



# Illinois Department of Transportation

## Memorandum

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To: Omer Osman  
From: Scott E. Stitt *Scott Stitt*  
Subject: Pavement Design  
Date: November 18, 2011

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FAP Route 809 (IL Route 158)  
Section 135-N  
St. Clair County  
At IL Routes 15 & 13 [Roundabouts]

Calculations favored a flexible design for this project. The district requested the use of a rigid design based on the following reasons:

- High truck volumes;
- Adjacent concrete pavement sections;
- In order to provide TL-2 protection for the proposed wall between the curb and the shared-use path, the wall must be poured integrally with the pavement [length of wall is approximately 350 feet];
- The use of a rigid pavement design throughout the project limits would provide a simpler construction project.

Because the difference in life cycle costs exceeded 10%, the rigid pavement design request was forwarded to the Director of Highways for approval. Approval was granted on November 18, 2011.

The approved pavement reconstruction for IL Route 158 is as follows:

9 inches of jointed PCC pavement with tied curb and gutter  
4 inches of aggregate base  
12 inches of lime modified soil

If you have any questions, or need further information, please contact Paul Niedernhofer at (217) 524-1651.



# Illinois Department of Transportation

Memorandum

**RECEIVED**

NOV 8 2011

BUREAU OF  
DESIGN & ENVIRONMENT

To: Scott Stitt  
From: Omer M. Osman  
Subject: Pavement Design Approval  
Date: November 3, 2011

Attn: Paul Niedernhofer  
By: Jeffrey Keirn /Patti LeBeau *JK/PL*

FAP Route 809 (IL 158) / FAU 9251 (IL 15) / FAU 9269 (IL 13)  
Section 135-N  
St. Clair County

IL 158 at IL 15 and IL 13 intersection improvements - Roundabouts

The subject project consists of transforming stop controlled intersections into roundabouts. In previous discussions with BDE personnel it was decided that, even though this is considered a special pavement design, district personnel would perform the analysis and make a recommendation to BDE for approval. Roundabout 1 will consist of IL 158, IL 13 and the IL 15 westbound entrance and exit ramps. Roundabout 2 will consist of IL 158, Whiskey Road, and the IL 15 eastbound entrance and exit ramps. The existing adjacent pavement consists of 2 1/2" HMA resurfacing over 10' PCC with a 6" granular subbase.

IL 158 and IL 15 are both Class II truck routes. Truck generators to utilize this intersection include a bottled water plant, storage facilities, a gas station, three landscaping material suppliers, schools, hospitals, garbage haulers, and emergency vehicles.

Items to be tied into the proposed pavement are concrete: existing pavement, proposed curb and gutter, proposed truck aprons, barrier wall on top of the curb to separate traffic from the sidewalk, a new box culvert, and a possible retaining wall.

Due to the close proximity of the roundabouts to each other, the District prefers both proposed roundabouts and proposed adjacent pavement have the same pavement structure so that the pavement will be consistent throughout the project.

The methodology used to determine the pavement design is shown below:

- Mechanistic Design JPCP (Rigid)
- Mechanistic Design Full Depth HMA (Flexible)

Scott Stitt  
November 3, 2011  
Page 2

Based upon district calculations, the proposed pavement design requires a minimum of 9" of PCC pavement (with 4" of Aggregate base) or 11 1/2" of polymerized HMA pavement in order to meet the current BDE pavement design criteria. As previously stated, the existing pavement structure adjacent to the proposed pavement is 10" of PCC with 2 1/2"± of HMA overlay.

Although the cost of PCC pavement is 25-30% higher than the polymerized HMA pavement, it is the District Pavement Design Engineer's recommendation to use the 9" of PCC pavement for the following reasons:

- high truck volumes
- adjacent pavement composition
- in order to provide TL-2 protection for the proposed wall between the curb and the shared-use path, the wall must be poured integrally with the pavement (the wall is approximately 350 feet in length)

Attached is the pavement design and corresponding supporting data including:

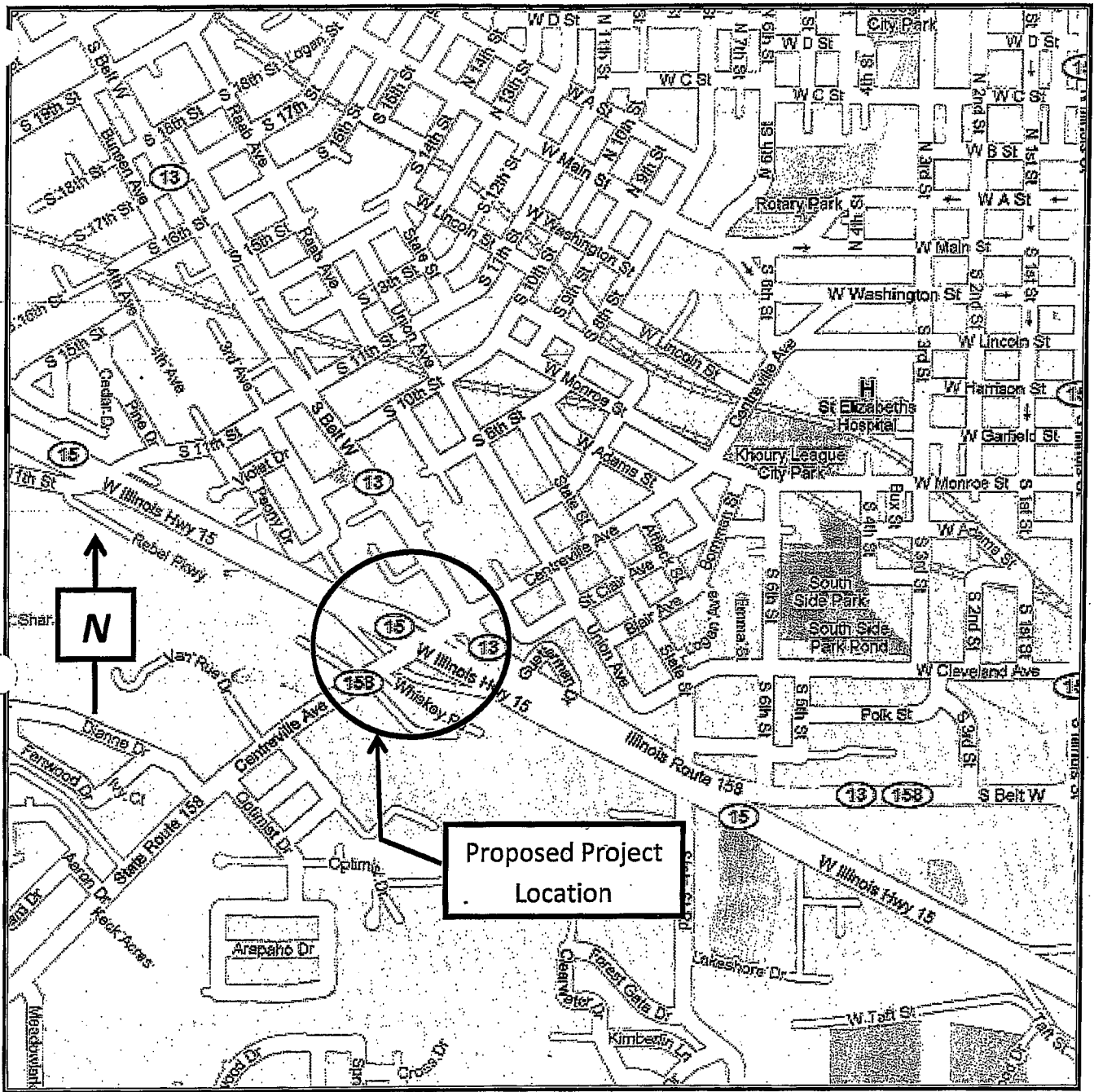
- Location Map
- ADT
- Sub-grade Supporting Rating Chart
- AC Mixture Temperature Chart
- Pavement Design
- Plan Sheet
- Profile Sheets
- Typical Sections
- Estimate of Cost

In order to maintain project schedules, please provide your comments and/or approval by no later than November 18, 2011.

If you have any questions or comments please contact Rob Harbaugh at 618-346-3329.

