NORTH DAKOTA
DEPARTMENT OF TRANSPORTATION

MATERIALS AND RESEARCH DIVISION

Experimental Study ND 00-01

Six - Cell Seal
Delastic® Sealer

Final Evaluation Report

Project IM-8-029(026)053
Project IM-5-094(018)059

April 2007

Prepared by

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
BISMARCK, NORTH DAKOTA
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U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

EXPERIMENTAL PROJECT REPORT

EXPERIMENTAL PROJECT

EXPERIMENTAL PROJECT NO.

	STATE	YEAR		NUMBER	SURF
1	ND	98	-	05	

CONSTRUCTION PROJ NO: 8 NH-7-085(028)126

LOCATION: McKenzie County 28

EVALUATION FUNDING

1	X	HP&R	3	DEMONSTRATION
2		CONSTRUCTION	4	IMPLEMENTATION

48

NEEP NO. 49

PROPRIETARY FEATURE? 51 X Yes No

SHORT TITLE

TITLE 52: Sawing and Sealing Joints in Bituminous Pavement

THIS FORM

DATE	MO.		YR.	REPORTING
140	01	--	07	1 INITIAL 2 ANNUAL 3 X FINAL

KEY WORDS

KEY WORD 1 145: ASPHALT	KEY WORD 2 167: PAVEMENT
KEY WORD 3 189: JOINTS	KEY WORD 4 211: OVERLAY
UNIQUE WORD 233: SAWING & SEALING	PROPRIETARY FEATURE NAME 255

CHRONOLOGY

Date Work Plan Approved	Date Feature Constructed:	Evaluation Scheduled Until:	Evaluation Extended Until:	Date Evaluation Terminated:
02-98	10-98	01-07		02-07
277	281	285	289	293

QUANTITY AND COST

QUANTITY OF UNITS (ROUNDED TO WHOLE NUMBERS): 14,510 linear feet — 297

UNITS — 305

1	X LIN. FT	5	TON
2	SY	6	LBS
3	SY-IN	7	EACH
4	CY	8	LUMP SUM

UNIT COST (*Dollars, Cents*): $1.25 per linear foot total=$18,137.50 — 306

AVAILABLE EVALUATION REPORTS

X -CONSTRUCTION — 315

X -PERFORMANCE

X FINAL

EVALUATION

CONSTRUCTION PROBLEMS — 318

1		NONE
2	X	SLIGHT
3		MODERATE
4		SIGNIFICANT
5		SEVERE

PERFORMANCE — 319

1		EXCELLENT
2	X	GOOD
3		SATISFACTORY
4		MARGINAL
5		UNSATISFACTORY

APPLICATION

320

1	ADOPTED AS PRIMARY STD.	4 X	PENDING
2	PERMITTED ALTERNATIVE	5	REJECTED
3	ADOPTED CONDITIONALLY	6	NOT CONSTRUCTED

(Explain in remarks if 3, 4, 5, or 6 is checked)

REMARKS

321

The pavement is in good shape. Sawing in the joints will control the transverse crack pattern. The joint success will be determined by the type of reservoir and length between the joints. It has been used in two different projects. It is not a current practice of the NDDOT.

Experimental Study ND 00-01

Evaluation Of Six-Cell Delastic ® Sealant

FINAL REPORT

IM-8-029(026)053
and
IM-5-094(018)059

April 2007

Written By
Jeff M. Richter
Kyle Evert

Disclaimer

The contents of this report reflect the views of the author or authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not reflect the official views of the North Dakota Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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Appendix B: IM-5-094(018)059 Data ..... B
Appendix C: Product Data C

EVALUATION OF SIX-CELL DELASTIC® SEALANT

Purpose and Need

This study is to evaluate the ability of **DELASTIC® SIX - CELL SEALANT** to remain in the joint properly. When water enters a joint, it may cause damage to the base below the concrete pavement due to freeze/thaw cycles. Additionally, incompressibles may become lodged between the joints and remove the space reserved for thermal expansion. This is the rationale to using a joint sealant for concrete pavement.

Objective

The objective is to determine the effectiveness of the **DELASTIC®SIX - CELL SEALANT** to prevent debris and moisture from infiltrating the joints on concrete pavements using.

Scope

The **DELASTIC®SIX - CELL SEALANT** was used to seal the transverse joints of project IM-8-029(026)053 and project IM-5-094(018)059. Fifteen of these joints in each project was evaluated annually to determine the effectiveness and durability of **DELASTIC®SIX - CELL SEALANT**.

Location

These experimental sections are located on Interstate 29 south of Fargo and on Interstate 94 near Dickinson. The six-cell sealant joints selected on Interstate 29 are from Reference Point 60 then proceeding 15 joints north in the northbound roadway. The six-cell sealant joints selected on Interstate 94 are from Reference Point 60 then proceeding 15 joints in east eastbound roadway. Project plan sheets and typical sections are found in Appendix A for the I-29 project and in Appendix B for the I-94 project.

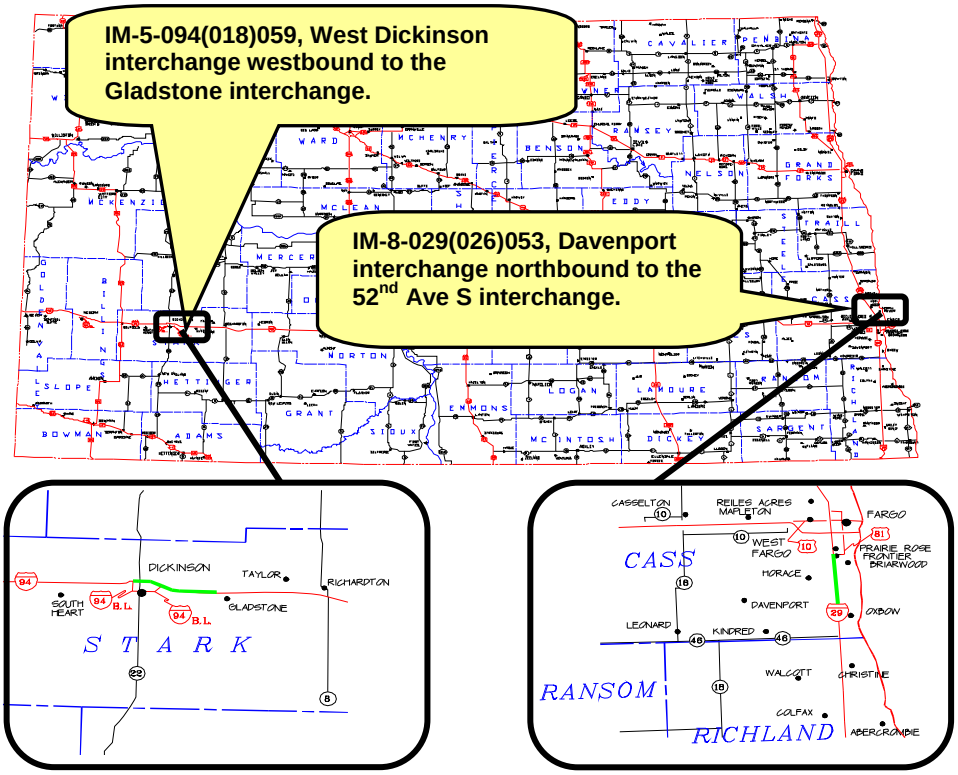


Figure 1

Project Historical Information

RIMS Data

Year	Components	Left Shoulder Width (ft)	Roadway Width (ft)	Right Shoulder Width (ft)	Depth (in)	OIL/CON Type	Class Aggregate
1999	Grade	-	59.5	-	-	-	-
1999	Salvaged Bituminous Base	-	43.0	-	8.0	-	-
1999	Permeable Cement Stabilization Base	-	28.0	-	4.0	AE	5.0
1999	Non-Reinforced PCC	4.0	24.0	10.0	10.0	AE	S4
1999	Landscaping	-	-	-	-	-	-

Table 1 – IM-8-029(026)053

RIMS Data

Year	Components	Left Shoulder Width	Roadway Width	Right Shoulder Width	Depth	OIL/CON Type	Class Aggregate
2000	Milling	-	24.0	-	-3.0	-	-
2000	Salvaged Aggregate Base	-	35.5	-	4.0	-	-
2000	Permeable Cement Stabilization Base	-	29.0	-	4.0	AE	S4
2000	Non-Reinforced PCC	-	28.0	-	9.0	AE	S3
2000	Recycled PCC	-	-	10.0	-	AE	S4
2000	Joint Space 16 Ft.	-	-	-	-	-	-
2000	Doweled	-	-	-	-	-	-
2000	Edge Drain	16.0	-	12.0	-	-	-
2002	Landscaping	-	-	-	-	-	-

Table 2 - IM-5-094(018)059

Traffic

Year	Pass>Car	Trucks	Total	Rigid ESALs – One Way
1998	7,239	1,267	8,506	1,688
1999	7,472	1,271	8,743	1,721
2000	8,008	1,401	9,409	1,856
2001	7,529	1,399	8,928	1,856
2002	8,242	1,419	9,661	1,890
2003	9,170	1,449	10,619	1,924
2004	9,578	1,451	11,029	1,924
2005	9,749	1,454	11,203	1,924
2006	9,731	1,454	11,185	1,924

Table 3 – IM-8-029(026)053

Year	Pass>Car	Trucks	Total	Rigid ESALs - One Way
1999	3,816	949	4,765	1,268
2000	3,875	965	4,840	1,300
2001	4,099	1,125	5,224	1,296
2002	4,141	1,135	5,276	1,296
2003	4,112	1,125	5,237	1,296
2004	4,217	1,135	5,352	1,296
2005	4,075	1,125	5,200	1,269
2006	4,097	1,282	5,379	1,199

Table 4 – IM-5-094(018)059

Design

The designs for the use of this product on these projects are shown in Figure 2 through Figure 5. The product data sheet can be found in Appendix C. The only difference in the design between the two projects; I-29 versus I-94 is that the minimum and maximum widths of the saw cuts are different; I-29 has 5/16” Min. and 9/16” Max. while I-94 has 3/8” Min. and 7/16” Max.

