contains information, which may be useful in the preparation of contract specifications. However, the report is not designed as a specification document and may not contain sufficient information for this use without proper modification.

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The scope of our geotechnical services did not include any environmental site assessment for the presence or absence of hazardous/toxic materials. Kleinfelder will assume no responsibility or liability whatsoever for any claim, loss of value, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project sites, or from the discovery of such hazardous materials.

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We appreciate the opportunity to be of service on this project. Should you have any questions or comments concerning this letter please do not hesitate to contact the undersigned at your earliest convenience.

Respectfully submitted,
KLEINFELDER WEST, INC.

Carlos V. Amante, PE, GE
Geotechnical Group Manager

Richard F. Escandon, PG, CEG
Principal Geologist

Attachments: Plates 1a and 1b – Exploration Location Map
Appendix A – Previous Boring Data

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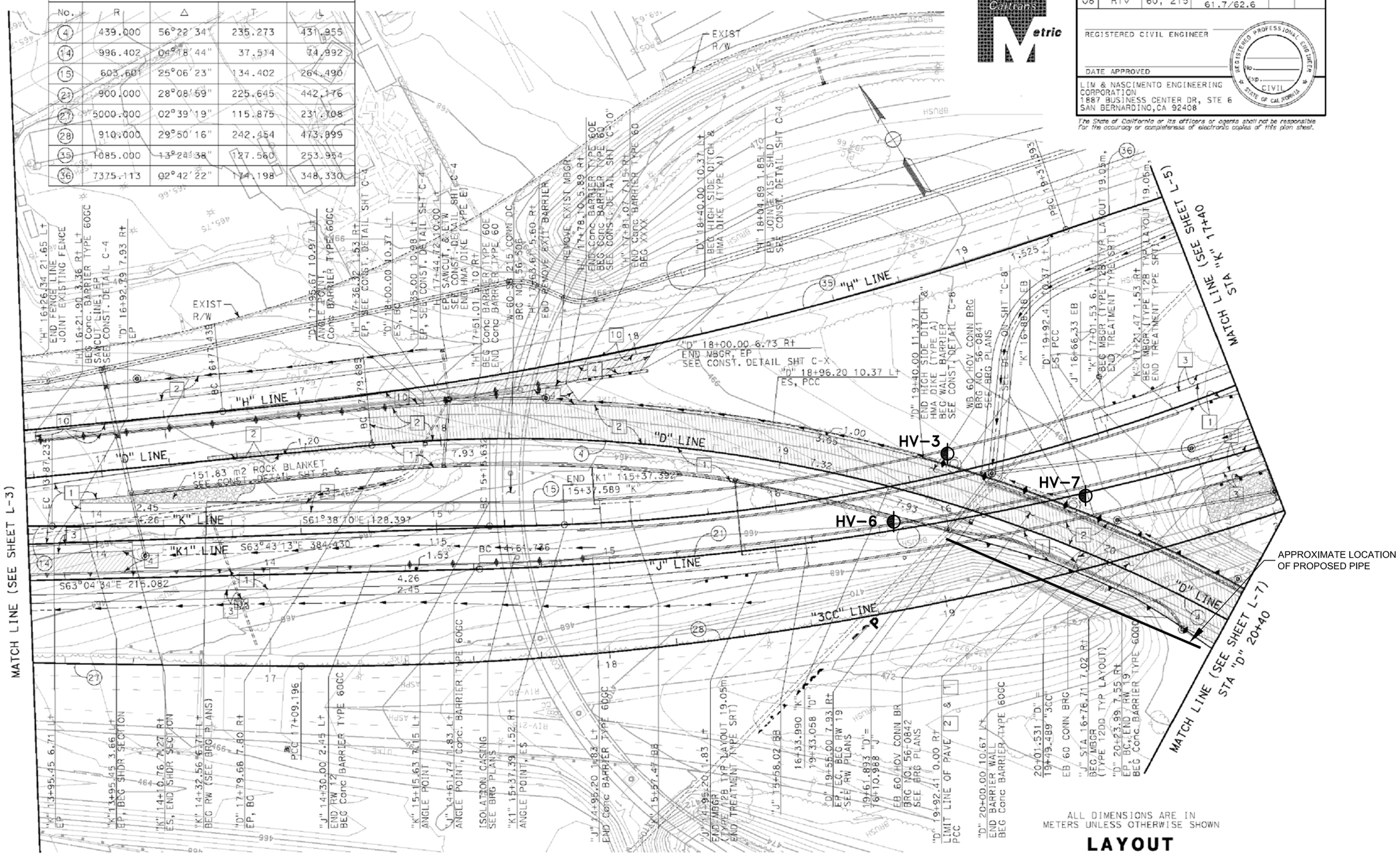
PLATES

EXPLORATION LOCATION MAP

ATTACHED IMAGES: Images: For plate 2b.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\032409_I-215_SR60(RCP)\ LAYOUT: 1 PLOTTED: 25 Mar 2009, 1:27pm, MGriffin

CURVE DATA				
No.	R	Δ	T	L
4	439.000	56°22'34"	235.273	431.955
14	996.402	04°18'44"	37.514	74.992
15	603.601	25°06'23"	134.402	264.490
21	900.000	28°08'59"	225.645	442.176
27	5000.000	02°39'19"	115.875	231.708
28	910.000	29°50'16"	242.454	473.999
35	1085.000	13°24'38"	127.560	253.954
36	7375.113	02°42'22"	174.198	348.330



DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

REGISTERED CIVIL ENGINEER

DATE APPROVED

LIM & NASCIMENTO ENGINEERING CORPORATION
1887 BUSINESS CENTER DR, STE 6
SAN BERNARDINO, CA 92408

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

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Caltrans **Metric**

EXPLANATION

HV-7 — APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

APPROXIMATE LOCATION OF PROPOSED PIPE

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REFERENCE: BASE MAP PROVIDED BY LAN ENGINEERING, DATED 8/20/2008.

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PROJECT NO.	76979
DRAWN:	3/24/09
DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p1a.dwg

EXPLORATION LOCATION MAP

PROPOSED 900-MM JACKED RCP
I-215/SR-60 EAST JUNCTION
RIVERSIDE COUNTY, CALIFORNIA

PLATE **1a**

ATTACHED IMAGES: Images: For Plate 2d.tif
ATTACHED XREFS:
DIAMOND BAR, CA
CAD FILE: L:\2009\CADD\76979\I-215_SR60\032409_I-215_SR60(RCP)\ LAYOUT: 1b PLOTTED: 25 Mar 2009, 1:38pm, MGriffin

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	60, 215	19.4/21.5 61.7/62.6		

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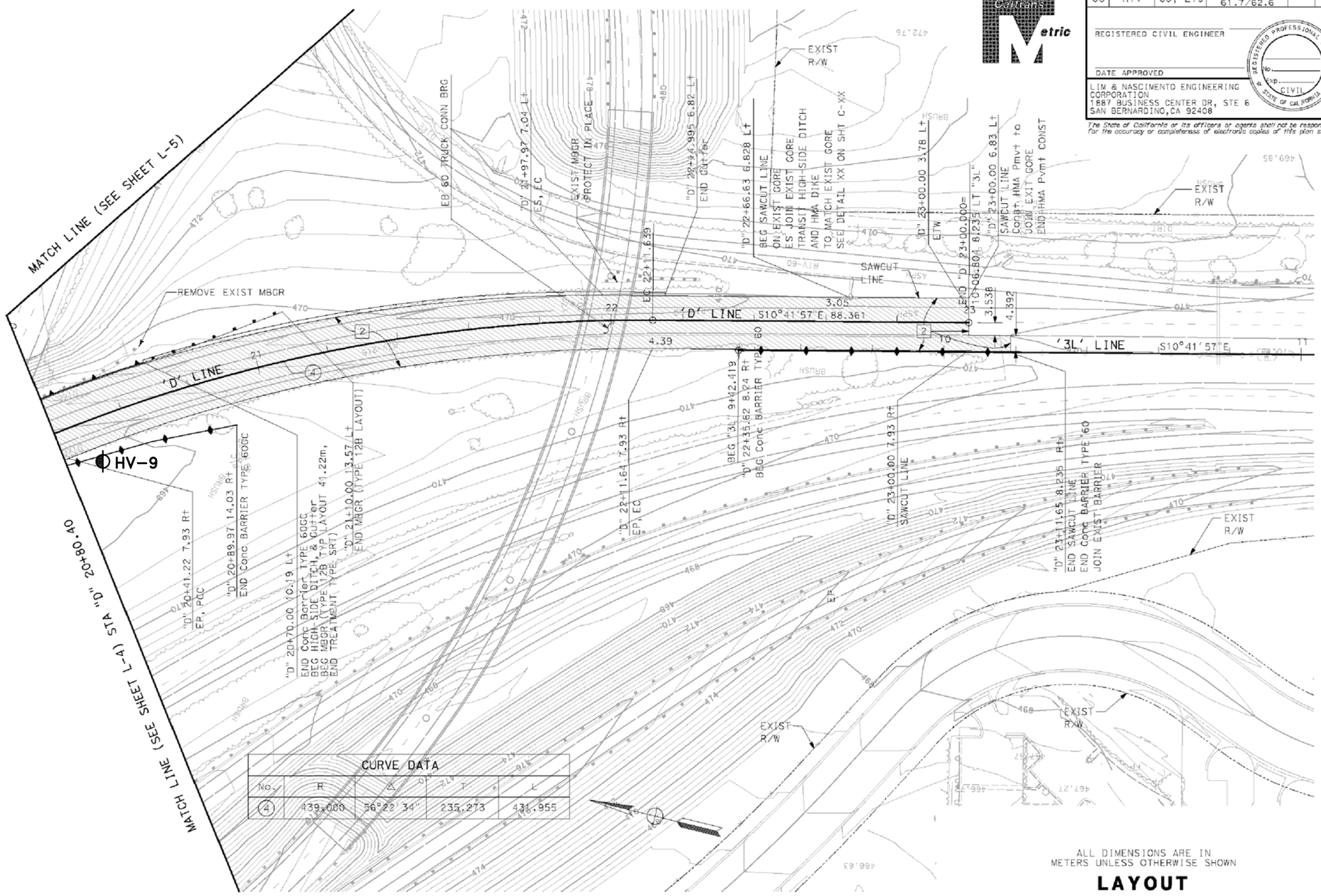