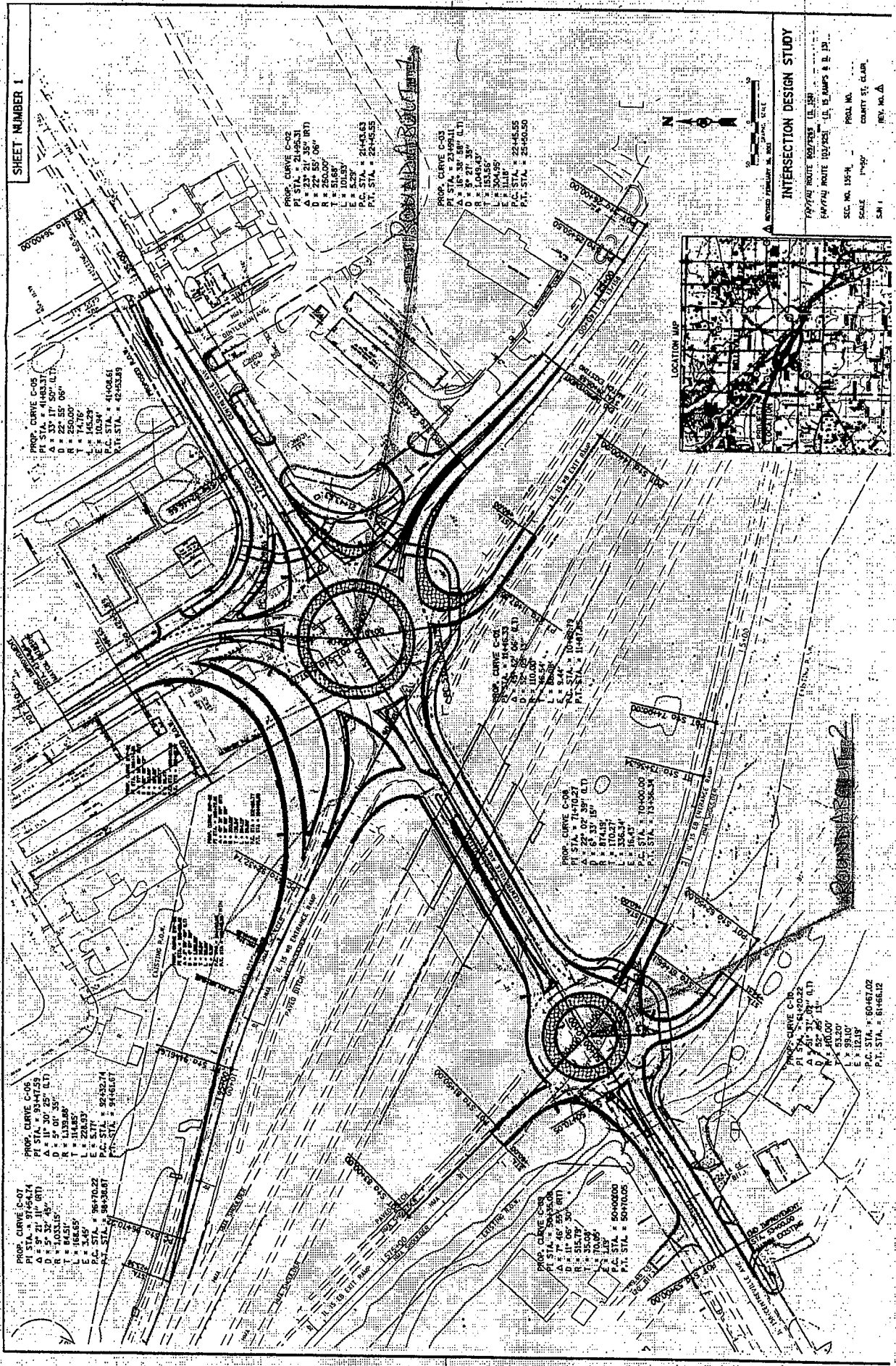
  
Jeffrey L. Keirn  
Program Development Engineer

RDH/S:\Squad\_6\Pavement Design Reviews\IL15-13-158 Roundabouts\Memo to  
Springfield.docx

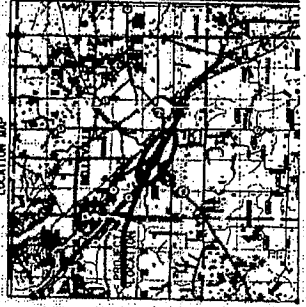


**Project Location Map**

SHEET NUMBER 1



**INTERSECTION DESIGN STUDY**  
 1974/75 ROUTE 103/252 - LE 389  
 HAYWARD ROUTE 103/252 - LE 389 RAMP # 1 & 2  
 SEC. NO. 157-1      PROJ. NO.      COUNTY ST. CLERK  
 SCALE 1"=80'      REV. NO. Δ



PROP. CURVE C-05  
 P.I. STA. = 213.17  
 P.C. STA. = 17.50  
 P.T. STA. = 224.55  
 R = 250.00'  
 L = 103.29'  
 E = 14.76'  
 P.C. STA. = 4104.61  
 P.T. STA. = 4245.38

PROP. CURVE C-02  
 P.I. STA. = 21395.11  
 P.C. STA. = 217.35  
 P.T. STA. = 224.55  
 R = 250.00'  
 L = 103.29'  
 E = 14.76'  
 P.C. STA. = 2144.63  
 P.T. STA. = 2244.55

PROP. CURVE C-03  
 P.I. STA. = 21395.11  
 P.C. STA. = 217.35  
 P.T. STA. = 224.55  
 R = 250.00'  
 L = 103.29'  
 E = 14.76'  
 P.C. STA. = 2244.55  
 P.T. STA. = 25400.50

