



Illinois Department of Transportation

To: Jeffrey L. Keirn Attn: Carrie Nelsen
From: Maureen M. Addis *MA*
Subject: Pavement Design Approval
Date: March 16, 2017

Route: FAP 331 (IL 13)
Section: (5-3)R-1,N-1,B-5,BR-1,B-6,BR-2
County: Jefferson
Contract: 78295
Limits: Giant City Rd to West of Reed Station Road, East of Carbondale

We have reviewed the pavement design for the above referenced project which was most recently submitted on March 13, 2017. The scope of the project is to widen and resurface IL 13 from a 4-lane to a 6-lane cross-section, replace two structures, and rehabilitate two other structures.

The pavement design resulted in two pavement widening options: 12.25" Full-Depth HMA and 9.5" PCC. The first cost analysis of those options resulted in the HMA being 18.7% less expensive (\$3,359,078 vs. \$3,985,743) and thus the preferred option.

The approved pavement design is as follows:

- 12.25" Full-Depth HMA Widening
- 12.25" HMA Shoulders
- 12" Aggregate Subgrade Improvement

If you have any questions, please contact Mike Brand at (217) 782-7651.



Illinois Department of Transportation

Memorandum

To: Maureen Addis Attn: Mike Brand
From: Jeff Keirn By: Carrie Nelsen
Subject: Pavement Design IL 13 Giant City Road to Reed Station
Road, Jackson County
Date: March 13, 2017

FAP 331 (IL 13)
Illinois 13 - Giant City Road to Reed Station Road Bridge and Roadway
Improvements
Jackson County
Contract No. 78295

Attached please find the required documentation for a pavement design on IL 13 between Giant City Road and Reed Station Road (east side of Carbondale). Two structures will be replaced, two will be rehabilitated. A 12' third lane will be added on IL 13 the length of the improvement to accommodate the bridge stage construction.

On July 1, 2014 a HMA pavement design was approved as part of an Illinois 13 Phase I study from Carterville to Carbondale. Recently an updated pavement type analysis was conducted using todays prices and limits of this particular project. Typical sections for both pavement types are attached. Based on first cost comparison HMA is the preferred pavement type.

Please review the attached documents and concur with our preferred pavement design.

Flexible Pavement:

Thickness – 12.25”

Shoulders – 12.25” HMA Shoulders

Improved Subgrade – Subbase Granular Material, 12”

PROJECT AND TRAFFIC INPUTS

(Enter Data in Gray Shaded Cells)

Route: IL 13	Comments:			
Section: (5-3)R-1,N-1,B-5,BR-1,B-6,BR-2	Design Date: 03/13/2017	<-- BY		
County: Jackson	Modify Date:	<-- BY		
Location: btw Giant City Rd and Reed Station Rd		ADT	Year	
Facility Type: Other Marked State Route		Current:	-	-
# of Lanes = 6 or more		Future:	-	-
Road Class: I		Structural Design Traffic		
Rural or Urban ? Rural		Minimum ADT	Actual ADT	Actual % of Total ADT
Subgrade Support Rating (SSR): Poor		PV = 0	29,362	93.3%
Construction Year: 2017		SU = 250	1,017	3.2%
Design Period (DP) = 20 years		MU = 750	1,076	3.4%
		Struct. Design ADT = 31,455	(2027)	
				% of ADT in Design Lane
				P = 20%
				S = 40%
				M = 40%

TRAFFIC FACTOR CALCULATION

FLEXIBLE PAVEMENT

Cpv = 0.15
 Csu = **132.5**
 Cmu = **482.53**
 TF flexible (Actual) = 5.25 (Actual ADT)
 TF flexible (Min) = 3.16 (Min ADT Fig. 54-2.C)

RIGID PAVEMENT

Cpv = 0.15
 Csu = **143.81**
 Cmu = **696.42**
 TF rigid (Actual) = 7.18 (Actual ADT)
 TF rigid (Min) = 4.47 (Min ADT Fig. 54-2.C)

