INFORMATION HANDOUT

For Contract No. 08-0K841
At 08-SBd-L5726

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Project ID 0814000073

MATERIALS INFORMATION

Summary of Foundation Recommendation dated October 28, 2014

State of California — Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. JOE ESFANDIARY, CHIEF — Date: October 28, 2014

STRUCTURAL DESIGN BRANCH 1
OFFICE OF TRANSPORTATION ARCHITECTURE
STRUCTURE DESIGN SERVICES & EARTHQUAKE ENGINEERING
DIVISION OF ENGINEERING SERVICES

Attention: Mr. Gang Hong

File: 08-54M-L5726
San Bernardino
Maintenance Station
Replace Office Building
EA No. 08-0K841G
Project No. 0814000073

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES - MS #5
OFFICE OF GEOTECHNICAL DESIGN SOUTH-2

Subject: Foundation Recommendations, Replacement Office Building, San Bernardino Maintenance Station, 175 West Cluster Street, San Bernardino

This report presents the Foundation and Seismic Design Recommendations per California Building Code 2013 for the proposed New Office Building at San Bernardino Maintenance Station. The proposed project site is located southeast of the intersection of South Mountain View Avenue and West Cluster Street in the city of San Bernardino. The following Foundation Recommendations are based on a review of Site Plan and other detail sheets dated June 24, 2014 for the proposed New Office Building, existing building, and subsurface geotechnical investigation of July 2014. The General and foundation plans and other detail sheets for the proposed site were provided by the Structural Design Branch 1, Office of Transportation Architecture. All elevations referenced in this report are in feet, and are based on elevations shown on the proposed general and foundation plans, and other detail sheets.

Project/Site Description

The Caltrans's Shop 8 of San Bernardino Maintenance Station is located at 175 West Cluster Street in the City of San Bernardino, California. The project site is located on moderate level undulating terrain. The General Plan dated June 24, 2014 shows that the proposed project consists of construction of a single–story New Office Building as a replacement of the existing Office Building.

Geology and Site Class Definition and Subsurface Soil Profile

The site is in the San Bernardino county area within the eastern part of the Upper Santa Ana River (USAR) Valley, generally called the San Bernardino Valley. The USAR Valley is a broad flat plain that slopes gently to the south between the San Gabriel Mountains on the north, the San Bernardino Mountains on the east, the Perris Uplands and San Timoteo Badlands on the south, and the Puente-San Jose Hills on the west. The margins of the plain rise abruptly to the mountains in steep escarpments that are a result of uplift by active faulting and folding related to regional geological forces.

The San Bernardino Valley, as well as most of the USAR Valley, is underlain by unconsolidated alluvial sediments, primarily sand and gravel with some local finer and coarser deposits. These alluvial deposits generally are poorly bedded, discontinuous, and lenticular strata deposited by streams as stream-channel deposits, stream overbank deposits (floodplain), and alluvial fans.

The Office of Geotechnical Design South-2, Branch A drilled two (2) 6-inch diameter Hollow Stem Auger Borings on July 22, 2014. The maximum depth of this investigation was 26.5 feet (approximately at elevation 307.5 feet) below the ground surface at the locations of borings (A-14-001 and A-14-002). Based on above field investigations, the soil beneath the San Bernardino Maintenance Station consists of loose to very dense, poorly graded, fine to medium grained sand. Bedrock was not encountered during the 2014 subsurface investigation. For site-specific subsurface soil information, refer to the Log of Test Borings (LOTB) sheet(s).

Based A-14-001 and A-14-002, the calculated average shear wave velocity (V_{S30} = 880 feet/sec.) and average field Standard Penetration Resistance Test (SPT), $\overline{N}$ = 22), for the upper 100 feet of subsurface materials the site class is D as defined in Table 20.3-1 American Society of Civil Engineering, ASCE Standard 7-10.

HYDROLOGY

The principal surface drainages in the site area are Lytle Creek west of the site and the Santa Ana River south of the site. Lytle Creek flows southerly and the Santa Ana River flows westerly. Local drainages include Warm Creek, East Twin Creek, Sand Creek, and City Creek. These smaller creeks flow southerly and westerly from the San Bernardino Mountains and merge just east of the site area. Together they flow southwesterly to merge with the Santa Ana River and Lytle Creek just south of the site area.

Most of the creeks within the urban areas are channelized within concrete- or rip-rap-lined aqueducts. It is recommended that the Office of Structure Hydrology and Hydraulics study potential flooding at the site.

Groundwater

Groundwater was not encountered during the 2014 subsurface geotechnical investigation, and is assumed to be deeper than 26.5 feet (elevation 307.5 feet) below ground surface. Municipal records indicate the presence of groundwater at a depth of approximately 62 feet below the ground surface. This may vary seasonally and with annual rainfall locally. There may be regionally shallow perched water from surface runoff, irrigation and other at the site.

