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To: MR. MINH HA, CHIEF
Office of Bridge Design - West
Structure Design MS9/ 3-3G
Design Branch 4

Date: March 13, 2006

Attention: Linan Wang

File: 04-SON-128-KP 5.44
59-930322
Russian River Bridge (Replace)
Bridge No. 20-0038

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Subject: Final Foundation Recommendations (Revised)

INTRODUCTION

This final foundation recommendation memorandum is provided in response to your request dated January 30, 2006 for the proposed replacement of the existing Russian River Bridge. The bridge was significantly damaged during the New Years Eve/Day storm of 2005/2006 and is deemed Scour Critical. The damage involved the settlement of Bent 2 south column resulting in sagging of two spans, and front to back cracking of the web wall and Bent cap. The bridge has been declared unsafe and is closed to traffic. A new ten span, 2 columns per bent PC/PS Box Girder Bridge supported by 1.2 m diameter CISS piles, is proposed to replace the damaged bridge. Seat type abutments are also proposed, each supported on three freestanding designed 1.2 m diameter CISS piles.

To facilitate demolition of the damaged bridge and construction of the new bridge, a temporary trestle constructed on the up stream side of the damaged bridge is proposed. Additionally, the damaged spans will have to be stabilized by replacing Bent 2 with two pairs of 0.61m diameter CISS pile extensions, one pair placed on each side of the north and south Bent columns.

Caltrans Office of Geotechnical Design West, performed a foundation design investigation that included 5 borings drilled through the existing bridge deck. The drilling commenced on January 13, 2006 and was completed on February 10, 2006. The maximum depth of these borings is 62.7 m (205.7 ft), or Elevation 3.8 m (12.5 ft). The Log of Test Boring associated with the existing bridge was not available. The original 1932 Contract Plans, the 1978 Water Main Addition, As Built Plans and bridge maintenance records were reviewed.

GEOLOGY

The bridge site is located approximately ½ mile east of Geyserville in Alexander Valley. This valley, which is situated in the central Northern Coast Ranges, is about 1 to 1.5 miles wide, typically flat and near the bridge site is at approximately elevation 61m. The surrounding ridges rise to elevations over 427m. Below the valley floor, there is a relatively deep basin filled with sedimentary deposits extending to depths possibly greater than 152 m. These deposits consist of unconsolidated to consolidated poorly stratified flood plain, streambed and alluvial fan deposits.

Based on the Borings RR06-1, 2 and 3, the west side of the proposed bridge is generally underlain with medium dense interbeded sand, gravelly sand, and sandy gravel from the mud line to elevations ranging from 42 to 57 m. Underneath to the maximum exploration depth of 62.7 m (Elevation 3.8 m), these deposits are compositionally similar as above but become predominately dense to very dense. Soil deposits underlying the east side of the bridge (Borings RR06-4 and RR06-5) generally consist of interbeded dense to very dense sands, gravelly sand, sandy gravels, and stiff clay. The detailed soil descriptions are presented in the Log of Test Borings (LOTB) Attachment.

GROUNDWATER

The groundwater depth at the bridge site will typically fluctuate with season and will correlate with the local topography and with the water level in the river. During the site investigation, the water level in the river fluctuated around elevation 60 meters+/-, which would reflect closely the ground water elevation at the abutment and bent locations. For the pile design analysis, a 100-year flood was assumed and the groundwater was taken at the ground surface or mud line elevation.

SCOUR

The Final Hydraulics Report (Sharon Ropp, February 27, 2006) indicates that the maximum scour at Abutment 1 and Bents 2 through 7 is at elevation 49.03m and at Bents 7 through 10 and Abutment 11, is at elevation 50.62m. Maximum scour would potentially expose on average 11 meters of unsupported pile at the abutments. As a consequence the abutment piles were design to be free standing. The estimated potential scour at the bridge site as presented in the Hydraulics Report is provided in Table 1 below.