NEW CONSTRUCTION / RECONSTRUCTION PAVEMENT DESIGN CALCULATIONS

Full-Depth HMA Pavement		JPC Pavement	
Use TF flexible = 5.25	PG Grade Lower Binder Lifts = PG 64-22 (Fig. 53-4.R)	Use TF rigid = 7.18	Edge Support = Tied Shoulder or C.&G.
Goto Map	HMA Mixture Temp. = 80.5 deg. F (Fig. 54-5.C)	Rigid Pavt Thick. = 9.50 in. (Fig. 54-4.E)	
Design HMA Mixture Modulus (E _{HMA}) = 540 ksi (Fig. 54-5.D)	Design HMA Strain (ε _{HMA}) = 75 (Fig. 54-5.E)	CRCP Pavement	
Goto Map	Full Depth HMA Design Thickness = 12.25 in. (Fig. 54-5.F)	Use TF rigid = 7.18	IBR value = 3
Limiting Strain Criterion Thickness = 16.75 in. (Fig. 54-5.I)	Use Full-Depth HMA Thickness = 12.25 inches	CRCP Thickness = 8.50 in. (Fig. 54-4.M)	

TF MUST BE > 60 FOR CRCP

RECONSTRUCTION ONLY (SUPPLEMENTAL) PAVEMENT DESIGN CALCULATIONS

HMA Overlay of Rubblized PCC		Unbonded Concrete Overlay	
Use TF flexible = 5.25	HMA Overlay Design Thickness = 9.00 in. (Fig. 54-5.U)	Review 54-4.03 for limitations and special considerations.	
Goto Map	Limiting Strain Criterion Thickness = in. (Fig. 54-5.V)	JPCP Thickness = NA inches	
Use HMA Overlay Thickness = 999.00 inches			

CONTACT BMPR FOR ASSISTANCE

DESIGN TABLES FROM BDE MANUAL CHAPTER 54 - PAVEMENT DESIGN

Class I Roads	Class II Roads	Class III Roads	Class IV Roads
4 lanes or more Part of a future 4 lanes or more One-way Streets with ADT > 3500	2 lanes with ADT > 2000 One way Street with ADT <= 3500	2 Lanes (ADT 750 -2000)	2 Lanes (ADT < 750)

Facility Type	Min. Str. Design Traffic (Fig 54-2.C)			
	PV	SU	MU	
	Interstate or Freeway	0	500	1500
	Other Marked State Route	0	250	750
Unmarked State Route	No Min	No Min	No Min	

Class	Traffic Factor ESAL Coefficients				
	Rigid (Fig. 54-4.C)		Flexible (Fig. 54-5.B)		
	Csu	Cmu	Csu	Cmu	
	I	143.81	696.42	132.50	482.53
	II	135.78	567.21	112.06	385.44
III	129.58	562.47	109.14	384.35	
IV	129.58	562.47	109.14	384.35	

Class Table for One-Way Streets	ADT	Class
	0 - 3500	II
	>3501	I

Class Table for 2 or 3 lanes (not future 4 lane & not one-way street)	ADT	Class
	0 - 749	IV
	750 - 2000	III
	>2000	II

Number of Lanes	Design Lane Distribution Factors For Structural Design Traffic (Fig. 54-2.B)					
	Rural			Urban		
	P	S	M	P	S	M
1 Lane Ramp	100%	100%	100%	100%	100%	100%
2 or 3	50%	50%	50%	50%	50%	50%
4	32%	45%	45%	32%	45%	45%
6 or more	20%	40%	40%	8%	37%	37%

PARTIAL DEPTH SHLD PATCH	(Mill & Fill Surf)	Shoulder Mix	2.00	\$78.06	/ SQ YD
PARTIAL DEPTH PVMT PATCH	(Mill & Fill +2.00 ")	Leveling Binder Mix	2.00	\$79.52	/ SQ YD
PARTIAL DEPTH SHLD PATCH	(Mill & Fill +2.00 ")	Shoulder Mix	2.00	\$78.06	/ SQ YD
LONGITUDINAL SHOULDER JOINT ROUT & SEAL				\$2.00	/ LIN FT
CENTERLINE JOINT ROUT & SEAL				\$2.00	/ LIN FT
RANDOM / THERMAL CRACK ROUT & SEAL	(100% Rehab = 110.00' / Station / Lane)			\$2.00	/ LIN FT

FLEXIBLE TOTAL LIFE-CYCLE COST	\$711,101
FLEXIBLE TOTAL ANNUAL COST PER MILE	\$153,133

PCC PAVEMENT

JPCP

ROUTE
SECTION
COUNTY
LOCATION

Job Route
Job Section
Job County
Job Location

FACILITY TYPE

INTERSTATE

PROJECT LENGTH 1000 FT == > 0.19 Miles
 # OF CENTERLINES 2 CL
 # OF LANES 4 LANES
 # OF EDGES 4 EP
 LANE WIDTH - AVERAGE 12 FT
 SHOULDER WIDTH PCC Inside 6 FT
 PCC Outside 10 FT
 Total Width of Paved Shoulders 32 FT

