Final

Pavement Design Report

I-25 and Crossroads Boulevard Bridge Replacement

Loveland, Colorado CDOT Region 4 Larimer County

CDOT Project No. IM 0253-242 (20575)

Yeh Project No.: 215-043

March 18, 2016

Prepared for:

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1. PURPOSE AND SCOPE OF STUDY

This report presents the result of pavement design performed for the proposed I-25 Crossroads Boulevard (Blvd) Bridge Replacement project near Loveland, Colorado. A subsurface exploration and investigation program was conducted (see Final Geotechnical Investigation Report I-25/Crossroads Bridge Replacement Project, dated December 11, 2015) to obtain information on soil and groundwater conditions to determine pavement thicknesses for mainline I-25, associated ramps, and maineline Crossroads Blvd. This report summarizes the pavement related data obtained and presents our pavement design conclusions and recommendations based on the proposed construction and subsurface conditions encountered during preliminary soil investigations.

2. PROPOSED CONSTRUCTION

Based on information provided by AECOM, we understand that the proposed construction will include a new bridge at Crossroads Blvd, reconstruction of mainline I-25 for approximately 7,450 feet, reconstruction of I-25 ramps at Crossroads Blvd, and reconstruction of mainline Crossroads Blvd for approximately 450 feet connecting the existing roundabouts. We realize that the new structure at Crossroads Blvd and I-25 mainline roadway alignment will be constructed at new proposed profile grades to accommodate for a future managed lane build-out.

In order to balance the earthwork, in-situ materials may be handled and reused at different stages of the project based on the planned construction phasing. The contractor shall provide a method to protect soil that has been processed so that it does not become over wetted and unworkable. If soil becomes over wetted, the contractor shall be responsible for returning the soil to an acceptable condition prior to placement of pavement.

As the proposed profile grade may be in cut or fill sections, it is crucial to know the existing pavement structure layers and thicknesses as well as necessary provisions to construct the proposed pavement layers to maximize the use of in-place materials providing an optimized and homogeneous section.

Existing pavement layers within the project limits on I-25 mainline from top to bottom as indicated in the I-25 project history report provided by the Region 4 Pavement Manager are as follows:

2" of SMA PG 76-28 3" of HMA S (100) PG 76-28 8" of Rubblized PCCP 1"-3" of HMA, potentially degraded to a base 8" of deteriorated PCCP 2" Base Course 8" Sub-base Class 1 Semi-Infinite layer of A-6

The following provisions should be adhered to where PCCP overlay is constructed on top of existing I-25 pavement so the drainage flows away from the pavement structure effectively:

• Fill materials other than Aggregate Base Course (ABC) should not be placed directly over existing rubbilized PCCP unless it is more than 2.5 feet or greater in thickness (see Figure 1).

- New PCCP overlay should be constructed directly over existing HMA when proposed profile is to be raised.
- Existing HMA layer shall be removed when new PCCP overlay is not placed directly on top of the HMA layer.



Figure 1- Depiction of CUT/FILL Sections for New PCCP

3. SUBSURFACE INVESTIGATION

The subsurface investigation program included a total of 37 pavement borings along northbound and southbound I-25, on Crossroads Blvd, and on the existing I-25 ramps at Crossroads Blvd. In general, bulk samples were collected within the top 5 feet in all borings. Lab tests indicate that the surficial soils in the project area along northbound I-25 generally consist of A-6 soils with plasticity indices (PIs) in the low 20's. Soils along southbound I-25 generally consist of A-6 and A-7-6 soils with plasticity indices in the low to high 20's. Higher PIs indicate that the majority of soils at this location are susceptible to swelling. Swell-consolidation tests on samples from borings also supported this assumption. The tests indicated percent swells of -0.5 percent (consolidation) to 1.8 percent (swell) which correspond to a low to medium risk of swell damage.

3.1 Sulfate Concentration

Seven (7) soil samples were tested for soluble sulfate concentration which ranged from 0.008 to 0.069 percent. These concentrations result in a severity of Sulfate Exposure for concrete of class 0 in accordance with Section 601.04 of the CDOT 2011 Standard Specifications for Road and Bridge Construction.

3.2 Chemical Testing

In addition to soluble sulfate, 7 samples were tested for pH, soluble chloride and resistivity. Soluble chloride ranged from 0.0021 to 0.0325 percent, pH ranged from 7 to 10.4 and resistivity ranged from 533 to 1721

ohm.cm. These values should be used in helping to select the appropriate culvert material in conjunction with the CDOT Culvert Pipe Selection guidelines.

3.3 Resilient Modulus, Mr

Hveem "R"-value tests were performed on bulk samples considered to be representative of the subsurface conditions along the alignment that were collected from borings YA-PSB-1, YA-PSB-5, YA-PSB-10, YA-PNB-6, YA-PNB-12, YA-PC-2, YA-PR-1 and YA-PR-4. The measured R-values are presented in Table-1 below. The Mechanistic Empirical (M-E) pavement design software uses a single input value (Resilient Modulus, M_r). The measured R-values were correlated to obtain the design resilient modulus using equation 4-1 from the CDOT Pavement Design Manual (M_r =3438.6*R^{0.2753}). These values were used to determine a resilient modulus value for use in the M-E Pavement Design program.

Boring	R-Value	Resilient Modulus	AASHTO Classification
		Mr	
YA-PSB-1	15	7247	A-6 (17)
YA-PSB-5	12	6815	A-7-6 (21)
YA-PSB-10	14	7110	A-7-6 (11)
YA-PNB-6	30	8770	A-6 (3)
YA-PNB-12	16	7376	A-7-6 (8)
YA-PC-2	23	8152	A-6 (3)
YA-PR-1	29	8689	A-6 (4)

 Table 1 - MEASURED R-VALUES AND CALCULATED RESILIANT MODULUS

4. PAVEMENT DESIGN

The pavement recommendations were developed using the AASHTOWare Mechanistic Empirical Pavement Design program, Version 2.2.

4.1 Traffic

The M-E, pavement design program for determining pavement thickness, uses the truck volumes and compounded annual growth rates and subgrade strength properties to determine the recommended pavement thickness. Version 2.2 of the M-E program used has been calibrated to address Colorado conditions for climate, and PCC and HMA mixes. Truck type distributions called "Cluster" have also been developed for various conditions in Colorado. For example Cluster 1 represents an urban condition with primarily Class 5 (single unit) trucks.

Truck traffic volumes and truck types were obtained from AECOM (see Table 2 Annual Average Daily Traffic Forecasts). This truck information was used to determine the cluster for input to the design program.

