State of California

Business, Transportation and Housing Agency

Memorandum

To: MR. CARL SAVAGE
District 11
Design Branch

Date: June 11, 2001

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Gonzales Creek On-Ramp
Bridge No. 57-1078K and
Gonzales Creek Off-Ramp
Bridge No. 57-1078S

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Structure Foundations South - MS 5

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Subject: Foundation Recommendations

This report presents the foundation recommendations for the proposed Gonzales Creek On-Ramp (Bridge No. 57-1078K) and Gonzales Creek Off-Ramp (Bridge No. 57-1078S) Bridges. These structures are part of the proposed construction of the Middle Segment of State Route 56 Project in San Diego, California. The Structures Foundations South (SFS) of the Office of Geotechnical Services completed a foundation investigation pursuant to the March 26, 2001 request by the District 11, Design Branch for a foundation investigation and recommendations for the two proposed structures. T.Y. Lin International is the consultant firm in charge of the design of these structures.

The following foundation recommendations are based on subsurface information gathered during the recent foundation investigation (April 2001) performed by Caltrans along with a review of subsurface information which was obtained in August 2000 for the mainline Gonzales Creek Bridges (Br. No. 57-078 R/L). With regards to the current foundation recommendations, all elevations referenced within this report and shown on the Log of Test Boring Sheets are based on the NAVD 88 vertical datum.

Project and Site Description

Each of these proposed structures is to consist of a three-span, cast-in-place, post-stressed concrete box girder bridge. The proposed bridge lengths and widths are 111.20 m and 15.47 m for the On-Ramp Structure and 97.2 m and 16.51 m for the Off-Ramp Structure, respectively.

The project site is located just within the Carmel Valley area within San Diego County. The project site is located approximately 1.8 km east of the intersection of Carmel Country Road and State Route 56. The proposed Gonzales Creek On-Ramp and Off-Ramp bridges are located along the proposed Route 56, where the proposed highway crosses Gonzales Creek. The

proposed bridge sites will span Gonzales Creek, which is a subsurface, alluvial drainage that flows to the south. The land surrounding the proposed structure site is presently undeveloped and used for agricultural purposes.

Geology

The subsurface investigation completed by Caltrans consisted of eight mud rotary borings advanced to a maximum depth of 15.5 m (50.9 ft) along with eight supplemental 64-mm diameter dynamic-displacement (hydraulically driven) soil soundings that were advanced to a maximum depth of 10.58 m (34.7 ft).

The Caltrans subsurface investigation (April 2001) for the proposed Gonzales Creek On-Ramp (Bridge No. 57-1078K) and Gonzales Creek Off-Ramp (Bridge No. 57-1078S) structures revealed that the soils encountered at the proposed bridge sites can be generally separated into two units.

On the hillside areas near the proposed Abutment1, Bent 2 and Abutment 4 locations for the Gonzales Creek On-Ramp Bridge, the upper unit soil is described as a thin layer of loose cultivated top-soil consisting of clayey sand with scattered plant rootlets to a depth of 0.61m (elev. 46.28 m) in boring B-01-2, a depth of 0.49 m (elev. 55.1 m) in boring B-01-3 and a depth of 0.52 m (elev. 51.0 m) in boring B-01-4. On the lower basin/creek area at the Bent 3 location, the upper unit soils are described as layers of (variably loose to dense) cultivated top soil and alluvial sediments consisting of clayey sand and poorly graded sand with trace gravel to a depth of 6.50 m (elev. 40.20 m) in boring B-01-1.

On the hillside areas near the proposed Abutment1 location for the Gonzales Creek Off-Ramp Bridge, the upper unit soil is described as thin layer of loose cultivated top-soil consisting of clayey and silty sand to a depth of 0.85m (elev. 49.30 m) in boring B-01-1. At the Bent 2 and Abutment 4 locations, construction of earth pads for drill rig access resulted in removal of 1m or less of upper unit soil in Borings B-01-4 and B-01-3. On the lower basin/creek area at the Bent 3 location, the upper unit soils are described as layers of (variably medium dense to dense) cultivated top soil and alluvial sediments consisting of clayey sand and poorly graded sand with trace gravel to a depth of 7.01 m (elev. 36.43 m) in boring B-01-2.

The upper unit soils at the site are underlain by a poorly indurated, non-cemented sandstone (La Jolla Group) consisting of a very dense, silty and clayey sand with silt, clay, gravel, (hard) cobbles. Some localized hard lenses of well-cemented sandstone were encountered in the drilled borings, please see the Log of Test Boring Sheets for details. These formational earth materials were encountered at all boring locations.

