COLORADO
Department of Transportation
Region 4

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11/12/19

Colorado Department of Transportation

To: Gary DeWitt/R4 Staff

From: Steven Heimmer

Subject: SA#: 22975, R400-370, Final HWY 40H and 287B Passing Lanes Pavement Design

General Information:

This letter addresses the recommendation associated with the addition of passing lanes in multiple areas on HWY 287B and 40H near Limon and Kit Carson. The following areas and roadways have been identified as potential passing lane areas on this project;

Project Areas: 40H and 287B

Roadway	Beginning MP	End MP	Direction
40H	390.25	391.25	Northbound
40H	407.32	407.93	Northbound
40H	408.6	409.6	Northbound
40H	410	411	Southbound
40H	414.66	415.26	Southbound
40H	417.6	418.2	Northbound
40H	434.13	435.13	Northbound
287B	123.5	124.5	Northbound
287B	124.75	125.75	Southbound

This recommendation excludes any bridge rehabilitation or work. CDOT's Bridge Division shall be responsible for developing treatments on their structures if it is deemed to include it within the project limits. This segment of both HWY 40H and 287B are on the NHS, are classified as High Volume Traffic roadways, and are listed as Principle Arterial-Other functional class roadways. These roadways consist of primarily 2 total lanes of traffic with occasional passing lanes.

The proposed recommendation was arrived at through the use of AASTHO's Pavement ME 2.3.1 program. Distress thresholds from the 2019 Pavement Design Manual were utilized for this analysis. These thresholds are contained within the Pavement ME designs for reference. The soil profile contained on the Form #555 was collected and analyzed by CDOT in calendar year 2019. The traffic and geometric info for this analysis was compiled from OTIS in 2019. The 2019 Pavement Design Manual was followed for recommended pavement design practice.

Site Conditions:

Reviewing the Form 555 and historical projects it appears that these sections in most cases consists of PCCP over HMA. Below is a general breakdown of each area's pavement structure. As these were select boreholes only in the shoulder it should not be construed that everything listed below is all inclusive of

any possible combinations of soils or thicknesses. It should be anticipated that when cutting into the mainline slabs, differences in thicknesses and soils should be expected from what is listed below. Please also note that listed soils may not be strong enough to be re-utilized on project and import materials should be expected to be needed. Please carefully review the included Form 555s for these areas to better understand what materials may be encountered. For construction of the new lanes, existing shoulders will need to be fully removed in addition to removal of some of the existing drive lane slab to the side of the paint stripe.

Generalized Existing Pavement Structure

HWY	BMP	EMP	Direction	Generalized Structure
287B	124.75	125.75	NB Shoulder	5" to 6.75" of PCCP on 3" to 4" of HMA on A-2-4 and A-3 soils
287B	123.5	124.5	SB Shoulder	5.5 to 10.75" of PCCP on A-2-4 and A-2-6 soils
40B	390.25	391.25	NB Shoulder	9.5" to 10.75" of PCCP on 9.25" to 11.25" of HMA, on A-2-4 and A-6 soils
40B	407.32	407.93	NB Shoulder	10.5" to 12.5" of PCCP on 0" to 16.5" of HMA on A-2-4, A-2-6 and A-6 soils
40B	408.6	409.6	NB Shoulder	10.5" to 11" of PCCP on 9" to 11" of HMA on A-2-4 and A-6 soils
40B	410	411	SB Shoulder	11.25" to 11.75" of PCCP on 5.25 to 6.25" of HMA on A-1-b, A-2-4, A-2-6, A-2-7, A-6, and A-7-6 soils
40B	414.66	415.26	SB Shoulder	10.5" to 12" of PCCP on 6.5" to 11.5" of HMA on A-1-b, A-2-4, A-2-6, and A-7-6 soils
40B	417.6	418.2	NB Shoulder	10" to 11.5" of PCCP on 2" to 10" of HMA on A-1-b, A-6, and A-7-6 soils
40B	434.13	435.13	NB Shoulder	9" to 10.25" of PCCP on 6.75" to 11.25" of HMA on A-1-b, A-2-4, and A-6 soils

It appears that a significant number of through-lane slabs may be longitudinally cracked. This passing lane project is not anticipated to address this significant cracking. If the scope of the project changes to include rehabilitation of these slabs, we should be contacted to provide a relevant rehabilitation technique.