Annual Average Daily Traffic Forecasts

NS	1-25		NB		SB			Crossroads	
EW	Crossroads	NB Off	NB On	I-25	SB Off	SB On	I-25	EB	WB
10	Count	4,900	3,800	37,500	4,100	4,300	37,300	7,200	7,400
015	Single	170	90	1,690	120	180	1,580	220	470
	Combined	470	140	3,310	110	420	2,760	140	100
4	Forecast	5,100	4,500	39,600	4,500	4,600	39,600	8,500	8,700
2017	Single	180	90	1,730	130	180	1,730	230	490
	Combined	470	140	3,210	110	430	3,210	150	110
~	Forecast	5,300	4,800	40,600	4,600	4,800	40,600	9,100	9,300
2018	Single	180	90	1,780	130	180	1,780	240	500
	Combined	470	150	3,300	110	430	3,300	160	110
035	Forecast	7,500	10,400	59,000	7,700	7,500	59,000	19,900	19,800
	Single	190	140	2,580	160	200	2,580	370	670
	Combined	510	220	4,790	140	470	4,790	250	150
~	Forecast	7,900	11,400	62,300	8,200	7,900	62,300	21,800	21,700
503	Single	190	140	2,720	170	200	2,720	390	700
	Combined	510	230	5 <i>,</i> 050	150	470	5 <i>,</i> 050	260	160
	Forecast	9,100	14,300	72,000	9,800	9,400	72,000	27,500	27,200
047	Single	200	170	3,140	180	210	3,140	460	790
7	Combined	530	260	5,840	160	490	5,840	310	180
20-y	r Growth Factor	1.5	2.7	1.6	1.9	1.7	1.6	2.8	2.7
	HV%								
	2015	13%	6%	13%	6%	14%	12%	5%	8%
2017		13%	5%	13%	5%	13%	12%	5%	7%
2018		12%	5%	13%	5%	13%	12%	4%	7%
	2035	9%	3%	12%	4%	9%	12%	3%	4%
	2038	9%	3%	12%	4%	8%	13%	3%	4%
2047		8%	3%	12%	3%	7%	13%	3%	4%

The above traffic information and 20-year Growth Factors were utilized to determine the annual rate of growth using CDOT Eq. 3.1, $T_f = (1 + r)^{20}$ where T_f is the 20-year Growth Factor.

Segments	Ramp	AADTT	20-year	Annual	Cluster					
		(2017)	Growth	Growth Rate						
			Factor	(r)						
I-25 Mainline		9,880	1.6	2.378	2					
Crossroads Blvd.		980	2.8	5.283	1					
SB On Ramp	Ramp A	610	1.7	2.689	2					
NB Off Ramp	Ramp B	650	1.5	2.048	2					
SB Off Ramp	Ramp C	240	1.9	3.261	3					
NB On Ramp	Ramp D	230	2.7	5.092	2					

Table 3 - ANNUAL GROWTH RATE

4.2 Climate

Climate data for the M-E Design software was obtained from Fort Collins weather stations (FORT COLLINS, CO 40.45200 -105.00100 5016). Information such as temperature, precipitation, wind speed, percent sunshine and relative humidity are used to predict the temperature and moisture profiles within the pavement structure.

ANNUAL STATISTICS:

Mean annual air temperature 48.89⁰ F Mean annual precipitation 12.42 (inches) Freezing index 429.31 days Average annual number of freeze/thaw cycles: 81.58

4.3 Subgrade Strength

For the pavement design, in order to provide a uniformly strong subgrade, we recommend that in areas with new alignment, the top three feet of material below ABC have a minimum R-value of 20 which is the general characteristic of the in-situ material.

4.4 Recommended Threshold Values of Performance Criteria for Rigid Pavement (JPCP)

PCCP initial design life	30-Years
Terminal IRI (inches per mile)	160
Transverse slab cracking (percent slabs)	7
Mean joint faulting (Inches)	0.12
Reliability (percent)	95

4.5 Recommended Threshold Values of Performance Criteria for Flexible Pavement

HMA initial design life	20-Years
Terminal IRI (inches per mile)	160
Permanent deformation-total pavement (in)	0.55
AC bottom –up fatigue cracking (%lane area)	10
AC thermal cracking (ft/mile)	1500
AC top –down fatigue cracking (ft/mile)	2000
Permanent deformation-AC only (in)	0.40

5. RECOMMENDED PAVEMENT THICKNESSES

Pavement thickness recommendations are presented in Table 4 and Table 5 below. Since, the M-E pavement design is very sensitive to Terminal IRI (in/mile) especially when dealing with relatively high traffic loading, a reliability target of 90 percent was considered for mainline I-25 to reach an optimum thickness design. Consideration of 90 percent reliability for terminal IRI was discussed with the CDOT Region 4 Materials Engineer.

Amongst many iteration of pavement designs on mainline I-25, removing and replacing 3 feet of existing in-situ material with R 40 or better was also considered as a viable option for this project (see Table 4 below).

	Heavy Trucks	Dowel	Joint	IRI	ABC	HMA	PCCP T	hickness (in)
Location	(Cumulative)	Diameter	Spacing	Reliability	Class	Thickness		
	(30 years)	(in)	(ft)	(%)	6	(in)		
					(in)	S(100) PG 64-22	Design	Recommended*
I-25 Mainline CUT Section, Shallow Bedrock (Moisture Conditioned Subgrade)	69,923,900	1.5	15	90.77	6		11.5	12
I-25 Mainline FILL Section (Moisture Conditioned Subgrade)	69,923,900	1.5	15	90.61	6		12.75	13
<u>I-25 Mainline</u> (R 40 Material)	69,923,900	1.5	15	91.94	6		11.75	12
<u>I-25 Mainline</u> JPCP Over AC (Overlay Section)	69,923,900	1.5	15	97.43	6		11.75	12
<u>I-25 Mainline</u> JPCP Over AC (Widened Section)	69,923,900	1.5	15	97.56	12	5	11.75	12
Crossroads Blvd.	48,411,500	1.25	15	96.24	6	8.5		9
Ramp A	10.081,700	1.25	15	96.85	6	7.5		8
Ramp B	9,704,110	1.25	15	97.00	6	7.5		8
Ramp C	4,351,350	1.25	15	98.80	6	7.5		8
Ramp D	5,670,350	1.25	15	98.28	6	7.5		8

Table 4 - PAVEMENT THICKNESS RECOMMENDATIONS

* Includes an additional ¼ inch of thickness for future diamond grinding and was rounded up to the nearest ½ inch.

