Memorandum

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Tennessee Hollow NB & SB
(Bridges No. 34-0164 L/R)
Girard NB – Ramp
(Bridge No. 34-0167)
Gorgas Ramp
(Bridge No. 34-0168)

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Subject: Preliminary Foundation Recommendations

INTRODUCTION

This memorandum provides preliminary foundation recommendations for the Tennessee Hollow NB & SB (Bridges No. 34-0164 L/R), Girard NB – Ramp (Bridge No. 34-0167), and Gorgas Ramp (Bridge No. 34-0168) structures in the City of San Francisco, San Francisco County, based on the advance planning study plan dated December 6, 2006. The proposed structures consist of three six-span bridges (Bridges No. 34-0164 L/R and Bridge No. 34-0167) and one single-span bridge (Bridge No. 34-0168) belonging to the site called Tennessee Hollow Causeway. These structures are allowing the future expansion of the Crissy Marsh and restoration of the Tennessee Hollow riparian corridor. The proposed structures are part of the project to replace Doyle Drive, a stretch of Highway 101 extending to the southern approach of the Golden Gate Bridge. The existing stretch includes an approximately 1520 foot long high viaduct near the western end, and an approximately 3730 foot long low viaduct at the eastern end.

SITE GEOLOGY AND SUBSURFACE CONDITIONS

General Site Geology

Shallow bedrock of the Franciscan Formation generally underlies the more elevated western areas of the project site. This Formation consists of heavily folded and sheared assemblage of Greywacke Shale Sandstone, Chert, and Serpentinite. The overburden soil are made up of artificial fill, slope debris, and ravine fill and or the Colma Formation, which is a unconsolidated fine to medium-grained sand unit with clay beds. The lower elevations on the eastern side reflect an estuarine deposition environment where the bedrock is located at a significant depth. The surficial soil in the eastern side consists of dune and beach sands and soft clayey silt layers. These soils are generally underlain by Colma Formation, which overlies the Franciscan bedrock. The bedrock is exclusively serpentinite west of Station 90+00± and Sandstone/Shale is found east of Stations 90+00±.

In the past, the project site consisted of extensive tidal marsh separated from the Bay by a beach and dunes. The area that extends from the Crissy Field in southerly direction towards Lombard Street and underlies Doyle Drive east of Post Commissary building was filled with hydraulic fill in 1912. The hydraulic fill consists of loose sands with variable amount of silt and clay.

Site Specific Subsurface Conditions

At the Tennessee Hollow Causeway site, the Colma Formation is not present, and Franciscan bedrock is overlain by fill and thick Quaternary deposits including beach sand.

The preliminary subsurface investigation conducted by Taber Consultants in January 2001 close to the alignment consisted of two auger borings (HGB-2 and HGB-3) drilled to approximate Elevation –78 ft, or a depth of 90 ft from the existing ground surface, and one cone penetration test (CPT-4) to approximate Elevation -38.0 ft, or 50 ft below the existing ground surface. Based on these logs of test borings, the site is underlain by 13 ft to 26 ft of loose to compact silty and clayey sand, interbedded with very soft to soft clay. Below these deposits is very dense silty and clayey sand layer which was encountered to approximate elevation 61 ft, or approximately 72 ft depth. Underlying this layer is hard sandy and silty clay and clay to the maximum exploration depth. The borings do not reach Franciscan bedrock.

The Final Hydrological and Water Resource Technical Report for Doyle Drive project dated October 2004, prepared by Baseline Environmental Consulting, and other data obtained from the Report titled Final Corrective Action Plan, Building 1065, Presidio, San Francisco, California, dated January 2007, prepared by MACTEC, indicate that the Tennessee Hollow Causeway site is underlain by shallow and deep groundwater zones (aquifers). The groundwater in the shallow zone is unconfined and is located approximately 6 ft below ground surface, or approximate Elevation 6.0 ft. Wells screened in the deeper zone (±20 ft below the ground surface) show that it is confined with substantial upward vertical gradient. Several of the wells installed at the site were found to be flowing artesian wells and the stabilized potentiometric head water level was above the ground surface. At this time, we do not have quantitative information to determine the actual potentiometric head. The groundwater zones are separated by an aquitard consisting 2 to 3 feet thick layer of stiff silty clay. The data obtained from the above referenced reports indicate that the permeability of the deeper aquifer is low to medium.