CURVE DATA				
No.	R	Δ	T	L
4	439.000	56°22'34"	235.273	431.955

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

LAYOUT

SCALE: 1:500 **L-7**

EXPLANATION

HV-9 APPROXIMATE KLEINFELDER BORING LOCATION, MARCH 2007.

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DRAWN BY:	MRG
CHECKED BY:	MC
FILE NAME:	76979p1b.dwg

EXPLORATION LOCATION MAP

PROPOSED 900-MM JACKED RCP
I-215/SR-60 EAST JUNCTION
RIVERSIDE COUNTY, CALIFORNIA

PLATE **1b**

APPENDIX A

PREVIOUS BORING DATA

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	ID	DESCRIPTION	MAJOR DIVISION		LTR	ID	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Well-graded gravels, gravel-sand mixtures	FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands
		GP		Poorly-graded gravels, gravel-sand mixtures			CL		Inorganic clays of low to medium plasticity; gravelly clays silty clays,sandy clays, lean clays
		GM		Silty gravels, gravel-sand-silt mixtures			OL		Organic silts and organic silt-clays of low plasticity
		GC		Clayey gravels, gravel-sand-clay mixtures		SILTS AND CLAYS LL > 50	MH		Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
	SAND AND SANDY SOILS	SW		Well-graded sands, gravelly sands			CH		Inorganic clays of medium to high plasticity
		SP		Poorly-graded sands and gravelly sands			OH		Organic clays of medium to high plasticity
		SM		Silty sands, sand-silt mixture		HIGHLY ORGANIC SOILS	Pt		Peat, muck and other highly organic soils
		SC		Clayey sands, sand-clay mixture					

▼ Approximate water level observed in boring following drilling

SOIL SAMPLE

- Bulk Sample
- Drive Sample - California Sample
- Shelby Tube Sample
- Standard Penetration Test (SPT) Sample

ADDITIONAL TESTS

CN	- Consolidation
COR	- Corrosion
CP	- Collapse Potential
DS	- Direct Shear
EI	- Expansion Potential
MAX	- Maximum Dry Density
OC	- Organic Content
PI	- Plasticity Index
RV	- R-Value
SE	- Sand Equivalent
GS	- Grain Size Distribution

NOTES:

Blow counts represent the number of blows of a 140-pound hammer falling 30 inches required to drive a sampler through the last 12 inches of an 18-inch penetration, unless otherwise noted.

The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings. Logs represent the soil section observed at the boring location on the date of drilling only.

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LEGEND TO LOGS

PLATE A-1

Date Drilled	3/8/07	Water Depth:	11 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/8/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	467 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1					**Fill**			
466	1	2	39			SM	**Silty Sand:** dark brown, dense, fine to coarse grained sand, with fine gravel and asphalt grindings			
465	2	3	29				--medium dense, asphalt grindings	15.3	6.6	
		4	13				--fine grained sand, trace medium sand, iron staining, gravel content decreasing			
464	3	5	4			SM	**Alluvium** **Silty Sand:** brown, slightly moist, loose			GS
463	4									
462	5	6	77			SM	**Silty Sand:** red-brown, slightly moist, very dense, fine to medium grained sand, trace clay	20.7	7.0	
461	6	7	33				--dense, fine grained sand			
460	7									
459	8	8	64			SC	**Clayey Sand:** brown, moist, very dense, fine grained sand			
458	9									
457		9	33, 50/13				--very dense			

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-2a

PROJECT NO. 76979

LOG OF BORING HV- 3

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAININ WALL.GPJ KA_RDLND.GDT 1/30/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
456 11	10	33, 50/13				--groundwater encountered at 11 meters			
455 12	11	50/75				**Bedrock:** Tonalite, gray-brown, wet, moderately weathered --drilling effort increases			
454 13									
453 14	12	50/75				--gray			
452 15						--very difficult drilling			
	13	50/75				--slightly weathered, moist, gray-brown, fine to medium grained	20.0	3.0	DS
451 16									
450 17	14	50/50				--wet Practical drill refusal at 17.1 meters			

Boring terminated at 17.1 meters due to practical refusal.
Groundwater encountered at 11 meters.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

LOG OF BORING HV- 3

PLATE
A-2b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAININ WALL.GPJ KA_RDLND.GDT 1/30/09

Date Drilled	3/6/07	Water Depth:	10 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/6/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	466 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium** **Silty Sand:** brown, dry, medium dense, fine grained sand			
465	1	1 2	27							
		3	22							
464	2									
		4	23			SW-SM	**Sand with Silt:** light brown, dry, medium dense, fine to coarse grained sand	17.2	1.2	DS
463	3	5	6				--loose			GS
462	4									
		6	43			SM	**Silty Sand:** brown, dry, dense, fine grained sand			
461	5									
460	6	7	29				--medium dense, trace clay			
459	7									
458	8	8	33, 50/13				--very dense, fine to medium grained, sand			
457	9	9	27, 50/13				--slightly moist			
456										

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-3a

PROJECT NO. 76979

LOG OF BORING HV- 6

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAININ WALL.GPJ KA_RDLND.GDT 1/30/09

Elevation (approx.) (meters) Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
						--groundwater encountered at 10.4 meters			
455 11	10	35, 50/13				--moist			
454 12	11	28, 50/10				--wet			
453 13									
452 14	12	41				--dense			
451 15	13	20, 50/13				--very dense, trace clay			
450 16									
449 17	14	34, 50/13				**Bedrock:** Tonalite, moderately weathered			
448 18									
447 19	15	50/100				--slightly weathered			
446 20	16	50/130							
445 21									

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I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

LOG OF BORING HV- 6

PLATE

A-3b

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAININ WALL.GPJ KA_RDLND.GDT 1/30/09

Elevation (approx.) (meters)	Depth	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
		17	50/130					18.4	20.8	
444	22									
443	23	18	50/100							
442	24									
		19	50/50							
441	25									

Practical drill refusal on on bedrock at approximately 25.3 meters

Boring terminated at 25.3 meters due to practical refusal.
Groundwater encountered at 10.4 meters.
Hole backfilled and tamped using soil from cuttings.