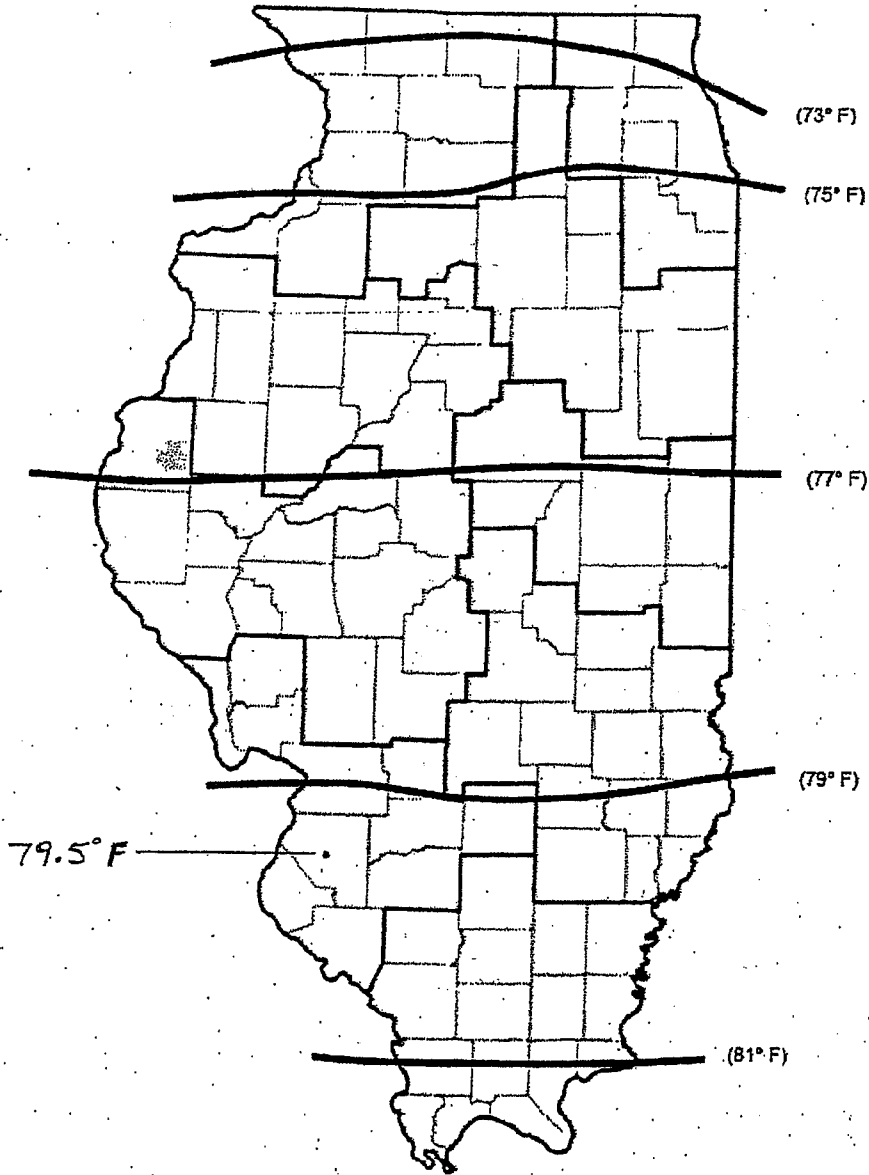
PROP. CURVE C-04  
 P.I. STA. = 11470.21  
 P.C. STA. = 107.39  
 P.T. STA. = 11477.50  
 R = 874.05'  
 L = 135.34'  
 E = 16.47'  
 P.C. STA. = 10400.00  
 P.T. STA. = 13358.34

PROP. CURVE C-06  
 P.I. STA. = 9347.53  
 P.C. STA. = 11.30  
 P.T. STA. = 9358.83  
 R = 5' 00" 35"  
 L = 114.85'  
 E = 228.93'  
 P.C. STA. = 9232.74  
 P.T. STA. = 9461.67

PROP. CURVE C-07  
 P.I. STA. = 9347.53  
 P.C. STA. = 11.30  
 P.T. STA. = 9358.83  
 R = 5' 32" 45"  
 L = 103.315'  
 E = 84.33'  
 P.C. STA. = 9670.22  
 P.T. STA. = 9838.67

PROP. CURVE C-08  
 P.I. STA. = 5045.08  
 P.C. STA. = 17.46  
 P.T. STA. = 5062.54  
 R = 11' 06" 30"  
 L = 35.17'  
 E = 70.69'  
 P.C. STA. = 5040.00  
 P.T. STA. = 5040.00

PROP. CURVE C-10  
 P.I. STA. = 1420.22  
 P.C. STA. = 25.25  
 P.T. STA. = 1445.47  
 R = 40.00'  
 L = 53.20'  
 E = 99.10'  
 P.C. STA. = 8046.02  
 P.T. STA. = 8166.12



*Note: The minimum design HMA mixture temperature will be 73°F.*

**HMA MIXTURE TEMPERATURE  
(Mechanistic Design: Flexible Pavement)**

Figure 54-5.C

## MECHANISTIC PAVEMENT DESIGN

FAP 809 FAU 9251/9269  
SECTION 135-N  
ST. CLAIR COUNTY  
JOB NO. D-98-051-09

INTERSECTION IMPROVEMENTS - ROUNDABOUTS ON IL 158 AT IL 15 AND IL 13

Design Period: 20 Years

	ADT'S: YEAR 2023			
	PV	SU	MU	TOTAL
Actual Roadway	96.1 %	2.5 %	1.4 %	17200
Minimum Traffic Volumes	0	250	750	
 % Traffic in Design Lane Class I (Two-Way)	 50 %	 50 %	 50 %	

### TRAFFIC FACTORS

	<u>Rigid</u>	<u>Flexible</u>	
Class I Actual	2.32	1.76	
Class I Minimum	5.58	3.95	Use minimum

