NORTH DAKOTA
DEPARTMENT OF TRANSPORTATION

MATERIALS AND RESEARCH DIVISION

Experimental Study ND 94-01

Evaluation of Saw and Seal over the Overlaid Existing Concrete Joints

Final Report

Project NH-3-002(040)212

October 2001

Prepared by

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U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

EXPERIMENTAL PROJECT REPORT

EXPERIMENTAL PROJECT

EXPERIMENTAL PROJECT NO.

	STATE	YEAR		NUMBER		
1	ND	94	-	01		

CONSTRUCTION PROJ NO
NH-3-002(040)212
8

LOCATION
Pierce and Benson
28 Counties

EVALUATION FUNDING
1 X HP&R 3 DEMONSTRATION
48 2 CONSTRUCTION 4 IMPLEMENTATION

NEEP NO.
49

PROPRIETARY FEATURE?
Yes
51 X No

SHORT TITLE

TITLE
52 Evaluation of Saw and Seal Over the Overlaid Existing Concrete Joints

THIS FORM

DATE MO. YR.
140 1 2 - 0 1

REPORTING
1 INITIAL 2 ANNUAL 3 X FINAL

KEY WORDS

KEY WORD 1
145 PAVEMENTASPHALT

KEY WORD 2
167 OVERLAYS

KEY WORD 3
189 Design

KEY WORD 4
211 Concrete

UNIQUE WORD
233 Saw and Seal

PROPRIETARY FEATURE NAME
255

CHRONOLOGY

Date Work Plan Approved	Date Feature Constructed:	Evaluation Scheduled Until:	Evaluation Extended Until:	Date Evaluation Terminated:
09-93	-94	-99		10/2001
277	281	285	289	293

QUANTITY AND COST

QUANTITY OF UNITS
1512
297

UNITS
1 X LIN. FT
2 SY
3 SY-IN
4 CY
5 TON
6 LBS
7 EACH
8 LUMP SUM
305

UNIT COST (*Dollars, Cents*)
4.00.
306

AVAILABLE EVALUATION REPORTS

X CONSTRUCTION
315

X PERFORMANCE

FINAL

EVALUATION

CONSTRUCTION PROBLEMS
1 X NONE
2 SLIGHT
3 MODERATE
4 SIGNIFICANT
318 5 SEVERE

PERFORMANCE
1 EXCELLENT
2 X GOOD
3 SATISFACTORY
4 MARGINAL
319 5 UNSATISFACTORY

APPLICATION

1 ADOPTED AS PRIMARY STD.
2 PERMITTED ALTERNATIVE
320 3 ADOPTED CONDITIONALLY
4 PENDING
5 REJECTED
6 NOT CONSTRUCTED

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

REMARKS

321 The saw and seal section appears to be in good condition. There is no uncontrolled reflective cracking occurring in the vicinity of the saw and seal joints. Recent coring of the test section shows reflective cracking is converging with the overlay pre-sawed asphalt joints.

700

Form FHWA 1461

Experimental Study ND 94-01

Evaluation of Saw and Seal over the Overlaid Existing Concrete Joints

FINAL REPORT

Project NH-3-002(040)212

October 2001

Written by

Mike Marquart

Disclaimer

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EVALUATION OF SAW AND SEAL OVER THE OVERLAID EXISTING CONCRETE JOINTS

Objective

The objective of this study is to evaluate what effect a sawed and sealed joint in asphalt has on controlling reflective cracking from an existing concrete joint. If effective, this method may be adopted by the North Dakota Department of Transportation (NDDOT) as an option to help solve the problem of reflective cracking.

Scope

In 1994 the NDDOT constructed a test section comprised of 54 sawed and sealed joints constructed over existing concrete joints. The sections were installed immediately after a four-inch hot bituminous asphalt pavement was applied over the surface of the existing concrete. The performance of the test section will be evaluated, by the NDDOT, for a period of five years.

Location

The project begins on Highway 2 just east of Rugby, North Dakota, at reference point 212.634 and extends eastward for a total project length of 23.239 miles. The project involves the two eastbound lanes only. The experimental saw and seal section is found between reference point 227 and 228 at station 1427+12 Rt to station 1435+90 Rt. Project plans and typical sections are found in Appendix A.

