

Memorandum

To: JOSEPH PRATT - MS #5
Office of Structure Foundations
Division of Structures and Foundations

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S805/S5 Truck Connector
Bridge No. 57-1069F

From: DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICE CENTER
Division of Materials Engineering and Testing Services – MS #5
Office of Testing and Technology Services

Subject: **Corrosion Review for S805/S5 Truck Connector**

We have completed our corrosion mitigation review of the S5/S805 Truck Connector project outlined in a May 8, 2000 memorandum sent to Doug Parks of the Corrosion Technology Branch. Our review is based on corrosion test results of soil samples, summarized information from the Log of test borings, and Caltrans Bridge Design Specifications 8.22 (May 2000 draft).

Project Description

The site is part of the Route 5/805 Freeway improvements in San Diego County. The proposed bridge will span over Los Penasquitos Creek with Bent 13 to be located within the stream channel. The bridge abutments will be supported by plumb, 1.2m (4 ft) diameter, Cast-in-Drilled-Hole (CIDH) Piles. The bent supports will be supported by plumb 2.4, 3.0, and 3.6 m (8, 10, and 12 ft) diameter drilled shafts. It is the understanding of the Corrosion Technology Branch that permanent steel casings, 13mm to 25mm (1/2 in to 1in) in thickness, will be used as a construction aid on some of the CIDH piles. The permanent steel casings will serve as a barrier against corrosive conditions. The permanent steel casings will not serve as part of the structural section of the pile. Approximately six supports, extending north of Los Penasquitos Creek, may not have a permanent steel casing.

Corrosion Review

Caltrans defines a corrosive area as an area where the soil and/or water contains more than 500 ppm of chlorides, more than 2000 ppm of sulfates, has a minimum resistivity of less than 1000 ohm-cm, or has a pH of 5.5 or less.

An extensive amount of coring was done at the S5/S805 Truck Connector site and in the nearby area. A total of twenty soil samples were taken at the S5/S805 Truck Connector, the N805/N5 Truck Connector (Br. 57-1070G), the Sorrento Viaduct (Br. 57-0513R/L), Retaining Wall Nos. 524 and 525, and the Route 5/805 Separation-Widen (Br. 57-0512). Groundwater at the site was found between elevation +8.84 m and elevation +9.48 m (+29.0 ft. to +31.1 ft.). Groundwater was found between elevation +5.71 m and elevation +8.29 m (+18.7 ft. to +27.2 ft) at the nearby sites. No corrosion samples were taken of the groundwater. However, two samples were taken of the surface water at Los Penasquitos Creek where the proposed bent 13 will be located. The soil and water samples were tested for pH, minimum resistivity, sulfate concentration, and chloride concentration per CTM 417, CTM 422, and CTM 643. The testing results of the soil and water are listed below.

The pH level of the soil ranged from 7.4 to 8.6. The minimum resistivity of the soil ranged from 250 to 2100 ohm-cm. The sulfate concentration of the soil ranged from 25 ppm to 6000 ppm and the chloride concentration of the soil ranged from less than 25 ppm to 1200 ppm.

The pH level of the surface water at Los Penasquitos Channel ranged from 7.4 to 7.6. The minimum resistivity of the surface water at Los Penasquitos Channel was 350 ohm-cm for both samples. The sulfate concentration of the surface water at Los Penasquitos Channel ranged from 361 ppm to 434 ppm, and the chloride concentration of the surface water at Los Penasquitos Channel ranged from 746 ppm to 760 ppm.

The soil on-site is corrosive based on high levels of sulfates, high levels of chlorides, and low minimum resistivity levels. The surface water on-site is corrosive based on high levels of chlorides, and low minimum resistivity levels.

Corrosion Recommendations

In order to maintain a 75-year design life for the structure, we recommend the following corrosion mitigation measures:

- The minimum concrete cover requirements for chloride environments are addressed in Table 8.22.1 of the BDS (May 2000 draft). Chloride concentrations for soil and surface water at the site are between 500 ppm and 5000 ppm. A minimum concrete cover of 75 mm (3 inches) should be used for reinforcing steel in pile caps, footings, walls, CIDH piles (not inside a steel casing), the exposed upper surface of the CIDH piles next to the bottom of the columns, and the column at Bent 13. For CIDH piles (protected by a steel casing), the minimum standard concrete cover of 50 mm (2 inches) is required. The steel casing of the CIDH piles will protect the concrete, and steel reinforcement on the inside of the pile from diffusion of chlorides. Also, the permanent steel casing will be seated, or rock socketed, into the bedrock to seal the casing from intrusion of groundwater, and caving of soil. Therefore, the CIDH piles will be protected against chlorides with a permanent full-length steel casing on the sides and the rock socket will protect the CIDH piles at the pile tip.
- The minimum requirements for protection of reinforced and unreinforced concrete against acid and sulfate exposure shall be in accordance with Table 8.22.2 of the BDS (May 2000 draft). For footings, pile caps, walls, CIDH piles (not inside a steel casing), and the exposed upper surface of the CIDH piles next to the bottom of the columns, and the column at Bent 13, the concrete should contain a minimum cementitious material content of 400 kg per cubic meter. Cementitious material shall consist of 75% by mass Type II modified, or Type V portland cement and 25% by mass mineral admixture conforming to ASTM C618 Type F or N (flyash or natural pozzolans). Also, the water-to-cementitious material ratio shall be a maximum of 0.40.
- For CIDH piles (protected with a steel casing), no additional concrete corrosion mitigation measures are required. The typical corrosion rate used by Caltrans for steel pipe piles exposed to corrosive soil and/or water in the soil embedded zone is 0.0254 mm/yr (0.001 in/yr) per exposed face. The sacrificial thickness of steel on the CIDH piles would be 1.9 mm (0.075 inches). The minimum thickness of the steel casing for the CIDH piles is 13 mm (0.50 inches) which exceeds the minimum sacrificial thickness previously mentioned. The permanent steel casing will protect the concrete inside the CIDH piles from corrosive conditions during the 75-year design life for the structure.

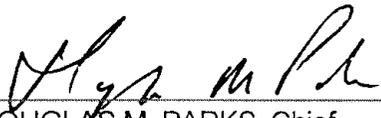
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If you have any questions regarding our comments, please contact Michael Tolin at (916) 227-5297 or Doug Parks at (916) 227-7007.



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Reviewed By:



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