**Pavement Design Thicknesses**                      **9.00 in.**                      **11.50 in.**

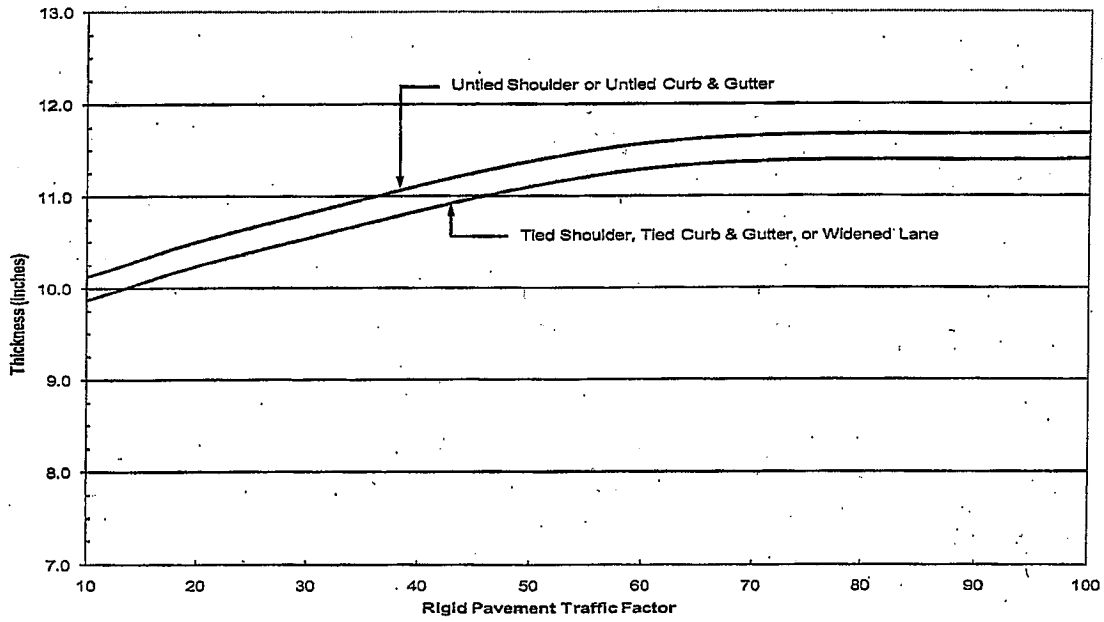
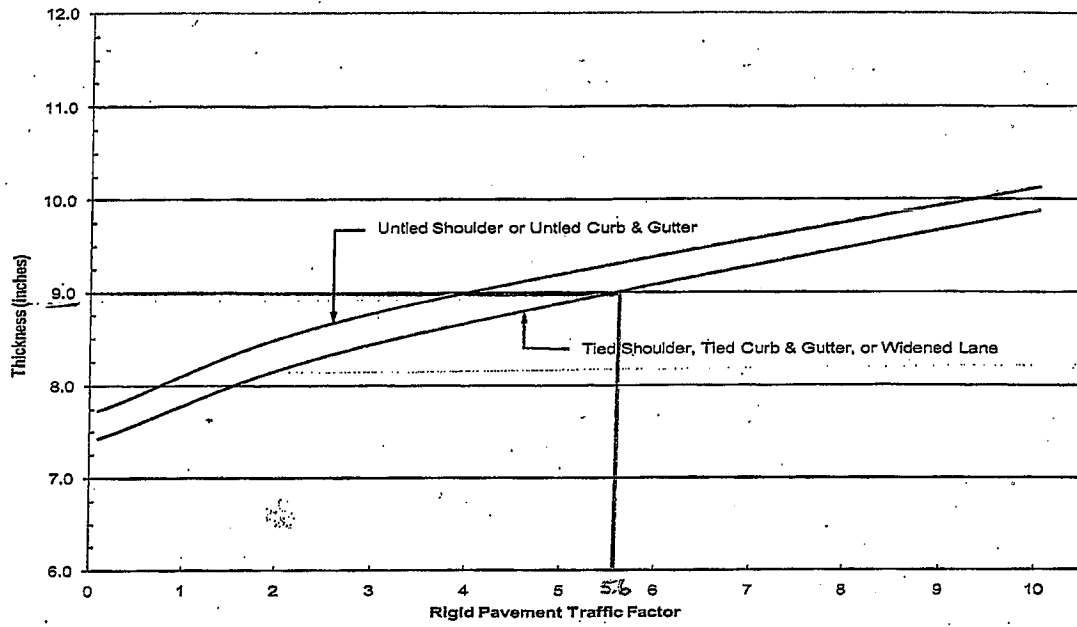
**Traffic Factor Equations Used:**

Class I Rigid	TF=DP[(0.15*P*PV)+(143.81*S*SU)+(696.42*M*MU)]/10^6	Equation 54-4.1
Class I Flexible	TF=DP[(0.15*P*PV)+(132.50*S*SU)+(482.53*M*MU)]/10^6	Equation 54-5.1

<b>R I G I D</b>		Actual
TF <sub>R(A)</sub> =	20 x ( 0.15 x P x PV )+( 143.81 x S x SU )+( 696.42 x M x MU )/( 1 X 10 <sup>6</sup> )	
TF <sub>R(A)</sub> =	20 x ( 0.15 x 0.5 x 16529 )+( 143.81 x 0.5 x 430 )+( 696.42 x 0.5 x 241 )/( 1000000 )	
TF <sub>R(A)</sub> =	20 x ( 1239.675 )+( 30919.15 )+( 83918.61 )/( 1000000 )	
TF <sub>R(A)</sub> =	20 x ( 116077.435 )/( 1000000 )	
TF <sub>R(A)</sub> =	2321548.7	
TF <sub>R(A)</sub> =	2.32	
Equation 5A-4.1		
TF <sub>R(A)</sub> =	20 x ( 0.15 x P x PV )+( 143.81 x S x SU )+( 696.42 x M x MU )/( 1 X 10 <sup>6</sup> )	
TF <sub>R(A)</sub> =	20 x ( x x )+( 143.81 x 0.5 x 250 )+( 696.42 x 0.5 x 750 )/( 1000000 )	
TF <sub>R(A)</sub> =	20 x ( 0 x 0 )+( 17976.25 )+( 261157.5 )/( 1000000 )	
TF <sub>R(A)</sub> =	20 x ( 279133.75 )/( 1000000 )	
TF <sub>R(A)</sub> =	5582675	
TF <sub>R(A)</sub> =	558	