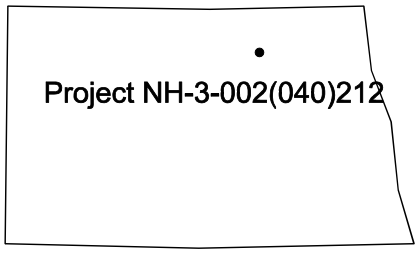


Photo 1 and 1A shows an overview of the saw and seal section for 2000 and 2001.

Photo 1
Overview of the Saw and Seal Section just east of Knox

Photo 1A
Overview of the Saw and Seal Section just east of Knox

Project History

Construction

The roadway was graded in 1976 followed by a two-inch layer of aggregate base. The roadway was then paved in 1977. It consisted of a six-inch layer of a low strength concrete (econocrete) placed monolithicly with three inches of portland cement concrete (PCC) placed on top. A short time after this pavement was placed in service, longitudinal cracks began to develop. As years passed by, cracking accelerated and "D" cracking became more evident. Some areas along the longitudinal and transverse cracks broke up and punched down.

After all options of rehabilitation were considered, a four-inch asphalt overlay was selected. The four inch asphalt overlay was constructed in 1994.

Traffic

The traffic for the eastbound lanes are shown below in Table 1. These are upgraded for each year a report is written.

Year	Pass>Car	Trucks	Total	Max30th	Flex ESALs
1993	750	160	910	90	130
1997	825	230	1,055	110	193
1998	935	265	1,200	120	240
1998 Traffic Data is the latest data available					

Table 1

Design

One section of the existing roadway showed very little cracking. A study revealed that this section consisted of concrete using good quality aggregates.

Previous tests done on saw and seal test sections indicated that if good concrete exists, with little cracking, the saw and seal joints will perform satisfactorily. Based on these findings, this area was chosen as a good candidate for a saw and seal test section.

Construction

Project NH-3-002(040)212 was constructed in 1994. The prime contractor was Mayo Construction of Cavalier. The subcontractor for the saw and seal portion of the project was Zimmerman Construction of Minot, North Dakota.

The next few paragraphs will provide a summary of the steps in constructing the saw and seal test section.

The existing joints in the concrete were located and referenced by the contractor prior to the asphalt overlay. The most critical element of the operation was accurately locating the underlying joints after the overlay.

Photo 2.
A view of the Process by which the joints were reestablished in the overlying asphalt layer

The joint locations were reestablished by a chalk line run between the reference points as shown in photo 2.

After the joints were located a rideable concrete saw was used for the dry cutting of the joints as shown in photo 3. The Special Provision for sawing and sealing of joints states that the saw cut shall be free of dust and cleaned with a hot compressed air (HCA) heat lance prior to sealing the sawcuts. After the joints were sawed the contractor used compressed air to clean out any loose debris left after the sawing operation. The cleaning operation failed to remove all debris clinging to the walls of the asphalt. The contractor decided to use a sandblaster to remove this material in

Photo 3
A view of the saw cutting operation

order to achieve a clean joint. Many of the sawcuts had places that were wet or moist as shown in photo 4. No explanation was given for the presence of the moisture. The contractor believed the moist joints would present a problem for the sandblasting operation. This prompted the contractor to apply the HCA step prior to the sandblasting. Photo 5 shows a view of this.

After the sawcuts were cleaned, heat lanced, sandblasted, and cleaned again the backer rod was installed.

