State of California | Business, Transportation and Housing Agency

Memorandum

To: **Mustapha Raouf,**
Office Chief, Design A

Date: Aug 27, 2014

Attention: **Paul Phan,**
Project Engineer

File No: 08-SBd-040 PM
R105.2/R106.5
EA 08-0N550
Bridge Replacement

From: **DEPARTMENT OF TRANSPORTATION**
Bruce W. Kean, District 8 Materials Engineer

Subject: **Updated Materials Report**

1.0 GENERAL

1.1 Proposed Improvements

According to your request, this project proposes to replace the left Watson Wash Bridge (Bridge #54-0805 L westbound) on the Interstate 40 near Essex in the County of San Bernardino. A temporary detour will be constructed for the median crossovers during the replacement of the bridge. All work will be performed within the State right of way limits.

1.2 Existing Facilities

Interstate 40 (I-40) is a major east-west route of the Interstate Highway System. It starts out at a junction with I-15 in Barstow and heads east across the Mojave Desert in San Bernardino County past the Clipper Mountains to Needle, before it crosses into Arizona east of Kingman.

I-40 was realigned in 1970 between Kelbaker Road (PM 79.7) and Essex Road (PM 100.3), and the new alignment lies northerly from the original highway. Near and at the project site, I-40 is a four-lane divided (independent alignments) highway consisting of two 12-feet-wide lanes in each direction. The inside and outside shoulders in each direction are 5 and 10-feet-width respectively. Both roadbeds are separated with about 200 feet dirt median.

1.3 Geology, Terrain

The project is located in the Mojave Desert Region, the limits of which are roughly bounded by the Garlock Fault on the north and northwest, the San Andreas Fault and San Bernardino Mountains on the southwest and south and the Colorado River on the east. Broad linear valleys, most of which contain playas or dry lakes, characterize the desert east of Barstow. Isolated mountain masses and linear ridges, mostly disposed without apparent pattern are evident. Cinder cones are widely found in the Mojave Region and many flows of basalt have moved down the valleys. Soils in the project area are generally sands, gravelly sands, and sandy gravels interspersed with small rock and occasional pockets of silt.

1.4 Climate

The normal annual rainfall in the project area is about five inches. Storms during the months of July through October, which account for half of the yearly precipitation, are largely the result of tropical air masses. These storms, of short duration, are characterized by very intense rates of rainfall. The annual range of temperatures is from a minimum of 20 °F to a maximum of 120 °F.

2.0 EXISTING STRUCTURAL SECTIONS

The existing pavement section consists of (as per as-built EA: 48377 and EA: 48630) 0.79' AC over 0.50' Cement Treated Base (CTB).

The following shows a list of As-Builts found for this Route near or within the project limits:

- Year: 2005: Bridge Rehabilitation - Treat Bridge Decks & Seals, EA:48377 (PM R80.4/ PM R119.6)
- Year 2007: Pavement Rehabilitation with Median Shoulder Widen, EA: 48630 (PM 89.0/119.0)
- Year 2007: Replace Bridges Eastbound, EA: 0J101 (PM R80.4/ R97.7)
- Year 1993: Rehabilitate Roadway, EA: 34900 (PM R73.0/ R136.3)

3.0 PAVEMENT DESIGN PARAMETERS

3.1 Traffic Index (TI)

The following Traffic Index values (TI) were provided in the memorandum dated September 20, 2012 from the Office of Forecasting.

Forecasted Period	SBd-040 PM R105.2/ R106.5			
	Inside Lane		Outside Lane	
	Mainline	Shoulder	Mainline	Shoulder
10-Year	13.50	8.50	13.50	8.50
20-Year	15.50	9.50	15.50	9.50
40-Year	17.00	10.50	17.00	10.50

The above 20-Year TI (15.50) and the HDM Table 613.3C "Conversion of ESAL to Traffic Index" were used to estimate the TI for the temporary median crossover. Since it is unknown at this time how long

these temporary crossovers are going to be in service, TIs for different service lives are estimated and shown in the table below:

Service Life	Temporary Crossovers (TI)
6-month	10.0
9-month	10.5
12-months	11

3.2 Pavement Design Life

For the temporary pavement design (median crossovers), we will provide temporary pavement design for 6, 9, and 12-month service life.

3.3 R- Value for Basement Soils

A Materials Report for project 046831 dated July 28, 1965 (SBd 40 PM 100.3/123.8) reports that R-values testing were performed by collecting soil samples from boreholes at various stations (between Sta 3787+00 and Sta 3875+00) at various depths and the R- values ranged between 73 to 80. The report states Materials from excavation should serve as excellent embankment materials.

Based on the above information, and following the HDM Topic 614.3 guidelines for R-values limitations, an R-value of 50 will be selected for HMA pavement design.

4.0 STRUCTURAL SECTION DESIGN

According to the project scope, a temporary pavement design is required for the median crossovers during the replacement of the bridge. However, we will also provide pavement design for the existing AC pavement which will need to be reconstructed at the beginning and end of the detour.

