

# Illinois Department of Transportation

## Memorandum

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To: Bureau of Design and Environment  
From: Susan Poe  
Subject: Pavement Design  
Date: June 26th, 2017

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Contract: 78557  
Section: (104,13)N-1  
Job Number: C-99-008-17  
Route: IL 146 (Vienna St.) / Main St.  
County: Union

District 9 Geometrics Unit is in the initial stages of plan preparation for the intersection of IL 146 and Main St. in Anna. The existing pavement is a thin concrete overlay (whitetopping) that has been patched several times. The current plan is to remove and replace the pavement at the intersection. The District feels that it would be preferable to replace with 9" of PCC Pavement with tied edge support and 12" aggregate improved subgrade

For reference we have attached the Mechanistic Pavement Design with calculated pavement thicknesses and traffic volumes. We have also attached a traffic count that was conducted in 2015. Please contact Susan Poe at 618-351-5213 with questions.

SMG/SLP

Attachment: IDOT Mechanistic Pavement Design 06-26-17.xlsm

**PROJECT AND TRAFFIC INPUTS**

(Enter Data in Gray Shaded Cells)

Route: <b>IL 146 ( FAP 885)</b>	Comments:	
Section: <b>(104,13)N-1</b>	Design Date: <b>06/26/2017</b>	<b>SMG</b>
County: <b>Union</b>	Modify Date:	
Location: <b>Main St. and Vienna St. Intersection</b>		
Facility Type: <b>Other Marked State Route</b>		
# of Lanes = <b>2 or 3</b>		
Part of future 4 lanes or more ? <b>No</b>		
One Way Street ? <b>No</b>		
Road Class: <b>II</b>		
Subgrade Support Rating (SSR): <b>Poor</b>		
Construction Year: <b>2018</b>		
Design Period (DP) = <b>20</b> years		

	<- BY			
	<- BY	ADT	Year	
Current:	14,000	2018		
Future:	17,250	2038		

<b>Structural Design Traffic</b>				
	Minimum ADT	Actual ADT	Actual %of Total ADT	% of ADT in Design Lane
PV =	0	14,315	91.6%	P = <b>50%</b>
SU =	250	585	3.7%	S = <b>50%</b>
MU =	750	725	4.6%	M = <b>50%</b>
	Struct. Design ADT =		15,625	(2028)

**TRAFFIC FACTOR CALCULATION**

<b>FLEXIBLE PAVEMENT</b>		<b>RIGID PAVEMENT</b>	
Cpv =	0.15	Cpv =	0.15
Csu =	<b>112.06</b>	Csu =	<b>135.78</b>
Cmu =	<b>385.44</b>	Cmu =	<b>567.21</b>
TF flexible (Actual) =	3.47	(Actual ADT)	
TF flexible (Min) =	3.17	(Min ADT Fig. 54-2.C)	
		TF rigid (Actual) =	4.93
		TF rigid (Min) =	4.59
		(Actual ADT)	
		(Min ADT Fig. 54-2.C)	

**NEW CONSTRUCTION / RECONSTRUCTION PAVEMENT DESIGN CALCULATIONS**

<b>Full-Depth HMA Pavement</b>	<b>JPC Pavement</b>
Use TF flexible = 3.47	Use TF rigid = 4.93
PG Grade Lower Binder Lifts = <b>PG 64-22</b> (Fig. 53-4.R)	Edge Support = <b>Tied</b> Shoulder or C.&G.
HMA Mixture Temp. = <b>81.5</b> deg. F (Fig. 54-5.C)	<b>Rigid Pavt Thick. = 9.00 in. (Fig. 54-4.E)</b>
Design HMA Mixture Modulus (E <sub>HMA</sub> ) = 520 ksi (Fig. 54-5.D)	
Design HMA Strain (ε <sub>HMA</sub> ) = 84 (Fig. 54-5.E)	<b>CRCP Pavement</b>
Full Depth HMA Design Thickness = 11.75 in. (Fig. 54-5.F)	Use TF rigid = 4.93
Limiting Strain Criterion Thickness = <b>17.00</b> in. (Fig. 54-5.I)	IBR value = <b>3</b>
<b>Use Full-Depth HMA Thickness = 11.75 inches</b>	<b>CRCP Thickness = 7.75 in. (Fig. 54-4.N)</b>

**TF MUST BE > 60 FOR CRCP**

**RECONSTRUCTION ONLY (SUPPLEMENTAL) PAVEMENT DESIGN CALCULATIONS**

<b>HMA Overlay of Rubblized PCC</b>	<b>Unbonded Concrete Overlay</b>
Use TF flexible = 3.47	Review 54-4.03 for limitations and special considerations.
HMA Overlay Design Thickness = 8.25 in. (Fig. 54-5.U)	
Limiting Strain Criterion Thickness = in. (Fig. 54-5.V)	
<b>Use HMA Overlay Thickness = 999.00 inches</b>	<b>JPCP Thickness = NA inches</b>