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PROJECT NO. 76979

I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

LOG OF BORING HV- 6

PLATE

A-3c

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAININ WALL.GPJ KA_RDLND.GDT 1/30/09

Date Drilled	3/6/07	Water Depth:	11 meters(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/6/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	468 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
						SM	**Alluvium** **Silty Sand:** light brown, dry, dense, fine to medium grained sand			
467	1	1 2	45							COR
466	2	3	24, 50/130				--very dense, light brown to olive-brown, mottled, trace clay	19.7	7.8	
		4	40, 50/130				--iron staining			
465	3	5	64							
464	4									
463	5	6	84				--brown, dry, fine to medium grained sand, trace clay	20.1	7.4	
462	6	7	37				--dense			
461	7									
460	8	8	35, 50/130				--very dense			
459	9	9	70							
458	10									

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 76979

I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

LOG OF BORING HV- 7

PLATE
A-4a

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAINING WALL.GPJ KA_RDLND.GDT 1/30/09

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION *(Continued From Previous Page)*	Dry Unit Weight (kN/m^3)	Moisture Content (%)	Additional Tests & Remarks
457	11	10	30, 50/13				--groundwater at 10.7 meters			
456	12	11	64							
455	13									
454	14	12	50/130				**Bedrock:** Tonalite, moderately weathered, fine to medium grained			
453	15	13	50/130				--slightly weathered, fine to coarse grained	17.4	6.1	
452	16									
451	17	14	50/100							
450	18	15	50/100							
449	19									
448	20	16	50/100							
447	21	17	50/25				--difficult drilling, unweathered bedrock Practical drill refusal at approximately 21.3 meters			

Boring terminated at 21.3 meters due to practical refusal.
Groundwater encountered at 10.7 meters.
Hole backfilled and tamped using soil from cuttings.

KLEINFELDER
Bright People. Right Solutions.

I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-4b

PROJECT NO. 76979

LOG OF BORING HV- 7

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAININ WALL.GPJ KA_RDLND.GDT 1/30/09

Date Drilled	3/7/07	Water Depth:	Not Encountered(approx.)
Drilled By:	Cal Pac Drilling	Date Measured:	3/7/07
Drilling Method:	200mm Hollow-stem auger	Elevation:	468 meters (approx.)
Logged By:	J. Perry	Datum:	MSL

Elevation (approx.)	Depth (meters)	Sample Number	Blows per 300 mm	Sample Type	Graphic Log	USCS Description	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	Dry Unit Weight (kN/m³)	Moisture Content (%)	Additional Tests & Remarks
		1					**Alluvium**			
467	1	2	50/130			SM	**Silty Sand:** light brown, slightly moist, very dense, fine to medium grained	19.9	6.6	
466	2	3	76				--slightly moist	19.6	9.4	
465	3	4	42				--dry, dense			GS
464	4	5	40, 50/13				--light brown, very dense, fine to medium grained sand			
463	5	6	48				--dense, trace clay			

Boring terminated at 5.0 meters.
Groundwater was not encountered.
Hole backfilled and tamped using soil from cuttings.

KLEINFELDER
Bright People. Right Solutions.

I-215/SR60 East Junction
Proposed Retaining Walls
Riverside, California

PLATE
A-5

PROJECT NO. 76979

LOG OF BORING HV- 9

Legend to Logs on Plate A-1

Note: The boundaries between soil and/or rock types shown on the logs are approximate as the transition between different soil layers may be gradual.

GEOTECH TEMECULA 76979 I-215 SR-60-RETAININ WALL.GPJ KA_RDLND.GDT 1/30/09

STATE OF CALIFORNIA ARNOLD SCHWARZENEGGER, Governor

DEPARTMENT OF INDUSTRIAL RELATIONS
DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT
464 West Fourth Street, Suite 354
San Bernardino, CA, 92401

Telephone (909) 383-6782
FAX (909) 388-7132

RECEIVED
JUN 30 2009

June 22, 2009

Mr. Norman V. Suydam, P.E.
Lim and Nascimento Engineering Corporation
1887 Business Center Drive Suite 6
San Bernardino, CA 92408

Subject: Underground Classification Numbers – C099-065-09T thru C103-065-09T
Drainage Systems No. 6, 12, 16, 17 & 23 – 60/215 East Junction HOV Gap Closure

Dear Mr. Suydam:

The information provided to this office relative to the above project has been reviewed. On the basis of this analysis, Underground Classifications of "Potentially-Gassy" have been assigned to the tunnel bores identified on your submittal. Please retain copies for your records and deliver true and correct copies of the Classification to the contractor(s) engaged in the work (for posting at the jobsite). In the future, any classification request will require a full size set of drawings.

A Pre-job Conference with the Division is required prior to commencing any activity associated with construction of tunnels. Also, be advised that, whenever an employee enters any bore or shaft being constructed under 30-inches in diameter, the Mining and Tunneling Unit then has immediate jurisdiction over that job. Please contact us prior to entering such spaces.

If you have any questions, please contact this office.

Sincerely,

Jim Henze
Senior Engineer

cc: Mr. Joseph Meraz, P.E.
Cal Trans District 8
464 West 4th Street 11th Floor
San Bernardino, CA 92401

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C099-065-09T

Cal-Trans District 8

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

464 West 4th Street 11th Floor San Bernardino, CA 92401

of

(MAILING ADDRESS)

Drainage System No. 6 - 60/215 East Junction HOV Gap Closure

at

(LOCATION)

*****POTENTIALLY-GASSY*****

has been classified as

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

SPECIAL CONDITIONS

1. The exact locations of an existing hazardous utility line such as the **jet fuel lines** in vicinity of the bore are to be field verified. In accordance with §1541, the excavator shall be notified by the facility owner/operator of the existence of the high priority subsurface installation before the legal excavation start date and time in accordance with Government Code Section 4216.2(a), and an onsite meeting involving the excavator and the subsurface installation owner/operator's representative shall be scheduled by the excavator and the owner/operator at a mutually agreed on time to determine the action or activities required to verify the location of such installations.

A 72-inch diameter estimated 633-feet long bore underneath the I-215 just west of the intersection of Box Springs Road and Morton Road between unknown construction stations, Riverside, Riverside County.

This classification shall be conspicuously posted at the place of employment.

Date June 22, 2009

Jim Henze, Senior Engineer

cc: File

01 02340

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C100-065-09T

Cal-Trans District 8

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

of 464 West 4th Street 11th Floor San Bernardino, CA 92401

(MAILING ADDRESS)

at **Drainage System No. 12 - 60/215 East Junction HOV Gap Closure**

(LOCATION)

has been classified as ***POTENTIALLY-GASSY***

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

An 18-inch inside diameter estimated 56-feet long bore up to the edge of pavement on the north bound 215 at the intersection of Box Springs Road and Morton Road between unknown construction stations, Riverside, Riverside County.

This classification shall be conspicuously posted at the place of employment.

Date June 22, 2009

Jim Henze, Senior Engineer

cc: File

91 02340

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C101-065-09T

Cal-Trans District 8

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

464 West 4th Street 11th Floor San Bernardino, CA 92401

of

(MAILING ADDRESS)

Drainage System No. 16 - 60/215 East Junction HOV Gap Closure

at

(LOCATION)

*****POTENTIALLY-GASSY*****

has been classified as

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

An 18-inch inside diameter estimated 110-feet long bore underneath the northbound 215 at the intersection of Box Springs Road and Morton Road estimated to be between unknown construction stations, Riverside, Riverside County.

This classification shall be conspicuously posted at the place of employment.

Date June 22, 2009

Jim Henze, Senior Engineer

cc: File

01 62246

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C102-065-09T

Cal-Trans District 8

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

464 West 4th Street 11th Floor San Bernardino, CA 92401

of

(MAILING ADDRESS)

Drainage System No. 17 - 60/215 East Junction HOV Gap Closure

at

(LOCATION)

*****POTENTIALLY-GASSY*****

has been classified as

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

A 34-inch inside diameter estimated 222-feet long bore underneath the southbound 215 connector to the eastbound 60 at the Moreno Valley interchange estimated to be between unknown construction stations, Riverside, Riverside County.

This classification shall be conspicuously posted at the place of employment.

Date June 22, 2009

Jim Henze, Senior Engineer

cc: File

State of California

Department of Industrial Relations

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH
MINING AND TUNNELING UNIT

San Bernardino Office R5D3

Underground Classification

C103-065-09T

Cal-Trans District 8

(NAME OF TUNNEL OR MINE AND COMPANY NAME)

464 West 4th Street 11th Floor San Bernardino, CA 92401

of

(MAILING ADDRESS)

Drainage System No. 23 - 60/215 East Junction HOV Gap Closure

at

(LOCATION)

*****POTENTIALLY-GASSY*****

has been classified as

(CLASSIFICATION)

as required by the California Labor Code Section 7955.

The Division shall be notified if sufficient quantities of flammable gas or vapors have been encountered underground. Classifications are based on the California Labor Code Part 9, Tunnel Safety Orders and Mine Safety Orders.

A 54-inch inside diameter estimated 113-feet long bore underneath the west bound 60 connector to the northbound I-215 just east of the intersection of Box Springs Road and Morton Road estimated to be between unknown construction stations, Riverside, Riverside County.

This classification shall be conspicuously posted at the place of employment.