<b>F L E X I B L E</b>		Actual
TF <sub>R(A)</sub> =	20 x ( 0.15 x P x PV )+( 132.5 x S x SU )+( 482.53 x M x MU )/( 1 X 10 <sup>6</sup> )	
TF <sub>R(A)</sub> =	20 x ( 0.15 x 0.5 x 16529 )+( 132.5 x 0.5 x 430 )+( 482.53 x 0.5 x 241 )/( 1000000 )	
TF <sub>R(A)</sub> =	20 x ( 1239.675 )+( 28487.5 )+( 58144.865 )/( 1000000 )	
TF <sub>R(A)</sub> =	20 x ( 87872.04 )/( 1000000 )	
TF <sub>R(A)</sub> =	1757440.8	
TF <sub>R(A)</sub> =	1.76	
Equation 5A-5.1		
TF <sub>R(A)</sub> =	20 x ( 0.15 x P x PV )+( 132.5 x S x SU )+( 482.53 x M x MU )/( 1 X 10 <sup>6</sup> )	
TF <sub>R(A)</sub> =	20 x ( x x )+( 132.5 x 0.5 x 250 )+( 482.53 x 0.5 x 750 )/( 1000000 )	
TF <sub>R(A)</sub> =	20 x ( 0 x 0 )+( 16562.5 )+( 180948.75 )/( 1000000 )	
TF <sub>R(A)</sub> =	20 x ( 197511.25 )/( 1000000 )	
TF <sub>R(A)</sub> =	3950225	
TF <sub>R(A)</sub> =	3.95	

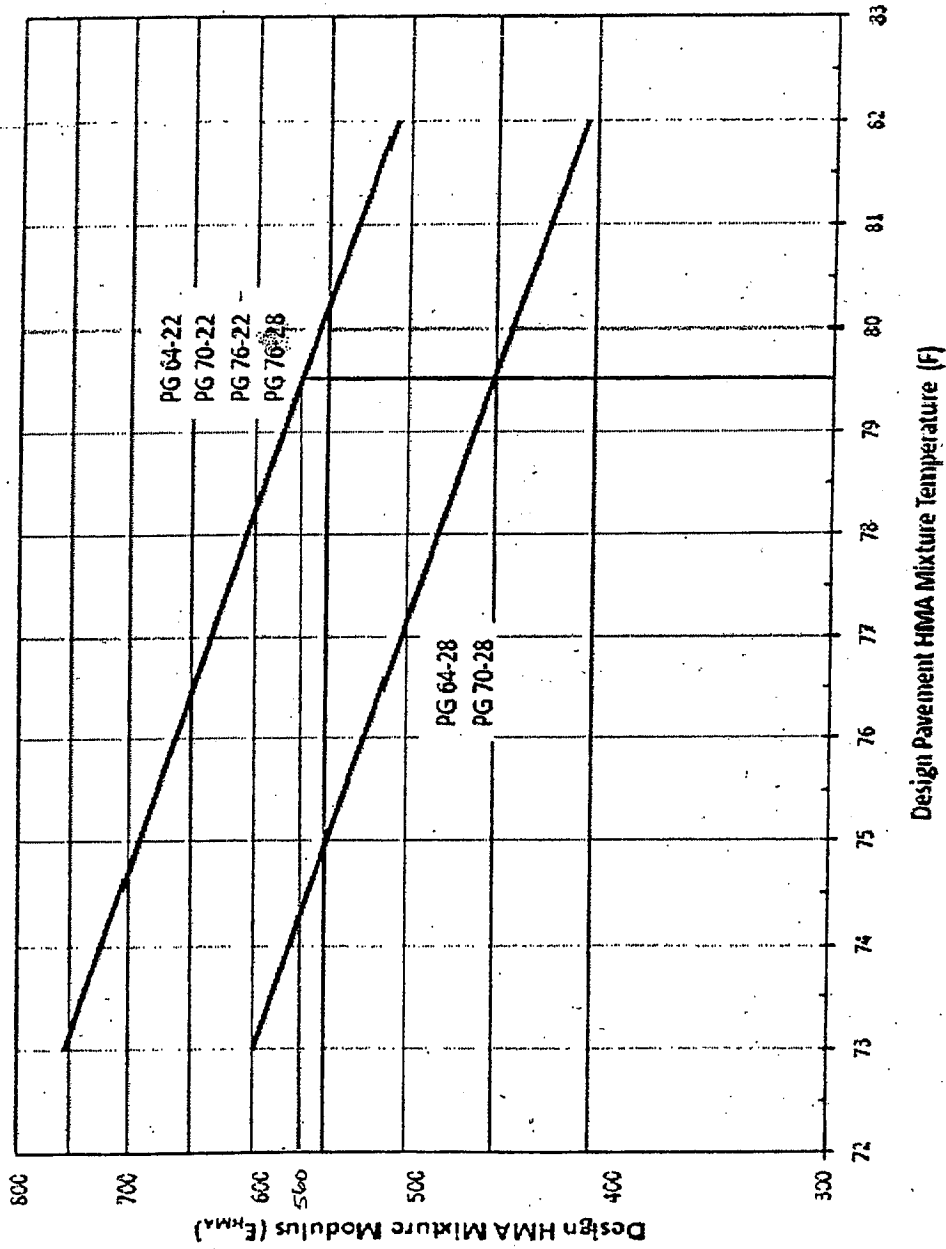




Note: Use of untied shoulder design requires BDE approval.