Location	Heavy Trucks (cumulative)	TOP LIFT SMA (inch)	Lc S(100	ower Lifts)) PG (64-22) (inch)	ABC Class (6) (inch)
			Design	Recommended*	
I-25 Mainline HMA Transition Sections (Moisture Conditioned Subgrade)	40,976,400	2	11.5	11.5	6
RAMPS HMA Transition Sections (Moisture Conditioned Subgrade)					
RAMP A RAMP B RAMP C RAMP D	5,800,950 5,796,150 2,419,000 2,804,950	2 2 2 2	6.75 6.75 5.5 5.75	7 7 5.5 6	6 6 6 6

Table 5 – HMA PAVEMENT THICKNESS RECOMMENDATIONS FOR TRANSITION SECTIONS

* Rounded up to the nearest ½ inch

6. DETOUR PAVEMENT

This section describes the minimum thickness of new detour pavement required to handle traffic for two years for previously unpaved sections. A reliability factor of safety of 85 percent was used to account for the inherent variations in construction, materials, traffic, climate and other design inputs. The resulting designs are shown in Table 6.

If detour pavement is considered to remain in place as part of the permanent pavement structure, then moisture conditioning of the subgrade and minimum 6 inches of ABC Class will be required prior to the placement of the detour pavement.

HMA	Detour	PCCP Detour		
S(100) PG (64-22)	ABC	РССР	ABC Class(6)	
(inch)	Class(6) (inch)	(inch)	(inch)	
6	4	6	4	

7. PAVEMENT SUBGRADE PREPARATION

The swell test results on samples taken from representative soils along the alignment indicated swell potentials ranging from -0.5 percent (consolidation) to 1.8 percent (swell). This range of results typically indicates a low to medium risk for damage due to swelling soils based on Table 4.9 of the CDOT Pavement Design Manual.

Although, there are no indications of swelling conditions in existing pavement, it could be an indication that the in-situ moisture content is high enough that there was minimal swell potential observed. Extra care should be exercised when handling the in-situ material when excavated and used as fill for different construction staging of the project. If the soil is allowed to dry out during construction, the swell potential is greatly increased and concrete pavement becomes more sensitive to swelling soil damage. In this circumstance, stabilization with lime may be considered as an alternative. Removal and replacement of existing soil with 3 feet of R40 or better material may also be considered a viable and cost effective option (see Pavement Thickness Recommendations Table-4).

If lime treatment or removal and replacement of existing soil are not feasible options for this project, then moisture conditioning is recommended in accordance with Table 4.8 of the CDOT Pavement Design Manual, which states that subgrade materials with a PI between 10 and 20 require a minimum treatment depth of 2 feet. Subgrade materials with a PI between 20 and 30 require a minimum treatment depth of 3 feet. We recommend that the soil underneath the proposed ABC Class 6 be moisture conditioned and recompacted to + 2 percent wet of optimum, following section 203 of the 2011 CDOT Standard Specifications for Road and Bridge Construction, to a depth of 3 feet. The prepared subgrade should be proof rolled to determine if any soft spots are present. Any soft spots should be removed and recompacted and proof rolled again. If this does not eliminate the soft spot, the soil should be excavated and replaced, recompacted, and proof rolled until satisfactory. Proof rolling and subgrade compaction tests should be observed and reviewed by a representative of the geotechnical engineer prior to paving.

Granular soils should not be used as backfill for subexcavation or replacement of expansive subgrade soils without a filter separator layer and edge drains to collect and divert the water from the pavement structure. Per CDOT Roadway Design Guide 2005, Typical Section Figures 4-1 through 4-5, the above treatments should extend to the side slope in areas with unprotected slope. In areas with curb and gutter, the treatment should extend for a minimum distance of 12" beyond the back face of the gutter, if possible. These should be shown in the plan set typical sections. A 6-inch aggregate base course should be specified to minimize future pavement distress caused by fines migration and pumping.

8. LIMITATIONS

This study was conducted in accordance with generally accepted geotechnical engineering practices in this area for use by the AECOM for design and construction purposes. The conclusions and recommendations submitted in this report are based upon the data obtained from exploratory borings and field review and the proposed type of construction. Subsurface variations across the site are likely and may not become evident until excavation is performed. If during construction, fill, soil, rock or water conditions appear to be different from those described herein, this office should be advised at once so reevaluation of the recommendations may be made. We recommend on-site observation of excavations and pavement subgrade conditions by a representative of the geotechnical engineer.

9. REFERENCES

Geotechnical Investigation Report, December 11, 2015, Yeh and Associates

2016 Colorado department of Transportation M-E Pavement Design Manual

2011 Colorado department of Transportation Standard Specifications for Road and Bridge Construction

Appendix A

PAVEMENT DESIGN PROGRAM OUTPUTS:

- I-25 Mainline CUT Section-New JPCP Dec 2015
- I-25 Mainline FILL Section-New JPCP Dec 2015
- I-25 Mainline FILL Section R 40-New JPCP Dec 2015
- I-25 Mainline Overlay Section-New JPCP Dec 2015
- I-25 Mainline Widened Section-New JPCP Dec 2015
- I-25 Mainline HMA Transition Section-New AC Dec 2015
- **Crossroads Blvd-New JPCP Dec 2015**
- I-25 Ramp A-New JPCP Dec 2015
- I-25 Ramp B-New JPCP Dec 2015
- I-25 Ramp C-New JPCP Dec 2015
- I-25 Ramp D-New JPCP Dec 2015
- I-25 Mainline Detour-New AC Dec 2015
- I-25 Mainline Detour-New JPCP Dec 2015
- I-25 Ramp A HMA Transition New-AC Dec 2015
- I-25 Ramp B HMA Transition New-AC Dec 2015
- I-25 Ramp C HMA Transition New-AC Dec 2015
- I-25 Ramp D HMA Transition New-AC Dec 2015

Jointed Plain Concrete Pavement (JPCP) Asphalt Concrete (AC)







2047 (30 years)

69,923,900

I-25 Mainline Overlay Section-New JPCP_over_AC_ Dec 2015 Pv D e: C:\Users\mghaeli\Desktop\MAY 1 2015\Masoud's Projects\215-043 I 25 @ Crossroads Blvd\Pavement Design\Designs with bedrocks within 20\I-25 Ma **Design Inputs** Existing construction: Climate Data Design Life: 30 years May, 2010 40.452, -105.001 Sources (Lat/Lon) Design Type: JPCP over AC July, 2017 Pavement construction: Traffic opening: September, 2017 Traffic **Design Structure** Heavy Trucks (cumulative) Layer type Material Type Thickness (in) Joint Design: Age (year) PCC R4 Level 1 Lawson 11.8 15.0 Joint spacing (ft) 2017 (initial) 9,880 R4 SMA 2.0 1.50 Flexible (existing) Dowel diameter (in) 2032 (15 years) 28,862,500 R1 Level 1 S(100) PG 64-Slab width (ft) 12.0

3.0

8.0

8.0

10.0

36.0

72.0

Semi-infinite

Design Outputs

Flexible (existing)