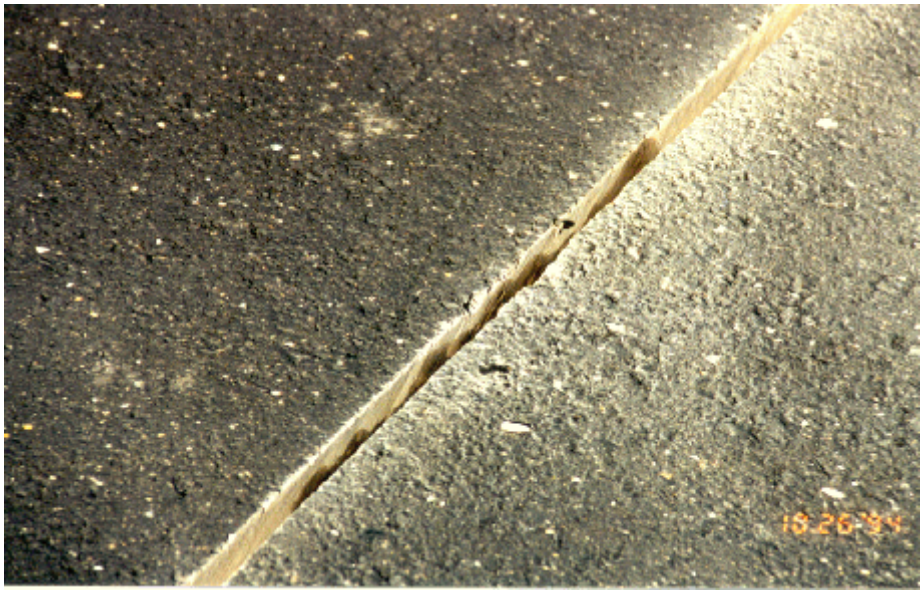


Photo 4
A view of a vessel that had moisture present along the walls

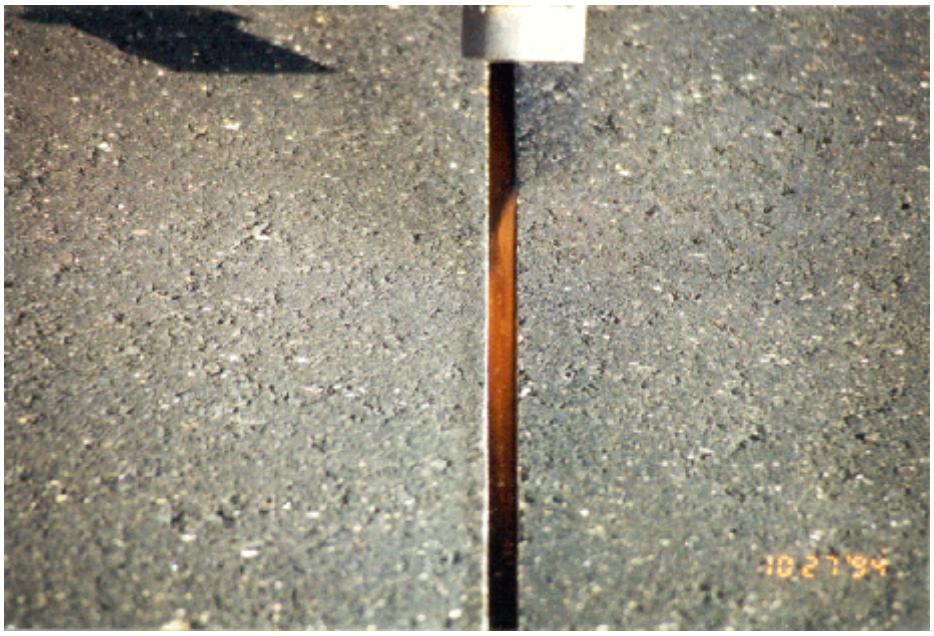


Photo 5
A view of the heat lance operation.

The next step was to seal the vessels with Sealtight Sof-Seal 3407 sealant. The product was manufactured by W. R. Meadows Incorporated. The Sealtight Sof-Seal is an extra low-modulus, premium grade, single component, hot applied horizontal sealant specifically developed for the effective sealing of cracks in asphaltic concrete pavement. A Crafco Melter/Applicator Model E-Z Pour was used to melt the sealant

Photo 6
A view of the squeegee operation.

and fill the sawcuts. The sealant was heated to 355EF to 360EF before crack filling began. The filling of the transverse joints was started on the low side moving to the high side filling from the bottom up. All the vessels were slightly overfilled from the bottom up and followed with a soft rubber U-shaped squeegee to form a "wipe zone" of approximately three inches wide along the vessel and flush with the pavement surface. The joints were squeegeed in both directions. This procedure is shown in photo 6. The sealant quickly cools and contracts after it is squeegeed.

Photo 7 shows a joint that has been filled and squeegeed.

Photo 8 shows a joint that has been filled and not squeegeed. Only one of the joints were non-squeegeed. Extra time is required to fill a vessel that will not be squeegeed since care has to be taken to ensure the sealant is being applied at just the right height.