During the Caltrans subsurface investigation (August 2000) for the proposed mainline Gonzales Creek Bridges (Br. No. 57-1078 R/L), temporary slotted PVC casing placed inside Boring B-00-6 (Bent 3, Br. No. 57-1078R) to measure groundwater. From August 2000 to January 2001, periodic groundwater measurements were recorded and varied from elevations 33.9m to 33.2m.

The proposed bridge site spans an existing natural drainage feature; therefore, during construction of the support bents the contractor should anticipate encountering groundwater. Groundwater elevations will vary based on seasonal precipitation.

Based on the conditions encountered during the field investigation completed by Caltrans for the proposed Gonzales Creek On-Ramp (Bridge No. 57-1078K) and Gonzales Creek Off-Ramp (Bridge No. 57-1078S) Bridges, the near-surface soils present at the site are potentially scourable within the lower basin/creek area. Based on the subsurface investigation by Caltrans, potentially scourable soil was identified down to approximately elevation 42.6 m near the Bent 3 location of the proposed the Gonzales On-Ramp Bridge and at elevation 36.4 m near the Bent 3 location of the proposed the Gonzales Off-Ramp Bridge. At the time this report was written, a hydrology report was not yet available. For specific recommendations regarding the potential for scouring and the scour elevation, please contact the Hydrology and Hydraulics Office.

Corrosion

At various support locations for the proposed Gonzales Creek On-Ramp (Bridge No. 57-1078K) and Gonzales Creek Off-Ramp (Bridge No. 57-1078S) Bridges, composite samples retrieved at various depth intervals from the April 2001 subsurface investigation were tested for corrosive potential. The Office of Testing and Technology Services, Corrosive Technology Branch (CTB) tested a total of 19 composite samples for corrosive potential. The results of the laboratory tests determined that 9 of the 19 composite samples were corrosive. For specific laboratory test results, refer to Table 1 and Table 2 for the proposed Gonzales Creek On-Ramp and Off-Ramp Bridges.

Table 1: Corrosion Test Summary-Gonzales Creek On-Ramp Bridge (Bridge No. 57-1078K)

Boring No. / Corrosion No.	Sample Depth (m)	pH	Minimum Resistivity (Ohm-Cm)	Sulfate Content (PPM)*	Chloride Content (PPM)*
B-01-1 / 01-0449	0.46 to 1.74	6.7	950	170	21
B-01-1 / 01-0450	2.20 to 3.26	7.5	1000	66	27
B-01-1 / 01-0451	3.72 to 4.79	7.3	1100	51	26
B-01-1 / 01-0452	5.24 to 6.31	7.0	1400	86	36
B-01-1 / 01-0453	9.78 to 10.21	7.1	940	63	77
B-01-1 / 01-0448	12.56 to 13.05	7.0	1450	87	26
B-01-2 / 01-0443	2.93 to 3.23	8.6	1950	94	27
B-01-2 / 01-0444	5.97 to 6.25	4.3	545	4000	220
B-01-2 / 01-0445	8.87 to 9.14	7.4	495	990	95
B-01-2 / 01-0446	11.58 to 11.89	6.1	900	190	82

*The Corrosion Technology Branch policy states that if the minimum resistivity is greater than 1000ohm-cm the sample is considered to be non-corrosive.

Table 2: Corrosion Test Summary-Gonzales Creek Off-Ramp Bridge (Bridge No. 57-1078S)

Boring No. / Corrosion No.	Sample Depth (m)	pH	Minimum Resistivity (Ohm-Cm)	Sulfate Content (PPM)*	Chloride Content (PPM)*
B-01-2 / 01-0454	0.46 to 1.68	6.8	1000	83	17
B-01-2 / 01-0455	3.66 to 4.72	6.8	1100	71	21
B-01-2 / 01-0456	6.71 to 7.01	6.9	820	86	29
B-01-2 / 01-0457	9.60 to 10.00	7.6	1600	55	21
B-01-2 / 01-0447	13.08 to 13.56	7.0	1900	70	17
B-01-4 / 01-0439	2.98 to 3.53	6.7	640	70	350
B-01-4 / 01-0440	6.01 to 6.34	6.4	350	5200	630
B-01-4 / 01-0441	8.93 to 9.24	7.8	685	170	250
B-01-4 / 01-0442	11.58 to 11.89	10.5	1800	130	43

*The Corrosion Technology Branch policy states that if the minimum resistivity is greater than 1000ohm-cm the sample is considered to be non-corrosive.

A request for corrosion recommendations for the proposed Gonzales Creek On-Ramp (Bridge No. 57-1078K) and Gonzales Creek Off-Ramp (Bridge No. 57-1078S) Bridges was submitted to Mr. Douglas Parks of the Corrosion Technology Branch (CTB) on April 30, 2001. Specific questions concerning the corrosion recommendations should be directed to Mr. Douglas Parks at 916-227-7007.