Stabilized

Subgrade Subgrade

Bedrock

NonStabilized

NonStabilized

Distress Prediction Summary

22

A-1-a A-6

A-7-6

weathered

Sandwich Granular

Highly fractured and

Crushed stone

Distress Type	Distress @ Relia	Specified bility	Reliab	Criterion	
	Target	Predicted	Target	Achieved	Saustieur
Terminal IRI (in/mile)	160.00	137.67	90.00	97.43	Pass
Mean joint faulting (in)	0.12	0.10	95.00	99.18	Pass
JPCP transverse cracking (percent slabs)	7.00	2.47	95.00	100.00	Pass

Report generated on: 12/4/2015 1:59 PM

Version: 2.2

Created^{by:} on: 10/3/2011 3:31 PM

Approved by: on: 10/3/2011 3:31 PM

2047 (30 years)

69,923,900

I-25 Mainline Widened Section-New JPCP_over_AC_ Dec 2015 AASHTOW Pv D C:\Users\mghaeli\Desktop\MAY 1 2015\Masoud's Projects\215-043 I 25 @ Crossroads Blvd\Pavement Design\Designs with bedrocks within 20'I-25 Mair **Design Inputs** Design Life: 30 years Existing construction: May, 2017 Climate Data 40.452, -105.001 Sources (Lat/Lon) Design Type: JPCP over AC Pavement construction: July, 2017 Traffic opening: September, 2017 Traffic Design Structure Layer type Material Type Thickness (in) Joint Design: Heavy Trucks Age (year) (cumulative) PCC R4 Level 1 Lawson 11.8 Joint spacing (ft) 15.0 2017 (initial) 9,880 R1 Level 1 S(100) PG 64-Dowel diameter (in) 1.50 Flexible (existing) 5.0 22 28,862,500 2032 (15 years) 12.0

12.0

36.0

72.0

Semi-infinite

Slab width (ft)

Design Outputs

NonStabilized

Subgrade

Subgrade

Bedrock

Distress Prediction Summary

A-1-a

A-7-6

weathered

Highly fractured and

A-6

Distress Type	Distress @ Relia	Specified bility	Reliab	ility (%)	Criterion
	Target	Predicted	Target	Achieved	saustieu?
Terminal IRI (in/mile)	160.00	137.05	90.00	97.56	Pass
Mean joint faulting (in)	0.12	0.09	95.00	99.26	Pass
JPCP transverse cracking (percent slabs)	7.00	2.47	95.00	100.00	Pass

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Version: 2.2

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AASHTI

I-25 Mainline HMA TransitionNew_AC_Design Dec 15

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Design Inputs

Pv D

Design Life:	20 years
Design Type:	Flexible Pavement

Base construction: Pavement construction: August, 2017 Traffic opening:

March, 2017 September, 2017 Climate Data 40.452, -105.001 Sources (Lat/Lon)

Design Structure Layer type Thickness (in) Material Type Flexible R4 SMA 2.0 R1 Level 1 S(100) PG 64-Flexible 11.5 22 NonStabilized Aggregate Base 6.0 36.0 Subgrade A-6 A-7-6 72.0 Subgrade Highly fractured and Semi-infinite Bedrock weathered



Traffic	Tranic							
Age (year)	Heavy Trucks (cumulative)							
2017 (initial)	9,880							
2027 (10 years)	18,091,700							
2037 (20 years)	40,976,400							

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Relia	Specified bility	Reliab	ility (%)	Criterion
	Target	Predicted	Target	Achieved	sausneu?
Terminal IRI (in/mile)	160.00	153.28	90.00	93.28	Pass
Permanent deformation - total pavement (in)	0.55	0.51	95.00	97.78	Pass
AC bottom-up fatigue cracking (% lane area)	10.00	5.43	95.00	99.89	Pass
AC thermal cracking (ft/mile)	1500.00	108.29	95.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	330.05	95.00	100.00	Pass
Permanent deformation - AC only (in)	0.40	0.42	95.00	93.19	Fail

Report generated on: 12/7/2015 2:56 PM

Version: 2.2

Created by: Jay Goldbaum on: 12/2/2014 12:00 AM

Approved by: on: 12/2/2014 12:00 AM



esign Inpu	ts						
)esign Life: 3)esign Type: J P	0 years Existi ointed Plain Concrete Pavement (JPCP) Traffi	ing construction: ment construction ic opening:	- 1: April, 2017 August, 20	, s)17	limate Data ources (Lat	ı 40.452, -10 /Lon)	5.001
esign Structu	ure					Traffic	
Layer type	Material Type	Thickness (in) Joint De	sign:		Anna (waan)	Heavy Truck
PCC	R4 Level 1 Lawson	8.5	Joint spa	icing (ft)	15.0	Age (year)	(cumulative)
NonStabilized	A-1-b	6.0	Dowel di	ameter (in)	1.50	2017 (initial)	4,000
Subgrade	A-6	36.0	Slab wid	th (ft)	12.0	2032 (15 years)	15,297,900
Subgrade	A-7-6	36.0				2047 (30 years)	48,411,500
Bedrock	Highly fractured and weathered	Semi-infinite					
esign Outp	outs						
Distress Pre	diction Summary						
Distress			Distress @	Specified	Deli	1 2124 - 404 3	
	Distress Type		Relia	bility	Rein	ability (%)	Criterion Satisfied?
Terminal IRI (i			160.00	AFE 49	os oo	Achieveu	Dean
Terminal Int (i	n/mile)		160.00	155.40	95.00	90.24	Pass
Mean joint lau	/ting (in)		7.00	0.00	95.00	99.99	Pass
JPCP dansyo	se cracking (percent statio)		7.00	0.14	55.00	30.70	Pass
Distress Cha	arts						
	IRI				Fau	ulting	
160	160	155.4/	0.14			0.12	
150			0.12				
E 130				-			
E 120		100.4	E Soos				0.06
H 100		100.4	- L				
90 80 Initial IR	I: 75		0.04	-			0.02
70			0.02				
60 0	5 10 15 2	0 25	30	0 5	10	1.5 20	25 30
	Pavement Age (years	0			Pavem	ent Age (years)	
0 1	Cracking PCC		-				
			-				
£ 6		5.17	a				
- Sec			-				
S 4			-				
de j			-				
1							
0		0.07	7				
ò	5 10 15 20 Pavement Age (years	ວ 25 ສ ຄ)	ao				
			10.10.1.1.1		50% Palis	hilito	
	— Threshold Valu	10 ····· @ Spec	citiedReliabil		0030 Nella		