Date June 22, 2009

Jim Henze, Senior Engineer

cc: File

91 02348

P3017-CI-00105

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

RECEIVED
MAR 31 2010
RIVERSIDE COUNTY TRANSPORTATION COMMISSION

RECEIVED
APR 01 2010
BECHTEL INFRASTRUCTURE CORPORATION

March 29, 2010

Ms. Patricia Castillo
Riverside County Transportation Commission
4080 Lemon Street, 3rd Floor
Riverside, CA 92501

REVISED CLEAN WATER ACT SECTION 401 WATER QUALITY STANDARDS CERTIFICATION FOR INTERSTATE-215 (I-215)/STATE ROUTE-60 (SR-60) CONNECTOR LANES TO EXISTING HIGH OCCUPANCY VEHICLE CONNECTOR PROJECT AT DAY STREET, UNINCORPORATED AREA, RIVERSIDE COUNTY (CORPS FILE NO. NOT AVAILABLE)(SARWQCB REFERENCE NO. 332010-02)

Dear Ms. Castillo:

This correspondence revises and replaces the Clean Water Act Section 401 Water Quality Standards Certification ("Certification") issued for this project on March 17, 2010 by this agency. Revisions have been made in response to comments received by representatives of your agency on March 17 and 25, 2010, that clarified certain project details.

On January 19, 2010, we received an application for Clean Water Act Section 401 Water Quality Standards Certification ("Certification") for the proposed expansion of two additional High Occupancy Vehicle (HOV) connector lanes to augment the existing HOV lanes on SR-60 at Day Street in an unincorporated area of Riverside 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: Construction of two new HOV connector lanes, which will connect the existing HOV lanes on SR-60 at Day Street to the I-215 lanes located west of Box Springs Road. This project includes:

1) The reconstruction of the northbound I-215 mainline to achieve a 16.5-foot clearance where I-215 crosses under eastbound SR-60;

2) The realignment and widening of Box Springs Road to accommodate the widening of northbound I-215 over the existing railroad tracks;

3) Converting an existing earthen channel, located adjacent to the railroad tracks at the northern portion of the realignment of Box Springs Road, to a soft-bottom rip-rap lined trapezoidal channel; and,

4) The installation of approximately 800 feet of 72-inch diameter reinforced concrete pipe (RCP), to drain the existing detention basin at the northeastern end of River Crest Drive, south of the I-215/SR-60 interchange, into the channel described in 3), above.

The project is located within Section 33 of Township 2 South and Range 4 West of the U.S. Geological Survey *Riverside East, California*, 7.5-minute topographic quadrangle map (117 17' 53" W/ 33 56' 50" N).

Receiving Waters: Unnamed tributary to Santa Ana River in the Box Springs Canyon area of Moreno Valley.

Fill Area: 0.01 acre of permanent impact to wetlands (161 linear feet). 0.15 acre of permanent impact to riparian habitat (318 linear feet) (includes impact to wetland).

Dredge Volume: 160 cubic yards.

Federal Permits: US Army Corps of Engineers Nationwide Permit No. 14.

You have proposed to mitigate water quality impacts as described in your Certification application. The proposed mitigation is summarized below:

Onsite Water Quality Standards Mitigation Proposed:

- Best Management Practices ("BMPs") will be specified in the project Storm Water Pollution Prevention Plan ("SWPPP").
- Any temporarily-impacted areas will be re-vegetated with native vegetation.

Offsite Water Quality Standards Mitigation Proposed:

- A total of 1.02 acres of riparian habitat within the same sub-watershed as this project will be enhanced, by removal of trash and exotic plant species, and

replanting with native, riparian habitat plant species. The project proponent will participate in the Santa Ana Watershed Association (SAWA) in-lieu fees program in order to enhance approximately 0.5 acre immediately upstream of the culvert crossing under I-215 at Central Avenue, within 1 mile of the project site. An additional 0.52 acre of enhancement will occur downstream of the culvert crossing in the vicinity of the Quail Run Open Space Area, in the City of Riverside.

Should the proposed project impact state- or federally-listed endangered species or their habitat, implementation of measures identified in consultation with U.S. Fish and Wildlife Service and the California Department of Fish and Game will ensure those impacts are mitigated to an acceptable level. Appropriate BMPs will be implemented to reduce construction-related impacts to Waters of the State in compliance with to the requirements of State Water Resources Control Board Order No. 2009-0009, General Permit for Discharges of Storm Water Associated with Construction Activities, including the preparation of a SWPPP.

Post-construction water quality impacts resulting from the use of the I-215 and SR-60 right-of-way improvement projects that are certified by this document 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, and subsequent iterations thereof. These requirements include the development and implementation of appropriate Best Management Practices for the purpose of removing transportation-related pollutants from discharges from Caltrans' rights-of-way and easements.

This Water Quality Certification is subject to the acquisition of all local, regional, state, and federal permits and approvals as required by law. Failure to meet any conditions contained herein, or any conditions contained in any other permit or approval for this project issued by the State of California, or any subdivision thereof, may result in appropriate enforcement action, including imposition of administrative civil liability.

You have applied for a permit from the U.S. Army Corps of Engineers, in compliance with Clean Water Act Section 404. The proposed project is subject to U.S. Army Corps of Engineers' CWA Section 404 Nationwide Permit 14. CalTrans approved a California Environmental Quality Act (CEQA) Environmental Impact Report (combined with a National Environmental Protection Act Environmental Impact Statement) for the project, in 2002. At the request of the Regional Board, an addendum to the CEQA report was prepared in December 2009. The Regional Board has considered CalTrans' 2002 Environmental Impact Report and its subsequent 2009 addendum in the issuance of this Certification.

This 401 Certification is contingent upon the execution of the following conditions:

1) The applicant must comply with the requirements of the applicable Clean Water Act Section 404 permit.

2) 1.02 acres of riparian habitat enhancements shall be implemented as proposed. All riparian habitat vegetation enhancements shall be fully established prior to the project's completion.

3) Areas that are temporarily impacted shall be mitigated as proposed.

4) Maintenance of the 1.02 acres of riparian enhancements shall strictly adhere to the proposed habitat enhancement plan for this project.

5) The proposed habitat enhancement plan for this project shall be submitted for Board staff approval within 90 days of the issuance of this certification. The habitat enhancement plan shall be revised to incorporate Board staff comments.

6) A copy of this Certification and any subsequent amendments must be maintained on site for the duration of work.

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.

The Clean Water Act Section 401 Water Quality Standards Certification issued for this project on March 17, 2010, is withdrawn.

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 Marc Brown at (951) 321-4584, or Mark Adelson at (951) 782-3234.

Sincerely,

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
U.S. EPA – Supervisor of the Wetlands Regulatory Office WTR- 8

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California Natural Resources Agency
DEPARTMENT OF FISH AND GAME
Inland Desert Region
3602 Inland Empire Blvd, Suite C-220
Ontario, CA 91764
(909) 484-0459
www.dfg.ca.gov

ARNOLD SCHWARZENEGGER, Governor
JOHN MC CAMMAN, Director

April 1, 2010

Patricia Castillo
Riverside County Transportation Commission
4080 Lemon Street, 3rd Floor
Riverside, CA 92501

Subject: Notification of Lake or Streambed Alteration No. 1600-2008-0166-R6
Interstate 215 and State Route 60 East Junction High Occupancy Vehicle (HOV) Lane Connector impacting an unnamed tributary to the Santa Ana River

Dear Ms. Castillo:

The Department had until March 30, 2010 to submit a draft Lake or Streambed Alteration Agreement ("Agreement") to you or inform you that an Agreement is not required. The Department did not meet that date. As a result, by law, you may now complete the project described in your notification without an Agreement.

Please note that pursuant to Fish and Game Code section 1602(a)(4)(D), if you proceed with this project, it must be the same as described and conducted in the same manner as specified in the notification and any modifications to that notification received by the Department in writing prior to March 30, 2010. This includes completing the project within the proposed term and seasonal work period and implementing all avoidance and mitigation measures to protect fish and wildlife resources specified in the notification. If the term proposed in your notification has expired, you will need to re-notify the Department before you may begin your project. Beginning or completing a project that differs in any way from the one described in the notification may constitute a violation of Fish and Game Code section 1602.

