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To: MR. FRANK WEI
Bridge Design Branch 19
Office of Bridge Design South
Structural Design
Division of Engineering Services

Date: April 19, 2019

File: 12-ORA-133-PM 8.926
Project ID: 1214000130
EA: 12-0N8900
New Tieback Wall At Abut 1 of
Barranca Pkwy OC
(Bridge No. 55-0654)

Attention: MR. AMIT JOSHI

From: **MICHAEL YEE**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South, Branch-C

SUBJECT: **STRUCTURE PRELIMINARY GEOTECHNICAL REPORT FOR THE PROPOSED TIEBACKWALL AT BARRANCA PARKWAY OVER CROSSING (BR. NO. 55-0654)**

In response to the request dated February 22, 2019 by the Division of Engineering Services, Bridge Design Branch 19 of the Office of Structure Design South (OSDS), the Office of Geotechnical Design South (OGDS) has prepared this Structure Preliminary Geotechnical Report (SPGR) for the proposed operational improvements along State Route (SR) 133 in the city of Irvine, California.

SCOPE OF WORK

This SPGR presents information of the existing structure foundations at Barranca Parkway OC and preliminary geotechnical recommendations for the proposed new tieback wall under the Barranca Parkway OC bridge. The scope of work determined by OGDS as per the request of OSDS dated February 22, 2019 is as follows.

1. Review of the available geotechnical information for the subject site and pertinent reports, plans, and As-built plans of the existing bridge structure.
2. Evaluate preliminary seismic hazard at the site.
3. Prepare preliminary recommendation for the design and construction of the new tieback wall and,
4. Prepare this report

The information and recommendations presented in this report are based on reviewing of available As-built plans, Log of Test Borings (LOTB), and other relevant site information obtained from resources such as Digital Archive of Geotechnical Data (GeoDOG), and Bridge Inspection Records Information System (BIRIS).

PROJECT DESCRIPTION

The subject project site is located in the city of Irvine, Orange County, California. The postmile for this site along SR 133 is approximately PM 8.926. This operational improvement project is for constructing an auxiliary lane on SR 133 from the southbound (SB) Interstate 5 (I-5)/SB SR 133 connector (SB I-5 connector) to the SB SR 133/northbound (NB) Interstate 405 (I-405) connector (NB I-405 connector). The auxiliary lane will become the second lane on the NB I-405 connector, and the number three lane will be extended on SB SR 133 approximately 300 feet south of San Diego Creek to match the existing roadway pavement.

Figure 1: Aerial View of the Barranca Parkway OC (Br No. 55-0654)

As part of this proposed construction, a new tieback retaining wall is proposed to be constructed next to the Abutment 1 of the Barranca Pkwy OC. The embankment next to the Abutment 1 will be cut back and the support to the abutment will be provided by the proposed tieback wall.

This report presents the information of the existing structure foundation details and preliminary recommendations for the proposed tieback wall construction.

According to the As-built plans and other documents, Barranca Pkwy Overcrossing is a two-span Cast-In-Place (CIP), Pre-Stressed (PS) Reinforced Concrete (RC) 11-cell box girder with RC (5 columns) bent and open-end RC seated abutments all supported on Cast-In-Drilled-Hole (CIDH) piles. Additional details of the existing pile foundations are presented later in the report.

Unless otherwise noted specifically, all elevations referenced in this report are based on the National Geodetic Vertical Datum of 1929 (NGVD29).

EXCEPTIONS TO POLICIES AND PROCEDURES

As per the available information and the scope of work, no exceptions to policies and procedures are identified for this project.

FIELD INVESTIGATION AND TESTING PROGRAM FOR THIS REPORT

No field investigation or a laboratory testing program was conducted for preparing this SPGR. All the information and recommendations provided in this report are based on the As-built LOTB data and other relevant information regarding the existing structure. OGDS recommends conducting additional geotechnical field exploration and a laboratory testing program for this project. Those recommendations are described more in detail later in this report under the section "ADDITIONAL FIELD WORK AND LABORATORY TESTING".