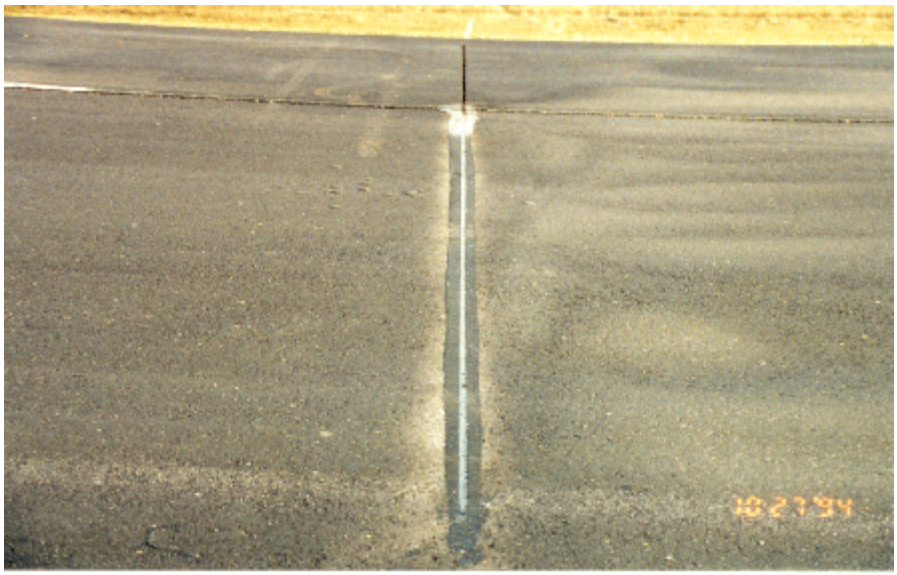


Photo 7
A view of a typical joint that has been filled with sealnt and squeegeed.

Overall the saw and seal operation was satisfactory. The project consisted of sawing and sealing 54 joints each 28 feet in length for a total of approximately 1512 linear feet. It took approximately 16 hours to complete the project.

Photo 8
A view of a vessel that was sealed but not squeegeed.

Evaluation

A short background will be given for the years 1995, 1996, 1997 and 1998. This project was not evaluated in 1999.

1995

No visual surface cracking near any of the sawed and sealed joints. Cores were taken and show that the saw and seal joints are within 5/8" of being directly over underlying joints.

1996

The joints are all in good condition. About 15% of the joints show reflective transverse cracks in the shoulders.

1997

The joints appear to be in good condition. Approximately 44% of the joints are experiencing reflective cracking in the shoulders. No other cracking can be seen in the test section.

1998

The joints are still in good condition. Approximately 54% of the joints are showing reflective cracking in the shoulders. Up to this point in the evaluation it has been assumed that reflective cracking is also taking place in the mainline by the adjacent shoulder cracking. Random coring of the joints was conducted to verify this assumption. Coring results show that the saw and seal joints were within 3/4" of the underlying joint. One case was found where the sawed joint was about two inches off but, even in that case the reflective crack still converged with the sawed joint.

2000

On September 19, 2000 Materials and Research conducted another evaluation of the Saw and Seal Experimental Section. Photo 9 shows a view of a typical sawed and sealed joint. At this location the crack has reflected through the shoulder.

The entire test section appears to be in good condition with only a few spalls in the driving lane where the wheelpaths intersect the joint.

Photo 9
Typical saw and seal crack

Photo 10
Spalling in wheelpath

Of the 54 sawed and sealed joints in this test section, 20 have established cracking in the shoulders. Another 12 joints are experiencing emerging or established cracking about two feet into the shoulders adjacent to them. This amounts to 59% of the total joints that are experiencing reflective cracking in the shoulders. There is no other cracking that can be seen on this test section. The section produces a good ride. One joint in the passing lane only was constructed without using a squeegee. This joint is performing very well. The sealant has not lost adhesion as was expected. This method however may not be feasible as controlling the level of the sealant during filling is slow and hard to achieve. Photo 11 shows this non squeegeed joint.

Photo 11
Non squeegeed joint

At this point in the evaluation there appears to be no uncontrolled reflective transverse cracking occurring in the vicinity of the sawed and sealed joints. The sealants performance has been excellent.

2001

A final evaluation of the project was conducted on 8-26-01. The section is performing about the same as in 2000 with one exception. Two longitudinal cracks developed in the shoulder between joints. One such crack is shown in photo 12.

Photo 12
Longitudinal shoulder crack

There has been no change in the number of transverse shoulder cracks or any added spalling. No reflected cracks can be found in the saw and seal portion of the test section.

Summary

The joints located in the saw and seal test section are in good condition. Approximately 59% of the joints are experiencing reflective cracking in the shoulders.

Recent coring of the test section showed that controlled reflective cracking is occurring even where there is no indication of shoulder cracking present. Coring results also revealed early indications that the reflective cracking is converging with the

overlying pre-sawed asphalt joints. A study lists the horizontal tolerance for pre-sawing joints in overlying asphalt pavement to be within plus or minus 1" from the underlying PCC joint. One sawed joint in the asphalt was 2" off horizontal from the underlying PCC joint but, still the reflected crack converged with the sawed joint in the asphalt.