The project will begin construction on or after September 30, 2010 and will terminate by April 29, 2013 and will include the following project aspects: 1) construction of two new HOV connector lanes, which will connect the existing HOV lanes on State Route 60 at Day Street to the Interstate 215 HOV lanes located west of Box Springs Road, 2) reconstruction of the northbound Interstate 215 mainline to achieve a standard 16.5-foot vertical clearance where Interstate 215 crosses under eastbound State Route 60, 3) realignment and widening of Box Springs Road to accommodate the widening of northbound Interstate 215 over the existing railroad tracks and 4) conversion of 318 feet of existing earthen-lined channel to a soft-bottom, rip-rap lined, open, trapezoidal channel located adjacent to the railroad tracks at the northern portion of the realigned Box Springs Road. Included in the conversion of the earthen-lined channel to a rip-rap lined channel would be the addition of a 72-inch diameter reinforced concrete pipe

(RCP) from the existing detention basin at the end of River Crest Drive to approximately 318 feet north of the existing Box Springs Frontage Road and the replacement of an existing 48-inch diameter pipe with a 60-inch diameter RCP and a bioswale north of the westbound State Route 60 mainline, south of the existing Box Springs Frontage Road and 140 feet south of Morton Road. Mitigation measures included for this project include the following: 1) observance of the nesting bird season from March 15th through September 15th with no vegetation removal to occur during this timeframe, 2) permanent impacts of 0.34 acres of riparian vegetation, with no other impacts to riparian vegetation, temporary or permanent, 3) purchase of 1.02 acres of mitigation credits through the Riverside County Park and Open Space District for permanent loss of 0.34 acres of riparian habitat and 4) observance of all best management practices (BMPs) and erosion control measures to ensure sediment deposit from the project area is not carried downstream as a result of this project. Receipt of the purchase of mitigation credits is due to the Department prior to ground-breaking activities commencing on this project. A final report, which will include site before and after photographs and all activities that occurred in jurisdictional areas, is due to the Department after the project is completed by June 30, 2013.

Also note that while you are entitled to complete the project without an Agreement, you are still responsible for complying with other applicable local, state, and federal laws. These include, but are not limited to, the state and federal Endangered Species Acts and Fish and Game Code sections 5650 (water pollution) and 5901 (fish passage).

Finally, if you decide to proceed with your project without an Agreement, you must have a copy of this letter and your notification with all attachments available at all times at the work site. If you have any questions regarding this matter, please contact me at (909) 987-8397 or MDFlores@dfg.ca.gov.

Sincerely,

Michael D. Flores
Environmental Scientist

cc: Wendy Walters, LSA Associates

DEPARTMENT OF THE ARMY
P.O. Box 532711
Los Angeles, CA 90017-3401

March 31, 2010

REPLY TO
ATTENTION OF:

Office of the Chief
Regulatory Division

DEPARTMENT OF THE ARMY NATIONWIDE PERMIT AUTHORIZATION

Patricia Castillo
Riverside County Transportation Commission
C/O: Wendy Walters
LSA Associates, Inc
1500 Iowa Avenue
Suite 200
Riverside, California 92507-7402

Dear Ms. Walters:

This is in reply to your application (File No. SPL-2009-00198-VCC) dated January 13, 2010, for a Department of the Army Permit to discharge 0.15 acre of permanent fill material into waters of the U.S., in association with the Interstate 215/State Route 60 East Junction East-West High Occupancy Vehicle (HOV) Connector Project. The proposed work would take place in an unnamed tributary of Box Springs Canyon within the City of Moreno Valley, Riverside County, California (see Figure 2 enclosed).

Based on the information you have provided, the Corps of Engineers has determined that your proposed activity complies with the enclosed terms and conditions of Nationwide Permit No. NWP 14 Linear Transportation Projects, as described in enclosure 1.

Specifically, you are authorized to:

1. Permanently discharge approximately 642 cubic yards of riprap and structure fill material for the reconstruction of the 318 linear foot and 12 to 20 foot wide earthen channel to a 42 foot wide soft bottom un-grouted riprap lined channel and approximately 97 cubic yards for the construction of headwalls and wingwalls into 0.14 acre of non-wetland waters of the U.S. and 0.01 acre of wetland waters of the U.S.
2. Conduct temporary construction access and water diversion activities within 0.14 acre of non-wetland waters of the U.S. and 0.01 acre of wetland waters of the U.S.

Furthermore, you must comply with the following non-discretionary Special Conditions:

Special Conditions:

1) Thirty (30) days prior to initiating construction in waters of the U.S., and to mitigate for impacts to 0.14 acre of non-wetland and 0.01 acre of wetland waters of the U.S., the Permittee shall provide documentation verifying purchase of one (1) acre of credits for the enhancement of wetland or riparian waters of the U.S. from a Corps-approved mitigation bank or in-lieu fee program (ILFP). The Permittee shall not initiate work in waters of the U.S. prior to receiving written confirmation (by letter or e-mail) from the Corps Regulatory Division as to compliance with this special condition. The Permittee retains responsibility for providing the compensatory mitigation until the number and resource type of credits described above have been secured from a sponsor and the district engineer has received documentation that confirms that the sponsor has accepted the responsibility for providing the required compensatory mitigation. This documentation may consist of a letter or form signed by the sponsor, with the permit number and a statement indicating the number and resource type of credits that have been secured from the sponsor.

2) The Permittee shall clearly mark the limits of the workspace with flagging or similar means to ensure mechanized equipment does not enter preserved waters of the U.S. and riparian wetland/habitat areas shown on Figure 2. Adverse impacts to waters of the U.S. beyond the Corps-approved construction footprint are not authorized. Such impacts could result in permit suspension and revocation, administrative, civil or criminal penalties, and/or substantial, additional, compensatory mitigation requirements

3) Prior to initiating construction in waters of the U.S., the Permittee shall submit to the Corps Regulatory Division a complete set of final detailed grading/construction plans showing all work and structures in waters of the U.S. All plan sheets shall be signed, dated, and submitted on paper no larger than 11x 17 inches. No work in waters of the U.S. is authorized until the Permittee receives, in writing (by letter or e-mail), Corps Regulatory Division approval of the final detailed grading/construction plans. The Permittee shall ensure that the project is built in accordance with the Corps-approved plans.

4) Pursuant to the requirements of the Migratory Bird Treaty Act, the Permittee shall not remove vegetation from waters of the United States between March 1 and August 30 of any given year without performing a bird nesting survey using a qualified biologist. The Permittee shall not remove vegetation earlier than August 30, if the survey indicates presence of active nests.

5) Within 45 calendar days of completion of authorized work in waters of the U.S., the Permittee shall submit to the Corps Regulatory Division a post-project implementation memo including:
A) Date authorized impacts to waters of the U.S. ceased;
B) Photographs taken at the project site before, during and after construction; and
C) One copy of "as built" drawings

6) The Permittee shall abide by the terms and conditions of the Clean Water Act (CWA) Section 401 Water Quality Standards Certification.

This verification is valid until the NWP is modified, reissued, or revoked. All of the existing NWPs are scheduled to be modified, reissued, or revoked prior to March 18, 2012. It is incumbent upon you to remain informed of changes to the NWPs. We will issue a public notice when the NWPs are reissued. Furthermore, if you commence or are under contract to commence this activity before the date that the relevant nationwide permit is modified or revoked, you will have twelve (12) months from the date of the modification or revocation of the NWP to complete the activity under the present terms and conditions of this nationwide permit.

A nationwide permit does not grant any property rights or exclusive privileges. Also, it does not authorize any injury to the property or rights of others or authorize interference with any existing or proposed Federal project. Furthermore, it does not obviate the need to obtain other Federal, state, or local authorizations required by law.

Thank you for participating in our regulatory program. If you have any questions, please contact Veronica Chan at 213-452-3292 or via e-mail at Veronica.C.Chan@usace.army.mil.

Please be advised that you can now comment on your experience with Regulatory Division by accessing the Corps web-based customer survey form at: http://per2.nwp.usace.army.mil/survey.html.

Sincerely,

Mark Durham for

Mark D. Cohen
Deputy Chief
Regulatory Division

Enclosure

LOS ANGELES DISTRICT
U.S. ARMY CORPS OF ENGINEERS

CERTIFICATION OF COMPLIANCE WITH
DEPARTMENT OF THE ARMY NATIONWIDE PERMIT

Permit Number: *SPL-2009-00198-VCC*

Name of Permittee: *Riverside County Transportation Commission, Patricia Castillo*

Date of Issuance: *March 31, 2010*

Upon completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the following address:

U.S Army Corps of Engineers
Regulatory Division
ATTN: CESPL-RG-SPL-2009-00198-VCC
P.O. Box 532711
Los Angeles, CA 90017-3401

Please note that your permitted activity is subject to a compliance inspection by an Army Corps of Engineers representative. If you fail to comply with this nationwide permit you may be subject to permit suspension, modification, or revocation procedures as contained in 33 CFR 330.5 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5.

I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the said permit, and required mitigation was completed in accordance with the permit condition(s).