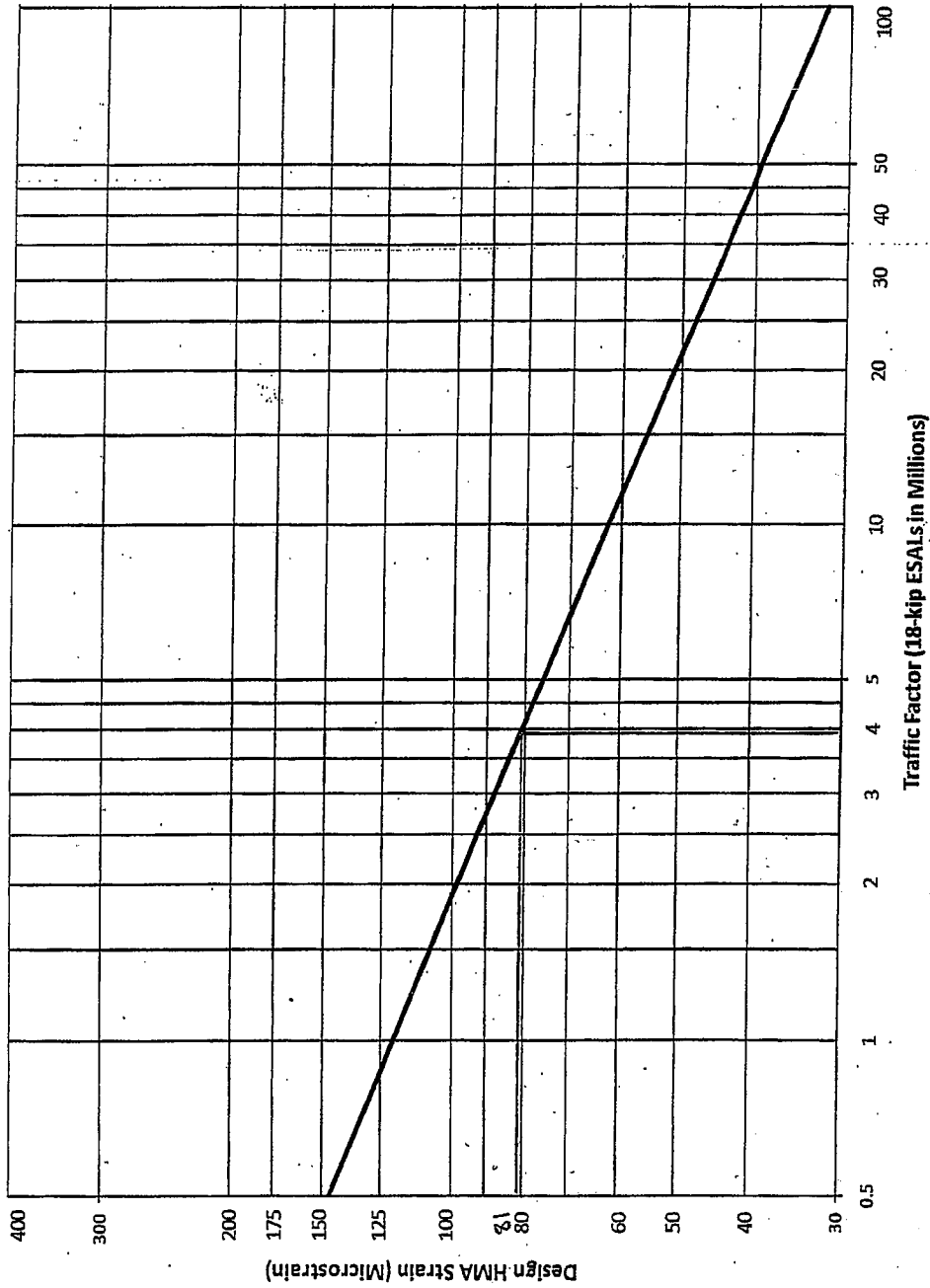
**RIGID PAVEMENT DESIGN CHART**  
 (Mechanistic Design: SSR = Poor)