esign Input	ts						
Design Life: 30 Design Type: Jo Pa	D years Existi binted Plain Concrete Paver avement (JPCP) Traffi	ng construction: ment construction: c opening:	- March, 201 August, 20	C 17 S 17	limate Data ources (Lat	a 40.452, -10 /Lon)	5.001
Design Structu	re					Traffic	
Layer type	Material Type	Thickness (in)	Joint De	sign:			Heavy Truck
PCC	R4 Level 1 Lawson	7.5	Joint spa	cing (ft)	15.0	Age (year)	(cumulative
NonStabilized	A-1-b	6.0	Dowel di	ameter (in)	1.25	2017 (initial)	650
Subgrade	A-6	36.0	Slab widt	th (ft)	12.0	2032 (15 years)	4,119,940
Subgrade	A-7-6	72.0				2047 (30 years)	9,704,110
Bedrock	Highly fractured and weathered	Semi-infinite					
esign Outp	uts						
Distress Pred	diction Summary						
Distress Free	action summary		Distress @	Specified			
	Distress Type		Relia	bility	Reli	ability (%)	Criterion Satisfied2
			Target	Predicted	Targe	t Achieved	aduaneu:
Terminal IRI (in	n/mile)		160.00	152.30	95.00	97.00	Pass
Mean joint fault	ting (in)		0.12	0.06	95.00	100.00	Pass
JPCP transvers	se cracking (percent slabs)		7.00	5.59	95.00	98.06	Pass
Distress Cha	rts						
	TRI				Ear	ulting	
170	160	182.20	0.14		10	0.12	
150		102100	0.12				
E 130			E 0.1				
<u>È 120</u>			80.08				
G 110 100		98.69	₽0.06				0.06
90 Initial IRI	(175		0.04				
70			0.02				
60	5 10 15 20	25 3	0	0 5	10	15 20	25 30
	Cracking PCC	,			Paven	enc Age (years)	
8	7		1				
E.		5.59					
e e e							
٩ <u>-</u>							
10 2							
1		0.11					
0	5 10 15 20 Pavement Age (years)	25 3	10				
			ified Reliabil	ity@	50%Relia	bility	
	Inreshold Valu	e w spec					

esign Input	ts						
Design Life: 3 Design Type: Jo P	0 years Exis binted Plain Concrete Pav avement (JPCP) Trai	sting construction: ement constructior ffic opening:	- March, 201 August, 20	C 17 S 117	limate Data ources (La	a 40.452, -10 t/Lon)	5.001
Design Structu	ire					Traffic	
Layer type	Material Type	Thickness (in) Joint De	sign:		Age (year)	Heavy Trucks
PCC	R4 Level 1 Lawson	7.5	Joint spa	cing (ft)	15.0	Age (year)	(cumulative)
NonStabilized	A-1-b	6.0	Dowel di	ameter (in)	1.25	2017 (initial)	240
Subgrade	A-6	36.0	Slab wid	th (ft)	12.0	2032 (15 years)	1,661,930
Subgrade	A-7-6	72.0				2047 (30 years)	4,351,350
Bedrock	weathered	Semi-infinite					
esign Outp	uts						
Distress Pred	diction Summary						
	,		Distress @	Specified	D-1	- 1 :1:4 - /0/)	
	Distress Type		Relia	bility	Rei	adility (%)	Criterion Satisfied?
			Target	Predicted	Targe	t Achieved	outionouti
Terminal IRI (ir	n/mile)		160.00	141.85	95.00	98.80	Pass
Mean joint faul	ting (in)		0.12	0.03	95.00	100.00	Pass
JPCP transver	se cracking (percent slabs)		7.00	4.46	95.00	99.52	Pass
Distress Cha	irts						
	TPT				Fa	ulting	
170	160		0.14	1	10	0.12	
150		141.8	0.12				
E 130			<u> </u>				
<u>Ē</u> 120			80.05	-			
Q 110 100		93.0	e 20.06				
90 - Initial IR	I: 75		0.04				0.03
70			0.02				0.00
60	5 10 15	20 25	30	0 5	10	15 20	25 30
	Pavement Age (year	rs)			Paver	ient Age (years)	
0	Cracking PCC		_				
	7						
£ 6			-				
No state		4.4	G				
8 4 							
<u>q</u> 3							
10 2 -							
1		0.0	3				
0	s io is Pavement Age (year	20 25 rs)	GE				
					E O O (D a lia	kilita	
	- Threshold Val	ue ····· @ Spe	citiedReliabil	(0)	3U 76 Kella		

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esign input	\$						
Design Life: 30 Design Type: Joi Pa	years Existin nted Plain Concrete Paven vement (JPCP) Traffic	g construction: nent construction: opening:	- March, 201 August, 20	CI 17 Sc 17	imate Data ources (Lat	40.452, -10 /Lon)	5.001
Design Structur	e					Traffic	
Layer type	Material Type	Thickness (in)	Joint De	sign:		Age (year)	Heavy Trucks
PCC	R4 Level 1 Lawson	7.5	Joint spa	cing (ft) 1	5.0	Allo (Joan)	(cumulative)
NonStabilized	A-1-b	6.0	Dowel dia	ameter (in) 1	.25	2017 (initial)	230
Subgrade	A-6	36.0	Slab widt	h (ft) 1	2.0	2032 (15 years)	1,825,360
Subgrade	A-7-6	72.0				2047 (30 years)	5,670,350
Bedrock	Highly fractured and weathered	Semi-infinite					
esign Outpu	ıts						
Distress Pred	iction Summary						
	Distress Type		Distress @ Relia	Specified	Reli	ability (%)	Criterion
			Target	Predicted	Target	t Achieved	Satisfied?
Terminal IRI (in/	/mile)		160.00	145.55	95.00	98.28	Pass
Mean joint faulti	ng (in)		0.12	0.04	95.00	100.00	Pass
JPCP transvers	e cracking (percent slabs)		7.00	4.67	95.00	99.33	Pass
170	IRI 160		0.14		Fau	0, <mark>12</mark>	
150		145.55	0.12				
E 130			5 0.1				
E 110			20.0s				
H 100		94.96	E 0.06				0.04
90 - so Initial IRI:	75		0.04				
70			0.02				0.01
0 5	10 15 20 Pavement Age (years)	25 30	,	0 5	io Pavem	is 20 ent Age (years)	25 30
8 <u>-</u>	Cracking PCC						
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× 1							
U 6-		4.6.4					
c ked							
Cracked C							
Slab Cracked (
C 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2							
C parte de la companya de	10 15 20	0.04 25 30	2				
	10 15 20 Pavement Age (years) Threshold Value	0.04 25 30	, fiedReliabili	ty@t	50% Relia	bility	

esign Inpu	uts						
Design Life: Design Type:	2 years Flexible Pavement	Base o Paven Traffic	construction: nent construction: opening:	March, 2017 June, 2017 September, 2017	Climate Da Sources (L	ta 40.452, -10 at/Lon)	95.001
Design Struct	ture					Traffic	
Layer type	Material Ty	ре	Thickness (in)	Volumetric at Cor	nstruction:		Heavy Truck
Flexible	R1 Level 1 S(100) PG 64-	6.0	Effective binder	11.5	Age (year)	(cumulative
NonStabilized	Aggregate Base		40	Air voids (%)	4.9	2017 (initial)	9,880
Subarada	A.6		36.0			2018 (1 years)	1,623,900
Subgrade	A-0		10.0	1		2019 (2 years)	3,286,420
Bedrock	Highly fractured a weathered	nd	Semi-infinite				