_____ _____

Signature of Permittee Date

Enclosure 1: NATIONWIDE PERMIT NUMBER(S) NWP 14 Linear Transportation Projects. TERMS AND CONDITIONS

1. Nationwide Permit(s) NWP 14 Linear Transportation Projects. Terms:

Your activity is authorized under Nationwide Permit Number(s) NWP 14 Linear Transportation Projects and NWP 33 Temporary Construction Access and Dewatering subject to the following terms:

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).

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.

2. Nationwide Permit General Conditions:
The following general conditions must be followed in order for any authorization by an NWP to be valid:

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 preconstruction 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 preconstruction 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 speciesspecific 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 preconstruction 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 preconstruction 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 preconstruction 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:

(1) Until 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) If 45 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 be 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 preconstruction 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 preconstruction 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 preconstruction 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) *District Engineer's Decision*: 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.

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.

3. Regional Conditions for the Los Angeles District:

In accordance with General Condition Number 23, "Regional and Case-by-Case Conditions," the following Regional Conditions, as added by the Division Engineer, must be met in order for an authorization by any Nationwide to be valid:

1. For coastal watersheds from the southern reach of the Santa Monica Mountains in Los Angeles County to the San Luis Obispo County/Monterey County boundary, all road crossings must employ a bridge crossing design that ensures passage and/or spawning of steelhead (*Oncorhynchus mykiss*) is not hindered in any way. In these areas, bridge designs that span the stream or river, including designs for pier- or pile-supported spans, or designs based on use of a bottomless arch culvert simulating the natural stream bed (i.e., substrate and streamflow conditions in the culvert are similar to undisturbed stream bed channel conditions) shall be employed unless it can be demonstrated the stream or river does not support resources conducive to the recovery of federally listed anadromous salmonids, including migration of adults and smolts, or rearing and spawning. This proposal also excludes approach embankments into the channel unless they are determined to have no detectable effect on steelhead.

2. For the State of Arizona and the Mojave and Sonoran (Colorado) desert regions of California in Los Angeles District (generally north and east of the San Gabriel, San Bernardino, San Jacinto, and Santa Rosa mountain ranges, and south of Little Lake, Inyo County), no nationwide permit, except Nationwide Permits 1 (Aids to Navigation), 2 (Structures in Artificial Canals), 3 (Maintenance), 4 (Fish and Wildlife Harvesting, Enhancement, and Attraction Devices and Activities), 5 (Scientific Measurement Devices), 6 (Survey Activities), 9 (Structures in Fleeting and Anchorage Areas), 10 (Mooring Buoys), 11 (Temporary Recreational Structures), 20 (Oil Spill Cleanup), 22 (Removal of Vessels), 27 (Stream and Wetland Restoration Activities), 30 (Moist Soil Management for Wildlife), 31 (Maintenance of Existing Flood Control Projects), 32 (Completed Enforcement Actions), 35 (Maintenance Dredging of Existing Basins), 37 (Emergency Watershed Protection and Rehabilitation), 38 (Cleanup of Hazardous and Toxic Waste) and 47 (Pipeline Safety Program Designated Time Sensitive Inspections and Repairs), or other nationwide or regional general permits that specifically authorize maintenance of previously authorized structures or fill, can be used to authorize the discharge of dredged or fill material into a jurisdictional special aquatic site as defined at 40 CFR Part 230.40-45 (sanctuaries and refuges, wetlands, mudflats, vegetated shallows, coral reefs, and riffle-and-pool complexes).

3. For all projects proposed for authorization by nationwide or regional general permits where prior notification to the district engineer is required, applicants must provide color photographs or color photocopies of the project area taken from representative points documented on a site map. Pre-project photographs and the site map would be provided with the permit application. Photographs should represent conditions typical or indicative of the resources before impacts.

4. Notification pursuant to general condition 27 shall be required for projects in all special aquatic sites as defined at 40 CFR Part 230.40-45 (sanctuaries and refuges, wetlands, mudflats, vegetated shallows, coral reefs, and riffle-and-pool complexes), and in all perennial waterbodies in the State of Arizona and the Mojave and Sonoran (Colorado) desert regions of California in Los Angeles District (generally north and east of the San Gabriel, San Bernardino, San Jacinto, and Santa Rosa mountain ranges, and south of Little Lake, Inyo County), excluding the Colorado River from Davis Dam downstream to the north end of Topock and downstream of Imperial Dam (Federal Register dated March 12, 2007 (72 FR 11092) - regional conditions requiring notification do not apply to Nationwide Permit 47).

5. Notification pursuant to general condition 27 shall be required for projects in all areas designated as Essential Fish Habitat by the Pacific Fishery Management Council (i.e., all tidally influenced areas - Federal Register dated March 12, 2007 (72 FR 11092), regional conditions requiring notification do not apply to Nationwide Permit 47).

6. Notification pursuant to general condition 27 shall be required for projects in all watersheds in the Santa Monica Mountains in Los Angeles and Ventura counties bounded by Calleguas Creek on the west, by Highway 101 on the north and east, and by Sunset Boulevard and Pacific Ocean on the south (Federal Register dated March 12, 2007 (72 FR 11092) - regional conditions requiring notification do not apply to Nationwide Permit 47).

7. Individual permits shall be required for all discharges of fill material in jurisdictional vernal pools.

8. Individual permits shall be required in Murrieta Creek and Temecula Creek watersheds in Riverside County for new permanent fills in perennial and intermittent watercourses otherwise authorized under NWPs 29, 39, 42 and 43, and in ephemeral watercourses for these NWPs for projects that impact greater than 0.1 acre of waters of the United States. In addition, when NWP 14 is used in conjunction with residential, commercial, or industrial developments the 0.1 acre limit would also apply.

9. Individual permits shall be required in San Luis Obispo Creek and Santa Rosa Creek in San Luis Obispo County for bank stabilization projects, and in Gaviota Creek, Mission Creek and Carpinteria Creek in Santa Barbara County for bank stabilization projects and grade control structures.

10. Notification pursuant to general condition 27 shall be required for projects in the Santa Clara River watershed in Los Angeles and Ventura counties, including but not limited to Aliso Canyon, Agua Dulce Canyon, Sand Canyon, Bouquet Canyon, Mint Canyon, South Fork of the Santa Clara River, San Francisquito Canyon, Castaic Creek, Piru Creek, Sespe Creek and the main-stem of the Santa Clara River (Federal Register dated March 12, 2007 (72 FR 11092) - regional conditions requiring notification do not apply to Nationwide Permit 47).

4. Further information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:
   ( ) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).
   (X) Section 404 of the Clean Water Act (33 U.S.C. 1344).
   ( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

2. Limits of this authorization.
   (a) This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.
   (b) This permit does not grant any property rights or exclusive privileges.
   (c) This permit does not authorize any injury to the property or rights of others.
   (d) This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:
   (a) Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.
   (b) Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.
   (c) Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.
   (d) Design or construction deficiencies associated with the permitted work.
   (e) Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:
   (a) You fail to comply with the terms and conditions of this permit.
   (b) The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).
   (c) Significant new information surfaces which this office did not consider in reaching the original public interest decision.

   Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 330.5 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measure ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you

for the cost.

6. This letter of verification is valid for a period not to exceed two years unless the nationwide permit is modified, reissued, revoked, or expires before that time.

7. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition H below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

8. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished with the terms and conditions of your permit.