Figure 54-4.E



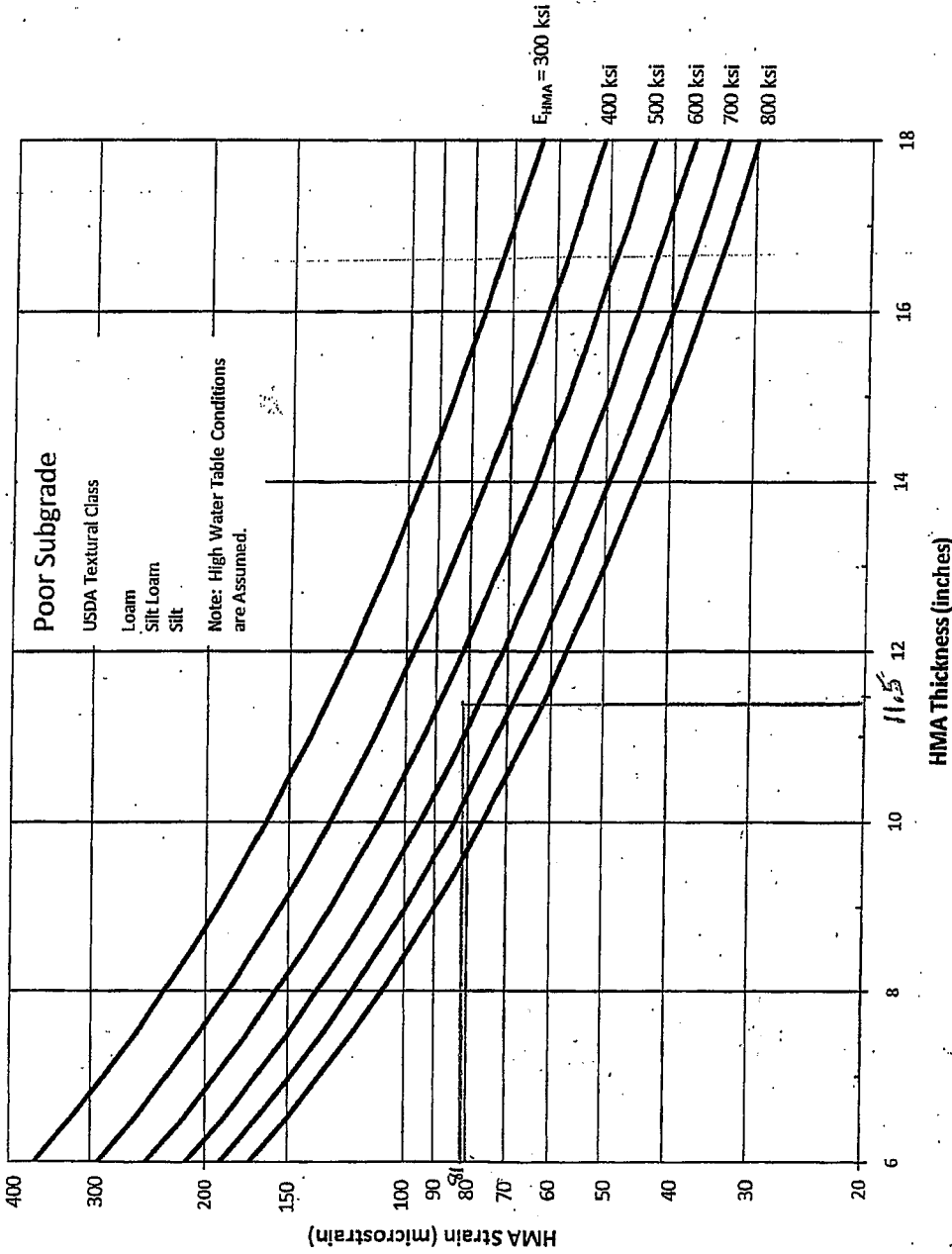
HMA MIXTURE MODULUS ( $E_{HMA}$ )  
(Mechanistic Design: Flexible Pavement)

Figure 54-5.D



**DESIGN HMA STRAIN**  
**(Mechanistic Design: Flexible Pavement)**

**Figure 54-5.E**



**HMA THICKNESS DESIGN CHART**  
(Mechanistic Design: Flexible Pavement: SSR = Poor)

Figure 54-5.F

FAP 809 / FAU 9251 / 9269  
 SECTION 135-N  
 ST. CLAIRE COUNTY  
 JOB NO. D-98-051-09

INTERSECTION IMPROVEMENTS - ROUNDABOUTS ON IL 158 AT IL 15 AND IL 13

PAY ITEM	QUANTITY	UNIT	UNIT COST	PAY ITEM COST
POLYMERIZED HOT-MIX ASPHALT PAVEMENT (FULL-DEPTH), 11 1/2" • polymerized HMA Binder Course (9 1/2") • polymerized HMA Surface Course (2")	4268 2270.576 478.016	SQ YD ton ton	\$87.00 \$102.00	\$197,540.11 \$48,757.63
<b>COST OF FLEXIBLE PAVEMENT</b>				
				<b>\$246,297.74</b>
PORTLAND CEMENT CONCRETE PAVEMENT 9" (JOINTED) STABILIZED SUBBASE 4"	4268 4268	SQ YD SQ YD	\$55.00 \$20.00	\$234,740.00 \$85,360.00
<b>COST OF RIGID PAVEMENT</b>				
				<b>\$320,100.00</b>

\$320,100.00 - \$246,297.74 = \$73,802.26

rigid is 29.96% greater than flexible

flexible is 23.06% less than rigid