Table 1- Scour Summary

Location	Column Configuration	Bent Scour Depth (m)	Bent Scour Elevation (m)	Bent Scour Elevation - Including Degradation (m)
Abutment 1	Single Row of Three Piles	3.6	52.03	49.03
Bents 2 through 7	Single Row of Two Pile Columns	3.6	52.03	49.03
Bents 8 through 10	Single Row of Two Pile Columns	8.0	53.62	50.62
Abutment 11	Single Row of Three Piles	8.0	53.62	50.62

CORROSIVITY

The site soil Corrosivity condition is pending the results of Corrosivity testing.

SEISMICITY/LIQUEFACTION POTENTIAL

Hossain Salimi from our Office will provide Seismic and Liquefaction Design Recommendations.

FOUNDATION RECOMMENDATIONS

The final foundation recommendations are based on the General Plan (February 17, 2006), the foundation loads provided by Minh Ha by email and observed subsurface soil conditions. Cast-in Steel Shell (CISS) piles were chosen based on their load bearing capacity, site conditions, and hydraulic suitability. Cast-in-drilled-hole piles were not recommended because of shallow groundwater and the granular soils underlying the site, which will cause severe caving during drilling. Displacement type pre-cast concrete driven piles were also not recommended because of the excessive pile lengths coupled with the high load bearing requirements and anticipated difficult driving conditions.

The pile specifications including pile tip elevations are presented in Table 2 for the proposed new bridge. Calculations for pile tip elevations utilized the method presented in American Petroleum Institute (API) Publication (1996). The Structure Designer determines the design tip elevations controlled by the lateral load demand. Specified pile tip elevations may be revised based on the results of the pile load test specified in this report.

Table 2 Pile Data Table (1220 x 25 CISS)

Location	Design Loading (kN)	Nominal Resistance		Cut-Off Elev. (m)	(1) Design Tip Elev. (m)	Specified Tip Elev. (m)	(2) Ultimate Geotechnical Resistance (kN)
		Compression (kN)	Tension (kN)				
Abutment 1	N/A	10200	2000	59.9	23.5 (a) 35.1 (b)	23.5	12,000
Bent 2	N/A	11300	2000	60.0	19.9 (a) 35.3(b)	19.9	14,235
Bent 3	N/A	11300	2000	60.7	19.7 (a) 35.3 (b)	19.7	14,235
Bent 4	N/A	11300	2000	59.0	19.7(a) 35.3 (b)	19.7	14,235
Bent 5	N/A	11300	2000	58.4	19.7 (a) 35.3 (b)	19.7	14235
Bent 6	N/A	11300	2000	58.9	20.4 (a) 36.2 (b)	20.4	15,570
Bent 7	N/A	11300	2000	59.9	21.4(a) 36.7 (b)	21.4	15,570
Bent 8	N/A	11300	2000	60.7	21.4 (a) 36.8 (b)	21.4	15,570
Bent 9	N/A	11300	2000	62.9	18.6 (a) 33.9 (b)	18.6	13,790
Bent 10	N/A	11300	2000	62.9	18.6 (a) 33.9 (b)	18.6	13,790
Abutment 11	N/A	10200	2000	60.1	18.8 (a) 33.9 (b)	18.8	13790

Notes: (1) Pile tip elevations are controlled by (a) Compression (b) Tension
(2) Ultimate Geotechnical Resistance expected at Design tip Elevation and it is used to help development the field acceptance criteria.

PILE LOAD TESTING

In order to establish the bridges final pile acceptance criteria, a pile load test is recommended. It is planned to conduct the test utilizing as many production piles as possible. A non-production pile test will be considered only, if it is found not practical to do so. The Pile test configuration includes a test apparatus (2 load beams), instrumentation and five piles, one test pile and four reaction piles. Each reaction pile is designed to resist (in tension) one-third plus 20 percent of the test load.

