FOR CONTRACT NO.: 07-4Y4204

INFORMATION HANDOUT

MATERIALS INFORMATION

FOUNDATION RECOMMENDATION REPORTS

ROUTE: 07-LA-14-R61.9

State of California

Business, Transportation and Housing Agency

Memorandum

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To: MR. LARRY WIERING
District 7, Division of Maintenance
Office of Maintenance Engineering

Attention: Bipin Patel

Date: November 9, 2009

File: 07-LA-14-PM R61.9
07-4Y4201
Overhead Sign Replacement

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design-South 1, Branch C

Subject: Foundation Report for the Construction of Overhead Sign

As requested by your memo dated July 01, 2009, the Office of Geotechnical Design-South 1, Branch C has prepared this foundation report for the construction of overhead sign on Route 14 in the City of Palmdale.

PROJECT DESCRIPTIONS

This project proposes to remove a damaged overhead sign and install a new cantilever overhead sign on southbound Route 14 off-ramp at 10" Street West. Based on the project plan plotted on July 6, 2009, the new sign is located approximately 15 feet north of the old sign foundation approximately 1,000 feet north of the 10" Street West Undercrossing (No. 53-2378). In order to support the sign, one cast-in-drilled-hole (CIDH) pile will be installed at the top of roadway embankment. During our field reconnaissance, the height and slope of embankment were roughly measured as 30 feet and 1 vertical in 1.5 horizontal, respectively. The foundation depth and diameter of the pile have been preselected in accordance with Standard Plan dated May 2006 as follows:

Table No. 1 – Foundation Information

Type	Location	Type of Foundation	Diameter	Foundation depth
Single Post (Type VII)	*Lt. 78' Sta 3269+73 (Centerline of SR-14)	CIDH pile	5.0 (ft)	23 (ft)

* The station and offset are estimated roughly based on the project plan.

FIELD EXPLORATION

One exploratory boring was performed to verify the subsurface condition at the location of pile. Groundwater was not encountered up to a maximum drilling depth of 6 1.5 feet below the top of embankment. The Standard Penetration Test (SPT) sampler was used to obtain soil samples at every 5.0 feet. The blow counts required to drive the 18 inch sampler for the last 12 inches or less was recorded as the Standard Penetration Resistance (N-value). The collected soil samples were sent to District 7 Material Testing Laboratory for corrosion test. Also, the Standard Penetration Resistances were used to estimate engineering properties of subsurface materials at the location of pile.

PERTINENT DOCUMENTS

The following documents were reviewed for the preparation of this report:
1. Project Plans for the proposed overhead sign replacement, July 2009.
2. Log of Test Borings for 10" Street West Undercrossing (No. 53-2378), 1971.

SITE GEOLOGY

The site is located in the Antelope Valley, which is bordered by the Garlock Fault and the Tehachapi Mountains to the north and the San Andreas Fault and the San Gabriel Mountains and the Sierra Pelona Mountains to the south. The Antelope Valley is a closed basin that includes several dry lakes. The topography of the valley is relatively flat and the lower elevations of the valley contain the dry lakes. The proposed location of a new sign is located approximately 15 feet north of an old sign foundation on the southbound Route 14 approximately 1000 feet north of the 10th Street West Undercrossing in the City of Palmdale. The project is at an elevation of approximately 30-35 feet above the original grade of the valley in this area as the 14 Freeway is constructed in fill section. The freeway fill in the project area is underlain by alluvium (Department of Water Resources, 1964). The alluvium is derived primarily from sediment laden floods emanating from the Tehachapi Mountains to the north and the San Gabriel Mountains to the south and consists of sand, silty sand, clayey sand, and gravels. The subsurface conditions found during the site investigation are discussed in the next section of this report "Subsurface Conditions". No bedrock was encountered in the borings for this investigation or for the 1969 investigation for Bridge 53-2378R/L. Depth to bedrock or bedrock like material can be expected to be greater than 150 feet (California Department of Water Resources, 1964).

SUBSURFACE CONDITIONS

Based on the recent field exploration, the site is underlain by medium dense to dense sand with varying amount of silt, clay and/or fine gravel up to 50 feet below top of roadway embankment. The sandy material becomes very dense after 50 feet and the boring was terminated at 61.5 feet below the top of embankment. Considering the pre-selected foundation depth (23 feet), it is our opinion that the pile will be located within medium dense to dense sand layer (SP/SM or SP/SC) and the internal friction angle of the material ranges from 30 to 38 degrees.

SEISMICITY

The closest fault to the site is the San Andreas Fault (SAC) located approximately 2.5 miles south of the site. This fault is included on the 1996 Caltrans Seismic Hazard Map and is depicted to have a potential for an 8.0 maximum credible earthquake. The site is located between the 0.5g and 0.6g acceleration contours from this fault. The closest fault zoned by the California Geologic Survey, Alquist-Priolo Earthquake Fault Zones of California, is the San Andreas Fault located approximately 2.5 miles south of the site. No faults have been mapped at the project site so potential for surface rupture is low.