**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)

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

	Traffic Factor ESAL Coefficients			
	Rigid (Fig. 54-4.C)		Flexible (Fig. 54-5.B)	
Class	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 2 or 3 lanes (not future 4 lane & not one-way street)	
ADT	Class
0 - 749	IV
750 - 2000	III
>2000	II

	Design Lane Distribution Factors For Structural Design Traffic (Fig. 54-2.B)					
	Rural			Urban		
Number of Lanes	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	<b>\$78.06</b> / SQ YD
PARTIAL DEPTH PVMT PATCH	(Mill & Fill +2.00 ")	Leveling Binder Mix	2.00	<b>\$79.52</b> / SQ YD
PARTIAL DEPTH SHLD PATCH	(Mill & Fill +2.00 ")	Shoulder Mix	2.00	<b>\$78.06</b> / SQ YD
LONGITUDINAL SHOULDER JOINT ROUT & SEAL				<b>\$2.00</b> / LIN FT
CENTERLINE JOINT ROUT & SEAL				<b>\$2.00</b> / LIN FT
RANDOM / THERMAL CRACK ROUT & SEAL	(100% Rehab = 110.00' / Station / Lane)			<b>\$2.00</b> / LIN FT

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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 : **6/29/17 8:21 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

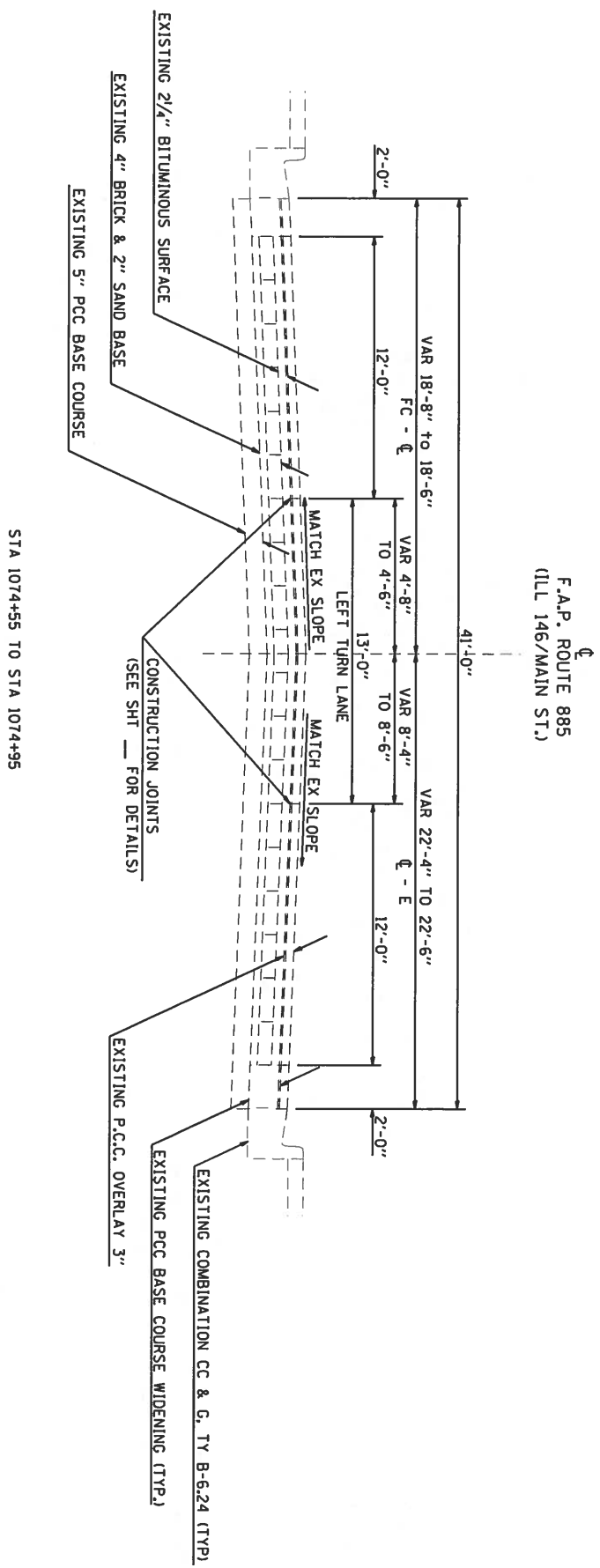
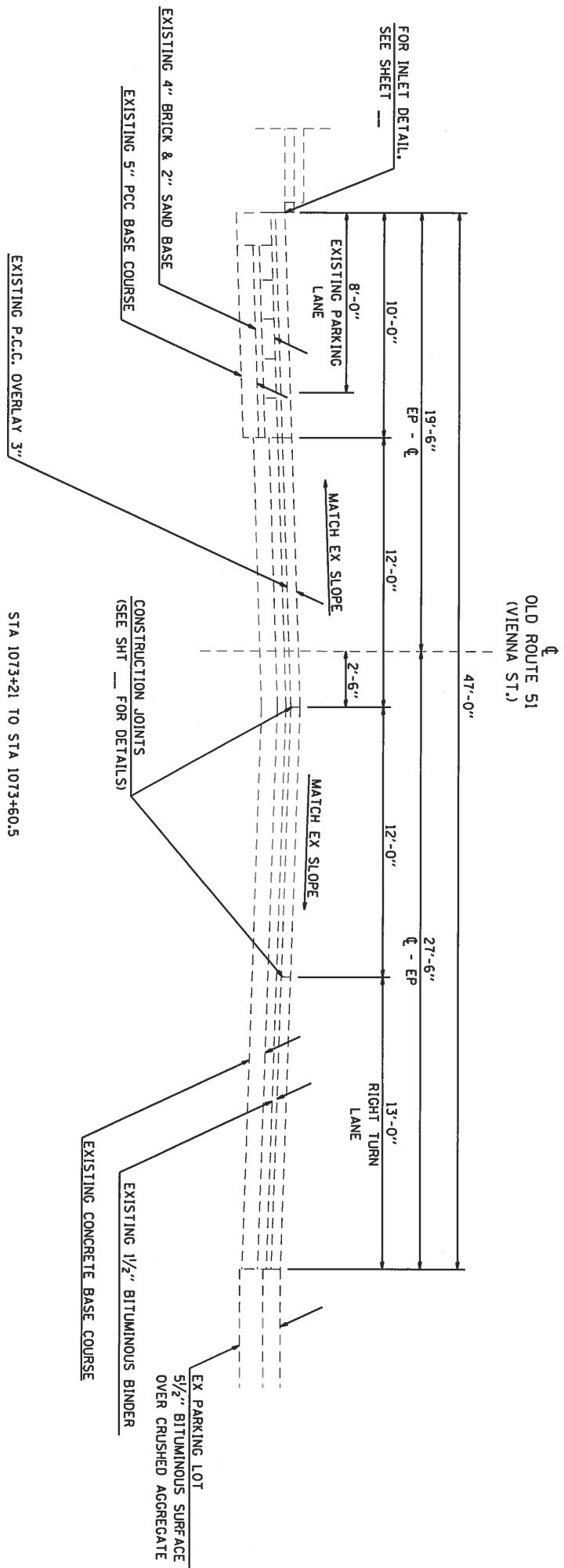
MAINTENANCE COSTS:	ITEM	%	QUANTITY	UNIT	UNIT COST	COST	PRESENT WORTH
<b>YEAR 5</b>							
	LONG SHLD JT R&S	100.00%	4,000	LIN FT	\$2.00	\$8,000	
	CNTR LINE JOINT R&S	100.00%	2,000	LIN FT	\$2.00	\$4,000	
	RNDM / THRM CRACK R&S	50.00%	2,200	LIN FT	\$2.00	\$4,400	
	PD PVMT PATCH M&F SURF	0.10%	5	SQ YD	\$80.64	\$403	
	PWFn =	0.8626		PW =	0.8626 X	\$16,803	\$14,494
<b>YEAR 10</b>							
	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