PAVEMENT THICKNESS (RIGID) JPCP 10.00 IN TIED SHLD
 SHOULDER THICKNESS 10.00 IN

POLICY OVERLAY THICKNESS 3.75 IN

RIGID PAVEMENT	TRAFFIC FACTORS	MINIMUM	ACTUAL	USE
Worksheet Construction Type is	New Construction	10.05	1.00	10.05
				The Pavement Type is JPCP

INITIAL COSTS

ITEM	THICKNESS	100% QUANTITY	UNIT	UNIT PRICE	COST
JPC PAVEMENT	(10.00")	5,333	SQ YD	\$50.00 / SQ YD	\$266,650
PAVEMENT REINFORCEMENT		0	SQ YD	\$22.00 / SQ YD	\$0
STABILIZED SUBBASE	(4.00")	6,000	SQ YD	\$19.00 / SQ YD	\$114,000
PCC SHOULDERS		3,556	SQ YD	\$40.00 / SQ YD	\$142,240
CURB & GUTTER		0	LIN FT	\$30.00 / LIN FT	\$0
SUBBASE GRAN MATL TY C	(~ 3.48")	418	TONS	\$25.00 / TON	\$10,450
IMPROVED SUBGRADE:	Modified Soil Width = 82.0'	9,111	SQ YD	\$7.00 / SQ YD	\$63,777
Reserved For User Supplied Item		0	UNITS	\$0.00 / UNITS	\$0
Reserved For User Supplied Item		0	UNITS	\$0.00 / UNITS	\$0
PAVEMENT REMOVAL		5,333	SQ YD	\$0.00 / SQ YD	\$0
SHOULDER REMOVAL		3,556	SQ YD	\$0.00 / SQ YD	\$0

Note: * Denotes User Supplied Quantity
 RIGID CONSTRUCTION INITIAL COST \$597,117
 RIGID CONSTRUCTION ANNUAL COST PER MILE \$128,587

MAINTENANCE COSTS:

ITEM	THICKNESS	MATERIAL	T	UNIT COST
ROUTINE MAINTENANCE ACTIVITY				\$0.00 / LANE-MILE / YEAR
HMA POLICY OVERLAY	(3.75")		3.75	
HMA POLICY OVERLAY PVMT	(3.75")	1.0130	3.75	\$20.21 / SQ YD
HMA SURFACE MIX	(1.50")	1.0052	1.50	\$8.02 / SQ YD
HMA BINDER MIX	(2.25")	1.0182	2.25	\$12.19 / SQ YD
HMA POLICY OVERLAY SHLD	(3.75")		3.75	\$15.12 / SQ YD
CLASS A PAVEMENT PATCHING				\$195.00 / SQ YD
CLASS B PAVEMENT PATCHING				\$150.00 / SQ YD
CLASS C SHOULDER PATCHING				\$145.00 / SQ YD
PARTIAL DEPTH PVMT PATCH (Mill & Fill HMA Surf)		Surface Mix	1.50	\$77.98 / SQ YD
PARTIAL DEPTH PVMT PATCH (Mill & Fill HMA 1.50")		Surface Mix	1.50	\$77.98 / SQ YD
LONGITUDINAL SHOULDER JOINT ROUT & SEAL				\$2.00 / LIN FT
CENTERLINE JOINT ROUT & SEAL				\$2.00 / LIN FT
REFLECTIVE TRANSVERSE CRACK ROUT & SEAL				\$2.00 / LIN FT
RANDOM CRACK ROUT & SEAL (100% Rehab = 100.00' / Station / Lane)				\$2.00 / LIN FT

RIGID TOTAL LIFE-CYCLE COST \$727,263
 RIGID TOTAL ANNUAL COST PER MILE \$156,613

LIFE-CYCLE COST ANALYSIS: NEW DESIGN

Calculated / Revised : **9/5/13 9:40 AM**

			JPCP	HMA
CONSTRUCTION	INITIAL COST	PRESENT WORTH	\$597,117	\$512,043
		ANNUAL COST PER MILE	\$128,587	\$110,266
MAINTENANCE	LIFE-CYCLE COST	PRESENT WORTH	\$130,146	\$199,058
		ANNUAL COST PER MILE	\$28,026	\$42,866
TOTAL	LIFE-CYCLE COST	PRESENT WORTH	\$727,263	\$711,101
		ANNUAL COST PER MILE	\$156,613	\$153,133