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The consulting firm, Parsons Brinkhoff, is working on the final hydraulic report. The finding will be included in the foundation recommendations.

CORROSIVITY

The site is anticipated to be corrosive due to its proximity to the San Francisco Bay and the past existence of a tidal marsh. Corrosion samples will be collected from this site during future field investigation, and tested. Sampling and testing of site soils and groundwater shall be in conformance with the Corrosion Guidelines for Foundation Investigations (Caltrans, 2003).

SEISMICITY/LIQUEFACTION POTENTIAL

Hossain Salimi from Office of Geotechnical Design West will provide preliminary seismic recommendations for this structure.

FOUNDATION TYPE RECOMMENDATIONS

Cast-In-Steel-Shell (CISS) piles, standard Caltrans open-ended pipe piles, and H piles are feasible choices for the proposed structures, based on the available subsurface information. Driving these types of piles may generate vibration and noise, but may fall within acceptable levels. Suitable corrosion mitigation measures need to be recommended and/or accounted for during final design.

Cast-In-Drilled-Hole (CIDH) piles are another feasible alternative. However, temporary and permanent casing may be needed because of the caving potential due to the granular materials at the site, the high groundwater table, and the artesian conditions. Difficulties in construction and anomalies within piles may be anticipated with CIDH piles under such site conditions. Artesian conditions may cause serious problems when installing CIDH piles at the site, including blow out of bottom of piles during excavation and pored concrete being washed away. If noise and vibration are of extreme concern, CIDH piles may be considered instead of CISS piles, standard open-ended pipe piles, and H piles. If further field exploration conducted before the final design concludes the artesian conditions, do not preclude the use of CIDH piles at the site.

Concrete driven piles and close-ended pipe piles are not recommended, due to the impact on the nearby existing structures and environment caused by potentially excessive noise and vibration during pile driving, and anticipated hard driving/refusal.

The presence of shallow and deep groundwater aquifers at the site will likely affect the design and construction of the proposed bridge pile foundation. The proposed pile cap is anticipated to be located below the groundwater table in the shallow groundwater zone and is an area that will be influenced by artesian pressure. The effect of artesian hydrostatic pressure shall be considered in the computing nominal axial pile resistance and pile cap design. Detailed recommendation will be provided in the final Foundation Report.

CONSTRUCTION COSIDERATIONS

The proposed excavation for the pile cap will extend close the top of the deep aquifer. Our preliminary calculations show that the anticipated reduction in overburden pressure due to excavation can cause uplift (blowout) of the excavation bottom due the artesian pressure. Since the permeability of the deeper aquifer is low to medium, it is our preliminary opinion that the bottom blowout can be prevented by installation of bleeder wells through the separating clay layer (aquitard) between the aquifers and dewatering the site. The spacing and diameter of the bleeder wells will depend on the permeability and water head in the deeper aquifer. Dewatering of the shallow aquifer should be performed prior to installation of bleeder wells.

ADDITIONAL FIELD WORK AND LABORATORY TESTING

Further field exploration is needed, specifically rotary wash borings and cone penetration tests. One rotary boring at each support with exploration depth of 100 ft is recommended for the two outside six-span bridges. One cone penetration test at every other support is recommended for the six-span bridge in the middle. One rotary boring is recommended for the one-span bridge. Additionally, three multistage piezometers and pump test(s) are needed to determine the permeability and piezometric water heads at the site.

Regulation pertaining to cross contamination of the aquifers during drilling operation has to be considered when planning the subsurface investigation. Use of conductor casing to isolate zones within the drilled hole will be required. Control of groundwater flow due to artesian pressure will also be required.

The number, locations, and depth of borings, piezometers, and pump test wells will be adjusted depending on the locations of supports, load demands, and pile/foundation type used in the final design. Soil samples will be collected for corrosion tests and other laboratory tests to obtain soil parameters necessary for foundation design.

The recommendations contained in this report are not final. A request for final recommendations should be made during final project design, and sent to the Office of Geotechnical Design West. Any questions regarding the above recommendations should be directed to the attention of Tung Nguyen at 510-622-1775 or Caroline Chen at 916-227-5386.

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