Impacts from Environmental are currently unknown and CDOT's Environmental unit should be consulted as the template of the roadway is being widened and significant new construction is anticipated.

We do not have access to flood plain maps for this area, CDOT Hydraulics should be consulted to verify that no hydraulic impacts will occur due to the scheduled treatment.

The topography of the areas to be constructed generally consists of rolling plains.

There currently does not appear to be any ADA impacts in the listed areas that need to be addressed.

Subgrade Materials:

Reviewing the test results on the Form 555, it appears that the soils in the sites range across nearly the full spectrum of AASTHO soils with large variability in soil strengths. Thorough review of the site specific areas listed on the Form 555 is recommended.

No special construction techniques other than CDOTs standard construction practices is anticipated for this project.

Design Traffic:

These segments of HWY 40H and 287B fall within the; NHS, High Volume Traffic category, and is Principle Arterial-Other functional class according to OTIS. These roadways are anticipated to serve between 2,789 and 7,081 vehicles per data by the design year of 2021 according to OTIS data collected on 3-8-19. Of this AADT, it is anticipated that between 1,691 and 1,979 trucks per day will use this facility of which up to 94.9% will be Class 9 or above. The data presented below was obtained from OTIS on 3-8-19.

Proj. Year	stationId	Route	BMP	EMP	Proj. AADT	Proj. SingleTrucks	Proj. ComboTrucks	Total Trucks	Growth Rate %
2021	13	040H	386.01	397.833	4,055	186	1,754	1,940	1.98
2021	101965	040H	397.833	398.846	4,654	188	1,662	1,850	2.18
2021	101966	040H	398.846	399.092	7,081	270	1,686	1,956	2.44
2021	101967	040H	399.092	399.505	6,780	260	1,582	1,842	2.54
2021	101968	040H	399.505	400.316	6,484	190	1,789	1,979	2.35
2021	101969	040H	400.316	413.641	3,219	89	1,665	1,754	2.22
2021	101970	040H	413.641	425.472	2,782	86	1,605	1,691	1.51
2021	101971	040H	425.472	433.02	3,210	96	1,605	1,701	1.51
2021	101973	040H	433.02	444.888	4,432	144	1,662	1,806	2.18

Proj. Year	stationId	Route	BMP	EMP	Proj. AADT	Proj. SingleTrucks	Proj. ComboTrucks	Total Trucks	Growth Rate %
2021	105206	287B	113.42	128.32	4362	223	1596	1819	1.4
2021	105208	287B	128.32	133.24	3631	139	1709	1848	1.47

A Reliability of 95% was selected for this roadway's design as this is a national freight corridor and also with this large of a percentage of combination trucks the risk of premature damage to the roadway is higher for unforeseen design circumstances.

A design life of 30 years was selected for this treatment as the abutting pavement is currently PCCP.

Please communicate to our Maint. forces that crack filling should occur as soon as cracks begin appearing in this roadway to maximize the life of the road.

Pavement Material Characteristics:

All assumed material inputs are provided in the Pavement ME file for further review.

Currently existing pavement materials characteristics consists in most areas of PCCP over HMA over generally weak substructure. There are some areas which have thin PCCP shoulders, notably the project areas on 287B. It should be anticipated that the existing through lanes in these areas are full thickness slabs ranging from 8" to 13" of PCCP.

Please see the table provided under the Site Conditions Section and the Form 555 for anticipated material thicknesses for each area.

It should be noted that the 2019 10th Mile distress data was reviewed to gauge performance of the existing through lanes. Currently the 10th Mile data is only collected in the North Bound lanes. This project however has more highly degraded South Bound lanes in this case which are not accurately represented by this data. Regardless of the direction, it does appear that there is significant longitudinal cracking in the 287B Segments between MP 123.5 – 124.5 and MP 124.7 – 125.8 in the distress data. On the segments of highway 40H it appears that there is significant longitudinal cracking between MP 390.0 and 391.1 in the distress data.

Presented below is the 2019 Aggregated Distress Data. As this data aggregates the 10th Mile data into averages and only looks at the North Bound direction, in this case, all distresses are underrepresented currently.