Distress Type	Distress @ Relia	Specified bility	Reliab	Criterion	
	Target	Predicted	Target	Achieved	Sausneu:
Terminal IRI (in/mile)	160.00	86.14	85.00	100.00	Pass
Permanent deformation - total pavement (in)	0.65	0.23	85.00	100.00	Pass
AC bottom-up fatigue cracking (% lane area)	35.00	15.90	85.00	99.59	Pass
AC thermal cracking (ft/mile)	1500.00	81.60	85.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	3000.00	392.00	85.00	100.00	Pass
Permanent deformation - AC only (in)	0.50	0.12	85.00	100.00	Pass

Version: 2.2

Created by: Jay Goldbaum on: 12/2/2014 12:00 AM

Approved by: on: 12/2/2014 12:00 AM

Design If:e: 2 years Design Type: Jointed Pain Construction: - Clinate Data 40.452, -105.001 Design Type: Jointed Pain Construction: March, 2017 Surces (Lal/Lon) Traffic Design Structure Traffic opening: Mayust, 2017 Traffic Image: Construction: August, 2017 NonStabilized A-6 36.0 Dowel dameter (in, 15.0) Dowel dameter (in, 15.0) Distress 02 (Jack 20, 00, 00, 00, 00, 00, 00, 00, 00, 00,	Design Inputs	\$						
Design Structure Traffic Layer type Material Type Thickness (n) 6.0 Distress (n) 5.0 Distress (n) 5.	Design Life: 2 y Design Type: Join Pay	ears Existin nted Plain Concrete Paven vement (JPCP) Traffic	ng construction: nent construction	- n: March, 201	7 Sc	limate Data ources (Lat	40.452, -10 /Lon)	5.001
Layer type Material Type Thickness (in) PCC Diskness (in) FCC FCC FCC <thfc< th=""> FCC FCC</thfc<>	Design Structur	e	opening:	August, 20	17		Traffic	
Distress Prediction Summary Distress Prediction Summary Distress Prediction Summary Distress Predicted Target Achieved Heining (n) 30.200, 200, 000, 000, 000, 000, 000, 000	Laver type	Material Type	Thickness (in	a) Loint Des	eian			Hoovy Truck
NonStabilized A-1-b 4.0 Subgrade A-6 36.0 Subgrade A-7.6 72.0 Bedrock Highly fractured and weathered Semi-infinite Distress Prediction Summary Distress @ Specified Reliability Reliability (%) Target Predicted Target Achieved Statisfied? Distress Type Distress @ Specified Reliability Reliability (%) Statisfied? Criterion Satisfied? Terminal IRI (in/mile) 160.00 101.90 85.00 99.97 Pass Pass JPCP transverse cracking (percent slabe) 7.00 5.40 85.00 91.64 Pass Pass Distress Charts IRI Image: State St	PCC	R4 Level 1 Lawson	60	Joint spa	cina (ft)	5.0	Age (year)	(cumulative)
Subgrade A-6 36.0 Subgrade A-7.6 72.0 Bedrock Highly fractured and semi-infinite Semi-infinite Design Outputs Distress Prediction Summary Distress Prediction Summary Distress @ Specified Reliability (%) Criterion Mean joint faulting (in) 0.12 0.11 85.00 99.97 JPCP transverse cracking (percent slabs) 7.00 5.40 85.00 91.64 Distress Charts If (1 years) 1.623,900 2.22 Distress Charts If (1 years) 0.12 0.01 85.00 99.97 Pass Distress Charts If (1 years) 1.60.00 101.90 85.00 99.97 Pass Distress Charts If (1 years) 1.60.00 101.90 85.00 91.64 Pass Distress Charts If (1 years) 1.60.00 101.90 95.00 91.64 Pass Distress Charts If (1 years) 1.60.00 91.97 Pass Pass Pass Distress Charts If (1 years) If (1 years) If (1 years) If (1 years) I	NonStabilized	A-1-b	4.0	Dowel dia	ameter (in)	.50	2017 (initial)	9,880
Subgrade A.7.6 72.0 Bedrock Highly fractured and weathered Semi-infinite Design Outputs Distress Prediction Summary Distress @ Specified Reliability Reliability (%) Criterion Satisfied? Terminal IRI (in/mile) Distress (0.00 0101.90 85.00 99.97) Pass Pass Pass Mean joint faulting (in) 160.00 101.90 85.00 99.97 Pass Pass Distress Charts 7.00 5.40 85.00 99.97 Pass Distress Charts 7.00 5.40 85.00 99.97 Pass Distress Charts 7.00 5.40 85.00 99.97 Pass Distress Charts 7.00 5.40 85.00 91.64 Pass Terminal IRI (in/mile) 150 0 0 0.1 85.00 91.64 Pass Distress Charts Faulting 0.14 0 0.12 0 0.0 0.5 0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Subgrade	A-6	36.0	Slab widt	h (ft) 1	2.0	2018 (1 years)	1,623,900
Bedrock Highly fractured and weathered Semi-infinite Design Outputs Distress Prediction Summary Distress @ Specified Reliability Reliability (%) Statisfied? Terminal IRI (in/mile) Distress (g) (percent slabs) Distress (g) (percent slabs) Distress (g) (percent slabs) Distress Charts Reliability Reliability Criterion Satisfied? Image: the state of the state	Subgrade	A-7-6	72.0				2019 (2 years)	3,286,420
Distress Prediction Summary Distress Type Distress @ Specified Reliability Reliability (%) Criterion Satisfied? Terminal IRI (in/mile) 160.00 101.90 85.00 99.97 Pass Mean joint faulting (in) 0.12 0.01 85.00 91.84 Pass Distress Charts 7.00 5.40 85.00 91.84 Pass Distress Charts reading (percent slabs) 7.00 5.40 85.00 91.84 Pass 014 160.00 101.90 65.00 91.84 Pass Pass 014 160.00 01.90 65.00 91.84 Pass Pass 014 160.00 101.90 65.00 91.84 Pass Pass 014 160.00 101.90 65.00 91.84 Pass Pass 014 160.00 101.90 60.00 1.84 Pass Pass 014 012 01.91 01.91 01.91 01.91 01.91 01.91 01.91 01.91	Bedrock	Highly fractured and weathered	Semi-infinite					