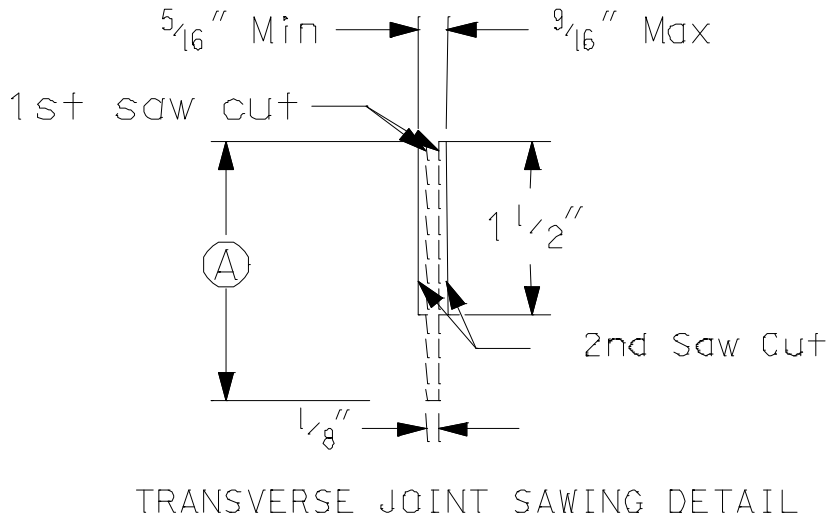


Figure 2 – Project IM-8-029(026)053

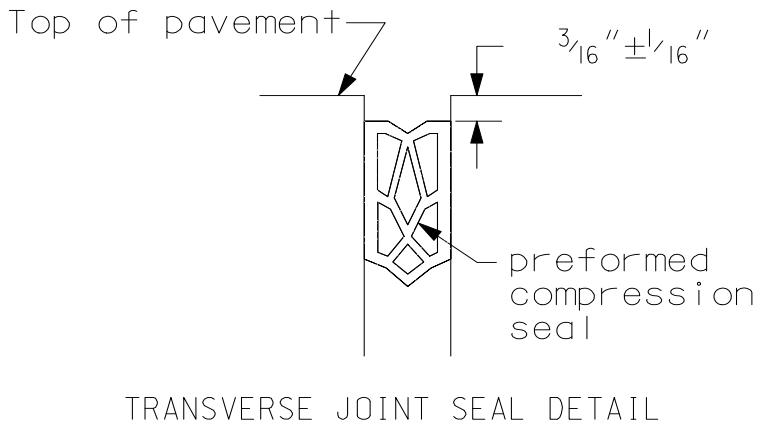


Figure 3 – Project IM-8-029(026)053

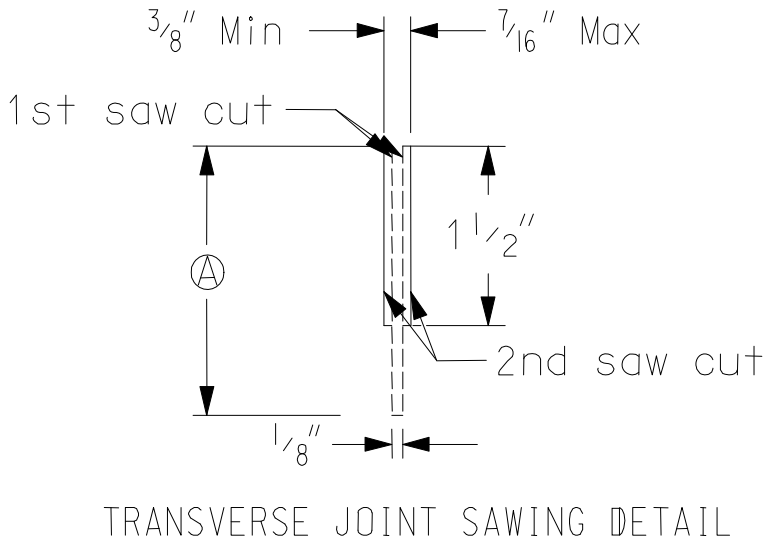


Figure 4 – Project IM-5-094(018)059

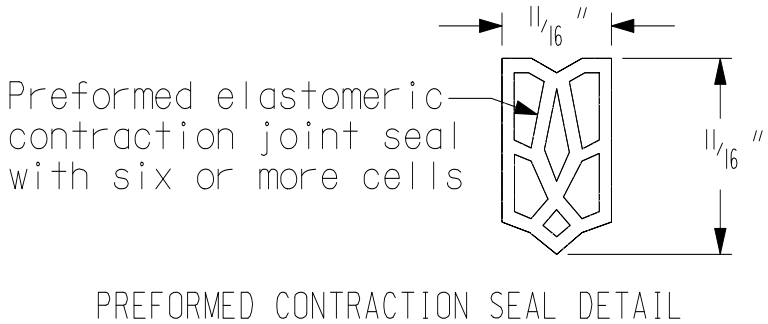


Figure 5 – Project IM-5-094(018)059

Construction

The construction of this research project went well. The research project was a part of projects IM-5-094(018)059 from the Dickinson District and IM-8-029(026)053 from the Fargo District. Project IM-8-029(026)053 was constructed in 1999 by “Superior Sawing” and the project engineer was Gary Heisler. Project IM-5-094(018)059 was constructed in 2000 and Ted Heinert was the project engineer. The project notes for the two projects can be found in Appendices A and B.

Evaluation

This project has been evaluated yearly for 5 years. The evaluation consists of a visual inspection of the joints to determine if the sealant has remained in place. This sealant is expected to deter the infiltration of debris into the joint.

Water and incompressibles may cause damages, such as cracking and spalling, to the roadway when infiltrated into the joint. Having a seal in good condition and operational will help prevent these damages to the roadway. The seals and joint were evaluated for the following conditions:

- Seal twisting or departing from the joint
- Seals being depressed into the joint
- Incompressibles confined in the joint
- Spalling of the joint
- 15 joints are used for the test section on each project

IM-8-029(026)053

There were no joints with six-cell sealant forced out of the joints in the fall November 2006 evaluation. There are 10 joints with the sealant depressed into the joint. This is 3 more depressed sealants compared to the previous evaluation. All of the depressed sealants except two have a large portion of the sealant depressed into the joint. The number of spalled joints has remained the same as the previous year. There were no incompressibles confined in the joints.

IM-8-029(026)053	Year				
Condition	2002	2003	2004	2005	2006
Depressed Sealant	0	3	5	8	10
Twisting or Departing Sealant	0	0	0	0	0
Confined Incompressibles in Joint	0	0	0	0	0
Spalled Joints	1	3	3	3	3

Table 5

IM-5-094(018)059

There were no sealants that were twisted or departed from the joint in the January of 2007 evaluation. The number of depressed sealants has decreased by three since the previous year. Most of the joints with depressed sealants have small areas where the sealant is depressed across the joint. This could be the reason why there are fewer joints with depressed sealants. Joints that have small portions of joint sealant being depressed may have been mistaken for a joint sealant that was good. The number of incompressibles has increases from zero to two. The passing lane appeared to be dirty when this section of roadway was evaluated. The incompressibles lay loosely in the joint. Table 6 shows the number of joints experiencing the conditions being evaluated for this research project.

IM-5-094(018)059	Year				
Condition	2002	2003	2004	2005	2006
Depressed Sealant	2	8	8	8	5
Twisting or Departing Sealant	0	0	1	0	0
Confined Incompressibles in Joint	6	1	0	0	2
Spalled Joints	1	1	1	1	1

Table 6

The level of depressed six-cell sealants is different at each joint for both interstates. Several of the joints had the six-cell sealant depressed the entire width of the road. Other joints have only small sections that are 1’ to 2’ in length. Photo 1 displays a portion of a depressed sealant.

Photo 1 – This is a depressed sealant in a joint on I-94.

Summary

It appears that the six-cell joint sealant becoming depressed is still the only noticeable problem. Although the depressed sealant is the only reoccurring condition being evaluated that is happening to the joints, the joint sealant appears that it will keep water and incompressibles from entering the joints. The depressed joint sealant remains high enough in the joints to allow traffic to remove the incompressibles.

Interstate 29 has increased by 2, now giving it 10 of 15 joints with depressed sealants and Interstate 94 has decreased to 5 joints from 8 joints out of 15 with depressed sealant. The severity of the depressed sealant changes throughout projects. Some of the sealant has small sections approximately 1’ to 2’ in length with the sealant depressed. Other joints have large sections with depressed sealants. These joints have areas that are depressed across the majority of the joint.

The rest of the distresses that have been evaluated, (such as spalling of joints, six-cell seals twisting or departing, and incompressibles confined in the joint), have not changed much since the last evaluation. In the Dickinson section there are some incompressibles in the passing lane. The sealants are performing about the same as

the previous evaluation. Table 7 displays the percentage of joints for each distress of the two projects.

IM-8-029(026)053		IM-5-094(018)059	
% of joints	**Distress**	**% of joints**	**Distress**
66.0%	Depressed Sealant	33.0%	Depressed Sealant
0.0%	Twisting or Departing Sealant	0.0%	Twisting or Departing Sealant
0.0%	Confined Incompressibles in joint	13.3%	Confined Incompressibles in joint
20.0%	Spalled joints	6.7%	Spalled joints

Table 7

Recommendation

The sealant was evaluated for the following conditions: the sealants twisting or departing, sealants depressing in joint, incompressibles in joint, and spalling of the joint. The sealant depressing into the joints is the only evaluated condition that appeared to be failing. The sealant looks as if it will still keep moisture and incompressibles out of the joint.