Site conditions at the time of construction coupled with the construction demolition schedule are factors that will in part influence the test program. Abutment 1 is the location of the recommended test site and all three of its piles will be incorporated in the test, two as anchor piles and one as the test pile (two piles will be wasted). Pre-drilling to elevation 52.8m or to existing pile tip elevation as verified by the contractor is anticipated to facilitate advancing the piles through the exiting piles at the abutment. Refer to the following Construction Considerations for more discussion. The test and reaction pile specifications and loads are summarized below.

	Load Test Pile	Anchor Pile(s)	
No. of piles	1	2	2
Pile function:	Production	Production	Non-production
Pile type:	CISS	CISS	CISS
Diameter (m)	1.2	1.2	1.2
Wall thickness (mm):	25	25	25
Tip Elevation (m):	23.5	34.0*	34.0
Minimum Embedment Lengths from bottom of abutment footing (El. 59.9m) (m):	36.4	25.9	25.9
Test Load:	12,000 kN **	Minimum Resistance Capacity:	4800 kN

Note: * Piles can be driven to final design tip if desired before the commencement of pile load test.

** The test load is based on pre-drilling to elevation 52.8m. If it is desired to change

the pre-drilling elevation or other method is used, the foundation designers shall be contacted to re-evaluate the pile test load.

The Pile will be load tested once it has reached the specified pile tip (SPT) elevation. If the expected capacity has been reached at the SPT elevation no further testing will be necessary and the pile field acceptance criteria can be established. If the expected capacity is not reached the pile will be driven further till the required capacity is achieved than tested.

CONSTRUCTION CONSIDERATIONS

1. Groundwater levels at the abutments and the retaining walls will exceed bottom of footing elevations and flooding of the proposed excavations is expected. Shoring, dewatering and possibly a concrete seal course placement will be necessary to facilitate safe construction. Structure Excavation Plan (Type 'A') will apply.

2. For the CISS piles, a soil plug of at least 6 pile diameters is required at the bottom of the shell. If the soil plug cannot be maintained (soil boil condition), then a seal course of at least 1.5 m thick shall be placed. The drilling of the soil inside steel piles shall be done under positive hydrostatic head, and the placement of the seal course if needed, the placement of the rebar cage, and concrete pour should be completed in a continuous operation.

3. The Office of Geotechnical West (OGDW) shall be contacted and OGDW staff shall be present on site for the first pile installed over water during initial cleaning out the pile(s) and seal course placement to make sure the plug is maintained and not disturbed. Then under the direction of the Structure Representative his staff will observe the clean out and seal course placement of the remaining piles.

4. Prior to placing the concrete in the shell, the interior surfaces of the shell shall be cleaned of all foreign material, including residue from the drilling operation. Brushing, pressure jetting or equivalent methods shall be used.

5. Pre-drilling will not be allowed below the scour and/or Liquefaction elevations; whichever is deeper. If hard driving conditions are encountered, center relief drilling may be used, provided the soil plug remains a minimum of 6-pile diameters. (See Pile Load Test section above regarding pre-drilling at Abutment 1.)

6. At the option of the Contractor a vibratory hammer may used to advance the piles to the depth of maximum scour (Elevation 49.03m (160.8 ft.)). Below the scour elevation, an impact hammer must be used.

7. The Contractor shall provide a driving system submittal including drivability analysis for approval prior to installing the piles.

8. The pile field acceptance criteria will be developed from the pile load test. The ultimate geotechnical capacities used for field acceptance criteria shall follow the values presented in the pile data table.

9. The piles of the existing abutment will not be completely removed by demolition. Therefore, pile obstructions at the abutments should be anticipated during installation of new piles. The Contractor shall verify the elevation and location of the existing piles.

The Office of Geotechnical Design West should be notified prior to pile installation and/or if any changes in design or location should occur. If you have any questions or need additional information, please call Bill Bertucci at 510-622-8744 or Caroline Chen at 916-227-5386.

c: TPokrywka, WBertucci, CChen, HSalimi, BLiebich, GWilcox, CMorton, JStayton (4), R.E. Pending File, Route File

WBertucci/CChen/mm