2019 Pavement Management Aggregated Data

Hwy	Dir	BMP	Emp	Length	Year	County	Depth	P_Grp	Iri	Rut	Tran	Long	Crbk	DL	DL_Idx	Cond
040H	1	386	391	5	1995	Lincoln	10.5	3432	87	99	100	100	100	18	IRI	HIGH
040H	1	391	396	5	1995	Lincoln	10.5	3432	87	99	100	99	100	18	IRI	HIGH
040H	1	403.8	408.8	5	2010	Lincoln	10.75	3432	88	100	100	100	100	18	IRI	HIGH
040H	1	408.8	413	4.2	2010	Lincoln	10.75	3432	85	100	100	100	100	17	IRI	HIGH
040H	1	413	418	5	2009	Lincoln	10.75	3432	85	98	100	100	100	17	IRI	HIGH
040H	1	427.2	431.7	4.5	2002	Cheyenne	11	3442	88	100	100	100	100	18	IRI	HIGH
040H	1	431.7	435.7	4	2006	Cheyenne	9.75	3442	85	100	100	99	100	17	IRI	HIGH

Hwy	Dir	BMP	Emp	Length	Year	County	Depth	P_Grp	Iri	Rut	Tran	Long	Crbk	DL	DL_Idx	Cond
287B	1	122.5	127.5	5	1999	Cheyenne	10.5	3442	85	99	100	84	100	17	LONG	HIGH

As this project is traffic capacity related and is not utilizing Resurfacing Program funding it is not subject to Matching requirements.

Pavement Design and Selection Process:

Please see attached pavement designs for the inputs used in the design of the treatments. As the existing lanes that will be added to are PCCP, these additional lanes should also be PCCP.

The below treatments should be applied to the respectively listed sections. Of particular importance is that the existing shoulder should be fully removed. In addition, the existing through lane slabs should be cut to be roughly 12' wide which will necessitate removing potentially thicker pavement than what is listed as being found in the shoulders. When installing the new concrete, it should be tied into the existing concrete in accordance with M and S Standards, in addition it should utilize dowels of 1.5" diameter.

Treatments to be Applied

HWY	BMP	EMP	Direction	Treatment
287B	124.75	125.75	NB	10.5" PCCP on 6" ABC on 18" of R-40, 1.5" Dowels
287B	123.5	124.5	SB	10.5" PCCP on 6" ABC on 18" of R-40, 1.5" Dowels
40B	390.25	391.25	NB	10.5" PCCP on 11" ABC, on native subgrade, has asphalt that needs to be removed under the existing PCCP, 1.5" dowels
40B	407.32	407.93	NB	10.5" PCCP on 16.5" ABC, on native subgrade, has asphalt that needs to be removed under the existing PCCP, 1.5" dowels
40B	408.6	409.6	NB	10.5" PCCP on 11" ABC, on native subgrade, has asphalt that needs to be removed under the existing PCCP, 1.5" dowels
40B	410	411	SB	10.5" PCCP on 11" ABC on native subgrade, has asphalt that needs to be removed under the existing PCCP, 1.5" dowels
40B	414.66	415.26	SB	10.5" PCCP on 11" ABC, on native subgrade, has asphalt that needs to be removed under the existing PCCP, 1.5" dowels
40B	417.6	418.2	NB	10.5" PCCP on 11.5" ABC, on native subgrade, has asphalt that needs to be removed under the existing PCCP, 1.5" dowels
40B	434.13	435.13	NB	10.5" PCCP on 10.5" ABC, on native subgrade, has asphalt that needs to be removed under the existing PCCP, 1.5" dowels

Reviewing the sulfate tests of the soil sampling, the soil has a wide distribution of water soluble sulfates. Generally, sulfates were found to be between 0.00% and 1.12%. As required by the 2019 Standard Specifications the Severity of Sulfate Exposure is Class 2 and Class 2 Cementitious Material Requirements shall be required for the PCCP.

LCCA Results

A Life Cycle Cost Analysis was not performed as this design may be broken up into several different projects which individually fall below the $ 3 M threshold for a life cycle requirement. In addition to this, as the existing through lanes are made out of concrete the solution to minimalize future maintenance costs regarding differing materials necessitates the use of concrete in this case.

If you have any questions, please feel free to contact me.

Regards,

Steven Heimmer, PE
Region 4 Pavement Manager

SPV: AUT: Steven Heimmer
Attachments: Form 555, Pavement Design
cc: Gary DeWitt
Jake Schuch
Bryce Reeves
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