Based on the evaluations, this type of joint sealant appears to be effective in preventing moisture and incompressibles from entering the joint, but will become depressed into the joint. A different size reservoir may help in preventing the sealant from becoming depressed. This product appears to be a good joint sealant and it resists pull out. If the six-cell is used on future projects, it is recommended that modifications be made to the joint reservoir detail to resist sealant depression within the joint.

APPENDIX A

DESIGN DATA				
Traffic	Average Daily			Est.Max.Hr.
Current 1998	Pass: 5420	Trucks 730	Total 6150	750
Forecast 2018	Pass: 11920	Trucks 1460	Total 13380	1650
Minimum Sight Dist. for:		Design Speed 75 MPH		
Stopping 675'		Bridges		
Full Control of Access				
No Point of Access Other Than at Interchange Ramps				

JOB# 11

FHWA REGION	STATE	PROJECT NO.	SHEET NO.
8	ND	IM-8-029(026)053	1

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

FEDERAL AID PROJECT IM-8-029(026)053

PCC PAVEMENT (N Bound Rdwy)
GRADING, SURFACING & RESHAPING
OF MEDIAN CROSSOVERS, FENCING
AND REMOVAL OF RAMP CONNECTIONS

In
Cass County

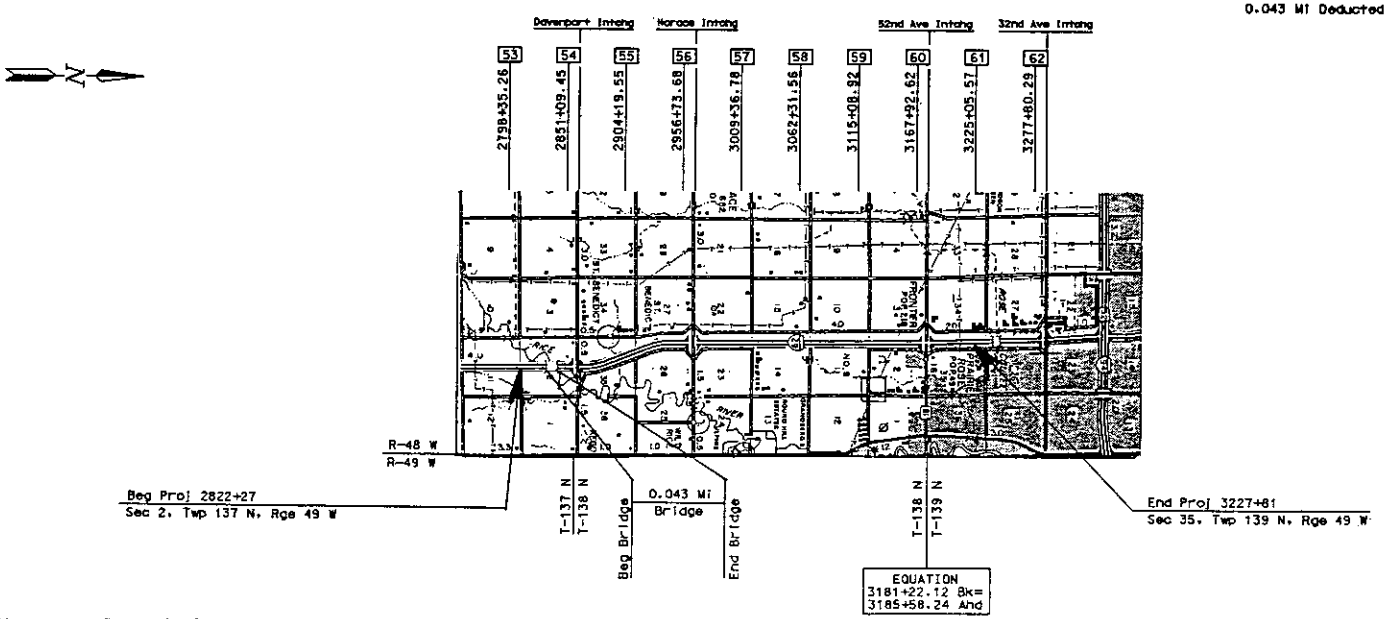
GOVERNING SPECIFICATIONS:

Standard Specifications adopted by the North Dakota Department of Transportation October 1997; Standard Drawings currently in effect; and other Contract Provisions submitted herein.

LENGTH OF PROJECT

Miles Gross	Miles Net
7.598	7.555

0.043 Mi Deducted for Structures



DESIGNER Michael A Sleckler
DESIGNER Hudson Herbert
DESIGNER Gary R. Huster
RECOMMEND APPROVAL Dec. 22, 19 98
DESIGN ENGINEER Grant Sei

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED

DIVISION ADMINISTRATOR DATE

APPROVED DATE 12-22-98

EAST REGION ENGINEER
NORTH DAKOTA
DEPARTMENT OF TRANSPORTATION

DENNIS JACOBSON REGISTERED PROFESSIONAL P.E. 1967 ENGINEER NORTH DAKOTA

Title

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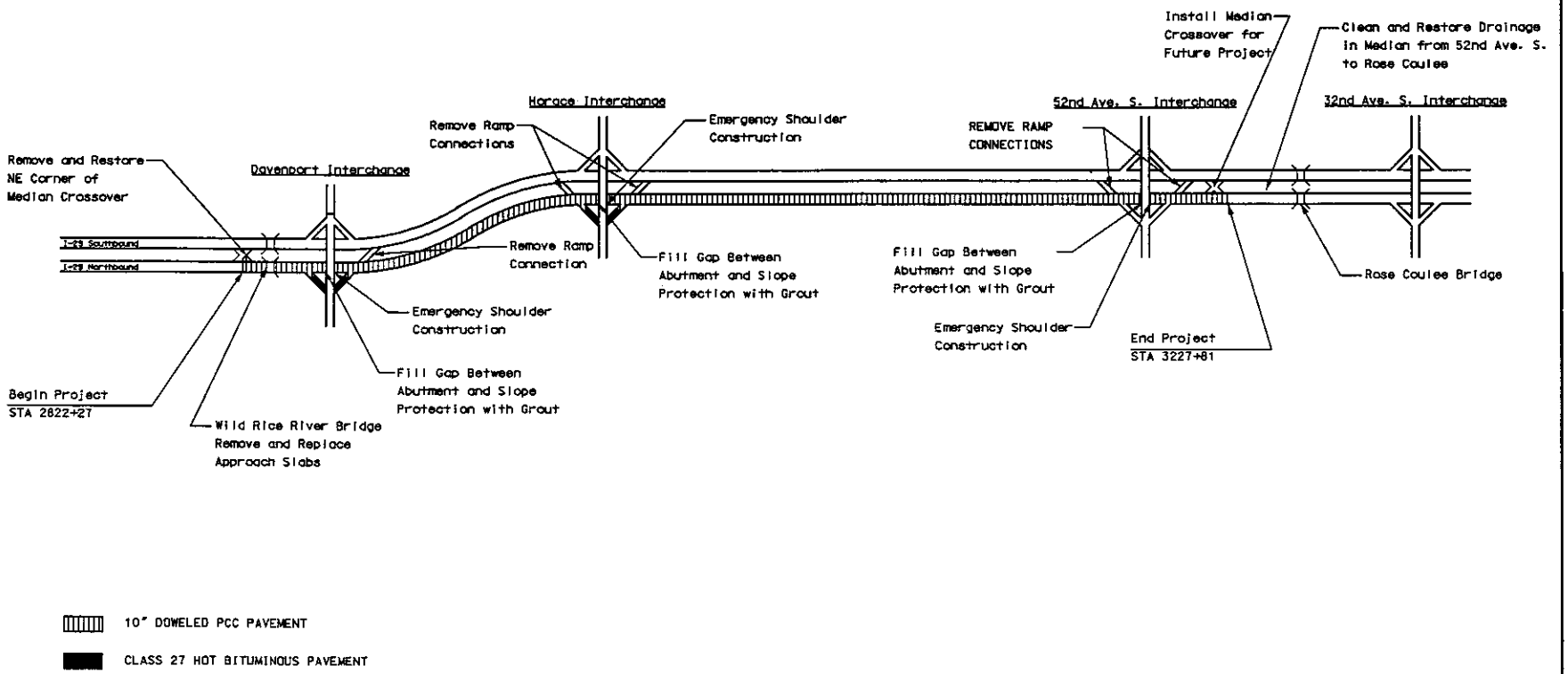
FHWA REGION	STATE	PROJECT NO.	SHEET NO.
8	ND	IM-8-029(026)053	5



MAJOR SCOPE OF WORK
(Not to Scale)

...\12953nb\sbplans\scope.dgn Dec. 14, 1998 12:49:58

NOTES

will be replaced with hot bituminous pavement. The remaining depth will be replaced with salvaged base course as requested or approved by the engineer.

Payment for salvaged base course will be at the unit price bid. Hot bituminous pavement patching shall include full compensation for all other labor, equipment, and materials (including asphalt cement) to complete this work.

408-P02 HOT BITUMINOUS PAVEMENT CLASS 27: The three inch or greater thickness hot bituminous pavement Class 27 shall be paver laid in two approximately equal lifts. The less than three inch hot bituminous pavement Class 27 shall be paver laid in one lift.

550-P01 TIE BARS: Tie bars shall be held in place by the metal support device securely staked to the roadbed. The device shall hold the tie bars at the correct spacing, alignment, and elevation with a 1/8-inch/foot vertical and horizontal tolerance.

550-P02 SURFACE FINISH: The carpet drag machine shall be run off a stringline.

550-P03 DOWEL BAR ASSEMBLY: Dowel bar assemblies will be included in the cost for "10 In Non-Reinforced Concrete Pavement Class AE" and "10 In Non-Reinforced Concrete Pavement Class AE - High Early".

