FOR CONTRACT NO.: 08-499804

INFORMATION HANDOUT

Foundation Report

Dated May 2, 2011

ROUTE: 08-Riv-5728

State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
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To: MR. JOE ESFANDIARY
Branch Chief
Office of Transportation Architecture
Structure Design Services and Earthquake Engineering

Date: May 2, 2011

File: Banning M.S.
0800020324
56-M5728

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design South 2

Subject: Foundation Report

The Office of Transportation Architecture has requested a final foundation report for at the Banning Maintenance Station near the City of Banning in Riverside County.

The recommendations provided in this report are based on the Request for Final Foundation Report dated February 28, 2010 (sic), and the 3 test borings completed on April 22, 2011. Also, the Log of Test Borings completed for the East Ramsey Street Undercrossing, Bride No. 56-0328, dated July 26, 1954, was reviewed along with the Foundation Comments and Recommendations for the Banning Maintenance Station Modifications dated June 17, 1998.

Project Description

The site is currently an active maintenance station. The proposed improvements include construction of a warehouse/shop building and a material storage bin on the site.

Surface Water and Topography

The site has been previously graded with minor amounts of cuts and fill for leveling of the site. Site drainage is via sheet flow towards the south into the street, then into the local surface drainage system.

Locally, drainage of the San Gorgonio Pass area is from the northwest to the southeast, flowing into the San Gorgonio River, and then east. All of these drainages are normally dry ephemeral washes, flowing only in response to locally intense rainfall, or seasonally heavy precipitation and runoff from the local mountains.

Topographically, the maintenance station is situated at approximately the 2240 feet

elevation (MSL). All elevations referenced in this report are based on GPS measurements taken on-site at the time of this investigation. These are referenced from the top of the loading dock at the east side of the container bins being at elevation 2247 feet above sea level. The coordinates are approximately as follows: Longitude of W 116.854 degrees and latitude of N 33.928 degrees.

Geology

The Banning Maintenance Station lies within the San Gorgonio Pass area of Riverside County. The Banning pass area is situated in the transition zone between the eastern San Bernardino Mountains of the Transverse Ranges geomorphic province on the north, across the San Andreas fault, and the San Jacinto Mountains of the Peninsular Ranges geomorphic province on the south.

Locally, the maintenance station site is situated on late Pleistocene to Holocene aged alluvial fan deposits consisting of sands and gravels washed out from the eastern San Bernardino Mountains to the northwest of the site. The depth to bedrock like materials underlying the site is unknown, but estimated to be on the order of several hundred feet deep. At depth the site may be underlain with the meta-sedimentary rocks (mica schist) and other "granitic" rocks that comprise the local hills to the south of the site.

The maintenance station site has been graded and is paved. It is underlain by dense to very dense well graded sands with gravel to the 21.5 feet maximum depth of the three (3) borings excavated for this investigation. Cobbles and small boulders were observed to be scattered across the surface of the adjacent undeveloped properties. The East Ramsey Street Undercrossing Bridge is located approximately 800 feet southeast of the maintenance station site. The prior investigation for the bridge showed the site to be underlain by gravel with sand and abundant cobbles and scattered boulders.

Ground Water

Ground water was not encountered during the investigation. Municipal records indicate the presence of groundwater at a depth greater than 300 feet below the local ground surface. This may vary seasonally and with recent rainfall totals. There may be regionally perched water with elevation dependant on recent rainfall and possibly localized irrigation.

Corrosion Potential

Due to the granular nature of the soils and the absence of groundwater, corrosion potential is not anticipated. The site is considered to be non-corrosive for the structural elements in contact with the soil based on the current Caltrans guidelines. For Caltrans to consider a site soils to be corrosive for structural elements, one or more of the following conditions must exist for the representative soil and /or water samples taken: Chloride concentration of 500 ppm or greater; Sulfate concentration is 2000 ppm or greater; and

the pH is 5.5 or less.

Seismicity

The controlling fault for the proposed site is the San Gorgonio Pass Fault a north dipping reverse fault with a MCE of 7.0, located approximately 1.15 miles (1.86 km) to the northeast of the site. Also the San Bernardino Mountain –Southern Segment of the San Andreas Fault, a right lateral strike slip fault with a MCE of 7.8, is located 2.9 miles (4.78 km) to the north of the site. The site is NOT situated within and Earthquake Fault Zone as mapped by the State or County. Accordingly, the site is not considered prone to surface rupture from known faults there are no known faults projecting towards or passing through the project site.