The test boring information in this report including approximate stations, top of borehole elevations, depths, and groundwater level measurements are summarized in Table 1.

Table 1. Summary of Geotechnical Exploration Information

Boring Number	Top of Borehole Elevation (feet)	Exploration Depth (feet)	Bottom of Borehole Elevation (feet)	Groundwater Surface Elevation (feet)
A-14-001	334	26.5	307.5	Was not encountered
A-14-002	334	26.5	307.5	

Corrosion Evaluation

Selected representative soil samples collected from borings A14-001 and A14-002 from the 2014 field subsurface investigation were tested for pH, resistivity, soluble chloride, and soluble sulfate content to determine the corrosion potential of the in-situ soils. The results of these tests are presented in Table 2. Caltrans corrosion criteria currently defines a corrosive area as an area where the soil and water has a minimum resistivity of less than 1000 ohm-cm, and either contains more than 500 parts per million (ppm) of chloride, more than 2000 ppm of sulfate, or has a pH 5.5 or less.

Table 2. Summary of Laboratory Corrosion Tests

Boring No.	Sample Depth (Feet)	Sample at Elevation (Feet)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Chloride Content (ppm)	Sulfate Content (ppm)
A14-001	1 - 5	329	Poorly Graded Sand (SP)	1,028	7.6	8	1,000
	10 - 11.5	324		2,214	7.64	N/A	N/A
A14-002	0 - 5	329		2,618	8.16	N/A	N/A
	10 – 11.5	324		870	6.19	14	1,275

Comparison between the laboratory test results and Caltrans corrosion criteria indicates that the soil underlying at this site is not corrosive.

Seismic Data and Design Response Spectrum

According to the 2013 edition of the California Building Code (CBC), the Maximum Considered Earthquake Ground Motion for 0.2 seconds and 1 second (Ss and S_1), with 5% of critical damping, are 2.246g and 1.022g respectively [Figure 1613.3.1(1&2)]. Based on estimated V_{S30} of 880 feet/s (270 m/s), the soil corresponds to type "D" [Table 1613.3.3 (1&2)]. The site specific Maximum Considered Earthquake Ground Motion for short and long period, S_{MS} and S_{M1} are 2.246g and 1.534g, respectively. The Design Earthquake Spectral Acceleration for short period S_{DS} and long period S_{D1} are calculated as 1.497g and 1.022g, respectively, with controlling periods of T_0 and T_s calculated to be 0.137 and 0.683 seconds, respectively. The Acceleration Response Spectrum for the site, based on these values and as specified in ASCE 7-10 Figure 11.4-1 (page 66), is shown on the attached Figure 2.

Table 3. Summary of seismic design parameters in accordance with the 2013 CBC

Site Class	Spectral Acceleration at 0.2 seconds (g) S_S[a]	Spectral Acceleration at 1.0 seconds (g) S_1[a]	Site Coefficients Design Spectral Response		Design Spectral Response Parameters		Design PGA
			Fa	Fv	S_{DS}	S_{D1}	
D	2.246	1.022	1.0	1.5	1.1497	1.022	0.60

a. Used straight-line interpolation for intermediate values of mapped spectral response acceleration at Ss and S_1 periods

Surface Fault Rupture Hazard

The proposed site is not within an Alquist-Priolo Earthquake Fault Zone or an unzoned fault (15,000 years or younger in age within 1,000 feet of the bridge site). Per San Bernardino South Quadrangle dated January 1, 1977, the site is more than approximately 1.6 miles (2.6 km) from the nearest San Jacinto (San Bernardino Valley section) fault. Potential for surface rupture is low at this site from known active faults. No further work or design for surface rupture is required at this time.

Liquefaction Potential Evaluation

The site is not susceptible to liquefaction or lateral spreading during earthquakes due to the absence of groundwater within the depths of interest. The potential for any additional secondary seismic hazards including seismically induced ground settlement is considered very low.

Settlement

According to 2014 field investigations, subsurface soils are composed of predominantly granular material. Therefore, long-term consolidation settlement is not expected, and immediate settlement is expected to occur during construction with initial application of the loads. Settlement waiting period is not required.

Lateral Loading

The active (K_a), passive (K_p) and at rest (K_o) Earth Pressure Coefficients are 0.31, 3.26 and 0.5, respectively. The active lateral earth pressure is 37.0 lbs/ft^2/ft, allowable passive earth pressure is 300.00 lbs/ft^2/ft, and the lateral earth pressure at rest is 60 lbs/ft^2/ft and a soil unit weight of 120.0 pcf and angle of internal friction of soil 32 degrees. The coefficient of friction for well graded dense sand is 0.4. Resistance to lateral loads may be developed by combination of sliding friction acting at the base of the footings and passive earth pressure developed on the face of the spread footing. The coefficient of friction of 0.4 (corresponding to phi=32 degrees) can be used for this site. The equivalent fluid pressure of passive resistance at this site is 300 pound per cubic foot. The recommended lateral pressure values are summarized in Table 2.