550-P04 DOWEL BAR ASSEMBLY: After the dowel bar assembly is staked to the roadbed and the dowel bars are held firmly in place, the assembly ties running parallel to the dowel bars shall be removed to allow for free movement of the dowel bars.

550-P05 GAPS IN MAINLINE PAVING: The interchange ramp connections will result in gaps in the contractor's mainline paving operation. These gaps shall be constructed after concrete paving is completed either side of the gaps. Concrete placed in the gap areas shall be a high early mix. All costs for the high early concrete in gap areas shall be paid for as "10 Inch Non-Reinforced Concrete Pavement Cl AE - High Early." Traffic may be allowed on the gap concrete after 4 days or after the concrete has attained a flexural strength of at least 500 psi or a compressive strength of 3000 psi. All joint sealing shall be completed before traffic is allowed on the new gap concrete. A construction joint shall be placed at each end of the gap paving area and the cost for these shall be included in the unit price bid for "10-Inch Non-Reinforced Concrete Pavement Cl AE."

550-P06 INTERCHANGE RAMP CONNECTIONS: During the period that the gap in the mainline pavement (as a result of the interchange ramp connections) is being paved, the public traffic using the ramps shall be routed around the gap paving area with temporary ramp connections. The temporary ramp connections shall be constructed in accordance with Section 710. The ramp pavement removal, reshaping, subgrade preparation, aggregate placement, and paving operation shall also be performed during the period that the mainline gap is being paved. Ramp traffic shall be maintained during this period. All costs for flagging, signing, aggregate, and water necessary for constructing and maintaining the ramp connection shall be paid for at the unit price bid for each item.

550-P07 TRANSVERSE JOINTS SAWING AND SEALING: The contractor shall be allowed to skip saw the ten-foot PCC shoulder when it is paved separately. No other skip sawing shall be allowed.

550-P08 REINFORCING OVER PIPES: Additional reinforcing steel shall be provided and placed at the locations shown on the "Pavement Reinforcement Detail." All costs to provide, place, and support the reinforcing steel as shown shall be included in the price bid for "10-Inch Non-Reinforced PCC Pavement Cl AE."

550-P09 REMOVAL OF CONTINUOUS REINFORCED CONCRETE PAVEMENT: This pay item shall consist of the mainline continuous concrete pavement, and 20' of the 40' approach slabs at the Wild Rice River bridge. Existing bituminous blowup repairs, sealing material, and pothole patching removal is included in the cost of "Removal of Continuous Reinforced Concrete Pavement."

550-P10 ADDITIONAL PAVEMENT IMPRINTING: After texturing, the milepoint numbers shall be imprinted into the concrete

ESTIMATE OF QUANTITIES

FHWA REGION	STATE	FED. AID PROJ. NO.	SHEET NO.
8	N.D.	IM-8-029(026)053	18

SPEC	CODE	ITEM DESCRIPTION	UNIT	MAINLINE	TOTAL
103	0100	CONTRACT BOND	L SUM	1	1
202	0104	REMOVAL OF STRUCTURE	EA	2	2
202	0138	REMOVE & SALVAGE BASE COURSE	TON	24,093	24,093
203	0103	COMMON EXCAVATION-TYPE C	CY	8,572	8,572
203	0138	COMMON EXCAVATION-SUBCUT	CY	9,810	9,810
203	0208	GUARDRAIL EMBANKMENT-TYPE C	EA	2	2
216	0100	WATER	M GAL	3,904	3,904
230	0104	RESHAPING CONNECTION	EA	1	1
230	0106	RESHAPING ROADWAY	MILE	8.227	8.227
230	0190	SUBGRADE PREPARATION-TYPE C-12IN	MILE	7.555	7.555
302	0100	SALVAGED BASE COURSE	TON	69,301	69,301
302	0107	AGGREGATE FOR SUBGRADE REINFORCEMENT	TON	18,394	18,394
302	0120	AGGREGATE BASE COURSE CL 5	TON	40,149	40,149
304	5000	PERMEABLE STABILIZED BASE COURSE-SALVAGED	SY	128,534	128,534
401	0100	MC70 OR 250 LIQUID ASPHALT	GAL	32,134	32,134
401	0152	SS1H OR CSS1H EMULSIFIED ASPHALT	GAL	4,570	4,570
401	0160	BLOTTER MATERIAL CL 44	TON	121	121
405	0110	REMOVE & SALVAGE BITUMINOUS SURFACING	TON	9,307	9,307
408	0176	HOT BITUMINOUS PAVEMENT CL 27	TON	2,663	2,663
408	0198	HOT BITUMINOUS PAVEMENT PATCHING	TON	500	500
409	0445	PG 58-28 ASPHALT CEMENT	TON	160	160
410	0105	MILLING BITUMINOUS PAVEMENT	SY	222	222
550	0112	8IN NON-REINF CONCRETE PAVEMENT CL AE	SY	5,009	5,009
550	0118	10IN NON-REINF CONCRETE PAVEMENT CL AE	SY	173,550	173,550
550	0178	10IN NON-REINF CONCRETE PAVEMENT CL AE-HIGH EARLY	SY	8,000	8,000
550	0217	BRIDGE APPROACH SLAB-REMOVE & REPLACE	SY	182	182
550	0809	PREFORMED ELASTOMERIC COMPRESS JT SEAL 9/16IN	LF	104,503	104,503
550	0958	LONGITUDINAL JOINT SILICONE SEAL	LF	3,711	3,711
560	1580	PREPARE STOCKPILE SITE	L SUM	1	1
560	1590	REMOVAL OF CONCRETE PAVEMENT	SY	7,430	7,430
560	1591	REMOVAL OF CONTINUOUS REINF CONCRETE PVMT	SY	168,344	168,344
602	1210	BRIDGE END POST MODIFICATION	EA	2	2
702	0100	MOBILIZATION	L SUM	1	1
704	0100	FLAGGING	MHR	3,000	3,000

ESTIMATE NUMBER: 3365 RUN DATE: 01/21/1999 TIME: 13:57:32

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APPENDIX B

DESIGN DATA				
Traffic	Average Daily			Max.Hr.
Current 1998	Pass: 1360-2020	Trucks 460-530	Total 1820-2550	230-320
Forecast 2019	Pass: 1820-2900	Trucks 780-900	Total 2600-3800	325-480
Minimum Sight Dist. for:		Design Speed		
Stopping 625 FT		Bridges		
Full Control of Access				
No Point of Access Other Than at Interchange Ramps				

FHWA REGION	STATE	PROJECT NO.	SHEET NO.
8	ND	IM-5-094(018)059	1

JOB# 12

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

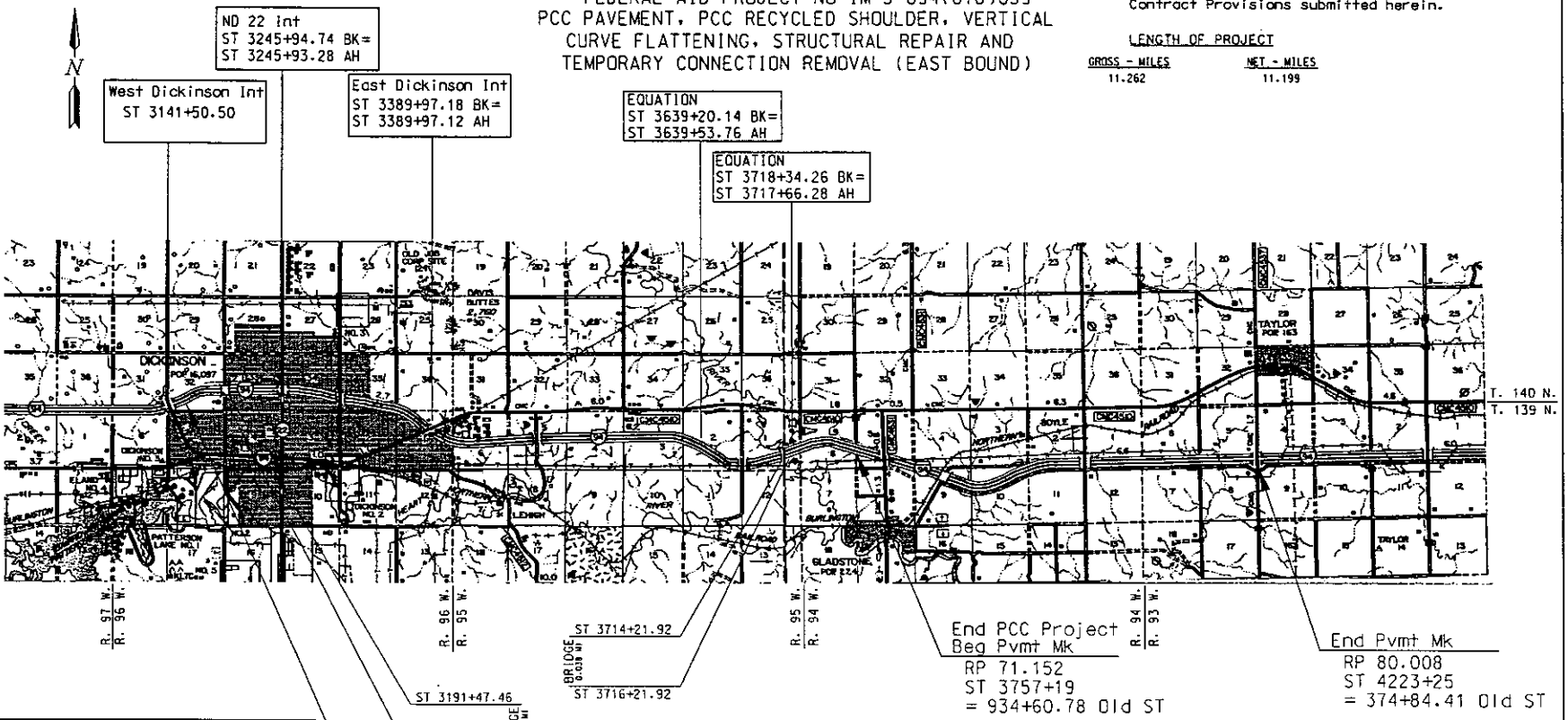
IN STARK COUNTY
FEDERAL AID PROJECT NO IM-5-094(018)059
PCC PAVEMENT, PCC RECYCLED SHOULDER, VERTICAL CURVE FLATTENING, STRUCTURAL REPAIR AND TEMPORARY CONNECTION REMOVAL (EAST BOUND)

GOVERNING SPECIFICATIONS:

Standard Specifications adopted by the North Dakota Department of Transportation October 1997; Standard Drawings currently in effect; and other Contract Provisions submitted herein.