Based on the 2007 California Building Code, the 0.2 Second Spectral Response Acceleration, S_s is 150% g. Also, based on the 2007 California Building Code, the 1.0 Second Spectral Response Acceleration, S_1 is 60% g. The T_0 is 0.10 and the T_S is 0.52.

For preliminary design purposes, the soil profile at this site is classified as Type C as defined in Table 1613.5.2 of the 2007 California Building Code. The recommended Acceleration Response Spectrum (ARS) is attached.

Liquefaction

Based upon the apparent density from the SPT blow counts of the gravelly sand soils encountered, and the lack of known or historic high groundwater within 50 feet of the surface, there were no soils found on the site that appear to be susceptible to potential liquefaction. Accordingly, the liquefaction potential of the onsite soils is considered to be remote under the current conditions.

Lateral Loading

The allowable passive bearing pressure is 170 lbs/ft^2/ft for well graded very dense sand at a depth of one foot and 340 lbs/ft^2/ft at a depth of two feet. The allowable active bearing pressure is 13 lbs/ft^2/ft for well graded very dense sand at a depth of one foot and 26 lbs/ft^2/ft at a depth of two feet. The coefficient of friction for well graded dense sand is 0.3.

Settlement

Loads were not supplied by Design. However, typical loads associated with the structures being considered should not have any significant settlement when underlain by the very dense sands investigated by the drilling program.

Subgrade Modulus K

The subgrade modulus K is estimated to be approximately 250 lbs/in^3. This was determined by general characteristics of the soil being a gravelly sand with approximately 10 percent moisture. The approximation was derived by using the table presented in "Foundation Analysis and Design", by Joseph E. Bowles, 1968.

Frost Depth Elevation

As per "Foundation Analysis and Design", by Joseph Bowles, 1996, the frost depth is zero.

Foundation Recommendations

The Office of Transportation Architecture has requested an investigation concerning the utilization of spread footings. The following table shows the design recommendations using the parameters requested.

Table 1 - Foundation Design Recommendations for Spread Footings[1]

Type of Footing	Minimum Footing Embedment Depth	Minimum Width	Ultimate Bearing	Allowable Bearing
Continuous	1 foot below grade	30 inches	9000 psf	3000 psf
Continuous	2 feet below grade	30 inches	14000 psf	4500 psf
Square	1 foot below grade	48 inches	11500 psf	3800 psf
Square	2 feet below grade	48 inches	15600 psf	5200 psf

[1]This table is only applicable if the following remedial foundation work is utilized.

General Notes/Construction Considerations:

Recommendations are based on the foundation data provided by Structure Design.

The field investigation was of a limited extent. It is probable that gravels, cobbles and small boulders may be encountered at any depth of excavation despite the fact that these materials are not shown in the "Log of Test Borings". Quality control should be practiced to ensure that the bottom of the footing excavation is level and clear of any loose debris. The foundation trenches should be kept moist and be thoroughly cleaned of all slough or loose materials prior to pouring concrete.

The proposed structures can be supported on conventional footings bearing on competent native soil or engineered fill. As requested, all footings should be founded at least 18 inches below lowest adjacent grade for the structure. The footings should be reinforced using two number 5 rebar each at the top and bottom of the foundation element or as specified by the structural engineer.
Should any large rock, concrete, rebar, undocumented fills, or other objects (not consistent with Standard Specifications) be found at the bottom of excavation elevations, the contractor should

be prepared to remove, and replace them with granular material at 95 percent RC or lean concrete. Competent soils exposed at the bottom of the excavated areas are to be scarified to a minimum depth of 6-inches. These soils are to be moisture conditioned if necessary and compacted to at least 95 percent of the maximum dry density. A representative from the Office of Geotechnical Design South-2 observe the exposed foundation excavation bottom to verify a firm and unyielding soil material sufficient to provide geotechnical support for the new tank foundation is present.