There is no uncontrolled reflective transverse cracking occurring in the vicinity of the sawed and sealed joints. This study has shown that a sawed and sealed joint in an asphalt overlay over existing concrete can be effective in controlling reflective cracking.

Recommendations

The North Dakota Department of Transportation should consider using the saw and seal method when a jointed concrete pavement is overlaid with asphalt. The existing PCC must be in fair condition. The sealing will control the cracking and prevent water intrusion into the pavement section. This insures lower maintenance costs and provides a good riding pavement surface.

Appendix A

DESIGN DATA				
Traffic	Average Daily			Est. Hour/Dir
Current (1990)	Pass. 625	Trucks 175	Total 800	90
Forecast (2013)	Pass. 925	Trucks 275	Total 1200	140
Minimum Sight Dist. Form		Design Speed 70 MPH		
Stopping 600'				
LIMITED CONTROL ACCESS				

JOB# ____

FEDERAL REGION	STATE	PROJECT NO.	SHEET NO.
8	ND	NH-3-002(040)212	1

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

IN

PIERCE & BENSON COUNTIES

FEDERAL AID PROJECT No. NH-3-002(040)212

PCC Pavement Cracking and Seating

Hot Bituminous Overlay

SOUTH ROADWAY

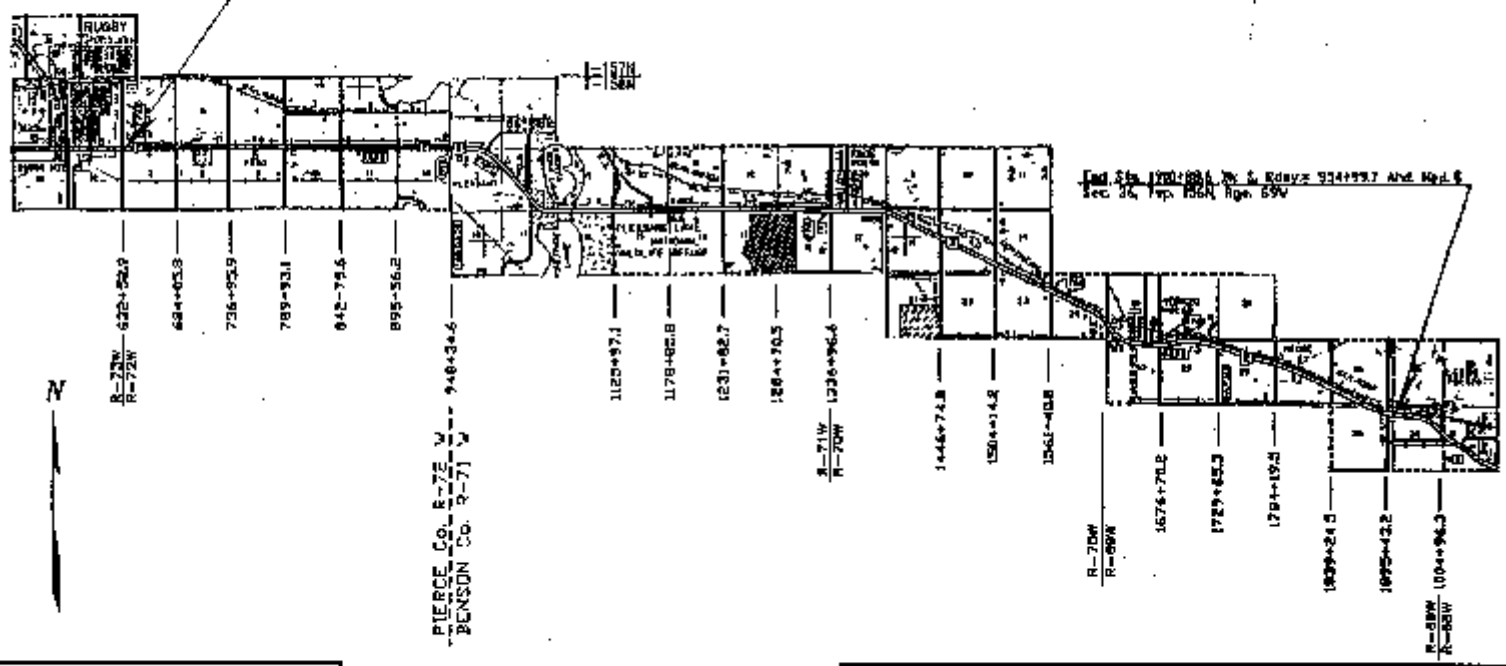
GOVERNING SPECIFICATIONS:

Standard Specifications adopted by the North Dakota Department of Transportation September 1990. Standard Drawings currently in effect and other Contract Provisions submitted herein.