LENGTH OF PROJECT

GROSS - MILES	NET - MILES
11.262	11.199



DESIGNER Susan K Forman
DESIGNER Dave Ellefson
DESIGNER
RECOMMEND APPROVAL 9-14 .1999
DESIGN ENGINEER

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED

DIVISION ADMINISTRATOR DATE

APPROVED DATE 9-14-99

DIRECTOR OF HIGHWAYS AND ENGINEERING
NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

DAVID K. O. LEER REGISTERED PROFESSIONAL P.E. 1199 ENGINEER NORTH DAKOTA

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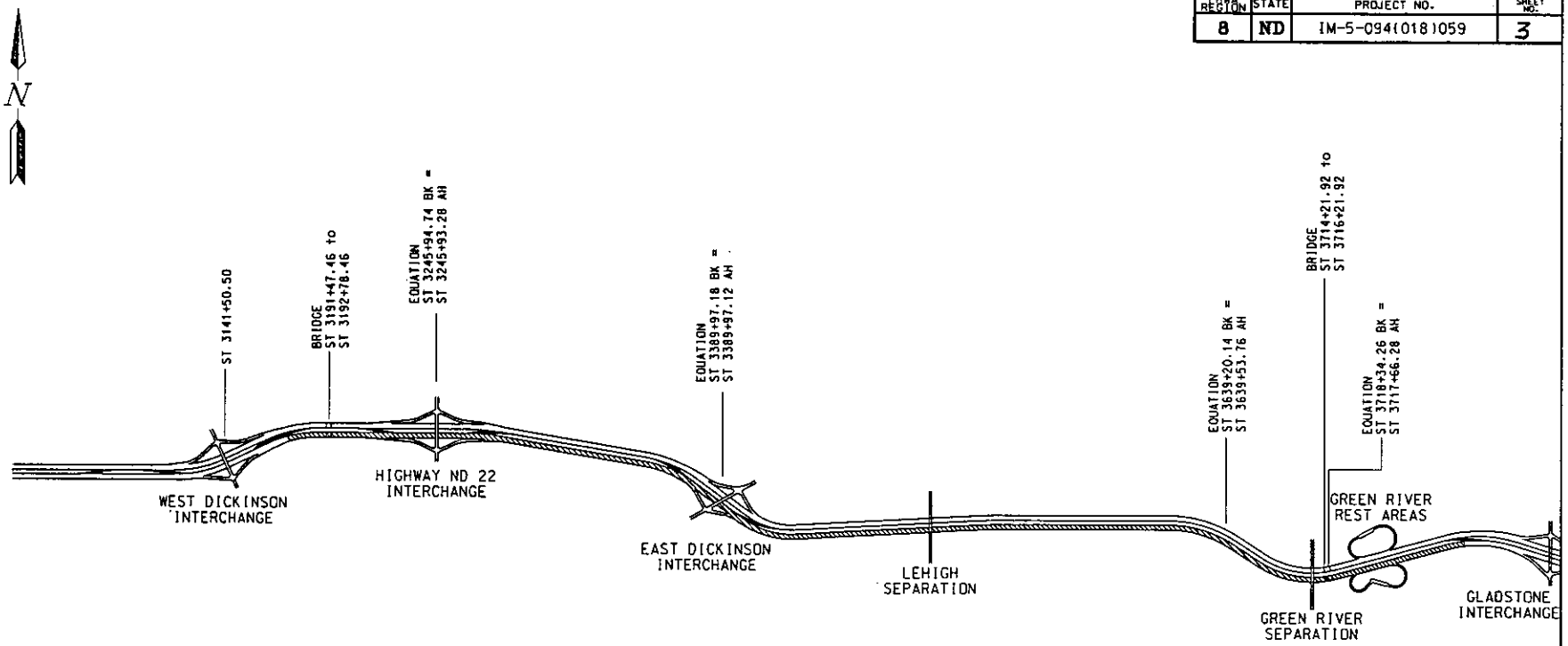
FHWA REGION	STATE	PROJECT NO.	SHEET NO.
8	ND	IM-5-094(018)059	3



LEGEND

Remove and Reconstruct Main Line Pavement

Remove Once Traffic Returns to Normal Operation.

SCOPE OF WORK

W DICKINSON INTERCHANGE TO
NEAR GLADSTONE (EB)

PCC AND RPCC PAVEMENT

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NOTES

may be obtained within the right of way at areas determined by the engineer.

203-P04 Topsoil removal at the east Dickinson crossroad widening will not be bid separately but will be included in the price bid for "Borrow."

203-P05 DITCH BLOCKS: Ditch block slope flattening will not be bid separately but will be included in the price bid for "Roadway Reshaping."

203-P06 BORROW: All borrow is to be contractor furnished borrow.

230-P01 The ramp taper reshaping shall not be measured and paid for separately but will be included in the price bid for mainline reshaping roadway. The mainline and ramp reshaping shall be performed prior to the subgrade preparation.

302-P01 TRIMMING SALVAGED BASE COURSE: Use surface tolerance Type B for the salvaged base course. Excess material removed from high points of the salvaged base course by the trimming operation shall be reincorporated into the salvaged base course.

The cost for providing the required grade and cross section shall be included in the unit price bid for "Salvaged Base Course."

302-P02 SALVAGED BASE COURSE: The salvaged base course shall consist of a uniform blend of salvaged PCC fines, salvaged bituminous, and salvaged aggregate material that is belt or bin blended. There will be a maximum of 20 percent salvaged PCC fines in the blend.

302-P03 TRIMMING AND PRIME: Keep the trimming of the salvaged base course within one mile of the completed laydown of this course. Keep the application of the prime coat within one mile of the trimmed, accepted salvaged base course.

304-P01 PERMEABLE STABILIZED BASE: Portland Cement shall be used as the stabilizing agent.

The aggregate for the bid item "Permeable Stabilized Base Course - Salvaged" shall be produced from the salvaged concrete pavement.

401-P01 BLOTTER: Class 44 blotter shall not be measured and paid for separately but will be included in the unit price bid for "MC 70 or 250 Liquid Asphalt."

409-P01 HOT BITUMINOUS PAVEMENT: All overlay areas shall be applied in two lifts.

410-P01 MILLING BITUMINOUS PAVEMENT ON MAINLINE: This work shall consist of milling approximately 3-4 inches of bituminous pavement, an asphalt-vulcanized rubber membrane, and ¼ inch minimum of concrete surface. This material shall all be milled in one operation on the mainline. If the milling is done before the shoulders are removed, the bituminous shoulders shall be milled approximately the same depth or removed to prevent ponding of water. All cost for milling, loading, hauling, and stockpiling of the material shall be included in the unit price bid for "Milling Bituminous Pavement," by the ton.

410-P02 MILLING BITUMINOUS PAVEMENT ON RAMPS AND CROSSROADS: The ramp and crossroad hot bituminous pavement overlay shall begin after the mainline and ramp PCC paving has been completed. The ramp and crossroad milling shall begin no more than two weeks prior to the hot bituminous pavement overlay.

The milled material shall become the property of the state of North Dakota and shall be delivered to the Dickinson district yard.

All cost for milling, loading, hauling, and stockpiling of the material shall be included in the unit price bid for "Milling Bituminous Pavement," by the square yard at plan quantity.

550-P01 WATER-REDUCING ADMIXTURE: Type A water-reducing concrete admixture shall be used in the 28' mainline concrete mix on this project. Dosage shall be at the manufacturer's recommendation.

550-P02 SURFACE FINISH: The carpet drag machine shall be run off a stringline.

550-P03 CONTRACTION JOINTS: Transverse joints shall be sealed using a preformed elastomeric compression joint seal.

550-P04 ADDITIONAL PAVEMENT IMPRINTING: After texturing, the milepoint numbers shall be imprinted into the 10' shoulder concrete surface by the contractor about one foot from the 12' driving lane, so the numbers can be read in the direction of the traffic. A zero shall be imprinted into the concrete at all headwall locations.

NOTES

550-P05 GAPS IN MAINLINE PAVING: The interchange ramp connections will result in gaps in the contractor's mainline paving operation. These gaps shall be constructed after concrete paving is completed either side of the gaps. Concrete placed in the gap areas shall be a 7.2 bag mix without flyash. All costs for the concrete in gap areas shall be paid for at the same unit price as other mainline concrete. Traffic may be allowed on the gap concrete after four days or after the concrete has attained a flexural strength of at least 500 psi or a compressive strength of 3,000 psi. All joint sealing shall be completed before traffic is allowed on the new gap concrete. A construction joint shall be placed at each end of the gap paving area and the cost for these shall be included in the unit price bid for "9-Inch Non Reinforced Concrete Pavement CL AE."

550-P06 Flyash and cement will not be bid separately but will be included in the price bid for "9 In Non-Reinforced Concrete Pavement CL AE."

550-P07 TIE BARS: Supplemental Specification 550.04 H shall be modified on this project to allow the tie bars to be inserted in the plastic concrete by approved mechanical devices after the concrete has been spread, struck-off, and consolidated to full depth.