Fault and Seismic Data

The following information given below is based on the memorandum concerning final seismic design recommendations (dated May 8, 2001) for both the proposed Gonzales Creek On-Ramp (Bridge No. 57-1078K) and Gonzales Creek Off-Ramp (Bridge No. 57-1078S) Bridges. The proposed bridge sites are potentially subject to strong ground motions from nearby earthquake sources during the design life of the new structure. The Newport-Inglewood-Rose Canyon (Strike Slip) fault, located approximately 9.7 km southwest of the site, is the controlling fault for this site with a maximum credible earthquake of Mw=7.0. The horizontal Peak Bedrock Acceleration at this site, based on the 1996 Caltrans California Seismic Hazard Map, is estimated to be 0.4g. At this site, the liquefaction potential is considered to be very low.

For site specific seismic data and design recommendations, refer to the memorandum concerning final seismic design recommendations, dated May 8, 2001, by Mr. Jinxing Zha of the Geotechnical Earthquake Engineering Branch (GEEB).

Foundation Recommendations

The following recommendations are for the proposed Gonzales Creek On-Ramp (Bridge No. 57-1078 K) and Off-Ramp Structures (Bridge No. 57-1078S), as shown on the General

Plans, dated May 9, 2001. The General Plans for these structures were developed by T.Y. Lin International for this project. A combination of shallow and deep foundations is recommended for support of both the proposed Gonzales Creek On-Ramp and Gonzales Creek Off-Ramp Bridges.

- Shallow Foundations

Spread footings are recommended for support at the Abutment 1, Bent 2 and Abutment 3 locations for both proposed structures. It is anticipated that both the On-Ramp and Off-Ramp Bridge Abutment No. 4 and the Off-Ramp Bridge Abutment No. 1 footings will be located on engineered fill constructed for the roadway approach to the bridge structures. However, the On-Ramp Bridge Abutment No. 1 bottom of footing elevation is partially situated on the top of the formational earth materials (La Jolla Group) described earlier. To eliminate the potential for differential settlement to occur across the On-Ramp Bridge Abutment No. 1 support location, sub-excavation of formational earth materials and replacement with engineered fill compacted to 95% relative compaction is recommended.

At the Bent 2 locations for both the On-Ramp and Off-Ramp Bridges, spread footings may be used for support. The bottom of spread footing foundations shall be located on undisturbed, formational earth materials, as described earlier in the geology section. All footings should be constructed at or below the maximum estimated depth of scour or outside and above the potential scour zone. If spread footings are not an option at the Bent 2 location due to the influence of scour (as determined by the Hydrology and Hydraulics Office), then SFS should be contacted for alternative foundation recommendations at these locations. The recommended Gross Allowable and Ultimate Soil Bearing Pressures to be used for design are listed below in Table 3.

Table 3: Spread Footing Data

Gonzales Creek On-Ramp (Br. No. 57-1078K) and Off-Ramp (Br. No. 57-1078S) Bridges

Support Location	Minimum Footing Width (m)	Bottom of Footing Elevation (m)	Recommended Soil Bearing Pressures	
			ASD[1]	LFD[2]
			Gross Allowable Soil Bearing Pressure (q_{all})	Ultimate Soil Bearing Pressure (q_{ult}')
Abutment 1 (On-Ramp Bridge)	3.6	53.60	192 kPa (4.0 ksf)	N/A
Bent 2 (On-Ramp Bridge)	3.6	43.80	N/A	480 kPa (10.0 ksf)
Abutment 4 (On-Ramp Bridge)	3.6	56.20	192 kPa (4.0 ksf)	N/A
Abutment 1 (Off-Ramp Bridge)	3.6	51.78	192 kPa (4.0 ksf)	N/A
Bent 2 (Off-Ramp Bridge)	3.6	40.80	N/A	480 kPa (10.0 ksf)
Abutment 4 (Off-Ramp Bridge)	3.6	51.00	192 kPa (4.0 ksf)	N/A

Notes: 1) Allowable Stress Design, (ASD). The Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Gross Allowable Soil Bearing Pressure, (q_{all}). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed 3 times the recommended Gross Allowable Soil Bearing Pressure, (q_{all}).
2) Load Factor Design, (LFD). The Maximum Contact Pressure, (q_{max}), divided by the Strength Reduction Factor, (ϕ), is not to exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}'). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}').