LENGTH OF PROJECT

Miles-Gross	Miles-Net
24.022	24.022

Beg. Sta. 638+52.9 South Roadway
Sec. 7, Twp 156N, Rge 78W



PAVING SECTION _____

URBAN SECTION _____

TRAFFIC SECTION _____

RURAL SECTION _____

RECOMMEND APPROVAL _____, 19___

DESIGN ENGINEER _____

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED

DIVISION ADMINISTRATOR DATE

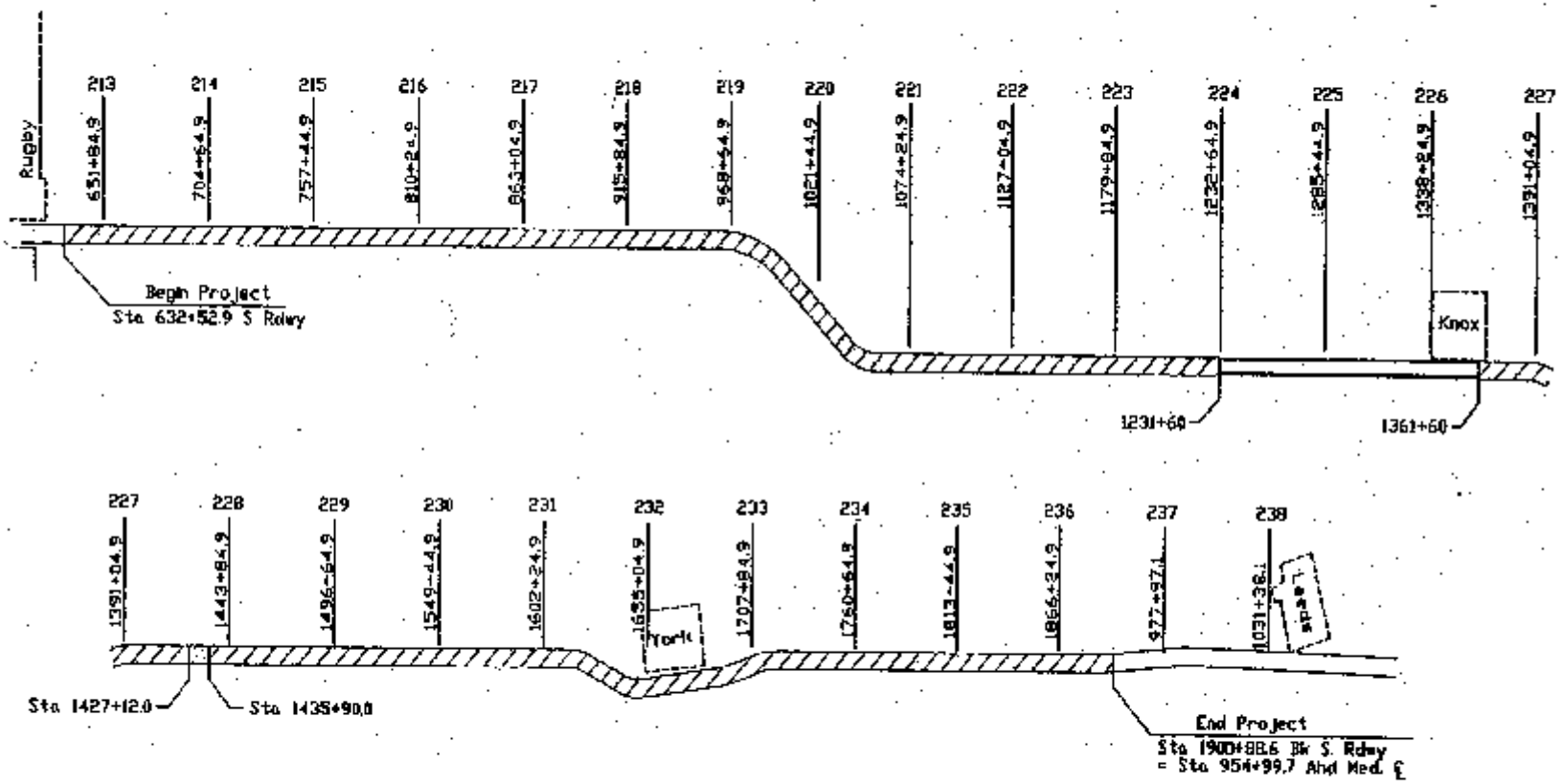
APPROVED DATE _____

