STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

CONTRACT CHANGE ORDER MEMORANDUM

TO: Tony Anziano, Program Manager /	FILE: E.A. 04 - 0120F4
FROM: Darryl Schram, Senior TE	CO-RTE-PM SF-80-13.2/13.9
	FED. NO. No
CCO#: 338 SUPPLEMENT#: 0 Category Code: CHTX	CONTINGENCY BALANCE (incl. this change) $47,509,348.62
COST: $250,000.00 INCREASE ☑ DECREASE ☐	HEADQUARTERS APPROVAL REQUIRED? ☑ YES ☐ NO
SUPPLEMENTAL FUNDS PROVIDED: $0.00	IS THIS REQUEST IN ACCORDANCE WITH ENVIRONMENTAL DOCUMENTS? ☑ YES ☐ NO
CCO DESCRIPTION: Pier E2 Permanent Bearing Interim Shims	**PROJECT DESCRIPTION:** CONSTRUCT SELF-ANCHORED SUSPENSION BRIDGE

Original Contract Time:	Time Adj. This Change:	Previously Approved CCO Time Adjustments:	Percentage Time Adjusted: (including this change)	Total # of Unreconciled Deferred Time CCO(s): (including this change)
2490 Day(s)	0 Day(s)	501 Day(s)	20 %	9

THIS CHANGE ORDER PROVIDES FOR:

Furnishing and installing temporary shim plates for the permanent bearings at Pier E2.

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 Provisions 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 Orthotropic Box Girder (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 metallurgic 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.

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 an alternate anchorage solution.

Multiple change orders will be issued for the alternate shear key solution including:

- CCO 312 furnish replacements for rods removed for testing,
- CCO 313 procure long lead time materials,
- CCO 314 perform work to remove, replace and test sample rods,
- CCO 319 fabricate saddles,
- CCO 320 shim temporary bearings,
- CCO 325 perform concrete and rebar demolition,
- CCO 326 core drill for through-cap tendons,
- CCO 327 install temporary work platforms, falsework, and saddles,
- CCO 328 furnish and install reinforcing bars,
- CCO 329 place shear key concrete,
- CCO 330 furnish and install post tensioning,

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- CCO 331 plan sheets
- CCO 337 furnish, install, and remove temporary rods, and
- CCO 338 shim permanent bearings

This change order (CCO 338) will install temporary shims at the Pier E2 bearings to replace the lost lateral and longitudinal capacity of Shear Keys S1 and S2. After the alternate Pier E2 Shear Key S1 and S2 saddle anchorage work is complete, these temporary shims will be removed.

The total cost of this change order is $250,000.00 force account, which can be financed from the contingency fund. A detailed cost analysis is on file.

Consideration of a time adjustment will be deferred until completion of the work specified herein. Determination of a commensurate time adjustment will be made in accordance with Section 10-1.13, "PROGRESS SCHEDULE (CRITICAL PATH METHOD)" and Section 10-1.14, "TIME-RELATED OVERHEAD" of the Special Provisions, as well as Section 8-1.07, "LIQUIDATED DAMAGES", of the Standard Specifications

The Toll Bridge Project Oversight Committee (TBPOC) initially (April 11, 2013) approved $4.3 million to continue work on the Shear Key S1 & S2 anchor rod replacement strategy solutions and to procure long lead time materials. The TBPOC revised this approval (May 9, 2013) to include all E2 shear key anchorage work within the approved $4.3 million funding. At the June 6, 2013 TBPOC meeting the TBPOC revised this approval to $7.5 million. At the July 10, 2013 TBPOC meeting the TBPOC further revised this approval to $18 million. CCO's 313, 319, 320, 325, 326, 327, 328, 329, and 330 are specific to this approval. The October 3, 2013 TBPOC meeting added CCOs 337 and 338 to the $18 million approval.

In addition, at the May 9th meeting the TBPOC also approved $1 million for the anchor rods test program. At the October 3, 2013 TBPOC meeting the TBPOC approved an additional $2.7 million for a total of $3.7 million. CCO's 312 and 314 are specific to this approval.

The SAS Second Quarter 2013 risk register is carrying the risk "Fabricate and Install a Retrofit for Shear Key bolts at Pier E2" in the range of $15M to $30M and was created to address the fabrication and installation of the new saddle design. The SAS risk register is also carrying the risk for the testing of ASTM A354 Grade BD Rods in the range of $2.05M to $25M to address testing and remedial actions as necessary.

This change order has concurrence from William Casey (Supervising TE), Rich Foley (HQ Oversight), Wenyi Long (Bridge Design), Ken Brown (Maintenance), and Jing Chen (District Design).

CONCURRED BY:			
Construction Engineer:	William Casey, Sup TE	Date	7/16/13
Bridge Engineer:	CT Oversight, Wenyi Long, P.E.	Date	7/16/13
Project Engineer:	District Design, Jing Chen	Date	7/25/13
Project Manager:		Date	
FHWA Rep.:		Date	
Environmental:		Date	
Other (specify):	HQ, Rich Foley	Date	7/16/13
Other (specify):	Struct. Maint, Ken Brown	Date	7/16/13
District Prior Approval By:		Date	
HQ (Issue Approve) By:		Date	
Resident Engineer's Signature:		Date	7/11/13

ESTIMATE OF COST

	THIS REQUEST	TOTAL TO DATE
ITEMS	$0.00	$0.00
FORCE ACCOUNT	$250,000.00	$250,000.00
AGREED PRICE	$0.00	$0.00
ADJUSTMENT	$0.00	$0.00
TOTAL	$250,000.00	$250,000.00

FEDERAL PARTICIPATION

☐ PARTICIPATING ☐ PARTICIPATING IN PART ☑ NONE
☐ NON-PARTICIPATING (MAINTENANCE) ☐ NON-PARTICIPATING

FEDERAL SEGREGATION (if more than one Funding Source or P.I.P. type)
☐ CCO FUNDED PER CONTRACT ☐ CCO FUNDED AS FOLLOWS

FEDERAL FUNDING SOURCE	PERCENT

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