SITE GEOLOGY AND SUBSURFACE CONDITIONS

Regional Geology

The site is located within the Peninsular Ranges geomorphic province north of the base of the San Joaquin Hills. The San Diego Creek flows along the southern edge of the project site, but it is concrete-lined in this area.

Site Geology and Topography

The project area is mapped as mostly Quaternary Alluvial Fan deposits, but there is an outcrop of the Eocene to Miocene aged Vaqueros Sandstone on State Route 133 just north of I-405. The surrounding terrain is relatively flat lying and mostly commercially developed.

Subsurface Conditions

Based on As-built Log of Test Borings for Barranca Parkway OC, the project site is underlain predominantly by sand with varying amount of clay, silt and gravel. Test boring data was used from previous LOTB for Barranca Parkway OC, which are close to the location of the proposed tieback wall next to Abutment 1. From the LOTB, the top thirty feet of soil is semi-compact to dense to an elevation of about +155.0 feet and becomes dense to very dense to the maximum drilling depth of the borings at an elevation of about +112.0 feet. Detailed information for the borings is shown in Table 1.

Table 1 – Summary of Existing Subsurface Exploration, Barranca Pkwy OC (Br No. 55-0654)

Borehole ID	Date Drilled	Total Depth (ft)	Surface Elevation (ft)	Station	Offset (ft)
B-1	05/28/1985	46	184	Sta 95+59	Rt. 5
B-2	05/29/1985	72	184	Sta 96+94	Rt. 36
B-3	05/30/1985	51	186	Sta 98+56	Lt. 14

GROUNDWATER

According to the As-built Log of Test Borings from Barranca Parkway Overcrossing, groundwater was encountered as described below in Table 2.

Table 2 – Summary of Groundwater Data from As-built LOTBs, Barranca Pkwy OC (Br. No. 55-0654)

Borehole ID	Date Drilled	Groundwater Elevation (ft)	Groundwater Depth (ft)	Station	Offset (ft)
B-2	05/29/1985	149	35	Sta 96+94	Rt. 36

The nearest well listed on the California Department of Water Resources Water Data Library website is located about 0.5 miles northwest of the northern end of the project site. Groundwater was measured at a depth of 53.53 ft. (Elev. 130.1 ft. NGVD29) in 1990.

The State Water Resources Control Board Geotracker website does not list any groundwater records near the project site.

A site-specific groundwater investigation is required during the design phase of the project to determine the depth to groundwater in the subject area.

SCOUR EVALUATION

Since this bridge does not cross over any body of water, there is no scour potential applicable to the design of this bridge and the proposed tieback wall.

CORROSION EVALUATION

The Department considers a site to be corrosive if one or more of the following conditions exist for the representative soil and/or water samples taken at the site: Chloride concentration greater than or equal to 500 ppm, sulfate concentration greater than or equal to 1500 ppm, or the pH is 5.5 or less.

No information of the corrosivity of site soils was found in the As-built records for the subject bridge site.

Other generally available authoritative resources such has soil survey data and corrosivity mapping from the Department of Agriculture's web-based system, indicate low corrosion potential for concrete elements, and high corrosion potential for steel components at the subject bridge site.

A subsurface soil investigation for corrosion evaluation is required during the design phase of the project to determine the corrosion potential.

PRELIMINARY SEISMIC DESIGN INFORMATION AND RECOMMENDATIONS

Faulting and Seismicity

The design Acceleration Response Spectrum (ARS) curve was developed for the seismic design of this bridge using the Caltrans ARS Online (v2.3.09) website and the Caltrans Fault Database V2. The nearest contributing fault to the site is the San Joaquin Hills fault. The fault parameters are listed below in Table 3.

An average shear wave velocity (V_{s30}) for the upper 30 meters (100 feet) of subsurface soils at the site was estimated to be about 280 m/sec (918 ft./sec) based on correlations with soil types and SPT blow counts. The soil is classified as marginal according to the Caltrans Seismic Design Criteria.