LIFE-CYCLE COST ANALYSIS: FINAL SUMMARY

LOWEST COST OPTION	=====>	HMA	\$153,133	
OTHER OPTIONS (LOWEST TO HIGHEST):	TYPE / PERCENTAGE	JPCP	\$156,613	2.3%

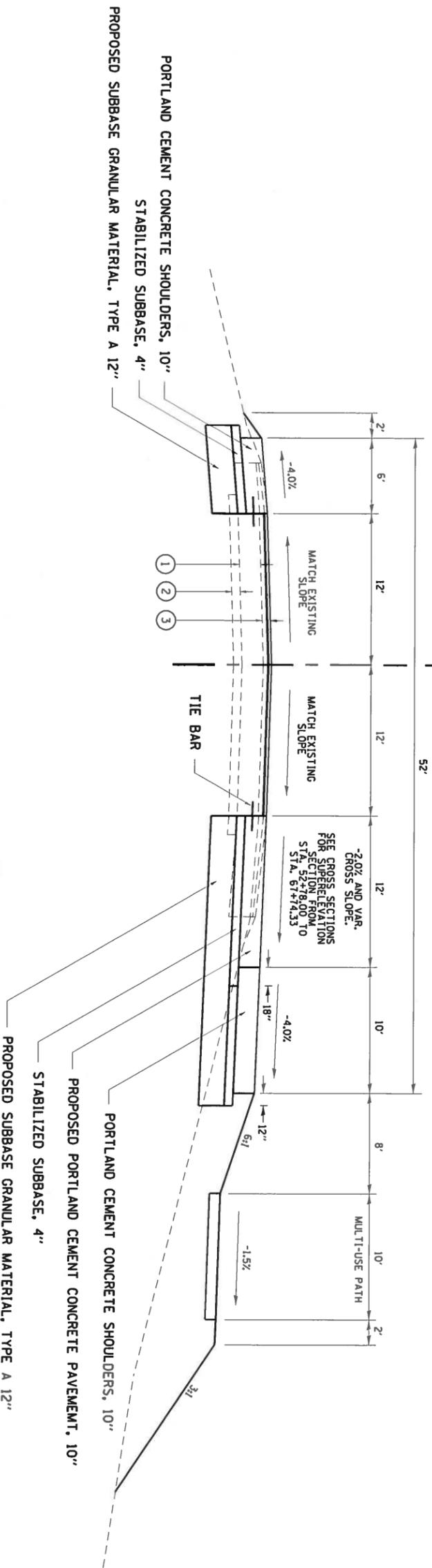
FULL-DEPTH HMA PAVEMENT
 HMA OVERLAY OF RUBBLIZED PCC PAVEMENT
 Figure 54-7.C
 STANDARD DESIGN