Distress Prediction Summary Distress Type Terminal IRI (in/mile) Mean joint faulting (in) JPCP transverse cracking (percent slabs) Distress Charts Teracking Predicted Target Achieved 160.00 101.90 85.00 99.97 0.12 0.01 85.00 100.00 Pass)esign Outpu	its		_				
Distress Type Distress @ Specified Reliability Reliability (%) Criterion Satisfied? Terminal IRI (infinile) 160.00 101.90 85.00 99.97 Pass Mean point faulting (in) 0.12 0.01 85.00 99.97 Pass JPCP transverse cracking (percent slabs) 7.00 5.40 85.00 91.84 Pass Distress Charts Faulting Output to the state of th	Distross Dradi	iction Summary				_		_
Distress Type Reliability Re	Distress Fred	cuton Summary		Distress @	Specified	Roli	ability (%)	Critorion
Terminal IRI (in/mile) Mean joint faulting (in) JPCP transverse cracking (percent slabs) Distress Charts		Distress Type		Relia	bility	T		Satisfied?
$\frac{10000}{1000} \frac{10190}{1000} \frac{10190}{1000} \frac{1000}{1000} \frac{10000}{1000} \frac{10000}{1$	Tamainal IDI (in (Target	Predicted	Target	Achieved	Dees
Mean joint tauting (in) 0.12 0.01 85.00 100.00 Pass JPCP transverse cracking (percent slabs) 7.00 5.40 85.00 91.64 Pass Distress Charts IRI Image: state	Terminal IRI (In/	mile)		160.00	101.90	85.00	99.97	Pass
JPCP transverse cracking (percent slabs) 7.00 5.40 85.00 91.64 Pass Distress Charts Image: constraint of the state of	Mean joint faultir	ng (in)		0.12	0.01	85.00	100.00	Pass
IRI 190 190 190 190 190 190 190 190	Distress Chart	ts						
Out of the state of the	170	IRI		0.14		Fau	ulting	
$\int_{0}^{100} \int_{0}^{110} \int_{0$	160	160		0.12		0	0,12	
$\int_{0}^{1} \int_{0}^{1} \int_{0$	⇒ 140 -			2 0.1				
$\frac{100}{90}$	E 130			20.08				
$\int_{a}^{b} \int_{a}^{b} \int_{a$	₩ 110		101.90	20.06				
Threshold Value @ Specified Reliability @ 50% Reliability	100			 				
0 0 0.8 1.2 1.4 1.6 1.8 2 2.2 Pavement Age (years) Cracking PCC 0 0.2 0.4 0.6 0.5 1.2 1.4 1.6 1.5 2 2.2 0 0.2 0.4 0.6 0.5 1.2 1.4 1.6 1.5 2 2.2 0 0.2 0.4 0.6 0.5 1.2 1.4 1.6 1.5 2 2.2 0 0.2 0.4 0.6 0.5 1.2 1.4 1.6 1.5 2 2.2 0 0.2 0.4 0.6 0.5 1.2 1.4 1.6 1.5 2 2.2 0 0.2 0.4 0.6 0.5 1.2 1.4 1.6 2.5 2.2 0 0.2 0.4 0.6 0.5 1.2 1.4 1.6 2.2 2.2 Pavement Age (years) 0 0.5 1.2 1.4 1.6 1.5 2 2.2 Pavement Age (years)	80 Initial IRI:	75	77.04	0.02				0.01
Cracking PCC	70			0.01			•••••	00:00
Cracking PCC	o dz d	4 ole ole i 1/2 1/4 Pavement Age (years)	1.6 1.8 2	22	o olz ol4	ole ole Pavem	i 1.2 1.4 1.6 ent Age (years)	1.8 2 2.2
0 7 0 0 0 0 <t< td=""><td>a .</td><td>Cracking PCC</td><td></td><td>_</td><td></td><td></td><td></td><td></td></t<>	a .	Cracking PCC		_				
0 0 5,40 0 0 5,40 0 0 0 0 0.2 0.4 0.6 0 0.2 0.4 0.6 1.5 2 Pavement Age (years) 0 Specified Reliability @ 50% Reliability		7						
0 0	£ 6		5.40	_				
0 0 0.57 0 0.2 0.4 0.6 1.2 1.4 1.6 1.5 2 2.2 Pavement Age (years)	a 5			-				
0.57 0 0.2 04 0.0 0.8 i 1.2 1.4 1.0 1.8 2 2.2 Pavement Age (years) Threshold Value @ Specified Reliability				-				
0 2 0.57 1 0.57 0 0.2 0.4 0.6 0.57 0 0 0.2 0.4 0.6 0.57 0 0 0.2 0.4 0.6 0.57 0 0 0.2 0.57 0 0 0.57 0 0.2 0.4 0.6 0.57 0 0 0.2 0.57 0 0 0.57 0 0.57 0 0.57 0 0.57 0 0.4 0.57 0.5 0 0.57 0 0.57 0 0.57 0 0.57 0 0.57 0 0.57 0 0.57 0 0.57 0 0.57 0 0.57 0 0.57 0 0.57 0 0.57 0 0.57 0 0.57 0 0.57 0 0.57 <td< td=""><td><u><u>a</u> 3</u></td><td></td><td></td><td>-</td><td></td><td></td><td></td><td></td></td<>	<u><u>a</u> 3</u>			-				
0 0 0 0 0 0 0 0 0 0 0 0 0 0	10 2		0.57					
O 0.2 0.4 0.6 0.5 1 1.2 1.4 1.6 1.5 2 2.2 Pavement Age (years) Threshold Value @ Specified Reliability @ 50% Reliability	1		0.57					
	0 0.2 0	9 0.6 0.8 1 1.2 1.4 Pavement Age (years)	1.6 1.8 2	2.2				
						noor nulli	k ilian	

Design Inp	uts						
Design Life: Design Type:	20 years Flexible Pavement	Base o Paven Traffic	construction: nent construction: opening:	March, 2017 August, 2017 September, 2017	Climate Dat Sources (La	a 40.452, -10: t/Lon)	5.001
Design Strue	cture					Traffic	
Layer typ	e Material Ty	ре	Thickness (in)	Volumetric at Co	nstruction:	Age (year)	Heavy Trucks
Flexible	R4 SMA		2.0	Effective binder	13.1		(cumulative)
Elexible	R1 Level 1 S(100)	PG 64-	6.8	content (%)	-	2017 (initial)	610
	22		0.0	AIr voids (%)	4.0	2027 (10 years)	2,517,900
NonStabilized	Aggregate Base		6.0	l		2037 (20 years)	5,800,950
Subgrade	A-6		36.0				
Subgrade	A-7-6		36.0	1			
Bedrock	Highly fractured ar weathered	nd	Semi-infinite	1			