The recommended gross allowable soil bearing pressures to be used for design, listed in Table 3, are based upon the following design criteria:

(1) All abutment footings have a minimum footing width of 3.6 meters for the abutments and a footing width of 4.88 meters for the bents,
(2) All abutment footings are positioned such that there will be a minimum horizontal distance of 1.22 meters from the near face/top of the footing to the face of the finished slope (Bridge Design Specifications 4.4.2.1),
(3) Concrete at the Bent 2 footing locations, with respect to the bottom of the footing excavation, shall be placed neat against the undisturbed formational materials.
(4) At the On-Ramp Bridge (Br. No. 57-1078K), Abutment No. 1, the footing shall be supported on 0.61 meter of engineered fill (extending down to elevation 52.99 meters) compacted to 95% relative compaction. The limits of sub-excavation and replacement with structure backfill shall conform to the limits required for relative compaction under retaining wall footings without piles as defined in section 19-5.03 of the Standard Specifications.

If any of the above minimum footing widths, horizontal embedment depth or sub-excavation limits are reduced, the SFS is to be contacted for reevaluation.

- Deep Foundations

At the Bent 3 locations for both On-Ramp and Off-Ramp Bridges driven "Class 625C", Alternative "V" closed-end, steel pipe piles are recommended for support. The Specified Tip Elevation (SPTE) is listed below in Table 4. The ultimate geotechnical capacity of the piles will equal or exceed the required nominal resistance in compression shown in the table below.

Table 4: Pile Data: Class 625, Alternative "V" Steel Pipe Piles (Closed Ended)

Location	Pile Type	Design Load	Nominal Resistance		Design Tip Elevation (m)	Specified Tip Elevation (m)
			Compression	Tension		
Bent 2 On-Ramp Bridge	Class 625C, Alt "V"	575 kN	1150 kN	0 kN	37.0 (1)	37.0
Bent 2 Off-Ramp Bridge	Class 625C, Alt "V"	575 kN	1150 kN	0 kN	31.5 (1)	31.5

Design tip elevation is controlled by the following demands: (1) Compression.

General Notes

1. The structure engineer shall show on the plans, in the pile data table, the minimum pile tip elevation required to meet the lateral load demands. If the specified pile tip elevation required to meet lateral load demands exceed the specified pile tip elevation given within this report, the Office of Geotechnical Services, Structure Foundations South should be contacted for further recommendations.

2. Support locations are to be plotted on the Log of Test Borings, in plan view, as stated in "Memos to Designers" 4-2. The plotting of the support locations should be made prior to the foundation review.

Construction Considerations

1. Due to granular nature of the soils, primary settlement is expected to occur immediately and concurrent with fill placement; therefore, no waiting period is required prior to beginning construction of the abutment spread footings.

2. Concrete for all abutment footings shall be placed neat against the undisturbed engineered fill at the bottom of the footing excavation. Should the bottom of the footing excavation be disturbed, then the disturbed soils shall be recompacted to 95% relative compaction prior to placement of concrete for the structure support footings.

3. Concrete for all Bent 2 footing locations shall be placed neat against the undisturbed formational materials at the bottom of footing excavation. Should the bottom of the footing excavation be disturbed, then the bottom of footing excavation shall be extended down at 0.33 meter intervals until undisturbed formational materials are observed and approved by the Engineer.

4. Difficult drilling and pile installation should be anticipated due to the presence of very dense formational earth materials (La Jolla Group) with cobbles and localized lenses of well-cemented sandstone underlying the proposed bridge sites (see Log of Test Boring Sheets for details). Driven precast concrete piles are not recommended; steel piles are recommended.

5. At the Bent 3 locations for both structures, the calculated geotechnical capacity of all driven piles is based upon End Bearing only. All driven piles are to achieve the required bearing during driving.

6. Pile bearing will be accessed by the ENR equation (Standard Specifications in Section 49-1.08).

7. Prior to driving each pile, drilling to assist driving (Standard Specifications in Section 49-1.05) will be required to obtain the specified penetration. Any drilling to assist driving, shall not extend beyond the recommended depth stated in Table 5. Drilled holes to assist driving shall not be greater than 360mm diameter. Equipment or methods used for advancing holes shall not cause quick soil conditions or cause scouring or caving of the hole.

Table 5: Drilling to Assist Elevation

Location	Drilling to Assist Elevation (m)
Bent 2 On Ramp Bridge (Br. No. 57-1078K)	38.5 m
Bent 2 Off Ramp Bridge (Br. No. 57-1078S)	33.0 m

8. Any driven steel piles achieving refusal during driving within 1.0 meter of specified pile tip elevations may be considered good and cut off with the Engineer's written approval. Refusal shall be defined as a pile achieving two times (2x) the required design loading as shown on the contract plans and above in Table 4. Two times (2x) required design loading shall be 1150 kN (129.3 tons).

The recommendations contained in this report are based on specific project information regarding structure type and structure location that has been provided by T.Y Lin International. Any questions regarding the above recommendations should be directed to the attention of Hector Valencia (916) 227-7081 (CALNET 498-7081) or Mark DeSalvatore (916) 227-7056 (CALNET 498-7056), Office of Geotechnical Services, Structure Foundations South.

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