Table 3 – Fault Information

Fault Name	Fault ID	Type	M_{max}	Dip direction (Dip angle)	R_X (km)	R_{JB} (km)	R_{RUP} (km)
San Joaquin Hills	376	Rev	7.0	W (23°)	0.23 (0.14 mi)	0.23 (0.14 mi)	2.01 (1.25 mi)

Notes: R_X = Horizontal distance to the fault trace
R_{JB} = Shortest horizontal distance to the surface projection of the rupture area
R_{RUP} = Closest distance to the fault rupture plane

The design ARS curve is an envelope of both deterministic and probabilistic acceleration response spectrum curves. The probabilistic ARS curve was developed with a ground motion return period

of 975 years, which corresponds to a 5% probability of exceedance in 50 years. The design Peak Ground Acceleration (PGA) has been evaluated as 0.62g from the design ARS curve and is controlled by the deterministic spectrum. The site to fault distance is also controlled by the deterministic spectrum at 1.0 seconds and is 1.25 miles.

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Surface Fault Rupture Hazard Evaluations

The project site is located neither within an Alquist-Priolo Earthquake Fault Zone (EFZ) as defined by the California Geologic Survey, nor within 1000 feet of an un-zoned fault that is Holocene (11,000 years) or younger in age. Therefore, there is no risk of surface fault rupture hazard for this location.

Liquefaction Potential

The design spectral PGA for the subject site is 0.62g. Due to the possibility of shallow groundwater conditions and the presence of moderately loose sandy and gravelly soil layers in the subsurface profile, there is a possibility of liquefaction affecting this structure due to a seismic event that can trigger strong enough shaking lasting for relatively longer duration.

A site-specific liquefaction evaluation will be performed during the design phase.

AS-BUILT FOUNDATION DATA

Table 4 presents existing foundation information for Barranca Parkway OC.

Table 4 – Foundation Information for Barranca Parkway OC (Br No. 55-0654)

Support Location	Foundation Type	Design Pile Capacity (Ton)	Bottom of Footing Elevation (ft)	Specified Pile Tip Elevation (ft)	# of Piles
Abutment 1	24-inch CIDH Piles	325	197.7	155	2 rows & total 13 piles
Bent 2	48-inch CIDH Piles	475	179.0	155	4 piles at each of the 5-column footings (total 20 piles)
Abutment 3	24-inch CIDH Piles	325	198.7	155	2 rows & total 13 piles

PRELIMINARY RECOMMENDATIONS

The proposed retaining wall will be constructed by cutting back the embankment slope in front of Abutment 1 of the Barranca Parkway OC. A tieback wall is recommended which is the most appropriate retaining wall type to minimize vertical and horizontal ground displacement near the abutments due to the construction of the retaining wall within the embankment slope under the bridge. Top-down wall construction is required for the proposed tieback wall. The apparent earth pressure distributions for anchored walls can be found in Section 3.11.5.7.1 – Cohesionless Soils of AASHTO LRFD Bridge Design Specifications (6^{th} edition, 2012).

A soil nail wall is not recommended since it is a passive soil reinforced system and not appropriate to be supporting bridge abutments where stringent requirement that limit the wall movement during construction. Standard retaining wall with spread footing and/or pile support, and soldier pile wall will not be appropriate due to the wall's relatively close proximity to the bridge foundation, and the limited space/clearance for pile installation under the bridge.

Based on the As-built LOTBs, the site soil is predominantly sandy, and hence caving potential is anticipated during excavation of soils below the grade at this bridge site.

The locations of the existing CIDH piles should be evaluated for designing/constructing the alignment of the ties for the retaining wall accordingly to avoid any possible interception of ties with existing piles. In order to avoid the stress influence from tieback system, the bonded zone of the ties should be at least 6 feet away from the existing pile locations.

The above are preliminary recommendations and may be revised and/or updated when a site-specific field investigation is completed. The above discussions are intended to provide preliminary interpretation of the site conditions for the purpose of cost estimates and preliminary planning and are not final recommendations.