Design Outputs

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Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion	
<i>"</i>	Target	Predicted	Target	Achieved	sausned?	
Terminal IRI (in/mile)	160.00	153.89	90.00	93.00	Pass	
Permanent deformation - total pavement (in)	0.55	0.52	95.00	97.46	Pass	
AC bottom-up fatigue cracking (% lane area)	10.00	8.81	95.00	96.96	Pass	
AC thermal cracking (ft/mile)	1500.00	109.13	95.00	100.00	Pass	
AC top-down fatigue cracking (ft/mile)	2000.00	334.28	95.00	100.00	Pass	
Permanent deformation - AC only (in)	0.40	0.41	95.00	93.56	Fail	

Report generated on: 12/9/2015 2:29 PM

Version: 2.2

Created by: Jay Goldbaum on: 12/2/2014 12:00 AM





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Design Inp	outs						
Design Life: Design Type:	20 years Flexible Pavement	Base o Paven Traffic	construction: nent construction: opening:	March, 2017 August, 2017 September, 2017	Climate Da Sources (La	ta 40.452, -10: at/Lon)	5.001
Design Strue	cture					Traffic	
Layer typ	e Material Ty	уре	Thickness (in)	Volumetric at Con	struction:	Age (year)	Heavy Trucks
Flexible	R4 SMA		2.0	Effective binder	13.1	Age (year)	(cumulative)
Elevible	R1 Level 1 S(100) PG 64-	6.8	content (%)	4.0	2017 (initial)	650
TICKIDIC	22		0.0	Air voids (%)	4.0	2027 (10 years)	2,605,310
NonStabilized	Aggregate Base		6.0			2037 (20 years)	5,796,150
Subgrade	A-6		36.0				
Subgrade	A-7-6		36.0				
Bedrock	Highly fractured a weathered	and	Semi-infinite				

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion
	Target	Predicted	Target	Achieved	Saushed?
Terminal IRI (in/mile)	160.00	153.86	90.00	93.02	Pass
Permanent deformation - total pavement (in)	0.55	0.52	95.00	97.49	Pass
AC bottom-up fatigue cracking (% lane area)	10.00	8.81	95.00	96.96	Pass
AC thermal cracking (ft/mile)	1500.00	109.13	95.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	334.28	95.00	100.00	Pass
Permanent deformation - AC only (in)	0.40	0.41	95.00	93.64	Fail

Report generated on: 12/9/2015 2:40 PM

Version: 2.2

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I-25 Ramp C HMA TransitionNew_AC_Design Dec 2015 he: C:\Users\mghaeli\Desktop\MAY 1 2015\Masoud's Projects\215-043 I 25 @ Crossroads Blvd\Pavement Design\December Designs-New Traffic\I-25 Ra

Design Inputs

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Design Life:	20 years	Base construction:
Design Type:	Flexible Pavement	Pavement construction:
		Traffic opening:

March, 2017 August, 2017 September, 2017

40.452, -105.001 Climate Data Sources (Lat/Lon)

Design Structure				
Layer type	Material Type	Thickness (in)		
Flexible	R4 SMA	2.0		
Flexible	R1 Level 1 S(100) PG 64- 22	5.5		
NonStabilized	Aggregate Base	6.0		
Subgrade	A-6	36.0		
Subgrade	A-7-6	36.0		
Bedrock	Highly fractured and weathered	Semi-infinite		

		Traffic
Volumetric at Cor	nstruction:	Age
Effective binder content (%)	13.1	2017 (in
Air voids (%)	4.0	2027 (10
		2037 (20

Trutte				
Age (year)	Heavy Trucks (cumulative)			
2017 (initial)	240			
2027 (10 years)	1,017,090			
2037 (20 years)	2,419,000			

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion	
<i></i>	Target	Predicted	Target	Achieved	Satisfied?	
Terminal IRI (in/mile)	160.00	148.58	90.00	95.12	Pass	
Permanent deformation - total pavement (in)	0.55	0.42	95.00	99.87	Pass	
AC bottom-up fatigue cracking (% lane area)	10.00	7.14	95.00	98.98	Pass	
AC thermal cracking (ft/mile)	1500.00	110.29	95.00	100.00	Pass	
AC top-down fatigue cracking (ft/mile)	2000.00	341.62	95.00	100.00	Pass	
Permanent deformation - AC only (in)	0.40	0.32	95.00	99.48	Pass	

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Approved^{by:} on: 12/2/2014 12:00 AM



AASHTO

I-25 Ramp D HMA TransitionNew_AC_Design Dec 2015 Name: C:\Users\mghaeli\Desktop\MAY 1 2015\Masoud's Projects\215-043 I 25 @ Crossroads Blvd\Pavement Design\December Designs-New Traffic\I-25 Ram

Design Inputs

Pv D

Design Life:	20 years
Design Type:	Flexible Pavement

Base construction: Pavement construction: August, 2017 Traffic opening:

March, 2017 September, 2017 Climate Data 40.452, -105.001 Sources (Lat/Lon)

Design Structure				
Layer type	Material Type	Thickness (in)		
Flexible	R4 SMA	2.0		
Flexible	R1 Level 1 S(100) PG 64- 22	5.8		
NonStabilized	Aggregate Base	6.0		
Subgrade	A-6	36.0		
Subgrade	A-7-6	36.0		
Bedrock	Highly fractured and weathered	Semi-infinite		

		Traffic
Volumetric at Cor	nstruction:	Age
Effective binder content (%)	13.1	2017 (ini
Air voids (%)	4.0	2027 (10
		2037 (20

:	Age (year)	Heavy Trucks (cumulative)
_	2017 (initial)	230
	2027 (10 years)	1,061,190
	2037 (20 years)	2,804,950

Design Outputs

Distress Prediction Summary

Distress Type	Distress @ Specified Reliability		Reliability (%)		Criterion
	Target	Predicted	Target	Achieved	Satisfied?
Terminal IRI (in/mile)	160.00	150.56	90.00	94.38	Pass
Permanent deformation - total pavement (in)	0.55	0.46	95.00	99.55	Pass
AC bottom-up fatigue cracking (% lane area)	10.00	8.70	95.00	97.12	Pass
AC thermal cracking (ft/mile)	1500.00	109.48	95.00	100.00	Pass
AC top-down fatigue cracking (ft/mile)	2000.00	341.33	95.00	100.00	Pass
Permanent deformation - AC only (in)	0.40	0.35	95.00	98.60	Pass

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