550-P08 CORED SAMPLE: The contractor shall be responsible for taking cored samples. The samples shall be taken according to specification 550.04Q.3. The samples shall be paid as "Cored Sample EA."

550-P09 The longitudinal construction joints must be supported by a metal keyway support.

550-P10 TESTS: If two consecutive tests fail in the concrete permeable base aggregate, edge drain aggregate, or the mainline concrete aggregate, operations shall be halted till the contractor has proven to the engineer that future samples will be acceptable.

560-P01 TRANSVERSE JOINTS SAWING AND SEALING: The contractor shall be allowed to skip saw the ten-foot PCC shoulder when it is paved separately. No other skip sawing shall be allowed.

560-P02 EXISTING REINFORCING STEEL: The reinforcing removed from the existing PCC Pavement shall become the property of the contractor and shall be removed from the highway right of way upon removal from the concrete.

560-P03 REMOVAL OF CONCRETE PAVEMENT: Equipment that might damage the subgrade will not be allowed to load the existing concrete as it is removed from the roadway.

560-P04 INTERCHANGE RAMP CONNECTION DETOURS: During the period that the gap in the mainline pavement (as a result of the interchange ramp connections is being paved and the edgedrains installed, the public traffic using the ramps shall be routed around the gap paving area with the ramp connection detours. The ramp pavement removal, reshaping, subgrade preparation, and paving operation shall also be performed during the period that the mainline gap is being paved and ramp traffic shall be maintained during this period. All costs for materials necessary for constructing and maintaining the interchange ramp connection detours shall be measured and paid for at the unit price bid for each ramp connection detour as "Temporary Bypass."

560-P05 CONCRETE PAVEMENT REMOVAL: At the completion of the project, any excess concrete material (from concrete removal) shall become the property of the contractor.

560-P06 Flyash and cement will not be bid separately but will be included in the price bid for "9 In Non-Reinforced Recycled Concrete Pavement CL AE."

602-P01 JERSEY BARRIER FORMED OR SLIPFORMED: This item shall consist of constructing reinforced concrete jersey barriers at median bridge piers as shown in the plans.

Where barriers are cast on both sides of bridge piers, the space between the two barrier walls shall be filled with aggregate and capped with a 4" reinforced concrete slab as shown in the plans. Each barrier wall shall not be measured separately. The pay length shall be from the beginning to the end of the complete barrier wall installation.

The price bid for the item "Jersey Barrier Formed or Slipformed" shall include furnishing and installing Class AAE-3 concrete, Grade 60 reinforcing steel, mastic, joint sealant materials, aggregate, and all other materials, equipment, and labor required to complete the installation as shown in the plans.

ESTIMATE OF QUANTITIES

FHWA REGION	STATE	FED. AID PROJ. NO.	SHEET NO.
8	N.D.	IM-S-094(018)059	15

SPEC	CODE	ITEM DESCRIPTION	UNIT	PROJECT	TOTAL
103	0100	CONTRACT BOND	L SUM	1	1
202	0115	REMOVAL OF CONCRETE-SITE 1	L SUM	1	1
202	0117	REMOVAL OF CONCRETE-SITE 3	L SUM	1	1
202	0118	REMOVAL OF CONCRETE-SITE 4	L SUM	1	1
202	0119	SAW CONCRETE	LF	832	832
202	0121	REMOVE & SALVAGE BITUMINOUS SURFACING	TON	89,438	89,438
202	0130	REMOVAL OF CURB & GUTTER	LF	320	320
203	0137	COMMON EXCAVATION-SUBGRADE REPAIR	CY	29,166	29,166
203	0140	BORROW	CY	2,051	2,051
203	0196	EMBANKMENT-TYPE B	EA	6	6
203	0208	GUARDRAIL EMBANKMENT-TYPE C	EA	11	11
210	0101	CLASS I EXCAVATION	L SUM	1	1
210	0203	FOUNDATION PREPARATION-SITE 2	L SUM	1	1
210	0204	FOUNDATION PREPARATION-SITE 3	L SUM	1	1
216	0100	WATER	M GAL	5,924	5,924
230	0106	RESHAPING ROADWAY	MILE	11.199	11.199
230	0182	SUBGRADE PREPARATION-TYPE B-12IN	MILE	4.769	4.769
230	0186	SUBGRADE PREPARATION-TYPE B-18IN	MILE	2	2
230	0188	SUBGRADE PREPARATION-TYPE B-24IN	MILE	2	2
302	0100	SALVAGED BASE COURSE	TON	132,954	132,954
302	0113	AGGREGATE BASE COURSE CL 3	TON	4,410	4,410
304	5000	PERMEABLE STABILIZED BASE COURSE-SALVAGED	SY	190,276	190,276
401	0100	MC70 OR 250 LIQUID ASPHALT	GAL	53,752	53,752
401	0150	SS1H OR CSS1H OR MS1 EMULSFIED ASPHALT	GAL	5,651	5,651
408	0185	HOT BITUMINOUS PAVEMENT CL 29	TON	12,271	12,271
408	0445	PG 58-28 ASPHALT CEMENT	TON	979	979
410	0100	MILLING BITUMINOUS PAVEMENT	TON	22,721	22,721
410	0105	MILLING BITUMINOUS PAVEMENT	SY	52,723	52,723
550	0117	9IN NON-REINF CONCRETE PAVEMENT CL AE	SY	189,345	189,345
550	0215	CONCRETE BRIDGE APPROACH SLAB	SY	338.6	338.6
550	0217	BRIDGE APPROACH SLAB-REMOVE & REPLACE	SY	359.5	359.5
550	0240	DOWELED CONTRACTION JOINT ASSEMBLY	LF	89,799	89,799
550	0810	PREFORMED ELASTOMERIC COMPRESS JT SEAL 11/16IN	LF	142,181	142,181
550	0958	LONGITUDINAL JOINT SILICONE SEAL	LF	8,198	8,198

ESTIMATE NUMBER: 3967 RUN DATE: 09/17/1999 TIME: 10:44:15

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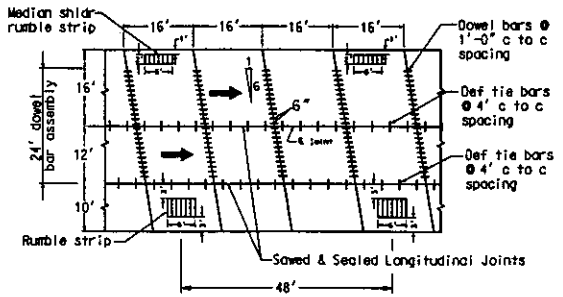
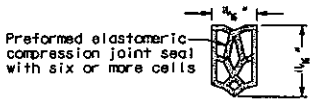
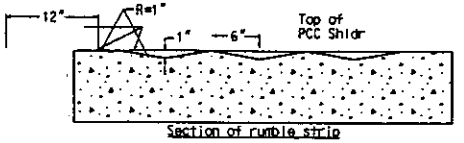
FHWA REGION	STATE	PROJECT NO.	SHEET NO.
8	ND	IM-5-094(018)059	43

Revised November 1, 1999

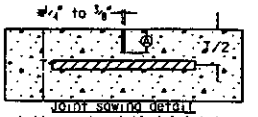




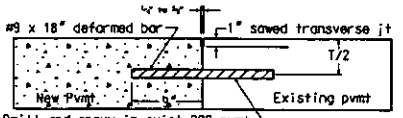
PREFORMED COMPRESSION SEAL DETAIL



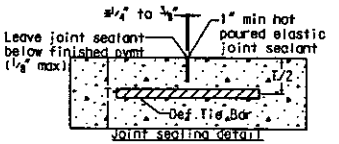
Section of rumble strip



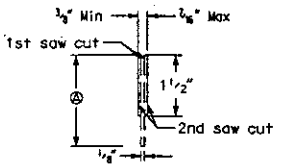
Joint sawing detail
(all sawed and tied joints)



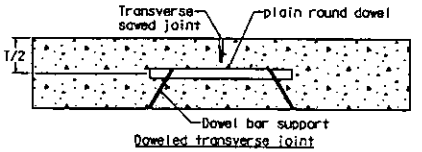
Drill and epoxy in exist PCC pvmt
Deformed bar installation (2'-0" c to c)



Joint sealing detail
(all sawed and tied joints)

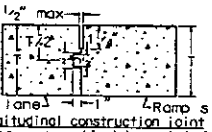


TRANSVERSE JOINT SAWING DETAIL



Doweled transverse joint

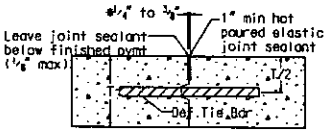
Longitudinal construction joint
(tied keyed joints)
(keyway and joint dimensions are the same as non-tied keyed joints)



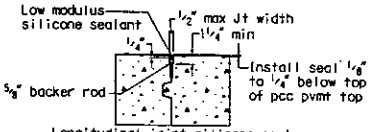
Longitudinal construction joint
(at ramps - non-tied keyed joints)

Longitudinal joint tie bars @ 4'-0" spacing

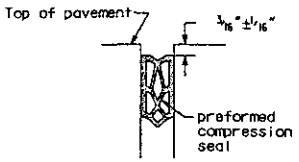
	PAVEMENT DEPTH	
	8"	9"
10' shldr	#5 x 2'-6"	
Cl ml	#6 x 3'-0"	



Longitudinal construction joint hot pour elastic joint seal
(tied keyed joints)



Longitudinal joint silicone seal
(non-tied keyed joints)



TRANSVERSE JOINT SEAL DETAIL

Dowel bars shall be 1 1/4" X 18" when T = 10" or less and shall be 1 1/2" x 18" when T is greater than 10".

Ⓐ = one-third thickness of the pcc pavement.

Ⓑ = Omit rumble strips through ramp taper areas.

T = pavement depth

#Width requirement for top 1" only: Bottom portion of saw cut may be narrower.