4.1 Structural Section for Temporary Median Crossovers

A flexible pavement design is recommended. Pavement sections shown below were obtained employing CalFP version 1.1, a computer program based on design methodology as documented in Chapter 630 of the Caltrans Highway Design Manual (HDM).

Several Design Lives, R-value 50

Structural Section	Temporary Median Crossovers Design Life		
	6-month (TI=10.0)	**9-month** (TI=10.50)	**12-month** (TI=11.0)
Hot Mix Asphalt Type A (HMA-A)	0.55'	0.55'	0.60'
Class 2 Aggregate Base (AB Cl 2)	0.55'	0.65'	0.65'

4.2 Structural Section for Reconstructing Existing AC Pavement

The TI value for the mainlines for 20.-Year is 15.5 which is too high to use the regular HMA pavement using CalFP version 1.1, a computer program based on design methodology as documented in Chapter 630 of the Caltrans Highway Design Manual (HDM). In this scenario, we will determine the flexible pavement sections using maximum TI value of 15.0 and CalFP 1.1 program. To compensate the TI value limitation of the computer program, enhancement for more than 20-year design stipulated in the HDM Topic 633 has been added to the pavement section. Instead of using 0.2'RHMA-G for top surface layer as part of enhancement, we have used 0.2' HMA-A in calculating the pavement thickness in order to avoid two different mixes. A small quantity of RHMA-G may become too expensive.

As the HDM Section 613.5 says "The total depth of the shoulder pavement structure (depth from the surface to the subgrade) shall match the pavement structure grading plane of the adjacent traffic lane", so in preparing the shoulder structural sections, the depth of the shoulder base and/or subbase has been increased in order to match the grading plane of the shoulder pavement structure to that of the adjacent traffic lane. This will provide a path for water in the pavement structure to drain away from the lane and into the shoulder. It can also provide a more cost effective means to upgrade the shoulder to a traffic lane in the future.

Structural Section	20-Year	
	Mainlines + first 2' of the Outside Shoulder and first 1' of the Inside Shoulder (TI=15.50)	Shoulders* (Inside/ Outside) (TI=9.5)
Hot Mix Asphalt Type A (HMA-A)	1.50'	1.00'
Class 2 Aggregate Base (AB Cl 2)	0.50'	1.00'

* If the shoulder width is less than 5 feet, as per Caltrans HDM Topic 613.5 2(b), shoulder shall have the same structural section as the adjacent mainline.

5.0 EARTHWORK: EXCAVATION AND EMBANKMENT

Earthwork will be necessary to construct the temporary crossovers. Due to the different profile grade of both roadbeds (eastbound and westbound), it appears that both cut and fill will be necessary. Embankment material and excavation, in general, should be structurally stable on slopes no steeper than 4H:1V.

Any Imported or Local Borrow required should conform to Section 19-7.02 of the Standard Specifications and the R-value minimum shall not be less than 50.

6.0 MATERIALS SPECIFICATIONS

6.1 Earthwork

- Clearing and grubbing is recommended as per section 16 of the Standard Specifications, to remove vegetation, topsoil, and any artificial fills or debris, and to prepare the site for the proposed facilities.
- Earthwork should conform to Section 19 of the Standard Specifications.
- The subgrades for paved areas should be compacted to a minimum relative compaction of 95%, as per Section 19-5.03B "Relative Compaction (95 Percent)" of the Standard Specifications.
- The subgrades to receive pavements should have a minimum R-value of 50, including any Imported or Local Borrow.

6.2 Base Materials

- Aggregate Base (AB) should be Class 2 Aggregate Base, and conform to Section 26 of the Standard Specifications.

6.3 Flexible Pavement

- **<u>Hot Mix Asphalt (HMA)</u>:**

  a) HMA-Type A: aggregate will comply with 1-inch grading. .

- **Asphalt Binder:**

  a) HMA-Type A: PG 64-28 M

- Aggregates for the HMA-Type A mix are to be treated with lime slurry marination.
- Prime Coat shall be applied to base material prior to placing hot mix asphalt concrete.
- Tack Coat shall be applied to the existing AC surface and between successive layers of HMA.

7.0 REFERENCE

- Materials Report for project EA 046831, prepared by Materials Engineering Branch, dated July 28, 1965 (Route SBd 40 PM 100.3/ 123.8).
- Materials Report for project EA 0N591, prepared by Materials Engineering Branch, dated July 19, 2010 (Route SBd 40 PM R94.5/ R95.7).
- Materials Report for project EA 0N560, prepared by Materials Engineering Branch, dated June 14, 2010 (Route SBd 40 PM R98.3/ R99.1).
- Highway Design Manual –California Department of Transportation.
- CalFP Version 1.1, a computer program.

8.0 CLOSURE

Our findings and recommendations were obtained in accordance with generally accepted professional principles in Materials Engineering, and are based on the results of the historical research, and Caltrans Highway Design Manual guidelines. If any change (i.e., structure type, location, scope of the project etc.) is implemented which materially alters the project, our recommendations may need to be revised.

If you have any questions, you may call Kazi Ahmed at (909) 888-2090, or me at (909) 888-2029.

BWK:EA