MAINTENANCE COSTS:	ITEM	%	QUANTITY	UNIT	UNIT COST	COST	PRESENT WORTH
YEAR 5							
	LONG SHLD JT R&S	100.00%	4,000	LIN FT	\$2.00	\$8,000	
	CNTR LINE JOINT R&S	100.00%	2,000	LIN FT	\$2.00	\$4,000	
	RNDM / THRM CRACK R&S	50.00%	2,200	LIN FT	\$2.00	\$4,400	
	PD PVMT PATCH M&F SURF	0.10%	5	SQ YD	\$80.64	\$403	
	PWFn =	0.8626			PW =	0.8626 X	\$16,803
							\$14,494
YEAR 10							
	LONG SHLD JT R&S	100.00%	4,000	LIN FT	\$2.00	\$8,000	
	CNTR LINE JOINT R&S	100.00%	2,000	LIN FT	\$2.00	\$4,000	
	RNDM / THRM CRACK R&S	50.00%	2,200	LIN FT	\$2.00	\$4,400	
	PD PVMT PATCH M&F SURF	0.50%	27	SQ YD	\$80.64	\$2,177	
	PWFn =	0.7441			PW =	0.7441 X	\$18,577
							\$13,823
YEAR 15							
	MILL PVMT & SHLD 2.00"	100.00%	8,889	SQ YD	\$3.00	\$26,667	
	PD PVMT PATCH M&F ADD'L 2.00"	1.00%	53	SQ YD	\$79.52	\$4,215	
	HMA OVERLAY PVMT 2.00"	100.00%	5,333	SQ YD	\$10.71	\$57,141	
	HMA OVERLAY SHLD 2.00 "	100.00%	3,556	SQ YD	\$8.06	\$28,672	
	PWFn =	0.6419			PW =	0.6419 X	\$116,695
							\$74,902
YEAR 20							
	LONG SHLD JT R&S	100.00%	4,000	LIN FT	\$2.00	\$8,000	
	CNTR LINE JOINT R&S	100.00%	2,000	LIN FT	\$2.00	\$4,000	
	RNDM / THRM CRACK R&S	50.00%	2,200	LIN FT	\$2.00	\$4,400	
	PD PVMT PATCH M&F SURF	0.10%	5	SQ YD	\$80.64	\$403	
	PWFn =	0.5537			PW =	0.5537 X	\$16,803
							\$9,303
YEAR 25							
	LONG SHLD JT R&S	100.00%	4,000	LIN FT	\$2.00	\$8,000	
	CNTR LINE JOINT R&S	100.00%	2,000	LIN FT	\$2.00	\$4,000	
	RNDM / THRM CRACK R&S	50.00%	2,200	LIN FT	\$2.00	\$4,400	
	PD PVMT PATCH M&F SURF	0.50%	27	SQ YD	\$80.64	\$2,177	
	PWFn =	0.4776			PW =	0.4776 X	\$18,577
							\$8,872
HMA SD							
YEAR 30 INTERSTATE							
	MILL PVMT ONLY 2.00"	100.00%	5,333	SQ YD	\$3.00	\$15,999	
	PD PVMT PATCH M&F ADD'L 2.00"	2.00%	107	SQ YD	\$79.52	\$8,509	
	PD SHLD PATCH M&F SURF 2.00"	1.00%	36	SQ YD	\$78.06	\$2,810	
	HMA OVERLAY PVMT 3.75 "	100.00%	5,333	SQ YD	\$20.21	\$107,785	
	HMA OVERLAY SHLD 1.75 "	100.00%	3,556	SQ YD	\$7.06	\$25,088	
	PWFn =	0.4120			PW =	0.4120 X	\$160,191
							\$65,997
YEAR 35							
	LONG SHLD JT R&S	100.00%	4,000	LIN FT	\$2.00	\$8,000	
	CNTR LINE JOINT R&S	100.00%	2,000	LIN FT	\$2.00	\$4,000	
	RNDM / THRM CRACK R&S	50.00%	2,200	LIN FT	\$2.00	\$4,400	
	PD PVMT PATCH M&F SURF	0.10%	5	SQ YD	\$80.64	\$403	
	PWFn =	0.3554			PW =	0.3554 X	\$16,803
							\$5,972
YEAR 40							
	LONG SHLD JT R&S	100.00%	4,000	LIN FT	\$2.00	\$8,000	
	CNTR LINE JOINT R&S	100.00%	2,000	LIN FT	\$2.00	\$4,000	
	RNDM / THRM CRACK R&S	50.00%	2,200	LIN FT	\$2.00	\$4,400	
	PD PVMT PATCH M&F SURF	0.50%	27	SQ YD	\$80.64	\$2,177	
	PWFn =	0.3066			PW =	0.3066 X	\$18,577
							\$5,695
							\$199,058
	ROUTINE MAINTENANCE ACTIVITY		0.76 Lane Miles		0.00	\$0	\$0
							MAINTENANCE LIFE-CYCLE COST \$199,058
45	YEAR LIFE CYCLE	CRFn = 0.0407852					MAINTENANCE ANNUAL COST PER MILE \$42,866