In addition, footings located adjacent to the other footings or utility trenches should have their bearing surfaces situated below an imaginary 1.5 horizontal to 1 vertical plane projected upward from the bottom edge of the slope, adjacent footings, or utility trenches.

At the proposed depths, the footings bearing on competent native soils or prepared engineered fill can be designed for the allowable bearing pressures shown in Table 1 due to dead loads plus live loads and may be increased by one-third for short term wind or seismic loads. These allowable bearing pressures are net values; therefore, the weight of the footings can be neglected for design purposes. All continuous footings must be designed with both top and bottom reinforcing to provide structural continuity and permit spanning of local irregularities.

Where utility lines cross under or through perimeter footings, they should be completely sealed to prevent moisture intrusion in to the areas under the slab and/or footings. The utility trench backfill should be impervious material for at least three feet on both sides of the exterior footings. The impervious material should be compacted to at least 90 percent relative compaction.

All final grades are to have a positive gradient away from foundations. Water is not to be allowed to pond on or immediately adjacent to foundations.

Obstructions may be encountered while excavating through any overlying fill that may be present throughout the maintenance station.

Slab on Grade Construction

For the workshop, slab-on-grade floors should be underlain by free-draining gravel or crushed rock to act as a capillary moisture break. A minimum of 4 inches of this material between a maximum size of one inch and a minimum size of one quarter inch should be placed beneath the slab on grade. The slab subgrades must not be allowed to dry and should remain near optimum moisture content. Prior to final construction of the slab, the subgrade surface should be proof-rolled to provide a smooth, firm surface for slab support.

In areas where movement of moisture vapor through the slab would be detrimental to its intended use, installation of a vapor barrier (e.g., visqueen) should be considered. Underneath this membrane should be four inches of free draining gravel. The membrane should be covered with two inches of sand to protect it during construction, and the sand should be lightly moistened just prior to placing the concrete. Alternatively, a capillary break can be provided by

using six inches of free draining gravel well graded between a maximum size of one inch and a minimum size of one quarter inch with zero percent passing the No. 4 sieve below the slab.

Concentrated flows from roof downspouts or area drains should be collected and conducted away from the structure foundations. As settling is not an issue, these structures do not need to have structure backfill placed one foot below the rock or gravel.

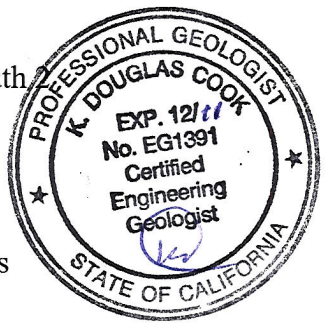
The site is considered to have low swelling potential. The foundation design does not need to be modified for this possibility.

Reinforcement of slab-on-grade floors consist of at least 6x6/10x10 welded wire fabric. Alternatively, minimum reinforcement may consist of No. 3 rear on 18-inch centers. It is important that the reinforcement be placed a mid-slab height. This slab reinforcement is provided as a "minimum only" guide. Final reinforcement and joint spacing should be determined by the structural engineer based on the anticipated slab loading. Temporary loads exerted during construction from vehicle traffic, cranes, forklifts, and storage of pelletized construction materials should be considered in the design of the slab.

The recommendations presented above should mitigate soils-related cracking of the slab-on-grade floors. Equally important to the performance and appearance of Portland-cement concrete slabs is the quality of the concrete, the skill of the concrete contractor placing and finishing the slab, the curing techniques utilized, and the spacing of control joints. We recommend that the general contractor, concrete subcontractor, owner/tenant, and the project design team meet prior to construction of interior floor slabs to discuss the construction sequence and the construction methods.

If you have any questions or need additional information, please call Douglas Cook at 916-227-4514 or Angel Perez-Cobo at 916-227-7167.

K. Douglas Cook
Engineering Geologist
Geotechnical Design-South 2
Design Branch A



Bill Lein for Angel Perez-Cobo
Angel Perez-Cobo
Senior Engineer
Geotechnical Design-South 2
Design Branch A

cc: APerez-Cobo
R.E. Pending File
Specs & Estimates
Proj Mgmt
DCook
File
Attachment-ARS Curve

2007 California Building Response Sepctrum for Banning Maintenance Station Project No. 0800020324