Subgrade Modulus K

The subgrade modulus K is estimated to be approximately 200 lbs/in3. This was determined by general characteristics of the soil being poorly graded sand with silt and with approximately 5 percent moisture (according to subsurface and laboratory test results). The approximation was derived by using the table presented in "Principle of Foundation Engineering 3rd. Edition ", by Braja M. DAS, 1995.

Frost Depth Elevation

As per "Foundation Analysis and Design", by Joseph Bowles, 1988 the frost depth is zero.

Foundation Recommendations

The following Foundation Recommendations are for the proposed San Bernardino Maintenance Station as shown site plan and other details sheets dated June 24, 2014. According to the plans, conventional strip, mat or spread footings may be used to support the proposed single story structure. The following recommendations for Allowable Bearing Capacities and Sliding pressure per CBC-2013 Table 1806A.2 are listed below in Table 2.

Table 2 – Allowable Foundation and Lateral pressure

Class of Materials	Footing Width "B" (feet)	ALLOWABLE[a] VERTICAL FOUNDATION PRESSURE (psf)	LATERAL BEARING PRESSURE (PSF/FT) (below natural grade)			LATERAL SLIDING RESISTANCE	
			Active	Allowable Passive	At Rest	Coefficient of friction[b]	Cohesion (psf)[c]
Poorly Graded Sands with Trace Gravel (SP)	2 (Square)	3,500	37	300	60	0.4	0
	4 (Square)	4,200					0
	2 (Strip)	3,300					0

a. Allowable vertical foundation pressure (psf) was calculated using 2 feet depth of footing provided by the Office of Transportation Architecture.
b. Coefficient to be multiplied by the dead load
c. Cohesion value to be multiplied by the contact area, as limited by section 1606.3.2.

EARTHWORK

Site Preparation

- Preparation of the building pad must consist of the removal of all existing debris from the removal of the tearing down the existing structure. The existing building footing should be totally removed including reinforce steel bars, concrete and all other deleterious materials during the removal of the existing building within the building footprint and extending outside of the building perimeter for a distance of at least two feet.
- In pavement areas, site preparation must include the removal of all surface vegetation, topsoil, and non-engineered fills more than 12 inches thick. As an alternative, all non-engineered fills may be removed from pavement areas.
- Following site stripping, saturated or near-saturated fine-grained soils will likely require stabilization with coarse gravel and cobbles. If the exposed natural subgrades are sufficiently firm and dry to not require stabilization, they must be proofrolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. Any excessively soft or loose soils encountered must be removed to a maximum depth of two feet and be replaced with granular structural fill.
- In pavement areas, remaining fills must be scarified for a depth of at least eight inches, moisture conditioned as necessary if not protected, and recompacted to the requirements for structural fill. As an alternative to scarification and recompaction, the remaining fills may be undercut eight inches, the underlying fill proofrolled, and then replaced with granular site grading fill. Natural subgrades exposed in pavement areas should be stabilized or proofrolled as described above.

FLOOR SLABS

Floor slabs must not be established upon the existing non-engineered fills, topsoils, on loose or disturbed natural soils. The fills, topsoils, etc. must be first removed, and the subgrade properly prepared prior to placement of floor slabs. To facilitate construction and to provide a capillary moisture break, we recommend that all at-grade slabs be immediately underlain by a minimum of four inches of "free-draining" granular material such as "pea" gravel with a six-mil Visqueen moisture barrier. Moisture barrier should be covered by approximately 2-in of sand to minimized punctures and to aid in concrete curing. The gravel may be placed directly upon properly compacted granular structural fill and/or suitable natural soils.

A representative from the Office of Geotechnical Design South-2 may be called to observe the exposed excavation bottom to verify a firm / dense and unyielding soil material sufficient to provide geotechnical support for the proposed foundations.

The Foundation Recommendations contained in this report are based on very limited information provided by the Office of Transportation Architecture. If any conceptual changes are made, the Office of Geotechnical Design-South II, Design Branch A should review those changes to determine if these Foundation Recommendations are still applicable. Any questions regarding the above recommendations should be directed to the attention of Asef Wardak, (916) 227-1219, or Angel Perez-Cobo, (916) 227-7167, at the Office of Geotechnical Design-South II, Branch A.