JOINTED PLAIN CONCRETE PAVEMENT
 UNBONDED JOINTED PLAIN CONCRETE OVERLAY
 Figure 54-7.A

MAINTENANCE COSTS:	ITEM	%	QUANTITY	UNIT	UNIT COST	COST	PRESENT WORTH	
YEAR 10								
	PAVEMENT PATCH CLASS B	0.10%	5	SQ YD	\$150.00	\$750		
		PWFn = 0.7441			PW = 0.7441 X	\$750	\$558	
YEAR 15								
	PAVEMENT PATCH CLASS B	0.20%	11	SQ YD	\$150.00	\$1,650		
		PWFn = 0.6419			PW = 0.6419 X	\$1,650	\$1,059	
YEAR 20								
	PAVEMENT PATCH CLASS B	2.00%	107	SQ YD	\$150.00	\$16,050		
	SHOULDER PATCH CLASS C	0.50%	18	SQ YD	\$145.00	\$2,610		
	LONGITUDINAL SHLD JT R&S	100.00%	4,000	LIN FT	\$2.00	\$8,000		
	CENTERLINE JT R&S	100.00%	2,000	LIN FT	\$2.00	\$4,000		
		PWFn = 0.5537			PW = 0.5537 X	\$30,660	\$16,976	
YEAR 25								
	PAVEMENT PATCH CLASS B	3.00%	160	SQ YD	\$150.00	\$24,000		
	SHOULDER PATCH CLASS C	1.00%	36	SQ YD	\$145.00	\$5,220		
		PWFn = 0.4776			PW = 0.4776 X	\$29,220	\$13,956	
YEAR 30								
	INTERSTATE							
	PAVEMENT PATCH CLASS B	4.00%	213	SQ YD	\$150.00	\$31,950		
	SHOULDER PATCH CLASS C	1.50%	53	SQ YD	\$145.00	\$7,685		
	HMA POLICY OVERLAY 3.75" (PVMT)	100.00%	5,333	SQ YD	\$20.21	\$107,785		
	HMA POLICY OVERLAY 3.75" (SHLD)	100.00%	3,556	SQ YD	\$15.12	\$53,760		
		PWFn = 0.4120			PW = 0.4120 X	\$201,180	\$82,883	
YEAR 35								
	INTERSTATE							
	LONGITUDINAL SHLD JT R&S	100.00%	4,000	LIN FT	\$2.00	\$8,000		
	CENTERLINE JT R&S	100.00%	2,000	LIN FT	\$2.00	\$4,000		
	RANDOM CRACK R&S	50.00%	2,000	LIN FT	\$2.00	\$4,000		
	REFLECTIVE TRANSVERSE CRACK R&S	40.00%	1,286	LIN FT	\$2.00	\$2,572		
	PD PVMT PATCH M&F HMA SURF 1.50"	0.10%	5	SQ YD	\$77.98	\$390		
		PWFn = 0.3554			PW = 0.3554 X	\$18,962	\$6,739	
YEAR 40								
	INTERSTATE							
	PAVEMENT PATCH CLASS B	0.50%	27	SQ YD	\$150.00	\$4,050		
	LONGITUDINAL SHLD JT R&S	100.00%	4,000	LIN FT	\$2.00	\$8,000		
	CENTERLINE JT R&S	100.00%	2,000	LIN FT	\$2.00	\$4,000		
	REFLECTIVE TRANSVERSE CRACK R&S	60.00%	1,930	LIN FT	\$2.00	\$3,860		
	RANDOM CRACK R&S	50.00%	2,000	LIN FT	\$2.00	\$4,000		
	PD PVMT PATCH M&F HMA SURF 1.50"	0.50%	27	SQ YD	\$77.98	\$2,105		
		PWFn = 0.3066			PW = 0.3066 X	\$26,015	\$7,975	
							\$130,146	
	ROUTINE MAINTENANCE ACTIVITY				0.76 Lane Miles	\$0.00	\$0	\$0
							MAINTENANCE LIFE-CYCLE COST	\$130,146
45	YEAR LIFE CYCLE	CRFn = 0.0407852				MAINTENANCE ANNUAL COST PER MILE	\$28,026	

**IL RTE 13
(EASTBOUND)
LOOKING EAST**



**TYPICAL SECTION
CONCRETE PAVEMENT**

- ① EXISTING PCC PAVEMENT
- 7" CRC STA. 49+25.00 TO 64+17.12
- 10" CRC STA. 66+22.88 TO 85+68.62
- 7" CRC STA. 88+75.05 TO 118+59.53
- ② EXISTING SUB-BASE 4"
- ③ EXISTING HMA OVERLAY 3 3/4" (APPROX)

FILE NAME =	USER NAME = Default	DESIGNED -	REVISOR -
path: \\094EBIDINTEG\11\proj\9007\06\manta\1007\office\Director\Projects\13	PROJECT: 107000 7 / in	CHECKED -	REVISOR -
MODEL NAME *	PLT DATE: 12/29/2015	DATE -	REVISOR -

**STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION**

SCALE:	SHEET	OF	SHEETS	STA.	TO STA.
	TYPICALS (EAST BOUND)				

F.A.P. RTE. 331	SECTION 5-3R-1A-1B-5BR-1B-6BR-2	COUNTY JACKSON	TOTAL SHEET NO. 18295
ILLINOIS FED. AID PROJECT			CONTRACT NO. 78295