GROUNDWATER

As mentioned earlier in Field Exploration, groundwater was not encountered to the maximum drilling depth of 61.5 feet during the recent field exploration. The As-built Log of Test Borings for 10th Street West Undercrossing indicates that groundwater at the project site was not measured to a maximum drilling depth of 50 feet corresponding to an elevation of 2,610 feet during 1969 investigation. From the 1930's to the mid 1960's the region has undergone a overall lowering of the groundwater table (10 to 120 feet of lowering) due to pumping for agricultural and industrial purposes (DWR, 1964). Considering the pre-selected foundation depth (23 feet) and the top elevation of pile (2,685 feet), encountering groundwater is not anticipated during the construction of this pile unless the pile is constructed during rainy season.

LIQUEFACTION EVALUATION

Liquefaction is defined as the phenomenon in a soil mass, because of the development of excess pore pressures, soil mass suffers a substantial reduction in its shear strength. During earthquake, excess pore pressures in saturated soil deposits may develop as a result of induced cyclic shear stresses, resulting in liquefaction. However, since the previous drilling records indicate no shallow groundwater at the site, the potential for liquefaction seems to be low.

CORROSIVITY

According to corrosion test result from District 7 Material Testing Laboratory, the pH and minimum resistivity of soil at the site are 8.09 and 3,600, respectively. The test result indicates that the site is not corrosive to the proposed CIDH pile. It should be noted that this corrosion results should only be used for the CIDH pile for this project.

FOUNDATION RECOMMENDATIONS

In order to verify that the pre-selected foundation depth is sufficient to support the proposed overhead sign, the vertical and lateral capacity of pile were analyzed. Service level loads at the top of pile for this sign were estimated and provided by Mr. K C Liu as follows:

Table No. 2 – Service level load & allowable pile deflection

Type	Axial Force (Kips)	Shear Force (Kips)	Bending Moment (Kips-ft)	Maximum allowable Pile-head deflection (inch)
Single Post (Type VII)	21.5	13.3	393	1.0

The computer software of Shaft and LPILE plus were employed to perform the vertical and lateral pile analysis. As mentioned earlier, the internal friction angles (ϕ) of materials surrounding pile were correlated with Standard Penetration Resistances and unit weights (γ) of materials were assumed as 120 pound per cubic foot (pcf) conservatively. In lateral pile analysis, resistance from surrounding soil was reduced due to descending slope next to the pile. Based on the vertical and lateral pile analysis, the pre-selected 23 feet CIDH pile has a sufficient vertical capacity to support the axial force and will undergo less pile head deflection, bending moment and shear force than pile, equally loaded with the same service level load, in standard condition (level ground, ϕ=30 deg, y=120 pcf). Therefore, the 23 feet CIDH pile should be used to support the proposed sign.

Table No. 3 – Pile Head Deflection, Maximum Moment & Shear

	Standard Condition (level ground, ϕ=30 deg, γ=120 pcf)	Site-Specific (slope, ϕ=33 to 38 deg, γ=120 pcf)
Pile Head Deflection (inch)	0.363	0.060
Maximum Moment (Kips-ft)	437.3	430.3
Maximum Shear (Kips)	38.6	35.9

CONSTRUCTION CONSIDERATIONS

1. Since the material at the project site within the depth of the proposed pile consists of sand with varying amount of silt, clay and/or gravel, moderate caving potential is anticipated. In order to prevent caving during construction of CIDH piles, temporary casing may be used during construction of the piles. If temporary casing is used, provisions in Section 49-4.03, "Drilled Holes" of the Standard Specifications shall be followed.

2. Encountering Groundwater is not expected during construction of pile foundations unless the pile is installed during rainy season.

3. Slurry displacement method for the pile installation is not recommended because stability of roadway embankment may be impaired locally by increasing saturation of soil.

4. It is highly recommended to protect embankment slope next to the pile during and after construction of pile.

The recommendations contained in this report are based on specific project information regarding overhead sign location, type, height and base plate elevations that has been provided to our office. If any conceptual changes are made during final project design, this office should review those changes to determine if these foundation recommendations are still applicable.

REFERENCES

1. AASHTO, LRFD Bridge Design Specifications 4th Edition, 2007

2. California Geologic Survey, Digital Images of Official Maps of Alquist-Priolo Earthquake Fault Zones of California, Southern Region, 2002

3. California Department of Water Resources, Bulletin No. 106-1 Ground Water Occurrence and Quality Lahontan Region, 1964

4. Caltrans, Seismic Hazard Map, 1996

5. Caltrans, Standard Plans, 2006

6. Caltrans, Standard Specifications, 2006

7. Caltrans, Test Borings for 10th Street West Undercrossing (Bridge No. 53-2378), 1971

If you have any questions, please contact Christopher Harris at (213) 620-2147 or Ted Liu at (213) 620-2136.

Prepared by: Date: 11-9-2009 Reviewed by: Date: 11-9-2009

Christopher R. Harris, C.E.G.
Engineering Geologist
Office of Geotechnical Design South 1
Branch C

Chi-Tseng Ted Liu, Ph.D., P.E., G.E.
Senior Transportation Engineer
Office of Geotechnical Design South 1
Branch C

c.c. OGDS-1-Los Angeles File (2)
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