72 hours advance notice must be given to the project engineer and to Clayton Schumaker (701)328-6906, before installation of the preformed compression seal.

A manufacturers representative of the preformed compression seal must be on site during its installation.

JOINT DETAILS

DOWELED 38' PCC PAVEMENT

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FHWA REGION	STATE	PROJECT NO.	SHEET NO.
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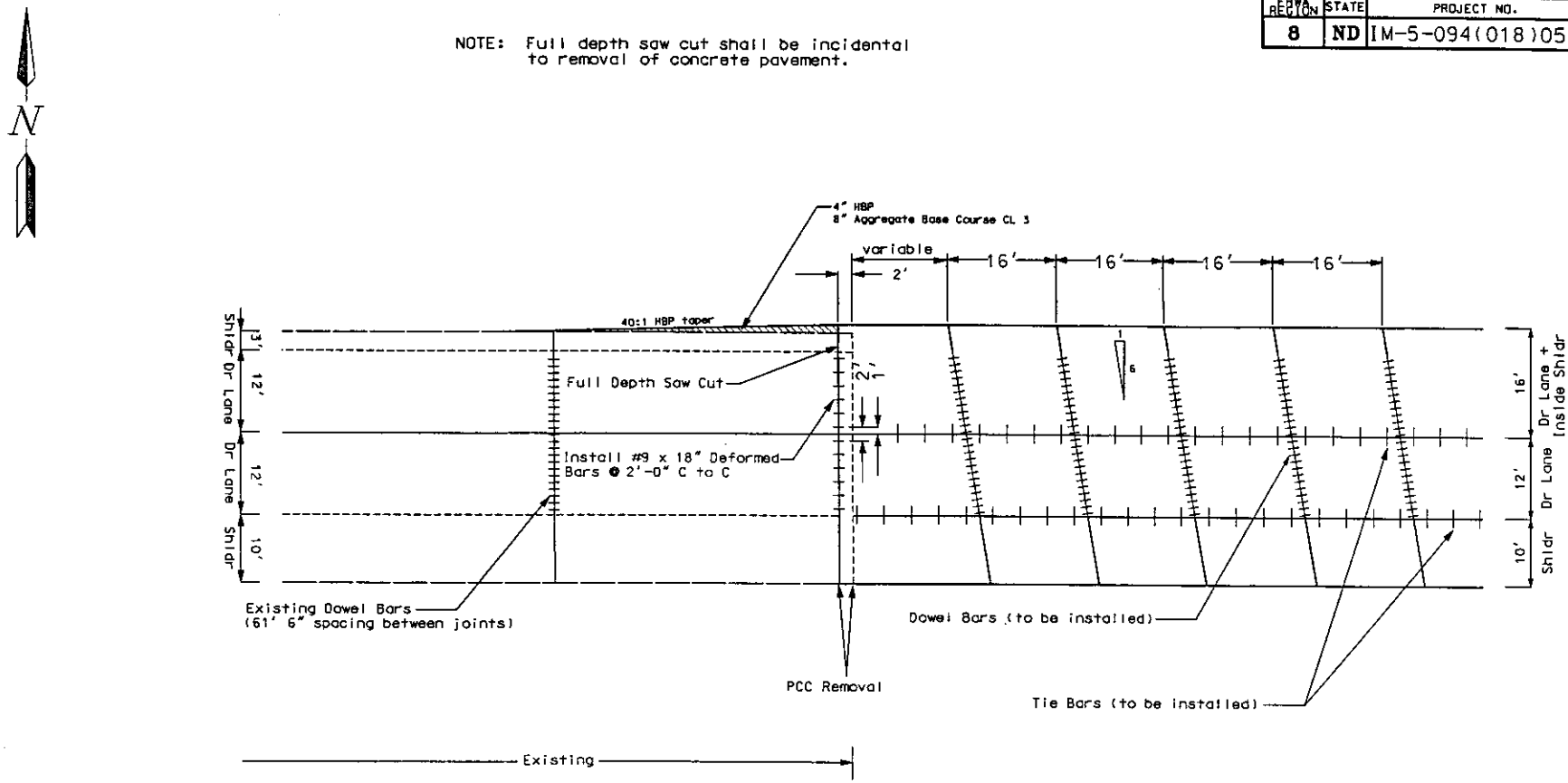
NOTE: Full depth saw cut shall be incidental to removal of concrete pavement.



ESTIMATED QUANTITIES

DESCRIPTION	UNIT	MAINLINE	3'+10' SHOULDER
Removal of Concrete Pvmt (9" JRCP, 24' Wide)	SY	5	
Remove and Salvage Bituminous Surfacing (32.6492 SF and 1.875 TON/CY)	TON		5
Hot Bituminous Pavement CL 29 (29.7415 SF and 2 TON/CY)	TON		19
PG 58-28 Asphalt Cement	TON		1
Aggregate Base Course CL 3 (29.7415 SF and 1.875 TON/CY)	TON		37

JOINT AT WEST END OF PROJECT

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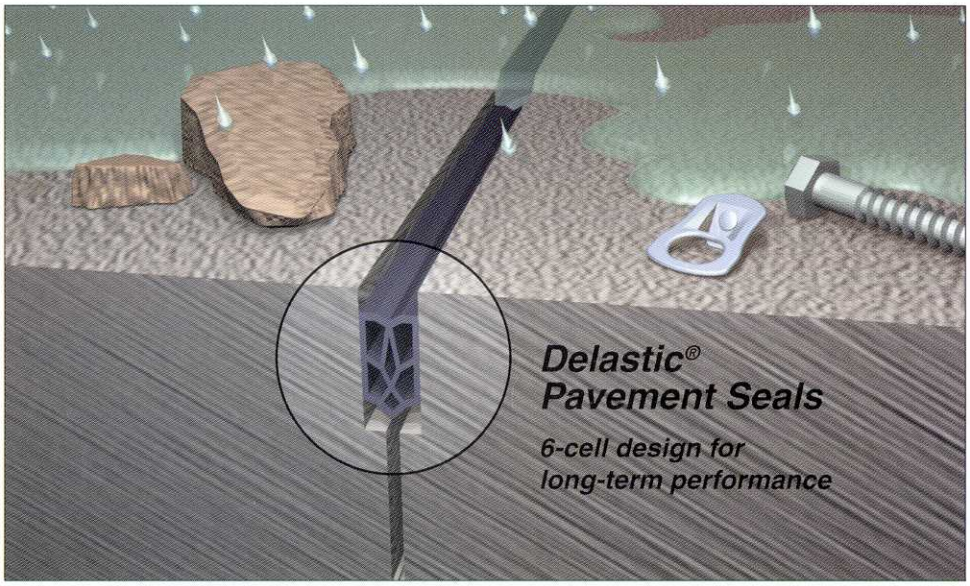
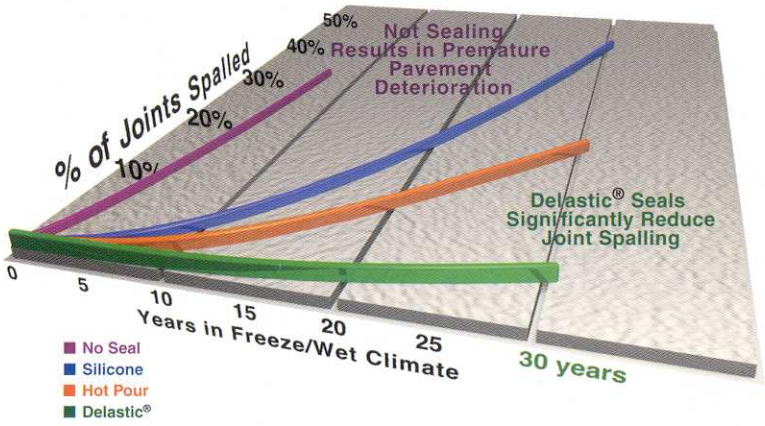
APPENDIX C

Why be short-sighted when your pavement must perform long-term?



Admit it. You specify concrete pavement because it performs. So why compromise that decision by using cheap, ineffective sealants... or worse, choosing not to seal the joints at all?

For nearly 40 years, D.O.T.s and other pavement engineers have used Delastic® Pavement Seals to improve pavement performance while reducing overall pavement costs.



Based on an independent study showing the effects of joint sealing on extending PCC pavement performance.

It's a fact. When compared to not sealing at all or using ineffective sealants, Delastic® Pavement Seals dramatically extend the life of your concrete pavement.

So, when you design your concrete pavement, think long-term. Specify Delastic® Pavement Seals.

Protect Your Investment

D.S. BROWN

The D.S. Brown Company
300 E. Cherry Street
North Baltimore, OH 45872

419.257.3561
fax: 419.257.2200
e-mail: dsb@dsbrown.com
www.dsbrown.com

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Meeting the Challenge

Building highways and airport runways to last is a challenging engineering assignment. Especially when the pavement must withstand heavy traffic, weather extremes, debilitating fuels and de-icing chemicals. You need reliable products with a proven track record. At The D.S. Brown Company, we can help.

Our Delastic® Pavement Seals have been specified and installed on highways and airport runways since 1960. Through time, they have proven to be durable and cost-effective.

But sealing joints are only one aspect of dealing with pavement design. You must also consider the repair of damaged concrete as well as methods to upgrade existing airfield lighting. Our unique Delpatch™ Elastomeric Concrete has been designed to solve those difficult problems.

This brochure provides details about our Delastic® Pavement Seals and Delpatch™ Elastomeric Concrete. For more information, contact our Pavement Products Sales Department in our corporate office at 419.257.3561.

Delastic® Pavement Seals

Why Delastic® seals?

Our Delastic® Pavement Seals for concrete pavement have one main purpose – to prevent water and debris from entering the joint. If that happens, the pavement can crack, chip, buckle and prematurely deteriorate.