DIRECTOR OF HIGHWAYS AND ENGINEERING

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

FHWA REGION	STATE	FED. AID PROJ. NO.	SHEET NO.
8	N.D.	NH-3-002(040)212	

SCOPE OF WORK



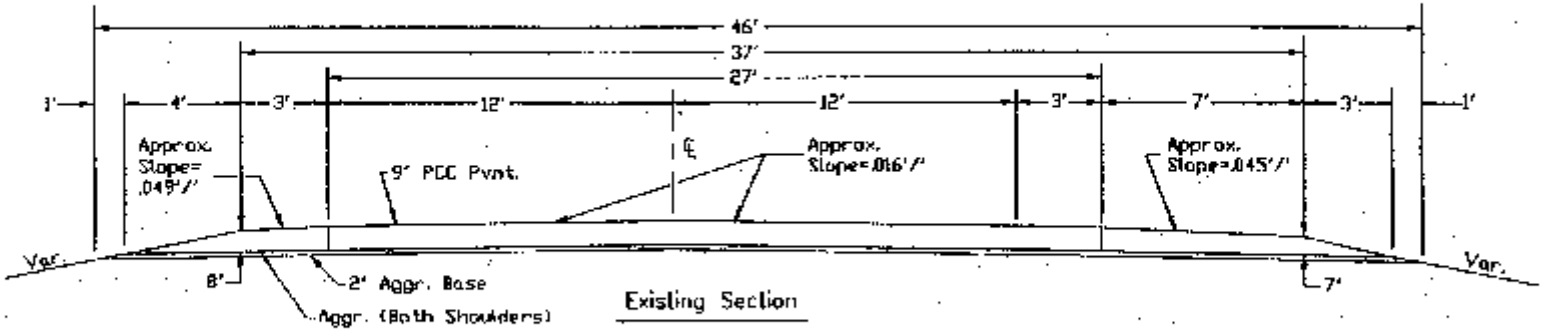
LEGEND

- Crack and Seat, HBP Overlay
- HBP Pave Shoulders
- HBP Overlay, Saw and Seal

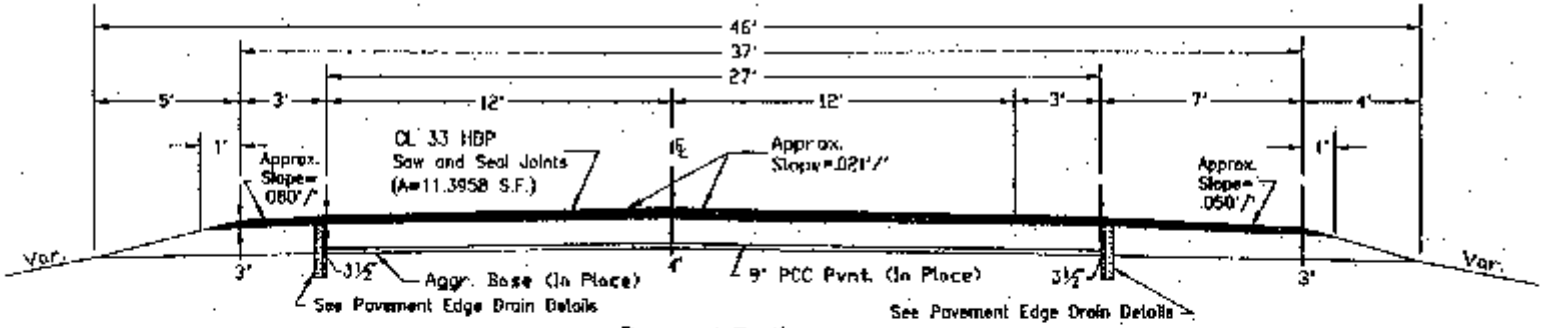
CIVIL DIVISION	STATE	FED. AID PROJ. NO.
8	N.D.	NH-3-002(040)212