Prepared by: Date: 10-28-2014

REGISTERED PROFESSIONAL ENGINEER
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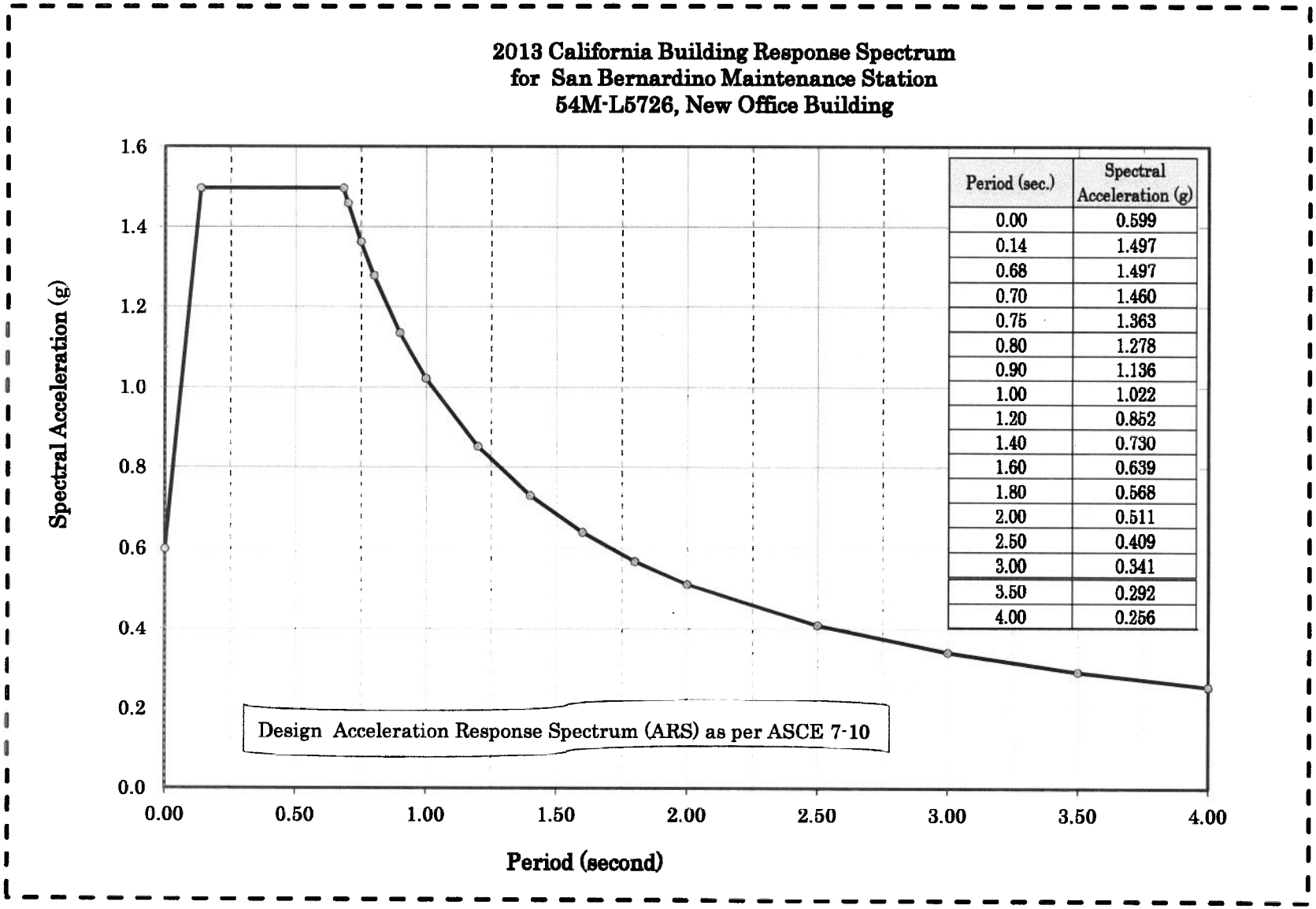
Transportation Engineer

Attachments:

Figure 1. Nearby Major Faults with Reference to the Project Site
Figure 2. Recommended Acceleration Response Spectrum (ARS) Curve

cc: District 08 Structure Construction R.E. – Pending File
District 08 Project Manager – Mike Ristic (Electronic File)
Specs & Estimates – Ofelia Alcantara (Electronic File)
District 08 Materials Engineer – Bruce Kean (Electronic File)
HQ Geotechnical Design South-2 – Abbas Abghari – OGDS-2 (Electronic File)
HQ Geotechnical Design South-2 – Angel Perez-Cobo (Electronic File) APC
HQ Geotechnical Archive

Figure 1. Nearby Major Faults with Reference to the Project Site



Period (sec.)	Spectral Acceleration (g)
0.00	0.599
0.14	1.497
0.68	1.497
0.70	1.460
0.75	1.363
0.80	1.278
0.90	1.136
1.00	1.022
1.20	0.852
1.40	0.730
1.60	0.639
1.80	0.568
2.00	0.511
2.50	0.409
3.00	0.341
3.50	0.292
4.00	0.256

Figure 2 - Design Acceleration Response Spectrum (ARS) Recommended for Design