Delastic® Pavement Seals are extruded from compounds of neoprene (polychloroprene) which meet or exceed current ASTM standard specifications. They are compressed and remain in contact with the joint walls while allowing the concrete pavement to expand and contract during temperature changes.

There are other joint seal products available, but each has its disadvantages. Silicone caulk can fail because of poor adhesion to the concrete walls. Hot pour asphalt systems do not age well and require the pavement joints to be resealed often, significantly increasing the overall cost. Only Delastic® Pavement Seals have proven to remain durable and effective through the years.

Meeting Specifications

Delastic® seals meet ASTM standard specifications. They are also recognized by the FHWA, U.S. Army Corps of Engineers, the U.S. Air Force, consulting engineers and other agencies as an effective, long-lasting concrete pavement joint seal solution.

Easy-to-install Delastic® Pavement Seals are an excellent choice for high-traffic airport runways, taxiways and aprons.

About the D.S. Brown Co.

Since 1960, the D.S. Brown Company has been a worldwide supplier of engineered products to the highway and bridge construction industries. We are a fully-integrated manufacturer, performing and controlling the following functions in our facilities:

- Research and development
- Engineering/CAD design
- Dynamic load testing
- Compounding, rubber mixing, extruding and molding
- Custom steel fabrication and machining

D.S. Brown offers its customers decades of experience along with fully-integrated engineering and manufacturing as well as knowledgeable sales professionals, all of which have enabled the D.S. Brown Company to become the leading manufacturer and supplier to the highway and bridge construction market.

DELASTIC® ADVANTAGES

Our "E" and "V" series Delastic® seals are the primary sealing system for concrete pavement slabs in highways, airport aprons and runways. Delastic® seals offer these advantages:

- Ability to seal joints in concrete even when moisture is present
- Resistance to jet fuel and other chemicals
- Speed of installation
- Product cleanliness
- Ease of inspection
- Dramatic reduction in concrete joint spalling

Delastic® Seal Catalog No.	SEAL CHARACTERISTICS			JOINT DESIGN CRITERIA		
	Nominal Width (W)	Nominal Height (H)	Max. Movement 1	Narrowest Opening 2 (A)	Widest Opening 3 (A)	Minimum Depth (B)
E-437	**0.437** (11.11)	**0.937** (23.81)	**0.184** (4.67)	**0.187** (4.75)	**0.371** (9.42)	**1.250** (31.75)
V-562	**0.562** (14.29)	**0.625** (15.88)	**0.178** (4.52)	**0.250** (6.35)	**0.478** (12.14)	**1.125** (28.58)
E-686	**0.687** (17.46)	**0.687** (17.46)	**0.259** (6.58)	**0.325** (8.26)	**0.584** (14.83)	**1.250** (31.75)
E-816	**0.812** (20.64)	**0.812** (20.64)	**0.348** (8.84)	**0.350** (8.89)	**0.698** (17.73)	**1.500** (38.10)
E-1006	**1** (25.40)	**1** (25.40)	**0.450** (11.43)	**0.400** (10.16)	**0.850** (21.59)	**1.750** (44.45)
E-1256	**1.250** (31.75)	**1** (25.40)	**0.612** (15.54)	**0.450** (11.43)	**1.062** (26.97)	**2** (50.80)
V-1625	**1.625** (41.28)	**1.125** (28.58)	**0.781** (19.84)	**0.600** (15.24)	**1.381** (35.08)	**2.375** (60.33)
E-2000	**2** (50.80)	**1.500** (38.10)	**0.950** (24.13)	**0.750** (19.05)	**1.700** (43.18)	**2.625** (66.68)
E-2500	**2.500** (63.50)	**2.500** (63.50)	**1.100** (27.94)	**0.775** (19.69)	**2.125** (53.98)	**4** (101.60)
E-3000	**3** (76.20)	**2.500** (63.50)	**1.260** (32.00)	**1.200** (30.48)	**2.550** (64.77)	**4.250** (107.95)

First number shown in bold represents inches, metric demensions (MM) are shown in parentheses.

Notes:

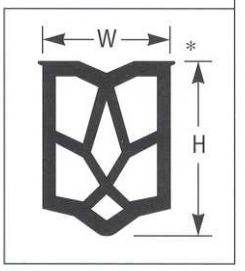
* Thickness of the seal wall and internal web are not drawn to scale.

1 Maximum movement which seal will accommodate in joint with correct design.

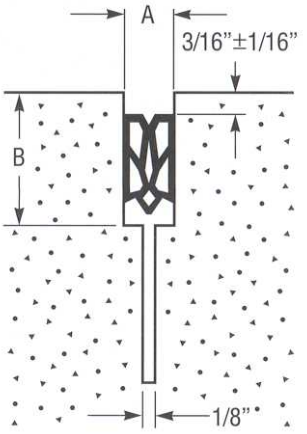
2 A narrower opening will place excessive stress on the seal and may cause premature failure.

3 A wider opening may not provide sufficient compressive force to hold the seal in place.

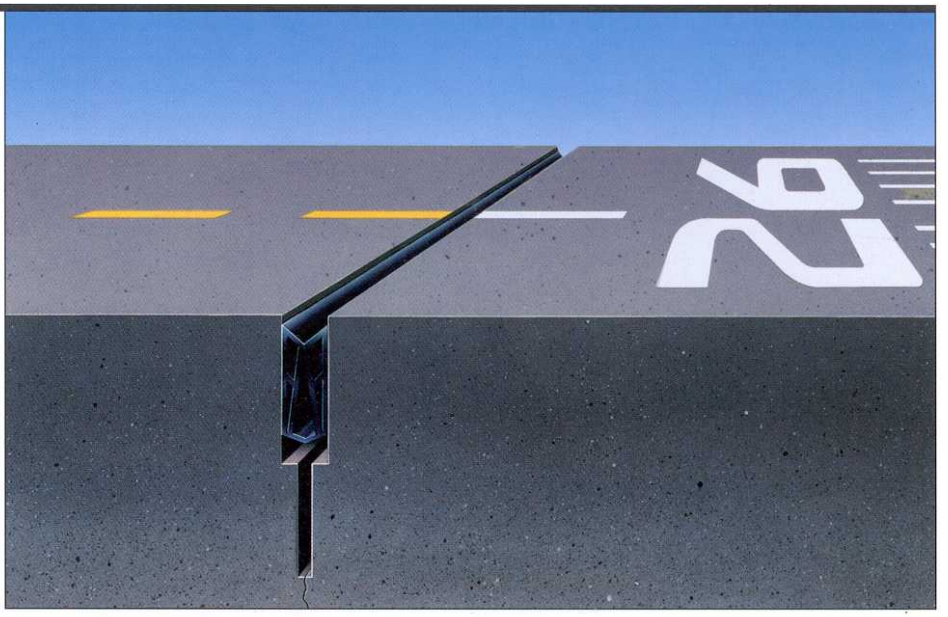
Meets ASTM D 2628 and AASHTO M-220 standard specifications.



Typical joint design for the "E" and "V" series pavement seals.



Delastic® seals effectively protect concrete pavement in highways, airport aprons and airport runways by keeping moisture, debris and incompressible material out of the joint opening.



Delastic® Installation

In all instances, the joint walls must be reasonably clean and free of spalls with a properly designed width. To facilitate seal installation, D.S. Brown offers its Delastall™ 105 and SealTek™ installation machines for rental or purchase.

Lubricants

Delastilube™ and Delastilube™-HS are used during installation to lubricate the seal when it is inserted in the joint opening. The minimum installation temperature on job sites should be 40°F (4°C) to assure proper performance of the lubricant.

Material/Specifications

For "E" and "V" series Delastic® seals, ASTM standard specification D 2628-97 applies. Delastilube™ lubricant meets ASTM D 2835 requirements while Delastilube™-HS meets ASTM D 4070.

Packaging

Delastic® seals are shipped on reels, spools or in boxes marked in ordered lengths according to customer requirements. Delastilube™ lubricant is supplied in one, five or 55 gallon containers.

ASTM D 2628 DELASTIC® PAVEMENT SEALS PHYSICAL REQUIREMENTS

Properties	Requirements	ASTM Test Method
Tensile strength, min, psi (MPa)	2000 (13.8)	D 412
Elongation at break, min, %	250	D 412
Hardness, Type A durometer, points	55±5	D 2240 (modified)[A]
Oven aging, 70 h at 212°F (100°C) Tensile strength, loss, max, % Elongation, loss, max, % Hardness, Type A durometer, points change	 20 max 20 max 0 to + 10	D 573
Oil swell, ASTM Oil No. 3, 70 h at 212°F (100°C) Weight change, max, %	 45 max	D 471
Ozone resistance 20% strain, 300 pphm in air, 70 h at 104°F (40°C)	 no cracks	D 1149 (modified)[B]
Low-temperature stiffening, 7 days at 14°F (-10°C) Hardness, Type A durometer, points change	 0 to + 15	D 2240
Low-temperature recovery, [C]72 h at 14°F (-10°C) 50% deflection, min, %	 88	9.2[D]
Low-temperature recovery, [C]22 h at -20°F (-29°C), 50% deflection, min, %	 83	9.2[D]
High-temperature recovery, [C]70 h at 212°F (100°C) 50% deflection, min, %	 85	9.2[D]
Compression-deflection, at 80% of nominal width, min, lbf/in. (N/m)	 3.5 (613)	9.3[D]

A The term "modified" in the table relates to the specimen preparation. The use of joint seal as the specimen source requires that more plies than specified in either of the modified test procedures be used. Such specimen modification shall be agreed upon by the purchaser and seller prior to testing. The hardness test shall be made with the durometer in a durometer stand as recommended in Method D 2240.

B Test in accordance with Procedure A of D 518.

C Cracking, splitting, or sticking of a specimen during a recovery test shall mean that the specimen has failed the test.

D The reference sections are those of this specification.

Delastic® Pavement Seals were successfully used on Route 407 near Toronto, Ontario.