ADDITIONAL FIELD WORK AND LABORATORY TESTING

OGDS recommends conducting a geotechnical field exploration and a laboratory testing program. The field exploration should include at least one boring, drilled at the embankment where the abutment 1 is associated to. Lane closures and permits may be required to complete the field exploration. Based on the existing information, OGDS anticipates the depth of boring(s) to be on the order of 70 feet.

Laboratory testing will be performed and may include moisture content and density, soil classification, corrosion, and direct shear tests. Other laboratory tests may be required depending upon the nature of the soils encountered during the investigation.

If you have any questions or comments, please call Bala Krish at (657) 328-6546, or Kris Barker at (909) 806-4701.

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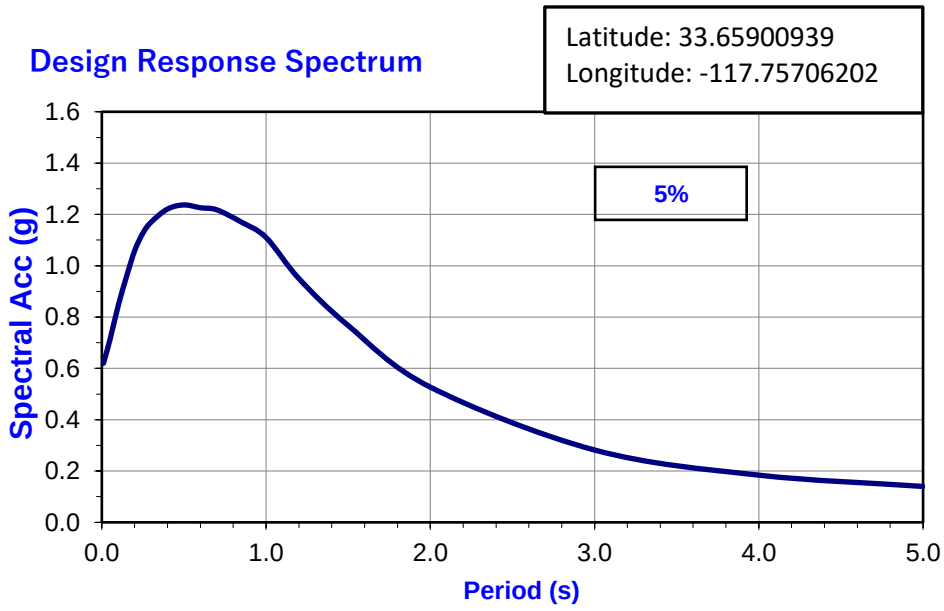
Appendix I: Preliminary Seismic Design Data Sheet

APPENDIX -I

(Preliminary Seismic Design Data Sheet)

Preliminary Seismic Design Data for the ERS at Barranca Pkwy OC (Bridge No. 55-0654)

Period (s)	Spectral Acceleration, Sa(g)
0.010	0.620
0.050	0.713
0.100	0.845
0.150	0.957
0.200	1.059
0.250	1.127
0.300	1.170
0.400	1.221
0.500	1.237
0.600	1.226
0.700	1.218
0.850	1.170
1.000	1.110
1.200	0.950
1.500	0.767
2.000	0.527
3.000	0.282
4.000	0.184
5.000	0.140



The Design Response Spectrum is the upper envelope of the deterministic and probabilistic response spectrum, but not less than the Minimum Deterministic Spectrum for California. The deterministic spectrum is obtained by using the average using the 2008 Campbell-Bozorgnia and the 2008 Chiou-Youngs ground motion prediction equations. Probabilistic response spectrum is obtained for 5 percent probability of exceedance in 50 years from the 2008 USGS Interactive Deaggregation web tool.

Seismic Loading Table (per MTD 1-47)

Soil Profile (V_{S30}): 919 ft/s (280 m/s)

Magnitude: $\mathbf{M}_{max}$ = 7.0 PGA: 0.62g