



CCO CONCURRENCE MEMO

California Department of Transportation

SFOBB – SAS

Contract No. 04-0120F4

CCO No.: 330 Supplement No.: 0

Title: Pier E2 Post Tensioning

Date: 5/31/2013

Requested By: Bill Casey, Supervising Transportation Engineer

(PRINT NAME)

(SIGNATURE)

Description of Work:

Furnish, install, stress, and grout post tensioning at Pier E2 for saddle installation.

Reason for Change:

Contract Plan Sheets 884R1 "Pier E2 Bearing Details No. 2" and 887R2 "Pier E2 Shear Key Details No. 1" identify the anchor bolts for the Pier E2 Shear Keys and Bearings as 76 mm A354 Grade BD Bolts. These plan sheets require the bolts to be tensioned to 0.70 Fu (70% of their ultimate strength). Special Provisions Sections 10-1.47 "Spherical Bushing Bearing (Pier E2)" and 10-1.50 "Shear Key (Pier E2)" provide the specification requirements for the anchor bolts. Both of these specifications refer you to Special Provision Section 10-1.59 "Steel Structures" which in turn refers you to various ASTM specifications including ASTMs A123, A153, A143, A354, etc. which provide further specifications for the manufacture and testing of the anchor bolts and hardware. While these references provide for the final mechanical properties and processes for the manufacture of the bolts, they do not specifically require hydrogen embrittlement testing for the anchor bolts.

Within days after tensioning was performed, the anchor bolts in the shear keys directly below the Eastbound and Westbound OBG structures (known as Shear Keys S1 and S2) began to fail. A total of 32 out of the 96 anchor bolts broke before the Department directed the Contractor to reduce the anchor bolt tension to prevent further failures. A forensic metallurgical examination was jointly performed with both the Contractor's and Materials Engineering and Testing Services' (METS) metallurgical experts. It was determined that while the failed bolts' material properties did meet the contract specifications, the hardness properties were at the upper limit and the ductility and toughness properties were at the lower limit. Taking this high end hardness and low end ductility into account and combining it with a high tensile stress (0.70 Fu) makes this material more susceptible to the effects of hydrogen cracking (also known as hydrogen embrittlement). The metallurgical examination indicated that the bolts were susceptible to hydrogen embrittlement due to a lack of uniformity in the microstructure of the rods. While this issue continues to remain under investigation, the Toll Bridge Project Oversight Committee (TBPOC) has for the time being tabled the discussion of contractual responsibility for the failures and chosen to focus on the solution in order to ensure the project stays on track to achieving seismic safety.

The anchor bolts at Shear Keys S1 and S2 are uniquely different from the anchor bolts at the remaining shear keys and bearings (known as Shear Keys S3 and S4 and Bearings B1, B2, B3, and B4) in that they were manufactured in 2008 as opposed to the remaining ones in 2010. In addition, due to physical limitations the anchor bolts at Shear Keys S1 and S2 have their anchors fully cast into the Pier E2 cap and are not replaceable, as opposed to the remaining shear keys and bearings which are thru bolted and thus replaceable. As such Shear Keys S1 and S2 will require a retrofit solution.

In an effort to move forward, multiple change orders will be issued for the shear key retrofit with direction provided by the TBPOC (April 11, 2013 meeting) including furnishing replacements for rods removed for testing (CCO 312) and procuring long lead time materials (CCO 313). The total approval for the early work was \$4.3 million. Since that time, not all of the funds have been required for the early work. In an effort to keep progression of the shear key work moving and until such time as the TBPOC decides to approve additional funding, TBPOC (May 9, 2013 meeting) clarified this approval to extend beyond the early work to include all other E2 shear key anchor bolt activities within the approved \$4.3 million funding authorization. The following change orders will be issued, up to the limited dollar approval, to allow the Contractor to start the work until such time that the full scope is approved by the TBPOC: fabricating saddles (CCO 319), shimming temporary bearings (CCO 320), performing concrete and rebar demolition of Pier Cap E2 (CCO 325), core drilling for through-cap tendons (CCO 326), installing falsework and saddles (CCO 327), furnishing and installing



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reinforcing bars (CCO 328), placing shear key concrete (CCO 329), and furnishing and installing post tensioning (CCO 330).

This change order (CCO 330) will install post tensioning at Shear Keys S1 and S2 to secure the saddles.

Toll Bridge Program Oversight Committee (TBPOC) approved change orders be issued for the shear key anchor rods on April 11, 2013, in the amount of not to exceed \$4,300,000.00.

Approvals Required By: Division of Construction, HQ TBPOC

Concurrence Required By:

- | | | | |
|--|--------------|---|-------------------|
| <input type="checkbox"/> Design Consultant: TyLin/ Marwan Nadar | Date: N/A | <input checked="" type="checkbox"/> Project Manager, Ken Terpstra | Date: Will Obtain |
| <input checked="" type="checkbox"/> Bridge Design Oversight: Wenyi Long | Date: 6/4/13 | <input type="checkbox"/> Architect: Clive Endress | Date: N/A |
| <input checked="" type="checkbox"/> District Design Oversight: Jing Z Chen | Date: 6/6/13 | <input checked="" type="checkbox"/> CT Maintenance: Ken Brown | Date: 6/11/13 |

Estimated Cost: \$1,000,000.00

Recommended Time Adjustment: None

Recommended Method of Payment:

- Contract Items Extra Work at Force Account Agreed Price (LS or UP) Other:

Concurrence/Prior Authorization:

- This represents Prior Authorization to proceed with the work.
 This represents an acknowledgement that the individuals below are in concurrence with this change order, which may require Division of Construction approval before proceeding with the work.

_____ on CCO 7/29/13
 Tony Anziano, Program Manager Date

_____ 5/30/13 _____ 6/4/13
 William Casey, Supervising TE Date Rich Foley, HQ Const. Coord. Date