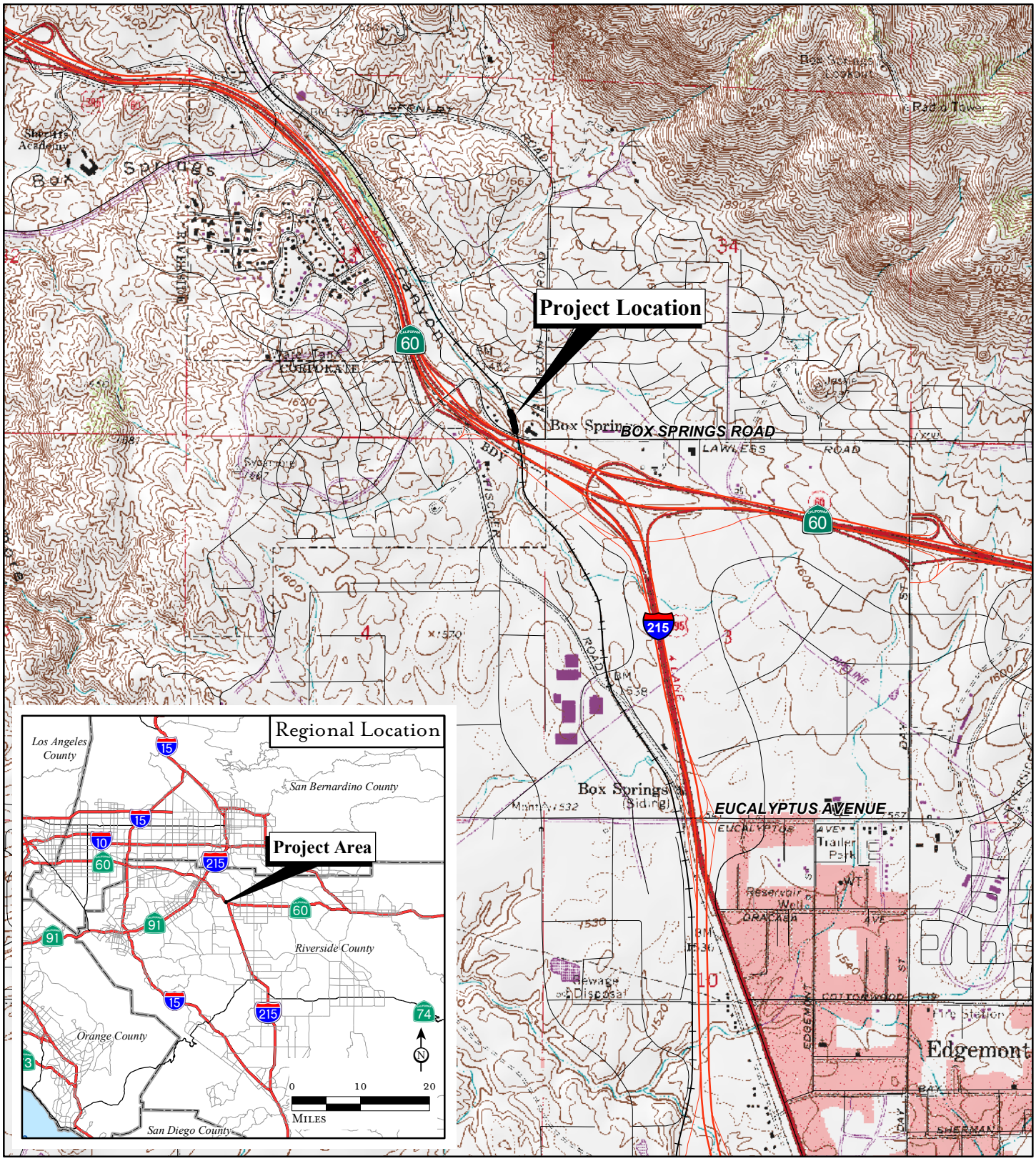

FIGURE 1

N

0 1,000 2,000

Feet

SOURCE: USGS 7.5' Quad: Riverside East (80), CA; Thomas Bros., 2007

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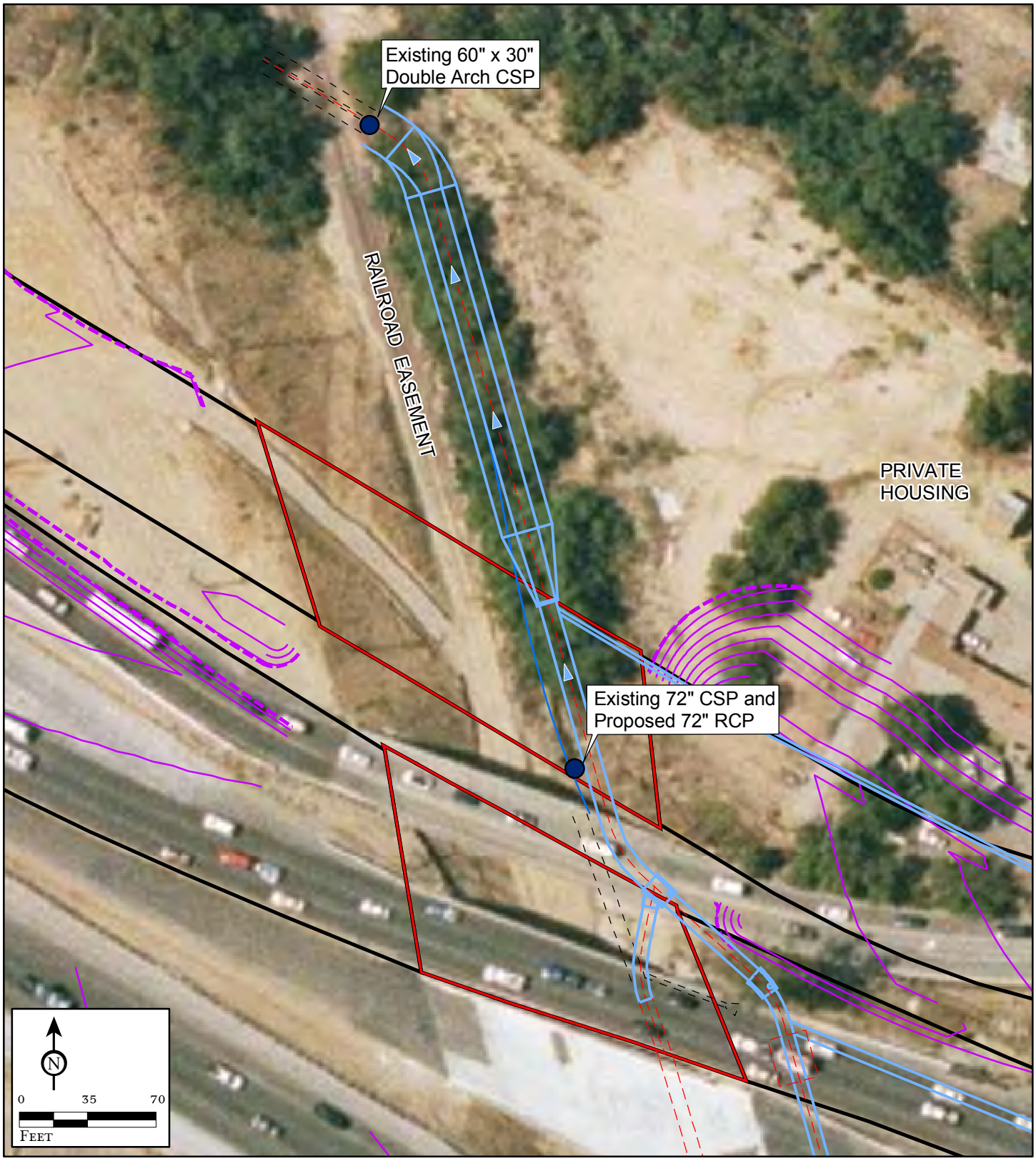
I-215/SR-60 East Junction EW HOV Connector

Delineation of Potential Jurisdictional Waters

Regional and Project Location



LSA

FIGURE 2

ROADWAY IMPROVEMENT
BRIDGE IMPROVEMENT
PROPOSED FLOW PATH
CULVERT

DRAINAGE IMPROVEMENT
EXISTING STORM DRAIN
PROPOSED CONTOUR GRADING
PROPOSED CUT AND FILL
EXISTING DRAINAGE CHANNEL

I-215/SR-60 East Junction EW HOV Connector
DBESP

Proposed Project Design

SOURCE: AirPhotoUSA (2007), Lan Engineering (2008).

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Guidelines for Design and Construction near Kinder Morgan Hazardous Liquid Operated Facilities

Name of Company:

The list of design, construction and contractor requirements, including but not limited to the following, for the design and installation of foreign utilities or improvements on KM right-of-way (ROW) are not intended nor do they waive or modify any rights KM may have under existing easements or ROW agreements. Reference existing easements and amendments for additional requirements. This list of requirements is applicable for KM facilities on easements only. Encroachments on fee property should be referred to the ROW Department.

Design

- KM shall be provided sufficient prior notice of planned activities involving excavation, blasting, or any type of construction on KM's ROW to determine and resolve any location, grade or encroachment problems and provide protection of our facilities and the public **before** the actual work is to take place.

- Encroaching entity shall provide KM with a set of drawings for review and a set of final construction drawings showing all aspects of the proposed facilities in the vicinity of KM's ROW. The encroaching entity shall also provide a set of as-built drawings showing the proposed facilities in the vicinity of KM's ROW.

- Only facilities shown on drawings reviewed by NameCompany (Company) will be approved for installation on KM's ROW. All drawing revisions that effect facilities proposed to be placed on KM's ROW must be approved by KM in writing.

- KM shall approve the design of all permanent road crossings.

- Any repair to surface facilities following future pipeline maintenance or repair work by KM will be at the expense of the developer or landowner.

- The depth of cover over the KM pipelines shall not be reduced nor drainage altered without KM's written approval.