<b>YEAR 15</b>							
	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
<b>YEAR 20</b>							
	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
<b>YEAR 25</b>							
	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
<b>HMA SD</b>							
<b>YEAR 30 INTERSTATE</b>							
	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
<b>YEAR 35</b>							
	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
<b>YEAR 40</b>							
	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	
<b>YEAR 10</b>								
	PAVEMENT PATCH CLASS B	0.10%	5	SQ YD	\$150.00	\$750		
		PWFn = 0.7441			PW = 0.7441 X	\$750	\$558	
<b>YEAR 15</b>								
	PAVEMENT PATCH CLASS B	0.20%	11	SQ YD	\$150.00	\$1,650		
		PWFn = 0.6419			PW = 0.6419 X	\$1,650	\$1,059	
<b>YEAR 20</b>								
	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	
<b>YEAR 25</b>								
	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	
<b>YEAR 30</b>								
	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	
<b>YEAR 35</b>								
	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	
<b>YEAR 40</b>								
	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	

# EXISTING TYPICAL SECTIONS



FILE NAME = P:\10848\BID\INTEG\11\moss\gov\p\DOT\Documents\DOT Offices\District 9\Projects\735	USER NAME = greenlasm PLOT SCALE = 1/8" = 1'-0" PLOT DATE = 3/19/2017	DESIGNED - CHECKED - DATE -	REVISED - REVISED - REVISED -
<b>STATE OF ILLINOIS</b> <b>DEPARTMENT OF TRANSPORTATION</b>		<b>EXISTING TYPICAL SECTIONS</b>	
SCALE: _____ SHEET _____ OF _____ SHEETS STA. _____ TO STA. _____		COUNTY _____ TOTAL SHEET _____ CONTRACT NO. _____	