TYPICAL SECTIONS

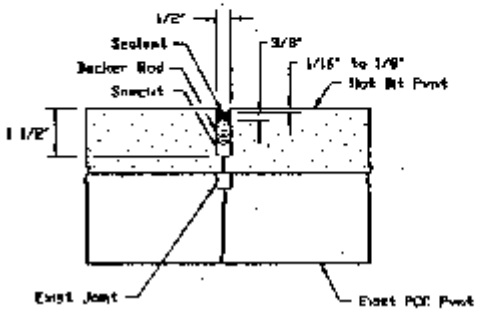
Sta 1427+12.0 to 1435+90.0



Existing Section



Proposed Section



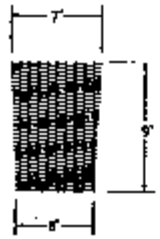
Saw & Seal Joint Detail

Note: Curve Section same as Tangent Section except for superelevation

DIVA REGION	STATE	FED. AID PROJ. NO.	SHEET NO.
8	N.D.	NH-3-002(040)212	16

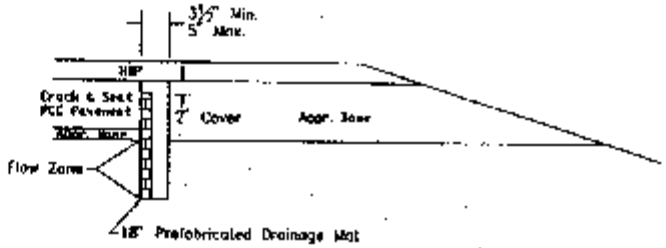
REVISED 8-13-93

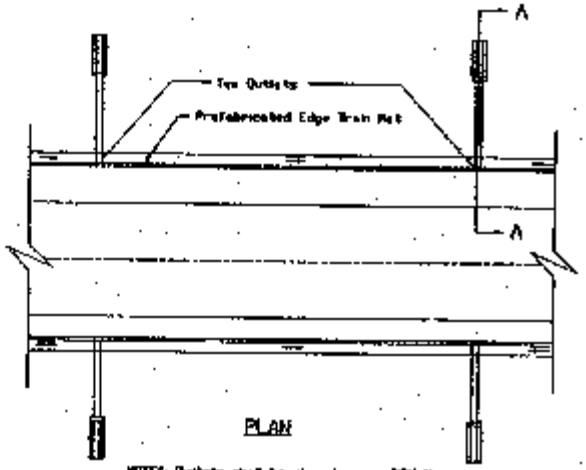
PAVEMENT EDGE DRAIN, PRECAST CONCRETE HEADWALLS, OUTLET PIPE, AND TRENCH DETAILS



VARMINT SCREEN

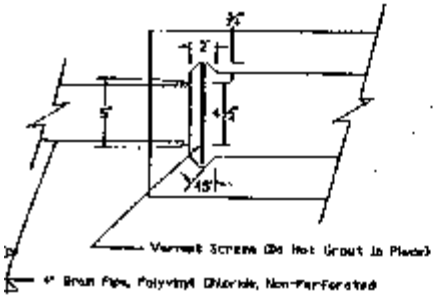
3X3 Galv. Hardware Cloth .063 (Wire or Equal)



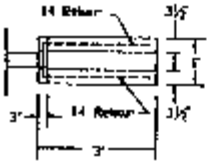


PLAN

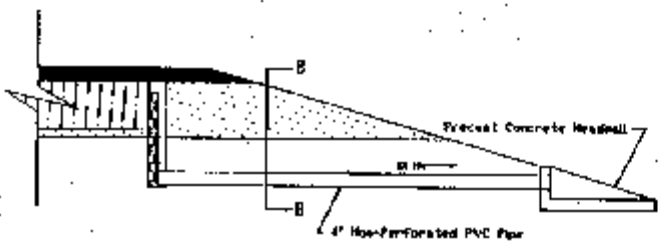
NOTES: Outlets shall be placed every 250' Max



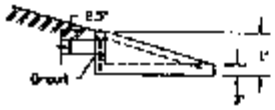
4" PIPE HOLE DETAIL



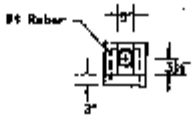
PRECAST CONCRETE HEADWALL
(Top View)



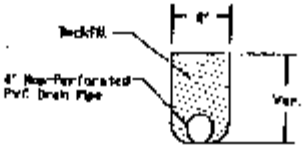
TYPICAL SECTION A-A



PRECAST CONCRETE HEADWALL
(Side View)



PRECAST CONCRETE HEADWALL
(Front View)



DETAIL CUT B-B

NOTE: All dimensions shown for concrete headwall are minimum dimensions.