- Construction of any permanent structure, building(s) or obstructions within KM pipeline easement is **not** permitted.

- Planting of shrubs and trees is not permitted on KM pipeline easement.

- Irrigation equipment i.e. backflow prevent devices, meters, valves, valve boxes, etc. shall not be located on KM easement.

- Foreign line, gas, water, electric and sewer lines, etc., may cross perpendicular to KM's pipeline within the ROW, provided that a minimum of two (2) feet of vertical clearance is maintained between KM pipeline(s) and the foreign pipeline. Constant line elevations must be maintained across KM's entire ROW width, gravity drain lines are the only exception. Foreign line crossings below the KM pipeline must be evaluated by KM to ensure that a significant length of the KM line is not exposed and unsupported during construction. When installing underground utilities, the last line should be placed beneath all existing lines unless it is impractical or unreasonable to do so. Foreign line crossings above the KM pipeline with less than 2 feet of clearance must be evaluated by KM to ensure that additional support is not necessary to prevent settling on top of the KM hazardous liquids pipeline.

- A foreign pipeline shall cross KM facilities at as near a ninety-degree angle as possible. A foreign pipeline shall not run parallel to KM pipeline within KM easement without written permission of KM.

- The foreign utility should be advised that KM maintains cathodic protection on their pipelines. The foreign utility must coordinate their cathodic protection system with KM's. At the request of KM, foreign utilities shall install (or allow to be installed) cathodic protection test leads at all crossings for the purposes of monitoring cathodic protection. The KM Cathodic Protection (CP) technician and the foreign utility CP technician shall perform post construction CP interference testing. Interference issues shall be resolved by mutual agreement between foreign utility and KM. All costs associated with the correction of cathodic protection problems on KM pipeline as a result of the foreign utility crossing shall be borne by the foreign utility for a period of one year from date the foreign utility is put in service.

- The metallic foreign line shall be coated with a suitable pipe coating for a distance of at least 10 feet on either side of the crossing unless otherwise requested by the KM CP Technician.

- AC Electrical lines must be installed in conduit and properly insulated.
- DOT approved pipeline markers shall be installed so as to indicate the route of the foreign pipeline across the KM ROW.
- No power poles, light standards, etc. shall be installed on KM easement
- No pipeline may be located within 50 feet (15 meters) of any private dwelling, or any industrial building or place of public assembly in which persons work, congregate, or assemble.

Construction

- Contractors shall be advised of KM's requirements and be contractually obligated to comply.
- The continued integrity of KM's pipelines and the safety of all individuals in the area of proposed work near KM's facilities are of the utmost importance. Therefore, contractor must meet with KM representatives prior to construction to provide and receive notification listings for appropriate area operations and emergency personnel. **KM's on-site representative will require discontinuation of any work that, in his opinion, endangers the operations or safety of personnel, pipelines or facilities.**
- The Contractor must expose all KM pipelines prior to crossing to determine the exact alignment and depth of the lines. A KM representative must be present. In the event of parallel lines, only one pipeline can be exposed at a time.
- KM will not allow pipelines to remain exposed overnight without consent of KM designated representative. Contractor may be required to backfill pipelines at the end of each day.
- A KM representative shall do all line locating. A KM representative shall be present for hydraulic excavation. The use of probing rods for pipeline locating shall be performed by KM representatives only, to prevent unnecessary damage to the pipeline coating.
- Notification shall be given to KM at least 72 hours before start of construction. A schedule of activities for the duration of the project must be made available at that time to facilitate the scheduling of Kinder Morgan, Inc.'s work site representative. Any Contractor schedule changes shall be provided to Kinder Morgan, Inc. immediately.
- Heavy equipment will not be allowed to operate directly over KM pipelines or in KM ROW unless written approval is obtained from (Company). Heavy equipment shall only be allowed to cross KM pipelines at locations designated by Kinder Morgan, Inc. Contractor shall comply with all precautionary measures required by KM to protect its pipelines. When inclement weather exists, provisions must be made to compensate for soil displacement due to subsidence of tires. Equipment excavating within ten (10) feet of KM Pipelines will have a plate guard installed over the teeth to protect the pipeline.
- Excavating or grading which might result in erosion or which could render the KM ROW inaccessible shall not be permitted unless the contractor/developer/owner agrees to restore the area to its original condition and provide protection to KM's facility.
- A KM representative shall be on-site to observe any construction activities within ten (10) feet of a KM pipeline or aboveground appurtenance. The contractor **shall not** work within this distance without a KM representative being on site. Only hand excavation shall be permitted within two (2) feet of KM pipelines, valves and fittings unless State requirements are more stringent. However, proceed with extreme caution when within three (3) feet of the pipe.
- A KM representative will monitor construction activity within 25 feet of KM facilities during and after the activities to verify the integrity of the pipeline and to ensure the scope and conditions agreed to have not changed. Monitoring means to conduct site inspections on a pre-determined frequency based on items such as: scope of work, duration of expected excavator work, type of equipment, potential impact on pipeline, complexity of work and/or number of excavators involved.
- Ripping is only allowed when the position of the pipe is known and not within ten (10) feet of KM facility unless company representative is present.
- Temporary support of any exposed KM pipeline by Contractor may be necessary if required by KM's on-site representative. Backfill below the exposed lines and 12" above the lines shall be replaced with sand or other selected material as approved

by KM's on-site representative and thoroughly compacted in 12" lifts to 95% of standard proctor dry density minimum or as approved by KM's on-site representative. This is to adequately protect against stresses that may be caused by the settling of the pipeline.

- No blasting shall be allowed within 1000 feet of KM's facilities unless blasting notification is given to KM including complete Blasting Plan Data. A pre-blast meeting shall be conducted by the organization responsible for blasting.
  KM shall be indemnified and held harmless from any loss, cost of liability for personal injuries received, death caused or property damage suffered or sustained by any person resulting from any blasting operations undertaken within 500 feet of its facilities. The organization responsible for blasting shall be liable for any and all damages caused to KM's facilities as a result of their activities whether or not KM representatives are present. KM shall have a signed and executed Blasting Indemnification Agreement before authorized permission to blast can be given.

  No blasting shall be allowed within 300 feet of KM's facilities unless blasting notification is given to KM a minimum of one week before blasting. *(note: covered above)* KM shall review and analyze the blasting methods. A written blasting plan shall be provided by the organization responsible for blasting and agreed to in writing by KM in addition to meeting requirements for 500' and 1000' being met above. A written emergency plan shall be provided by the organization responsible for blasting. *(note: covered above)*

- **Any** contact with any KM facility, pipeline, valve set, etc. shall be reported immediately to KM. If repairs to the pipe are necessary, they will be made and inspected before the section is re-coated and the line is back-filled.

- KM personnel shall install all test leads on KM facilities.

- Burning of trash, brush, etc. is not permitted within the KM ROW.

Insurance Requirements

- All contractors, and their subcontractors, working on Company easements shall maintain the following types of insurance policies and minimum limits of coverage. All insurance certificates carried by Contractor and Grantee shall include the following statement: "Kinder Morgan and its affiliated or subsidiary companies are named as additional insured on all above policies (except Worker's Compensation) and waiver of subrogation in favor of Kinder Morgan and its affiliated or subsidiary companies, their respective directors, officers, agents and employees applies as required by written contract." **Contractor shall furnish Certificates of Insurance evidencing insurance coverage prior to commencement of work and shall provide thirty (30) days notice prior to the termination or cancellation of any policy.**

1. Statutory Coverage Workers' Compensation Insurance in accordance with the laws of the states where the work is to be performed. If Contractor performs work on the adjacent on navigable waterways Contractor shall furnish a certificate of insurance showing compliance with the provisions of the Federal Longshoreman's and Harbor Workers' Compensation Law.
2. Employer's Liability Insurance, with limits of not less than **$1,000,000** per occurrence and **$1,000,000** disease each employee.
3. Commercial General Liability Insurance with a combined single limit of not less than **$2,000,000** per occurrence and in the aggregate. All policies shall include coverage for blanket contractual liability assumed.
4. Comprehensive Automobile Liability Insurance with a combined single limit of not less than **$1,000,000.** If necessary, the policy shall be endorsed to provide contractual liability coverage.
5. If necessary Comprehensive Aircraft Liability Insurance with combined bodily injury, including passengers, and property damage liability single limits of not less than **$5,000,000** each occurrence.
6. Contractor's Pollution Liability Insurance this coverage shall be maintained in force for the full period of this agreement with available limits of not less then **$2,000,000** per occurrence.
7. Pollution Legal Liability Insurance this coverage must be maintained in a minimum amount of **$5,000,000** per occurrence.